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Report

COMPILATION OF DATA

PERTAINING

TO

THE TYBO MINE AREA

Tybo Mining District, Nye County, Nevada

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INTRODUCTION

At the request of Mr. W. R. Kelsey, president of the Silver Mining, Smelting and Refining Corporation, a compilation of data pertaining to the Tybo Mine area has been made. The data furnished by Mr. Kelsey consists of:

Treadwell Yukon Co., Ltd. mine maps and one section.

Geological and development reports and surface geology map by Oscar H. Hershey of Burch, Hershey and White and Hershey and White, consulting engineers of San Francisco, California. These 12 comprehensive reports are dated from December 24, 1925, through November 19, 1935.

Tybo examination by W. G. Luckhard, dated October 31, 1910.

A report on the properties of the Tybo Consolidated Mining Company by John B. Farish, dated October 24, 1910.

A statement of October 30, 1967, by Mr. A. E. Jutila, formerly Tybo Mine Foreman for the Treadwell Yukon Co., Ltd., concerning the ore remaining in the Tybo Mine one month before the shutdown in 1937.

U. S. Bureau of Mines Information Circular 6430, March, 1931, "Milling Methods and Costs at the Lead-Zinc Concentrator of the Treadwell Yukon Co., Ltd., at Tybo, Nevada."

Various miscellaneous letters, assays, and smelter reports.

The University of Nevada Bulletin No.3, by Henry G. Ferguson, "The Geology of the Tybo District, Nevada", and various U. S. Geological survey publications have been found useful, as have several graduate theses on the general geology of the surrounding area. A conversation with U. S. Geological Survey geologists, regarding the geology of the Tybo area, was very helpful.

For the purpose of this report, which is a summary of the available information concerning the underground development and possibilities of the Tybo and adjacent mines, no field work was done.

The pertinent underground areas that I would have needed to see are not open due to the fact that the mines are flooded or inaccessible. I have been to

Tybo several times in the past and, therefore, have a general knowledge of the district geology.

After due consideration, it was felt that the geological and development possibilities of the Tybo mine would be best presented by means of a 120° Isometric Block Diagram. This block diagram has been constructed, and it shows the mine workings and average grades on the 710 level, the geology as plotted from Hershey's reports, and various projections of geology and ore trends.

GEOLOGY

The Tybo and adjacent mines have been developed along veins following faults that cut Paleozoic and Tertiary (?) sedimentary rocks. These sediments have also been intruded by quartz porphyry, of Tertiary age, as dikes and sills. The most productive veins are found along the faults in and adjacent to the quartz porphyry dikes. The mineralization occurs in sheared and altered porphyry dikes and the enclosing altered wall rock material. The strongest mineralization is to be found as vein-like replacements of the altered porphyry dikes. There is also weaker vein-like replacement mineralization in the limey sediments, along the faults; and, in places, there appears to have been a tendency for bedded mineralization to develop.

The ores at Tybo have been won from vein deposits. The environment, in which these veins have developed, is such that bedded deposits could have been formed along them at depths where the mineralized fault zones and intrusive porphyries cut favorable sedimentary horizons, such as are found in the Eureka and Pioche districts. Although these sedimentary horizons (favorable for bedded deposits) are not exposed at Tybo, they should, as part of the sedimentary section, be present below the mine workings and be cut by the same mineralized fault zones that localize the ore bodies at Tybo.

A comparison of the sedimentary sections at Tybo, Eureka and Pioche is as follows:

	TYBO After Ferguson U.N. Bulletin No.3		EUREKA After Nolan U.S.G.S. P.P. 406			PIOCHE After Westage & Knopf U.S.G.S. P.P. 171		
Silurian	Lone Mountain dolomite	Several hundred feet			ore horizons	gray and brown dolomite	75'	ore horizons
Ordivician			Hanson Creek formation	±300'	some ore	Ely Springs dolomite	675'	
	Eureka Quartzite	±150'	Eureka Quartzite	300'	usually unfavorable	Eureka Quartzite	200'	
	Pogonip Limestone	±3000'	Pogonip Group	1600'—1830'	many prospects	Tank & Yellow Hills limestone	1120'	
	Hales Limestone	±3000'	Windfall formation	650'	little ore	Mendha Limestone	±2000'	some siliceous ore
Cambrian	Tybo Shale	±1600'	Dundenburg Shale	265'	no ore			
	Swarbuck Formation	2500'—3000	Hamburg Dolomite	1000'	ore second in importance	Highland Peak limestone	±3000'	ore in lower 50'
			Secret Canyon	± 650'	very little ore			
			Geddes Limestone	±330'	very little ore	Chisholm Shale	180'	barren
			Eldorado Dolomite	±2500'	ore first in importance	Lyndon Limestone	400'	good ore
			Pioche Shale	400'—500'	no ore	Pioche Shale	1114'	Combined Metals bed. Most favorable for ore.
			Prospect Mountain Quartzite	±1700'	some ore	Prospect Mountain Quartzite	±1500'	Black ledge well mineralized.

The foregoing comparative table shows that sedimentary horizons favorable for ore deposition should be found throughout the section at Tybo.

The veins at Tybo are located, for the most part, along major fault zones that have had several thousand feet of vertical movement. These faults bound fault-blocks containing formations of varying ages and have been mapped both by Hershey and Ferguson.

The most productive vein has been the 2G, or Tybo vein. Ferguson describes the 2G fault as follows:

> "The fault is certainly traceable for 8,000 feet, from the Uncle Sam fault eastward to the Swarbrick prospects on the east side of the ridge overlooking Hot Creek Valley. It carries the ore bodies of the Tybo mine and has been developed underground in that mine for a horizontal distance of about 2,400 feet and a depth of nearly 900 feet below the collar of the 2 G shaft. The average strike is about N. 68° W. and the dip is 70°—80° N. On the south the Pogonip limestone, with relatively gentle dips, forms the footwall for the entire distance. The northern or hanging wall consists of Cambrian strata. The limestone of the Hales formation forms the hanging wall at the eastern and western ends, with the lower formations, the Tybo and Swarbrick, in the middle part. Below the 300-foot level in the Tybo mine the overturned dips north of the fault cause the Hales limestone to be the hanging-wall rock of the mine workings, although shale of the underlying Tybo formation forms the hanging wall at the surface.
>
> "Porphyry is present in places along the fault plane itself, and cross cuts in the Tybo mine show that dikes also occupy parallel fissures close to the main fault. The largest mass is near the intersection of the two branches that diverge eastward.
>
> "At the western end there are two distinct branches with Pogonip limestone between them. These branches apparently unite on the surface near the 2 G shaft and are about 200 feet apart close to the Uncle Sam fault. What are apparently the same faults have also been developed on the 300-foot level of the mine. But the intersection, which pitches to the west, is presumably above the point where the 710-foot level intersects the Uncle Sam fault. Another branch from the 2 G fault diverges in the opposite direction from a point about 2,000 feet east of the intersection of the 2 G and Uncle Sam faults and where it crosses the ridge is about 1,000 feet from the 2 G fault."

Since Ferguson's last visit to the Tybo mine in 1930, and its subsequent shutdown in 1937, the Hales shaft was deepened from 900 to 1546 feet. From Hershey's descriptions, in his geological reports, it appears that the foot and hanging wall formations, of the 2 G fault, continued to be of Hales limestone on the hanging wall and Pogonip limestone on the foot wall, to the bottom of the shaft.

The 2 G vein is cut off on the west by the U.S. or Uncle Sam fault. This is a through-going north south-trending fault with a steep easterly dip. The displacement has probably been 2000 feet or more. There is scattered mineralization along the U.S. fault. No major ore bodies have been developed on the U.S. fault. The best mineralization along the fault is reported to be in the area where the Bunker Hill vein branches from the U.S. fault.

The Bunker Hill vein is on the west, or footwall, of the U.S. fault about 1200 feet northwest of the point where the U.S. fault cuts off the 2 G vein. Ferguson describes the Bunker Hill fault, where exposed on the surface near the Bunker Hill shaft, as a northwesterly striking normal fault diverging from the U.S. fault with an offset of no more than 300 feet.

On the 560' level of the Tybo mine, a drift follows the U.S. fault out beneath the Bunker Hill workings. From Hershey's descriptions, it appears that the mineralization and ore showings encountered, on the 560' level below the Bunker Hill mine, were along structures in the U.S. fault zone. It is possible that the Bunker Hill fault has not been found on the 560' level.

The workings on the Dimick and Gilmore faults are 800 to 1200 feet S.S.W. to S.W. or S20° to 50° W. of the point of eastern termination of the 2 G fault by the U.S. fault. The Dimick and Gilmore faults are also cut off on the east by the U.S. fault. Ferguson believes they may represent the offset portion of the two branches of the 2 G fault zone that he describes as having developed on the 2 G fault, just before its intersection by the U.S. fault. He says regarding the supposed offset of these faults by the U.S. Fault:

> "The Dimick and Gilmore faults are regarded by the writer as the continuation of the two western branches of the 2 G fault displaced by the Uncle Sam fault. Their intersections with the Uncle Sam fault are south of those of the two western branches of the 2 G fault with the Uncle Sam fault, and they are much farther apart than the two branches of the 2 G fault. This would be the expected situation of two faults with northerly converging dips displaced approximately vertically by a fault nearly at right angles to their strikes."

The Air Shaft fault zone is W. S. W. or S. 60° to 70° W. of the eastern termination of the 2 G vein by the U. S. fault. The Air Shaft fault zone, as the Bunker Hill fault, does not appear to have a very large displacement. It may well represent a late movement along the 2 G fault that cut through the offsetting U. S. fault. From Hershey's descriptions, it appears that the 300' and 710' levels follow this fault zone through the U. S. fault.

All of the faults, and some of the surrounding formations, have been intruded by porphyry dikes. Ferguson classifies these as quartz latite porphyry dikes.

The mineralization is definitely related to, and most usually found in, the porphyry dikes where they have been fractured and highly altered. Mineralization is also found along the fault zones where the sediments are also fractured and altered.

The primary ore minerals are argentiferous galena, sphalerite, and pyrite, with minor amounts of phyrrotite and arsenopyrite. The U. S. Bureau of Mines I.C. 4430, March, 1931, gives the silver content of the sulfide ore minerals as follows:

	Ounces Ag per ton
Galena	110.0 to 130.0
Sphalerite (upper levels)	12.0 to 20.0
Sphalerite (lower levels)	7.0 to 10.0
Pyrite (upper levels)	8.0 to 11.00
Pyrite (lower levels)	3.0 to 6.0

The ores above the 400' level were predominantly oxide and mixed oxide sulfides. Probably most of the oxide ores have been mined; however, some lower grade oxides may be left and would be economically mineable at the present price of silver. Since the future of the mine will depend upon the availability of primary sulfide ores, no further consideration will be given, in this report, to the problems of the remaining oxide ores.

Above the 710' level three ore zones or shoots have been developed and mined along the 2 G vein in the Tybo mine. These are the east ore zone, the central ore zone, and the west ore zone.

The east ore zone, which is east of the Hales shaft, has been mined to the 1310' level; and, according to Mr. Jutila, formerly the mine foreman:

> "The east ore body on the 1310' level on the sill is approximately 25 feet wide and 200 feet long. The ore assayed 10 oz. Ag, 6½% lead and 5% zinc."

On the 300' level to the east of the East ore body, the Hall Brothers, of Ely, reportedly opened up, but did not mine, 100 feet of sulfide ore averaging to the ton: 8 to 10% Pb, 16 to 20 oz. silver, and 0.10 oz. gold.

The central ore zone extends to the east of the Hales shaft approximately 1100 feet, to a point several hundred feet west of the 2 G shaft. Mr. Jutila says of this zone:

> "Below the 710 on the Orr, Barnett Stope, Hooper Stope and the McCormac Stope sills, 450 feet ore out of 1100 feet of vein. The ore was not cut on the 860 level."

Hershey's comments regarding the mineralization below the central ore zone in that part of the 860' level where Mr. Jutila says no ore was cut are as follows:

> "From the Carson crosscut the 860 level has been driven westward along the vein to the Orr fault and has yielded, I think, five or six carloads of ore. Some of the ground is bad and expensive to handle."

In the ground on the 860' level between the Central ore shoot and the west ore body, which was mined to the 1010' level, Hershey indicates that there may be areas that could be stoped. In fact, a vertical projection of the Tybo mine shows that stopes were opened up on the 710' level above the area in question Hershey says regarding this area:

> "The Carson drift on the 860 level had reached the Orr fault. Subsequently the vein was picked up by a crosscut to the left and a short drift driven upon it, whereupon the ground became heavy and caved. A new drift was then driven in the porphyry of the hanging wall, and after 120 feet the vein was again crosscut and found good ore. That leaves an unexplored section of 100 feet which may be ore. The drift has further been driven along the vein for about 190 feet. Much of this is stopable ore but it is narrower and more bunchy than on higher levels. The vein is thrown back and forth by small faults."

If the mine superintendent followed Mr. Hershey's suggestion, "That when he opens up a new level he drives on straight courses from convenient points near the shaft to the Virginia and Crosby shoots", this may be the reason that Mr. Jutila's only mention of ore to the west of the Hales shaft on the 1010 level is of the West ore body. A straight course from the shaft to the West ore body would have been off the vein and would not have explored the vein below the central ore shoot. Mr. Jutila's comments regarding the West ore body are as follows:

"The West ore body was not mined below the 1010 level and was approximately 200 feet long and up to a width of ten feet. The average width was ten feet. 10 - 11 oz. silver, 7% lead and 5½% zinc was the average of the ore on the 1010 sill."

To the immediate west of the U. S. fault, ore is reported to have been opened up shortly before the shut down in 1937. I would judge that this ore was found along the Air Shaft vein in much the same position that the Air Shaft vein mineralization was encountered on the 300' and 710' levels.

The Air Shaft and other small veins along Air Shaft ridge have not been large producers. They could offer interesting prospecting possibilities should geological studies indicate that more favorable horizons would be encountered at reasonable depths.

The Dimick and Gilmore faults should also be areas to prospect, if it can be determined that they will intersect favorable sedimentary horizons. The Gilmore fault vein appears to be the most promising, as it had fair mineralization where encountered by the south crosscut from the Dimick workings. Mr. Hershey describes the fault zone and ore shoot as follows:

"Then it (south crosscut) cut the G.F vein (Gilmore Fault). This is a zone of crushed rock between two fault gouges that dip northward 45° to 55°. ..... In the ore shoot which is probably 40 feet long, the rock between the gouges has been largely replaced by finely crystalized quartz, rich in pyrite, probably a little galena, some silver bearing mineral and a dark gray sooty mineral that may be secondary. The crosscut cut the best part of the shoot and the samples have assayed $5.00 to $8.00 in gold and 20 to 60 ozs. silver per ton. One sample assayed 3% lead but the lead content is relatively low. ...The ore shoot is pinched out westward by the two gouges coming together."

The Bunker Hill vein was mined, by several small stopes, in the oxide zone near the surface. On the 560' level, mineralization was encountered down dip from the surface showings. One small stope was started but apparently soon pinched out. There were other mineralized showings encountered. The Bunker Hill could well be another worthwhile prospect. Hershey describes the better ore showings:

"On the hanging wall side there is a very thin-bedded light gray limestone that dips northward 45°. In it there is a bunch of fair grade ore up to several feet thick. Besides the usual coarse-grained sphalerite, galena and pyrite or phyrrotite, there is stibnite and a white mineral that may bear bismuth. The ore pinches rapidly westward.... ."

No ore reserve figures can be given at this time since there is no data available from which to calculate them. The only assay data made available to me, from the primary ore zone, is an assay map of the 710' level of the Tybo mine. The widths and assays of these samples have been averaged and listed in a table showing a direct comparison between cut samples and the car samples for equivalent intervals.

The samples are listed from the west end of the mine to the east; and sample locations are measured, at intervals, east or west of the Hales shaft. Dollar values are given for the true width of the cut samples and have also been calculated for 4 and 5-foot mining widths.

These assays, from the 710' level, give a general idea of the grades and widths that might be expected in the Tybo mine.

The Hales shaft is reported as bottomed at 1546 feet or 236 feet below the 1310' level. The fact that the shaft was sunk to this depth, below the lowest level of mining, indicates that the management, up to the time of closing the mine in 1937, expected to open up at least one more working level.

CONCLUSIONS:

The following conclusions are of necessity based on the data from which this report is compiled. This data cannot be verified at this time, as the mines are flooded and inaccessible.

A. The best chances of developing ore are to be found in the Tybo mine, in the following places.

First: On the East ore shoot below the 1310' level and on the West ore shoot below the 1010' level.

Second: Ore should be available on the 300' level, at the extreme eastern end, where the Hall Brothers report 150 feet of developed ore.

Third: The present rise in the price of silver may sufficiently increase the value of lower grade mineralization, especially in the central ore shoot area, so that some of this formerly low-grade material will now be of ore grade.

Fourth: On the 560' level, to the west of the U.S. fault, the 50 feet of ore reported by Mr. Jutila could develop into an ore body.

B. Due to the increase in the price of silver, the other prospects — the Gilmore and Dimick veins, the Air Shaft veins, and the Bunker Hill vein — should be re-evaluated.

C. Deep drilling might develop bedded ores in favorable sedimentary horizons not exposed in the mine workings.

J McLaren Forbes

710 LEVEL SAMPLES

DIRECT COMPARISON BETWEEN CUT SAMPLES AND CAR SAMPLES

DOLLAR VALUES - CALCULATED FOR $35.00 GOLD, $2.00 SILVER, $0.13 LEAD AND $0.13 ZINC

		CUT SAMPLES									CAR SAMPLES					
	Sampled Length as Measured on		Oz. Per Ton				Dollars Per Ton Calculated				Oz. Per Ton					Dollars Per
Location	Section	Sample Width	Au	Ag	% Pb	% Zn	True Width	4' Width	5' Width	Length	Au	Ag	% Pb	% Zn		Ton
12.50 W-10.60 W	145	2.4	0.04	21.04	13.16	9.77	* 103.10	62.10	44.50	-	0.03	12.5	7.00	6.35		* 60.76
10.60 W-10.20 W	40	2.6	0.02	23.6	14.3	7.5	* 104.58	68.10	54.50	-	0.02	10.75	6.48	4.16		* 49.86
10.20 W- 9.95 W	25															
9.95 W- 8.12 W	183	2.6	0.01	10.57	6.86	5.43	* 53.44	34.64	27.70	-	0.01	5.64	4.0	4.0		* 32.43
8.12 W- 7.75 W	37															
7.75 W- 7.22 W	53	3.6	0.04	13.61	11.07	8.88	* 80.49	75.40	61.00		0.03	10.2	8.1	5.8		* 57.00
7.22 W- 6.60 W	62															
6.60 W- 5.53 W	107	3.0	0.03	16.6	12.5	8.9	* 89.89	67.50	54.00		0.02	8.83	6.0	4.8		* 46.44
5.53 W- 4.82 W	71	3.0	0.001	2.19	1.55	1.94	* 13.48	10.12	8.90	71	0.016	3.03	2.30	1.95		* 17.67
4.82 W- 3.77 W	105															
3.77W - 3.55 W	22										0.04	6.55	5.05	4.4		39.07
3.55W - 2.92 W	57															
2.92 W- 2.35 W	57	3.0	.015	5.69	4.36	5.21	36.82	27.59	22.30			9				
2.55 W- 1.20 W										135	0.015	6.80	5.8	4.0		39.61
2.35 W- 2.03 W	32															
1.90 W- 2.03 W	13	2.7	0.015	6.74	9.35	6.12	* 54.23	36.41	29.21	13	0.01	8.29	6.94	3.97		* 45.32
1.90 W- 1.20 W										-------See	255 W-120 W------					
1.20 W- 1.02 W	18															
1.02W - 1.55 E	10 scattered assays over 257'	3.0'	0.01	2.08	1.99	1.73	* 14.18	10.06	8.49	257'	0.01	1.73	1.68	1.23		* 11.38
1.55 E - 2.88 E	133									133	.01	5.54	4.9	3.0		* 31.97
1.55 E - 3.36 E	181	2.1	0.03	8.5	7.6	5.1	* 51.07	26.89	21.41							
2.88 E - 3.36 E																
3.36 E - 3.56 E	20	1.0	0.02	6.02	4.91	3.79	35.36	8.84	7.07	50						
3.36 E - 3.56 E	20															
	XCT	2.6	0.01	10.14	6.39	2.04	44.63	29.00	23.18							
3.56 E - 3.70 E	14															
3.70 E - 4.17 E	47	2.0	0.01	2.84	2.94	3.30	22.25	11.25	9.00							
4.27 E - 4.80 E																
4.80 E - 5.22 E	42	2.1	Tr	2.92	2.51	3.08	20.37	11.23	9.00							
5.22 E - 6.43 E	121															
6.43 E - 6.66 E	23	3.0	Tr	5.51	4.30	3.50	31.30	23.41	18.79							
6.66 E - 7.20 E	54	4.7	0.02	12.43	7.5	5.9	* 60.40	75.00	60.00	54		10.9	6.6	5.2		* 52.48
7.20 E - 8.30 E	110	4.7	0.01	12.96	8.86	6.4	* 65.95	77.40	61.80		0.01	11.75	4.5	6.1		* 51.41

* = Sampled over equivalent sample intervals.

Comparison of the eleven groups of cut and car samples that represent nearly equivalent sample intervals. The averages are weighted by the sample lengths.

Total length sampled 1214'.

		Dollars Per Ton
Average width of cut samples	3.0'	55.75
Using a calculated width of	4.0'	40.17
Using a calculated width of	5.0'	33.32
Car samples, over drift width		36.23

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