GEOLOGY OF THE FAWNIE CREEK MAP AREA

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INTRODUCTION

This report describes the results of 1:50 000-scale bedrock mapping conducted in the Fawnie Creek map area during 1993. This work is a component of the Interior Plateau project, which also includes surficial geology, lake sediment geochemistry and mineral deposits studies that were simultaneously conducted in the Fawnie Creek and adjoining map areas of the northern Interior Plateau region (*see* Giles and Levson, Cook and Jackaman, and Schroeter and Lane, 1994; this volume). The Interior Plateau project began in 1992 in collaboration with the Geological Survey of Canada, whose geoscience activities are discussed elsewhere (van der Heyden *et al.*, 1993). Bedrock mapping in the Fawnie Creek map is an extension of work in the Natalkuz Lake map area to the north (Diakow *et al.*, 1993; Green and Diakow, 1993).

The aim of the project is to provide new geoscientific data in order to facilitate evaluation of mineral potential in the region. The bedrock program covers two main mineralized stratigraphic successions. Two new epithermal precious metal targets have been identified in the older Middle Jurassic volcano-sedimentary rocks. Assessment of these rocks for massive sulphide potential requires additional study. Epithermal mineralization is also associated with Eocene volcanism, however hostrocks of this age have very limited distribution in the Fawnie Creek map area. Hydrothermally altered rocks are locally extensive along parts of the contact of the Late Cretaceous Capoose batholith. In the Fawnie Creek area there are skarn prospects, and a newly discovered zone of pervasively silicified Middle Jurassic strata near the pluton margin.

The Fawnie Creek map area is located in the Nechako Plateau near the geographic centre of British Columbia (Figure 1). Access to the area is from Vanderhoof, approximately 140 kilometres to the northeast, by the Kluskus-Ootsa Forest Service road. An important junction at 142 kilometres, marks the beginning of the Kluskus-Malaput Forest Service road, which in turn is intersected 4.5 kilometres away by the Van Tine road. A network of well-maintained logging roads developed throughout much of the topographically elevated Entiako Spur in the north, and the Naglico Hills in the south provides access to the main areas of bedrock. These ridges intersect the Fawnie Range, which trends southeast at the eastern margin of the Fawnie Creek area. Together they bound a central low-lying area occupied by Fawnie Creek and interconnected Laidman and Johnny lakes.

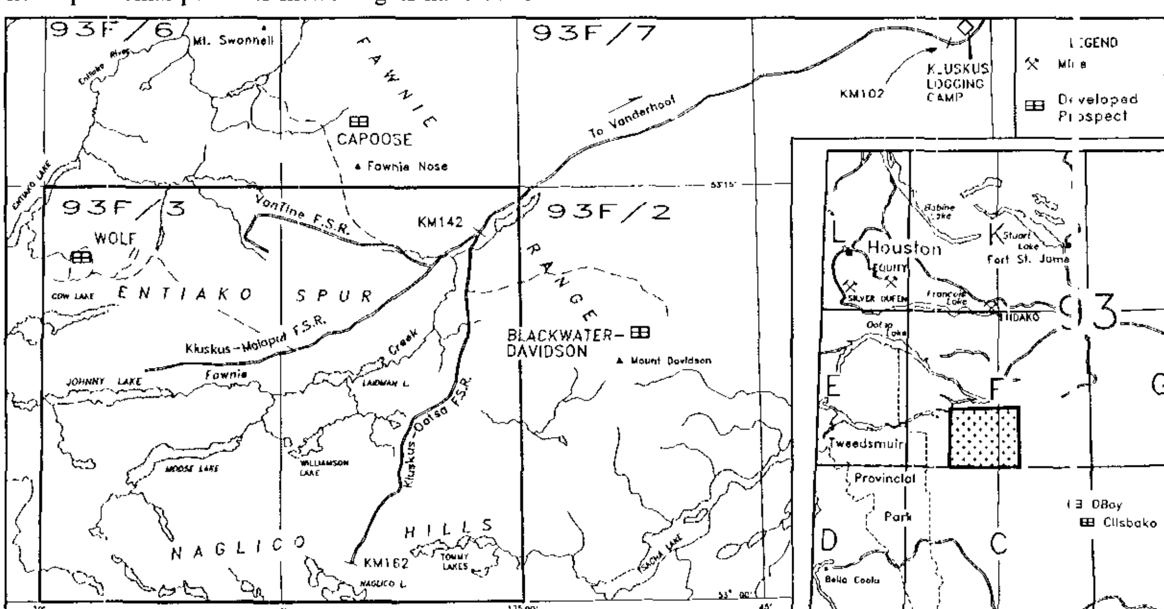


Figure 1. Location and road access to the Fawnie Creek map area.

VOLCANIC AND SEDIMENTARY ROCKS

The Fawnie Creek area is part of a zone of regional uplift that includes the Fawnie Range, and the Nechako Range to the east. The oldest rock unit, informally named the Naglico formation, consists of flows and volcaniclastic rocks containing interbeds of Middle Jurassic sediments. Small hypabyssal stocks and sills of augite porphyry are believed to be cogenetic with parts of the Middle Jurassic volcanic succession. The Late Cretaceous Capoose batholith intrudes and alters the Jurassic rocks. Eocene volcanic rocks of the Ootsa Lake Group form scattered, relatively thin (< 200 m thick) outliers that rest unconformably on the Jurassic basement. Basaltic lava flows, of probable Miocene and younger age underlie mainly topographically subdued areas south and northwest of the Naglico Hills.

MIDDLE JURASSIC

HAZELTON GROUP

NAGLICO FORMATION

The informal Naglico formation is named for silica-bimodal volcanic rocks and Bajocian intravolcanic sediments that appear to be gradationally overlain by marine sedimentary strata containing Callovian fossils in the topmost beds. These rocks underlie the entire Fawnie Creek area. Exposures are most continuous in the Naglico Hills; on the Entiako Spur the formation is less continuous and comprises a relatively thin blanket of thermally altered rocks in intrusive contact with the Capoose batholith. The altered rocks consist of an epidote-quartz-calcite ±garnet assemblage. Regionally, recognition of the Jurassic versus Tertiary successions is aided by the ubiquitous presence of epidote, chlorite and quartz in the older rocks. These minerals are most evident lining fractures, as veins and incipient replacement of groundmass and primary minerals, particularly in rocks of basaltic to andesitic composition. In contrast, the Eocene rocks lack this altered mineral assemblage and overall, they have a fresher appearance.

The Naglico formation in the Fawnie Creek area is subdivided into two main lithostratigraphic divisions. The lower division is composed of crudely layered fragmental and lesser flow rocks of rhyolitic composition, and local maroon and green andesitic tuffs deposited in a subaerial environment. The upper division, which is significantly more widespread, is dominated by mafic and intermediate lavas. Marine sedimentary rocks are interlayered with these volcanic rocks and become predominant in the stratigraphically highest Middle Jurassic exposures. Except for the acid volcanic rocks, this mixed volcano-sedimentary sucession is lithologically similar to, and represents the southern extension of units J(v,s) and mJs, mapped in the Natalkuz Lake map area (Diakow *et al.*, 1993; Green and Diakow, 1993). The base of the Naglico formation was not observed; the upper surface is an erosional unconformity with Tertiary volcanic rocks.

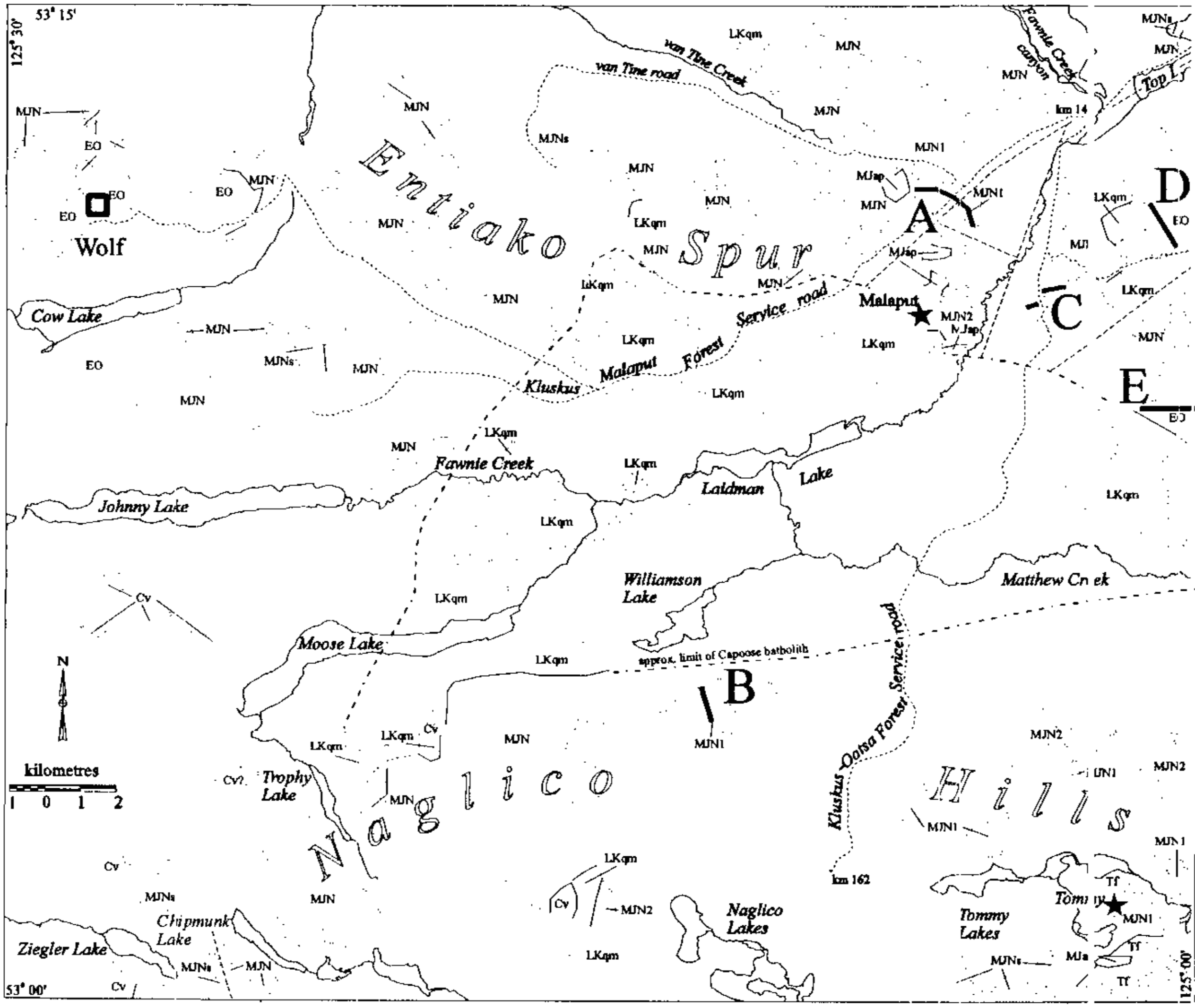
Rhyolitic Flows and Associated Pyroclastic Rocks (Unit MJN1)

The 150-metre reference section for the lower division is in a logged area adjacent to the 5-kilometre post of the Kluskus-Malaput Forest Service road (section A, Figure 2). The base is not exposed; however, the upper contact is sharp and conformable with the upper division, which includes pyroxene-phyric flows, and volcaniclastic and epiclastic rocks.

The rhyolitic rocks characteristically contain up to 3% rounded quartz phenocrysts. The lowest exposures of the reference section are rhyolites with light coloured flow laminae in a contrasting dark grey to black aphanitic groundmass (Plate 1A). Isolated outcrops of these distinctive lavas are found in the area between section A and the canyon of Fawnie Creek. Most of the section is made up of light grey fragmental rocks in typically thick, well-indurated beds devoid of internal structure. The beds are composed of lapilli and fewer block-sized fragments supported by a plagioclase-rich matrix (Plate 1B). The lithic fragments are mainly textural variants of plagioclase-porphyritic andesite, and some flow-laminated rhyolite. Several monzonitic fragments were also observed. Scarce, thin, welded zones within the otherwise massive unwelded tuffs have a compaction fabric defined by compressed lithic fragments (Plate 1C).

Rocks of the lower division crop out intermittantly in a broad area between Williamson and Tommy lakes, about 20 kilometres south of reference section A. Semicontinuous outcrop of the rhyolitic unit and its apparent conformable upper contact were observed in a logged area south of Williamson Lake (section B, Figure 2). In general, rhyolitic rocks at this locality differ from those at section A by the prominence of flows and subordinate fragmental and epiclastic rocks. The flow textures vary between sparsely porphyritic and crowded porphyritic, depending on the relative abundances of resorbed quartz, and plagioclase phenocrysts. The pyroclastic rocks include well-bedded lapilli tuff and finer graded tuffs containing abundant quartz. Periodic reworking of the rhyolitic flows and tuffs has resulted in local interbeds of volcanic sandstone and conglomerate.

Rhyolitic flows and minor welded ash-flow tuff of undetermined thickness crop out sporadically in the heavily treed area adjacent to Tommy Lakes. Epithermal veins and vein stockworks are exposed at a number of closely spaced localities in the rhyolitic rocks; they require further work to assess their mineral potential (*see* New Epithermal Precious Metal Prospects).



MIOCENE TO PLIOCENE - Chilcotin Group

Cv	Basalt flows, black, aphanitic and sparsely porphyritic with olivine and scarce coarse-grained plagioclase laths.

EOCENE - Ootsa Lake Group

EO	Mainly rhyolite with lesser andesite flows, quartz-bearing lapilli tuffs, minor lacustrine tuffaceous siltstone.

SYMBOLS

- Geological contact
- Fault
- Potential epithermal prospect ★
- Geological section
- Outcrop limit

MIDDLE JURASSIC - Hazelton Group - Naglico formation

MJNs	Volcanic derived, feldspar-rich fine to coarse grained clastic sediments containing abundant fossils; minor interlayed ash tuff and argillite.
MJN2	Augite-phyric basaltic and andesitic flows with associated compositionally similar lapilli and block tuffs; subordinate maroon tuffs with sparse quartz phenocrysts.
MJN1	Rhyolitic lava, ash-flow tuff and lapilli tuff containing diagnostic round quartz phenocrysts; minor epiclastic sediments with detrital quartz; local maroon and green ash and lapilli tuffs.

INTRUSIVE ROCKS

TERTIARY

Tf	Felsite sills, fine grained, granular; vitreous biotite.

LATE CRETACEOUS

LKqm	Quartz monzonite, pink, equigranular to porphyritic, accessory biotite and hornblende; volumetrically minor phases include quartz porphyry and biotite-hornblende quartz diorite.

MIDDLE JURASSIC

MJap	Mafic plugs containing diagnostic medium-grained augite and fine grained plagioclase phenocrysts.

Figure 2. Distribution of major lithologic units in the Fawnie Creek map area. The stars mark the Malaput and Tommy; two epithermal precious metal prospects dicovered during the mapping program.

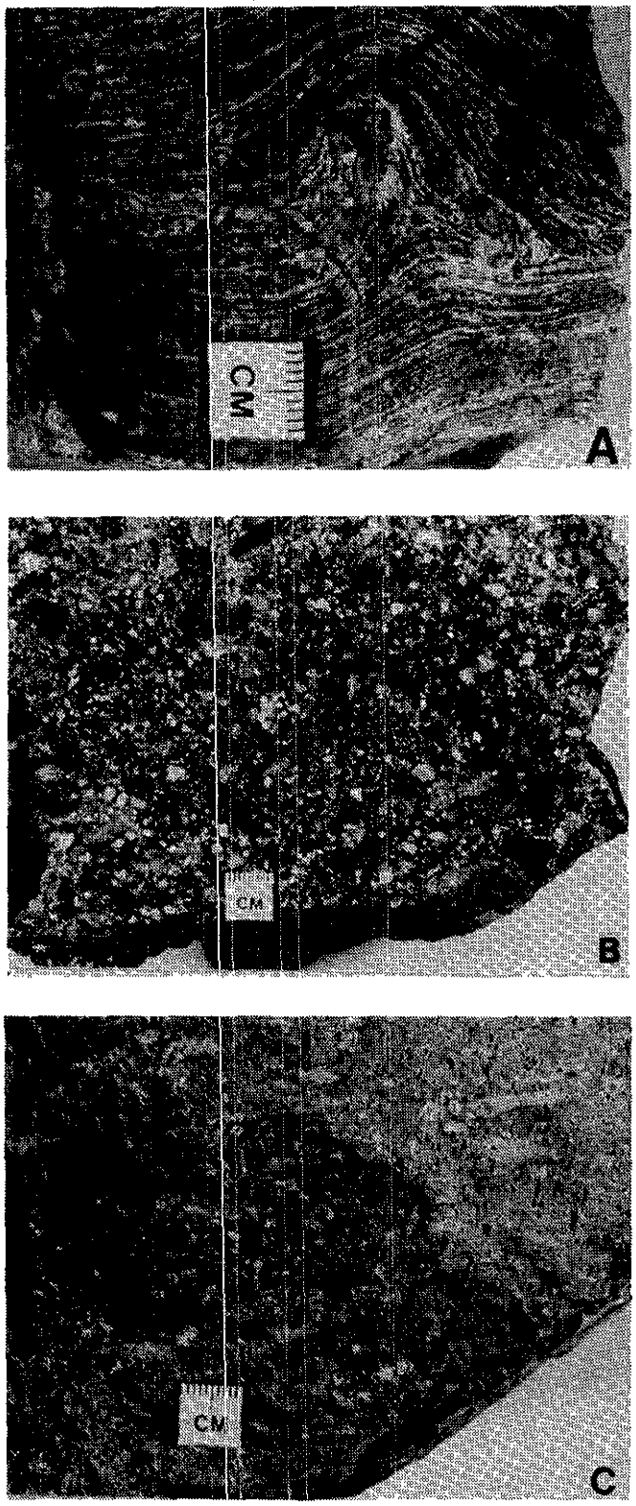


Plate 1. Representative rhyolitic rocks of the Middle Jurassic Naglico formation (unit MJN1). A) Finely laminated black lava flows found at the base of section A. B) Unwelded lapilli tuff is volumetrically the most significant rock type in section A. This rock characteristically contains round quartz grains, as shown immediately above the left side of the scale bar. C) Ash-flow tuff showing compaction foliation defined by compressed quartz-bearing cognate pyroclasts. This sample is from the Tommy Lakes area, where massive bedded quartz-bearing flows of unit MJN1 comprise the country rocks for epithermal quartz-barite-calcite veins and stockwork veinlets.

Southeast of section A, across the valley occupied by Fawnie Creek, quartz-bearing rhyolitic ash-flow tuff and lava are spatially associated with a significantly different rock sequence (section C, Figure 2). The stratigraphic position of these felsic rocks in relation to nearby isolated exposures of amygdaloidal, porphyritic and aphanitic andesite flows and volcanic conglomerate is unclear due to poor exposure. The conglomerate contains well-rounded clasts, some as large as 3 metres in diameter, of variants of porphyritic andesite and some welded dacite. Nearby and presumably a continuation of the section, the felsic rocks are about 25 metres thick at the base of a conformable overlying sequence composed of well-bedded, maroon and green fine-grained tuffs about 50 metres thick. Near the top, the tuffs are in contact with synvolcanic sediments and upsection they diminish to thin interbeds in the overlying sedimentary sequence (*see* Intravolcanic Sediments).

The rhyolitic sequence was probably deposited in a subaerial environment as suggested by welded ash-flow tuff and the absence of intercalated marine sedimentary rocks. In section C, where maroon tuffs underlie fossiliferous marine sediments, this relationship marks the transition from subaerial to shallow submarine deposition. The age of the rhyolitic sequence is unconstrained, but it is believed to be Middle Jurassic based on bivalves found in synvolcanic sediments at the upper gradational contact with volcanics at section C. Samples of rhyolitic rock from each of the three sections discussed were collected for U-Pb dating.

Augite-phyric Flows and Associated Pyroclastic Rocks (Unit MJN2)

The upper division is a lithologically varied succession dominated by andesitic flows and subordinate volcaniclastic rocks, and intravolcanic sedimentary rocks. This succession is regionally extensive, cropping out mainly in the Naglico Hills and Entiako Spur, but also scattered throughout the intervening low-lying area. To the north, in the adjacent Natalkuz Lake map area, an identical correlative volcano-sedimentary sequence underlies a broad area east of, and including the Fawnie Range (Diakow *et al.*, 1993). Variations in thickness of the upper division are difficult to ascertain because of the combined effect of generally poor exposure in monotonous volcanic sections that lack markers, and suspected intraformational stratigraphic repetition caused by numerous faults with small displacements. The upper division strata appear to be about 250 metres thick above the Capoose batholith, in the central part of the Entiako Spur; the thickest accumulation is believed to comprise a southwest-inclined homocline, south-southeast of Moose Lake in the Naglico Hills.

Because of the internal lithologic variability in rocks of the upper division no single section is representative, however, certain lithological features persist over broad areas. The primary lithologies include dark green flows of basalt and andesite. Vitreous augite phenocrysts, in amounts rarely exceeding 3% are ubiquitous, and a diagnostic feature of the andesitic flows. Plagioclase, the dominant phenocryst, varies in abundance. Some of the more common textural varieties include sparsely porphyritic, fine-grained crowded plagioclase porphyry to coarse-grained porphyry (Plate 2A,B). The flow succession also contains several other minor textural varieties. These include amygdaloidal lava with irregular, quartz-chlorite cavities, and dense, aphanitic basalt. Sometimes the basalt has resistant parallel ribs on the weathered surface, a feature that was observed in identical rocks in the Natalkuz Lake map area (Green and Diakow, 1993). Small-volume dacitic and rhyolitic lavas occupy relatively thin intervals in the more mafic succession.

Maroon and green pyroclastic rocks are interspersed with flows in the central part of the Entiako Spur. They are composed predominantly of lapilli tuff in which the lithic fragments and the matrix contain abundant plagioclase and subordinate chloritized mafic minerals. Quartz fragments are generally present, but because of their small size (< 2 mm) and low abundance (up to 2%) they can be easily overlooked. A somewhat different succession of fragmental rocks is found intimately layered with the augite porphyry flows in the central and eastern parts of the spur, and to the north-northeast across the headwaters of Van Tine Creek, in the Fawnie Range. They consist of lapilli and lesser block-tuffs dominated by plagioclase-rich pyroclasts with a fine-grained, crowded texture (Plate 2C). This distinctive texture is due to minute plagioclase up to 2 millimetres long in amounts up to 35 volume percent. Interbeds of ash tuff and rare accretionary tuff are also present. Accretionary lapilli were also found at another locality, in section B, where they are associated with bedded ash and lapilli tuffs that rest on crowded plagioclase ±pyroxene-porphyritic andesite flows. This sequence is capped by a cobble-boulder conglomerate containing locally derived rounded clasts of porphyritic andesite, and some quartz-bearing rhyolite eroded from the underlying lower division.

Fragmental rocks exposed mainly in the area between Chipmunk and Trophy lakes (local names) differ from those elsewhere in the map area, in that they consist mainly of aphanitic, off-white felsic(?) lapilli in a light green matrix. These rocks are commonly interlayered with augite-bearing andesite flows diagnostic of the upper division, and locally with welded dacite. The fragments are commonly subrounded, a feature that possibly reflects some post-depositional reworking. The interlayered relationship of these felsic rocks with andesitic flows is interpreted to suggest contemporaneous bimodal volcanism.

Deposition of much of the augite-phryric volcanic unit is presumed to be in a relatively shallow marine environment with local subaerial conditions, as indicated

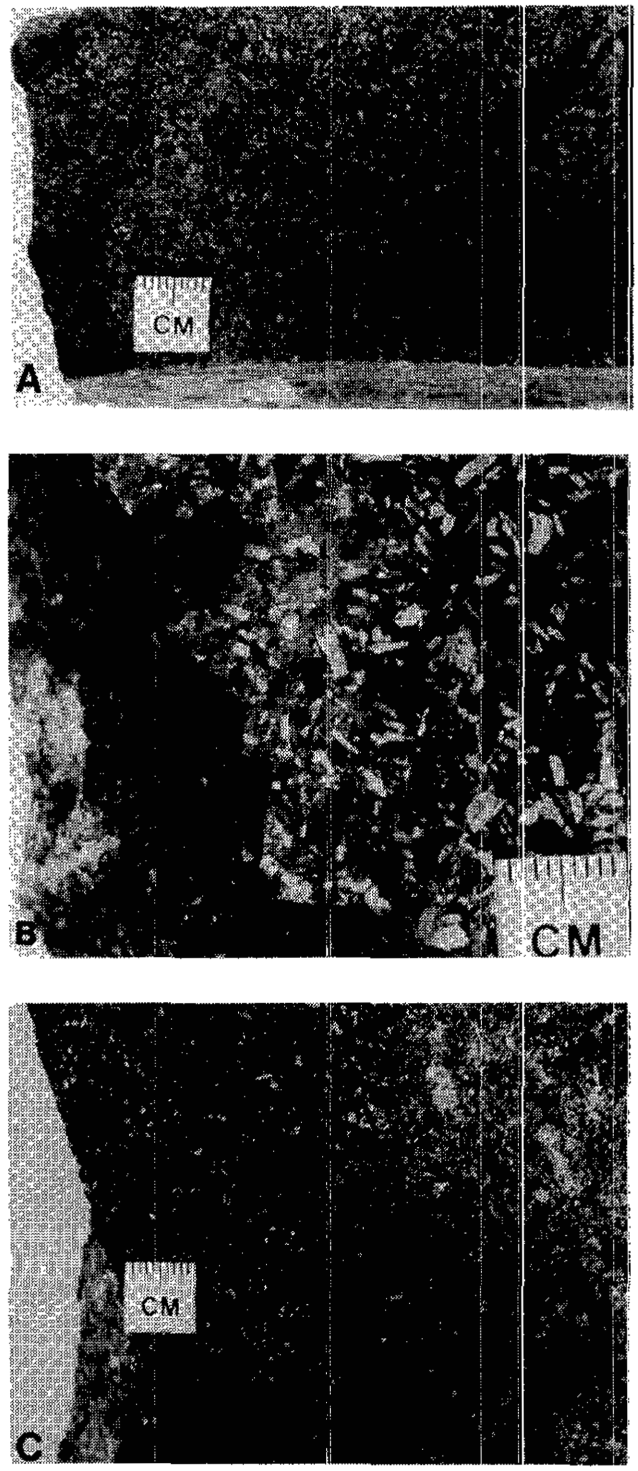


Plate 2. Representative augite-phyric rocks of the Middle Jurassic Naglico formation (unit MJN2). A) Typical fine-grained end-member "crowded" plagioclase porphyry lava composed of up to 40% plagioclase and sparse vitreous augite phenocrysts. B) The coarse-grained end-member flows contain plagioclase laths up to 5 millimetres long. Note the abundant vitreous augite evident as black grains. C) Monolithic "crowded plagioclase porphyry" lapilli tuff occur mainly in the eastern part of the Entiako Spur and into the Fawnie Range where they are interlayered with augite-phyric flows. Note the uniform fine-grained porphyritic texture of both the matrix and pyroclasts.

by rare accretionary lapilli. Evidence of marine deposition is based on a number of localties where the flows contain interbeds of volcanic-derived marine sedimentary rocks. These rocks are described in the following section. Despite textural variations, their bulk composition varies little in an area that encompasses the entire Fawnie Creek and much of the Natalkuz Lake areas. This broad distribution may reflect construction of a series of coalescing shield-like volcanoes in which there appears to have been a preponderance of tholeiite to weakly calcalkaline basalt (at present there is a small geochemical data set for flows in the Natalkuz Lake area. Rocks collected in the Fawnie Creek area had not been analysed in time for this report). Local concentrations of more felsic pyroclastic deposits probably indicate short-lived, more violent eruptive episodes or are coalescing deposits from a separate but nearby volcanic centre.

Intravolcanic Sediments (Unit MJNs)

Fossiliferous sedimentary rocks are randomly dispersed and stratigraphically conformable with andesitic rocks of the upper division. Generally the exposures are poor, and limited to angular debris churned up in roadcuts and logging cutblocks. Representative sections are exposed near the top of section A, and to the east of Fawnie Creek at section C. The main feature of the intravolcanic sediments is their immaturity, characterized by the high proportion of angular plagioclase and volcanic lithic detritus. The dominant lithologies include feldspathic sandstone and siltstone, tuffaceous argillite, locally prominent volcanic conglomerate and scarce limestone. Fossils are nearly always present, varying in abundance from a few belemnites and pelecypods to zones containing a rich and varied fauna that includes ammonites, gastropods, colonial corals, bryozoans and various bivalves. Preliminary fossil identifications by Dr. Howard Tipper of the Geological Survey of Canada indicate at least one early Bajocian collection; most are indeterminate or probable Middle Jurassic.

Near the top of section A, volcanogenic sedimentary rocks occupy an interval about 40 metres thick. They overlie rhyolitic rocks of the lower division, and the upper conformable contact is with coarse-grained, augite-phyric andesite flows. The base of the section is dominated by light green, tuffaceous siltstone and mudstone that alternate in differentially weathered, parallel beds between 5 millimetres and 3 centimetres thick. Convolute bedding and channels are observed in several intervals about 1.5 metres thick. These fine-grained rocks persist up-section to within about 20 metres of the upper contact where they comprise minor interbeds in a succession of thick, poorly sorted beds composed of subrounded to subangular pebble and cobble-sized detritus. Much of the detritus contains augite, derived from nearby augite-phyric volcanics. The interpretation drawn from these sediments is that the lower fine-grained sequence may be waterlain airborne ash deposited, in part, on an unstable slope susceptible to slumping. The overlying coarser deposits suggest a transition to a higher energy environment, perhaps associated with local progradation of a volcaniclastic-epiclastic apron.

Stratigraphic section A varies markedly from section C, across the valley of Fawnie Creek. As described above and summarized here, the strata underlying the Entiako Spur to the northwest are predominately volcanic rocks representative of both divisions of the Naglico formation. Minor intravolcanic marine sediments are found exclusively in the upper division. The volume of volcanic rocks is significantly less in the area to the southeast of Fawnie Creek. Most notable is the relative absence of augite-bearing flows and associated volcaniclastic rocks. Instead, they are supplanted by an apparently distal sedimentary succession, at least 150 metres thick, which is cut by augite porphyry sills and dikes. Similar intrusions (unit MJap) are believed to be comagmatic feeders for upper division volcanic strata. Extrusive augite-bearing volcanic rocks may well have been erupted above the sediments, but removed during a regional erosional episode in the interval spanning Late Cretaceous and Eocene time. Although the upper contact of the sedimentary succession was not observed, the uppermost exposure of sediments crops out topographically beneath a nearby outlier of Eocene volcanic strata. North of Top Lake a correlative section of sedimentary rocks dips gently to the southeast, and barring a fault, it is interpreted to project down dip beneath a distant exposure of augite-bearing flows. Rhyolitic rocks prevalent at the base of section A apparently continue across the valley to section C where they comprise a minor depositional unit within a heterogeneous succession of intermediate flows and variegated maroon and green fine-grained tuffs conformably overlain by sediments. The bottom of this sedimentary section is a well-exposed gradational contact in which volcanogenic fine and coarse-grained sediments rest directly on ash tuff. An identical tuff bed is enclosed by sediments about 10 metres above the contact. The bottom of the lowest sedimentary bed provides evidence of synchronous volcanism and marine sedimentation as shown by volcanic conglomerate dominated by angular clasts occupying ball and pillow structures in an underlying bed of vitric and ash tuff (Plate 3A). Bivalves and belemnites are concentrated in a thin layer within the basal conglomerate. Up-section, angular, volcanic lithic fragments and abundant plagioclase grains in the sediments suggest erosion of a nearby volcanic source or penecontemporaneous volcanic activity. These coarse immature rocks appear to rapidly diminish up-section, passing into finer grained feldspathic siltstone and sandstone (Plate 3B), and are eventually replaced by tuffaceous argillite. Discrete off-white weathered layers, believed to be ash, impart a striped appearance where they alternate with black argillite (Plate 3C). There are good exposures of these argillaceous rocks in rusty pyritic roadcuts between 143.5 and 146.5 kilometres on the Kluskus-Ootsa Forest Service road. They typically display uniform, parallel beds between 3 and 7 centimetres thick and contain calcareous concretions.

The recessive nature of the sedimentary rocks results in generally scattered exposures in section C. Although the section appears to be continuous, in reality a significant hiatus, spanning late Bajocian and Bathonian time is suspected. Belemnites and bivalves located at the base of the succession are not diagnostic, but based on lithology these rocks resemble early(?) Bajocian sediments found elsewhere in the upper division of the Naglico formation. At the top of the section, a fossil quarry contains a varied faunal assemblage that includes Callovian ammonites associated with abundant belemnites, pelecypods, brachiopods, and rare, star-shaped crinoid columnals. Comparable Callovian sediments are found at one other locality in the map area, about 1 kilometre north of Top Lake.

The strata at section C presumably represent the top of the Naglico formation preserved in the Fawnie Creek map area. Sedimentary rocks found in the upper division are interpreted to represent early Bajocian shallow-marine deposits within the influence of an active volcanic centre and followed in time by a significant increase in water depth and oxygen deficient conditions. This is indicated by the change from sediments rich in volcanic detritus at the base of the section to overlying parallel-bedded, pyritic tuffaceous argillite. By Callovian time a relatively shallow water near-shore environment was re-established giving way to feldspathic siltstone and sandstone replete with a diversified faunal assemblage.

A clastic succession, lithologically distinct from those previously described, is exposed in the area between Chipmunk and Ziegler lakes. To the east these rocks are faulted against andesite flows of the upper division; and to the west, they appear to be unconformably overlain by rocks of the Chilcotin Group. The succession is predominantely sorted sandstone that is interlayered with, and grades into, minor granule-pebble conglomerate. The arenaceous beds contain quartz, but lack high concentrations of detrital plagioclase, which distinguishes them from typical Bajocian and Callovian sandstones found elsewhere in the map area. The conglomerate beds are typically framework supported, characterized by well-rounded clasts. The clasts are mainly pale green siltstone, lesser black mudstone, and light grey chert. No fossils were found in these rocks, however, similar conglomeratic rocks conformably overlie a Bathonian or Callovian sedimentary sequence exposed along the eastern slope of the Fawnie Range (*cf.* unit mJs of Diakow *et al.*, 1993). A single, angular

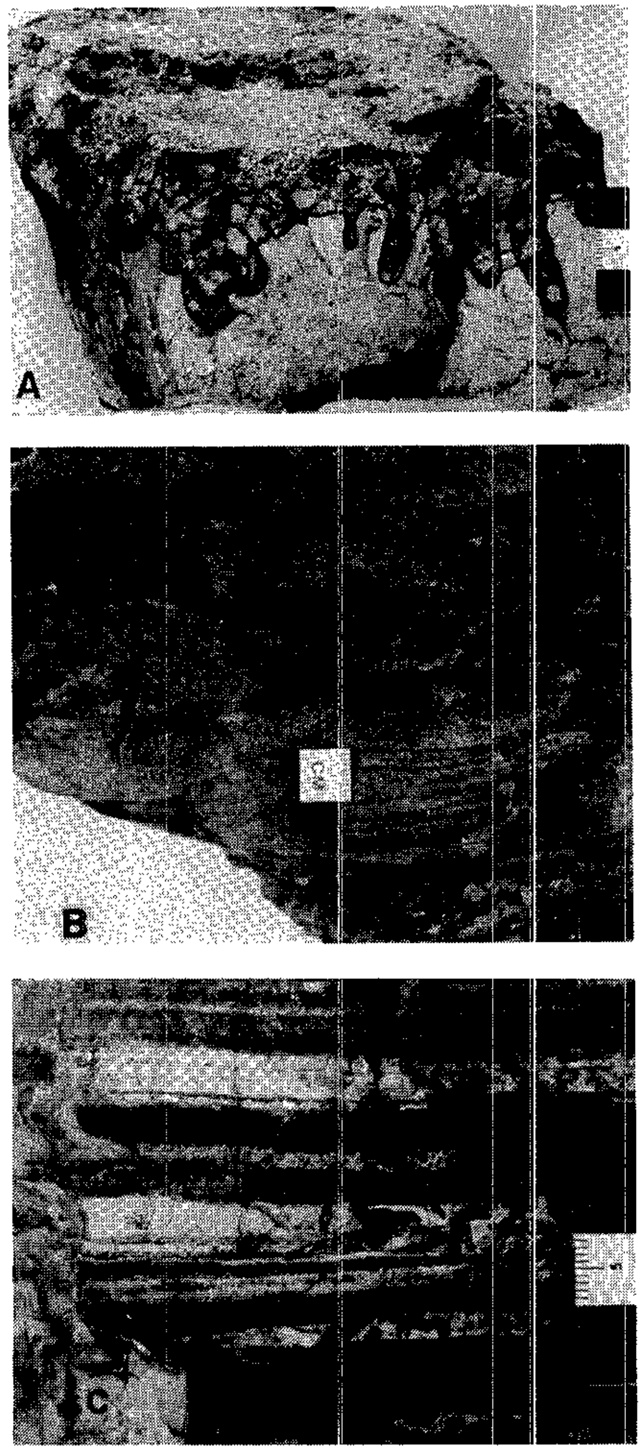


Plate 3. Volcanic-derived sedimentary rocks of the Naglico formation (unit MJNs). A) Sharpstone conglomerate and immature feldspathic sandstone overlying vitric ash tuff at the top of the underlying volcanics in section C. Load casts occur at the contact, highlighted by the black line. They provide evidence of synvolcanic sedimentation. Note necking of the lobes and the detached sediment-filled sphere enclosed by ash. B) Feldspathic sandstone, comprised mainly of angular plagioclase grains, is the dominant rock type of unit MJNs. In this example fine grained feldspathic sandstone and mudstone show flaser bedding. C) Parallel laminated white ash tuff interlayered with tuffaceous argillite. These rocks overlie coarser grained volcanic sediments and mark the transition in time to a deeper quiet water environment.

fragment of an identical conglomerate was found immediately upsection from Callovian sediments at section C; however, outcrop of this rock was not located.

EOCENE

OOTSA LAKE GROUP (UNIT EO)

Volcanic rocks of the Ootsa Lake Group occur in three widely spaced localities. They cap three knolls north of Cow Lake, where they comprise the host rocks for the Wolf epithermal precious metal prospect, and two outliers are situated along the western slope of the Fawnie Range. It is uncertain whether the group was uniformly deposited over the intervening area and subsequently eroded or that these outliers represent areally restricted deposits erupted from separate volcanic centres. We favour the latter interpretation because there are significant lithologic differences in Eocene strata near Cow Lake compared to correlative rocks along the Fawnie Range. Furthermore, we believe that emplacement of the Capoose batholith elevated the central Entiako Spur forming a paleo-topographic high and consequently a local barrier for Eocene eruptives. The preserved Eocene volcanic sequences are relatively thin; about 150 to 175 metres thick north of Cow Lake and at least 155 metres thick in the Fawnie Range (section E, Figure 2). The succession may be somewhat thicker where it is exposed north of the access road to the Blackwell-Davidson prospect (section D, Figure 2). Volcanic rocks and a cogenetic subvolcanic intrusion at the Wolf prospect yield three K-Ar dates, on whole rocks, between 47.6 ±1.7 and 49.9 ± 1.7 Ma (Andrew, 1988).

The lower contact of the Ootsa Lake Group apparently dips gently westward on the three isolated hills north of Cow Lake. A basal conglomerate crops out in a creek along the northwest-facing side of the westerly hill. On the central and easterly hills, the Ootsa Lake Group sits unconformably either on fossiliferous sedimentary rocks or pyroxene-bearing flows of the Naglico formation. A similar contact relationship apparently exists in the Fawnie Range where rocks of the Naglico formation, cut by quartz porphyry dikes (unit LKqp) and the Capoose batholith, crop out topographically below comparatively unaltered strata of the Ootsa Lake Group.

Eocene strata at the Wolf prospect generally dip southwest, but north and northeast-trending faults cause local deviations from this trend. The base of the succession is locally marked be an oligomictic orthoconglomerate about 20 metres thick. It is composed of well-rounded hornblende-biotite quartz monzonite and aplite clasts up to 1.3 metres in diameter. The texture and mineralogic features of the clasts suggest a local provenance from the Capoose batholith. The conglomerate is overlain by tuff, which is part of a poorly exposed, predominantely pyroclastic section that comprises as much as 30% of the Eocene succession in the subsurface (personal communication, D. Heberlein, 1993). The tuffs include welded and non-welded zones in ash and lithic-rich beds, and some locally significant heterolithic breccia. Tuffaceous siltstone and sandstone of probable lacustrine origin form lenticular deposits conformable with the overlying rhyolite flows. These lavas comprise the stratgraphic top of the Eocene section, dominating the upper slopes and capping the three prominent knolls at the Wolf prospect. Despite their apparent spatial dominance, due to their resistance and relatively flat attitude, they make up only about 30% of the overall Eocene succession. The rhyolite flows contain up to 5% quartz, typically a few millimetres in diameter, orthoclase and abundant microscopic zircon. Although biotite is generally present elsewhere in rhyolitic rocks of the Ootsa Lake Group, it was not observed in the lavas at the Wolf property. Felsic tuffs and flows (units EOrt and EOr of Diakow *et al.*, 1993), believed to be correlative with rocks at the Wolf prospect, crop out sporadically along the Entiako River in the southeast corner on Natalkuz Lake map area. Here rhyolite conformably overlies andesitic flows, which in turn, are unconformable on the Capoose batholith. These andesitic flows were not observed at the Wolf prospect, however, south of Cow Lake similar rocks underlie a cluster of low-lying knolls that pass at lower elevation into pyroxene-phyric rocks of the Naglico formation.

At the Wolf prospect, a sill-like body and rhyolitic dikes, interpreted as synvolcanic hypabyssal plutons, intrude the lavas. They have a medium to coarse-grained porphyritic texture imparted by plagioclase, potassium feldspar and quartz, listed in order of abundance. Hydrothermal alteration is extensive and locally intensive, as indicated by the destruction of primary volcanic textures in bleached rocks, and the introduction of silica as a pervasive replacement and veinlets (*see* Schroeter and Lane, 1994, this volume).

Three main lithologies make up the Ootsa Lake Group near the eastern boundary of the map area (sections D and E, Figure 2). At section E, off-white, laminated rhyolite flows, brecciated towards the top of the unit predominate near the base of a crudely bedded volcanic succession. The thin flow-laminae in these rocks are locally obscured by the overgrowth of spherulites, which coalesce and form discontinuous layers. Scarce lithophysae are also present. Typically these rhyolitic rocks have an aphyric texture, however, some contain sparse plagioclase, quartz and biotite phenocrysts. Andesite flows conformably overlie the rhyolite. They contain diagnostic plagioclase laths up to 6 millimetres long in a dark matrix. The uppermost part of section E is dominated by lapilli tuff characterized by 20% bipyramidal and broken quartz fragments between 1 and 4 millimetres in diameter. The lithic fragments are typically dark brown and subangular, aphanitic and porphyritic volcanic rocks. These quartz-rich tuffs resemble a solitary outcrop mapped north of Entiako Lake (unit EOrt of Diakow *et al.*, 1993). They are also strikingly similar to tuff interbeds in a probable Jurassic volcano-sedimentary sequence exposed at the top of Mount Davidson.

Rhyolite and andesite flows predominate in the outlier north of access road to the Blackwater-Davidson mineral prospect (section D, Figure 2). The main difference between this succession and section E is that the quartzose tuff unit is absent. Other distinguishing lithologic features include round amygdules, filled with chlorite and opalescent silica, common in the overlying coarse-grained plagioclase phyric andesite flows. The underlying rhyolites are distinctly laminated, mauve and pale green, and contain beds of monolithic breccia.

MIOCENE and YOUNGER VOLCANIC ROCKS

CHILCOTIN GROUP (UNIT MPcv)

Relatively thin, sheet-like basalt flows, tentatively assigned to the Chilcotin Group, are generally found in topographically low-lying areas, below 1150 metres elevation, where exposure is obscured by glacial deposits. Commonly, where outcrop is sparse the presence of nearby flows is indicated by boulder fields. Abundant large boulders of basalt are found in the low-lying area south of the Naglico Hills. The subdued topography in the southwest part of the map area, between Ziegler Lake to the south and Johnny Lake to the north, is believed to be manifestation of basaltic sheet flows. The topographically highest flows outcrop in the centre of the Naglico Hills at about 1300 metres elevation. The basaltic lavas are generally massive and characteristically vesicular. They weather light brown. and fresh surfaces are black with a dense aphanitic texture. Fresh olivine is locally abundant; plagioclase laths between 1 and 1.5 centimetres long are present, but rarely.

INTRUSIVE ROCKS

MIDDLE JURASSIC

AUGITE PORPHYRY (UNIT MJap)

Augite porphyry plugs, typically less than 1.5 square kilometres in area, are exposed in the eastern part of Entiako Spur and south of Tommy Lakes. These plutons apparently intrude and bleach rocks of unit MJN2. Their main feature is subhedral augite phenocrysts, which comprise as much as 25% of the rock, and plagioclase microphenocrysts arranged in a felty texture (Plate 4).

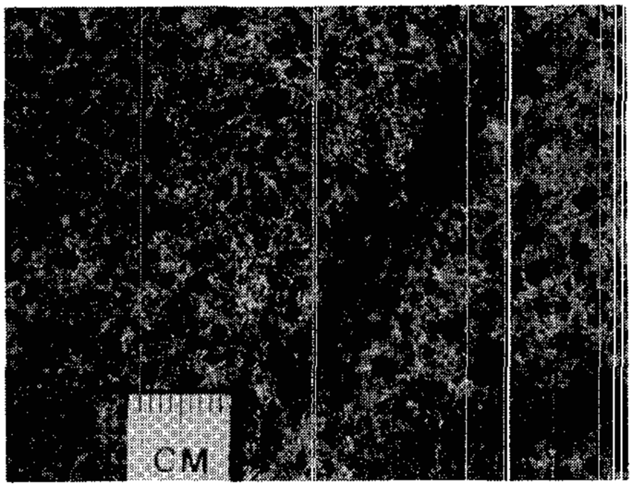


Plate 4. Type specimen of augite porphyry hypabyssal stock west of section A. The dark subhedral grains are vitreous augite phenocrysts supported by a matrix composed of randomly oriented plagioclase grains. These plutons are believed to be cogenetic with the augite-phyric volcanic rocks of unit MJN2.

The similar texture, mineralogy, and spatial relationship of these plutons with volcanic rocks of unit MJN2 are interpreted to suggest they may be cogenetic. A similar pluton south of Tommy Lakes is surrounded by sedimentary rocks of probable Middle Jurassic age, however, a contact was not observed. At one locality a remnant of a probable Eocene sill (unit Tf) rests directly on this pluton. Near section C, sedimentary rocks of unit MJNs are cut by augite-phyric dikes and sills(?). No contacts were observed, and it is difficult to distinguish these so called sills from thin flows on the basis of texture and composition.

LATE CRETACEOUS

CAPOOSE BATHOLITH (UNIT LKqm)

Quartz monzonite of the Capoose batholith outcrops in the extreme north of the map area, along Van Tine Creek, extending the body southward from the Natalkuz Lake map area (Diakow *et al.*, 1993). The batholith underlies as much as 150 square kilometres of the Fawnie Creek map area. It continues to the south beneath the Entiako Spur, cropping out extensively along its southern slope down to Laidman and Moose lakes, and beyond to its southern contact in the Naglico Hills. Thick glacial drift mantles the batholith in the valley east of Laidman Lake. However, the pluton is exposed in an incised creek valley, and north of Matthews Creek along the base of the Fawnie Range. Although the contact between the batholith and stratified rocks was not observed, the thermal effects on Jurassic strata are widespread, particularly in the central part of the Entiako Spur where volcanic rocks are variably replaced by an assemblage of chlorite, epidote, silica and pyrite with or without garnet. The Capoose batholith has one reported K-Ar date of 67.1 ± 2.3 Ma determined on biotite (Andrew, 1988). A site along the Kluskus-Malaput road was sampled this season. The rock contains both fresh biotite and hornblende which are suitable for K-Ar dating. A sample of biotite-hornblende quartz diorite (unit LKqd), which is locally intruded by quartz monozonite, will also be dated by the K-Ar method.

The main phase of the batholith is a homogeneous medium to coarse-grained, equigranular quartz monzonite. The rock is typically light pink and contains 35% quartz, roughly equal proportions of alkali feldspar and plagioclase, and about 10 to 15% combined fresh hornblende and biotite. Xenoliths in the pluton are abundant and composed of fine-grained porphyry with randomly oriented plagioclase laths less than 1millimetre long and an interstitial anhedral mafic mineral, possibly hornblende.

At the east end of Moose Lake the quartz monzonite is gradational into a porphyritic monzonite. Plagioclase phenocrysts in this rock are subhedral and approximately 5 millimetres long, forming an an interlocking aggregate with anhedral potassium feldspar, approximately 10% quartz, and 5% hornblende and biotite. A small isolated stock, south of the main body in the Naglico Hills, may represent yet another phase of the Capoose batholith. It consists for the most part of white, equigranular granodiorite with up to 15% chloritized mafic minerals. Pyrite is common in pyroxene-bearing flows of the Naglico formation cropping out east of the intrusive contact. Along the northern margin the pluton contains coarse-grained potassium feldspar phenocrysts, and chloritized plagioclase and biotite.

BIOTITE-HORNBLENDE QUARTZ DIORITE (UNIT LKqd)

Biotite-hornblende quartz diorite forms isolated plugs and small stocks near the margin of, and rarely enclosed by, quartz monzonite of the Capoose batholith. Dikes of quartz monzonite and aplite are locally observed cutting the diorite. Typically these plutons are dark greyish green with a medium-grained equigranular texture. Hornblende, the dominant mafic mineral, commonly approaches 25% of the rock. Xenoliths in the diorite are generally quite rare except for one locality where pyroxene porphyry, which resembles Middle Jurassic lithologies, and other fine-grained dioritic fragments are abundant in zones of agmatite.

QUARTZ PORPHYRY (UNIT LKqp)

Quartz porphyry dikes and several plug-size plutons are found mainly east of Fawnie Creek. They cut Middle Jurassic sedimentary rocks; however, nowhere were they observed cutting rocks of the nearby Ootsa Lake Group. These plutons are pink and characterized by 5 to 15% quartz phenocrysts. They also contain up to 5% hornblende, and subordinate biotite phenocrysts. Locally, small (< 1 cm diameter) mariolitic cavities suggest high-level emplacement. Based on their texture, composition and spatial association they are interpreted as subvolcanic apophyses projecting from the Capoose batholith.

TERTIARY

BIOTITE-BEARING FELSITE SILLS (UNIT Tf)

Greyish green fine-grained crystalline felsite sills that characteristically contain up to 5% vitreous biotite are confined to the area south and east of Tommy Lakes. Sporadic outcrops of these rocks in spatial association with rhyolite flows of the Naglico formation are found close to Tommy Lakes. In the extreme southeast corner of the study area these rock comprise a laterally extensive sheet that is concordant with gently south dipping volcanic and sedimentary rocks of the Naglico formation, and an isolated remnant rests directly on an augite porphyry plug (unit MJap). The sills weather to porcellaneous, concoidally fractured fragments. Sparse plagioclase phenocrysts, up to 4 millimetres long, are observed on the fine granular weathered surface.

STRUCTURE

The Fawnie Creek area is part of a regional east-trending horst, the Nechako uplift, locally manifest as the Fawnie Range, Naglico Hills and Entiako Spur. Evidence of uplift is inferred from topographically highstanding basement rocks, mainly of Jurassic age, which to the south and north pass into extensive areas covered by Eocene and younger rocks The lateral transition from old to young stratigraphy coincides with several inferred northeast-trending structures, which delimit the Fawnie and Nechako ranges to the north and south. These structures include the Natalkuz fault, mapped to the north of the ranges (Diakow *et al.*, 1993); the Blackwater drainage system appears to follow a parallel structural zone to the south.

Uplift of the Middle Jurassic Naglico formation appears to be relatively uniform across much of the Natalkuz Lake and Fawnie Creek map areas, as suggested by widely distributed augite-phyric lavas and intravolcanic sedimentary rocks. In the central Naglico Hills, the formation comprises a southwest-dipping homocline, however this trend in bedding is disrupted in the east near Tommy Lakes, where comparable Jurassic strata dip to the south. Significant variability in bedding attitudes is also observed along the axis of the Entiako Spur. In the eastern part of the spur, the layered rocks dip in opposing directions across Fawnie Creek. Immediately west of Fawnie Creek, throughout section A, the beds dip at low to moderate angles northwest; farther west bedding attitudes change significantly from one ridge to another. Much of the variablility is attributed to tilting along normal faults.

Faults in the Fawnie Creek typically trend north and northwest. Displacements are assumed to be small as they affect rocks mainly from the Naglico formation. Near the Wolf prospect, strata of the Ootsa Lake Group in contact with the underlying Naglico formation are disrupted by steeply dipping structures. Faults apparently occupy the two valleys between three knolls, causing the unconformable surface between Eocene and Jurassic basement to step down progressively toward the west. Jurassic sedimentary rocks in the vicinity of section C, east of Fawnie Creek, are truncated on the north by a steep, northwest-trending fault. The trace of this fault is lost where it intersects the Fawnie Creek valley, and field evidence suggests the structure does not extend directly across the valley. However, a fault which may be its northern extension is suspected to trace through the Fawnie Creek watershed where it turns sharply up-slope in the Fawnie Range. Interpretation of these segments as a continuous structure requires a crossfault with right-lateral motion, trending northeast through the valley occupied by Top Lake. There is little direct field evidence for such a fault, although it would be difficult to recognize as its trace would roughly parallel the strike of layered rocks in the area.

The high-level emplacement of the Late Cretaceous Capoose batholith into Jurassic rocks beneath the Entiako Spur generated numerous small-scale faults and fractures. Fracturing is most intense in the central part of the spur where the batholith is closest to the surface. Increased permeability in these rocks chanelled the flow of hydrothermal solutions, as evidenced by widespread propylite, and more localized skarn alteration and pervasive silicification.

ECONOMIC GEOLOGY

Except for epithermal vein and disseminated precious metal mineralization at the Wolf property, which is related to Eocene felsic magmatism, most mineral propects in the Fawnie Creek and adjoining Natalkuz Lake map areas occur near the margin of the Capoose batholith. Precious metal mineralization at the Capoose prospect, in the Natalkuz Lake map area, is temporally and probably genetically related to the emplacement of batholith (Andrew, 1988). A similar spatial relationship exists in the Fawnie Creek map area where skarn and epithermal prospects occur in hydrothermally altered Middle Jurassic rocks near the contact with the batholith. Two new epithermal targets, one a system of discordant veins and the other a zone of pervasive silicification, were discovered during the bedrock mapping program in volcanic rocks of the Naglico formation. Features of these occurrences are discussed in the following section. The setting of other known deposits in the Fawnie Creek map area is described elsewhere (Schroeter and Lane, 1994: this volume).

NEW EPITHERMAL PRECIOUS METAL PROSPECTS

MALAPUT (UTM 358470E, 5893455N)

The Malaput occurrence is in a gently sloping logged area accessed by a secondary road off of the Kluskus-Malaput Forest Service road. The occurrence consists of pervasively silicified rocks that crop out sporadically through apparently thin glacial drift in a zone measuring approximately 125 by 75 metres. Outcrops of the Capoose batholith occur about 1 kilometre to the northwest and comparatively unaltered green and maroon volcanic rocks, tentatively assigned to unit MJN1, are exposed about 50 metres to the east.

The altered rocks are composed mainly of fine-grained silica, in places accompanied by sericite and rare, crystalline barite. The texture of these rocks is typically massive with some irregular open cavities lined by drusy quartz. Finely disseminated pyrite, present in trace quantities, is generally oxidized resulting in a limonitic coating on weathered surfaces. About 50 metres to the east a solitary exposure of layered volcanic rocks contains bedding-parallel pyritiferous laminae.

The altered mineral assemblage is suggestive of a low-temperature, oxidized, epithermal setting. At present this alteration zone is poorly exposed; it requires additional work to assess its precious metal potential. A relatively flat site and the nature of alteration are amenable to an exploration program involving mechanized trenching and an induced polarization survey.

TOMMY (UTM 363750E, 587650N)

The Tommy occurrence is actually three isolated quartz vein and stockwork veinlet occurrences found in the vicinity of Tommy Lakes in the southeast corner of the map area. At present, there are no roads in this area. It is occupied by tree-covered hills with generally poor rock exposures limited to their crests and steeper slopes. The veins occur in rhyolitic flows and lesser ash-flow tuff of unit MJN1.

The UTM grid coodinate cited above is for the largest of the veins. At this site a vertical quartz vein can be traced discontinuously for 50 metres along a trend of 045°. The vein is typically less than 1.5 metres wide. The quartz is white, finely crystalline to massive, rarely banded along vein margins with drusy crystals growing inward toward the centre of some anastomising veinlets. Sparry calcite sometimes occupies a void at the centre of the banded veins. Pyrite is present in trace amounts. Alteration of the country rocks is shown by minor reddening of the groundmass and plagioclase phenocrysts. Small outcrops of quartz can be traced intermittantly for about 500 metres to the northeast.

Stockwork veinlets are exposed on a knoll due south of the eastermost of the Tommy Lakes. Prominent fractures and brecciated vein material trend northeast. Another system of stockwork veinlets crop out on a knoll near the centre of a recent forest burn, northeast of Tommy Lakes. These quartz veins are similar to others south of Tommy Lakes, however, they also contain crystalline barite.

Limited time was devoted to prospecting in the Tommy Lakes area during the course of bedrock mapping. We believe there is excellent potential for the discovery of additional epithermal quartz veins and their potential for precious metals is untested.

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