REPORT

ON THE GEOLOGY OF THE

MAMMOTH MINE

OF THE

WESTERN EXPLORATION CO. LTD.

SILVERTON, B. C.

To

Mr. A. M. Ham, General Manager,
Silverton, B. C.

By

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GEOLOGY OF THE MAMMOTH MINE

INTRODUCTION:

The following report is based on a three weeks study of the underground workings of the Mammoth Mine. All workings were open and accessible except No. 1 Tunnel, and the two short tunnels on the ridge to the west of the main workings which were omitted on account of snow conditions; and except the considerable parts of the large stopes on Levels 5, 6, and 7 which are filled. None of the surface could be seen on account of snow.

As general the location, property, and other physical features of the ~~property~~ mine are familiar to you they will be omitted in this report.

References will be made ~~furthermore~~ to the work reports of Dr. C. E. Cairnes for the Canada Geological Survey in Memoirs 173 and 184.

GENERAL GEOLOGY: (C. G. S. Memoir 173)

The claims are underlain by rocks of the Slocan Series of Triassic (Mesozoic) age, which here consist of argillites and argillaceous quartzites which are generally quite massive. They are generally, throughout the region, much folded and faulted. The argillites consist of very fine grained ~~dark~~ massive rocks ranging from dark brown to black and from argillite to quartzite; the great bulk of the rock at the Mammoth being of intermediate type.

The intrusive rocks mentioned by Dr. Cairnes (Memoir 184, p. 76) as occuring on the group were not found in the mine workings.

MINE GEOLOGY:

The rocks exposed in the mine are massive, and generally intermediate between argillite and quartzite

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in composition. On the whole, there is very little change in character from one part of the mine to another. Except at a few points, bedding planes are ill defined and difficult to determine; in the immediate vicinity of the vein they are generally obliterated. What bedding data is to be found, is often indefinite and sometimes conflicting. Partings between different beds are sometimes quite prominent as in the outer part of No. 7 adit, but generally are no more prominent or definite than joint planes, or shear zones, such as appear in No. 4 adit crosscut and may represent the Buffalo, or other, vein.

Narrow bands of varying shades, corresponding to slight changes in composition, (see also Memoir 173 bottom p. 52) have been taken as the deciding factor in the bedding. While this criterion is occasionally contradictory it predominently indicates a rather uniform strike of N 30° to 40° W and a dip of 40° to 50° southwest. These show most clearly in the Level 7 crosscut to the surface, the most easterly crosscut south on Level 7, the south crosscut on Level 6, in the short crosscut in Level 3½, and in the Level 2 adit crosscut.

A wide spread and prominent system of joints and fractures strikes N 20° to 35° E and dips 30° to 50° southeast; it is often very easily mistaken for bedding planes. This agrees well with the course of the so-called Buffalo vein in Level 1, is not widely different from the vein-shear along the Level 4 adit crosscut, and agrees fairly with some of the fracures and walls(?) in the large stopes on levels 6 and 7.

VEIN:

The Mammoth vein lies in a very strong shear-zone striking east and west and dipping 45° south. The zone varies from ten to seventy five feet, or more, in width

and consists of highly sheared and brecciated rock which has been more or less altered and mineralized. The movement along the shear zone is not indicated, but is probably considerable and has been of long duration as evidenced by occasional brecciation & shearing in some of the ore. The planes of greatest movement are represented by thick bands of gouge accompanied by considerable graphite. There are many cross fractures within the shear, some of which are mineralized, forming locally almost a linked-vein structure.

Many small spurs and fractures turn off from the main shear but most of them appear to curve back into it again. Probably some of them do not curve back to the main vein but gradually pinch out. There is no evidence that any of them are of any importance except where practically in contact with the main shear.

The vein-zone filling consists largely of gouge, and crushed rock sparingly impregnated with fine pyrite and partially healed by calcite with minor amounts of gray-copper, and a little quartz. In the ore areas, galena and zinc-blende have been deposited with calcite, quartz, and siderite. Occasional specks of chalcopyrite were also noted.

Continued movement in the shear-zone has often brecciated the sphalerite and sheared the galena. The ore minerals were probably deposited largely in open spaces in the shear but also to a considerable extent have replaced the more brecciated portions of the rock.

Pyrite appears to have deposited before the galena and sphalerite, although continuing to a slight extent during the deposition of the latter minerals. Zinc-blende deposited before the galena, generally, although there is an evident overlap. Quartz appears to have deposited sparingly through the whole cycle, and calcite deposited before and during the deposition of zinc, and during at least the first part of the galena deposition. The mineralizing solutions are generally believed to be connected in origin with the underlying granite.

Dr. Cairnes states that the deposition of siderite is essentially intermediate between calcite and sphalerite, and that gray copper deposited with, or just before, the galena.

There are no marked changes between the deposition in the upper and lower levels of the mine, there is however a slight decrease in quartz as depth is attained and a corresponding increase in calcite and siderite. There also ~~seems to be~~ a slight ~~increase~~ in the ratio of ~~zinc~~ lead to ~~lead~~ zinc, and both galena and blende seem to have a tendency to crystallize more coarsely. These changes were noted in the examination of specimens. To check the change in the ~~ratio~~ ratio of lead to zinc, mine samples ~~were~~ taken ~~after~~ from October 1935 to the end of operations in February 1936 were compared.

Those taken from Levels 2 and 3 averaged Pb.: Zn = 1 : 2.20

and from Levels 6 and 7 ..... Pb : Zn = 1 : 2.58

- an increase of approximately 17% in the ratio of lead to zinc from the upper to the lower levels.

NOTES ON WORKINGS: Level 1 Not visited. Dr. Cairns reports that the Mammoth vein is cut, and slightly faulted by the Buffalo vein which was followed in by the adit.

Level 2. The vein was followed continuously for 800 feet, of which about 400 feet was on ore. There is a strong suggestion of "linked veins" in the vicinity of Sta. 209 and Sta. 219. The footwall branch of the vein, north of Sta. 210, while it shows no ore on the level, is strong and should be further prospected above the level. With this exception there are no seemingly important branches or spurs on the level. No indication whatever was found of an

intersecting vein, although the so-called Buffalo vein should pass through at about the head of the main raise. Some detail is probably covered by close lagging.

Level 3. This level has been opened for 540 feet, of which 235 feet is on ore. Near the east end of the level there is a marked widening of the vein with a narrow, very weakly mineralized zone in the center. This appears to be the continuation downward of the wide structure on Level 2 above.

At the west end of the level the south spur vein of the Level 3½ should be about 40 feet in the hanging wall; it does not seem probable that it contains ore, but it is advisable to crosscut to it to make certain. The Buffalo (?) vein should intersect this level just east of the main raise, but no indication of its presence can be found.

Level 4. This level is 630 feet long on the vein and shows 480 feet of ore. The wide vein-zone on east Level 3 narrows before reaching this level. The extreme west end of the level opens the two veins of Level 3½ just about where they join on the dip. The long north crosscut at Sta. 110 shows rather broken ground throughout most of its length with weakly mineralized shears, probably subsidiary to the main shear, at 100 and 150 feet; these have no evident importance. The adit from the surface to the vein follows a weakly mineralized vein, or shear, near the surface for a distance of nearly 300 feet. This consists of a weak shear or fractures having roughly the strike of the Buffalo(?) vein in N Tunnel 1. Little movement is indicated along the shear, which much resembles bedding planes; there is slight mineralization over a width varying from one to ten inches. There is no indication where this crosses the main vein, unless it be a few small seams of about [illegible] dip and strike near the first crosscut east of the main one;-which is further east than the

vein should be.

Level 5. Most of this level, 260 feet long, is on ore. On account of extensive stope-filling it was found impossible to work out the geology satisfactorily. Fracturing and crushing are intense over a width of fifty feet, much of which is well mineralized. There appear to be several parallel vein-strands, sometimes connected by diagonals of a linked-vein type. There is no definite evidence of an intersecting vein, nor is there any evidence that there is not.

A short crosscut should be driven north from the vicinity of Sta 509 to prospect for the vein-strand in the footwall.

Level 6. This level covers a length of 235 feet of which approximately 125 feet are on ore. In the stope, conditions are almost entirely obscured by filling up to the fourth floor (31 feet) which has little more than one third the area of the sill-floor. According to the evidence obtainable, ore made along east west fractures (main vein) chiefly, but also along fractures running approximately N 60° E, and, according to verbal reports, approximately N 20° E also; I was unable to confirm this last by any visible data. At fifty feet west of the main raise the west drift makes a sharp turn to the northward (N 55° W) on strong fracturing and non-commercial vein matter.

As there is no comparable turn on either the 5th or the 7th levels the hanging wall should be explored from near the face of the drift for another strand of the vein. The south crosscut shows nothing of particular interest. The north crosscut at the start shows six feet of medium mineralization in a strongly fractured zone striking N 72° W. Eight feet north and parallel to it there is an eight inch stringer carrying considerable galena, and sphalerite, and calcite. Twenty three feet further north in the crosscut there is a four foot fracture showing weak mineralization. The vein-strand at the start of the crosscut

has some possible prospective value and should be followed to the westward.

Level 7. The drift on this level has more or less followed the vein for 930 feet, of which little more than 120 feet is on ore.

Immediately east of the main raise ore occurs over a width of fifty feet, with one strand of the vein to the northward not yet cut in the stope. This stope is not so completely filled as those on Levels 5 and 6 and most of the vein- and strand-walls can be seen. These have a general strike a little north of east and a dip of 45° to 55° south. There is also some strong fracturing accompanied by ore, which runs from N 15° to 35° E and dips from 50° to 80° eastward. This corresponds reasonably well with the attitude of the Buffalo(?)vein on Levels 1 and 4. East of this stope the first crosscut south, and the drift, show a more northerly strand of the vein, containing weak mineralization, which should be found a few feet back in the footwall of the main stope. South of this strand, in the crosscut, there is a five foor zone of broken rock followed by a five foot vein-strand showing strong fracturing but rather weak mineralization . Twenty feet south of this there is a three foot zone of shearing with little mineralization, which is apparently the barren extension of some of the strongest shearing and mineralization in the stope. Eighty feet east of this crosscut there is another one which is completely filled with broken ore and cannot be seen.

The drift in this section is north of the vein and barely touches the footwall of the most northerly strand.

West of the main stope the vein mineralization of the vein-strands weaken and most of them pinch to mere seams, although some of the more northerly strands have not been

opened west of the main raise and there may possibly contain ore there. In the main crosscut the hanging-wall strand (at Sta. 709) is the strongest and has been followed to the end of the west drift. Throughout this distance the fissure is strong but the vein generally narrow and the mineralization weak. At Sta. 720 a spur showing weak mineralization leads off from the vein to the eastward in the footwall and may possibly connect with one of the strands of the vein east of the main raise. One or more crosscuts should be driven to prospect the footwall west of the main raise; extension of the main crosscut north for another 50 feet would be good prospecting.

The first crosscut east of the stope should also be extended southward another 30 feet, on the possibility that all the strands of the vein have not yet been cut by the present crosscut. The second crosscut should be cleaned out.

Nothing of particular interest shows in the main crosscut to the south. The Buffalo vein, if present in the stope, should pass through the crosscut but if so was not recognized there unless a rather weak unmineralized fracture passing through Sta 715 is it.

Orebodies east of raise on Levs 5, 6, & 7:

The orebody as opened on these three levels is somewhat different, at least in degree, from those on the upper levels. The rocks are much more widely fissured and crushed and mineralization is more widespread. The reason for this is not entirely clear. There is no conclusive evidence that the Buffalo vein, or any other, cuts the Mammoth vein at these points, although there is slight indication that it may, especially in the stope on Level 7. Assuming that the same vein appears in No. 1 tunnel and in the crosscut to N Level 4, a slight change, only, in dip and strike would place it at the east end of the stope on Level 7. On the way down it would also pass through the stopes on Levels 5 and 6,

and should ~~occur~~ a shear in the vicinity of the main raise on Levels 2, 3, and 4. It seems probable that this intersecting vein or shear, though ~~would, naturally, occur~~ not always identifiable is actually present and partially accounts for the large bodies of ore on the three lower levels; why larger bodies of ore do not occur at the presumed intersection on the upper levels is not clear. There is also evidence of a curve in the Mammoth vein, convex to the south, on the three lower levels centering near the main raise. This would cause more intense crushing and fissuring of the rocks and tend to promote the circulation of the mineralizing solutions at that point.

FUTURE PROSPECTS: The Mammoth shear-zone is strong and may be confidently expected to extend for considerable distances in all directions. It is likely that it may be possible to trace it on the surface both east and west when the snow goes; also it may be possible to locate its intersections with other shears or veins on the surface. It is at such points that the chances are best for the finding of further ore bodies.

Aside from what surface data may be obtained later, it it is advisable to drive Levels 4 and 7 west underneath the tunnel on the next ridge west of the mine, where some ore has been found. As it is planned to have a geological study made of the surface this summer, further recommendations for lateral work may best be left until that is done.

There seems little question that the shear zone will extend a long distance below the present workings, - probably thousands of feet. As to the continuation of ore to depth - It has been the experience in the Slocan district

that orebodies are lenticular in shape and of limited vertical length, and that there is a comparatively rapid change in mineralization as depth is attained, due probably to changes in temperature during deposition. Experience has shown that generally the upper parts of individual orebodies are high in lead and silver. ~~and contain comparatively large amounts of quartz.~~ Lower down silver and lead diminish in quantity and zinc increases, with also some increase in pyrite toward the lower limit of mineralization. Quartz is more plentiful in the top and bottom parts of the deposition zone, and siderite in the middle.

At the Mammoth, silver, lead, and quartz are ~~more~~ prominent in the upper levels. In the lower levels all three have decreased somewhat but are still present in important amounts, together with increased amounts of zinc and calcite. It would appear therefore that ~~the~~ Level 7 is ~~more or less in the center~~ not far below the center of the orebody, ~~or that not much below it~~, and that it is reasonable to expect several hundred feet of profitable ore below it, with silver-lead gradually decreasing and zinc increasing. This orebody has already been followed for about 1200 feet on its dip which is about as far as any of the orebodies of the district have extended, and further than most, so that while the mineralogy appears good for a considerable further downward extension of the ore, too great an additional depth must not be expected.

DEVELOPMENT RECOMMENDED: In the orebody as a whole as considered above, pay-ore occurs in shoots separated by material too lean to be profitable. In order not to miss any of these and to develop them for stoping, small prospect raises should be run between all levels at not more than 100

foot intervals. In so far as possible it would be well to start them in ore, or direct them forward ore known on the level above. Most of the important development has already been mentioned but for conveniende is tabulated below.

Work Recommended

Level	Class	Direction	Distance	Location	Remarks
#2	Raises	-	170'	each	At 100 ft intervals, or less.
3	Raises	-	130'	each	" 100' " " "
	X-cut	South	40'	Near Sta.310	To south spur vein.
	Drift	E & W	100'	each	
4	Raises	-	100'	each	At 100' intervals, or less.
	Drift	West	700'		To under West tunnel
	Drift	East	200'(plus)		
5	Raise	-	150'	E. end E stope	
	Raise	-	65'	Near Sta 509	Completing present raise
	X-cut	North	40'	Near Sta 509	Prospecting N. vein-strand
	Drifts	E & W	-		Under favorable ground on Lev. 4
6	Raise	-	200'		
	X-cut	South	30'		For Hanging wall of zone.
	Drift	West	50'(±)	Near Sta 606	On F. Wall strand;
	Drift	E & W	-		Under ore on levels above.
7	Raise	-	200'	Near Sta 708	
	Raise	-	200'	Near Sta 712	
	X-cut	South	30'	S. of Sta 708	Continue present X-cut
	X-cut	North	50'	N of Sta 703	For north vein-strands
	Drift	E & W	-		From faces; for exploration

This program entails a lot of work and naturally cannot all be done at once. It would be well to concentrate at first on the raising between levels and crosscutting for unopened strands of the vein; in other words to completely develop and prospect the ground within the central area, giving first preference to the upper levels. It would also be well to drive the main Level 4 westward as rapidly as possible.

Further developemnt in depth may, I believe, be deferred until more intensive development of the central area is finished and more lateral exploration completed.

In some places it would be advisable to drive short crosscuts from stopes and raises where ~~it~~ there is reason to suspect ~~believe~~ other strands of vein may exist. In the case of stopes, a 45° raise into the hanging wall serves both to prospect the wall and to furnish waste for filling, if ore is not encountered.

CONCLUSION:

The Mammoth shear-zone is exceptionally strong and should extend for a long distance. The orebody has already extended for a good distance in depth as compared with other of the larger properties in the district, but may be reasonably expected to extend for some hundreds of feet deeper ~~before~~ before becoming too low grade and zincy to mine. There should be good chances of finding other orebodies on the surface along the course of the shear, and especially so if intersecting veins can be found. Under these conditions I believe that considerable ~~work~~ exploration and prospecting work is justified. No attempt has been made in this ~~report~~ examination to estimate the quantity or value of the ore now partially developed. To make an accurate estimate would necessitate the taking of a large number of smaples ~~be~~ in addition to those already taken, and considerable raising etc to more thoroughly block out the ore. ~~There~~ That there is a very considerable tonnage ~~of ore~~ of pay ore at average prices for the metals there can be no doubt.

Respectfully Submitted,