GEOLOGY OF THE BIG MIKE PROPERTY
PERSHING COUNTY, NEVADA

Ward Carithers
J. McLaren Forbes

February 21, 1969

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SUMMARY

The Big Mike ore deposit consists of a pod of massive and disseminated copper-iron sulfides which is partly leached and enriched by secondary copper minerals. The deposit is situated in a northwest-southeast shear zone at a juncture with east-west fracturing. The shear has a strike length of at least 3,000 feet, but down dip it appears to be cut off or stopped by a structural change at 300 to 350 feet. This change might be part of a regional thrust fault or it might be a formational change.

The ore deposit is enclosed by greenstone flows and pyroclastics together with intercalated chert and shale beds of the Carboniferous Pumpernickel formation. The rocks below the postulated thrust are mostly limey tuffs, limey shales and chert of either the Pumpernickel or the Permian Havallah formation. Geologic mapping indicates that the fabric of the surface rocks strikes generally east or southeast and dips 45 - 55^{o} north; this might be a shear structure superimposed on unrecognized bedding.

Soil and drill-hole geochemical sampling with analyses for copper and mercury vapor has been completed over most of the property, and this work is continuing. Four anomalous areas have been indicated for evaluation by shallow drilling. Analyses of copper in soil appears satisfactory for reconnaissance, but bedrock sample analyses, especially from shallow drill holes, give the best reflection of the Big Mike deposit.

Mercury vapor results quite faithfully reflect the structure of the sampled area, particularly the Big Mike shear zone and also a range-front fault west of the mine area. A source of mercury is suggested to be associated with the range-front fault.

A geophysical survey made in late 1968 found several EM and two IP anomalies. A few of these have been drilled without favorable results. Others will be evaluated by geochemical prospecting methods before drilling is considered.

CONCLUSIONS AND RECOMMENDATIONS

1. A potential for additional ore exists in the Big Mike shear zone, both northwest and southeast of the present Big Mike oreshoot; the places are designated as "Areas of Interest" 2, 3 and 4. Further evaluation of each of these is recommended by drilling shallow Airtrac holes for bedrock geochemical samples. Lines for these holes are laid out on the geochemical prospecting maps. If suitable targets can be thus developed, they can then be tested by either diamond or rotary drilling.

2. Area of Interest 1 is obscured by alluvium too deep to test by Airtrac drilling. However, an EM anomaly beneath the area, anomalous geochemical copper-mercury values around the fringes, and copper float in the alluvium all strongly suggest that mineralization underlies the area. Three holes designated PDH A, B and C are shown on the geochemical maps for possible testing by diamond drilling. However, the positioning of these holes is simply by guess. A considerably better job could probably be done by rotary drilling with mud down through the alluvium and taking geochemical rock samples of the top 10 to 20 feet of bedrock. If this were done on, say, 200-foot centers and a target like that over the Big Mike oreshoot could be developed, the spotting of deeper holes would be much simplified and more reliable. This course of action therefore is recommended, and two fences of holes 400 feet apart are laid out on the geochemical maps from north to south across Area of Interest No.1. If the holes are 200 feet apart on each line, this preliminary drilling will total about 1600 feet for 25 holes.

3. Several small geochemical anomalies of unknown potential exist here and there in the Big Mike area. Additional soil sampling is laid out on lines shown on the geochemical maps to check these anomalies, and also to help evaluate two moderate IP anomalies in the south and southeast part of the prospect area.

4. A magnetometer survey would help in resolving some of the geologic problems at Big Mike, as well as evaluating EM anomalies. Therefore, a small instrument, such as the Jaylander, should be rented (or borrowed from Cerro if one is available) and a survey run using claim corners for control. This could be done easily by a man already on the Big Mike job.

5. Geologic mapping is incomplete in the south and southeast

parts of the prospect area. This work should be completed as part of the anomaly evaluation.

6. As some of the mercury vapor geochemical results are high enough (12,000 ppb) to be reflecting mercury ore, consideration should be given to prospecting for a mercury deposit. The most likely place is along the range front, just west of the mine and mill area where the geochemical results suggest a mercury source. This possibility can be evaluated better after completing the work proposed for Areas of Interest 1 and 2.

7. The primary ore of the Big Mike deposit, as so far known, consists of a rather small oreshoot of massive and disseminated chalcopyrite and pyrite which might be cut off at its bottom by a thrust fault. If this is a fact, and a downward extension of this oreshoot exists somewhere in the area, it will likely be a small target and certainly difficult to find. Consequently, the possibility of trying to find this theoretically faulted segment is not a particularly attractive exploration bet. However, some diagnostic information might yet come from the additional drilling and other work proposed above, in which case the prospects for finding a faulted orebody can be reappraised.

INTRODUCTION

The Big Mike mine, Pershing County, Nevada, is on the eastern edge of a broad basin called Grass Valley, about 35 miles by road south of the town of Winnemucca (see Figure 1). The original prospect has been long known as a small showing containing a little gold, silver and copper in a gossan zone, and it has had a variety of ownerships. In 1966 the property was acquired by C. C. Chamberlain who then formed the Big Mike Corporation. Drilling by this firm and also by a previous optionee, Goldfield Corporation, delineated a few thousand tons of oxide copper ore; part of this was shipped direct to a smelter in 1967 and part was put through a small mill and leaching plant in 1968.

Early in 1968 exploration of the property was taken over by Cerro Corporation who then began a deep drilling program, and in May of that year hole No.7 found heavy sulfide mineralization on a downward projection of the gossan and oxide zone. Subsequent drilling has delineated an oreshoot of approximately 500,000 tons with a tenor of about $4\frac{1}{2}$ percent copper.

At the time the general geology of the Big Mike area was last described in a brief progress report, dated April 28, 1968, only four diamond drill holes had been put down. Since then, mostly in conjunction with the delineation of the Big Mike oreshoot, an additional 55 diamond drill and rotary holes have been drilled, adding considerably to the sub-surface data. Also, several thousand feet of bulldozer cuts have been dug and geochemically sampled, and IP and EM geophysical surveys have been run in an effort to find clues for additional ore. This report is to consolidate these data, present our interpretations and speculations as to the geologic setting of the Big Mike oreshoot, and to make recommendations for additional work.

MAPS

Forty-one plans and sections accompany this report, and as folding and including them herewith is not practical, they are presented separately in an atlas. The base maps for the 50- and 200-scale plans were prepared from aerial photographs with ground control and supervision by the firm of Barton, Stoddard, Millhollin & Higgins of Boise, Idaho. Datum is mean sea level, having been carried to the mine area from a USGS bench mark 2 miles west. North was taken from the direction between the

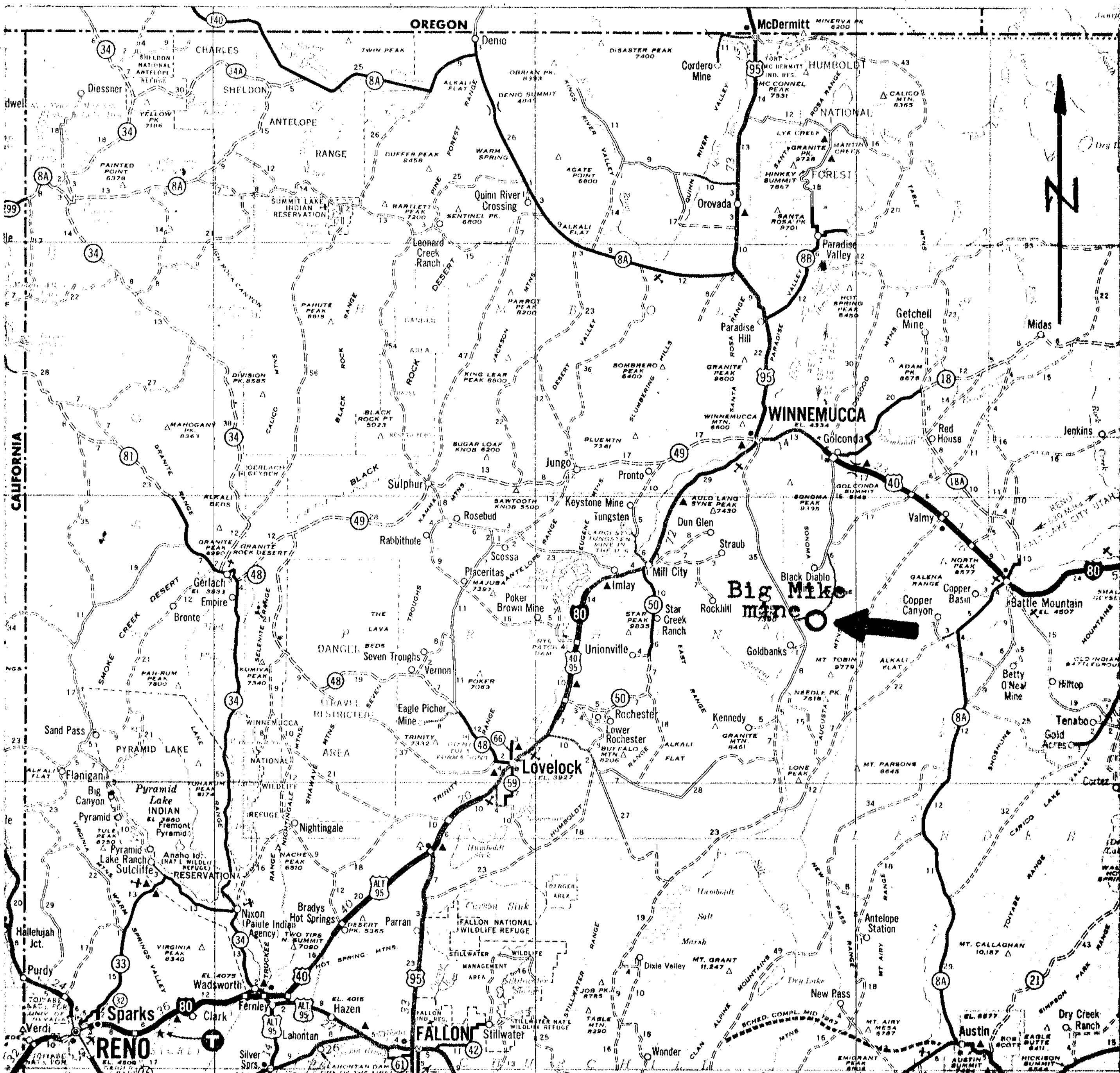


Figure 1. Map of northwest Nevada showing location of Big Mike mine.

northwest corner of Section 21 and the southwest corner of Section 18, Township 31 North, Range 39 East; this is true north, according to U.S. Bureau of Land Management records. Station "A" near the Big Mike mine was arbitrarily designated 15,000 N., and 25,000 E., to establish the coordinate system.

The 1000-scale maps are photographic enlargements of a part of the USGS Leach Hot Springs quadrangle and, hence, they are not exact. The claim data was superimposed on these maps by using the Barton-Stoddard stations "Y" and "W" which coincide with prominent points on the quadrangle.

Most of the 50-scale cross sections are from sepias prepared in the New York office, then revised at Winnemucca. The 200-scale sections were prepared by the writers.

The Big Mike diamond drill holes, which provide the basic information for the sub-surface geology, were logged by W. Carithers, H. W. Schreiber, H. R. Craig and J. W. Santos. Each of these persons logged somewhat differently and also each had slightly different interpretations of some features such as alteration, shearing and bedding. This resulted in a hodgepodge of data which is now being reorganized. A few thin sections were studied by petrologist P. T. Moyer, Jr. of Golden, Colorado, to help resolve some questions, and certain sections of the drill core were revised or relogged by the writers.

PROPERTY

The Big Mike Lode claims were surveyed in August, 1969, by Barton, Stoddard, Milhollin and Higgins, using aerial photography and triangulated ground control. Preliminary to the flying, all corners were flagged with white crosses. These show up readily on the photos and were then plotted by photogrametry. The claim corners appear on all of the 200-scale claim maps which, we are advised, are correct within a plotting error of about 2 feet.

The accompanying 1,000-scale topographic map shows the Big Mike lode claims and also nine 160-acre placer claims covering the valley floor for two miles west of the mine. These are called the Big Pat 1 through

9 and are Association Placer claims which were located by various stockholders of the Big Mike Corporation, then assigned over to the corporation. Corners were placed by a transit-stadia survey starting at the southwest corner of Section 28, Township 31 North, Range 39 East.

Three 40-acre parcels of privately owned land lie just west and southwest of the Big Mike property and are also identified on the 1,000-scale map. One of the parcels, the Northeast quarter Southwest quarter Section 22, Township 31 North, Range 39 East, is within the Big Pat placer claim group. This and the other two parcels (the Northeast quarter Southwest quarter Section 27 and the Northwest quarter Northwest quarter Section 21, Township 31 North, Range 39 East) are owned by Rene Amat of Winnemucca.

As indicated on the 1,000-scale map, a number of foreign claims have been "staked" around the Big Mike. The claims just south are known as the PC 1 through 14, and those just north and northeast are the PC 30 through 72. These are claimed by Scott Huntsman, J. W. and G. L. Deans, H. M. Olsen and W. R. Bunker of Salt Lake City. As mentioned in previous memoranda, there is some question as to the validity of these properties; proper Certificates of Location were not recorded, in accordance with state law, and also some of the claims are not properly cornered — for example, PC 72 is more than 2,500 feet long, and PC 30 has no corners (nor a location notice for that matter). No mineral showings are known on the PC claims. They were obviously staked to box in the Big Mike.

The Smuggler and Fanola claims two miles north of the Big Mike were staked in late 1968 by Robert Breckenridge for Centennial Development Company, Eureka, Utah. The mineralization consists of a few narrow copper-barite veins in rhyolite, and the prospects do not appear to have economic importance. The property was reportedly taken over in early January, 1969, by Utica Mines, Ltd. of Vancouver, British Columbia, but, as of February 1, a drilling job was being carried on by Centennial.

The Chorizo is a prospect a mile east of the Big Mike and was staked in early 1968 by Lawrence F. Moiola of Elko, Nevada. Mineralization occurs locally as thin copper-oxide-filled fractures along a short zone of fracturing in quartzite. Bulldozing in late August found that the showing has no persistence and that it holds no promise.

DRILLING

The drilling by Cerro on the Big Mike property was begun in February, 1968, and was continued without serious interruption until December 31, 1968. Three contractors were employed: Sprague & Henwood, Inc., with two Sprague 142 diamond drills, one of which was a skid rig and the other truck-mounted; E. J. Longyear Company with two Longyear 38 diamond drills, also one skid and one truck-mounted; and Centennial Development Company with a truck-mounted Mayhew 1500 air-rotary rig. Most of the air drilling was with rotary bits, but a down-the-hole Mission hammer was employed in some sections of hard rock.

A total of 59 holes was put down, amounting to 23,088 feet; all are shown on the 200-scale maps in the Big Mike map atlas, and they are summarized herein in Table 1.

Besides the Cerro holes, which are identified on the plans and sections simply by numbers, several dozen Airtrac and rotary holes were drilled by Goldfield Corporation and by Big Mike Corporation before Cerro took over the exploration. Many of these holes are plotted on the 50-scale plans and sections and are identified by the prefix "Z" (i.e. Z-32).

Since late in 1968, a number of Airtrac holes have been put down to shallow depths for geochemical prospecting, and this work is continuing. These are plotted to February 1, 1969, on the 200-scale and 50-scale plans and are numbered consecutively starting with 1001.

A water well was completed and cased to 284 feet in January, 1969, by Dave McNinch of Winnemucca using a cable-tool rig. The location, about a mile west of the mine near the southwest corner of Section 22, is shown on the 1,000-scale claim map. As described by C. C. Chamberlain in his memorandum of January 15, 1969, the well was tested with a steady flow of 200 gpm. It might produce more, however, for part of the flow was apparently blocked by mud and sand during the test.

Table 1. Big Mike Drill hole summary

Hole No		Grid		Angle	Bearing	Coordinates			Rotary Drilling			Diamond drilling			Total depth
		NW	NE			North	East	Elev.	From	To	Feet	From	To	Feet	
1		6	-	-90	-	14,409	24,400	5238	0	30	30	30	967	937	967
2		-	-	-90	-	14,669	23,978	5270	0	40	40	40	590	550	590
3		I¼	104½	-90	-	15,577	24,966	5276	0	15	15	15	586	571	586
4		-	-	-90	-	16,632	25,006	5337	0	286	232*	286	711	479*	711
5		-	-	-45	S6½W	15,466	24,885	5263	0	42	39*	42	545	506	545
6		-	-	-90	-	15,645	23,411	5211	0	85	64*	85	501	437	501
7		M	102	-60	S33W	15,236	25,190	5293	0	30	30	30	475	445	475
8		M	103	-90	-	15,238	25,192	5293	0	50	50	50	343	293	343
9		N½	102	-90	-	15,076	25,270	5317	0	81	81	81	291	210	291
10		M½	104	-90	-	15,285	25,281	5304	0	334	334	334	469	135	469
11		L	104	-90	-	15,379	25,167	5285	0	300	300	300	462	162	462
12		O	103	-90	-	15,127	25,360	5320	0	221	221	221	406	185	406
13		O	104	-90	-	15,212	25,412	5319	0	348	348	348	455	107	455
14		I	102	-90	-	15,376	24,795	5256	0	210	210	-	-	-	210
15		I	103	-90	-	15,459	24,854	5261	0	235	235	-	-	-	235
16		I	101	-90	-	15,297	24,746	5250	0	230	230	-	-	-	230
17		K	102	-90	-	15,258	24,965	5275	0	205	205	-	-	-	205
18		M	102	-90	-	15,149	25,136	5306	0	186	186	-	-	-	186
19		L	103	-90	-	15,293	25,108	5284	0	200	200	200	416	216	416
20		K	103	-90	-	15,346	25,021	5270	0	10	10	10	336	326	336
21		N	103	-90	-	15,185	25,278	5305	0	304	304	304	371	67	371
22		N	102	-90	-	15,097	25,219	5310	0	185	185	185	250	65	250
23		L	102	-90	-	15,207	25,051	5291	0	64	64	64	147	83	147
24		J	101	-90	-	15,255	24,835	5268	0	250	250	-	-	-	250
25		J	102	-90	-	15,321	24,881	5266	0	114	114	114	345	231	345
26		J	103	-90	-	15,403	24,940	5267	0	147	147	147	382	235	382
27		L½	103½	-90	-	15,307	25,179	5291	0	147	147	147	380	233	380
28		K½	103½	-90	-	15,361	25,098	5280	0	150	150	150	427	277	427
29		I	100	-90	-	15,212	24,685	5237	0	210	210	-	-	-	210
30		H	100	-90	-	15,264	24,599	5239	0	243	243	-	-	-	243
31		M	103½	-65	S36W	15,401	25,305	5307	0	30	30	30	708	678	708
32		H	101	-90	-	15,347	24,655	5243	0	218	218	-	-	-	218
33		N	101	-90	-	15,023	25,162	5321	0	195	195	-	-	-	195
34		R	104	-90	-	15,046	25,659	5381	0	200	200	200	632	432	632
35		J	106	-90	-	15,646	25,109	5302	0	185	185	185	556	371	556
36		M	106	-90	-	15,492	25,356	5314	0	315	315	-	-	-	315
37		P	106	-90	-	15,327	25,611	5363	0	350	350	350	789	439	789
38		P	104	-90	-	15,153	25,491	5339	0	363	363	-	-	-	363

Table 1. Big Mike Drill hole summary--continued

Hole No		Grid NW	Grid NE	Angle	Bearing	Coordinates North	Coordinates East	Coordinates Elev.	Rotary Drilling From	Rotary Drilling To	Rotary Drilling Feet	Diamond drilling From	Diamond drilling To	Diamond drilling Feet	Total depth
39		P	103	-90	-	15,072	25,437	5340	0	245	245	245	397	152	397
40		P	102	-90	-	14,990	25,383	5340	0	180	180	-	-	-	180
41		P	101	-90	-	14,909	25,326	5335	0	224	224	-	-	-	224
42		K	104	-90	-	15,431	25,075	5284	0	196	196	196	350	154	350
43		M	105	-90	-	15,403	25,309	5306	0	200	200	200	534	334	534
44		J	104	-90	-	15,485	24,996	5278	0	203	203	203	378	175	378
45		-	-	-90	-	16,159	24,829	5343	0	283	283	-	-	-	283
46		-	-	-90	-	16,340	24,940	5342	0	30	30	-	-	-	30
47		-	-	-55	S38W	15,888	24,914	5288	0	45	45	45	567	522	567
48		-	-	-55	S11W	19,975	25,120	5322	0	50	50	50	371	321	371
49		O¼	102	-90	-	15,030	25,324	5331	0	60	60	60	257	197	257
50		-	-	-62	S33W	16,346	25,208	5328	0	30	30	30	451	421	451
51		L	102½	-90	-	15,239	25,080	5287	0	31	31	31	288	257	288
52		-	-	-90	-	15,167	24,191	5217	0	160	133*	160	473	340*	473
53		-	-	-60	S33W	16,199	25,706	5370	0	60	60	60	395	335	395
54		-	-	-60	S33W	15,955	24,719	5310	0	10	10	10	548	538	548
55		-	-	-90	-	16,755	28,873	5212	0	20	20	20	489	469	489
56		J½	101½	-90	-	15,258	24,903	5272	0	10	10	10	225	215	225
57		-	-	-90	-	15,302	23,922	5208	0	21	21	21	453	432	453
58		-	-	-90	-	16,921	23,460	5216	0	20	20	20	394	374	394
59		J½	104½	-90	-	15,504	25,079	5291	0	150	150	150	401	251	401
Total											8931			14,157	23,088

*Hole 4: Rotary 0-40, 67-85, 95-185, 209-286.
" 5: Rotary 0-20,23-42.
" 6: Rotary 0-42, 63-85.
Hole 52: Rorary 0-40, 67-160.

REGIONAL GEOLOGY

General Geology

The regional geology of the area around the Big Mike mine is shown and briefly described on the U.S.G.S. "Geologic Map of the Winnemucca Quadrangle, Nevada", by Ferguson, Muller and Roberts (see Figure 2). The geology is complicated by folding and an extensive series of thrust faults which overlap formations of different ages. Recognition of the individual thrust faults is often difficult, especially in localized areas due to a strong resemblance among the several thick sequences of Triassic and Paleozoic sedimentary and volcanic rocks involved in the thrusting. There are also later high angle faults, particularly of the Basin-Range suite, which offset the earlier formed structures.

Stratigraphy

The geologic column, as exposed in the Winnemucca and adjacent quadrangles, includes a thick series of sedimentary and volcanic rocks ranging in age from Cambrian to Quaternary. These rocks are intruded by upper Jurassic (?) granitics and overlain by Tertiary volcanics.

In the southeast corner of the Winnemucca Quadrangle, in which the Big Mike is located, the predominant rocks are the Cambrian Pumpernickel (Cp) formation and the Permian Havallah (Ph) formation. Immediately to the north and northeast, the Permian Koipato (Pk) formation and the Triassic China Mountain (Trcm) formation also outcrop.

These rocks are described by the U.S.G.S. in the Winnemucca geology sheet as follows:

The Pumpernickel formation is Pennsylvanian (?) in age and is made up of "Greenstone, dark chert and dark argillite with interbedded limestone and clastic sediments; proportions variable. Greenstone varies from chloritic schist to recognizable andesitic lavas and breccias. Dark chert may be in part silicified ash or fine grained tuff. Interbedded siliceous slates and phyllite, probably in part tuffaceous. Interbedded sediments in upper part of formation resemble those of the Havallah formation. Thickness may exceed 6,000 feet; base not exposed."

The overlying Permian (?) Havallah formation is "Dominantly intertonguing cherts and quartzites with smaller amounts of limestone and

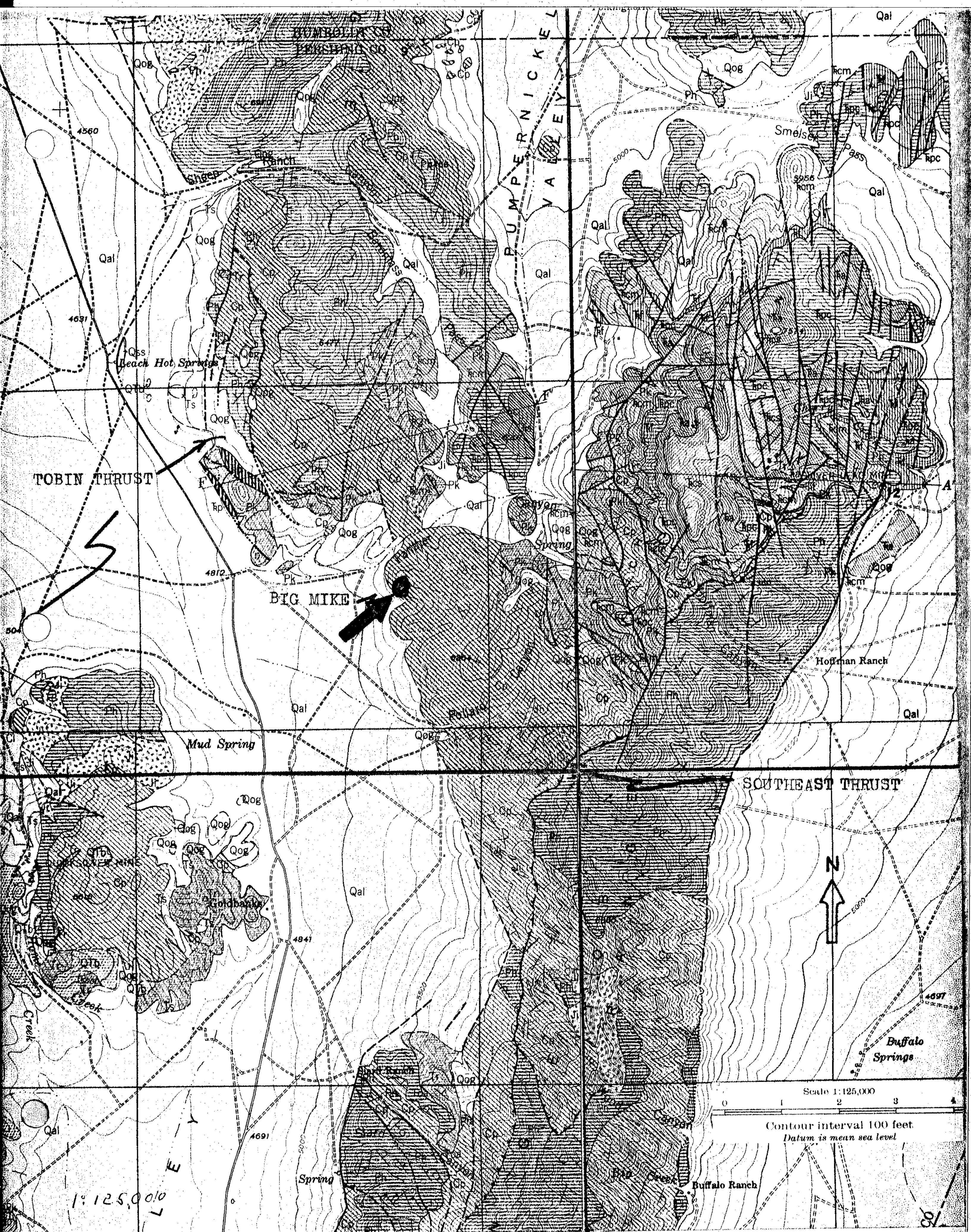


Figure 2. REGIONAL GEOLOGY of THE BIG MIKE AREA. (From U.S.G.S. GQ- 7,11,12 and 15)

slate, minor conglomerate, and quartoze grit. Individual beds are not persistent. Quartzite is light brown, mostly very fine-grained, locally crossbedded, rarely conglomeratic. Limestone in thin beds and lenses grades into calcareous shale, or into quartzite through sandstone with calcareous matrix. Slate and shale, sandy or calcareous with quartzite and limestone, dense and siliceous with chert. Chert, even-bedded, mostly gray to jade-green; rarely white or black. Shaly limestones and calcareous shales carry abundant worm tracks and feathery algae, ----. At least 10,000 feet thick at type locality in Tobin Range ----."

The Koipato formation, upper Permian, consists of "rhyolite and trachyte flows, some breccias and tuffs, andesite, small amounts of conglomerate, sandstone and tuffaceous slate ----; in Sonoma Range, in upper plate, thickness 300 feet or less, in places missing."

The China Mountain formation, Lower Triassic, is made up of "Conglomerate, sandstone, shale, and yellowish impure dolomite. At base fanglomerate and conglomerate up to 100 feet thick, containing chert and quartzite fragments up to 2 feet in diameter. Pebbles of rhyolite from Koipato formation in conglomerate higher in formation. May include at top the thinnest equivalent of Favret formation (Middle Triassic) of adjacent quadrangles. Thickness about 500 feet."

Structure

The region is one of folding and complicated thrust faulting and is briefly described by the U.S.G.S. in the following:

"There were at least two episodes of Paleozoic folding, the first prior to the middle Pennsylvanian and the second within the Permian. Superposed on these older structures is a complex series of thrusts that developed after the close of the Triassic. The largest of these, the Tobin thrust, brings together two sequences of Triassic rocks that were originally deposited a considerable distance apart."

The extensive Tobin thrust fault has been mapped to the north of the Big Mike, in the Sonoma Range. It also outcrops west of the Big Mike across Grass Valley in the East Range. It has not been identified in the north end of the Tobin Range, near the Big Mike property, from Panther Canyon to the southeast corner of the Winnemucca Quadrangle geologic map. However, there is a small segment of a northeast striking, northwest dipping thrust fault plotted at the extreme southeast corner of the map. The same fault has been mapped to the northeast into the Golconda quadrangle and southwest into the Mount Tobin quadrangle. This fault has thrust Pumpernickel formation over the Havallah formation and will be called herein the "Southeast" thrust.

This Southeast thrust might be an unidentified branch of the Tobin thrust or a minor related thrust. Portions of the Tobin thrust are known by various names and other segments of the Tobin thrust have probably not been found.

Only unfaulted Pumpernickel formation is shown on the map between Panther Canyon and the Southeast thrust. The Havallah formation is usually found to the southeast and on the footwall of the Southeast thrust. However, to the south, in the Mount Tobin Quadrangle, portions of the Southeast thrust have Pumpernickel formation on the foot and hangingwall sides of the fault.

The Southeast thrust fault must surely extend to the northwest below the Pumpernickel outcrops and the Big Mike property. At a 7-degree dip, this thrust fault would pass beneath the Big Mike ore zone at about the 5,000-foot elevation in the vicinity of an apparent formational change that is indicated by some of the diamond drill holes, and shown on the sections.

To date sporadic mineralization has been found that could be related to the Tobin and the Southeast thrust faults.

BIG MIKE GEOLOGY

Mapping

Much of the Big Mike area has been mapped on a scale of 1" = 200'. The outcrops are few and far between and most of the surface is covered with soil and alluvium. If several thousand feet of bulldozer roads had not been cut to expose bedrock, only a very few naturally exposed locations would have been available for detailed mapping. As it is, the exposures are indefinite and both structures and rock types are hard to distinguish. Probably not more than one-tenth of the surface in the mine area is mappable, and these places are scattered.

The projections shown on the maps and sections are theoretical and are mostly based on scant and nebulous data. However, an outcrop map with no interpretation is, at best, a vague representation of the geology. Therefore, rock types, contacts, and faults are shown as theoretically projected in the bedrock beneath the soil and alluvium cover.

Rock Types

The Pumpernickel formation has been separated into four groups on the 1" = 50' sections and the 1" = 200' scale plans and sections. These rock types are gradational and difficult to segregate not only in the field but also in drill core.

1. Greenstone of flow origin is usually somewhat granular, igneous in appearance, and dark to olive green in color. The presence of occasional to abundant pillows and pisolites are a diagnostic characteristic. The pillows are two to twelve or more inches in diameter and may be replaced by chert or red jasper. The pisolites are normally one-quarter to one-half inch in diameter, are dense, and of varying shades of light pistachio green in color.

2. Greenstone of pyroclastic origin is a dense tuffaceous rock; very small rock shards can usually be seen megascopically or with a hand lens. The color of this rock is various shades of green that can grade into brown or tan tones. The rock can be either massive thin-bedded, or shaly. Some of it is limey. Chert is sometimes present as narrow beds or lenses, commonly crenulated. The greenstone flows and pyroclastics are difficult to separate and at some locations they may be inter-mixed or gradational.

3. Tuffaceous sediments and related rocks make up the third group. These are usually thin-bedded, buff to tan in color, often slightly limey, and may contain abundant chert as thin and irregular beds. Some of the cherty sections consist of narrow chert beds inter-layered with black carbonaceous shales. They may appear to be predominantly chert when seen at the outcrop.

"Zebra" rock is a term used to describe intimately interbedded chert and shale (often carbonaceous). The chert-shale mixture is crenulated, broken and contorted; certain of these Zebra rock beds may represent zones of flowage or faulting.

4. Tuffaceous sediments that are slightly limey or dolomitic make up the fourth group. These may grade into dolomites or dirty limestones.

The tuffaceous sediments and the greenstone pyroclastics are difficult to separate both in the field and in drill core. The limey phase might be mistaken for portions of the Havallah formation.

Dikes are generally dioritic in composition and range from fine-grained aphanitic rocks (at places porphyritic) to medium-grained phaneritic rocks. The colors range from light greenish-gray through tan to white. There also may be some dense, dark blue-green basic dikes, for irregular outcrops of this rock type have been observed in the area.

Structure

The lineation or fabric in the basement rocks of the area strikes from northeast-southwest to east-west, with the major lineations in the northeast-southwest direction. The dips range from 40 to 60 degrees north to northeast. This lineation is shown by the projected outlines of the greenstone flows, greenstone pyroclastics, and tuffaceous sediments, as well as by the dips and strikes of other fabrics such as bedding, chert lenses, pillow lavas, shears, and faults.

The Big Mike shear zone can be traced and projected, using the plan and sections, for at least 1,500 feet northwest of the Big Mike pit and to the southeast for 2,500 feet or more. This is assuming that there are no major offsets by north to northeast high-angle faults. Such faults do exist, but the amount of movement along any of them is not known.

The Southeast thrust fault can be projected beneath the Big Mike orebody, at about the 5,000-foot elevation. The 1" = 200' and 1" = 50' sections show that there is a definite change in rock type between the 4,500 and 5,000-foot elevations. This change, as recorded in the diamond drill logs, consists of a definite increase in limey sediments below a zone usually logged as sheared and faulted Zebra rock. The limey sediments, although plotted as being of the Pumpernickel formation, could be a portion of the Havallah formation.

Big Mike Ore Deposit

The Big Mike oreshoot consists of a secondarily enriched pod of nearly massive copper and iron sulfides enveloped by altered rock containing zones and disseminations of secondary copper mineralization. As shown on the 1" = 50' and 1" = 200' sections, particularly sections 25,100E and 15,200N, the oreshoot is situated within the Big Mike shear zone at the upper junction of two faulted blocks of greenstone flows. This junction is just above the nearly flat-lying sheared contact between greenstones above and limey tuffs and shale below, which, as mentioned previously, might be a major thrust fault. The Big Mike shear zone could be related to this low angle structure either as a tear fault, slightly offsetting the thrust or as a branch of the thrust itself. In the latter case the Big Mike shear would not project below the low angle thrust.

On the other hand, there is also the possibility that the Big Mike shear zone is a pre-thrust structure, in which case the presently known mineralization could be the upper portion of a mineralized shear which has been dislocated by the thrust. This, of course, leads to speculation as to whether a lower portion could be found, if indeed one exists. However, at present we have no indication of the direction or amount of movement along this low-angle contact zone.

The primary mineralization of the Big Mike oreshoot consists of disseminated and massive pyrite and chalcopyrite with minor amounts of galena and sphalerite, gold and silver. The sulfides were deposited at the juncture of the two fracture zones and at one time probably occupied much of a pipe-like zone of broken and brecciated chert, jasper and greenstone. This zone, as shown on cross sections and horizontal sections, extends from the top of the oreshoot to the surface.

The leaching of this zone by supergene water and the redistribution of copper (and iron) into adjacent rocks has formed an envelope of mixed oxide-sulfide ore. Chalcocite replaces and coats pyrite and chalcopyrite, and it grades from complete replacements to pyrite covered by thin chalcocite skins or with pyrite containing fine disseminations and veinlets of chalcocite. The rocks surrounding the sulfide mass are strongly bleached by acid from the oxidizing pyrite, and they are streaked and soaked by secondary copper oxide minerals such as tenorite (and other black copper oxides), cuprite, native copper, chrysocolla, azurite and malachite. A halo of disseminated pyrite, as well as calcite veining and limey greenstone, contributed to the fixing of the copper in the rocks adjacent to the sulfide. Consequently, the secondary copper has remained in a confined envelope fairly close to its origin.

The water table at the Big Mike is presently about 180 feet below surface. This is approximately the top of the primary sulfide zone, but as the oxide envelope extends deeper — even below the sulfides—the water table might have been considerably lower at one time.

Cross sections I through 0 and the horizontal sections at elevations 5,000, 5,100 and 5,150 feet show the detailed delineations of four classes of mineralization: (1) massive sulfide ore, (2) oxide and mixed ore with more than 1% Cu, (3) oxide mineralization 0.6 to 1.0% Cu, and (4) oxide mineralization 0.2 to 0.6% Cu. In estimating the ore reserve, the area of each class of ore was measured on each cross section, and the volume calculated by applying the measured horizontal influence of each section. Tonnage was computed with a factor of 9 cubic feet per ton for the sulfide ore and 13 cubic feet per ton for all other classes. The following was reported in the Summary Report of January 5, 1969:

Massive sulfide ore	74,000 tons	@	11.78% Cu
Oxide and mixed ore	380,000 tons	@	3.16% Cu
Total	454,000 tons	@	4.56% Cu

In addition, the following occurs with plus 1% Cu ore:

Oxide, 0.6 to 1% Cu	70,000 tons	@	0.76% Cu
Oxide, 0.2 to 0.6% Cu	110,000 tons	@	0.38% Cu
Total, all classes	634,000 tons	@	3.41% Cu

GEOCHEMICAL PROSPECTING

As the Big Mike mine area is well obscured by a mantle of soil, a geochemical prospecting program was initiated to see if any reflection of the mineralization could be detected by analyses for copper, zinc, lead or mercury vapor in the soils. Both the copper and mercury appear valuable as shown by Figure 3, a profile of these metals in the soil over the mine area. A few dozen zinc and lead analyses were also made, but they are not plotted here. The zinc generally follows the copper profile, but with such high background values that there is little contrast. Lead values, on the other hand, are generally low, erratic and non-diagnostic.

In sampling, two layers of soil were found: (1) a lower layer which is generally brown-colored silty clay formed by residual weathering of the underlying rock, and (2) an upper layer of grey silt which is wind-blown and non-residual. Thicknesses of both layers are quite variable, ranging from zero on south- to southwest-facing slopes and wind-swept ridges to 6 or 8 feet each on north and northeast leeward slopes.

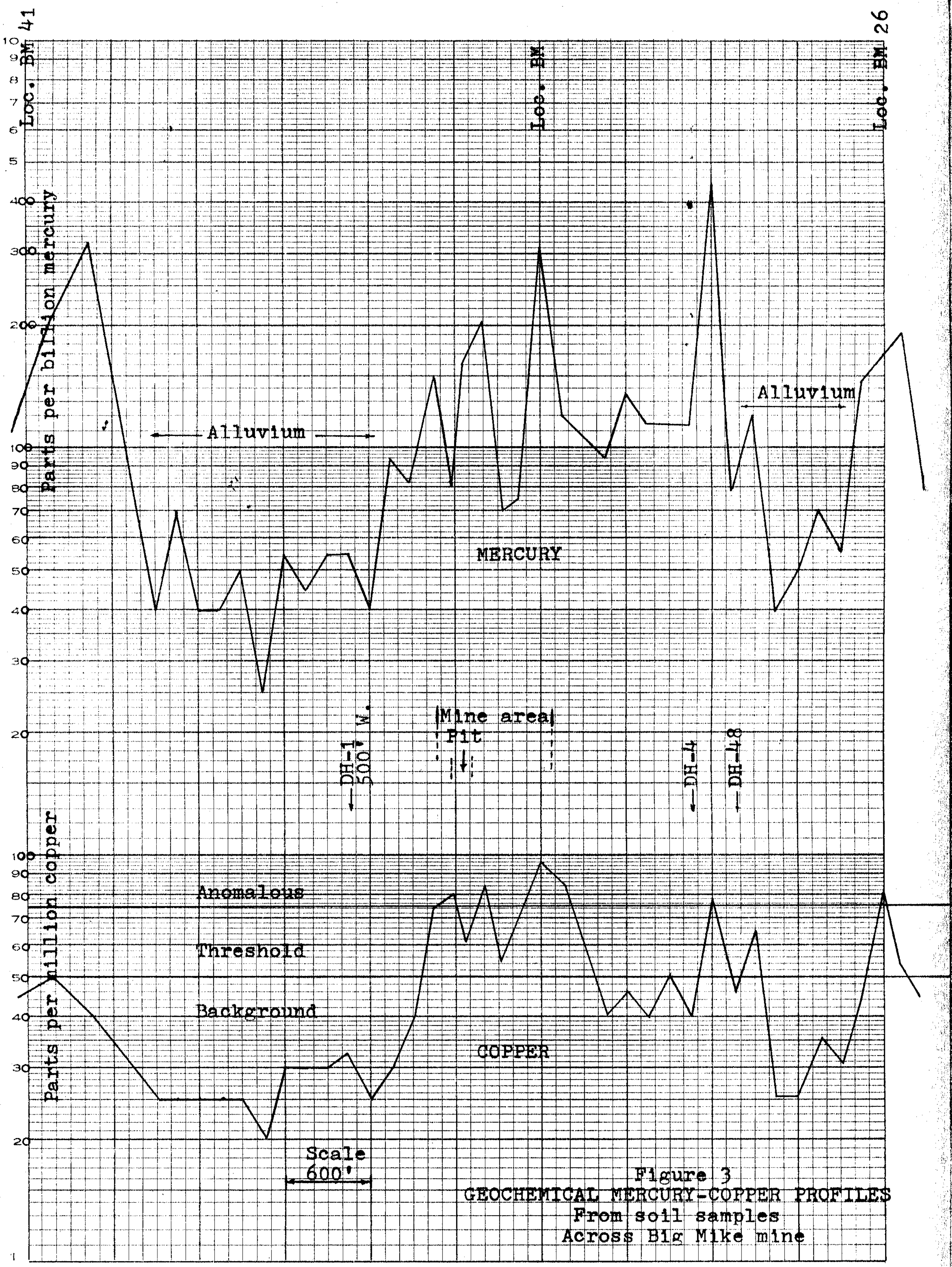


Figure 3
GEOCHEMICAL MERCURY-COPPER PROFILES
From soil samples
Across Big Mike mine

10/8/68

Logically the lower, residual layer is the more desirable for geochemical prospecting. This is also suggested by the results of samples of each soil type and rock taken at two different places over the Big Mike ore deposit:

Sample	Site at Hole 24 Cu, ppm	Site at Hole 24 Hg, ppb	Site at Hole 25 Cu, ppm	Site at Hole 25 Hg, ppb
Windblown silt	65	70	50	45
Residual soil	140	140	150	120
Rock	100		103	

As the residual soil gives the higher values and better resolution, it was sampled wherever possible in the lower part, or "B" zone, just above weathered bedrock. Fortunately, the upper soil also has some reflection, so anomalous values in this layer can be given some consideration. In some areas of deep soil and alluvium, however, Airtrac drilling and sampling is being done to help delineate anomalies, and this work is continuing. These holes are drilled with a percussion drill which blows out the cuttings similar to air rotary. Holes generally range from 25 to 75 feet deep; most are in rock, but some do not reach bedrock, either because of caving ground or because the rock is too deep. In these cases the soil or alluvium is analyzed.

The soil and Airtrac geochemical results for copper in parts per million and for mercury in parts per billion are plotted and contoured on the respective Cu and Hg 200-scale maps. The principal IP anomalies and EM conductive zones, as indicated by the geophysists are also plotted on these maps for convenience. The coincidence of the copper anomaly with the Big Mike oreshoot is obvious. However, the size and resolution of this anomaly is mostly due to the plotting of geochemical analyses of the top 20 to 30 feet of rotary drilling rather than of soil analyses alone. When the soil results only are used, they plot as a rather small anomaly directly over the outcrop. For this reason it is highly desirable to follow up any soil anomalies, even small ones, with bedrock sampling in order to see if a target for deeper drilling can be indicated.

The mercury vapor plotting indicates that practically the entire western edge of the hills in the Big Mike area holds an anomalous amount of mercury. The hillside front probably marks the trend of a major Basin-Range fault which is also indicated by a sharp interface in a resistivity survey at about 14,000 N, 23,750 E. This fault is about where one ought to be on the range front, and it could have been the locus of recent hot spring activity, as well as possible mercury deposition. The travertine vein or dike in the south part of the property and the alteration of rocks in the mill area would be a result of this activity.

Anomalous mercury vapor zones also trend southeastward into the Big Mike mine area and faithfully follow the Big Mike shear zone, as well as a possible parallel zone just north. This strongly suggests that mercury has leaked into shears and fractures of the Big Mike area from a source on the northwest, presumably the zone along the range front. Consequently, the mercury vapor analyses are probably a reflection of structure in which copper mineralization exists — or might exist—rather than of the copper itself. On the other hand the mercury vapor might also be reflecting significant amounts of mercury deposition, and as much as 12,000 ppb Hg was detected in Airtrac samples from fractured jaspery zones near 14,400 N, 23,500 E. This is comparable to quantities found in soil and rocks over some mercury ore deposits, so some follow-up drilling is indicated.

Areas around the Big Mike where geochemical anomalies appear significant enough to warrant additional work are so indicated on the geochemical prospecting maps. Area of Interest No. 1, about 1200 to 1500 feet southwest of the Big Mike oreshoot, is almost entirely covered by alluvium. However, Airtrac samples around the north and east sides are anomalously high in both copper and mercury (up to 3,000 ppm Cu and 12,000 ppb Hg) and a specimen of oxide copper float was found in the gravel pit on the southwest edge of the area. An EM anomaly also extends through the area. The alluvium is too deep for Airtrac drilling — it caves with percussion drilling— so rotary holes using mud will be required to reach bedrock.

In Area of Interest No. 2, a single Airtrac hole shows a slightly anomalous amount of copper approximately on the northwest trend of the Big Mike shear zone. It, and nearby holes also contain anomalous mercury vapor, and the area is underlain by a high order EM anomaly. Additional Airtrac holes are scheduled to see if a target can be better delineated, in which event rotary or diamond drilling may be in order.

Area of Interest 3 is also on a northwest trend of the Big Mike shear zone, but present information is insufficient to determine whether or not any mineralization of importance exists. Two lines of Airtrac holes should resolve this.

Area of Interest 4 covers a possible southeast extension of the Big Mike shear zone between the oreshoot and a geochemical anomaly which is coincident with a strong EM anomaly. It is possible that the EM anomaly is caused by a clay bank or a carboniferous shale zone, but in any event the three lines of Airtrac holes across the trend should help determine if, or where, a diamond drill hole should be put down.

Additional soil sampling is laid out in a few areas where small, low order anomalies have been detected but where the information is not sufficient to propose drilling. The most important of these is at the south edge of the Big Mike property. Soil sampling should be done to learn whether or not the anomaly at 12,100 N, 25,400 E extends southward and also if copper mineralization is associated with the moderate IP anomaly shown. This work should be done as soon as the area is free of snow, for in the event the area is of interest, action should be taken to acquire the ground. It is presently within the controversial PC claims (see Claims and Property section).

Soil sampling lines are also proposed to offset weak anomalies at 17,200 N, 26,500 E; 18,000 N, 25,300 E; and in the vicinity of 12,000 N, 29,000 E. A few additional sample lines will prospect places not previously covered.

GEOPHYSICAL PROSPECTING

A geophysical survey of the Big Mike property was made in October, 1968, by Heinrichs Geoexploration Company of Tucson, Arizona, and a detailed report with supporting maps describing this work are on file in the Winnemucca and New York offices.

Upon beginning this survey, an IP line (line "L") was run directly over the Big Mike ore deposit with 250-foot spacing to see what the response might be. It gave only very weak IP anomalism and practically no self-potential response. On the other hand, an electromagnetic survey utilizing the Turam method, and also a preliminary magnetometer survey gave good responses.

Most of the western two-thirds of the Big Mike claim area was surveyed by the Turam method, and a host of conductive zones were found. The principal ones are plotted on the geochemical prospecting maps of this report. Two IP lines were run in the eastern part of the claim area: one southward through the middle of claims BM 45 through 53, and the other southward through the middle of claims BM 54 through 60. A third IP line was run southward off the property from the southeast corner of the BM 41 claim. Two IP anomalies of "moderate intensity" were found and these also are plotted on the geochemical maps. Plans for evaluating these anomalies by soil sampling were mentioned in the geochemical section.

The Heinrichs report points out three EM anomalies which are recommended for drilling:

1. Line group GG, line 30, zone X is a conductive zone at 17,700 N, 25,200 E. Two Airtrac holes were recently drilled here, but no indication of mineralization was found. A small geochemical copper anomaly just north is to be further checked by soil sampling, and if this is encouraging, additional drilling might be warranted.

2. Line group BB, line 8, zone X is a conductor mentioned in the geochemical section to be in Area of Interest No. 2. Additional Airtrac drilling is scheduled to further evaluate the anomalous area.

3. Line group KK, line 33, zone III is also mentioned in the geochemical prospecting section as Area of Interest 4. Here, again, Airtrac drilling is scheduled.

The Heinrichs report also recommends that another kind of a geophysical survey be made over the Big Mike claim area to "more quantitatively determine the nature of the conductors". As the preliminary magnetic survey gave a good response over the ore body and also as this method is cheap and easy to perform, a survey of this type would be a good idea. It is highly probable that some of the conductive zones, as well as IP responses, are due to carbonaceous strata in the area and this survey, coupled with the geochemical prospecting, ought to complete the evaluations of the anomalies.

Henrichs further proposes that additional EM surveying be done to cover the eastern side of the Big Mike claim area where we now have the two IP lines. The writers, however, urge that consideration of this work be deferred until the areas already covered are checked to see if the Turam has really helped to produce economic results.

Ward Carithers

Ward Carithers

J. McLaren Forbes

J. McLaren Forbes

Big Mike Geology and Geochem
Colors and symbols

Pumpernickel formation

738	Greenstone, flow origin
738½	Greenstone, pyroclastic origin - limey
734½	Shale and argillite
745½	Quartzite, sandstone
737	Chert, jasper
740½	Limestone, dolomite
740½ / 734½	Limey tuff and/or shale
745½	Light colored dike rock
752	Dark colored dike rock
737 / 734½	"Zebra" rock (chert & shale)

Phyllite

Mineralization, plus 1% Cu
" 0.6 to 1% Cu
" 0.2 to 0.6 % Cu

Geochem-copper

	Less than 50 ppm
735½	50-75 ppm
731	75-100 ppm
745	plus 100 ppm

- o Soil sample
- □ Rock sample
- ▽ Stream sed sample

Geochem-mercury vapor

	Less than 75 ppb
740½	75-110 ppb
741	110-200 ppb
743½	plus 200 ppb

Color numbers refer to Eagle Verithin type

Columbia University in the City of New York | *New York, N.Y. 10027*

DEPARTMENT OF GEOLOGY 413 Schermerhorn Hall

March 16, 1970

Mr. J. McLaren Forbes
2275 Mueller Drive
Reno, Nevada 89502

Dear Mr. Forbes:

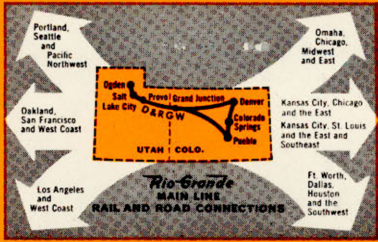
In my study of the Big Mike Prospect I was intrigued by the similarity to another deposit which I studied some time ago in Ecuador--the Macuchi deposit.

Actually there is very little written about the deposit, but you may equate Macuchi with any non-metamorphic massive sulfide deposit. The N. Brunswick ones come very close to it (although slightly metamorphic).

Sincerely,

Peter J.M. Ypma
Associate Professor of
Economic Geology

PJMY:kb



Big Mike - Ranchers Dev.

Dave Hogan Manager

Larry Lahuer (?) asst. Gen.

Gordon Pugh

Ore Control Engineer

visited Big Mike on Feb 25, 1970
with V. Frank Sharp.

Assayer Mr Frasies

DENVER AND RIO GRANDE WESTERN RAILROAD
HOTEL UTAH
SALT LAKE CITY, UTAH 84111
TELEPHONE 322-5741

Forbes Geochemical Samples

F-G-1 — Jasper — predominately
50 reddish — some yellow. — black stain

25 -2 Jasper — red + v. minor yellow black-stain

20 3 Jasper Same

20 4 Chert — red with some yellow
coating on some joints sparse
black stain. Occ ± 1mm white
quartz veinletts

20 5 Jasper — reddish, v.sp. yellow
+ m- black stain, v. Occ. ± 1mm
quartz veinlets

over

F-G - 6 ✓ Jasper - reddish - some yellow
25 as seams - calachie ± 3mm on
one face. sp. pyrite (FeS_2)
specks

7 ✓ Jasper red - to reddish - sp. gray.
20 some black coating v. sp. yellow
one or two ± 5cm 1/4" SiO_2 seams

10 8 ✓ Jasper - red. m-sp. black stain
sp. fine SiO_2 - sp FeS_2

70 9 . Jasper - Tan (yellow-tan) slightly
vuggy . sp black stain

FG

10 ✓ Jasper - reddish-brown to
950 yellowish - black coating
(desert varnish) occ. sp. - 1mm quart seams

900 10+1 ✓ yellowish and sintery

45 11 ✓ Jasper - reddish to yellow
sp. black stain some white SiO_2 ± 5mm
or 1/4 inch.

70 12 ✓ Jasper - reddish r gray to
dark gray some white quartz

20 13 - Jasper - reddish From replaced
pillow

FG

60 14 ✓ Jasper – Red with yellowish tan to light gray-white chert(?) sp black stain

55 15 ✓ Jasper – Dark reddish brown to light tannish gray. – some black stain

50 16 ✓ Jasper – Dark reddish brown with sp light yellow-~~tan~~ black stain v. occ. ± 4mm quartz

15 ✓ 17 (Float) Jasper – Dark brown with white quartz ~ v. sp. + occ. box.

FG

18 20 ✓ Jasper – Darker red with black coating – some yellow-gray (chert)??

~~19 – none~~

35 20 ✓ Jasper – lighter red – some yellowish scattered sp fine FeS2 x/s.

45 21 ✓ Jasper (?) – red + some soft as altered gg. – some yellow

60 22 ✓ White Quartz + brown-yellow altered inclusions

FG

10 23 Jasper – red with some (sp) yellow and v. sp. occ ± 1/4" white quartz.

30 24 ✓ Grayish chert some ?? black box-work

santos

60 25 55-4

May 8, 1970

Mr. J. Frank Sharp
Director, Mine Development Division
Cerro Corp
300 Park Avenue
New York N.Y. 10022

Dear Frank: Big Mike Project.

The Big Mike property was visited on May 6th and 7th. Mining and stockpiling of sulfides had just started on the 6th. Although the crushing plant was in operation, making greesstone gravel for the roads, it had not yet beem used to crush sulfides.

Up to 3 P.M. on the 6th, the following tonnages had been mined and stockpiled.

Grade Groups % Co	Tons
0.05 - 4.5	1500
4.5 - 7.0	120
7.0 - 9.0	270
9.0 -+11.0	270
+11.0	120

The stockpiles for grades 4.5% Cu through +11.0 % Cu will be crushed and sampled by an automatic sampler. Each grade group will be re-stockpiled

The re-stockpiled and re-sampled sulfides will now be blended to make a shipping grade product.

At present, it is not clear how the 0.5 % to 4.5% Cu stockpile will be used.

The mingng is being carefully supervised. It appears that very little sulfide is going to either oxide or waste dumps.

There does not seem to be any provision, for rapid pit sampling and assaying, to determine the grade of questionable ore or waste banks, during the mining operation.

Some very interesting geological features are showing up in the pit. These include, rather strong faulting and late hydrothermal or hot spring activity. Larry Lahusen continues to map the geology, as time permits.

The late hydrothermal or hot spring activity is shown by several features, such as cherty, and sintery or sandy light colored to white quartz, which has been seen cutting and veining the massive pyrite. There is deposition of native sulphur. There has been altering, granulation, and softening of the pyrite. Copper has been mobolized and re-precipitated, on or around pyrite and sulphur, as digenite, chalcocite, or covelite.

The pit walls, although relatively steep, appear to be holding up reasonably well. There is, at least, one area of doubtful stability.

Sincerely,

J.McLaren Forbes

June 29, 1970

Mr. J. Frank Sharp
Director of Mines Development
Cerro Corp
300 Park Avenue
New York, N.Y. 10022

Dear Frank: Big Mike Project

I have just returned from another visit to the Big Mike Project. They are now mining the 5060 - 5080 bench. So far this bench has been somewhat lower in grade than had been anticipated. As the bench is completed higher grade ore is expected to be mined.

To date, the overall mined ore grade has been slightly lower than calculated, and the tonnage has been about 1000 tons higher. This is due, in part, to lack of continuity of grade between drill holes and also, I am sure, to the difficulty of sorting narrow bands of waste from the ore with the large shovel loaders being used. Although Ranchers and Dravo seem to be working very well together there is an inherent conflict of interest. The contractor is out to move tonnage and Ranchers is after grade as well as tonnage. Despite this they seem to be doing very well.

Each truck load of the lower grade stockpile material is marked, when dumped, then sampled and assayed. If it turns out to be that the load is, in fact, shipping ore is is picked up and moved to the crusher and shipped as ore.

The anticipated water problem has not yet developed. Water is often encountered in the drill holes. So far the water has moved down dip, after blasting, ahead of the mining.

The pit walls do not appear as ragged as on my last visit. Dravo has done some scaling, by dragging the walls with a weighted cable. There have also been several more small slides. Part of the greenstone wedge and some of the gossan area may still come down. The proposed change in the haulage road has not been made, as yet. Unless the contractor gets the haul road backe to the planned design some of the best sulfide ore may have to be left until the final pit clean up.

The last shippment drew down the supply of mined higher grade sulfide ore. Since there is not sufficient of this high grade on hand, to make up the blend of shipping grade ore, the truck haulage has been shut down for about a week. Hauling will begin again as soon as the supply of high grade is adequate for blending.

Sincerely

J. McLaren Forbes

August 5, 1970

Mr. J.Frank Sharp
Cerro Corp
300 Park Avenue
New York, N.Y. 10022

Dear Frank:

A final visit was made to observe the Big Mike Project on Saturday August 1, 1970. Upon arrival at the mine I was told that the sulfide ore had been mined out that mowning . When Larry Lahuer and I went down into the pit about 11:30 A.M. the last piece of equipment was moving out.

When you were last in the Big Mike pit the haul road went down into the pit clockwise, to the very bottom. At that time it appeared that some sulfide ore might be left underneath this road, on the southeast side of the pit.

This ore, beneath the road, has now been removed. This was done by changing the last several hundred feet of the haul road so that it now comes into the bottom of the pit in a counterclock wise dorection. This allowed the lower part of the former haul road to be removed, so that the remainder of the sulfide ore could be mined out, which was done.

No more high/grade sulfide ore is left in the pit and only oxide ore was seen at the pit bottom.

Not all of the mined sulfide ore had been crushed and shipped, at this date. I was told that when the shippments were completed that about 110,000 tons of sulfide ore would have been mined and shipped.

The Big Mike Project has been most interesting. I have been gratified to have had some part in the exploitation of this ore body, up to its present stage of development. I would be very pleased should Cerro Corp need my services, in some manner, throughout the completion of the mining, processing, and further exploration of the Big Mike ore deposit.

Sincerely,

J.McLaren Forbes

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