

REPORT
ON

ST. EUGENE MINE

MOYIE, B. C.

Fort Steele

MINING DIVISION

Alexander Smith,
Geologist.

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R E P O R T

on

ST. EUGENE MINE

MOYIE, B. C.

by

ALEXANDER SMITH, GEOLOGIST

Vancouver, B. C.
July 15th, 1949.

ST. EUGENE MINE

MOYLE, B.C.

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INDEX TO REPORTS

CONTAINED IN EXPANDING ENVELOPE

1. Report on St. Eugene Mine, Moyie, B. C. by -
Alexander Smith, July, 1949.
2. Earlier Reports on St. Eugene Mine by -
F. A. Chubb
F. A. Kerr
R. R. Wilson
G. J. Schofield
J. M. Turnbull
J. Drybrough
J. G. Gwillam
3. Magnetometer Survey Report & Map Mo-29 - Alexander Smith, 1949
4. Geochemical Prospecting " " " Mo-35 - " " "
5. Diamond Drilling " " "
6. Mine and Dump Sampling " " "
7. Society Girl Mine - L. K. Armstrong and S. L. MacDonald.
8. Indexes and Legend.

ST. EUGENE MINE

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M A P I N D E X

<u>NO. of MAP</u>	<u>SCALE</u>	<u>DESCRIPTION</u>
Mo-1	1" = 200'	Barkshanty Creek Area, Moyie, B. C.
Mo-2	1" = 200'	Etna Creek Area, Moyie, B. C.
Mo-3	1" = 200'	Glencairn Creek Area, Moyie, B. C.
Mo-4	1" = 200'	Hogarth Area, Moyie, B. C.
Mo-5	1" = 200'	Larsen Area, Moyie, B. C.
Mo-6	1" = 200'	Rudd Area, Moyie, B. C.
Mo-7	1" = 200'	Society Girl Area, Moyie, B. C.
Mo-8	1" = 200'	Tradedollar Area, Moyie, B. C.
Mo-9	1" = 1000'	Geology & Topography, Moyie Area
Mo-10	1" = 200'	Magnetometer Survey, Moyie Lake
Mo-11	1" = 200'	Magnetometer Survey, Moyie #5 Group (Barkshanty Area)
Mo-12	1" = 200'	Magnetometer Survey, Moyie #6 Group (Tradedollar Area)
Mo-13	1" = 200'	Surface St. Eugene Mine Area - Geology and Topography.
Mo-14	1" = 200'	Surface Upper Mine to Society Girl - Geology and Topography.
Mo-15	1" = 200'	Surface East Side of Lake - Geology and Topography.
Mo-16	1" = 200'	St. Eugene Mine Composite Level Plan Adit Levels.
Mo-17	1" = 200'	Longitudinal Projection (W. portion Aurora).
Mo-18	1" = 200'	Longitudinal Projection (Central por- tion Lower Workings St. Eugene).

<u>NO. of MAP</u>	<u>SCALE</u>	<u>DESCRIPTION</u>
Mo-19	1" = 200'	Longitudinal Projection (Upper Mine to Society Girl)
Mo-20	1" = 200'	Vertical Section along E. side of Moyie Lake.
Mo-21	1" = 80'	Section E2200 St. Eugene Mine Shaft Workings. (Lakeshore Shoots).
Mo-22	1" = 80'	Section E2600 St. Eugene Mine Shaft Workings.
Mo-23	1" = 80'	Section E3900 St. Eugene Mine, Moyie Mine Section.
Mo-24	1" = 80'	Section E5700 St. Eugene Mine, Upper Mine Workings.
Mo-25	1" = 50'	Aurora & Guindon Plan of Workings.
Mo-26	1" = 50'	Aurora & Guindon Longitudinal Projection A-A.
Mo-27	1" = 50'	Guindon Longitudinal Projection D-D
Mo-28	1" = 1500'	Claim Map, Moyie Area.
Mo-29	1" = 1000'	Magnetometer Surveys, Moyie Area (included with Magnetometer Report - same folder).
Mo-30	1" = 90'	Moyie Tailings Pile & Soundings Map.
Mo-31	1" = 1000'	Chubb's Geology, Plan and Section.
Mo-32	1" = (Various)	Set of 15 Maps - F.A.Kerr, Moyie Geology. Compiled by B.Vincienne, 1938.
Mo-33	1" = 40'	2200' Level St. Eugene Mine (S.S.Saxton)
Mo-34	1" = 40'	2400' Level St. Eugene Mine (S.S.Saxton)
Mo-35	1" = 1000'	Geochemical Prospecting, Moyie Area. (included with Geochemical Prospecting Report - same folder).
Mo-36	1" = 200'	Stratigraphic Columns.
Mo-37	1" = 80'	Set of St. Eugene Mine Level Plans with Gwillam's Notes.

ST. EUGENE MINE

MOYIE, B. C.

SUMMARY AND CONCLUSIONS:

The St. Eugene Mine had a production valued at \$12,000,000., from 1,000,000 tons of ore averaging 8 oz. silver, 15% lead and 4% zinc per ton. The ore occurred in shoots of good mining width with little gangue. The property was developed by 20 miles of drifts and an 800 foot shaft through a vertical distance of 2500 feet. There was, however, little exploration for ore beyond testing the downward extension of the three known ore shoots; the fracture zones in which these occurred extend beyond the limits explored.

The Company controls a block of 100 claims covering and adjacent to the principal deposits. There is a modern mining plant on the property. The shaft was re-timbered in 1940 and key adit levels could be re-opened.

There are three attractive possibilities of finding other orebodies of the St. Eugene type -

1. Exploration of the St. Eugene fractures westward out under the lake down the supposed rake of the ore zone.
2. Exploration eastward from the surface between the Upper Mine and the Society Girl, and from such levels as the 1300 and 1800.

SUMMARY AND CONCLUSIONS: contd.

3. Testing surface indications of other veins parallel to the St. Eugene veins.

In addition, there is the possibility of finding a bedded replacement deposit of the Sullivan type. Certain sections of the area from the U. S. boundary north to beyond Kimberley warrant careful prospecting, using modern technique. It is "elephant" country with the chances good that any deposits found would be of real value.

INTRODUCTION:

This report and accompanying maps attempt to bring together the information available on the St. Eugene property. Included are some fifty maps; also copies of earlier reports by seven engineers and geologists.

Explanatory notes where needed are bound in with the various maps. Separate reports in the expanding envelope give data on such phases as Diamond Drilling, Magnetometer Surveying, Sampling, Geochemical Prospecting, etc. This avoids a mass of detail herein, yet makes such information readily available if needed.

Mapping by the writer of various sections adjacent to the mine are given on 200' scale field sheets (Maps Mo-1 to Mo-8). These are generalized on the 1000' scale map of the Moyie area (Mo-9).

LOCATION AND PROPERTY:

The St. Eugene mine at Moyie is in the East Kootenay district of British Columbia, about twenty miles southwest of Cranbrook, B. C., and forty miles north of the U. S. border at Kingsgate. The property is well situated for economical mine operation. It is on the Crow's Nest branch of the Canadian Pacific Railway, a distance of 160 miles by rail from the lead-zinc smelter at Trail. A hard surface highway, the southern branch of the proposed Trans-Canada Highway, goes through Moyie. A power line owned by the C. M. & S., extends south from Cranbrook to Moyie

and supplies the town and mine.

The St. Eugene Mining Corporation Limited, NPL. owns or has under lease a block of 100 claims, including and surrounding the old mine workings (Map No-28). The old St. Eugene mine property on the east side of the lake, consisting of 24 Crown Granted claims, is owned by the Consolidated Mining and Smelting Company; these claims are under lease to the St. Eugene Mining Corporation. The Crown Grants on the west side of the lake are owned outright by this Company, and include the old Aurora and Guindon mines. Adjoining and surrounding these Crown Grants they have, since 1945, held by location some 60 claims known as the M.L. and Adel claims. These claims are now being surveyed; only one more year's assessment work is required to qualify most of them for Crown Grants. Much of the field work done by the writer in the Moyie area has been geological or magnetometer surveying submitted as assessment work on these sixty claims.

The Society Girl and Black Pine claims to the east of the St. Eugene are owned by Mr. M. Nicholson of Moyie; the John Dee, on their east, by Mr. Laird of Oliver.

The area is in the dry belt region of southern British Columbia, with an annual precipitation of about 20" and temperatures range from over 100° in summer to 25° below zero in the winter. The country around Moyie has been well timbered with Spruce, Jack Pine and Tamarack. Although much has been burned over or logged off, there is considerable timber available for mining purposes even on the Company's claims;

also there are long term logging and milling operations conducted on the water shed of Lamb Creek, some ten miles from the town of Moyie.

Moyie Lake is at an elevation of 3040 feet. Back from it the hills rise to about 5200 feet, the highest elevation of any of the Company's claims. There appears to have been an extensive old surface or plateau level at this elevation. Above this the higher peaks in the area range up to 8,000 feet.

HISTORY AND PRODUCTION:

The St. Eugene mine was discovered in 1895 and operated up to about the time of the first world war. Later considerable ore was mined by leasers. Schofield gives the total production of the St. Eugene mine up to September 30, 1913, as 1,017,106 tons of ore containing 5,365,232 ounces of silver and 229,305,721 pounds of lead, having a given value of \$10,626,608. In addition the ore contained an average of 4% zinc for which no payment was received, but on which there were penalties. Under present conditions the dollar value of this production would be almost double.

The Aurora and Guindon properties, on the west side of the lake, have shipped over 3300 tons of ore averaging 3.25 oz silver, 7.74% lead, and 18.5% zinc. In 1927 the Consolidated erected a re-treatment plant for the St. Eugene tailings, pumping them from the lake. They are

reported to have made a million dollars profit on this operation, mainly from the zinc content of the tailings.

From 1928 to about 1938 the area was dormant. In 1938 Ventures Limited pumped out and re-timbered the old St. Eugene shaft, establishing access to some of the levels therefrom. The two lower levels were mapped (Mo-33 and Mo-34), but no worthwhile indications of ore were found thereon. A well equipped mine plant, consisting of electric hoist, compressor, blacksmith shop, etc., was placed on the property at that time. It is still intact and in practically new condition. In 1940 the work was suspended for the war years.

In 1946 the present study was started; it has consisted mainly of geological and magnetometer surveying, together with 1300 feet of short hole drilling. The program to date has of necessity been concentrated on work that could be submitted as assessment.

GEOLOGICAL SETTING:

The lead-silver-zinc deposits at Moyie are in the upper third of the Aldridge formation of Late Pre-Cambrian age. These sediments are warped into a broad open anticline trending north from the border. The axis of the arch lies near the St. Eugene Shaft. The Moyie thrust fault strikes northeasterly across the area: lying some 4 miles northwest of the mine.

Stratigraphy:

The Aldridge is a member of the Lower Purcell series of sediments. It is the equivalent of the Prichard formation of the Belt series (Proterozoic) of Idaho and Montana. In the East Kootenay area the formation consists of quartzites and argillites, together with intermediate types. The sediments show many features of shallow water deposition such as ripple marks, mud cracks and rain drop impressions. They have been mapped in detail on our field sheets Mo-1 to Mo-8. On Mo-8 they have been generalized into arbitrary units.

There are few distinctive horizons, and in addition there is considerable lensing in and out of different horizons. The contact between the Aldridge and the overlying Creston formation is gradational. For our work it was placed at the top of the black argillite horizon in which the upper St. Eugene shoots are found. The upper portion of the Society Girl workings are then, using this interpretation, in the base of the Creston formation.

That portion of the Aldridge formation occurring around Moyie is more thin bedded and more argillaceous than the lower section.

It consists approximately of -

		<u>Thickness of beds</u>
25% Light Grey	- Quartzites	6" - 72"
35% Medium & Dark Grey	- Argillaceous Quartzites	2" - 30"
15% Medium & Silver Grey	- Argillaceous Siltstones	1/2" - 2"
20% Black & Dark Grey	- Argillites	1/34" - 3/4"
5% Rhythmically banded alternating Light Grey & Black	- thin bedded sediments	1/8" - 1"

(Chubb's Arenaceous Argillite - i.e. our MAR beds)

The 600 feet immediately underlying the Creston contain only occasional beds of quartzite.

In general the formation becomes more quartzitic and competent on going down through it. The Sullivan mine at Kimberley in the lower third is much more thick bedded and is predominantly quartzite.

Rice (G.S.C. Memoir 207 pp. 6-8) gives a total thickness of 16,000 feet for the Aldridge. Gunning considers the formation in the Moyie area to be considerably thinner, probably only about 9,000 feet thick. In 1948 he apparently found the underlying Fort Steele formation exposed in the central portion of the anticlinal arch near the border.

The Aldridge formation is distinguished partly from other members of the Purcell series by its characteristic rusty appearance on weathered surfaces, (this probably resulting from oxidation of biotite in the sediments). The overlying Creston, about 6,500 feet thick, consists of similar sediments but having characteristic green or purplish color. The succeeding Kitchener (6,000 feet) differs from the underlying rocks in that it is composed of mainly soft, buff weathering, calcareous and dolomitic argillites. The writer has not encountered any carbonate rich horizons in either of the underlying Creston or Aldridge formations. But small lenses of such rock are reported in the lower Aldridge. The upper part of the Fort Steele consists of dolomitic argillite

Intrusives:

Purcell sills (mainly diorite and quartz gabbro) occur in the Fort Steele, Aldridge and Kitchener formations. None are known to occur in the intervening Creston. South of Moyie (Mo-6 and Mo-9) two such sills, called herein the Rudd sills - 600 and 200 feet thick, occur in the Aldridge formation. These, if projected, would lie about 2,000 feet below the collar of the St. Eugene shaft. In the mine area two small sills, 8' thick, outcrop on both sides of the lake a few hundred feet below the top of the Aldridge. In the lower portion of the Aldridge there is probably another six or eight sills of 200 - 1000 feet thickness and numerous smaller bodies. These sills, in the literature, have been given a Pre-Cambrian (Purcell) age, but it is the opinion of several recent workers that they are probably much younger and are an early phase of the widespread Mesozoic period of intrusion.

The ore deposits of the region appear to be related to "granitized" portions of the Purcell Intrusives. The Sullivan and Estella mines are near protrubances in Purcell Sills of complex lithology. Anderson (Econ. Geol. Vol. 44, No. 3, May, 1949) considers the quartz monzonite intrusives of the Coeur d'Alene area to be derived by deuteric alteration of these diorite intrusives. The same may apply to the Sullivan deposit; the granitized areas being in part altered diorite.

The outcrops of the Rudd sills do not show

any such intense internal alteration, although there are areas of much more leucocratic rock near the hanging wall of the upper sill. There is, however, an offset or roll in these sills which may be comparable to the protrubances described above. The presence of this irregularity in the sills below the St. Eugene mine is a hopeful indication for the downward continuation of the ore, since the Sullivan and other deposits continue much closer to the intrusive.

Associated with Purcell sills are dykes of the same rock. At Moyie two of these strike northeasterly in the vicinity of the workings. They have steep dips and are from 10 to 100 feet in width. One occurs on each side of the lake. On the eastern side the dyke splits south of the mine with one branch trending northerly to cut the vein structures in the area of the Upper Mine ore shoot, and the other intersecting the projection of the vein about one thousand feet further east. On the western side of the lake a dyke has been traced northeasterly for several thousand feet to a point about 5000 feet south of the Aurora property where it disappears under overburden.

Structure:

The two major structural features of the area are the arch of sediments and the Moyie fault. The Moyie fault has been traced from just south of Cranbrook in an arcuate course for some 140 miles into Montana.

In the vicinity of Moyie it strikes northeas-

terly following the valley of Lamb Creek and cutting across the northern end of Upper Moyie Lake. It is a high angle reverse fault dipping northwesterly. The hanging wall has moved upward relative to the footwall, some 10,000 feet or more bringing the Aldridge on the hanging wall to juxtaposition with the Kitchener. As one approaches it from the southeast, that is, in the footwall, the sediments on the western limb of the arch steepen gradually to over 80° in dip. The hanging wall sediments where exposed northwest of the fault appear to have relatively gentle dips. It does not have characteristics of a typical low angle thrust fault of great relative horizontal movement.

The sediments on the anticlinal arch in the vicinity of Moyie have relatively gentle dips; those on the east side of the lake dipping northeasterly, and those on the western side, northwesterly. The axis of the arch in the vicinity of Moyie appears to strike about $N.20^{\circ}E$ and to plunge gently to the north at an angle of about 10° .

On an ideal anticline of this orientation cross joints or fractures, normal to the anticlinal axis, would strike about $N.70^{\circ}W$ and dip 80° southwest. In addition, there should develop high angle longitudinal joints striking $N.20^{\circ}E$. Fractures having these orientations are common in the area. The St. Eugene veins occupy structures having the orientation of the cross fractures. They are cut by north-south zones of fracturing accompanied by second order folding and crumbling which could be the longitudinal fractures on the anticlinal structure.

The area, in addition, has a pattern resembling block faulting. The writer believes it to be cut by numerous faults most of them having a rotational movement of small displacement. These faults are often not exposed as they occur in topographic depressions and draws. They are confirmed by small offsets in the stratigraphy and by distinct changes in strike and dip of the strata. As shown on Mo-9 it has been possible to measure offsets in a dozen or so cases. However, the orientations of these various breaks are often doubtful, i.e. the offset may be proven but the orientation of the fault is questionable or unknown. One reason for suspecting block faulting is that dips and strikes of the strata may be constant over an area, while across a draw or creek valley there is an adjoining area having another definite but different orientation. The present arching may have developed not only by straight folding or bending of the strata, but also by the block faulting of numerous small relatively rigid blocks. In general the north sides of faults appear to have rotated clockwise, i.e. the west side of the north block moved upwards (see Mo-9 and discussion below on Chubb fault and vein fractures). This movement could be related to the steepening of beds on approaching foot-wall of the Moyie fault.

Among these faults are several that may have had considerable influence on the localization of the ore deposits. One of these, known as the Chubb Fault (Mo-18,

19 and 31), was mapped originally as extending southwesterly across the lake from Glencairn Creek to Etna Creek. Chubb measured an offset along Etna Creek of some 800 feet with the north side moving upward 800 feet. This offset has been confirmed independently by the writer. On the east side of the lake, at Glencairn Creek, Chubb had a movement of 200 feet downward on the north side. The Chubb fault, then, was considered to be a pivotal fault dipping 35° to the north and along which the north side was rotated in a clockwise direction. The writer has mapped a fault trending northeasterly from the Rudd sills that projects to the Chubb fault at Glencairn Creek. The Chubb fault may have this trend rather than the one previously given by Chubb; this, however, is not proven. On the upper Rudd sill the offset is 650 feet, the west side moving upward.

The Chubb fault, in either of these two positions, would have a trace on the plane of the St. Eugene veins paralleling the slope of the hill. It might thus have acted as a structural control, accounting for the apparent rake of the known ore zone parallel to the slope of the hill. Also the north trending zone of faulting seen in the lower Society Girl tunnel (Mo-7 and Mo-14) would have a trace paralleling the apparent rake of the ore zone.

ORE DEPOSITS:

The St. Eugene deposits are a high temperature type similar mineralogically to those of the Sullivan Mine.

They have also been compared by Schofield to those of the Coeur d'Alene district in Idaho. Evidently this belt, extending from Coeur d'Alene to Kimberly, is a distinct metallogenic province.

The St. Eugene ore consisted mainly of coarse grained galena with minor amounts of sphalerite, pyrrhotite, magnetite and chalcopyrite. The portion of gangue in the ore is small; it is mainly garnet, amphibole, quartz and minor calcite. There is no apparent vertical mineralogical zoning in the ore deposits such as is encountered in many lead-zinc camps, e.g. the Slocan. However, the ore shoots at the Upper mine and those on the Aurora appear to carry more zinc and pyrrhotite than do the Lakeshore and Moyie shoots. This seemingly higher temperature condition may be caused in both instances by proximity to the Purcell dykes.

The ore in the St. Eugene mine (Mo-16) occurred associated with two sub-parallel fracture zones, trending N.70°W and dipping on the average about 65° southwest. These may be considered as cross fractures about normal to the anticlinal axis. Ore found to date has been localized in three separate areas (Mo-18-19), known as the Lakeshore, Moyie and Upper or St. Eugene shoots. The north fracture, known as the Main vein or North vein, was in general the more productive. The so-called South vein workings do not appear to have been on one continuous fracture but rather a series of parallel breaks. In the vicinity

of the shaft (Lakeshore shoots) the South vein converged slightly with the North vein and ore was found both on these two veins and on avenues and parallels lying between them. On going westward and to depth the ore appears to have "crossed over" on the avenues from the North to the South vein.

The Aurora and Guindon veins on the west side of the lake are in the same zone of fracturing as the St. Eugene and might be a continuation of the St. Eugene vein structures, but it appears likely that no through going structure could be followed across the lake from the St. Eugene into the Aurora and Guindon mines.

The St. Eugene fracture zones are persistent; they can be traced on the surface for 12,000 feet east of the shaft, while 5,000 feet to the west across Moyie Lake the Aurora and Guindon veins are apparently in the same zone. There is then considerable strength to the vein structures.

The location of the ore shoots within this long fracture zone was apparently controlled by the intersection of the vein structures with north-south zones of fracturing, and small scale folding or crumbling. The ore shoots definitely occur at these minor irregularities on the major anticlinal pattern. Long stretches along the vein where the strata dips regularly have been drifted on and found barren. The ore found to date is confined to these irregular areas with the barren portions generally

devoid of visible galena or sphalerite.

Stratigraphy does not appear to have been the dominant control in localizing the ore shoots, although from inspection of the longitudinal section (Mo-18 and Mo-19) it is apparent that some beds were more favourable for ore deposition than others, one reason may be the variation in vein dip in going from one type of bed to another. In the Upper mine area the ore apparently died out in the argillite just underlying the base of the Creston formation.

Thick bedded quartzites appear to have been the best host rock. They are the rocks most competent to sustain clean cut fracturing. The Lakeshore shoots were in such rock; these contained the greatest concentration of ore found to date. The intermediate Moyie shoots occur in alternating thick and thin bedded quartzites, while the Upper mine shoots are on the surface principally in very thin bedded argillaceous rocks. If a suitable disturbed area along the fracture zone were encountered, favourable stratigraphic horizons would probably be found frequently therein.

On Chubb's vertical Section (Mo-31) the beds are shown dipping regularly to the eastward. Recently the writer obtained from the C.M. & S., copies of Gwillem's Geological notes and maps (Mo-30) for the old mine levels. An interpretation of these level plans is shown on projection Mo-18 and Mo-19. This suggests that in the Lakeshore and Moyie shoots and intervening area the strata parallel the levels for long distances. Only in the Upper mine are

they going steadily into stratigraphically higher rocks on going eastward.

Apparent offsets of the dyke by the vein fracture indicate a rotational movement along the vein fracture in the same sense as that indicated by Chubb for the Chubb fault, that is, where the north side rotated clockwise.

Judging from longitudinal and cross sections through the workings (Mo-18 to Mo-24) the ore shoots occur in the more steeply dipping portions of the veins. Why this should be, if the movement was mainly rotational, is not clear. There is a decided flattening in the vein dip below the Moyie and Lakeshore shoots (Mo-18 and Mo-19), and this flattening appears to rake westerly nearly parallel to the rate of the known ore zone.

Aurora and Guindon:

The ore in both the Aurora tunnels and the Upper Guindon tunnel appears to have been localized by a zone of faulting, and minor folding striking N.20°W., (Mo-2, Mo-5, Mo-25, Mo-26, Mo-27). These areas on different veins, cut by the same N.20°W., zone are the only showings carrying lead and zinc visible on the western side of the lake. A small amount of ore is reported to have been found in the lower Guindon tunnel, but this is not now accessible. The showings at the upper Guindon tunnel, though small, are worth some additional prospecting. The Aurora shoot is in

the upper portion of the same stratigraphic horizon as the Lakeshore shoots; the upper Guindon, the same as upper St. Eugene shoots.

Other Development:

There has been a fair amount of underground and surface stripping done on other N.70°W vein structures in the Moyie area. These, for the most part, have followed narrow quartz veins with accompanying chlorite, and have been without any sulphide mineralization except a little pyrite and pyrrhotite.

The Midway mine, south of the Budd sills, follows a persistent north-south fracture dipping 45° to the east. This structure has been drifted on for some 1300 feet. Along it several shoots containing encouraging gold values were encountered. The ore is in quartz with pyrite and smaller amounts of arsenopyrite, galena, sphalerite and tetrahedrite. The best shoot found to date was near the portal of the adit where a length of 80 feet averaged 0.35 oz. gold and 2.5 oz. silver across a width of 4.6'. Thicker bedded quartzites underlie the lowest horizon explored.

MAGNETOMETER RESULTS:

A magnetometer survey has been made on the lake, and on the Moyie No. 5 and 6 Groups. The results are given in the accompanying report with the generalized 1000' scale map Mo-29; for details see Mo-10-12.

Anomalies of up to 200 gammas occur over the St. Eugene veins. It was hoped to trace these veins by magnetometer out under the lake, to prospect for other parallel veins or for bedded replacement deposit. The effect of the St. Eugene veins out under the lake is very weak, but there does appear to be a break in the magnetic contours along the projection of the veins. A much stronger parallel break occurs near the north end of the lake. Near the south end of the lake and on the M L 6 Group, south of the dyke, a series of northeasterly trending anomalies is apparent. The strongest anomaly found was that crossing the lake in the vicinity of the old mill; this is likely due to the tailings. It is stronger than the anticipated effect of the Moyie mine tailings, but unfortunately some 4000 tons of low grade Sullivan ore containing pyrrhotite was run through the re-treatment plant at the close of that operation. Probably this caused the anomaly. That portion of the lake is particularly interesting as it might contain a bedded replacement deposit at the intersection of the Chubb fault with the anticlinal axis.

The results of the magnetic survey to date are sufficiently encouraging to warrant submitting the report and maps to a competent mining geophysicist for a more technical interpretation.

GEOCHEMICAL PROSPECTING:

It was thought that prospecting in the Moyie area would be aided by the examination of concentrates made by panning stream and side hill gravels and soils (Mo-35);

using the pan for lead prospecting in the same way as for tracing gold bearing lodes. In the first attempt to determine the lead minerals, a petrographic microscope was used; this was found to be slow and difficult. The Department of Mines at Victoria, B. C., are now analyzing these samples spectrographically to determine the merits of that method. The results received are given on Mo-35 and indicate it is a useful tool in prospecting the area. Additional work of this type should be done in tracing up the indications found and in covering other likely sections.

There is a wide variation in the lead content of the pannings concentrates; so-called positive areas have values 20 times as great as the lead content in negative areas. This range should be very useful in prospecting. Even the lead content of the glacial gravels, i.e., a glacial train might, if properly interpreted, be of use.

DIAMOND DRILLING:

This, too, is covered in a separate report with the drill logs. Six holes drilled in 1940 did not intersect any ore. Three of these drilled on the alluvial cone of Glensairn Creek, were not to bedrock, although one reached a total depth of 244 feet in overburden. Two drill holes on the west side of the lake intersected what might be the downward extension of the Aurora vein;

where cut, it was lean.

Five holes along the eastern shore of Moyie Lake, drilled in 1946, were located so that they could be used for assessment work. None were carried to their objectives; they were to prospect draws and other areas that might contain veins of the St. Eugene type. One did intersect a vein type structure 8 feet wide that contained about 2% coarse sphalerite. Additional drilling should be done to determine the orientation of this break and to prospect it in stratigraphically favorable places.

Numerous short holes to locate extensions of known ore shoots were drilled from the St. Eugene mines workings at the time of operation, but no long range exploration program, such as is carried on under present day conditions, was conducted.

One feature of diamond drilling in the area is that the holes tend to deviate badly when drilled at narrow angles to the bedding of the sediments. Otherwise the rock is good drilling and core recovery good.

STRUCTURAL CONTROL OF ORE DEPOSITS:

The known orebodies in the Moyie area are controlled in location by certain structural features. The important controls are thought to be -

- 1 - The veins are in N.70°W fracture zones.
- 2 - Where these zones are intersected by north trending zones of faulting, folding or crumpling.

- 3 - In steeply dipping portions of the vein structure.
- 4 - In stratigraphic horizons that could maintain an open fracture.
- 5 - Beneath or close to faults striking northeasterly and dipping at medium angles to the west, i.e. close to such structures as the Chubb fault, and perhaps the fault west of the Society Girl.

The first two controls appear to be fairly well established. The influence of such structures as the Chubb fault is not definitely proved. If one were to disregard the supposed control by such structures as the Chubb fault, exploration in the area would seem considerably easier, and large areas could be considered favorable for exploration. This or other postulated faults with a parallel trace on the vein provide a facile explanation for what looks like a rake to the ore zone. But at the present stage of exploration distance from, or absence of, such a structure, should not be allowed to condemn as unfavorable areas having the other controls.

SEARCH FOR ORE:

(a) For St. Eugene Type Deposits within the Moyie Area:

These structural controls suggest the following possibilities in the exploration for orebodies of the St. Eugene type:

- 1 - Diamond drilling from the surface of the eastward extension of the Moyie veins, between the Upper Mine workings and the Society Girl. A series of inclined holes about 300 feet deep (see Mo-18-19) should be drilled to test the projection of the vein structure at the same stratigraphic horizon as that in which the Upper Mine ore shoots occurred. This drilling should first test the intersections with the vein zone of the north-south faults and the eastern branch of the dyke (Mo-14 & Mo-19).

- 2 - To re-establish access to such levels as the 1300 and 1800 and to explore from them by diamond drilling or drifting the possible favorable sections having high dip and good stratigraphic horizon. Some of these features are indicated on Mo-19. In addition, from such levels as the 1300 the South vein could be explored by drill holes from the north vein drift (for example see Mo-23).

One cannot draw up a satisfactory exploratory program for this work at present; it would be guided

largely by the stratigraphy and structure found when the levels were re-opened.

- 3 - Exploration from the shaft levels or from the surface for the westward continuation of the ore zone out under the lake. It appears from study of surface geology and Saxton's and Gwillam's maps that the bottom levels of the shaft were in the 190 foot thick bed of argillite outcropping south of the mine (Mo-20 and Mo-21). Also that the most promising vein structures appear to be to the south of the South vein on the lower levels, and that the 2400 level is nearly through the unfavorable argillite horizon. The quartzite underlying this argillite may be particularly favorable (i.e. if the argillite had a capping effect), and suggests exploration from the bottom levels to the south and west of the present workings. Gwillam mentions a dark limey sill occurring in the shaft below the 2400 level. This, if it is a sill, would be a favorable feature; again it might be a chloritic halo such as overlies the Sullivan orebody. The possibility of ore to the south and west of the lower shaft workings could be tested if necessary by drill holes 800 to 1000 feet deep from set-ups along the eastern side of the lake (Mo-20). These set-ups would be nearly on bedrock; that is, set-ups could be obtained where one would not have the difficulties with overburden encountered in the 1940 drilling program.

4 - Exploration of Parallel Structures: There are numerous small veins, draws, and creek valleys in the area that strike N.70°W parallel to the St. Eugene veins. These might have possibilities if tested at their intersections with north-south zones of folding and faulting. Among the most interesting of these are the valleys of Glencairn Creek and Etna Creek. The intersection of the valley of Glencairn Creek with the Chubb fault should be particularly favorable for the finding of ore on the N.70°W structures, under the fault. D. D. H. #11 was started to explore this possibility. Before any extensive drilling program to test these possibilities was undertaken they should first be tested by a magnetometer survey and by some means of geochemical prospecting, such as our pannings concentrates. Indications of mineralization have been found in this way on Etna Creek (Mo-35) and to the east on the projection of the St. Eugene fracture zone beyond the John Dee workings.

The ore shoots on the Aurora and Guindon and the valley of Etna Creek to the south are in the upper portion of the stratigraphic horizon that on the east side of the lake contains the Lakeshore shoots. Favorable loci for ore should occur in this horizon where the Aurora and Guindon breaks and other possible parallel fractures to the south in Etna Creek valley are intersected by either the dyke or the N.20°W zone of fracturing.

(b) Search for Sullivan Type Bedded Replacement Deposits
in the Moyie Area:

The ore horizon at the Sullivan Mine is in the lower portion of the Aldridge formation. It is in an argillite and siltstone horizon characterized by beds 3' to 20' thick. A footwall conglomerate may indicate deltaic origin; the beds may be relatively restricted in extent. As far as the writer knows, the country rocks of the Sullivan ore horizon have not been traced extensively throughout the Cranbrook area. The formations at Moyie are very much more thin bedded than those characteristic of the Sullivan. The Sullivan deposits are overlain by zones of chloritization and albitization and underlain by a large tourmalinized area, so-called Kimberley cherts. Again at greater depth there are granitized areas which are the altered protrubances from diorite Purcell sills and metamorphosed adjacent sediments.

In the Moyie area the most likely area for finding a bedded replacement deposit would be below the shaft levels and above the Rudd sills, somewhere within a half mile or so of the axis of the arch. In this stratigraphic interval of 1200 feet or so there is no horizon outcropping that appears to offer special advantages for a bedded replacement deposit. However, such a deposit could occur in numerous horizons in that area if alteration and fault structure were present. The intersection of the

Chubb fault, with the quartzite, underlying the 2400 level argillite is a particularly favorable area to explore for such a deposit. The green dyke-like rock, which may be a chloritic halo, noted by Gwillam below the 2400 level, and the alteration in this same horizon, at the south end of the lake, are both hopeful signs. Vertical drill holes might be drilled from the ice on the lake; with modern casing techniques, drilling should be able to get through the loose material on the lake bottom and into bedrock. However, as a preliminary to exploration for a bedded deposit the magnetometer survey should be extended from the lake southward through the M L 60 to 71 claims to the Rudd sills.

(c) Search for Ore beyond the limits of the Moyie Area:

The exploration of a larger area should be guided by such features as major and minor faults, irregularities and alteration in Purcell sills; and alteration of the sediments by tourmalinization, albitization, chloritization or the development of garnets and pyroxenes. In addition to these geologic features, the work should be accompanied by magnetometer prospecting and geochemical work. Our experience to date indicates that a widespread search for these features and detailed prospecting of favorable areas would be more likely to find ore in the East Kootenay district than would detailed stratigraphic and structural mapping of the sediments.

In 1947 an area on Mathew Creek, to the west of the Sullivan, was staked and some preliminary magnetometer and geological work done. The ground was later dropped as no positive indication of ore was found and we were not able at that time to continue an intensified search. However, structurally the area is favorable and warrants more prospecting along the lines indicated above.

On the Kootenay Indian Reserve, north of Cranbrook, Rice has mapped several small areas of intrusives. The writer believes these to be of the same origin as the so-called granitized areas associated with the Purcell sills and ore. In 1947 the Indian Department could not get the tribe to give up their mineral rights on the reserve. Now, however, since Indians have been given the franchise they may do this. This would place the reserve open to prospecting under permit.

An area of Aldridge rocks lying north of the Moyie fault is cut by a north-south fault along which is a Purcell dyke, a granitized area, and a tourmalinized body with some mineralization exposed. This lies in a direct line between Moyie and Kimberley. Air photos for this section have been obtained and the area should be prospected as soon as possible.

East of Yahk and south towards the International Boundary there is a belt of sediments near the base of the Aldridge with considerable alteration (garnets and pyroxenes similar to the gangue minerals found with the ore.

Large float blocks of tourmaline are known to occur. We have the air photos for this area, and it should be prospected as soon as possible.

R E C O M M E N D A T I O N S .

The eastward extension of the St. Eugene fracture zone should be under Company control if any exploration is intended in this vicinity in the near future. The other 5/16ths interest in the Baltimore claim should be obtained from the owners, if they can be located. Also the Society Girl, Black Pine and John Dee claims purchased or placed under option if they can be had on reasonable terms. The known ore deposits on these claims are very small perhaps because they are in the upper thin bedded horizons. If some of the lower St. Eugene levels were carried eastward they might find larger ore shoots beneath. In view of the results of our geochemical prospecting a string of claims should be staked east of the John Dee claim.

A drilling program should be started and exploration of the Company ground continued. The other favorable areas discussed above should be prospected as soon as possible. The district is well suited to the use of modern geochemical and geophysical techniques. Other companies are getting the same ideas. St. Eugene should concentrate on this work to take advantage of its knowledge and experience in the area.

Vancouver, B. C.
July 15, 1949.

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