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GEOLOGICAL SURVEY

PRELIMINARY REPORT

WEST HALF OF THE FORT FRASER MAP-AREA, B. C.

BY

J. E. Armstrong

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INTRODUCTION

The area described in this report lies in central British Columbia in the western part of the Northern Interior Plateau, between Francois and Babine lakes and longitudes 125 and 126 degrees west. It is approximately 40 miles from east to west, 35 miles from north to south, and 1,400 square miles in area.

This area was geologically mapped during the summer of 1936. The base map used was supplied by the Topographical Division of the Geological Survey.[1]

The area is easily accessible, the Canadian National railway and the highway from Prince George to Hazelton traversing it from east to west. From the village of Burns Lake, which is on the Canadian National railway, 150 miles west of Prince George, roads run southward to Francois lake and northward to Babine lake. The road to Francois lake is 14½ miles in length, well gravelled, of easy grades, and suitable for automobile travel. The road to Babine lake branches at Pinkut lake, 11 miles north of Burns Lake, one branch leading north 10 miles to Babine lake, and the other east 13 miles to the Taltapin Mining Company's property on Pinkut creek, and then north 3 miles to the Silver Island Mining Company's property on Babine lake. This road is suitable for automobile travel only to Pinkut lake. A road suitable for automobiles skirts the north shore of Francois lake, running westward from Francois Lake post office to Colleymount, and another runs southward 6 miles from the village of

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[1] Topographical Survey Division, Bureau of Geology and Topography, Department of Mines and Resources.

Endako to the east end of Francois lake. The country is well provided with trails over which pack horses can be taken. The many lakes in the area, especially the two largest, Babine and Francois, are extensively used as transportation routes.

The first geological mapping of any part of the map-area was done in 1876 by G.M. Dawson who made a reconnaissance survey along Francois lake.[1] In 1924 George Hanson made a geological examination of several localities in the vicinity of Burns and Francois lakes.[2] The more important mineral deposits, and the contact zones of the batholithic rocks east of Burns Lake were examined by F.A. Kerr in 1934.[3] Other geological studies have been made by D. Lay, and are published in the Annual Reports of the Minister of Mines, British Columbia.[4]

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[1] Geol. Surv., Canada, Rept. of Prog. 1876-77, pp. 83-88.

[2] Geol. Surv., Canada, Sum. Rept. 1924, pt. A, "Prince Rupert to Burns Lake, B.C.", pp. 42 and 43.

[3] Prelim. Rept., "Mineral Resources along the Canadian National Railway, between Prince Rupert and Prince George, B.C."; Geol. Surv., Canada, Paper 36-20, 1936, pp. 137-167.

[4] Ann. Repts., Minister of Mines, B.C.: 1933, p. 115; 1932, p.80; 1931, p. 76; 1929, p. 147.

PHYSICAL FEATURES

Fort Fraser map-area lies wholly within the western part of the Northern Interior Plateau. Although spoken of as a plateau the area is by no means flat, but has an average relief of 1,500 to 2,000 feet, with an occasional mountain rising from 2,500 to 3,000 feet above the valley bottoms. The valleys are wide and fairly flat with an average elevation above sea-level of 2,000 to 2,500 feet. This western part of the plateau is commonly called "the lake district of British Columbia" and

contains innumerable lakes of all sizes. These lakes range in size from mere ponds to Babine lake, 110 miles long, which is the largest in the province.

The map-area lies on both sides of the Fraser-Skeena drainage divide. The local topography is controlled by three main transverse drainage depressions which are as follows: (1) the depression occupied by Francois lake, which roughly follows the 54th parallel, the southern boundary of the area under discussion; (2) the Babine Lake-Sutherland River drainage system, which forms the northern boundary of the area, and strikes approximately north 30 degrees west; and (3) the valley of Endako river approximately midway between Francois and Babine lakes and roughly paralleling the latter.

Both Francois and Babine lakes are long and narrow and apparently occupy old stream valleys. They probably originated from the damming of the valleys by glacial transported drift.

Francois lake is 70 miles long, averages 2 miles in width, and has an elevation of 2,375 feet. It lies approximately east and west, but is slightly sinuous and resembles the valley of a river. It is drained by Stellako river which breaks out from the north shore one mile from the east end. The principal terrace is at an elevation of about 100 feet.

Endako river rises in the vicinity of Rose lake, at an altitude of 2,359 feet, and flows south 30 degrees east to Fraser lake. It is a sluggish, tortuous stream winding from side to side in a valley about 1 mile wide, but which is wider where tributary streams enter. Endako river widens in places to lakes, Burns and Decker being the principal ones.

Babine lake, as previously stated, is the longest and largest lake in British Columbia. It is 110 miles long, and varies in width from 1 to 7 miles, the average being about 2 miles.

Sutherland river flows into Babine lake at the east end. This is a small, winding stream that heads in the plateau to the southeast. Near its junction with Babine lake it occupies a flat, open valley a mile or two wide. The elevation of Babine lake is 2,222 feet.

Most of the tributary creeks in the area cut canyons 100 to 300 feet deep as they approach the main drainage channels. This is especially true when the creeks flow through areas of Tertiary volcanics.

The south shore of Francois lake is bordered by low, broken country for most of its length, and except for Uncha mountain there are no prominent peaks.

Much of the country between Francois lake and Endako river is characterized by hills of Tertiary volcanics and granite. The hills of volcanic rocks rarely rise more than 2,000 feet above the valleys, and commonly have long, gradual, even slopes with steep cliffs. The granite hills have an irregular, rounded surface. Extensive areas of flat, drift-covered country are also found. The hills bordering Endako valley are composed of Tertiary lavas and in some places have steep rock cliffs 200 feet high.

The area west of the Babine Lake road and north of Endako valley is unmarked by prominent hills, and is underlain by volcanic rocks of Tertiary age. The slopes rise gradually to the height of land from the north and south.

The country to the east of the Babine Lake road is the most rugged in the whole area. There several mountains rise to an elevation of more than 5,000 feet, Taltapin mountain being the highest. Most of the higher peaks are composed of granitic rocks or related intrusives, capped by Tertiary volcanics.

GENERAL GEOLOGY

The oldest rocks exposed occur in the northeastern part of the area, and are a series of gneisses, schists, slates, phyllites, and quartzites, at least in part of sedimentary origin, and presumably of Carboniferous (?) age. Younger than this series, but in no place found overlying it, is a series of Jurassic (?) volcanic rocks predominately of massive green andesites. These two formations are intruded by batholithic masses and smaller bodies of diorite, granodiorite, and granite, the diorite being the oldest as in some localities it is cut by the other two. Unconformably overlying these batholithic rocks, especially in the southeastern part of the area, is a younger series of rocks made up of a lower division of andesitic porphyry, an intermediate sedimentary division of conglomerate and arkose, and an upper division of rhyolitic flows. Rhyolitic and trachytic dykes and stocks were injected at a late stage in this period of vulcanism. Apparently overlying this series, although at no place in actual contact, are small, scattered patches of Upper Eocene sediments consisting of sandstone, conglomerate, and shale, and containing fossil plant remains and streaks of lignite. Unconformably above these sediments are nearly horizontal amygdaloidal and vesicular lava flows of Tertiary age. This series is the most widely distributed in the map-area and even covers some of the most prominent peaks, such as Taltapin mountain. Related to these Tertiary lavas are andesitic and basaltic dykes which cut all the older formations in the area and in part cut the Tertiary lavas. The entire area has been glaciated, resulting in a mantle of glacial material in the lower parts, and a rearrangement of the drainage.

TABLE OF FORMATIONS

PLEISTOCENE AND RECENT	Boulder clay, sand, gravel, silt
TERTIARY	Dykes of andesite and basalt Vesicular and amygdaloidal, andesitic, basaltic, and dacitic lava flows; agglomerate, breccia, and feldspar porphyry
	Conglomerate, sandstone, shale
	Rhyolitic and trachytic flows and dykes Conglomerate and arkose Andesitic and trachytic porphyries
	Batholithic rocks, granite, granodiorite, diorite
Jurassic (?)	Andesitic and basaltic flows
Carboniferous (?)	Gneiss, schist, greenstone, slate, quartzite

Carboniferous (?)

The oldest rocks exposed in the map-area are schists, quartzites, slates, phyllites, gneisses, and greenstones. The main mass of these rocks occurs along the south shore of Babine lake east of Pinkut creek and Taltapin mountain. Small roof pendants of this series occur in the diorite-granodiorite batholith on the west side of Taltapin mountain, and in the granite batholith north of Burns lake. The members of this series strike in a northwesterly direction, and have an average dip of 30 to 45 degrees to the southwest.

The greater part of the series is composed of greenish black mica and hornblende schist interbedded with banded, green hornblende, feldspar gneiss. Less common are belts of fine-grained greenstone (andesite), greenish grey diorite gneiss, banded white quartzite, rusty, grey and blue-black phyllite and slate. These belts are usually only a few feet wide, but in places are several hundred feet in width. All gradations between the various members of the above series of rocks are found. Most of the gneisses contain scattered pyrite.

The series is cut by fine-grained, dark greyish green diorite dykes up to 10 or more feet in width. Some of the dykes resemble diorite gneiss and some of the gneisses may be metamorphosed dykes. The rocks are also cut by stringers of quartz and epidote, which pinch and swell from a mere thread to 5 or 6 inches in width, and by aplite stringers 1 inch or 2 inches wide.

This series is intruded by the diorite-granodiorite batholith occurring on the west side of Taltapin mountain. It is correlated on the basis of lithology with Carboniferous rocks near Stuart lake.

Jurassic (?) Volcanics

The main body of Jurassic (?) volcanics occurs in a belt south of Decker lake. Similar rocks are found as roof pendants in the granite batholith along Sheraton creek, and along the contact of the granite batholith near Priestly. Similar rocks also occur near Pinkut creek. As the Jurassic (?) volcanics resemble closely some bodies of younger volcanics some areas mapped as younger may in part belong to the Jurassic (?) volcanics.

These volcanics are usually massive and dark green. Less commonly they are red, grey, purple, and black. They are represented by andesites, basalts, dacites, and trachytes.

Andesitic flows are the most common in the group. They are generally dark greenish grey, rusty weathering, massive, slightly porphyritic, and exhibit little flow structure. Phenocrysts, which are usually of white feldspar, are rarely more than one-eighth inch in length. These rocks are not as a rule vesicular, but in a few places hold calcite amygdules up to several inches in diameter. These amygdules are common in the roof pendants, and along the contact zone of the granite near Priestly.

The red and purple varieties are dominantly trachytes and andesites, and are porphyritic, the phenocrysts being laths of white feldspar up to one-quarter inch in length. The red and purple colouring of the base is due to the presence of hematite.

Grey and black, non-porphyritic, compact andesites and basalts that can be definitely correlated with this group are poorly represented, occurring only in a few scattered localities near Boo mountain.

Alteration has been extensive to limonite, chlorite, and epidote. The epidote occurs in many places as numerous thin

veins usually less than 2 inches wide irregularly distributed throughout the rock. These veins may have distinct boundaries, but usually they grade into the host rock. The veins also contain some quartz. Epidotization is most pronounced in the rocks of Boo mountain. The younger volcanic rocks have not been as much chloritized and epidotized.

The Jurassic (?) volcanics are cut by green andesitic and basaltic dyke rocks, and also by light-coloured, rhyolitic dykes. As the volcanics occur in some places as roof pendants in the granite batholiths, they are older than the granites. This volcanic series has been correlated lithologically with a portion of the Hazelton group of Jurassic age, but as no fossils were found the age is not definitely known.

Batholithic Rocks

These rocks are exposed over approximately one-quarter of the map-area. They occur as two batholithic masses and several stocks. One area of these rocks extends northeasterly from Burns lake to Taltapin mountain. Within this area there is one exposure of overlying Tertiary volcanics. The other batholithic mass occurs along the eastern border of the map-area, and extends from Francois lake on the south to approximately 15 miles north of Endako.

These batholithic rocks may be divided into two main groups. One of these groups is largely of diorite, which grades in places to granodiorite; and the other is of granite, which in many places grades to granodiorite and even to quartz diorite. Related to this last group are some marginal phases of syenite. Rocks of the diorite group occur principally in the vicinity of Taltapin mountain, and rocks of the granite group predominate near Boo mountain and Burns lake, and compose the batholith near Endako.

The diorite is a dark greenish grey, medium- to fine-grained rock, characterized by the abundance of hornblende. In places the diorite ranges in composition to that of a hornblendite. The diorite is cut by the granite, but the two groups are probably related.

The granitic rocks vary considerably, and two distinct varieties may be distinguished: (1) a pink granite, and (2) a grey granite and granodiorite. The pink granite, which is the most prevalent type, ranges from very coarse material, like pegmatite, to fine-grained.

Most of it is a coarse porphyritic rock, consisting of pink feldspar, white feldspar, quartz, biotite, and hornblende. The pink feldspar usually forms large, well-formed crystals up to 2 inches in size; whereas the white feldspar along with the quartz forms the base of the rock. The grey, granitic rocks are non-porphyritic, medium- to fine-grained, and show very little pink feldspar. They range in composition from granite to granodiorite and quartz diorite. All these types grade into one another. Locally the pink granite is gneissic. At several localities pegmatite veins were observed, the largest being 12 inches in width. It had an 8-inch centre of quartz with a 2-inch border of pink feldspar on each side. In many places, thin, irregular stringers of epidote occur, and spots of epidote are also scattered irregularly throughout the rock mass.

The syenite, which represents a marginal phase of the granite, is a coarse-grained rock composed of pink feldspar and hornblende.

On the west side of Taltapin mountain a body of granodiorite cuts the diorite, and may be of a different age from the other granites referred to, but on a lithological basis it has been correlated with them. The main body is light grey, medium-

grained, and contains besides white feldspar and quartz considerable chlorite and epidote.

The batholithic rocks intrude the Carboniferous (?) and Jurassic (?) series of rocks exposed in the area and are younger. Sediments and volcanics believed to be pre-Upper Eocene contain granite boulders, similar in appearance to the granites of the batholiths, and directly overlie the granitic rocks. Therefore, these batholithic rocks are at least older than the Upper Eocene.

Younger Volcanics

This group of rocks is divided into three divisions: (1) andesitic and trachytic porphyries with or without rhyolitic bands; (2) conglomerate and arkose; and (3) light-coloured rhyolitic and trachytic flows and dykes. The relations that these three divisions bear to one another are not definitely known, but the dyke rocks are at least in part the youngest as in places they are found cutting the other groups, and the sedimentary series is intermediate, as it is overlain and underlain in places by members of the porphyry and rhyolite divisions. All of the divisions overlie the granitic rocks and underlie the Tertiary lavas. In view of the resemblance, however, to phases of the Tertiary, and Jurassic (?) volcanics, some of the rocks mapped as younger volcanics may belong to these younger or older groups.

Exposures of the porphyry division are found on the north shore of Francois lake opposite Uncha mountain, and capping the prominent hill near the west end of the lake. Other outcrops occur north of Tchesinkut lake. The division is made up of andesites and trachytes with bands of basalts and rhyolites. The andesites and trachytes are usually grey, green, or purple. They are predominately porphyritic with phenocrysts of white feldspar approximately one-quarter inch in length, and less commonly

phenocrysts of hornblende and biotite, in a dense, hard groundmass showing little evidence of flow structure. Non-porphyritic phases also occur. These rocks are not vesicular, but in places contain amygdules that range up to 2 inches in diameter, and many of which contain a centre of white calcite surrounded by a ring of clear quartz crystals. The basalt is a dark, hard, dense rock, and the rhyolite is pink to grey, hard, and dense. The rocks contain spots of epidote, but do not have as much epidote and chlorite as the older Jurassic (?) rocks.

The main exposures of the sedimentary division are found in the areas lying north and south of the west end of Tchesinkut lake. At the west end of Tchesinkut lake these sediments strike north 25 degrees east and dip 45 degrees south-west, and form a band that extends north for 4 miles. The division is probably much more than 100 feet thick, but this was the greatest thickness observed in any one exposure. The exposures usually occur on cliff faces and commonly consist of beds of conglomerate averaging 10 feet in thickness, interlayered with beds of arkose 3 feet thick.

The conglomerate is made up of pebbles ranging in size from a fraction of an inch to boulders 8 or 10 inches in diameter, the common size being from $\frac{1}{4}$ to 1 inch in diameter. The pebbles are fairly well rounded and consist mainly of white quartz, pink granite, blue-black chert, grey cherty quartzite, and to a lesser extent of greenstone and rhyolite. Some phases of this conglomerate, especially those in which granite pebbles are lacking and quartz and chert pebbles predominate, resemble the conglomerate of Upper Eocene age. The arkose is a fine-grained, red, bedded rock, which consists of fragments of quartz and feldspar in a hematitic cement.

The flow rocks of the rhyolite division are exposed along the north and south shores of Francois lake from a point 6 miles east of the post office to within 3 miles of the west boundary of the map-area. Other exposures occur on the north side of Tchesinkut lake. Intrusive members of this series are found throughout the map-area cutting the older rocks, but in no place cutting the Tertiary lavas. These intrusives are especially abundant near Silver island (Babine lake), Taltapin mountain, Sheraton creek, and east of Priestly. In many places it is difficult to tell whether the exposures represent flows, dykes, sills, or stocks.

The majority of the flow rocks are white, pink, brown, or grey, dense, non-porphyritic rhyolites, and white, buff, or grey, porphyritic rhyolites. The latter are composed of phenocrysts of colourless quartz and white feldspar from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, in a dense, feldspathic base. Associated with the above flow rocks are rhyolite flow breccias consisting of angular fragments of porphyritic and non-porphyritic rhyolite and quartz, in a matrix of similar composition that show flow lines bending around the fragments. Intrusive members of the series are largely represented by similar rhyolites and rhyolite porphyries, and by trachyte porphyries. The trachyte porphyries have phenocrysts of white and pink feldspar, and green chloritized hornblende embedded in a compact, white to grey, feldspathic groundmass. Dykes of brown quartz and orthoclase porphyry also occur. The intrusive bodies vary in size from dykes 3 to 10 feet wide to stocks 1 to 2 miles in diameter.

Upper Eocene Sediments

These sediments outcrop along the north shore of Francois lake west of the post office, and near the base of the hills on the north side of Endako valley west of Burns lake. The strata are

commonly flat, but have local steep dips due to slumping. In few places is the formation more than 200 feet thick. The rocks consist of loosely consolidated conglomerate, sandstone, and shale, and all intermediate gradations. In some localities the sandstone is calcareous. A section exposed along Mourse creek shows from top to bottom:

	Feet
Small pebble conglomerate.....	10
Sandstone with streaks of lignite coal	10
Coarse pebble conglomerate	15
Feldspathic sandstone and crumbly shale	20

The pebbles of the conglomerate, which are mainly blue-black chert, cherty quartzite, and quartz, are well rounded and range in size from $\frac{1}{4}$ to 1 inch in diameter. The matrix is grey or buff, and consists of smaller fragments of the same material in a siliceous cement. The sandstone, which grades into conglomerate and shale, is usually a massive, buff-coloured rock. The shale is blue-black and crumbly. Throughout the whole series are found streaks of lignite, and petrified wood. In many places these sediments are unconformably overlain by the Tertiary lavas, but in several localities they are conformably overlain by white rhyolitic tuffs and breccias.

Fossils were collected from these rocks on the northern shore of Francois lake and have been examined by W.A. Bell of the Geological Survey, who has furnished the following report.

"Lot No. 44-1 has fragments of dicotyledonous leaves, too small to be identified, petrified wood, and a few fragments of Sequoiites langsdorfi (Brongniart). The age is Tertiary and whilst the florule is too small to have any further stratigraphic value it is assumed the age is that of so many Tertiary formations of British Columbia, viz., Upper Eocene".

Tertiary Lavas

These lavas commonly form hills with long, gradual, even slopes and steep cliffs. This feature is well exhibited in the map-area, because approximately one-half of it is underlain by rocks of this group. The rocks consist chiefly of green, red, brown, and black, dacitic, andesitic, and basaltic, amygdaloidal, and vesicular lava flows. The degree of vesicularity varies greatly, and in some places the rocks are so vesicular that they resemble pumice. The larger vesicles show horizontal elongation, averaging one inch in length. The greater the degree of vesicularity the more rapidly these rocks weather. Chalcedonic quartz, cream-coloured calcite, pectolite, prehnite, and zeolites fill some of the vesicles.

Associated with these vesicular flow rocks are agglomerates, breccias, feldspar porphyries, columnar volcanics, and compact basalts. The most typical agglomerates are brown or black, and contain rounded masses of basalt and andesite up to a few feet in diameter. A good exposure of such a type occurs near the mouth of Mourse creek. North of Burns lake agglomeratic flows directly overlie granite and contain granite pebbles. The breccias are of several distinct types, the following being the most widely distributed: (1) an andesitic flow breccia in which angular fragments of a brown, vesicular andesite are embedded in a glassy matrix; (2) a basaltic flow breccia in which the fragments and matrix are of a dense black basalt; and (3) an acid flow breccia composed of small, angular fragments of andesite, chert, quartz, jasper, feldspar, and granite in a glassy, green matrix. Flows of feldspar porphyry make up the greater part of the Tertiary lavas outcropping along the lower extremities of Shovel creek. These rocks contain phenocyrsts of white and pink feldspar up to one-half inch in length, and to a lesser extent of biotite and

hornblende in a greenish or lavender-grey groundmass. In many places the phenocrysts have weathered out, imparting to the rock a pseudo-vesicular appearance.

Along the shores of Babine lake several outcrops of columnar volcanics occur, in which eight-sided columns are well developed. These volcanics are dark greenish grey, slightly vesicular, augite andesites. The mountain at the east end of Babine lake is composed of a pitch black, compact, olivine basalt, in which are a few scattered vugs containing prehnite and zeolites. Similar basalts are exposed along Mourse and Shovel creeks. Compact, black basalts that break into slabs and look like slates are found in some localities. These rocks are placed in the Tertiary because they unconformably overlie Upper Eocene sediments, and they are in part lithologically similar to the Tertiary volcanics to the south.

Tertiary Dyke Rocks

Andesitic and basaltic dykes related to the Tertiary lavas are abundant. They are dark green, fine-grained, hard rocks, commonly impregnated with pyrite, and occur mainly as dykes, varying in width from a few inches to over 30 feet. A few stocks occur, one of the largest outcropping near the summit of Uncha mountain. These rocks appear to be most abundant in the areas of the batholithic rocks, but as they are difficult to see in the darker volcanics they may be as extensive in them.

ECONOMIC GEOLOGY

Lode Deposits

Prospecting in Fort Fraser map-area has been quite extensive and a considerable number of mineral deposits have been located. These deposits may be divided into three main divisions: (1) silver-lead-copper-zinc deposits; (2) gold-silver deposits; and (3) molybdenite deposits.

The deposits of division (1) are represented by three distinct types according to the minerals present. These are: (a) small irregular veins, 2 inches to 3½ feet wide, filling shear zones and fissures, and containing galena, sphalerite, chalcopyrite, and in some cases tetrahedrite, native silver, and argentite, in a gangue of quartz, and minor quantities of calcite; (b) fracture zones containing specularite, pyrite, and chalcopyrite, with a quartz gangue, and the whole zone cut by quartz epidote stringers; (c) veins containing galena and chalcopyrite, with a barite, quartz, and fluorite gangue. Deposits associated with type (a) are the Taltapin, Silver Island, and Anderson groups near Taltapin mountain and Babine lake; and the Silver Glance, and Golden Glory properties south of Decker lake. Considerable development work has been done on the Silver Island and Taltapin properties and high silver assays have been obtained. The veins on the Silver Island property occur at the contact of a rhyolite stock and a diorite body. On the Taltapin group the veins are within dark green andesites (Jurassic ?) near their contact with a granodiorite body. On the Anderson group only a few, small, sparsely mineralized veins, occurring in a roof pendant of gneiss and schist in the granodiorite, have been exposed. The deposits south of Decker lake have not been developed beyond the prospecting stage and appear to be low-grade. They occur in volcanics of the Jurassic (?) group.

The Three Star group on Boo mountain is the only example of type (b). Here the mineralization occurs in a fracture zone over 20 feet wide and 300 feet long in a country rock of andesite (Jurassic ?). The Mona property west of Tchesinkut lake is the only occurrence of type (c). Only one, small, sparsely mineralized vein is found on this property.

In division (2), two widely divergent types of deposits have been grouped. (a) The Radio Gold property, where showings consist of epidote, quartz, and pyrite disseminations and veins in a dioritic rock, and sparsely mineralized quartz lenses in a gneiss. These showings occur in the contact zone of the diorite, granodiorite intrusives with the Carboniferous (?) gneisses, and schists. (b) The Hiyou property on Bald mountain, where a pyritized rhyolite dyke cutting a pink granite is found. Assays from both the above properties were low in gold and silver. Considerable development work has been done on the Radio Gold property.

To division (3) belong the Stella and adjoining molybdenite properties southwest of Endako. On the Stella group, several quartz veins (up to 2 feet wide), and many large pieces of quartz float (maximum 3 feet square) containing molybdenite occur. The country rock is a coarse-grained, pink granite.

Other Mineral Deposits

Asphaltum Occurrence[1]

A small vein that contained asphaltum and phosphate minerals, on the Collier ranch near Francois lake, was examined. Of special interest is collinsite ($2\ CaO\ (Mg\ Fe)\ O\ P_2O_5\ 2\frac{1}{2}\ H_2O$), a rare phosphate. The rock in which this vein occurs is an amygdaloidal and vesicular andesitic lava, the amygdule fillings being chalcedony. This lava overlies Upper Eocene sandstone and shale. The asphaltum may possibly have been derived by some process of natural distillation from carbonaceous material in these underlying sediments. The deposit does not appear to be of economic importance.

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1. Ann. Rept., Minister of Mines, B.C., 1924, p. 101.
Hanson, G.: "Prince Rupert to Burns Lake, B.C."; Geol. Surv., Canada, Sum. Rept. 1924, pt. A, p. 43.

Description of Properties

Silver Island Mining Company[1]

Silver island is in Babine lake, about 3,000 feet from the south shore and 10 miles from the east end. The island is about 1,300 feet long, 750 feet wide, has an elevation above the lake of 135 feet, and is covered by the Silver Island mineral claim. A wagon road connects the south shore of Babine lake with the settlement of Burns Lake, 27 miles to the southwest.

The island is underlain by a dark green, hornblende diorite, and a light-coloured rhyolite, each outcropping in about equal proportions. The rhyolite occurs as a stock cutting the diorite. Numerous stringers of calcite occur in the diorite.

The mineral deposits, which are mainly narrow fissure veins in the diorite, consist of tetrahedrite (grey copper), argentite, native silver, and small amounts of galena, sphalerite, chalcopyrite, pyrite, malachite, and azurite in a gangue of calcite, barite, and quartz.

Two prospecting adits, 65 feet apart, and following the stringers, have been run in at the lake level. Of these No. 1, the more westerly, followed a zone of weak mineralization inwards for 50 feet in a direction south 45 degrees east. At 40 feet from the portal a winze has been sunk, but it was full of water and could not be examined. This adit is wholly within the diorite. No. 2 adit runs in a direction of south 55 degrees east for a distance of 150 feet, and two winzes were sunk at distances of approximately 50 and 75 feet from the portal. As in the case of the other winze these were flooded. No. 2 adit penetrates the rhyolite for the first 100 feet. It is reported this adit followed a richly mineralized fissure vein, which was fairly persistent, but only 1½ inches wide.

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[1] Ann. Rept., Minister of Mines, B.C., 1925, pt. A, pp. 142-143.

Assays of these narrow veins show a silver content from 9 to 693 ounces a ton.[1]

The mineralization appears to be related to the rhyolite. No active work has been done on the property for the last few years.

Taltapin Group[2]

The property is situated on Pinkut creek (15-mile creek) 3 miles south of Babine lake. It consists of the Silver Fox and six adjoining claims. It has been optioned several times, but so far the options have been allowed to lapse. The Silver Fox claim is held by C.S. Anderson under a Crown grant. Access to Burns Lake, 25 miles to the southwest, is by wagon road.

The main exposures of country rock occur in a canyon, 100 feet deep, on Pinkut creek. Exposed on the walls of the canyon are metamorphosed, light to dark green, partly bedded, massive andesites and a lesser amount of graphitic schist. These volcanics, which the writer has correlated with the older volcanics of Jurassic (?) age, are intruded by a medium-grained, grey granodiorite. This granodiorite represents one phase of an intrusive body lying to the east of Pinkut creek, and which ranges in composition from a diorite to granodiorite (granite to quartz diorite). The granodiorite is a later phase and cuts the diorite in many places. The contact of this intrusive body with the volcanics is very irregular, and the mineral deposits occur in roof pendants overlying the granodiorite, and in masses of volcanics lying between projections of the granodiorite. All the deposits observed lie within 150 feet of the contact. The mineral

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[1] Ann. Rept., Minister of Mines, B.C., 1925, pt. A, p. 143.

[2] Ann. Repts., Minister of Mines, B.C., 1927, 1926, 1925, and 1920.
Kerr, F.A. "Mineral Resources along the Canadian National Railway, between Prince Rupert and Prince George, B.C."; Bureau of Economic Geology, Paper 36-20, pp. 159-161.

deposits are probably genetically related to the granodiorite. Cutting the volcanics and the intrusives are dykes of dense, light-grey rhyolite. Only one such dyke was observed on the Taltapin property, but they are more numerous to the north and east.

The mineral deposits are narrow, irregular veins, and consist of galena, chalcopyrite, sphalerite, pyrite, tetrahedrite, and a little white mica in a quartz gangue, wholly within the volcanics. Small, pre- and post-mineral faults occur in the area.

The "High Grade" vein is on the Silver Fox claim in the bed of the creek and on the east wall of the canyon. It varies in width from 6 inches to 2 feet, strikes north 30 degrees east, and dips 60 degrees to the northwest. According to Lay a sample from this vein assayed: gold, trace; silver, 3.6 ounces to the ton; copper, 1 per cent; lead, 3 per cent; zinc, 27 per cent. Three sparsely mineralized quartz veins occur 200 feet farther down the creek. They vary in width from 1 to 4 feet, and are from 10 to 20 feet apart. Two prospecting adits have been driven on these veins.

The underground workings on the Silver Fox claim consist of a vertical shaft 112 feet deep, and three crosscuts, but as they were flooded they could not be examined. Two of the crosscuts are reported to have cut veins up to 3½ feet wide, in which were well-mineralized seams 6 to 8 inches wide.

Irregular veins, very sparingly mineralized, and varying in width from a few inches to several feet, have been exposed on the other claims.

R.C. Campbell-Johnson in his report of the property in 1926 gives the following average assays from seventeen samples: eleven samples from surface showings -- gold 0.01 ounce to the ton, silver 4.4 ounces to the ton, copper nil, lead 9.25 per cent, zinc 5.67 per cent; six samples from shaft -- gold 0.57 ounce to

the ton, silver 131.8 ounces to the ton, copper 1.4 per cent, lead 11.88 per cent, zinc 22.40 per cent.

Anderson Group

This group is owned by C.S. Anderson and associates, and is situated on the western slope of Taltapin mountain, at an elevation of 3,100 feet, approximately 2½ miles southeast of the Taltapin group.

The best showings occur on the east wall of a ravine 100 feet deep. They consist of small stringers of quartz, 2 to 3 inches wide, containing galena, pyrite, and minor amounts of chlorite, and white mica. These stringers occur in a roof pendant of well-banded green gneisses of Carboniferous (?) age. These gneisses strike south 10 degrees east and dip 10 degrees to the southwest. Although there are no exposures of granodiorite in the ravine, outcrops occur in the immediate vicinity. Grey feldspar porphyry dykes cutting both the gneisses and the granodiorite occur throughout the group.

Considerable surface stripping has been done, and a prospecting adit 50 feet in length driven, but only a few sparsely mineralized zones were revealed.

Radio Gold Mines, Limited[1]

This property is situated approximately 3 miles northeast of the Taltapin property. Work commenced in 1934 resulted in much surface trenching and in two shafts being sunk. These shafts were flooded at the time of examination.

The geology in this region is very complex. The showings occur at the contact of the metamorphosed Carboniferous (?) rocks,

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[1]Ann. Rept., Minister of Mines, B.C., 1933.
Kerr, F.A.: Mineral Resources along the Canadian National Railway, between Prince Rupert and Prince George, B.C.; Bureau of Economic Geology, Paper 36-20, pp. 158-159.

and the diorite, granodiorite intrusives. This contact is very indefinite and irregular, and throughout the area the Carboniferous (?) gneisses and schists are cut by dykes and larger bodies of diorite, which in turn are cut by projections of the granodiorite intrusive body lying to the south.

Several, large, irregular masses or lenses of glassy quartz, carrying very minor amounts of pyrite, chalcopyrite, and molybdenite, are exposed in the gneisses and schists. These attain a maximum size of 20 to 30 feet thick, and 100 to 200 feet long.

Elsewhere on the property, and associated with the diorite, which varies from a fine-grained andesitic phase to a hornblende-rich phase, are much glassy quartz, epidote, magnetite, and bronze-coloured pyrite scattered throughout the country rock, and as irregular quartz veins and quartz epidote stringers.

According to Kerr several samples of the most highly mineralized rock from various sections of the property yielded on assay insignificant amounts of silver and gold.

Golden Glory Group[1]

This group, owned by W. Reed and R.H. Gerow, of Burns Lake, is situated on Reed creek which flows into Decker lake from the south, opposite the settlement of Decker Lake on the north shore. At the time the writer visited the property the two prospecting adit tunnels that had been driven were caved in, so only a surface examination was possible.

The property is situated about 1 mile up from Reed creek in a canyon over 200 feet deep cut down into the prevailing volcanic rocks in the vicinity. These volcanics, which are andesites and believed to belong to the group of older volcanics

[1] Ann. Rept., Minister of Mines, B.C., 1926, 1927, and 1930.

of Jurassic (?) age described elsewhere in this report, are oxidized to a soft, light-grey material, and to a lesser extent to orange, yellow, and brown material. In places these volcanics are extensively fractured, and several, small, very irregular veins, consisting of chalcopyrite, sphalerite, galena, and pyrite, in a quartz gangue, occur in this fractured zone. One small vein, striking north 20 degrees east, follows the creek for more than 100 feet. A second vein is exposed at the mouth of the adit at the south border of Golden Glory No. 1 claim. This vein is 22 inches wide at the surface, but it is reported to be very irregular, the maximum width being 22 inches. Several assays showing a good percentage of lead, zinc, and copper, but only a trace of gold and a few ounces of silver, have been obtained from the above two veins.

Silver Glance Claim[1]

This claim is owned by J.C. MacLean of Burns Lake, and it immediately adjoins the Golden Glory on the south. Geological conditions are similar to those on the Golden Glory group. A prospecting tunnel has been driven in a direction south 45 degrees west along a vein mineralized with galena, sphalerite, and chalcopyrite. This tunnel was flooded at the time of the visit, but a 2-foot mineralized zone is reported in a crosscut 40 feet from the portal. According to Lay a selected sample assayed: gold, 0.02 ounce to the ton; silver, 3.1 ounces to the ton; lead, 29.8 per cent; zinc, 18.2 per cent. Pyrite occurs as specks scattered throughout the country rock.

A rhyolite dyke, related to the rhyolite intrusives described elsewhere in this report, cuts the volcanics on the Silver Glance claim. This rock may bear some genetic relation to the mineralization. No other intrusive rocks that may have been a source of the mineralizing solutions were noted in the immediate vicinity.

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[1] Ann. Rept., Minister of Mines, B.C., 1930.

Three Star Group[1]

This group is owned by V. Schjelderup, P. Sandnes, and K. Nysven, and is situated on Boo mountain at an elevation of 2,900 feet, about 2 miles south of Palling station on the Canadian National railway. The property was optioned to the Topley-Richfield Mining Company from 1929 to 1930. At that time considerable development work was done, but since then there has been little further work.

The country rock is a dark green, sheared andesite of the older volcanic (Jurassic ?) group. The strike of the shearing is north 80 degrees east, and the dip 85 degrees south. The chief minerals are chalcopyrite, pyrite, specularite, and quartz and occur in a zone of fracturing up to 20 feet wide and over 300 feet long. These minerals occur as bands, varying from one-sixteenth of an inch to several inches wide, and as vugs in the country rock. Specks of pyrite occur scattered throughout the country rock.

A crosscut adit 180 feet long and driven in a direction west of south exposed 4 feet of well-mineralized quartz and country rock on the foot-wall, and 3 feet on the hanging-wall, with a sparsely mineralized zone between. No ore of commercial importance has yet been found.

Elsewhere on Boo mountain narrow stringers of epidote and quartz occur.

Mona Group[2]

The Mona property is situated on Deep creek one-half mile from the Burns Lake-Francois Lake road. No active work has been done on the property for several years.

Two prospecting adits and several open-cuts have exposed several veins. In one open-cut a vein 1 to 2 feet wide, and 10

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[1] Ann. Rept., Minister of Mines, B.C., 1929 and 1930.

[2] Ann. Rept., Minister of Mines, B.C., 1925

feet long has on the foot-wall 6 to 9 inches of galena and chalcopyrite, in a gangue of barite, quartz, and minor amounts of fluorite. The country rock is a coarse-grained, green andesite. Assays have been very low in precious metals.

Hiyou Claim[1]

The Hiyou claim is owned by A. Ostrem of Burns Lake, and is situated near Bald mountain, 5 miles northeast of Burns Lake.

The showing consists of a rhyolite dyke, mineralized with pyrite, cutting a pink granite. According to Lay assays showed no values in gold and silver.

Stella Molybdenite Property[2]

This property, which is owned by A. Langley, C.H. Foote, J. Braithwaite, and W. Foote, of Fraser Lake and Endako, consists of four full claims. The property is situated about 5 miles southwest of Endako and 3 miles north of Francois lake. A road from Endako passes within 2 miles of the property. As at the time the writer visited the property there was over 8 inches of snow much of the information regarding it was obtained from the Annual Reports of the Minister of Mines, British Columbia.

The most important showings occur on two east-west ridges 300 to 400 feet apart, and at an elevation of 3,450 feet. These ridges are underlain by pink, coarse-grained granite, which outcrops only in a few places and is covered elsewhere by a thin mantle of soil, drift, and shattered rock. Molybdenite occurs as fine scales disseminated through quartz veins, and to a lesser extent as impregnations in the granite close to the veins. In

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[1] Ann. Rept., Minister of Mines, B.C., 1933.

[2] Ann. Rept., Minister of Mines, B.C., 1927, 1928, 1929, 1931, 1933, 1934.
Kerr, F.A.: Mineral Resources along the Canadian National Railway, between Prince Rupert and Prince George, B.C.; Bureau of Economic Geology, Paper 36-20, pp.163-165.

some cases the molybdenite is weathered to the yellow oxide, molybdic ochre. Pyrite and hematite occur very sparsely in the deposit.

The more important showings are as follows: No. 1 vein on Stella No. 2 claim. This vein strikes approximately east-west and dips 60 degrees to the south. The foot-wall is granite; followed by 2 feet of quartz vein well impregnated with molybdenite; then 15 inches of granite inclusion, followed by 30 inches of siliceous granite containing considerable molybdenite; and finally 20 feet of granite containing a little molybdenite. The vein has been exposed for over 150 feet. A shaft has been sunk 20 feet on this vein, but as it was filled with water it could not be examined. The vein is reported to pinch to 6 inches at the bottom. An assay on the vein, according to Lay, gave 2.43 per cent molybdenite. At a distance of 50 feet down the south face of the ridge on Stella No. 2 claim a prospecting adit has been driven 30 feet, cutting one vein that is 12 inches wide and carries molybdenite. Another showing on No. 2 claim occurs 200 feet southeast of No. 1 vein and consists of three parallel quartz stringers 4 to 6 inches wide. On Stella No. 3 claim a vein 6 inches wide has been exposed. Its strike is about the same as the others and it dips north.

Scattered in the debris for 500 to 1,000 feet along each ridge are blocks of quartz which carry considerable molybdenite. These blocks appear to be approximately in place and range in size up to a maximum of 3-foot cubes. The soil in the vicinity of the showings is reported to as ay up to 1 per cent molybdenite.

The occurrence of the molybdenite deposits well within the granite, and the absence of any other rock types in the vicinity, would indicate the deposits were probably derived from the granite.

Snowbird Group

The Snowbird group of five mineral claims joins the Stella group on the north. Several open-cuts have been made, but up to the present only barren quartz veins have been uncovered.

Other Molybdenite Showings

Molybdenite showings have been staked in two other localities. A. Ostrem has uncovered a pegmatite vein carrying flakes of molybdenite, 3 miles south of Ling lake. The vein, which has an 8-inch centre of quartz and a 2-inch border of orthoclase on each side, cuts a coarse-grained, pink granite. A little work has been done $3\frac{1}{2}$ miles southwest of Savory on an occurrence similar to that at the Stella, but much less extensive.

Prospecting Possibilities

Although the mapping has not been sufficiently detailed to conclude that any part of the area is completely lacking in mineral occurrences, it is possible from a study of the geological conditions found at the known mineral deposits to outline the areas that appear to be most suitable for further prospecting.

Extensive drift-covered areas in the map-area have practically no mineral possibilities. These areas are usually low lying and may be fairly flat, as in the case of the valley occupied by Endako river, or they may exhibit a typical morainal topography as is developed to the east of Tchesinkut lake, where many small lakes separated by hills 100 to 200 feet high occur. Although much of the area mapped as being underlain by rocks of various ages is covered by a mantle of drift there are at least some outcrops to be found; whereas in the areas mapped as drift no outcrops occur.

The writer regards the Tertiary lavas as unfavourable for prospecting, because no mineral deposits of importance have been found in them or similar rocks either in the map-area or elsewhere in the northern interior of British Columbia. The only occurrence of mineral in them in the map-area, exclusive of amygdule fillings, is a small vein of asphaltum near François Lake post office. Many of the andesitic and basaltic dyke rocks related to these Tertiary lavas are impregnated with specks of pyrite. As has been previously pointed out approximately one-half the map-area is underlain by these lavas, and areas underlain by them are characterized by hills with long gradual slopes and steep cliffs.

The small areas of Upper Eocene sediments have no minerals associated with them except streaks of lignite.

Little indication of mineral deposits was observed in the areas of pre-Upper Eocene and post-batholithic rhyolitic flows, conglomerates and arkoses, and andesite and trachyte porphyries, but these rocks should be as good hosts for mineral deposits as any others in the district, especially where they are found in contact with the larger intrusive bodies of rhyolite or trachyte. As the silver-lead mineralization at Silver island occurs at the contact of a rhyolite body with a body of older diorite, it is quite possible that other mineral deposits may occur near the contact of some of these larger bodies of rhyolite and related acid intrusives with older rocks elsewhere in the map-area, and, therefore, they would seem worthy of investigation wherever they occur.

The Taltapin silver-lead property occurs in the andesite (Jurassic ?) near the contact of a granodiorite body, which occupies a considerable area on the west side of Taltapin mountain. The Anderson group of claims is located in what appears to be a roof pendant of Carboniferous (?) metamorphic rocks in the same

granodiorite body. Therefore, it is possible that either at the contact of the granodiorite body or in roof pendants in it other similar mineral deposits may be found. In view of the above facts the area on the west side of Taltapin mountain, and especially to the southwest where less prospecting has been done, should be favourable for further prospecting.

On the north side of Taltapin mountain in the contact zone of a diorite body with the Carboniferous (?) metamorphic rocks much pyrite, magnetite, and quartz occur. As yet no deposits of economic importance have been found in this contact zone and it would not appear to be as favourable a zone to prospect as the contact zone of the granodiorite.

The contact zones of the granitic bodies north of Burns Lake and near Endako, with older rocks, are obscured in most places by overlying younger rocks and drift and in the few places they were seen only unimportant quantities of metallic minerals are found. However, quartz deposits containing molybdenite occur throughout the granitic bodies and deposits similar to those on the Stella property may be discovered.

In several known localities, notably Pinkut creek, Reed creek, and Boo mountain, the older Jurassic (?) volcanics have acted as host rocks to mineralizing solutions forming small silver-lead-copper-zinc deposits. Therefore, these rocks would seem to be most favourably suited to further prospecting, especially where they are cut by younger intrusive bodies.

Although no mineral occurrences of economic importance have yet been found in the Carboniferous (?) metamorphic rocks, areas of these rocks should be regarded as promising prospecting ground, especially where they are in contact with younger intrusive bodies or occur as roof pendants in them.

Gold colours have been obtained on panning a number of creeks in the map-area, notably Shovel creek, but the possibility of finding placer deposits of commercial importance seems rather remote, because the whole area has been glaciated, during which process the gold was probably carried away or buried under a deep mantle of drift.