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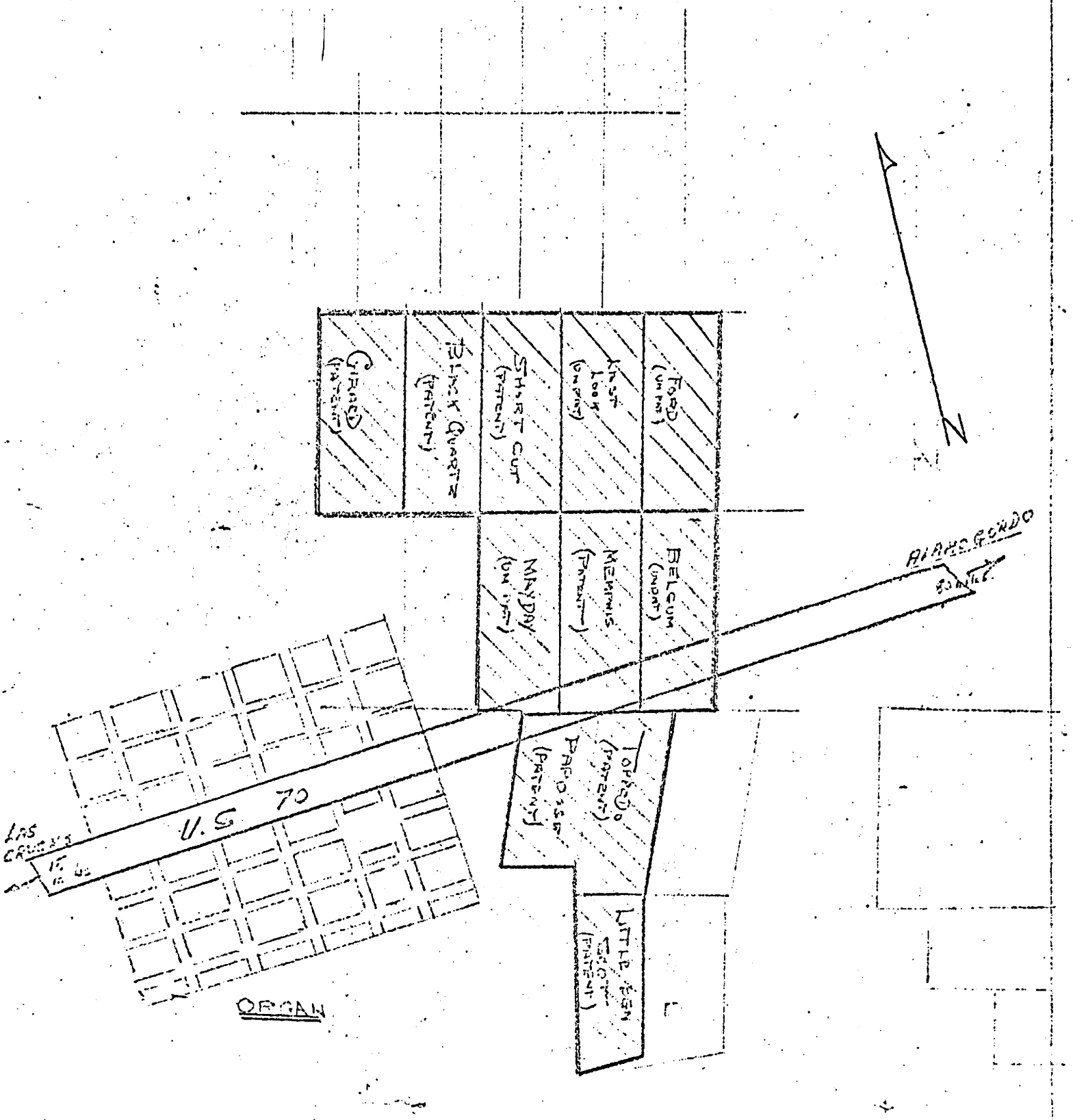
New Mexico

300,000 3%
100,000 8%
50,000 10%
6,000 15%

(26) Dunham p. 217

(27) Dunham p. 219



CLAIM MAP

Scale: 1" = 1000 ft.

ORGAN PROJECT

ORGAN DEVELOPEMENT CORP

10/3/61

PREPARED BY: LOWE ENGINEERING & PROPERTIES CORP.

(29) Dunham p. 231-232

(30) Dunham p. 232-234

(32) Dunham p. 240-241

Bureau of Mines
Report of Investigations 4791

INVESTIGATION OF THE TORPEDO COPPER DEPOSIT ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

BY JOHN H. SOULE

United States Department of the Interior— May 1951

INVESTIGATION OF THE TORPEDO COPPER DEPOSIT, ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

by

John H. Soule[1]

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1/ Mining engineer, Bureau of Mines.

Report of Investigations 4791

INTRODUCTION AND SUMMARY

The Torpedo copper mine in the Organ Mining District, Dona Ana County, N. Mex., was discovered in 1899, and production of copper from oxidized-ore deposits was begun in 1900. Production continued through 1907, but operations were only intermittent from 1907 through 1921. The production of copper during these periods amounted to about 3,500,000 pounds. Reserves of primary sulfide copper ore were believed to occur below the old workings, and after a detailed examination of accessible workings and a study of drilling records of several private companies by an engineer of the Bureau of Mines,2/ a development program of diamond core drilling was initiated.

This investigation was started October 3, 1949, and completed April 30, 1950. Four holes totaling 2,122.3 feet were diamond-drilled, and 70 samples were analysed. All drilling was done with a Government-owned hydraulic-feed drill having special rods and core barrels to increase the recovery of core in critical zones.

This report describes the location, history, ore deposits, and factual data obtained by the Bureau of Mines from the drilling.

ACKNOWLEDGMENTS

Acknowledgment is made of the assistance given by W. R. Storms, chief, Arizona-New Mexico Branch, Mining Division, Region IV, Bureau of Mines, and by W. D. McMillan, supervising engineer of the New Mexico Field Office of Region IV, Bureau of Mines. All samples were analysed at the Tucson laboratory of the Bureau of Mines under the supervision of J. Bruce Clammer, chief, Southwest Experiment Station, Metallurgical Branch, Region IV, Bureau of Mines. Production figures were obtained from the Statistical Branch, Region IV, of the Bureau of Mines, through the courtesy of A. J. Martin, supervising engineer.

Acknowledgment is also due A. S. Putney, president and trustee of the Torpedo Mining Co., for the use of old maps of the Torpedo mine and for permission to publish the maps and production figures.

LOCATION AND ACCESSIBILITY

The Torpedo copper mine is in the Organ Mining District, Dona Ana County, N. Mex. It is half a mile east of the town of Organ on the northwestern slope of the Organ Mountains, in sec. 1, T. 22 S., R. 3 E. (see fig. 1).

2/ W. R. Storms, N. Mex. Field Office, then Tucson Branch, Mining Division, Silver City, N. Mex.

The mine may be reached by going east from Organ on paved U. S. Highway for half a mile to the gate in the fence that borders the highway on the south. Passing through this gate, unimproved roads lead to various parts of the property, all within 1 mile of the gate (see fig. 2). Organ is 12.5 miles northeast of Las Cruces, N. Mex., via U. S. Highway 70.

Postal service is available at Organ and telephone, telegraph, and rail connection are available at Las Cruces, N. Mex. Minor supplies are obtainable at Las Cruces, but major mining items must be obtained at El Paso, Tex., 43 miles south of Las Cruces.

A high-tension power line traverses the Torpedo property, but Organ receives single-phase power from Las Cruces. The capacity of the Organ power line would be inadequate for any but the most limited power requirements.

PROPERTY AND OWNERSHIP

The Torpedo mine is on the patented Torpedo mining claim, which is owned by the Torpedo Mining Co. An extension of the mineralized zone continued south on the patented Little Ben Scott claim. The Torpedo and Little Ben Scott claims were located in 1896 and patented in 1902. In addition to these claims, the Torpedo Mining Co. owns other claims, both patented and unpatented, including the Memphis claims north of the Torpedo and the Stevenson-Bennett claims to the south.

A. S. Putney, of Mikana, Wis., and Judge E. Mecham, of Las Cruces, N. Mex., are trustees for the Torpedo Mining Co. The Torpedo Mining Co. property is now (August 1950) under lease to J. H. Brown, of Organ, N. Mex. Brown plans to reopen the mine, as well as others in the district, and is now concentrating his efforts on the Memphis mine adjoining the Torpedo on the north.

S. A. Walters, of Organ, N. Mex., claims the Jones' Well claims east of the Torpedo, and Miss Judith Shipe owns the unpatented Organ claim west of the Little Ben Scott (see fig. 2).

LABOR AND LIVING CONDITIONS

All labor for mining in the Organ area must be imported. Las Cruces is the nearest source of labor, and it is doubtful whether there is any skilled mining labor closer than the Central Mining District, near Silver City, N. Mex., 120 miles to the west and north.

Housing accommodations at Organ are primitive and inadequate for more than a few men. There are two cafes, where meals may be procured. These establishments cater largely to transient tourist trade.

PHYSICAL FEATURES AND CLIMATE

The Torpedo mine is on the edge of the bolson plains that flank the Organ Mountains. The topography is not rugged, and the relief is low. Altitudes range from 5,160 to 5,340 feet (see fig. 2). Southeast of the Torpedo claim, the Organ Mountains are very rugged and reach an altitude slightly over 9,100 feet.

The weather is typical of south-central New Mexico. Mining will be hampered little by the weather, which is generally mild in winter and warm in summer. Extreme cold is rare, although some freezing weather occurs in the winter. Snowfall is usually light and remains on the ground for only short periods. Summer rains and flash floods contribute the bulk of the annual precipitation, which averages about 10 inches.

There is no timber for mining operations on any of the claims, and the stands of Ponderosa pine in the higher reaches of the Organ Mountains are inaccessible. Timbering is a major industry at Alamogordo, N. Mex., some 57 miles to the northeast.

Greasewood, mesquite and various cactuses, shrubs, and other desert flora constitute the relatively sparse vegetation in the vicinity of the mine.

There are no permanent streams in the area, and almost all of the drinking water is rain water collected in cisterns. A few wells with windmills supply some water. The permanent water table is a little over 300 feet below the surface, as shown in the Copper Bar and Stevenson-Bennett shafts. Water from the Copper Bar shaft was used for drilling and contained considerable dissolved solids. No attempt was made to determine its potability. Reported estimates on the quantity of underground water range from 500 to 1,000 gallons per minute. The former figure seems more nearly correct.

HISTORY AND PRODUCTION

The history of the Organ Mining District dates back to 1849 with the discovery of the Stevenson-Bennett mine.[3] Legend indicates even earlier mining in the area. The Torpedo mine was discovered in 1899 by Henry Foy, although the claim was located in 1896. This was the last of the larger mines to be discovered.

Numerous parties have been interested in the Torpedo mine. A mining company purchased the mine from Foy shortly after its discovery and began production immediately. A little later, G. E. Fitzgerald acquired and operated the property. The Torpedo Mining Co. controlled the property in 1902 and is the present owner. Various lessees and sublessees have leased the mine, and many have done considerable work. The Torpedo Mining Co. operated the property until 1907, when it was leased to R. McCart, who held it until 1914. The Phelps-Dodge Corp. leased the mine in 1916-17 and did a considerable amount of development work. It was leased to the Organ Ore Co. in 1921; to Griffith and Phelps in 1928-29, who sank the No. 4 shaft; to the Willett Mining Co. from 1939 to 1944 and subleased to the Afterthought Mining Co., which did considerable exploratory work in 1941-42; and finally to J. H. Brown, the present lessee. The E. J. Longyear Co. subleased from Brown and, in conjunction with the New Jersey Zinc Exploration Co., carried out extensive exploration in 1946-47. Figures 4 and 5 show sections of drilling done by the companies. M. Drunzer subleased the Torpedo mine in 1949 and shipped some of the old dumps for siliceous fluxing ore to the El Paso, Tex., smelter.

3/ Dunham, K. C., Geology of the Organ Mountains: New Mexico School of Mines, State Bur. of Mines and Min. Resources, Bull. 11, 1935, p. 185.

Production from the Torpedo mine was almost continuous from its discovery to 1907. Subsequent production has been small and sporadic. The mine has produced no ore since 1921,[4] until Drunzer shipped some dump material in 1949. The total production from the Torpedo mine since its discovery has been about 3,500,000 pounds of copper and some silver. Production, by years, is shown in table 1.

TABLE 1. - Torpedo mine production

Year	Crude ore, tons	Ounces		Pounds	
		Au	Ag	Cu	Pb
1900.....	-	-	-	1/712,358	-
1901.....	-	-	-	1/515,162	-
1903.....	-	-	-	1/611,796	-
1904.....	-	-	-	1/40,000	-
1905.....	-	-	-	1/96,058	-
1906.....	-	-	-	1/434,000	-
1907.....	-	-	-	1/776,125	-
1908.....	102	-	289	6,569	-
1918 2/.....	605	-	1,859	75,534	930
1919 2/.....	1,797	-	3,980	317,876	11,659
1920.....	944	-	689	156,951	-
1928 3/.....	303	0.38	220	35,000	625
1929 3/.....	90	-	37	5,893	-
1937 3/.....	20	-	258	264	6,751
1939 3/.....	1	-	1	141	-
1949.....	969	-	138	26,202	-
Total.....	Incomplete			3,809,929	

1/ County production, largely from Torpedo, but other mines included.

2/ Production from adjoining mines probably included.

3/ Production believed entirely from adjoining mines of group, as the Torpedo mine itself has been reported idle from 1921 to 1949.

GEOLOGY AND ORE DEPOSITS

The Torpedo ore bodies occur in a north-south trending zone between monzonite on the east and Pennsylvanian limestones on the west. This zone averages about 100 feet in thickness, as shown in Bureau of Mines drill holes (see fig. 3). It dips steeply to the east but may overturn at depth, as shown in the log of hole A4 (see fig. 4). This apparent overturn may be due to faulting or a deviation in strike of the bore hole, which was surveyed for dip but not for strike.

The zone consists of some limestone, but mostly monzonite, which has been silicified and highly altered, brecciated, and recemented with silica. A number of faults traverse the zone, apparently more or less parallel with the zone itself. Some of these faults indicate considerable movement, but data are insufficient to measure the displacement.

4/ L. B. Bentley, oral communication.

The monzonite east of the zone of ore bodies shows weathering effects near the surface. It becomes fresh with depth and contains specks and small stringers of pyrite. It is virtually barren of copper. Upon approaching the mineralized zone, it becomes hydrothermally altered but still retains its texture.

The limestone west of the zone is garnetized and silicified in part, although much of the limestone shows only slight alteration. The garnetization apparently extends, in favorable beds, over 200 feet from the monzonite contact. A few specks of sphalerite and galena were noted at rare intervals in the limestone core.

The above data are derived mainly from study of cores obtained by the Bureau of Mines. The underground workings were not accessible for inspection.

Judging from the stoped areas (see fig. 6) the individual ore bodies were elliptical in plan and generally steeply plunging, whereas the zone of the ore bodies seems to have a definite rake to the south. Only one of the ore bodies outcrops, and the discovery was made here. According to old smelter settlements,5/ most of the ore was produced from above the 300-foot level and was oxidized. The sulfur content was very low until the lower levels were mined. The ore mineral was chrysacolla with local occurrences of native copper. All ore minerals noted in the drill cores were the sulfides chalcopyrite, sphalerite, and galena. The gangue mineral seen in drill cores was silica, usually as the siliceous breccia.

DEVELOPMENT

The Torpedo mine was developed through four vertical shafts. No. 1 shaft is near the discovery and is shown to be a little over 200 feet deep (fig. 6). Shaft 2 is 250 feet deep, No. 3 is 500 feet, and No. 4 is 165 feet. All of these shafts are interconnected by lateral workings, which also extend north and connect with the Copper Bar south shaft. Most of the stopes were between No. 1 and No. 2 shaft, with another shown just south of No. 2 shaft. None of these workings were accessible in April 1950.

WORK BY THE BUREAU OF MINES

The development work by the Bureau of Mines was started October 3, 1949, and completed April 30, 1950. Because none of the mine workings were accessible, the work was confined to diamond core drilling, and all data were obtained therefrom. Four holes were drilled for a total of 2,122.3 feet.

All drilling was done with a Government-owned, medium-sized machine with hydraulic-feet drill head. Special large rods and special core barrels were used to obtain better core recovery in the critical zones than was possible with the standard-type tools previously used in this area. Core recovery in the ore zones is shown in figure 3, and total core recovery is shown in the summary logs that follow.

Seventy samples were split from the cores and analysed. Many were known to be low-grade. Analyses of the samples are shown in figure 3 and in the following summary logs of the drill holes.

5/ Dunham, K. C., op. cit., p. 217.

TORPEDO COPPER DESPOSIT

Log of Hole 1

Location: N. 5238.82, E. 5151.77
Elevation of collar: 5,215 ft.
Depth: 597.7 ft.
Dip: -50°
Bearing: N. 67°41' W.

Date begun: Nov. 4, 1949.
Date completed: Dec. 15, 1949.

Footage			Recoveries				Core size	Analyses, percent			Description and remarks
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.		Cu	Pb	Zn	
0.0	24.0	24.0	0	-	0	100	3-1/2"				Weathered monzonite, overburden.
24.0	65.0	41.0	38.5	61,131	94	100	NX				Monzonite.
65.0	100.0	35.0	34.5	52,904	99	95	NX				Monzonite.
100.0	113.2	13.2	11.2	15,829	85	95	NX				Monzonite, scant pyrite.
113.2	113.5	0.3	0.3	525	100	95	NX	0.01			Do.
113.5	269.4	155.9	153.9	263,687	99	95	NX				Do.
269.4	269.7	0.3	0.3	525	100	95	NX	.01			Do.
269.7	269.9	0.2	0.2	350	100	95	NX				Do.
269.9	289.2	19.3	19.3	35,168	100	0	NX				Do.
289.2	303.0	13.7	13.7	23,581	100	85	NX				Do.
303.0	313.3	10.3	10.3	9,291	100	85	BX				Do.
313.3	313.6	0.3	0.3	300	100	85	BX	.01			Do.
313.6	388.5	74.9	74.7	77,023	99	85	BX				Do.
388.5	393.5	5.0	5.0	4,865	100	85	BX	.01			Altered monzonite, scant sulfides.
393.5	398.0	4.5	4.5	5,606	100	85	BX	.06			Do.
398.0	403.0	5.0	5.0	6,578	100	85	BX	.08			Do.
403.0	408.0	5.0	5.0	5,135	100	85	BX	.05			Do.
408.0	413.0	5.0	5.0	5,023	100	85	BX	.16			Do.
413.0	418.0	5.0	5.0	5,850	100	85	BX	.07			Do.
418.0	423.0	5.0	5.0	6,138	100	85	BX	.05			Do.
423.0	427.7	4.7	4.7	5,280	100	85	BX	.05			Do.
427.7	431.7	4.0	4.0	4,666	100	85	BX	.06			Do.
431.7	434.5	2.8	2.8	2,936	100	85	BX	.05			Do.
434.5	439.0	4.5	4.5	4,591	100	85	BX	.05			Do.
439.0	443.5	4.5	4.5	4,912	100	85	BX	.05			Do.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	BX	.05			Do.

Hole 1 (Cont.)

Footage			Recoveries				Core size	Analyses, percent			Description and remarks
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.		Cu	Pb	Zn	
443.5	448.0	4.5	4.5	5,148	100	85	BX	0.10			Altered monzonite, scant sulfides.
448.0	453.0	5.0	5.0	5,091	100	85	BX	.02			Do.
453.0	458.0	5.0	5.0	4,720	100	85	BX	.07			Do.
458.0	462.5	4.5	4.5	4,413	100	85	BX	.07			Do.
462.5	467.0	4.5	4.5	3,786	100	85	BX	.10			Do.
467.0	471.0	4.0	4.0	5,068	100	85	BX	.22			Do.
471.0	475.5	4.5	4.5	4,871	100	85	BX	.53			Do.
475.5	480.0	4.5	4.5	4,526	100	85	BX	1.58	0.33	2.4	Do.
480.0	486.0	6.0	3.5	3,921	58	85	BX	6.36	.05	1.9	Do.
486.0	491.0	5.0	5.0	4,643	100	85	BX	3.08	.05	3.7	Do.
491.0	495.0	4.0	4.0	3,368	100	85	BX	9.47	1.14	4.2	Siliceous breccia with sulfides.
495.0	499.0	4.0	4.0	3,725	100	85	BX	2.70	1.00	3.7	Do.
499.0	503.0	4.0	4.0	3,680	100	85	BX	.04			Siliceous breccia, scant sulfides.
503.0	507.5	4.5	4.5	4,151	100	85	BX	.03			Do.
507.5	512.0	4.5	4.5	3,444	100	85	BX	.02			Do.
512.0	517.0	5.0	5.0	3,406	100	85	BX	.10			Do.
517.0	522.0	5.0	5.0	3,993	100	85	BX	.02			Do.
522.0	526.5	4.5	4.5	2,690	100	85	BX	.02			Do.
526.5	531.0	4.5	4.5	2,133	100	85	BX	.02			Do.
531.0	535.5	4.5	4.5	4,310	100	85	BX	.02			Do.
535.5	540.0	4.5	4.5	2,897	100	85	AX	.02			Do.
540.0	545.0	5.0	5.0	1,996	100	85	AX	.02			Do.
545.0	550.0	5.0	5.0	2,013	100	85	AX	.02			Do.
550.0	554.5	4.5	4.5	2,185	100	85	AX	.02			Do.
554.5	559.0	4.5	4.5	2,173	100	85	AX	.02			Do.
559.0	565.5	6.5	6.5	2,613	100	85	AX				Do.
565.5	594.3	28.8	9.4	3,012	33	75	AX				Siliceous breccia and fault gouge.
594.3	597.7	3.4	2.4	673	71	50	AX				Fault gouge, limestone fragments.

Log of Hole 2

Location: N. 5240, E. 5150
Elevation of collar: 5,216 ft.
Depth: 489.5 ft.
Dip: -37°
Bearing: N. 67°41' W.

Date begun: Dec. 16, 1949.
Date completed: Jan. 25, 1950.

Footage			Recoveries				Core size	Analyses, percent			Description and remarks
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.		Cu	Pb	Zn	
0.0	9.5	9.5	2.1	2,329	22	100	3-1/2"				Weathered monzonite, overburden.
9.5	34.0	24.5	8.3	17,404	34	100	do.				Do.
34.0	42.5	8.5	8.5	13,267	100	100	NX				Monzonite, scant pyrite.
42.5	249.0	206.5	205.8	355,467	99	95	do.				Do.
249.0	253.6	4.6	4.6	7,585	100	0	do.				Do.
253.6	280.0	26.4	26.4	45,043	100	100	do.				Do.
280.0	287.0	7.0	7.0	11,710	100	0	do.				Do.
287.0	313.5	26.5	26.5	45,871	100	90	do.				Do.
313.5	349.0	35.5	35.5	62,325	100	90	do.				Do.
349.0	358.6	9.6	9.6	17,603	100	90	do.	0.02	0.05	0.1	Altered limestone.
358.6	368.6	10.0	10.0	20,220	100	90	do.	.04	.05	.4	Do.
368.6	377.0	8.4	8.4	13,447	100	90	do.	.08	.05	.7	Do.
377.0	388.6	11.6	11.6	21,535	100	90	do.				Do.
388.6	405.0	16.4	14.6	21,183	88	90	do.				Fault gouge and breccia.
405.0	408.0	3.0	2.6	4,075	88	90	do.	.05			Crumbly pyrite.
408.0	412.0	4.0	4.0	7,520	100	90	do.	.12			Do.
412.0	442.0	30.0	30.0	42,705	100	90	do.				Siliceous breccia, fault gouge, pyrite.
442.0	482.2	40.2	36.3	48.635	90	90	do.				Breccia, shale?, sandstone?, pyrite.
482.2	486.5	4.3	4.3	5,102	100	90	do.	.02			Breccia, silicated material, scant pyrite.
486.5	489.5	3.0	2.5	3,934	83	90	do.				Breccia, shale, and calcite.

Log of Hole No. 3

Location: N. 5367.21, E. 5317.11
Elevation of Collar: 5286.46
Depth: 524.6 ft.
Dip: -50°
Bearing: N. 67°41' W.

Date begun: January 26, 1950
Date completed: March 14, 1950

Footage			Recoveries				Core	Analyses Percent			
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.	size	Cu	Pb	Zn	Description and remarks
0.0	49.0	49.0	1.7	3,762	3	95	3-1/2"				Weathered monzonite, overburden.
49.0	66.5	17.5	16.8	21,520	96	95	NX				Weathered, altered monzonite.
66.5	220.5	154.0	151.5	268,569	98	90	do.				Monzonite, scant pyrite.
220.5	448.6	228.1	224.7	389,629	99	90	do.				Altered monzonite, disseminated pyrite.
448.6	450.0	1.4	1.3	1,979	93	90	do.	0.02	-0.05	0.15	Do.
450.0	455.0	5.0	4.6	6,464	92	90	do.	.04	-.04	.04	Do.
455.0	460.0	5.0	4.7	3,798	94	90	BX	.06	-.05	.1	Do.
460.0	462.7	2.7	2.7	2,215	100	90	do.	.01	-.05	Tr	Do.
462.7	464.0	1.3	1.1	800	85	90	do.	.03	.05	Tr	Do.
464.0	466.1	2.1	2.1	1,923	100	90	do.	.02	-.05	Tr	Do.
466.1	467.6	1.5	1.0	551	67	90	do.	.02	-.05	Tr	Do.
467.6	468.1	0.5	0.5	100	100	90	do.	.02	-.05	Tr	Do.
468.1	470.1	2.0	2.0	1,419	100	90	do.	.01	-.05	Nil	Do.
470.1	472.7	2.6	2.6	1,491	100	90	do.	.01	-.05	0.1	Do.
472.7	474.4	1.7	1.7	1,468	100	90	do.	.03	-.05	Tr	Do.
474.4	478.8	4.4	4.3	2,931	98	85	do.	.02	-.05	Tr	Do.
478.8	482.2	3.4	3.4	3,204	100	80	do.	.06	.30	0.15	Vein material.
482.2	487.0	4.8	4.8	4,579	100	80	do.	1.05	.15	.55	Do.
487.0	493.0	6.0	6.0	4,404	100	75	do.	.07	.05	.15	Do.
493.0	498.7	5.7	5.7	4,982	100	60	do.	.10	.13	.1	Do. Sample to 495.3, then breccia
498.7	499.5	0.8	0.8	612	100	75	do.				Siliceous breccia.
499.5	524.6	25.1	13.3	9,848	53	75	do.				Do.

4224

Log of Hole 4

Location: N. 5268.66, E. 4502.33
Elevation of Collar: 5,172.71 ft.
Depth: 510.5 ft.
Dip: -45°
Bearing: S. 67°41' E.

Date begun: Mar. 13, 1950.
Date completed: Apr. 25, 1950.

Footage			Recoveries				Core size	Analyses, percent			Description and remarks
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.		Cu	Pb	Zn	
0.0	21.0	21.0	0.0	0	0	100	3-1/2"				Overburden.
21.0	26.2	5.2	5.2	10,829	100	100	NX				Garnet.
26.2	44.0	17.8	13.9	17,542	78	90	do.				Garnet and breccia.
44.0	56.1	12.1	12.0	23,305	99	90	do.				Garnet.
56.1	86.0	29.9	29.9	44,859	100	100	do.				Altered, silicated limestone.
86.0	176.2	90.2	90.2	173,525	100	87	do.				Slightly altered limestone.
176.2	342.0	165.8	135.8	140,511	82	90	BX				Do.
342.0	380.0	38.0	31.8	27,067	84	90	do.				Siliceous breccia and pryite.
380.0	394.6	14.6	13.5	8,315	92	90	do.				Fault gouge.
394.6	400.0	5.4	5.4	5,885	100	90	do.				Siliceous breccia.
400.0	420.5	20.5	17.4	15,711	85	90	do.				Siliceous breccia and pyrite.
402.3	440.0	37.7	31.7	25,545	84	90	do.				Do. Hole deflected at 402.3.
440.0	442.8	2.8	2.8	2,253	100	90	do.	0.27	0.35	2.65	Siliceous breccia with sulfides at 441 ft.
442.8	450.0	7.2	7.2	5,970	100	90	do.	.17	.20	1.45	Siliceous breccia with sulfides.
450.0	453.0	3.0	3.0	2,590	100	90	do.	.07	.07	.05	Breccia with pyrite.
453.0	458.0	5.0	5.0	4,928	100	90	do.	.05	.05	Tr	Do.
458.0	460.7	2.7	2.7	2,936	100	90	do.	.02	.02	Tr	Do.
460.7	464.5	3.8	3.8	4,603	100	90	do.	.05	.10	Tr	Do.
464.5	470.6	6.1	6.1	5,651	100	90	do.	.07	-.05	.05	Do.
470.6	478.0	7.4	7.4	7,499	100	90	do.	.05	-.05	.05	Do. Sample to 473.2, then monzonite.
478.0	510.5	32.5	31.5	16,440	97	90	AX				Monzonite.

4224
Interior - Bureau of Mines, Pittsburgh, Pa.

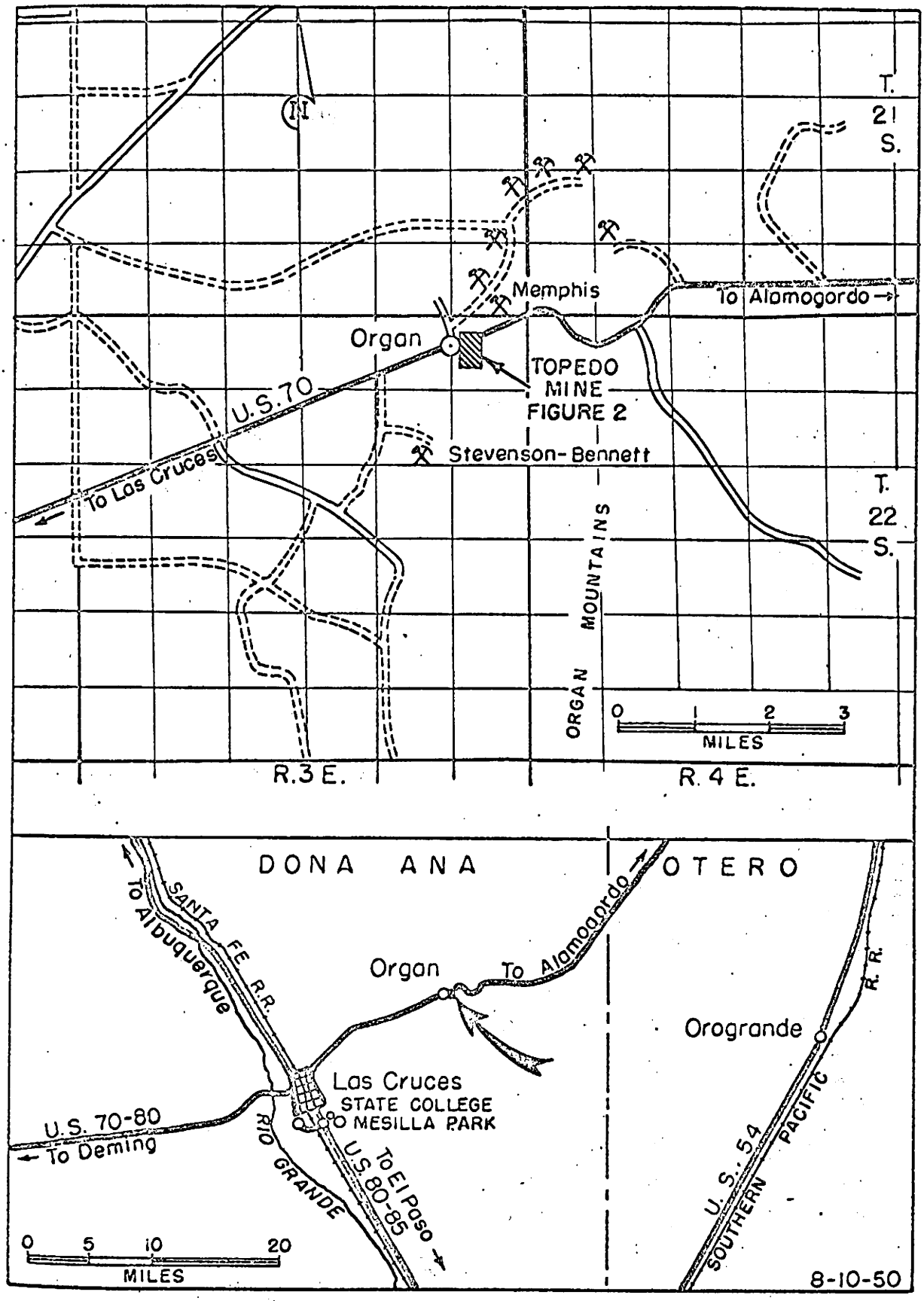


Figure 1. - Location map.

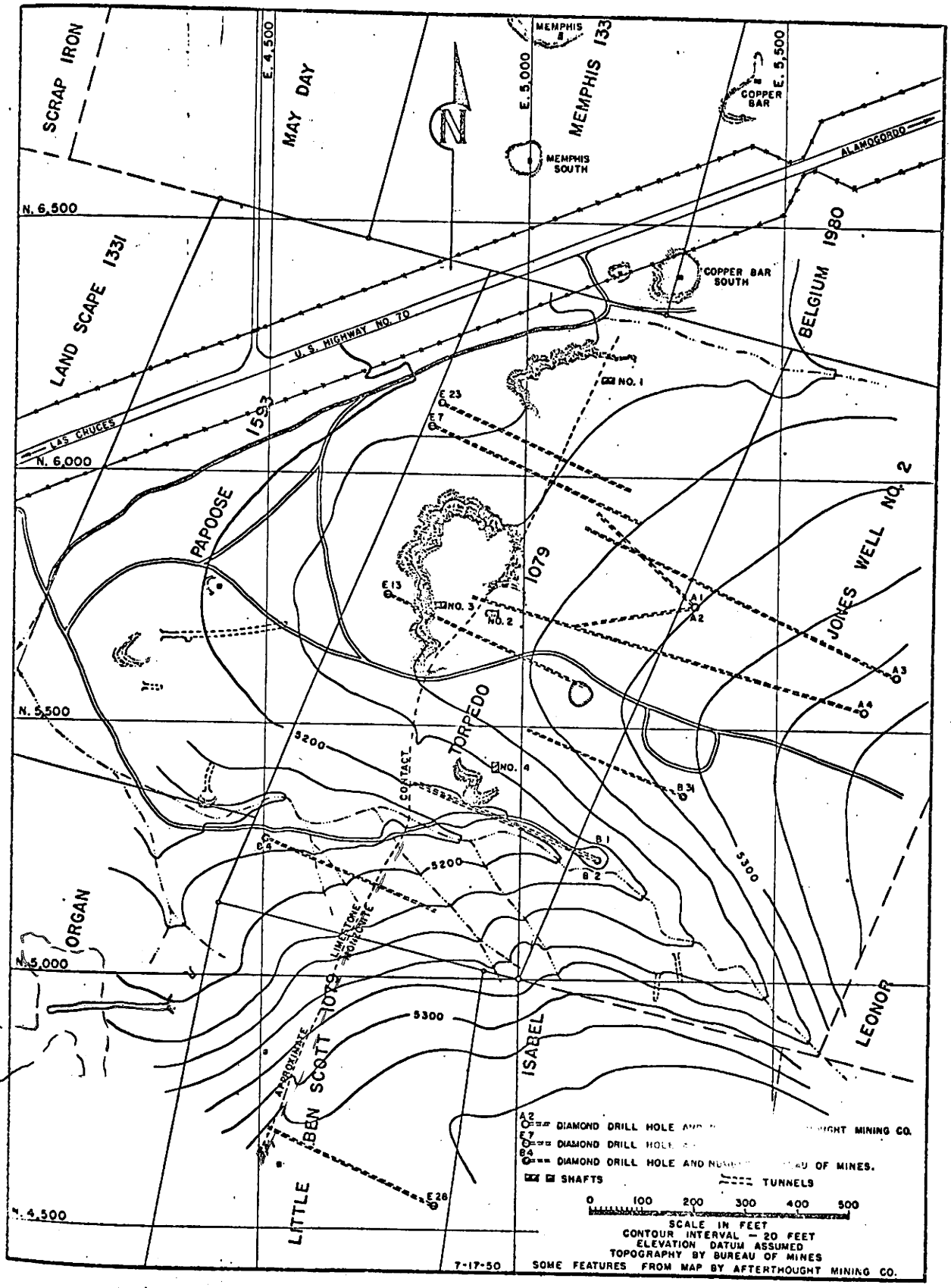
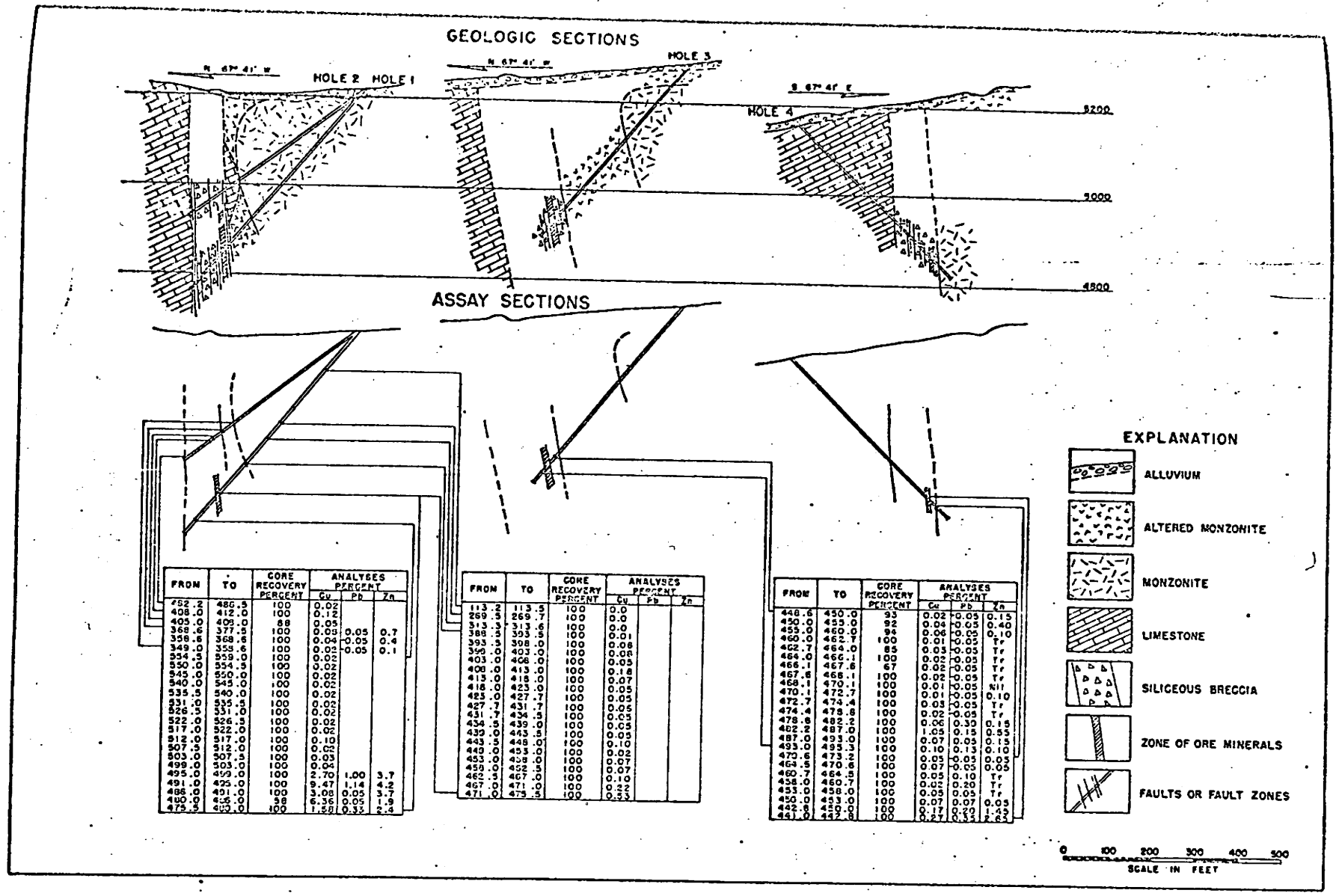


Figure 2. - Topographic and surface map.



FROM	TO	CORE RECOVERY PERCENT	ANALYSES PERCENT Cu	Pb	Zn
452.2	486.5	100	0.02		
408.0	412.0	100	0.12		
405.0	409.0	88	0.05		
368.6	377.5	100	0.09	0.05	0.7
358.6	368.6	100	0.04	0.05	0.4
349.0	358.6	100	0.02	0.05	0.1
354.5	359.0	100	0.02		
550.0	554.5	100	0.02		
545.0	550.0	100	0.02		
540.0	545.0	100	0.02		
535.5	540.0	100	0.02		
531.0	535.5	100	0.02		
526.5	531.0	100	0.02		
522.0	526.5	100	0.02		
517.0	522.0	100	0.02		
512.0	517.0	100	0.10		
507.5	512.0	100	0.02		
503.0	507.5	100	0.03		
499.0	503.0	100	0.04		
495.0	499.0	100	2.70	1.00	3.7
491.0	495.0	100	9.47	1.14	4.2
486.0	491.0	100	3.08	0.05	3.7
480.0	485.0	58	6.36	0.05	1.9
475.5	480.0	100	1.58	0.33	2.4

FROM	TO	CORE RECOVERY PERCENT	ANALYSES PERCENT Cu	Pb	Zn
113.2	113.5	100	0.0		
269.5	269.7	100	0.0		
313.3	313.6	100	0.0		
388.5	393.5	100	0.01		
393.5	398.0	100	0.08		
398.0	403.0	100	0.08		
403.0	408.0	100	0.05		
408.0	413.0	100	0.18		
413.0	418.0	100	0.07		
418.0	423.0	100	0.05		
423.0	427.7	100	0.05		
427.7	431.7	100	0.05		
431.7	434.5	100	0.05		
434.5	439.0	100	0.05		
439.0	443.5	100	0.05		
443.5	448.0	100	0.10		
448.0	453.0	100	0.02		
453.0	458.0	100	0.07		
458.0	462.5	100	0.07		
462.5	467.0	100	0.10		
467.0	471.0	100	0.22		
471.0	475.5	100	0.53		

FROM	TO	CORE RECOVERY PERCENT	ANALYSES PERCENT Cu	Pb	Zn
448.6	450.0	93	0.02	0.05	0.15
450.0	455.0	92	0.04	0.05	0.40
455.0	460.0	94	0.06	0.05	0.10
460.0	462.7	100	0.01	0.05	Tr
462.7	464.0	85	0.03	0.05	Tr
464.0	466.1	100	0.02	0.05	Tr
466.1	467.6	67	0.02	0.05	Tr
467.6	468.1	100	0.02	0.05	Tr
468.1	470.1	100	0.01	0.05	Nil
470.1	472.7	100	0.01	0.05	0.10
472.7	474.4	100	0.03	0.05	Tr
474.4	478.8	100	0.02	0.05	Tr
478.8	482.2	100	0.06	0.30	0.15
482.2	487.0	100	1.05	0.15	0.55
487.0	493.0	100	0.07	0.05	0.15
493.0	493.3	100	0.10	0.13	0.10
470.6	473.2	100	0.05	0.05	0.05
469.5	470.6	100	0.07	0.05	0.05
460.7	464.5	100	0.05	0.10	Tr
458.0	460.7	100	0.02	0.20	Tr
453.0	458.0	100	0.05	0.05	Tr
450.0	453.0	100	0.07	0.07	0.05
442.8	450.0	100	0.17	0.20	1.45
441.0	442.8	100	0.27	0.35	2.65

Figure 3. - Sections on Bureau of Mines drill holes.

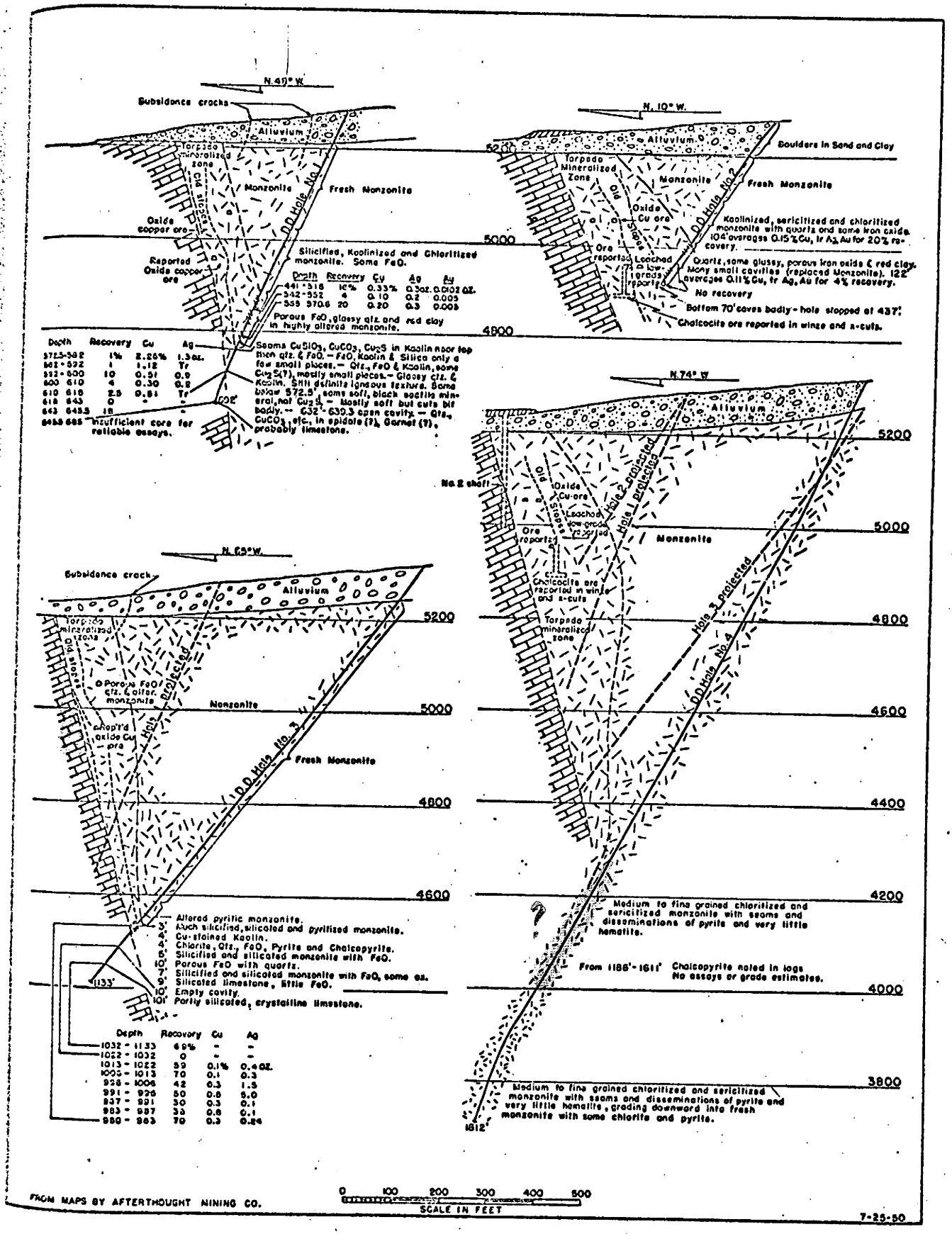


Figure 4. - Sections on drill holes A1, A2, A3, and A4.

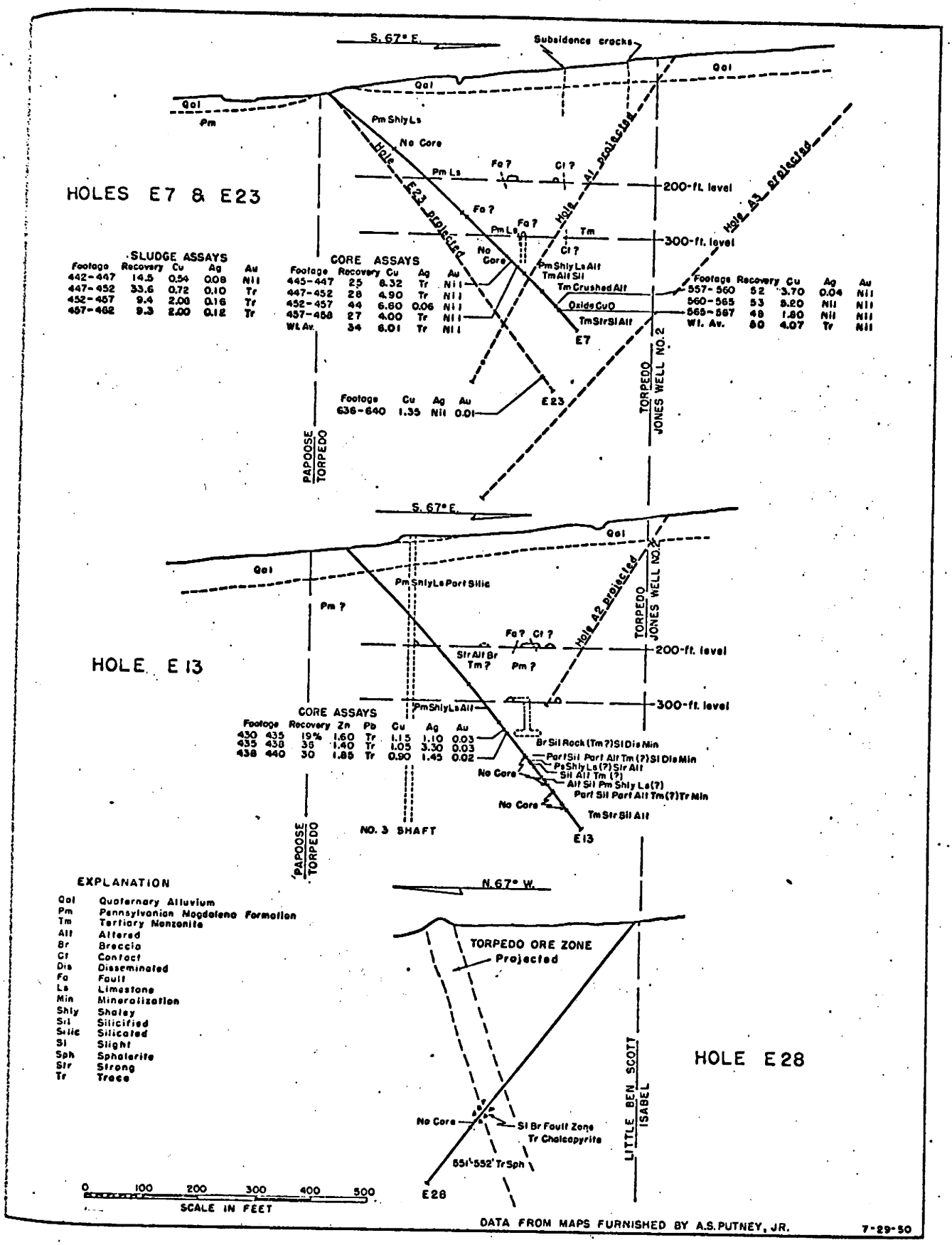


Figure 5. - Sections on drill holes E7, E13, E23, and E28.

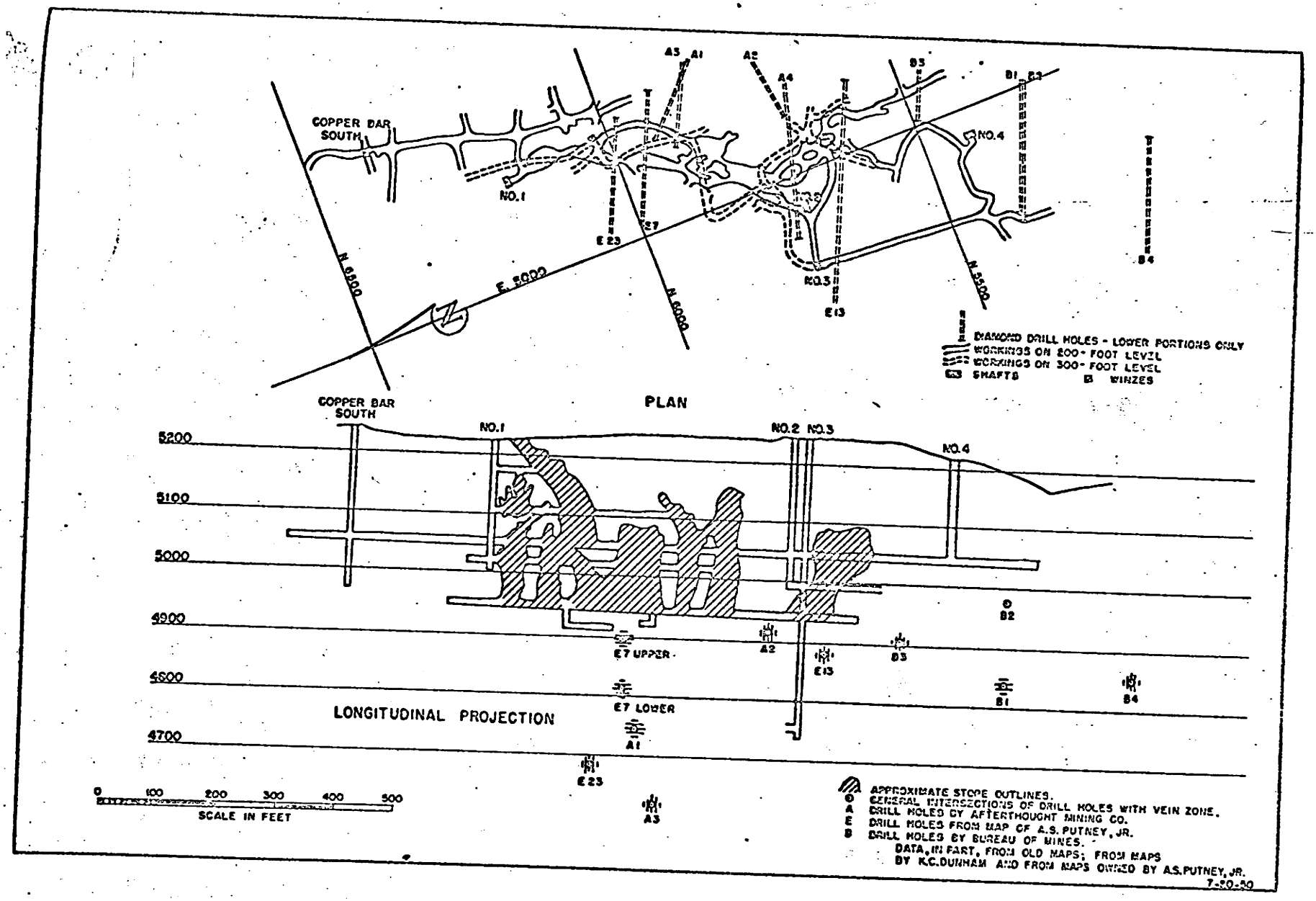
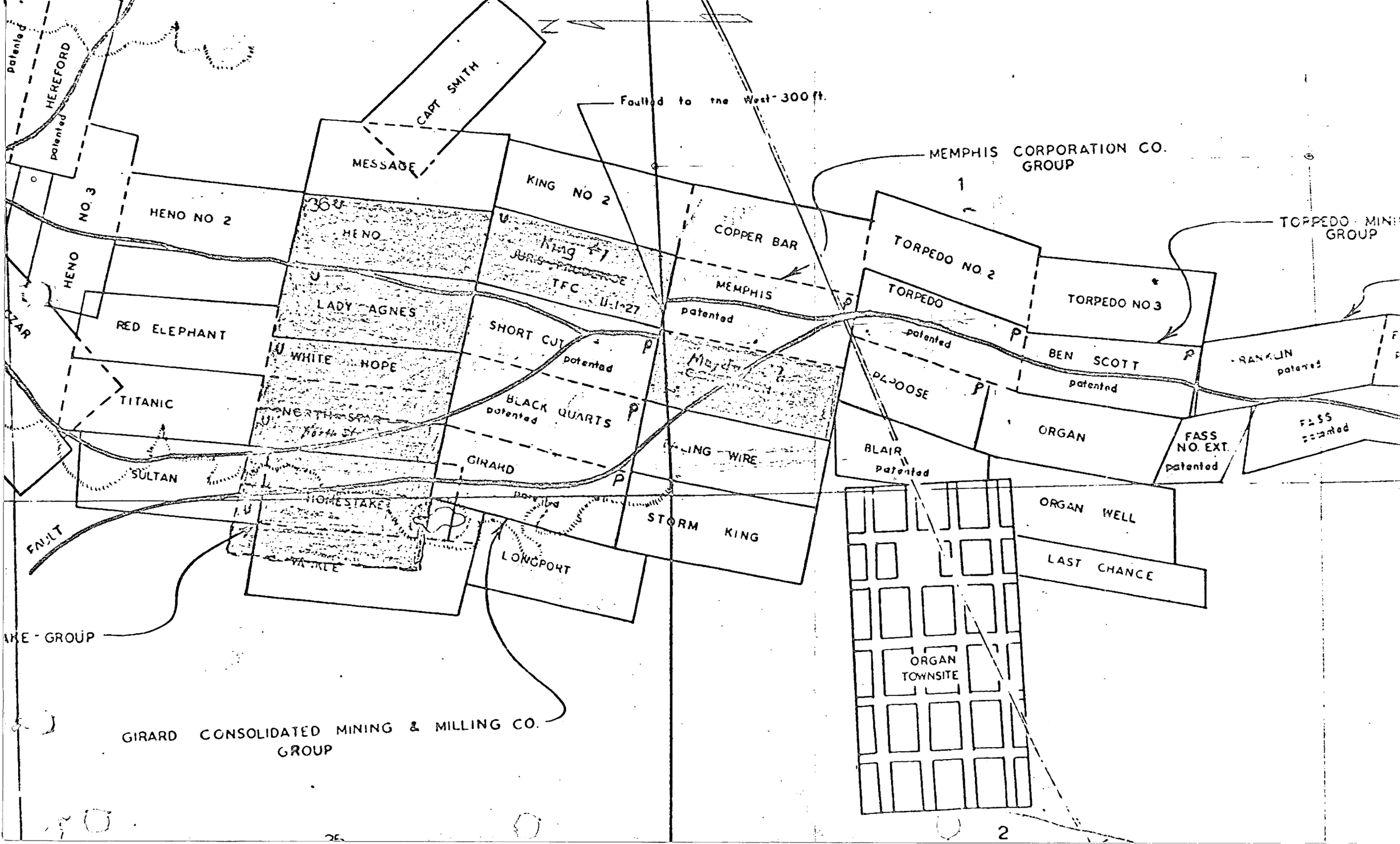


Figure 6. - Underground workings.


Faulted to the West - 300 ft.
MEMPHIS CORPORATION CO. GROUP
TORPEDO - MINE GROUP
GIRARD CONSOLIDATED MINING & MILLING CO. GROUP
HEREFORD
patented
CAPT SMITH
MESSAGE
KING NO 2
HENO NO 3
HENO NO 2
HENO
LADY AGNES
WHITE HOPE
NORTH STAR
HOMESTAKE
RED ELEPHANT
TITANIC
SULTAN
SHORT CUT
BLACK QUARTS
GIRARD
LONGPORT
COPPER BAR
MEMPHIS
TFC
STORM KING
TORPEDO NO 2
TORPEDO
TORPEDO NO 3
BEN SCOTT
PLOOSE
BLAIR
ORGAN
FASS NO. EXT.
ORGAN WELL
LAST CHANCE
ORGAN TOWNSITE
FAULT
1
2

Bureau of Mines
Report of Investigations 4791

INVESTIGATION OF THE TORPEDO COPPER DEPOSIT ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

BY JOHN H. SOULÉ

United States Department of the Interior— May 1951

INVESTIGATION OF THE TORPEDO COPPER DEPOSIT ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

BY JOHN H. SOULÉ

* * * * * * * * * **Report of Investigations 4791**

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
James Boyd, Director

Work on manuscript completed August 1950. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Report of Investigations 4791."

May 1951

INVESTIGATION OF THE TORPEDO COPPER DEPOSIT, ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

by

John H. Soule[1]

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1/ Mining engineer, Bureau of Mines.

INTRODUCTION AND SUMMARY

The Torpedo copper mine in the Organ Mining District, Dona Ana County, N. Mex., was discovered in 1899, and production of copper from oxidized-ore deposits was begun in 1900. Production continued through 1907, but operations were only intermittent from 1907 through 1921. The production of copper during these periods amounted to about 3,500,000 pounds. Reserves of primary sulfide copper ore were believed to occur below the old workings, and after a detailed examination of accessible workings and a study of drilling records of several private companies by an engineer of the Bureau of Mines,2/ a development program of diamond core drilling was initiated.

This investigation was started October 3, 1949, and completed April 30, 1950. Four holes totaling 2,122.3 feet were diamond-drilled, and 70 samples were analysed. All drilling was done with a Government-owned hydraulic-feet drill having special rods and core barrels to increase the recovery of core in critical zones.

This report describes the location, history, ore deposits, and factual data obtained by the Bureau of Mines from the drilling.

ACKNOWLEDGMENTS

Acknowledgment is made of the assistance given by W. R. Storms, chief, Arizona-New Mexico Branch, Mining Division, Region IV, Bureau of Mines, and by W. D. McMillan, supervising engineer of the New Mexico Field Office of Region IV, Bureau of Mines. All samples were analysed at the Tucson laboratory of the Bureau of Mines under the supervision of J. Bruce Clemmer, chief, Southwest Experiment Station, Metallurgical Branch, Region IV, Bureau of Mines. Production figures were obtained from the Statistical Branch, Region IV, of the Bureau of Mines, through the courtesy of A. J. Martin, supervising engineer.

Acknowledgment is also due A. S. Putney, president and trustee of the Torpedo Mining Co., for the use of old maps of the Torpedo mine and for permission to publish the maps and production figures.

LOCATION AND ACCESSIBILITY

The Torpedo copper mine is in the Organ Mining District, Dona Ana County, N. Mex. It is half a mile east of the town of Organ on the northwestern slope of the Organ Mountains, in sec. 1, T. 22 S., R. 3 E. (see fig. 1).

2/ W. R. Storms, N. Mex. Field Office, then Tucson Branch, Mining Division, Silver City, N. Mex.

The mine may be reached by going east from Organ on paved U. S. Highway for half a mile to the gate in the fence that borders the highway on the south. Passing through this gate, unimproved roads lead to various parts of the property, all within 1 mile of the gate (see fig. 2). Organ is 12.5 miles northeast of Las Cruces, N. Mex., via U. S. Highway 70.

Postal service is available at Organ and telephone, telegraph, and rail connection are available at Las Cruces, N. Mex. Minor supplies are obtainable at Las Cruces, but major mining items must be obtained at El Paso, Tex., 43 miles south of Las Cruces.

A high-tension power line traverses the Torpedo property, but Organ receives single-phase power from Las Cruces. The capacity of the Organ power line would be inadequate for any but the most limited power requirements.

PROPERTY AND OWNERSHIP

The Torpedo mine is on the patented Torpedo mining claim, which is owned by the Torpedo Mining Co. An extension of the mineralized zone continued south on the patented Little Ben Scott claim. The Torpedo and Little Ben Scott claims were located in 1896 and patented in 1902. In addition to these claims, the Torpedo Mining Co. owns other claims, both patented and unpatented, including the Memphis claims north of the Torpedo and the Stevenson-Bennett claims to the south.

A. S. Putney, of Mikana, Wis., and Judge E. Mecham, of Las Cruces, N. Mex., are trustees for the Torpedo Mining Co. The Torpedo Mining Co. property is now (August 1950) under lease to J. H. Brown, of Organ, N. Mex. Brown plans to reopen the mine, as well as others in the district, and is now concentrating his efforts on the Memphis mine adjoining the Torpedo on the north.

S. A. Walters, of Organ, N. Mex., claims the Jones' Well claims east of the Torpedo, and Miss Judith Shipe owns the unpatented Organ claim west of the Little Ben Scott (see fig. 2).

LABOR AND LIVING CONDITIONS

All labor for mining in the Organ area must be imported. Las Cruces is the nearest source of labor, and it is doubtful whether there is any skilled mining labor closer than the Central Mining District, near Silver City, N. Mex., 120 miles to the west and north.

Housing accommodations at Organ are primitive and inadequate for more than a few men. There are two cafes, where meals may be procured. These establishments cater largely to transient tourist trade.

PHYSICAL FEATURES AND CLIMATE

The Torpedo mine is on the edge of the bolson plains that flank the Organ Mountains. The topography is not rugged, and the relief is low. Altitudes range from 5,160 to 5,340 feet (see fig. 2). Southeast of the Torpedo claim, the Organ Mountains are very rugged and reach an altitude slightly over 9,100 feet.

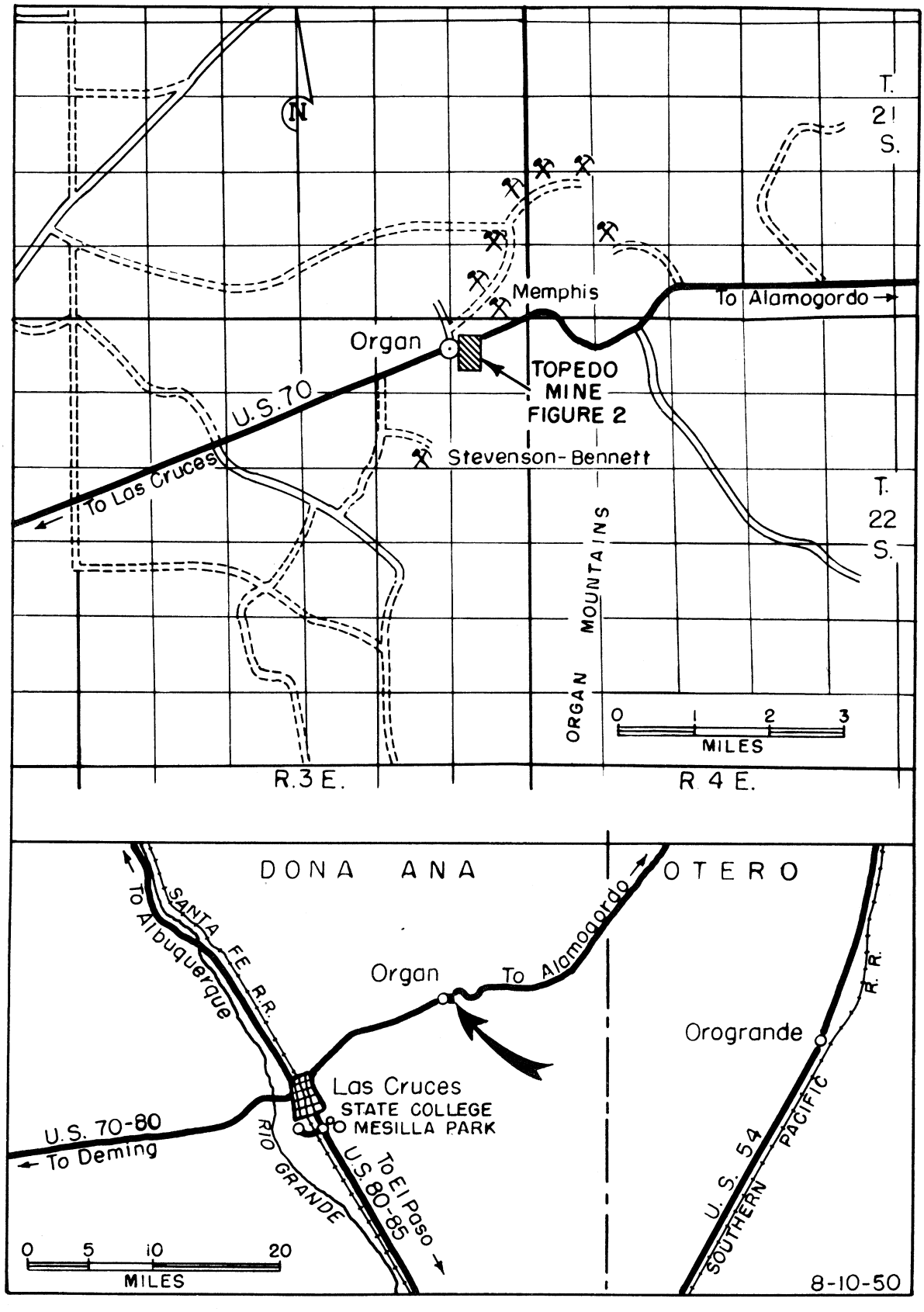


Figure 1. - Location map.

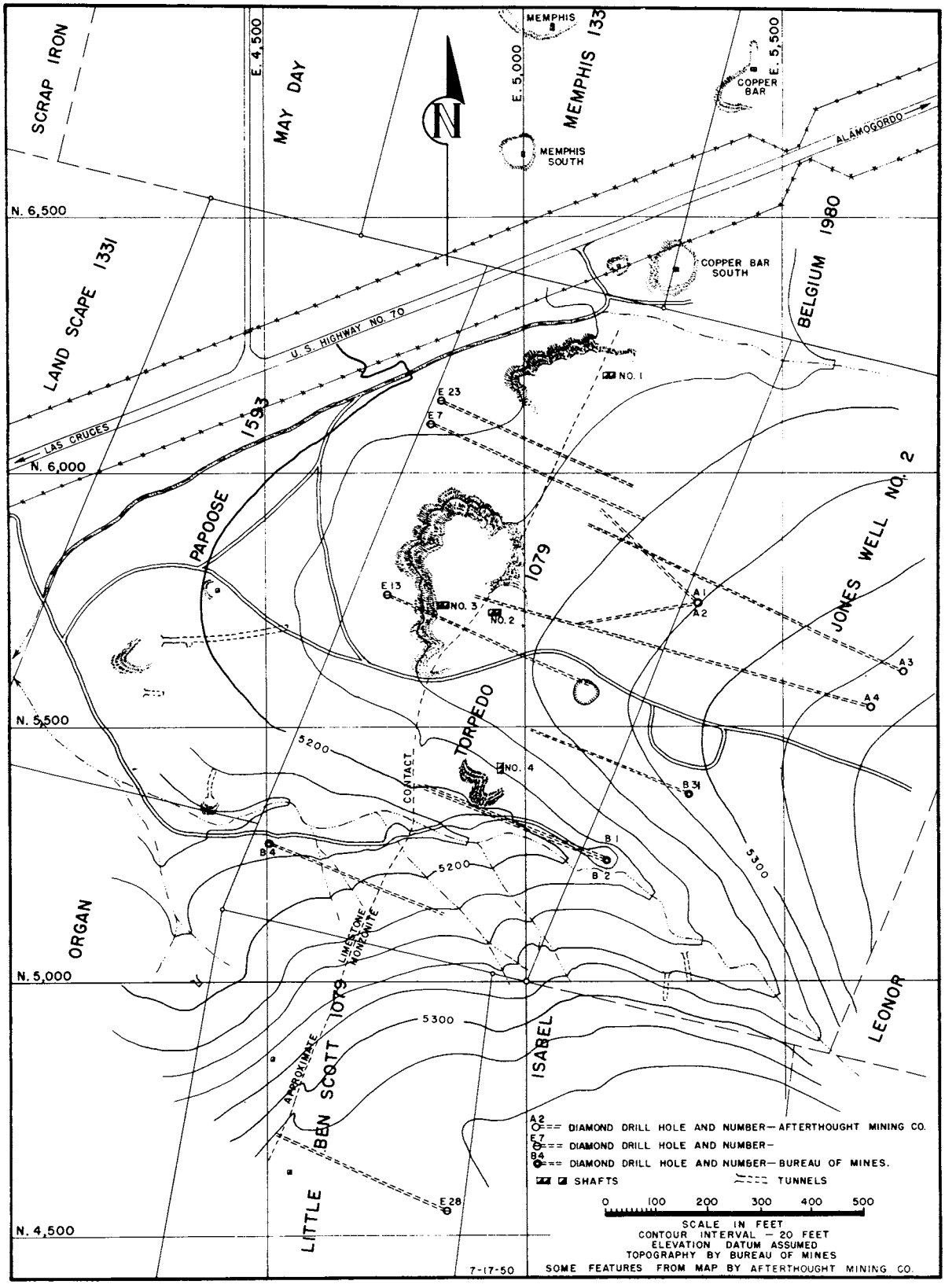


Figure 2. - Topographic and surface map.

The weather is typical of south-central New Mexico. Mining will be hampered little by the weather, which is generally mild in winter and warm in summer. Extreme cold is rare, although some freezing weather occurs in the winter. Snowfall is usually light and remains on the ground for only short periods. Summer rains and flash floods contribute the bulk of the annual precipitation, which averages about 10 inches.

There is no timber for mining operations on any of the claims, and the stands of Ponderosa pine in the higher reaches of the Organ Mountains are inaccessible. Timbering is a major industry at Alamogordo, N. Mex., some 57 miles to the northeast.

Greasewood, mesquite and various cactuses, shrubs, and other desert flora constitute the relatively sparse vegetation in the vicinity of the mine.

There are no permanent streams in the area, and almost all of the drinking water is rain water collected in cisterns. A few wells with windmills supply some water. The permanent water table is a little over 300 feet below the surface, as shown in the Copper Bar and Stevenson-Bennett shafts. Water from the Copper Bar shaft was used for drilling and contained considerable dissolved solids. No attempt was made to determine its potability. Reported estimates on the quantity of underground water range from 500 to 1,000 gallons per minute. The former figure seems more nearly correct.

HISTORY AND PRODUCTION

The history of the Organ Mining District dates back to 1849 with the discovery of the Stevenson-Bennett mine.3/ Legend indicates even earlier mining in the area. The Torpedo mine was discovered in 1899 by Henry Foy, although the claim was located in 1896. This was the last of the larger mines to be discovered.

Numerous parties have been interested in the Torpedo mine. A mining company purchased the mine from Foy shortly after its discovery and began production immediately. A little later, G. E. Fitzgerald acquired and operated the property. The Torpedo Mining Co. controlled the property in 1902 and is the present owner. Various lessees and sublessees have leased the mine, and many have done considerable work. The Torpedo Mining Co. operated the property until 1907, when it was leased to R. McCart, who held it until 1914. The Phelps-Dodge Corp. leased the mine in 1916-17 and did a considerable amount of development work. It was leased to the Organ Ore Co. in 1921; to Griffith and Phelps in 1928-29, who sank the No. 4 shaft; to the Willett Mining Co. from 1939 to 1944 and subleased to the Afterthought Mining Co., which did considerable exploratory work in 1941-42; and finally to J. H. Brown, the present lessee. The E. J. Longyear Co. subleased from Brown and, in conjunction with the New Jersey Zinc Exploration Co., carried out extensive exploration in 1946-47. Figures 4 and 5 show sections of drilling done by the companies. M. Drunzer subleased the Torpedo mine in 1949 and shipped some of the old dumps for siliceous fluxing ore to the El Paso, Tex., smelter.

3/ Dunham, K. C., Geology of the Organ Mountains: New Mexico School of Mines, State Bur. of Mines and Min. Resources, Bull. 11, 1935, p. 185.

Production from the Torpedo mine was almost continuous from its discovery to 1907. Subsequent production has been small and sporadic. The mine has produced no ore since 1921,[4] until Drunzer shipped some dump material in 1949. The total production from the Torpedo mine since its discovery has been about 3,500,000 pounds of copper and some silver. Production, by years, is shown in table 1.

TABLE 1. - Torpedo mine production

Year	Crude ore, tons	Ounces		Pounds	
		Au	Ag	Cu	Pb
1900.....	-	-	-	1/712,358	-
1901.....	-	-	-	1/515,162	-
1903.....	-	-	-	1/611,796	-
1904.....	-	-	-	1/40,000	-
1905.....	-	-	-	1/96,058	-
1906.....	-	-	-	1/434,000	-
1907.....	-	-	-	1/776,125	-
1908.....	102	-	289	6,569	-
1918 2/.....	605	-	1,859	75,534	930
1919 2/.....	1,797	-	3,980	317,876	11,659
1920.....	944	-	689	156,951	-
1928 3/.....	303	0.38	220	35,000	625
1929 3/.....	90	-	37	5,893	-
1937 3/.....	20	-	258	264	6,751
1939 3/.....	1	-	1	141	-
1949.....	969	-	138	26,202	-
Total.....	Incomplete			3,809,929	

1/ County production, largely from Torpedo, but other mines included.

2/ Production from adjoining mines probably included.

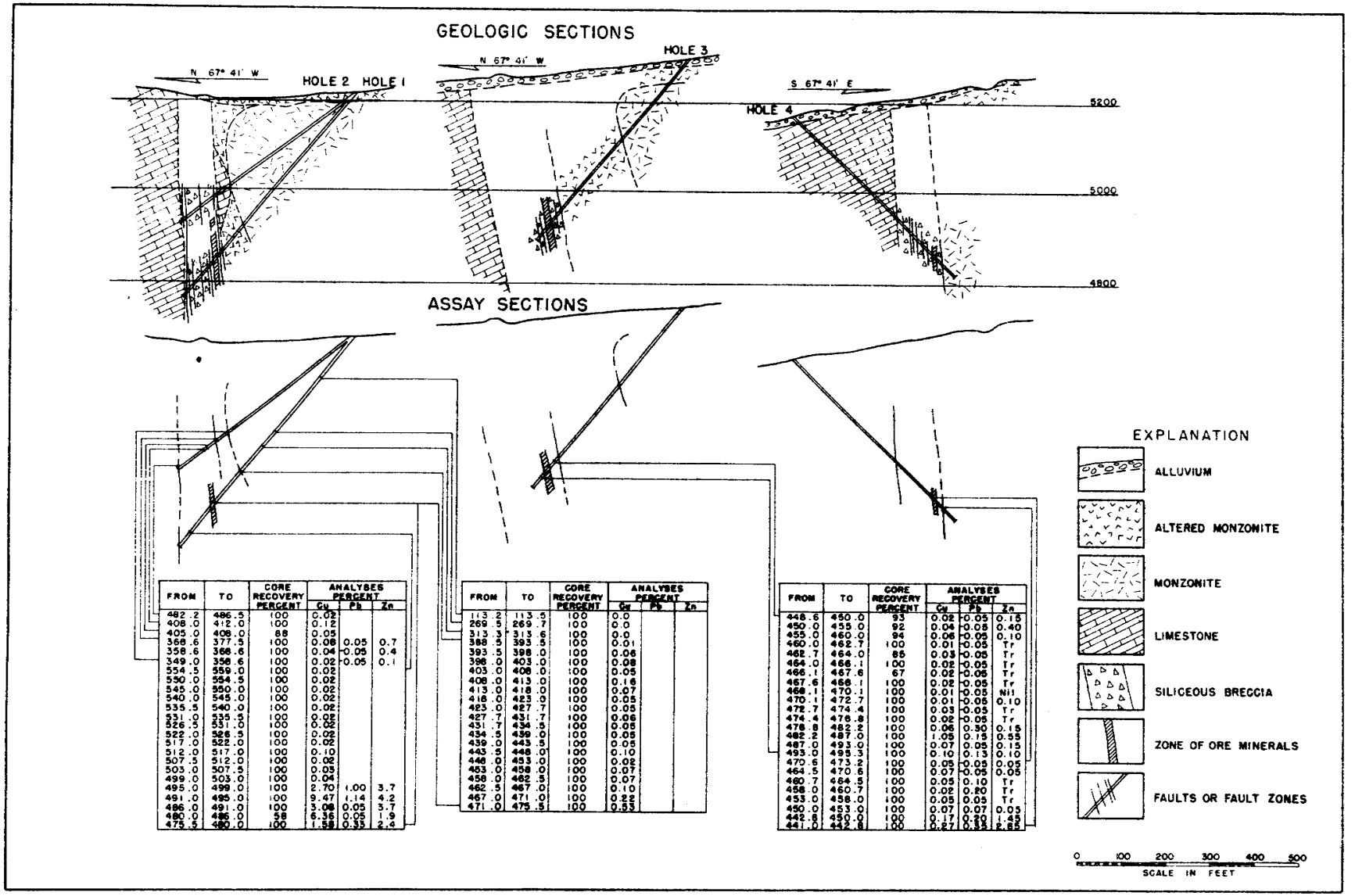
3/ Production believed entirely from adjoining mines of group, as the Torpedo mine itself has been reported idle from 1921 to 1949.

GEOLOGY AND ORE DEPOSITS

The Torpedo ore bodies occur in a north-south trending zone between monzonite on the east and Pennsylvanian limestones on the west. This zone averages about 100 feet in thickness, as shown in Bureau of Mines drill holes (see fig. 3). It dips steeply to the east but may overturn at depth, as shown in the log of hole A4 (see fig. 4). This apparent overturn may be due to faulting or a deviation in strike of the bore hole, which was surveyed for dip but not for strike.

The zone consists of some limestone, but mostly monzonite, which has been silicified and highly altered, brecciated, and recemented with silica. A number of faults traverse the zone, apparently more or less parallel with the zone itself. Some of these faults indicate considerable movement, but data are insufficient to measure the displacement.

4/ L. B. Bentley, oral communication.



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368.6	377.5	100	0.08	0.05	0.7
358.6	368.6	100	0.04	0.05	0.4
349.0	358.6	100	0.02	0.05	0.1
554.5	559.0	100	0.02		
550.0	554.5	100	0.02		
545.0	550.0	100	0.02		
540.0	545.0	100	0.02		
535.5	540.0	100	0.02		
531.0	535.5	100	0.02		
526.5	531.0	100	0.02		
522.0	526.5	100	0.02		
517.0	522.0	100	0.02		
512.0	517.0	100	0.10		
507.5	512.0	100	0.02		
503.0	507.5	100	0.03		
499.0	503.0	100	0.04		
495.0	499.0	100	2.70	1.00	3.7
491.0	495.0	100	9.47	1.14	4.2
486.0	491.0	100	3.08	0.05	3.7
480.0	486.0	58	6.36	0.05	1.9
475.5	480.0	100	1.58	0.35	2.4

FROM	TO	CORE RECOVERY PERCENT	ANALYSES PERCENT Cu	Pb	Zn
113.2	113.5	100	0.0		
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388.5	393.5	100	0.01		
393.5	398.0	100	0.06		
398.0	403.0	100	0.08		
403.0	408.0	100	0.05		
408.0	413.0	100	0.16		
413.0	418.0	100	0.07		
418.0	423.0	100	0.05		
423.0	427.7	100	0.05		
427.7	431.7	100	0.06		
431.7	434.5	100	0.05		
434.5	439.0	100	0.05		
439.0	443.5	100	0.05		
443.5	448.0	100	0.10		
448.0	453.0	100	0.02		
453.0	458.0	100	0.07		
458.0	462.5	100	0.07		
462.5	467.0	100	0.10		
467.0	471.0	100	0.22		
471.0	475.5	100	0.53		

FROM	TO	CORE RECOVERY PERCENT	ANALYSES PERCENT Cu	Pb	Zn
448.6	450.0	93	0.02	0.05	0.15
450.0	455.0	92	0.04	0.05	0.40
455.0	460.0	94	0.06	0.05	0.10
460.0	462.7	100	0.01	0.05	Tr
462.7	464.0	85	0.03	0.05	Tr
464.0	466.1	100	0.02	0.05	Tr
466.1	467.6	67	0.02	0.05	Tr
467.6	468.1	100	0.02	0.05	Tr
468.1	470.1	100	0.01	0.05	Nil
470.1	472.7	100	0.01	0.05	0.10
472.7	474.4	100	0.03	0.05	Tr
474.4	476.8	100	0.02	0.05	Tr
476.8	482.2	100	0.06	0.30	0.15
482.2	487.0	100	1.05	0.15	0.55
487.0	493.0	100	0.07	0.05	0.15
493.0	495.3	100	0.10	0.13	0.10
470.6	473.2	100	0.05	0.05	0.05
464.5	470.6	100	0.07	0.05	0.05
460.7	464.5	100	0.05	0.10	Tr
458.0	460.7	100	0.02	0.20	Tr
453.0	458.0	100	0.05	0.05	Tr
450.0	453.0	100	0.07	0.07	0.05
442.8	450.0	100	0.17	0.50	1.45
441.0	442.8	100	0.27	0.35	2.65

Figure 3. - Sections on Bureau of Mines drill holes.

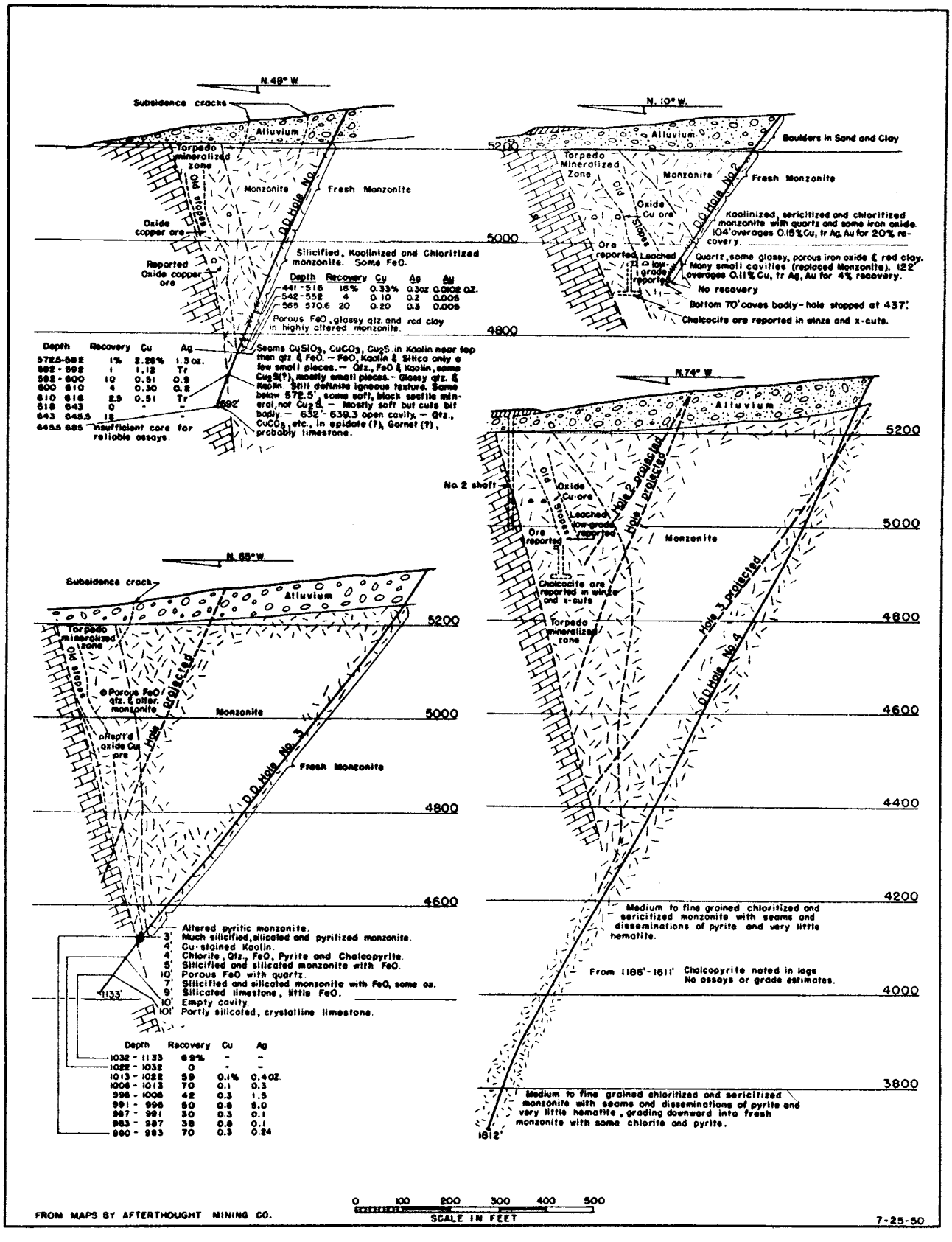

Figure 4. - Sections on drill holes A1, A2, A3, and A4.

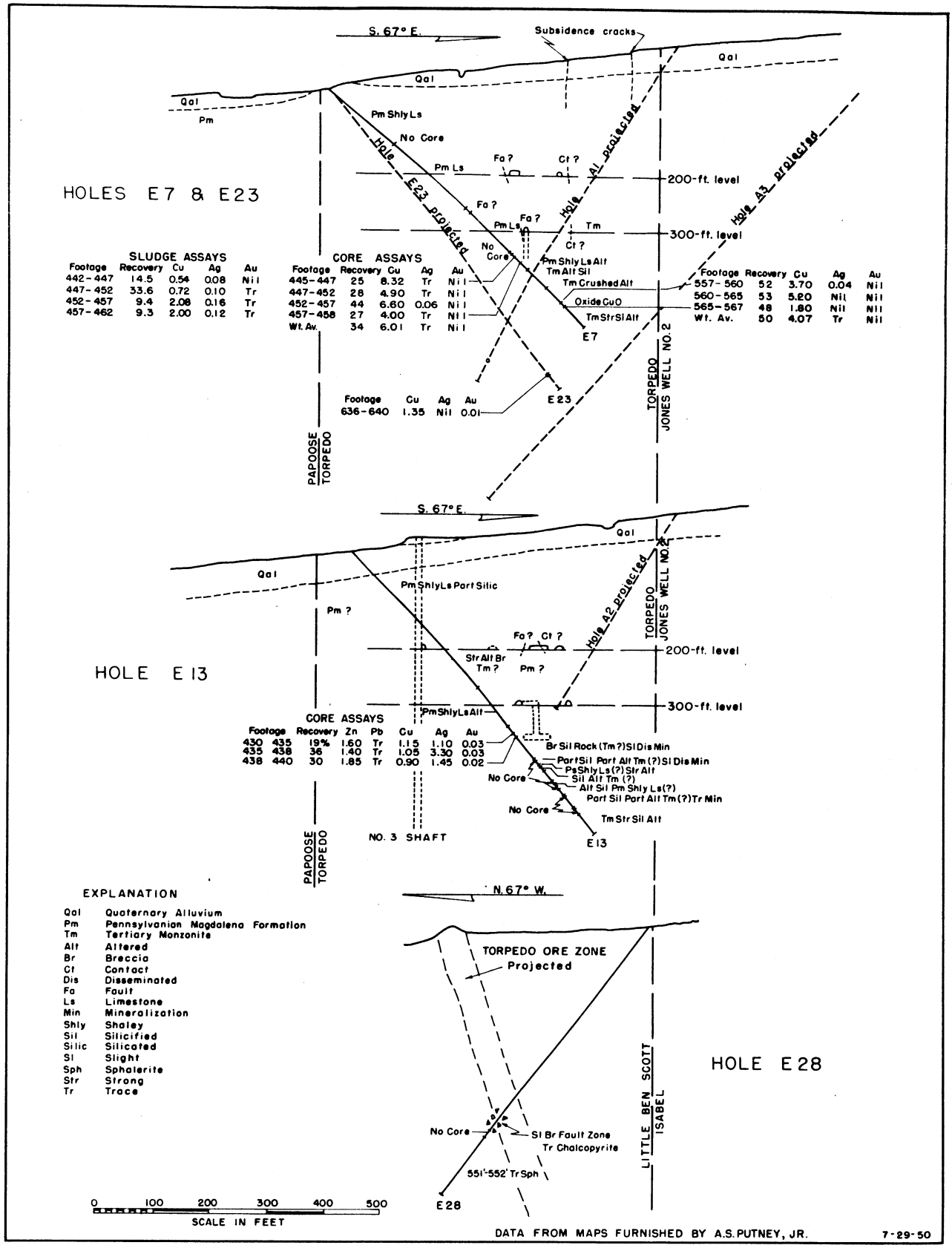

Figure 5. - Sections on drill holes E7, E13, E23, and E28.

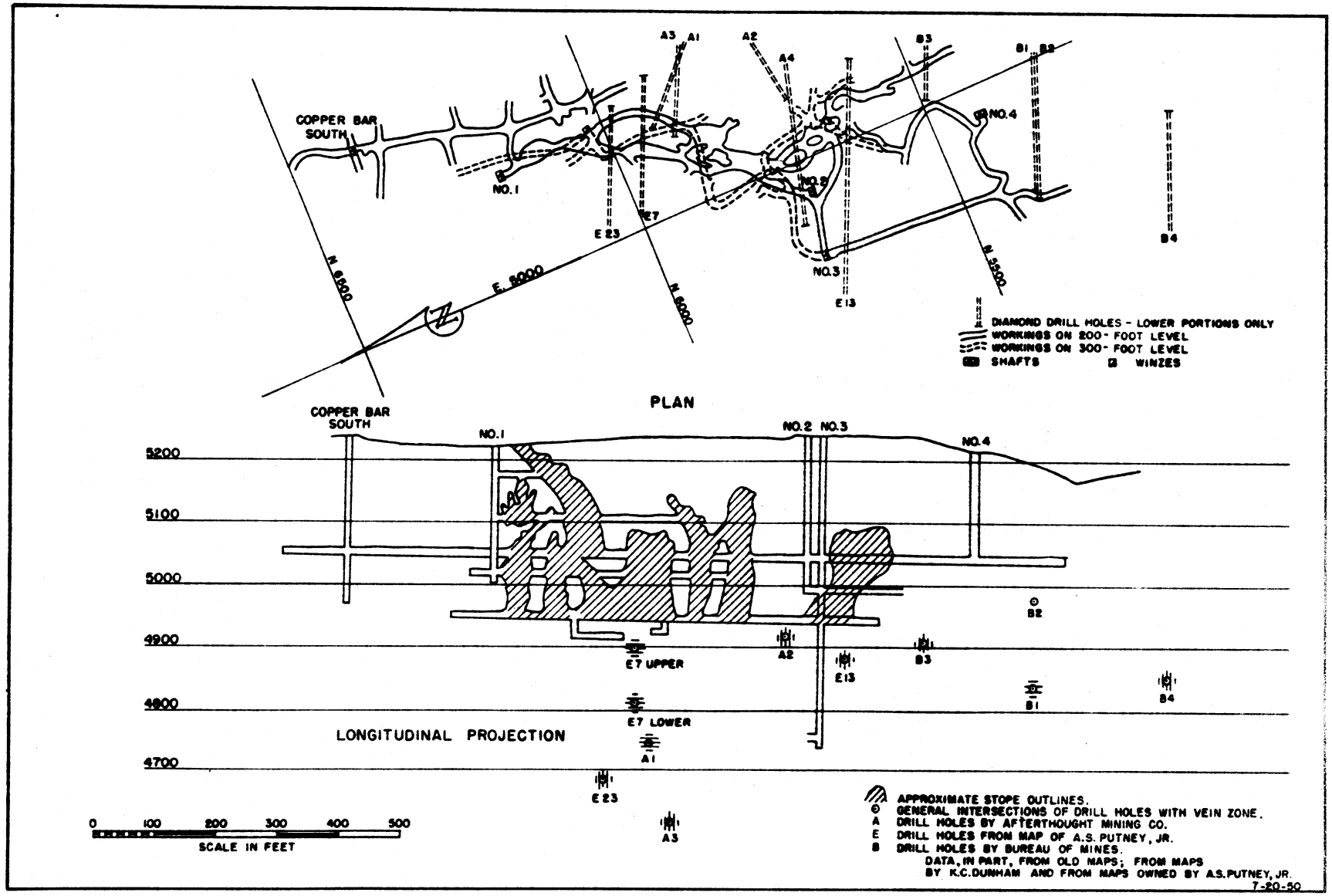

Figure 6. - Underground workings.

The monzonite east of the zone of ore bodies shows weathering effects near the surface. It becomes fresh with depth and contains specks and small stringers of pyrite. It is virtually barren of copper. Upon approaching the mineralized zone, it becomes hydrothermally altered but still retains its texture.

The limestone west of the zone is garnetized and silicified in part, although much of the limestone shows only slight alteration. The garnetization apparently extends, in favorable beds, over 200 feet from the monzonite contact. A few specks of sphalerite and galena were noted at rare intervals in the limestone core.

The above data are derived mainly from study of cores obtained by the Bureau of Mines. The underground workings were not accessible for inspection.

Judging from the stoped areas (see fig. 6) the individual ore bodies were elliptical in plan and generally steeply plunging, whereas the zone of the ore bodies seems to have a definite rake to the south. Only one of the ore bodies outcrops, and the discovery was made here. According to old smelter settlements,5/ most of the ore was produced from above the 300-foot level and was oxidized. The sulfur content was very low until the lower levels were mined. The ore mineral was chrysacolla with local occurrences of native copper. All ore minerals noted in the drill cores were the sulfides chalcopyrite, sphalerite, and galena. The gangue mineral seen in drill cores was silica, usually as the siliceous breccia.

DEVELOPMENT

The Torpedo mine was developed through four vertical shafts. No. 1 shaft is near the discovery and is shown to be a little over 200 feet deep (fig. 6). Shaft 2 is 250 feet deep, No. 3 is 500 feet, and No. 4 is 165 feet. All of these shafts are interconnected by lateral workings, which also extend north and connect with the Copper Bar south shaft. Most of the stopes were between No. 1 and No. 2 shaft, with another shown just south of No. 2 shaft. None of these workings were accessible in April 1950.

WORK BY THE BUREAU OF MINES

The development work by the Bureau of Mines was started October 3, 1949, and completed April 30, 1950. Because none of the mine workings were accessible, the work was confined to diamond core drilling, and all data were obtained therefrom. Four holes were drilled for a total of 2,122.3 feet.

All drilling was done with a Government-owned, medium-sized machine with hydraulic-feet drill head. Special large rods and special core barrels were used to obtain better core recovery in the critical zones than was possible with the standard-type tools previously used in this area. Core recovery in the ore zones is shown in figure 3, and total core recovery is shown in the summary logs that follow.

Seventy samples were split from the cores and analysed. Many were known to be low-grade. Analyses of the samples are shown in figure 3 and in the following summary logs of the drill holes.

5/ Dunham, K. C., op. cit., p. 217.

TORPEDO COPPER DESPOSIT

Log of Hole 1

Location: N. 5238.82, E. 5151.77
Elevation of collar: 5,215 ft.
Depth: 597.7 ft.
Dip: -50°
Bearing: N. 67°41' W.

Date begun: Nov. 4, 1949.
Date completed: Dec. 15, 1949.

Footage			Recoveries				Core size	Analyses, percent			Description and remarks
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.		Cu	Pb	Zn	
0.0	24.0	24.0	0	-	0	100	3-1/2"				Weathered monzonite, overburden.
24.0	65.0	41.0	38.5	61,131	94	100	NX				Monzonite.
65.0	100.0	35.0	34.5	52,904	99	95	NX				Monzonite.
100.0	113.2	13.2	11.2	15,829	85	95	NX				Monzonite, scant pyrite.
113.2	113.5	0.3	0.3	525	100	95	NX	0.01			Do.
113.5	269.4	155.9	153.9	263,687	99	95	NX				Do.
269.4	269.7	0.3	0.3	525	100	95	NX	.01			Do.
269.7	269.9	0.2	0.2	350	100	95	NX				Do.
269.9	289.2	19.3	19.3	35,168	100	0	NX				Do.
289.2	303.0	13.7	13.7	23,581	100	85	NX				Do.
303.0	313.3	10.3	10.3	9,291	100	85	BX				Do.
313.3	313.6	0.3	0.3	300	100	85	BX	.01			Do.
313.6	388.5	74.9	74.7	77,023	99	85	BX				Do.
388.5	393.5	5.0	5.0	4,865	100	85	BX	.01			Altered monzonite, scant sulfides.
393.5	398.0	4.5	4.5	5,606	100	85	BX	.06			Do.
398.0	403.0	5.0	5.0	6,578	100	85	BX	.08			Do.
403.0	408.0	5.0	5.0	5,135	100	85	BX	.05			Do.
408.0	413.0	5.0	5.0	5,023	100	85	BX	.16			Do.
413.0	418.0	5.0	5.0	5,850	100	85	BX	.07			Do.
418.0	423.0	5.0	5.0	6,138	100	85	BX	.05			Do.
423.0	427.7	4.7	4.7	5,280	100	85	BX	.05			Do.
427.7	431.7	4.0	4.0	4,666	100	85	BX	.06			Do.
431.7	434.5	2.8	2.8	2,936	100	85	BX	.05			Do.
434.5	439.0	4.5	4.5	4,591	100	85	BX	.05			Do.
439.0	443.5	4.5	4.5	4,912	100	85	BX	.05			Do.

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Hole 1 (Cont.)

Footage			Recoveries				Core size	Analyses, percent			Description and remarks
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.		Cu	Pb	Zn	
443.5	448.0	4.5	4.5	5,148	100	85	BX	0.10			Altered monzonite, scant sulfides.
448.0	453.0	5.0	5.0	5,091	100	85	BX	.02			Do.
453.0	458.0	5.0	5.0	4,720	100	85	BX	.07			Do.
458.0	462.5	4.5	4.5	4,413	100	85	BX	.07			Do.
462.5	467.0	4.5	4.5	3,786	100	85	BX	.10			Do.
467.0	471.0	4.0	4.0	5,068	100	85	BX	.22			Do.
471.0	475.5	4.5	4.5	4,871	100	85	BX	.53			Do.
475.5	480.0	4.5	4.5	4,526	100	85	BX	1.58	0.33	2.4	Do.
480.0	486.0	6.0	3.5	3,921	58	85	BX	6.36	.05	1.9	Do.
486.0	491.0	5.0	5.0	4,643	100	85	BX	3.08	.05	3.7	Do.
491.0	495.0	4.0	4.0	3,368	100	85	BX	9.47	1.14	4.2	Siliceous breccia with sulfides.
495.0	499.0	4.0	4.0	3,725	100	85	BX	2.70	1.00	3.7	Do.
499.0	503.0	4.0	4.0	3,680	100	85	BX	.04			Siliceous breccia, scant sulfides.
503.0	507.5	4.5	4.5	4,151	100	85	BX	.03			Do.
507.5	512.0	4.5	4.5	3,444	100	85	BX	.02			Do.
512.0	517.0	5.0	5.0	3,406	100	85	BX	.10			Do.
517.0	522.0	5.0	5.0	3,993	100	85	BX	.02			Do.
522.0	526.5	4.5	4.5	2,690	100	85	BX	.02			Do.
526.5	531.0	4.5	4.5	2,133	100	85	BX	.02			Do.
531.0	535.5	4.5	4.5	4,310	100	85	BX	.02			Do.
535.5	540.0	4.5	4.5	2,897	100	85	AX	.02			Do.
540.0	545.0	5.0	5.0	1,996	100	85	AX	.02			Do.
545.0	550.0	5.0	5.0	2,013	100	85	AX	.02			Do.
550.0	554.5	4.5	4.5	2,185	100	85	AX	.02			Do.
554.5	559.0	4.5	4.5	2,173	100	85	AX	.02			Do.
559.0	565.5	6.5	6.5	2,613	100	85	AX				Do.
565.5	594.3	28.8	9.4	3,012	33	75	AX				Siliceous breccia and fault gouge.
594.3	597.7	3.4	2.4	673	71	50	AX				Fault gouge, limestone fragments.

Log of Hole 2

Location: N. 5240, E. 5150
Elevation of collar: 5,216 ft.
Depth: 489.5 ft.
Dip: -37°
Bearing: N. 67°41' W.

Date begun: Dec. 16, 1949.
Date completed: Jan. 25, 1950.

Footage			Recoveries				Core	Analyses, percent			
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.	size	Cu	Pb	Zn	Description and remarks
0.0	9.5	9.5	2.1	2,329	22	100	3-1/2"				Weathered monzonite, overburden.
9.5	34.0	24.5	8.3	17,404	34	100	do.				Do.
34.0	42.5	8.5	8.5	13,267	100	100	NX				Monzonite, scant pyrite.
42.5	249.0	206.5	205.8	355,467	99	95	do.				Do.
249.0	253.6	4.6	4.6	7,585	100	0	do.				Do.
253.6	280.0	26.4	26.4	45,043	100	100	do.				Do.
280.0	287.0	7.0	7.0	11,710	100	0	do.				Do.
287.0	313.5	26.5	26.5	45,871	100	90	do.				Do.
313.5	349.0	35.5	35.5	62,325	100	90	do.				Do.
349.0	358.6	9.6	9.6	17,603	100	90	do.	0.02	0.05	0.1	Altered limestone.
358.6	368.6	10.0	10.0	20,220	100	90	do.	.04	.05	.4	Do.
368.6	377.0	8.4	8.4	13,447	100	90	do.	.08	.05	.7	Do.
377.0	388.6	11.6	11.6	21,535	100	90	do.				Do.
388.6	405.0	16.4	14.6	21,183	88	90	do.				Fault gouge and breccia.
405.0	408.0	3.0	2.6	4,075	88	90	do.	.05			Crumbly pyrite.
408.0	412.0	4.0	4.0	7,520	100	90	do.	.12			Do.
412.0	442.0	30.0	30.0	42,705	100	90	do.				Siliceous breccia, fault gouge, pyrite.
442.0	482.2	40.2	36.3	48.635	90	90	do.				Breccia, shale?, sandstone?, pyrite.
482.2	486.5	4.3	4.3	5,102	100	90	do.	.02			Breccia, silicated material, scant pyrite.
486.5	489.5	3.0	2.5	3,934	83	90	do.				Brecia, shale, and calcite.

Log of Hole No. 3

Location: N. 5367.21, E. 5317.11
Elevation of Collar: 5286.46
Depth: 524.6 ft.
Dip: -50°
Bearing: N. 67°41' W.

Date begun: January 26, 1950
Date completed: March 14, 1950

Footage			Recoveries				Core	Analyses Percent			
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.	size	Cu	Pb	Zn	Description and remarks
0.0	49.0	49.0	1.7	3,762	3	95	3-1/2"				Weathered monzonite, overburden.
49.0	66.5	17.5	16.8	21,520	96	95	NX				Weathered, altered monzonite.
66.5	220.5	154.0	151.5	268,569	98	90	do.				Monzonite, scant pyrite.
220.5	448.6	228.1	224.7	389,629	99	90	do.				Altered monzonite, disseminated pyrite.
448.6	450.0	1.4	1.3	1,979	93	90	do.	0.02	-0.05	0.15	Do.
450.0	455.0	5.0	4.6	6,464	92	90	do.	.04	-.04	.04	Do.
455.0	460.0	5.0	4.7	3,798	94	90	BX	.06	-.05	.1	Do.
460.0	462.7	2.7	2.7	2,215	100	90	do.	.01	-.05	Tr	Do.
462.7	464.0	1.3	1.1	800	85	90	do.	.03	.05	Tr	Do.
464.0	466.1	2.1	2.1	1,923	100	90	do.	.02	-.05	Tr	Do.
466.1	467.6	1.5	1.0	551	67	90	do.	.02	-.05	Tr	Do.
467.6	468.1	0.5	0.5	100	100	90	do.	.02	-.05	Tr	Do.
468.1	470.1	2.0	2.0	1,419	100	90	do.	.01	-.05	Nil	Do.
470.1	472.7	2.6	2.6	1,491	100	90	do.	.01	-.05	0.1	Do.
472.7	474.4	1.7	1.7	1,468	100	90	do.	.03	-.05	Tr	Do.
474.4	478.8	4.4	4.3	2,931	98	85	do.	.02	-.05	Tr	Do.
478.8	482.2	3.4	3.4	3,204	100	80	do.	.06	.30	0.15	Vein material.
482.2	487.0	4.8	4.8	4,579	100	80	do.	1.05	.15	.55	Do.
487.0	493.0	6.0	6.0	4,404	100	75	do.	.07	.05	.15	Do.
493.0	498.7	5.7	5.7	4,982	100	60	do.	.10	.13	.1	Do. Sample to 495.3, then breccia
498.7	499.5	0.8	0.8	612	100	75	do.				Siliceous breccia.
499.5	524.6	25.1	13.3	9,848	53	75	do.				Do.

Log of Hole 4

Location: N. 5268.66, E. 4502.33
Elevation of Collar: 5,172.71 ft.
Depth: 510.5 ft.
Dip: -45°
Bearing: S. 67°41' E.

Date begun: Mar. 13, 1950.
Date completed: Apr. 25, 1950.

Footage			Recoveries				Core size	Analyses, percent			Description and remarks
			Core		Percent						
From	To	Feet	Feet	Grams	Core	Wtr.		Cu	Pb	Zn	
0.0	21.0	21.0	0.0	0	0	100	3-1/2"				Overburden.
21.0	26.2	5.2	5.2	10,829	100	100	NX.				Garnet.
26.2	44.0	17.8	13.9	17,542	78	90	do.				Garnet and breccia.
44.0	56.1	12.1	12.0	23,305	99	90	do.				Garnet.
56.1	86.0	29.9	29.9	44,859	100	100	do.				Altered, silicated limestone.
86.0	176.2	90.2	90.2	173,525	100	87	do.				Slightly altered limestone.
176.2	342.0	165.8	135.8	140,511	82	90	BX				Do.
342.0	380.0	38.0	31.8	27,067	84	90	do.				Siliceous breccia and pryite.
380.0	394.6	14.6	13.5	8,315	92	90	do.				Fault gouge.
394.6	400.0	5.4	5.4	5,885	100	90	do.				Siliceous breccia.
400.0	420.5	20.5	17.4	15,711	85	90	do.				Siliceous breccia and pyrite.
402.3	440.0	37.7	31.7	25,545	84	90	do.				Do. Hole deflected at 402.3.
440.0	442.8	2.8	2.8	2,253	100	90	do.	0.27	0.35	2.65	Siliceous breccia with sulfides at 441 ft.
442.8	450.0	7.2	7.2	5,970	100	90	do.	.17	.20	1.45	Siliceous breccia with sulfides.
450.0	453.0	3.0	3.0	2,590	100	90	do.	.07	.07	.05	Breccia with pyrite.
453.0	458.0	5.0	5.0	4,928	100	90	do.	.05	.05	Tr	Do.
458.0	460.7	2.7	2.7	2,936	100	90	do.	.02	.02	Tr	Do.
460.7	464.5	3.8	3.8	4,603	100	90	do.	.05	.10	Tr	Do.
464.5	470.6	6.1	6.1	5,651	100	90	do.	.07	-.05	.05	Do.
470.6	478.0	7.4	7.4	7,499	100	90	do.	.05	-.05	.05	Do. Sample to 473.2, then monzonite.
478.0	510.5	32.5	31.5	16,440	97	90	AX				Monzonite.

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Interior - Bureau of Mines, Pittsburgh, Pa.

Bureau of Mines
Report of Investigations 4860

DIAMOND DRILLING AT TORPEDO COPPER MINE, ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

BY JOHN H. SOULÉ

United States Department of the Interior—March 1952

DIAMOND DRILLING AT TORPEDO COPPER MINE, ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

BY JOHN H. SOULE

* * * * * * * * * **Report of Investigations 4860**

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary
BUREAU OF MINES
J. J. Forbes, Director

Work on manuscript completed October 1950. The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is made: "Reprinted from Bureau of Mines Report of Investigations 4860."

March 1952

DIAMOND DRILLING AT TORPEDO COPPER MINE, ORGAN MINING DISTRICT, DONA ANA COUNTY, N. MEX.

by

John H. Soulé[1]

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1/ Mining engineer, Bureau of Mines.

Report of Investigations 4860

INTRODUCTION AND SUMMARY

The Torpedo Copper mine in the Organ Mining District, Dona Ana County, N. Mex., was discovered in 1899. Production was begun immediately and continued until 1907. Since 1907 very little ore has been produced, although many individuals and companies have been interested in the property at one time or another. Approximately 6,621 feet of diamond-core drilling had been completed on the property before 1949. The results from some of this drilling were unsatisfactory because of the poor core recovery. In addition to its investigation of the Torpedo ore deposits, attention was given by the Bureau of Mines to obtaining better core recovery through the use of special equipment and techniques.

This project was begun October 3, 1949, and was completed April 30, 1950. Four diamond-drill holes totaling 2,140.5 feet, which includes 18.2 feet of overlap in a deflected hole, were drilled. All drilling was done with a Government-owned hydraulic-feed drill with some special rods and core barrels, in addition to the usual equipment.

The over-all core recovery was 89.5 percent. Omitting the drilling in overburden where little or no core was desired, the recovery was 94.6 percent. Core recovery in the ore zones averaged 95.2 percent.

This paper describes the location, the general features of the area, the geology, the Bureau of Mines procedures, and the results attained by these procedures.

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Acknowledgment also is due to H. W. Foester, representative of the E. J. Longyear Co., for his cooperation and suggestions in the testing of the experimental L-Series core barrel and bits.

LOCATION AND ACCESSIBILITY

The Bureau of Mines drilling was confined to the Torpedo claim, in the NW1/4 sec. 1, T. 22 S., R. 3 E., in the Organ mining district, Dona Ana County, N. Mex. This area is 1/2 mile east of the town of Organ and is just

south of U. S. Highway 70 (see fig. 1). The property is easily accessible from Organ, as dirt roads reach each drill site as well as other parts of the area. Organ is 12.5 miles northeast of Las Cruces.

GENERAL INFORMATION

The foothill topography of the Torpedo and adjoining claims is not generally rugged, and the relief is not great. The mountains become steep and rugged southeast of the mine. The altitude of the project area vari s from 5,160 to 5,340 feet, as shown in figure 2.

The weather is generally good, although windy in the spring. Summers are not too hot, and the freezing weather in the winter is neither prolonged nor intense. The average annual precipitation is about 10 inches, largely as summer thundershowers. Winter snows are usually light and stay on the ground for only short periods of time.

There are no permanent streams, and the water table is about 300 feet below the surface. Drilling water was pumped from a depth of 317 feet in an old shaft. The country is arid, and the usual desert flora are present.

There is no skilled labor at Organ, and all such must be imported. The Bureau of Mines procured its labor from the Central mining district in Grant County, 125 miles to the northwest. Living accommodations at Organ are limited and primitive, and only the barest necessities may be purchased.

The Torpedo mine was discovered in 1899 and actively operated until 1907. Since that time, production has been sporadic, although many individuals and companies have been interested in the district. The total production from the Torpedo mine has been about 3,500,000 pounds of copper and a little silver.

GENERAL GEOLOGY

The most prominent geological feature of the Torpedo mine is the strong north-south trending, steeply dipping shear zone between the monzonite on the east and the Paleozoic limestones on the west. This zone contains the ore bodies and consists largely of monzonite, which has been silicified and highly altered, brecciated, and recemented with silica. Some altered limestone was noted in the drill core from the zone. A number of the faults of this shear zone apparently had considerable displacement, and the over-all displacement in the shear zone was large.

The monzonite is weathered at the surface and usually is covered by a few feet of rock overburden. Beneath the weathering, the monzonite is quite fresh and remains so, although some silicification may occur. Hydrothermal alteration is noticed before reaching the breccia zone, but the general texture of the monzonite is retained.

As shown in Bureau of Mines hole 4, the limestone is usually only slightly altered for the most part, although some beds are garnetized or otherwise silicated. Garnetization was noted over 200 feet from the breccia zone in some beds.

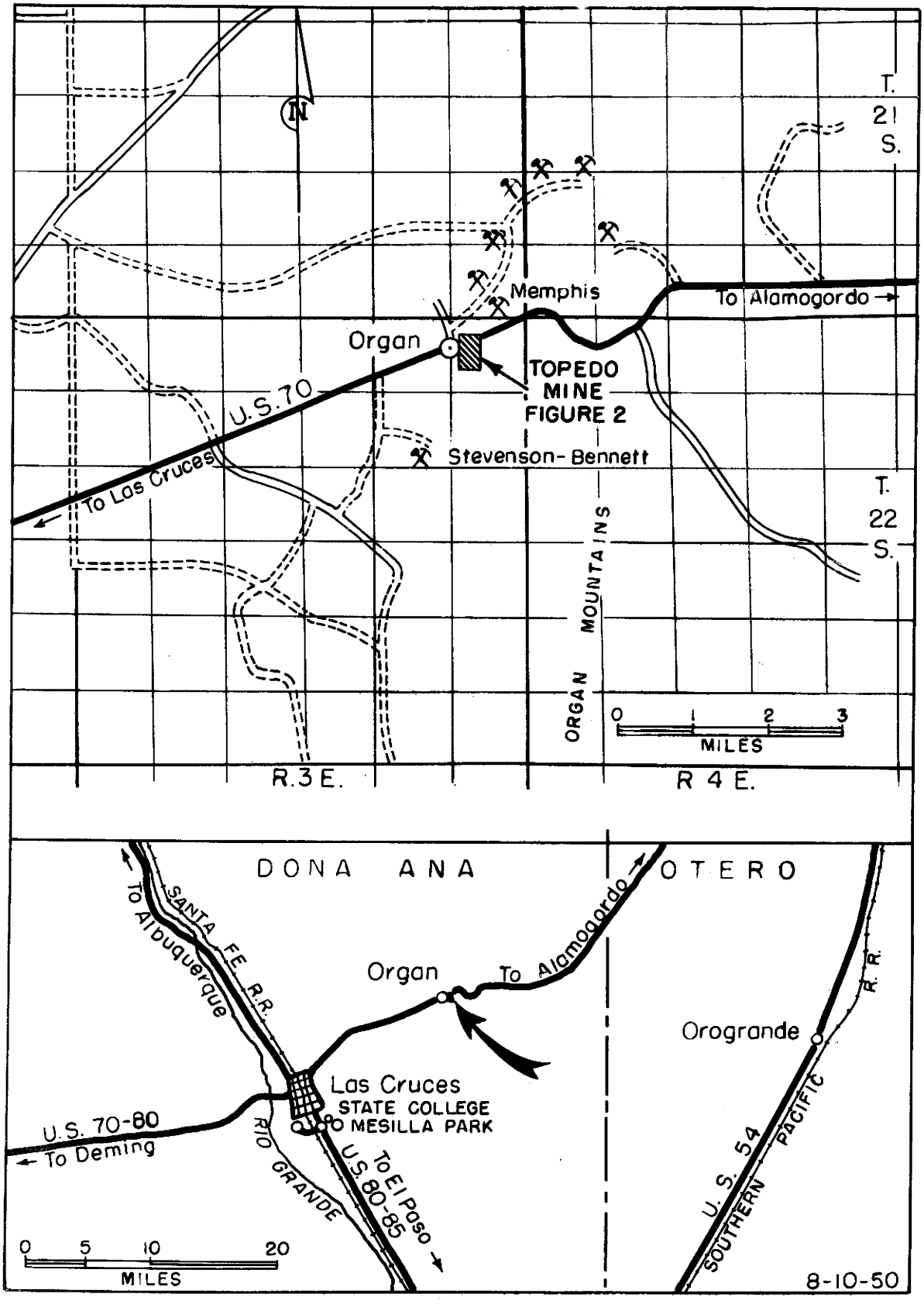

Figure 1. - Location map, Torpedo copper deposit, Dona Ana County, N. Mex.

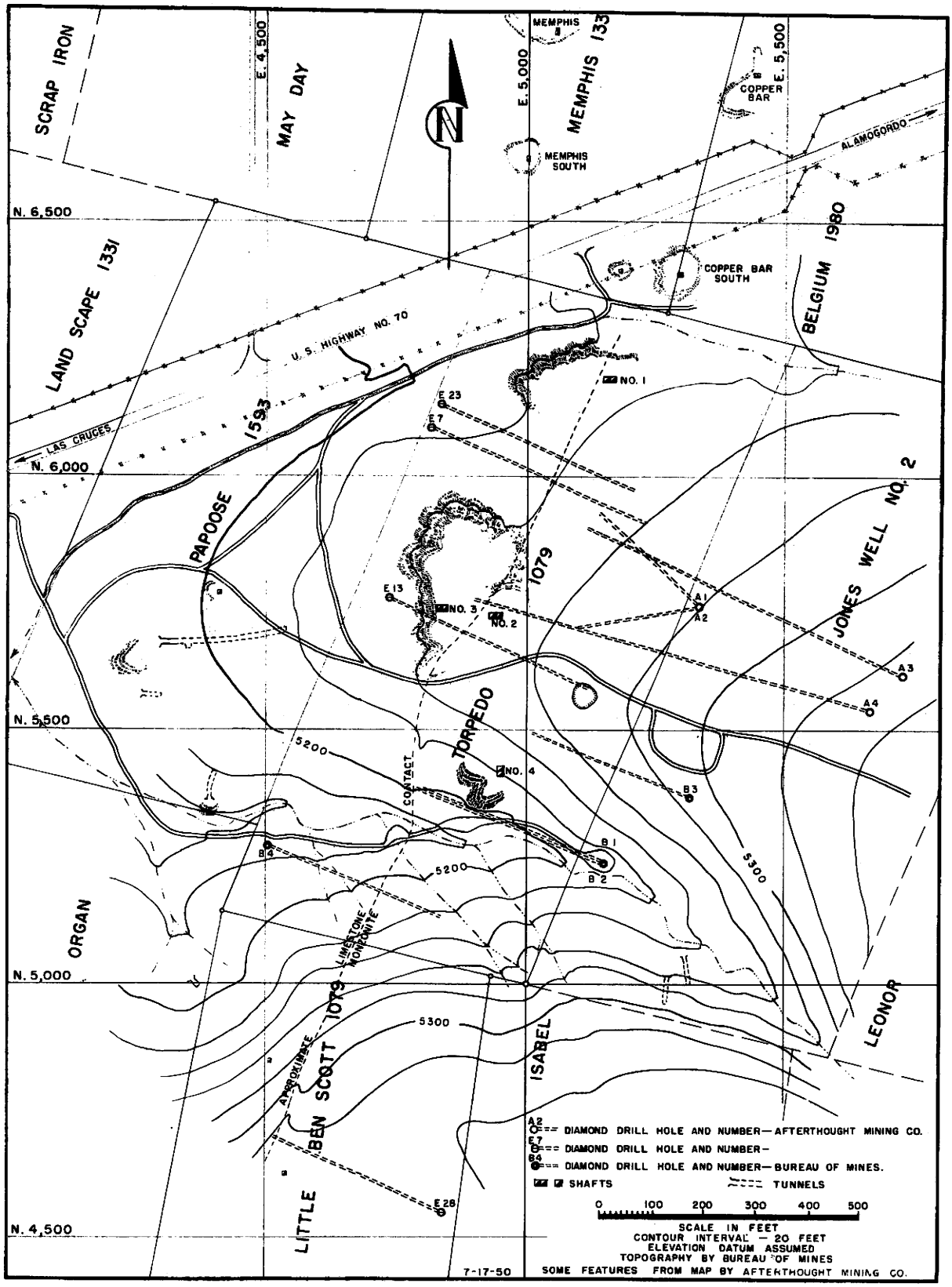

Figure 2. - Topographic and surface map.

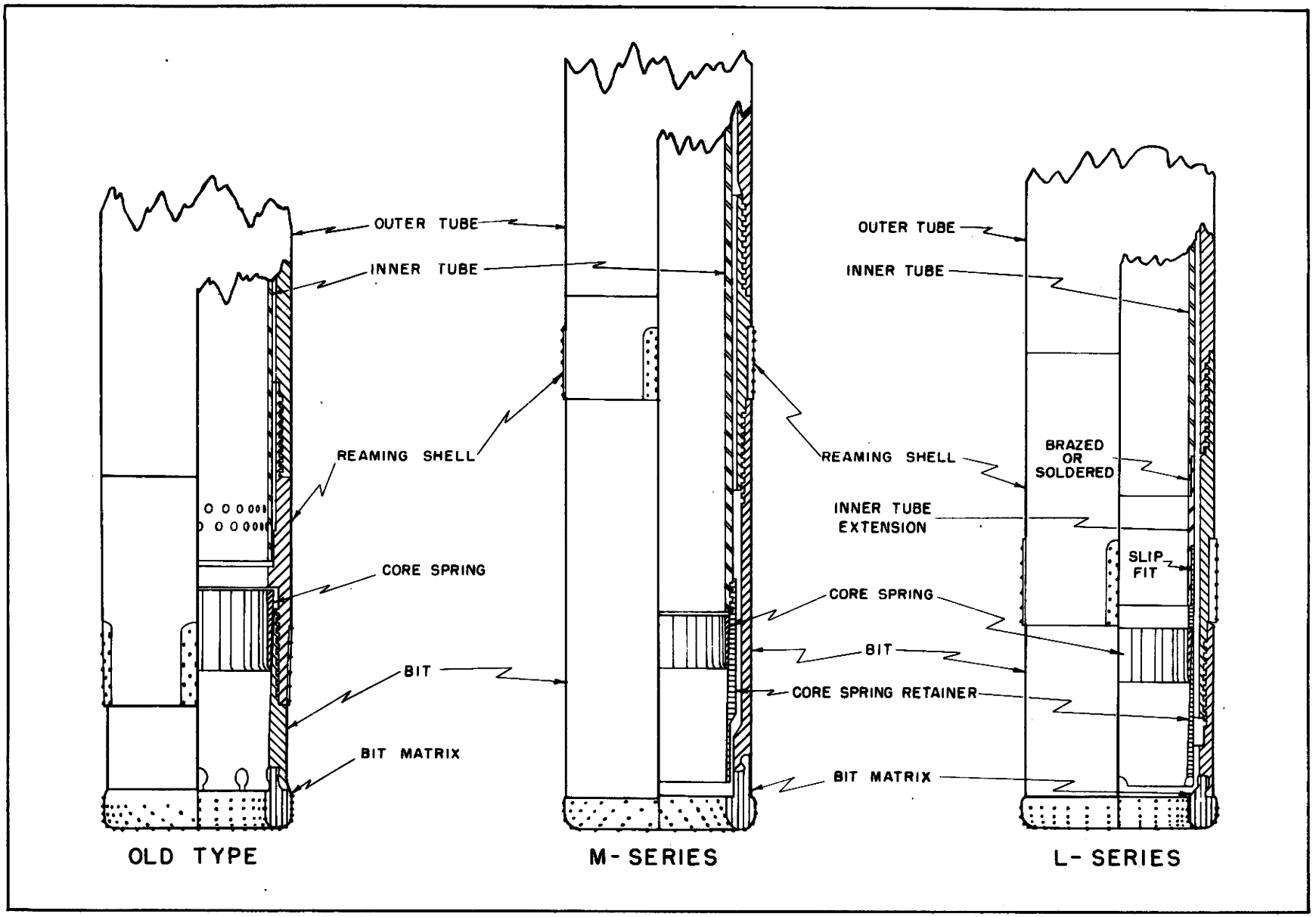

Figure 3. - Core-barrel diamond-bit assemblies.

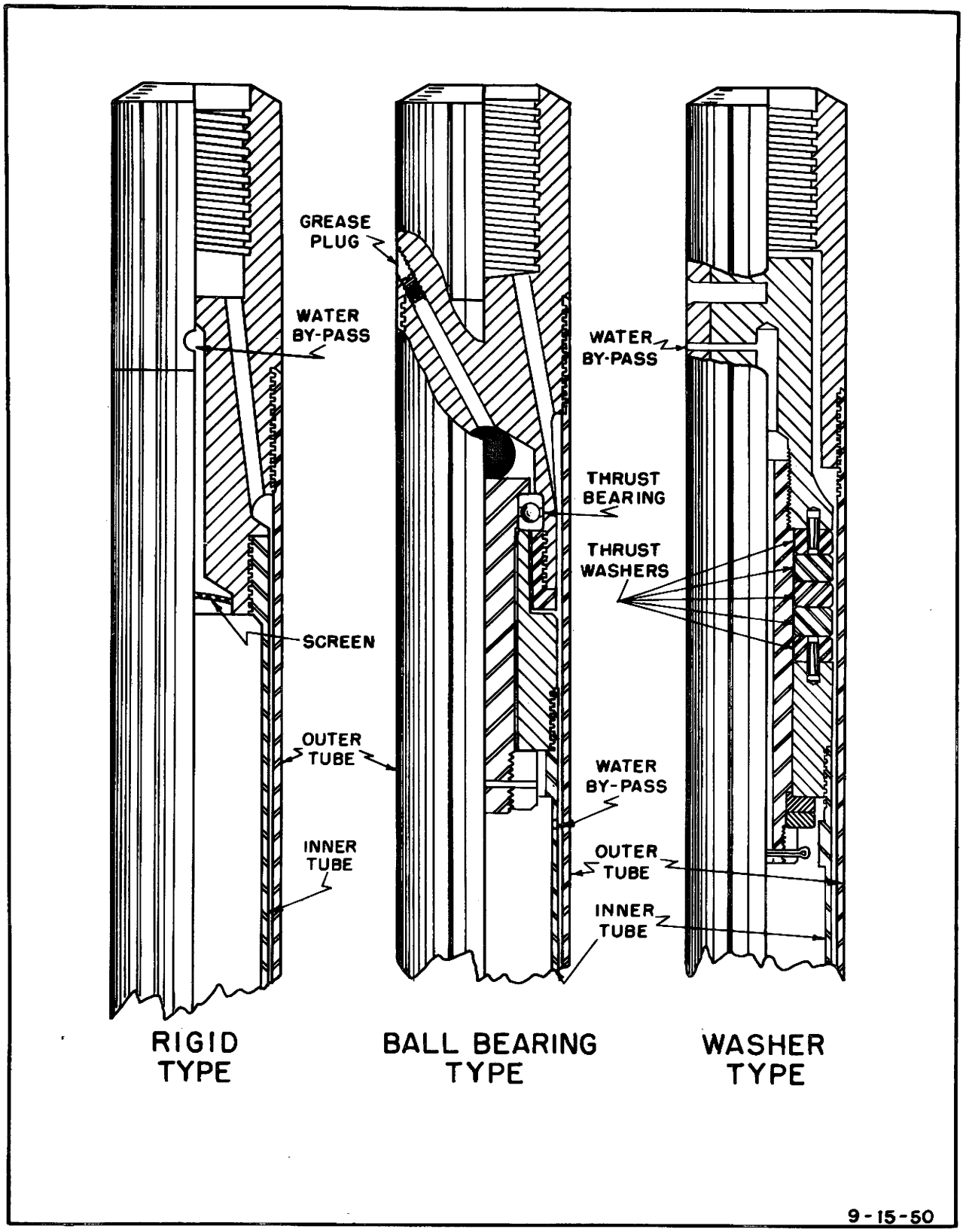

Figure 4. - Core-barrel backhead assemblies.

All of the rocks are jointed and fractured, and a piece of core over 2 feet long, was rarely taken from the core barrel, most pieces being 6 inches or less. This characteristic, as well as the fault gouges and breccias, may be in part responsible for the poor core recovery in previous drilling.

DIAMOND-DRILLING EQUIPMENT

A Government-owned, gasoline-engine-powered, skid-mounted drill having a rated capacity of 1,400 feet of A rod was used in this drilling. The drill was equipped with a closed-circuit, oil-activated hydraulic-feed head quilled for an A rod. The water was circulated by a three-cylinder, plunger-type, gasoline-engine-powered pump having porcelain-coated cylinder liners. A bail-type water swivel was used most of the time. A full complement of accessories, fishing tools, and other tools was available, as well as oxyacetylene welding equipment, which proved very useful a number of times. A heavy pole tripod was standard equipment.

Standard rods, fittings, and casing were available for AX drilling. Those used for NX and BX drilling were largely of special types or sizes and were purchased for the project. Most BX and NX casing was the heavy-duty-drive type used in anticipation of driving through the overburden; however, driving was not necessary. All larger-size rods were special, being termed BXO and NXO. The following tabulation describes the difference between the special rods and old standards.

	Outside diameter, inches	Wall thickness, inches	Weight per 10 feet, pounds
B rod.....	1-7/8	1/4	45
BXO rod.....	2-3/16	1/4	56
N rod.....	2-3/8	3/16	49
NXO rod.....	2-3/4	3/16	60

Most of the drilling was done with M-series core barrels and bits; a little work was done near the end of the project with an experimental L-series core barrel and bits in BX size. Figure 3 shows the lower or bit-end assemblies of the Standard, M-series, and L-series core barrels.

Figure 4 shows the back-head assemblies tried in this work. The bearing type, with a later replacement containing tapered roller bearings, was used most of the time. The washer type was used only in part of the last hole.

DIAMOND-DRILLING PROCEDURES

Only one of the drill operators had had any previous experience with a hydraulic feed head. The ability of the operators ranged from excellent to poor.

The need for special techniques of operation did not arise. The usual precautions any first-class drill operator would follow were used. Core recovery rather than speed was stressed repeatedly. Immediate pulling upon sign of a block was emphasized, but it is suspected that this was not always

done, especially after a very short run. It also was desired to use as little water as possible consistent with good drilling practice, but only the most-experienced men followed this. The less-experienced men seemed unable to grasp the idea and always tended to use an excess of water.

Care of the equipment was demanded at all times, but there was a tendency for the less-experienced men to forego greasing the machine and equipment and keeping it in perfect operating condition. It was difficult to keep the equipment clean at all times, usually because of neglect. It was standard practice to clean the equipment during delays owing to cementing or other causes.

The usual cementing techniques were followed. In cementing for cave or if cementing for water loss below the water table, all cement was inserted through the drill rods, which were cleaned immediately after the operation. The use of pellets of moist cement was resorted to a few times when it seemed that moving water in the hole would wash away cement inserted in a slurry form. In general, cementing was not particularly difficult, and rarely was a section of hole cemented more than two times to effect the desired results. One high-early-strength hydraulic cement was used throughout most of the work. Other cements tried when the hydraulic cement was not available were unsatisfactory, although some were of the high-early-strength type.

Most casing was thoroughly greased before being inserted in the hole, and no greased casing was lost. It appeared that one of the most important precautions to follow in casing a hole is to effect a perfect seal with the bottom of the hole. This will prevent return water from coming up outside the casing and washing away the grease, as well as serve to keep the fine cuttings from entering and settling around the outside of the casing. This was noted a time or two when a perfect seal was not effected and virtually all grease was washed from the casing and some sludge had settled behind it. One hundred fifty-three feet of BX casing was lost in hole 1 because the casing was not greased and, also, probably because the hole was under gage. No reaming shells were available at the start of this hole, and bits were issued in progressively smaller gage.

The drill rods were kept well-greased, two different greases being used. A universal joint grease was tried first and appeared to be beneficial in preventing caving of small particles in the hole, but it did not remain on the rods as well as was desired. The other grease was excellent for rods but may not be heavy enough to hold the walls of a hole in those areas where the slight support of a heavy grease might be advantageous.

All core was removed from the core barrel into a trough, made of an 11-foot piece of 2-1/2-inch pipe split lengthwise, with a piece of mild steel welded to one end to prevent its tipping over. The core was washed, if necessary, measured, and transferred to cardboard core boxes holding about 10 feet of core. Boxed core was then taken to the weighing shed where it was logged, remeasured, weighed, and split if desired. One half of the split portions were analyzed, and the remaining core was sent to a permanent core storage in Tucson, Ariz.

DRILLING DATA AND COSTS

A total of 2,140.5 feet was drilled in four holes, of which 18.2 feet was overlap drilling in an unintentionally deflected hole. Two holes were inclined at minus 50°, one at minus 45°, and one at minus 37°. All holes were drilled with an NX casing bit through the overburden to bedrock, then cased, and continued with NX size. Size was reduced when necessary or desirable.

In drilling 2,140.5 feet of hole, 413 pulls were made, an average of 5.18 feet drilled before blocking. With the NX double-tube, rigid type core barrel 5 ft. long, used before the receipt of the M-series equipment, an average of 3.73 feet was drilled before a block occurred. All other core barrels were 10 feet long. The remaining NX drilling averaged 5.23 feet per block, the BX drilling averaged 4.97 feet, and the AX drilling averaged 5.31 feet. Bit size seemed to have little effect on the frequency of blocking.

The 2,140.5 feet of hole were drilled in 197 drill shifts, an average of 10.87 feet per shift. Omitting six shifts spent jarring casing out of hole 1 but including every other delay, such as repairing equipment, moving, and setting up, waiting for cement to set, and other delays, drilling used 191 shifts, with an average of 11.21 feet per drill shift. Total labor amounted to 552 man-shifts, of which 192 were charged to sampling and the remainder to drilling.

The 111 bits used during the project are tabulated below.

Bit size and type	Number used
NX casing bits	8
NX standard bevel wall bits	3
NX M-series bits	62
BX M-series bits	29
BX L-series bits	5
AX M-series bits	4

The average footage drilled per bit was 19.28.

In addition to the drilling, 1,531 feet of casing was inserted into the holes. This includes overlap, and only 1,270 feet of hole was cased. A total of 684.8 feet of cemented hole was drilled out. Seventy samples were split from the cores and analyzed.

The drilling cost for the project was $14,327.51, which does not include the full cost of new equipment purchased. A portion of the cost of the new special rods, casing, and other equipment was charged according to the estimated amount of use they received. All transportation costs on equipment, as well as the cost of equipment lost or damaged, was fully charged to the project. All repair costs were fully charged, as well as an estimated cost for the use of equipment not purchased. No sampling costs are included.

The following table shows the distribution of the charges and the cost per foot:

TABLE 1. - Drilling costs

Item	Amount	Cost per foot
Labor	$4,941.07	$2.308
Supplies 1/	2,139.47	1.000
Supervision	2,904.55	1.357
Transportation 2/	294.81	0.138
Diamond bits	4,047.61	1.891
Total	$14,327.51	$6.694

1/ Includes an estimated amount for core barrels.
2/ Does not include express or freight on supplies. These are charged to supplies. Transportation includes the use of automotive equipment to haul water and for use around the project.

All diamond bits were handled through the Mount Weather, Va., Branch of the Bureau of Mines. All worn bits were sent to the Mount Weather Station, where they were examined and pertinent data were recorded; they then were sent to a bit manufacturer for resetting. The diamonds were reclaimed from the used bits, those not usable in a new bit being replaced with new stones. The cost of the new stones plus the setting charge, which consists of a new blank bit and the setting of the stones in their matrix in the blank, constitutes the cost of the bit. The setting charges vary from $6.20 to $24 per bit depending upon the bit type and size. The diamonds cost $4.20 to $11 per carat, depending on the grade. Table 2 shows the diamond consumption of each size and type of bit, while table 3 shows the diamond consumption for each different grade of diamond. These figures are indicative and not necessarily conclusive for two reasons: First, in some of the items not enough data are presented, being based upon the results obtained from too small a number of bits; and second, the distribution of the quality of the diamonds between the different bit sizes and types as well as the type of ground drilled is not constant. However, this distribution is broad enough to give credence to some of the figures.

Two major things are noted from the results given in table 2. Neglecting the BX L-series item, the per-foot bit costs are directly comparable to the size of the bit. It will be noticed that the bit costs decrease as the bit size decreases. Second, it is noted that bit costs rise when core is ground as shown in the NX casing and BX L-series items.

Table 3, based on the quality of the diamonds used and neglecting the two entries where only one bit was used, shows an advantage in using the cheaper diamonds. The use of cheapest diamonds resulted in less diamond wear as well as lower diamond costs per foot drilled.

TABLE 2. Diamond losses and costs by bit type and size

Item	Bits used	Feet drilled1/	Diamond loss		Diamond loss, carats		Cost in dollars2/	
			Carats	Dollars2/	Per bit	Per ft.	Per bit	Per ft.
NX casing	8	128.0	67.71	791.27	8.464	3/0.529	$98.91	3/$6.182
NX bevelwall	3	100.0	13.15	181.74	4.383	.132	60.58	1.817
NX M-Series	62	1,210.4	200.22	1,807.07	3.229	.165	29.15	1.493
BX M-Series	29	511.6	80.65	762.85	2.781	.158	26.31	1.491
BX L-Series	5	109.7	44.45	389.12	8.890	3/.405	77.82	3/3.547
AX M-Series	4	113.9	9.93	115.56	2.483	.087	28.89	1.015
Total	111	2,173.6	416.11	$4,047.61				
			Over-all average		3.749	.191	$36.46	$1.862

1/ Includes small footage drilled on other projects and machine anchors but no cement.
2/ Includes setting charge.
3/ Excessive figures owing to grinding core.

TABLE 3. - Diamond losses and costs by diamond quality

Diamond cost per carat	Bits used	Feet drilled1/	Diamond loss		Diamond loss, carats		Cost in dollars2/	
			Carats	Dollars2/	Per bit	Per ft.	Per bit	Per ft.
$11.00	5	127.5	46.95	$624.45	9.930	0.368	$124.89	$4.898
8.60	1	1.8	6.95	79.77	6.95	3/3.861	79.77	3/44.317
8.00	6	122.7	51.47	469.28	8.578	.419	78.12	3.825
7.75	17	341.7	57.24	664.21	3.367	.168	39.07	1.944
7.40	1	15.6	.55	18.82	.55	3/.035	18.82	3/1.206
4.20 4/	81	1,564.3	252.95	2,191.08	3.123	.162	27.05	1.401
Total	111	2,173.6	416.11	$4,047.61				
			Over-all average		3.749	.191	$36.46	$1.862

1/ Includes small footage drilled on other projects and machine anchors but no cement.
2/ Includes setting charge.
3/ Figures inconclusive because data based on the use of only one bit.
4/ Congo diamonds.

CORE RECOVERY

Good core recovery was one of the major problems of the project. The data obtained from the logs shown in table 8 at the end of this report are combined and broken down into the following tables. Some of these data are not conclusive, although they are indicative.

TABLE 4. - Core recoveries obtained in materials drilled

Item	Feet drilled	Core lost	Core recovery	
			Feet	Percent
Overburden	128.0	115.9	12.1	9.5
Weathered monzonite	17.5	.7	16.8	96.0
Fairly fresh monzonite	924.9	11.4	913.5	98.8
Hydrothermally altered monzonite	293.8	5.0	288.8	98.3
Siliceous breccia and gouge	334.7	54.8	279.9	83.6
Slightly altered limestone	295.6	30.0	265.6	89.9
Garnetized limestone	35.1	4.0	31.1	88.6
Silicated limestone, other than garnet	29.9	.0	29.9	100.0
Massive friable pyrite	20.6	.0	20.6	100.0
Vein (ore-bearing rocks)	60.4	2.9	57.5	95.2
Total	2,140.5	224.7	1,915.8	89.5

As far as this project was concerned, the last item was most important as recovery in the ore-bearing zone. Core recovery was satisfactory, the largest single loss being due to drilling overburden, which accounted for over half of the core lost.

TABLE 5. - Core recoveries obtained by different bit sizes

Item	Feet drilled	Core recovery	
		Feet	Percent
NX casing bit (3-1/2-in.)	128.0	12.1	9.5
NX bit	1,295.7	1,270.3	98.1
BX bit	622.1	560.1	90.0
AX bit	94.7	73.3	77.4

Table 4 indicates an increase in the core recovery with an increase in bit size, neglecting, of course, the 3-1/2-inch drilling where core was ground. It must be recognized that the smaller sizes encountered the most adverse conditions as they were necessarily used in the deeper sections of the holes, including the ore zones.

TABLE 6. - Core recovery obtained, by tool types

Item	Feet drilled	Core recovery	
		Feet	Percent
NX casing (single tube 3-1/2-in.)	128.0	12.1	9.5
NX rigid double tube	97.0	91.2	94.0
M-series tools	1,805.8	1,740.6	96.4
L-series tools (experimental)	109.7	71.9	65.5

The above table indicates exceptional recovery for the M-series tools as all types of ground were drilled. The standard NX bevelwall tools were used in good coring ground, and the NX casing tools were used in the overburden. The L-series tools were used in good coring ground, but core was lost through a defect in the bits. This defect will be explained later.

TABLE 7. - Combination of tables 4 and 5

Item	Feet drilled	Core recovery	
		Feet	Percent
NX casing - single tube barrel.....	128.0	12.1	9.5
NX rigid double tube bbl.	97.0	91.2	94.0
NX M-series.....	1,198.7	1,179.1	98.3
BX M-series - bearing backhead.....	505.3	481.1	95.2
BX M-series - washer backhead.....	7.1	7.1	100.0
BX L-series - no bevel, washer backhead.....	83.6	49.1	58.6
BX L-series - no bevel, bearing backhead.....	10.5	7.4	70.4
BX L-series - Beveled, bearing backhead.....	15.4	15.4	100.0
AX M-series.....	94.7	73.3	77.4

The major points of interest in the above table are the exceptional core recoveries obtained with the M-series equipment and the improvement in the core recovery obtained by the bevel in the bit of the L-series tools. This bevel pertains to the inner shoulder of the bit. The bevel in itself seems not so important as is the decrease in distance from the core barrel inner tube to the face of the bit. In the original bits the distance from the face of the bit to the inner shoulder was about 3/4 inch. Operations with these bits were difficult, in that the drill machine vibrated and it was impossible to tell when a block had occurred. At the suggestion of H. W. Foester, representative of the E. J. Longyear Co., a bevel of 60° was cut in this shoulder making the distance from the face of the bit to the shoulder about 3/8 inch. The results are shown in the next to the last item of table 7. Subsequent drilling on another project with L-series bits where the shoulder to face distance was about 3/8 inches showed great improvement of core recovery. In this subsequent work, different angles of bevels were used on the inner shoulder, but the critical point was the distance from the core spring retainer or end of the inner tube to the face of the bit. This distance should be as small as possible, about 3/8 inch.

The use of the bearing type and the washer type backheads in BX drilling also are shown in table 7. Used with the L-series equipment, the bearing type of backhead appeared to be more satisfactory in obtaining core recovery, although there are not enough data to prove this point. Subsequent work also showed that the bearing backhead gave better core recovery.

To drill additional footage after a block occurs is almost impossible in hard rock. As soon as the core is blocked in the core-barrel inner tube, the bit will cut itself clear of the rock, usually resulting in a free spin, and the pressure is transferred from the bit to the block, to the inner tube, and thence to the bearings. This excessive pressure damages the bearings, or the washers in the washer type backhead, necessitating replacement of the bearings or washers. If the ruined bearings are too badly broken, damage to the bearing space of the backhead may result. This means replacement of the backhead. For extended life of the backhead, as well as for an increase in core recovery, it is of utmost importance to stop drilling and pull the tools as soon as possible after a block occurs. The larger-sized bearings in the larger backheads are able to withstand greater pressure, and bearing breakage was more frequent in the smaller sizes.

One possible solution to the problem, especially with less-experienced drill operators, would be to use a spring-activated backhead that would tend to decrease or shut off the flow of water, thus increasing the pressure at the pump gage, when pressure on the backhead bearings becomes excessive. This would serve as a positive warning that a block had occurred and that further drilling would be useless. Naturally, the spring should allow an increase to normal of the water flow when the excessive pressure is released. Different spring strengths probably would be necessary for different types of material - strong springs for hard ground and weaker springs for the softer grounds.

It is difficult to determine the effect on core recovery of the oversized rods in NX and BX drilling. Very little vibration was noticed when these rods were used, and some slight part of the improved core recovery may have been due to these rods. Minor disadvantages of these rods was the increased weight to be handled and, in the NXO size, the lack of a foot clamp large enough to use with the rods. A knife dog was used, but a fitted clamp would have been much more satisfactory. Advantages of these rods are smoother operation, straighter holes, and virtually no shoulder between the core barrel and rods to catch on obstructions and small pieces of caved material.

Table 8 presents detailed logs of the four holes by each pull, showing core recovery, water return, tools used, and material penetrated.

CONCLUSIONS

The use of M-series core barrels was probably the major factor in obtaining improved core recovery on this project. Grinding core is difficult with these barrels, although some of the softer material may be crushed, ground, and washed away if drilling is attempted after blocking occurs. Progress might have been faster with standard tools; but, if rigid adherence to good drilling practice is maintained, it is doubtful if drilling progress would be any better. The results show that core recovery with standard tools in good coring ground is inferior to that obtained with the M-series equipment.

Constant emphasis on core recovery and the consequent greater care given to drilling practices also aided in improving core recovery.

Bit size appears to have had some effect on core recovery. After the overburden had been penetrated, better core recovery was obtained with the larger-size tools. One possible explanation for this is that the larger tools were used in better coring ground. However, it seems obvious that the larger core is more difficult to crush and grind than the smaller core and that the larger core can stand more erosion by the water action at the bit.

Core recovery was unsatisfactory with the experimental L-series equipment as received from the manufacturer.2/ A modification of the bit, reducing

2/ Since completion of the Torpedo mine project the manufacturers have made modifications in the design of the L-series core barrels, some on the basis of the work done here, which have materially improved the results obtained with this equipment.

the distance from the face of the bit to the inner shoulder, showed greatly improved core recovery.

The use of oversize rods in the BX and NX drilling reduced or eliminated rod whip and vibration, resulting in smoother operation. The tendency of the core barrel to wobble under pressure is reduced or eliminated, and this may contribute in some measure to improve core recovery.

Three other points were indicated by this drilling. The first is that the diamond loss per bit and cost per foot decrease with a decrease in bit size. The second is that the diamond loss and bit costs increase sharply when core is ground. Third, that the use of the cheapest and lowest-quality diamonds, "Congos", resulted in lower bit costs as well as less diamond wear per foot of hole drilled.

TABLE 8. - Bureau of Mines drill-hole logs

Log of hole 1

Location: N. 5,239, E. 5,152
Elevation: 5,215 ft.
Dip: -50°
Bearing: N. 67°41' W.

Hole started: 11/4/49
Hole completed: 12/15/49
Depth: 597.7 ft.

Footage			Core recovery		Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
From	To	Feet	Feet	Percent			
0.0	24.0	24.0	0.0	0.0	100	NX casing, single tube	Overburden.
24.0	27.0	3.0	2.8	93.3	100	NX	Monzonite.
27.0	29.0	2.0	1.7	85.0	100	rigid	Do.
29.0	33.0	4.0	4.0	100.0	100	double	Do.
33.0	35.0	2.0	1.8	90.0	100	tube	Do.
35.0	40.0	5.0	5.0	100.0	100	do.	Do.
40.0	44.6	4.6	3.6	78.3	100	do.	Do.
44.6	50.0	5.4	5.0	92.6	100	do.	Do.
50.0	55.0	5.0	5.0	100.0	100	do.	Do.
55.0	60.0	5.0	4.6	92.0	100	do.	Do.
60.0	65.0	5.0	5.0	100.0	100	do.	Do.
65.0	69.5	4.5	4.5	100.0	95	do.	Do.
69.5	75.0	5.5	5.0	90.9	95	do.	Do.
75.0	77.5	2.5	2.5	100.0	95	do.	Do.
77.5	81.0	3.5	3.5	100.0	95	do.	Do.
81.0	85.0	4.0	4.0	100.0	95	do.	Do.
85.0	88.5	3.5	3.5	100.0	95	do.	Do.
88.5	92.0	3.5	3.5	100.0	95	do.	Do.
92.0	97.0	5.0	5.0	100.0	95	do.	Do.
97.0	100.0	3.0	3.0	100.0	95	do.	Do.
100.0	104.0	4.0	2.5	62.5	95	do.	Do.
104.0	106.0	2.0	2.0	100.0	95	do.	Do.
106.0	108.0	2.0	2.0	100.0	95	do.	Do.

Log of hole 1, (Cont.)

Footage			Core recovery		Appar. wtr. ret.,	Tools: size, bit, barrel,	
From	To	Feet	Feet	Percent	percent	backhead	Geology
108.0	113.0	5.0	4.5	90.0	95	NX	Monzonite
113.0	116.5	3.5	3.5	100.0	95	rigid	Do.
116.5	120.0	3.5	2.7	77.1	95	double	Do.
120.0	121.0	1.0	1.0	100.0	95	tube	Do.
121.0	126.4	5.4	5.4	100.0	95	NX M-series	Do.
126.4	132.5	6.1	6.1	100.0	95	do.	Do.
132.5	138.5	6.0	6.0	100.0	95	do.	Do.
138.5	144.5	6.0	6.0	100.0	95	do.	Do.
144.5	152.0	7.5	7.5	100.0	95	do.	Do.
152.0	153.4	1.4	1.2	85.7	95	do.	Do.
153.4	163.4	10.0	10.0	100.0	95	do.	Do.
163.4	173.4	10.0	10.0	100.0	95	do.	Do.
173.4	180.0	6.6	6.5	98.5	95	do.	Do.
180.0	190.0	10.0	9.8	98.0	95	NX M-series	Monzonite.
190.0	200.0	10.0	10.0	100.0	95	do.	Do.
200.0	210.0	10.0	10.0	100.0	95	do.	Do.
210.0	218.5	8.5	8.5	100.0	95	do.	Do.
218.5	223.5	5.0	4.5	90.0	95	do.	Do.
223.5	231.5	8.0	8.0	100.0	95	do.	Do.
231.5	240.5	9.0	8.9	98.9	95	do.	Do.
240.5	250.5	10.0	10.0	100.0	95	do.	Do.
250.5	252.4	1.9	1.9	100.0	95	do.	Do.
252.4	259.5	7.1	7.1	100.0	95	do.	Do.
259.5	265.0	5.5	5.4	98.2	95	do.	Do.
265.0	269.9	4.9	4.9	100.0	95	do.	Do.
269.9	276.7	6.8	6.8	100.0	Lost	do.	Do.
276.7	286.2	9.5	9.5	100.0	0	do.	Do.
286.2	289.2	3.0	3.0	100.0	0	do.	Do.
289.2	297.5	8.3	8.3	100.0	85	do.	Do.
297.5	303.0	5.5	5.5	100.0	85	do.	Do.
303.0	313.0	10.0	10.0	100.0	85	BX M-series	Do.
313.0	323.0	10.0	10.0	100.0	85	do.	Do.
323.0	331.5	8.5	8.5	100.0	85	do.	Do.
331.5	341.5	10.0	10.0	100.0	85	do.	Do.
341.5	349.2	7.7	7.7	100.0	85	do.	Do.
349.2	359.2	10.0	10.0	100.0	85	do.	Do.
359.2	369.0	9.8	9.6	98.0	85	do.	Do.
369.0	378.5	9.5	9.5	100.0	85	do.	Do.
378.5	388.5	10.0	10.0	100.0	85	do.	Do.
388.5	393.5	5.0	5.0	100.0	85	do.	Do.
393.5	398.0	4.5	4.5	100.0	85	do.	Do.
398.0	403.0	5.0	5.0	100.0	85	do.	Do.
403.0	408.0	5.0	5.0	100.0	85	do.	Do.
408.0	413.0	5.0	5.0	100.0	85	do.	Do.
413.0	418.0	5.0	5.0	100.0	85	do.	Do.
418.0	423.0	5.0	5.0	100.0	85	do.	Do.
423.0	427.7	4.7	4.7	100.0	85	do.	Do.
427.7	431.7	4.0	4.0	100.0	85	do.	Do.

Log of hole 1, (Cont.)

Footage			Core recovery		Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
From	To	Feet	Feet	Percent			
431.7	434.5	2.8	2.8	100.0	85	BX M-series	Monzonite.
434.5	439.0	4.5	4.5	100.0	85	do.	Do.
439.0	443.5	4.5	4.5	100.0	85	do.	Do.
443.5	448.0	4.5	4.5	100.0	85	do.	Do.
448.0	453.0	5.0	5.0	100.0	85	do.	Do.
453.0	458.0	5.0	5.0	100.0	85	do.	Do.
458.0	462.5	4.5	4.5	100.0	85	do.	Do.
462.5	467.0	4.5	4.5	100.0	85	do.	Do.
467.0	471.0	4.0	4.0	100.0	85	do.	Do.
471.0	475.5	4.5	4.5	100.0	85	do.	Do.
475.5	480.0	4.5	4.5	100.0	85	do.	Vein.
480.0	486.0	6.0	3.5	58.3	85	do.	Do.
486.0	491.0	5.0	5.0	100.0	85	do.	Do.
491.0	495.0	4.0	4.0	100.0	85	do.	Do.
495.0	499.0	4.0	4.0	100.0	85	do.	Do.
499.0	503.0	4.0	4.0	100.0	85	do.	Siliceous breccia.
503.0	507.5	4.5	4.5	100.0	85	do.	Do.
507.5	512.0	4.5	4.5	100.0	85	do.	Do.
512.0	517.0	5.0	5.0	100.0	85	do.	Do.
517.0	522.0	5.0	5.0	100.0	85	do.	Do.
522.0	526.5	4.5	4.5	100.0	85	do.	Do.
526.5	531.0	4.5	4.5	100.0	85	do.	Do.
531.0	535.5	4.5	4.5	100.0	85	do.	Do.
535.5	540.0	4.5	4.5	100.0	85	AX M-series	Do.
540.0	545.0	5.0	5.0	100.0	85	do.	Do.
545.0	550.0	5.0	5.0	100.0	85	do.	Do.
550.0	554.5	4.5	4.5	100.0	85	do.	Do.
554.5	559.0	4.5	4.5	100.0	85	do.	Do.
559.0	565.5	6.5	6.5	100.0	85	do.	Do.
565.5	572.0	6.5	3.1	47.7	85	do.	Breccia and gouge.
572.0	582.0	10.0	4.0	40.0	75	do.	Do.
582.0	590.0	8.0	1.0	12.5	75	do.	Do.
590.0	594.3	4.3	1.3	30.2	50	do.	Do.
594.3	597.7	3.4	2.4	70.6	50	do.	Do.

Log of hole 2

Location: N. 5,240, E. 5,150
Elevation: 5,216
Dip: -37°
Bearing: N. 67°41'W.

Hole started: 12/16/49
Hole completed: 1/25/50
Depth: 489.5

Footage			Core recovery		Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
From	To	Feet	Feet	Percent			
0.0	9.5	9.5	2.1	22.1	100	NX casing, single tube	Overburden.
9.5	18.0	8.5	.0	.0	100	do.	Do.
18.0	25.0	7.0	1.0	14.3	100	do.	Do.
25.0	26.4	1.4	1.4	100.0	100	do.	Do.
26.4	27.5	1.1	.7	63.6	100	do.	Do.
27.5	31.0	3.5	2.3	65.7	100	do.	Do.
31.0	34.0	3.0	2.9	96.7	100	do.	Do.
34.0	35.0	1.0	1.0	100.0	100	NX M-series	Monzonite.
35.0	37.0	2.0	2.0	100.0	100	do.	Do.
37.0	38.0	1.0	1.0	100.0	100	do.	Do.
38.0	42.5	4.5	4.5	100.0	100	do.	Do.
42.5	50.1	7.6	7.6	100.0	95	do.	Do.
50.1	55.6	5.5	5.5	100.0	95	do.	Do.
55.6	60.7	5.1	5.1	100.0	95	do.	Do.
60.7	66.0	5.3	5.3	100.0	95	do.	Do.
66.0	69.6	3.6	3.6	100	95	do.	Do.
69.6	75.0	5.4	5.4	100	95	do.	Do.
75.0	83.0	8.0	8.0	100	95	do.	Do.
83.0	86.5	3.5	3.5	100	95	do.	Do.
86.5	89.5	3.0	3.0	100	95	do.	Do.
89.5	95.0	5.5	5.5	100	95	do.	Do.
95.0	99.6	4.6	4.6	100	95	do.	Do.
99.6	105.0	5.4	5.4	100	95	do.	Do.
105.0	108.0	3.0	3.0	100	95	do.	Do.
108.0	113.5	5.5	5.5	100	95	do.	Do.
113.5	118.0	4.5	4.5	100	95	do.	Do.
118.0	120.0	2.0	2.0	100	95	do.	Do.
120.0	126.0	6.0	6.0	100	95	do.	Do.
126.0	133.0	7.0	7.0	100	95	do.	Do.
133.0	138.0	5.0	5.0	100	95	do.	Do.
138.0	143.0	5.0	5.0	100	95	do.	Do.
143.0	149.3	6.3	6.3	100	95	do.	Do.
149.3	154.0	4.7	4.7	100	95	do.	Do.
154.0	158.0	4.0	4.0	100	95	do.	Do.
158.0	164.0	6.0	6.0	100	95	do.	Do.
164.0	166.0	2.0	2.0	100	95	do.	Do.
166.0	170.0	4.0	4.0	100	95	do.	Do.
170.0	176.4	6.4	6.4	100	95	do.	Do.
176.4	182.0	5.6	5.6	100	95	do.	Do.
182.0	187.0	5.0	5.0	100	95	do.	Do.
187.0	189.9	2.9	2.2	75.9	95	do.	Do.

Log of hole 2, (Cont.)

Footage			Core recovery		Appar. wtr. ret.	Tools: size, bit, barrel,	
From	To	Feet	Feet	Percent	percent	backhead	Geology
189.9	197.4	7.5	7.5	100	95	NX M-series	Monzonite.
197.4	205.9	8.5	8.5	100	95	do.	Do.
205.9	213.0	7.1	7.1	100	95	do.	Do.
213.0	220.8	7.8	7.8	100	95	do.	Do.
220.8	223.8	3.0	3.0	100	95	do.	Do.
223.8	230.8	7.0	7.0	100	95	do.	Do.
230.8	235.8	5.0	5.0	100	95	do.	Do.
235.8	241.0	5.2	5.2	100	95	do.	Do.
241.0	245.0	4.0	4.0	100	95	do.	Do.
245.0	249.0	4.0	4.0	100	95	do.	Do.
249.0	253.6	4.6	4.6	100	Lost	do.	Do.
253.6	256.0	2.4	2.4	100	100	do.	Do.
256.0	262.6	6.6	6.6	100	100	do.	Do.
262.6	266.6	4.0	4.0	100	100	do.	Do.
266.6	272.0	5.4	5.4	100	100	do.	Do.
272.0	273.5	1.5	1.5	100	100	do.	Do.
273.5	280.0	6.5	6.5	100	100	do.	Do.
280.0	287.0	7.0	7.0	100	Lost	do.	Do.
287.0	290.6	3.6	3.6	100	90	do.	Do.
290.6	294.0	3.4	3.4	100	90	do.	Do.
294.0	296.0	2.0	2.0	100	90	do.	Do.
296.0	299.5	3.5	3.5	100	90	do.	Do.
299.5	301.0	1.5	1.5	100	90	do.	Do.
301.0	307.5	6.5	6.5	100	90	do.	Do.
307.5	313.5	6.0	6.0	100	90	do.	Do.
313.5	323.5	10.0	10.0	100	90	do.	Altered Monzonite.
323.5	333.5	10.0	10.0	100	90	do.	Do.
333.5	341.5	8.0	8.0	100	90	do.	Do.
341.5	349.0	7.5	7.5	100	90	do.	Do.
349.0	358.6	9.6	9.6	100	90	do.	Altered monzonite and limestone.
358.6	368.6	10.0	10.0	100	90	do.	Limestone.
368.6	378.6	10.0	10.0	100	90	do.	Do.
378.6	388.6	10.0	10.0	100	90	do.	Do.
388.6	395.6	7.0	7.0	100	90	do.	Breccia and gouge.
395.6	400.0	4.4	4.4	100	90	do.	Do.
400.0	403.0	3.0	1.6	53.3	90	do.	Do.
403.0	405.0	2.0	1.6	80.0	90	do.	Do.
405.0	408.0	3.0	2.6	86.7	90	do.	Vein; massive pyrite.
408.0	412.0	4.0	4.0	100	90	do.	Do.
412.0	419.0	7.0	7.0	100	90	do.	Pyrite; siliceous breccia.
419.0	422.0	3.0	3.0	100	90	do.	Siliceous breccia.
422.0	424.0	2.0	2.0	100	90	do.	Do.
424.0	427.0	3.0	3.0	100	90	do.	Do.
427.0	433.0	6.0	6.0	100	90	do.	Do.

4640

Log of hole 2 (Cont.)

Footage			Core recovery		Appar. wtr. ret.,	Tools: size, bit, barrel,	
From	To	Feet	Feet	Percent	percent	backhead	Geology
433.0	442.0	9.0	9.0	100	90	NX M-series	Siliceous breccia.
442.0	444.6	2.6	2.5	96.2	90	do.	Breccia; alt. rocks.
444.6	453.0	8.4	7.6	90.5	90	do.	Do.
453.0	463.0	10.0	10.0	100	90	do.	Do.
463.0	468.0	5.0	5.0	100	90	do.	Do.
468.0	474.0	6.0	5.0	83.3	90	do.	Do.
474.0	478.0	4.0	2.0	50	90	do.	Do.
478.0	482.2	4.2	4.2	100	90	do.	Do.
482.2	486.5	4.3	4.3	100	90	do.	Do.
486.5	489.5	3.0	2.5	83.3	90	do.	Do.

Log of hole 3

Location: N. 5,367, E. 5,317
Elevation: 5,286
Dip: -50°.
Bearing: N. 67°41' W.

Hole started: 1/26/50
Hole completed: 3/14/50
Depth: 524.6

0.0	15.0	15.0	0.7	4.7	95	NX casing,	Overburden.
15.0	18.0	3.0	.6	20	95	single-tube	Do.
18.0	26.0	8.0	.0	0	95	do.	Do.
26.0	33.0	7.0	.4	5.7	95	do.	Do.
33.0	49.0	16.0	.0	0	Lost	do.	Do.
49.0	50.0	1.0	1.0	100	95	NX M-series	Weath. monzonite.
50.0	51.0	1.0	1.0	100	95	do.	Do.
51.0	52.5	1.5	1.5	100	95	do.	Do.
52.5	55.5	3.0	3.0	100	95	NX M-series	Do.
55.5	56.0	.5	.5	100	95	do.	Do.
56.0	60.0	4.0	4.0	100	95	do.	Do.
60.0	62.5	2.5	1.8	72	95	do.	Do.
62.5	63.5	1.0	1.0	100	95	do.	Do.
63.5	66.5	3.0	3.0	100	95	do.	Do.
66.5	69.0	2.5	2.5	100	95	do.	Monzonite
69.0	71.4	2.4	2.4	100	95	do.	Do.
71.4	75.9	4.5	4.5	100	95	do.	Do.
75.9	79.1	3.2	3.2	100	95	do.	Do.
79.1	82.9	3.8	3.6	94.7	90	do.	Do.
82.9	84.8	1.9	1.9	100	90	do.	Do.
84.8	91.3	6.5	6.5	100	80	do.	Do.
91.3	98.7	7.4	7.4	100	80	do.	Do.
98.7	102.0	3.3	3.3	100	80	do.	Do.
102.0	109.6	7.6	7.6	100	80	do.	Do.
109.6	114.9	5.3	5.3	100	80	do.	Do.
114.9	119.0	4.1	4.1	100	80	do.	Do.
119.0	122.8	3.8	3.8	100	80	do.	Do.
122.8	124.6	1.8	1.2	66.7	80	do.	Do.
124.6	133.0	8.4	7.3	86.9	80	do.	Do.
133.0	135.0	2.0	2.0	100.0	80	do.	Do.

Log of hole 3 (Cont.)

Footage			Core recovery		Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
From	To	Feet	Feet	Percent			
135.0	142.5	7.5	7.5	100	80	NX M-series	Monzonite
142.5	148.0	5.5	5.5	100	80	do.	Do.
148.0	154.5	6.5	6.5	100	80	do.	Do.
154.5	164.5	10.0	9.8	98	80	do.	Do.
164.5	172.1	7.6	7.6	100	Lost	do.	Do.
172.1	180.0	7.9	7.7	97.5	80	do.	Do.
180.0	189.9	9.9	9.7	98	80	do.	Do.
189.9	199.9	10.0	10.0	100	Lost	do.	Do.
199.9	208.9	9.0	9.0	100	90	do.	Do.
208.9	213.0	4.1	4.1	100	90	do.	Do.
213.0	218.0	5.0	5.0	100	90	do.	Do.
218.0	220.5	2.5	2.5	100	90	do.	Do.
220.5	228.2	7.7	7.1	92.2	90	do.	Altered monzonite.
228.2	238.2	10.0	10.0	100	90	do.	Do.
238.2	248.2	10.0	10.0	100	90	do.	Do.
248.2	255.6	7.4	7.4	100	90	do.	Do.
255.6	259.3	3.7	3.7	100	90	do.	Do.
259.3	263.9	4.6	4.6	100	90	do.	Do.
263.9	268.8	4.9	4.9	100	90	do.	Do.
268.8	273.8	5.0	5.0	100	90	do.	Do.
273.8	278.8	5.0	5.0	100	90	do.	Do.
278.8	283.8	5.0	5.0	100	90	do.	Do.
283.8	290.8	7.0	7.0	100	90	do.	Do.
290.8	294.0	3.2	3.2	100	90	do.	Do.
294.0	296.6	2.6	2.6	100	90	do.	Do.
296.6	300.2	3.6	2.9	80.6	90	do.	Do.
300.2	307.2	7.0	7.0	100	90	do.	Do.
307.2	308.2	1.0	1.0	100	90	do.	Do.
308.2	318.2	10.0	10.0	100	90	do.	Do.
318.2	328.2	10.0	10.0	100	90	do.	Do.
328.2	331.0	2.8	2.8	100	90	do.	Do.
331.0	336.0	5.0	5.0	100	90	do.	Do.
336.0	342.0	6.0	6.0	100	90	do.	Do.
342.0	348.6	6.6	6.4	97	90	do.	Do.
348.6	354.9	6.3	6.3	100	90	do.	Do.
354.9	363.0	8.1	8.1	100	85	do.	Do.
363.0	373.0	10.0	9.1	91	80	do.	Do.
373.0	382.0	9.0	9.0	100	50	do.	Do.
382.0	387.1	5.1	5.1	100	90	do.	Do.
387.1	390.7	3.6	3.6	100	90	do.	Do.
390.7	400.7	10.0	10.0	100	90	do.	Do.
400.7	410.7	10.0	10.0	100	90	do.	Do.
410.7	420.7	10.0	10.0	100	90	do.	Do.
420.7	422.5	1.8	1.8	100	90	do.	Do.
422.5	427.7	5.2	5.2	100	90	do.	Do.
427.7	434.4	6.7	6.7	100	90	do.	Do.
434.4	436.0	1.6	1.6	100	90	do.	Do.

Log of hole 3 (Cont.)

Footage From	Footage To	Footage Feet	Core recovery Feet	Core recovery Percent	Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
436.0	438.0	2.0	1.8	90	90	NX M-series	Altered monzonite.
438.0	446.6	8.6	7.8	90.7	90	do.	Do.
446.6	448.6	2.0	2.0	100	90	do.	Do.
448.6	450.0	1.4	1.3	92.9	90	do.	Do.
450.0	455.0	5.0	4.6	92	90	do.	Do.
455.0	460.0	5.0	4.7	94	90	BX M-series	Do.
460.0	462.7	2.7	2.7	100	90	do.	Do.
462.7	464.0	1.3	1.1	84.6	90	do.	Do.
464.0	466.1	2.1	2.1	100	90	do.	Do.
466.1	467.6	1.5	1.0	66.7	90	do.	Do.
467.6	468.1	.5	.5	100	90	do.	Do.
468.1	470.1	2.0	2.0	100	90	do.	Do.
470.1	472.7	2.6	2.6	100	90	do.	Do.
472.7	474.4	1.7	1.7	100	90	do.	Do.
474.4	478.8	4.4	4.3	97.7	85	do.	Do.
478.8	482.2	3.4	3.4	100	80	do.	Vein.
482.2	487.0	4.8	4.8	100	80	do.	Do.
487.0	493.0	6.0	6.0	100	75	do.	Do.
493.0	498.7	5.7	5.7	100	60	do.	Vein; siliceous breccia.
498.7	499.5	.8	.8	100	75	do.	Siliceous breccia, gouge.
499.5	500.6	1.1	.8	72.7	75	do.	Do.
500.6	502.6	2.0	.0	0	75	do.	Do.
502.6	503.6	1.0	.4	40	75	do.	Do.
503.6	513.6	10.0	2.0	20	75	do.	Do.
513.6	515.3	1.7	1.0	58.8	75	do.	Do.
515.3	515.8	.5	.5	100	75	do.	Do.
515.8	522.8	7.0	7.0	100	75	do.	Do.
522.8	524.6	1.8	1.6	88.9	75	do.	Do.

Log of hole 4

Location: N. 5,269, E. 4,502
Elevation: 5,173
Dip: -45°
Bearing: S. 67°41' E.

Hole started: 3/13/50
Hole completed: 4/25/50
Depth: 510.5

0.0	21.0	21.0	0.0	0	100	NX casing, single-tube	Overburden.
21.0	23.0	2.0	2.0	100	100	NX M-series	Garnet.
23.0	26.2	3.2	3.2	100	100	do.	Do.
26.2	28.0	1.8	1.8	100	100	do.	Do.
28.0	29.1	1.1	1.1	100	90	do.	Do.
29.1	31.5	2.4	1.3	54.2	90	do.	Do.
31.5	32.6	1.1	1.1	100	90	do.	Do.
32.6	33.4	.8	.8	100	90	do.	Do.
33.4	34.4	1.0	.8	80	90	do.	Do.
34.4	36.3	1.9	1.9	100	90	do.	Do.

Log of hole 4, (Cont.)

Footage			Core recovery		Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
From	To	Feet	Feet	Percent			
36.3	39.1	2.8	0.8	28.6	90	NX M-series	Garnet.
39.1	40.0	.9	.8	88.9	90	do.	Do.
40.0	41.6	1.6	1.1	68.8	90	do.	Do.
41.6	43.0	1.4	1.4	100	90	do.	Do.
43.0	44.0	1.0	1.0	100	90	do.	Do.
44.0	45.0	1.0	1.0	100	90	do.	Do.
45.0	47.3	2.3	2.3	100	90	do.	Do.
47.3	52.1	4.8	4.7	97.9	90	do.	Do.
52.1	56.1	4.0	4.0	100	90	do.	Do.
56.1	61.6	5.5	5.5	100	90	do.	Altered silicated limestone.
61.6	64.6	3.0	3.0	100	90	do.	Do.
64.6	65.6	1.0	1.0	100	90	do.	Do.
65.6	71.6	6.0	6.0	100	90	do.	Do.
71.6	77.6	6.0	6.0	100	90	do.	Do.
77.6	78.6	1.0	1.0	100	90	do.	Do.
78.6	79.9	1.3	1.3	100	90	do.	Do.
79.9	86.0	6.1	6.1	100	90	do.	Limestone slightly altered.
86.0	94.0	8.0	8.0	100	80	do.	Do.
94.0	104.0	10.0	10.0	100	75	do.	Do.
104.0	113.6	9.6	9.6	100	75	do.	Do.
113.6	114.4	.8	.8	100	90	do.	Do.
114.4	124.4	10.0	10.0	100	90	do.	Do.
124.4	132.4	8.0	8.0	100	90	do.	Do.
132.4	142.4	10.0	10.0	100	90	do.	Do.
142.4	144.1	1.7	1.7	100	90	do.	Do.
144.1	154.1	10.0	10.0	100	90	do.	Do.
154.1	161.0	6.9	6.9	100	90	do.	Do.
161.0	164.2	3.2	3.2	100	90	do.	Do.
164.2	168.2	4.0	4.0	100	90	do.	Do.
168.2	176.2	8.0	8.0	100	90	do.	Do.
176.2	180.6	4.4	2.8	63.6	90	BX L-series, no bevel, washer	Limestone slightly altered.
180.6	190.6	10.0	10.0	100	90	BX M-series, bearing	Do.
190.6	198.6	8.0	7.7	96.3	90	BX L-series, no bevel, washer	Do.
198.6	206.9	8.3	8.3	100	90	BX M-series, bearing	Do.
206.9	214.9	8.0	8.0	100	90	BX L-series, no bevel, washer	Do.
214.9	221.8	6.9	6.9	100	90	BX M-series, bearing	Do.

Log of hole 4, (Cont.)

Footage			Core recovery		Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
From	To	Feet	Feet	Percent			
221.8	229.0	7.2	7.2	100	90	BX M-series, bearing	Limestone, slight altered.
229.0	234.0	5.0	3.9	78	90	BX L-series, no bevel, washer	Do.
234.0	237.2	3.2	3.2	100	90		Do.
237.2	247.2	10.0	10.0	100	90	BX M-series, bearing	Do.
247.2	249.6	2.4	2.4	100	90	BX L-series, no bevel, washer	Do.
249.6	252.3	2.7	2.7	100	90	BX M-series, bearing	Do.
252.3	262.0	9.7	5.0	51.5	90	BX L-series, no bevel, washer	Do.
262.0	272.0	10.0	10.0	100	90	BX M-series, bearing	Do.
272.0	275.0	3.0	3.0	100	90	Do.	Do.
275.0	279.6	4.6	2.0	43.5	90	BX L-series, no bevel, washer	Do.
279.6	279.8	0.2	0.2	100	90	BX M-series, bearing	Do.
279.8	289.8	10.0	3.7	37	90	BX L-series, no bevel, washer	Do.
289.9	292.1	2.3	2.3	100	90	BX M-series, bearing	Do.
292.1	298.7	6.2	2.2	33.3	90	BX L-series, no bevel, washer	Do.
298.7	304.2	5.5	5.5	100	90	BX M-series, bearing	Do.
304.2	310.2	6.0	6.0	100	90	Do.	Do.
310.2	318.7	8.5	1.9	22.4	90	BX L-series, no bevel, washer	Do.
318.7	328.2	9.5	9.5	100	90	BX M-series, bearing	Do.
328.2	331.0	2.8	2.8	100	90	BX L-series, no bevel, washer	Do.
331.0	337.4	6.4	6.2	96.9	90	BX M-series, bearing	Do.
337.4	342.0	4.6	2.4	52.2	90	BX L-series, no bevel, washer	Do.
342.0	343.0	1.0	0.9	90	90	BX M-series, bearing	Siliceous breccia.
343.0	347.5	4.5	.4	8.9	90	BX L-series, no bevel, washer	Do.
347.5	352.0	4.5	4.5	100	90	BX M-series, bearing	Do.
352.0	356.1	4.1	4.1	100	90	Do.	Do.
356.1	360.4	4.3	3.4	79.1	90	Do.	Do.
360.4	364.9	4.5	4.5	100	90	Do.	Do.
364.9	368.9	4.0	4.0	100	90	Do.	Do.
368.9	375.1	6.2	5.3	85.5	90	Do.	Do.
375.1	377.1	2.0	2.0	100	90	Do.	Do.
377.1	380.0	2.9	2.7	93.1	90	Do.	Do.
380.0	386.0	6.0	5.7	95	90	Do.	Fault gouge.
386.0	387.5	1.5	.7	46.7	90	BX L-series, no bevel, washer	Do.
387.5	394.6	7.1	7.1	100	90	BX M-series, washer	Fault gouge, breccia.

Log of hole 4, (Cont.)

Footage			Core recovery		Appar. wtr. ret., percent	Tools: size, bit, barrel, backhead	Geology
From	To	Feet	Feet	Percent			
394.6	400.0	5.4	5.4	100	90	BX L-series,	Siliceous breccia.
400.0	410.0	10.0	10.0	100	90	beveled, bearing	Do.
410.0	414.0	4.0	3.3	82.5	90	BX L-series, no	Do.
414.0	418.5	4.5	3.7	82.5	90	bevel, bearing	Do.
418.5	420.5	2.0	.4	20	90	do.	Do.
402.3	409.0	6.7	6.3	94	90	BX M-series, bearing	Siliceous breccia;
409.0	412.7	3.7	3.7	100	90	do.	hole deflected.
412.7	417.2	4.5	4.5	100	90	do.	Do.
417.2	423.2	6.0	3.3	55	90	do.	Do.
423.2	425.3	2.1	2.1	100	90	do.	Do.
425.3	432.0	6.7	6.1	91	90	do.	Do.
432.0	435.2	3.2	3.2	100	90	do.	Do.
435.2	440.0	4.8	2.5	52.1	90	do.	Do.
440.0	442.8	2.8	2.8	100	90	do.	Vein
442.8	450.0	7.2	7.2	100	90	do.	Do.
450.0	453.0	3.0	3.0	100	90	do.	Siliceous breccia.
453.0	458.0	5.0	5.0	100	90	do.	Do.
458.0	460.7	2.7	2.7	100	90	do.	Do.
460.7	464.5	3.8	3.8	100	90	do.	Do.
464.5	470.6	6.1	6.1	100	90	do.	Do.
470.6	478.0	7.4	7.4	100	90	do.	Monzonite.
478.0	479.5	1.5	1.3	86.7	90	AX M-series	Do.
479.5	484.5	5.0	5.0	100	90	do.	Do.
484.5	491.0	6.5	6.5	100	90	do.	Do.
491.0	496.0	5.0	5.0	100	90	do.	Do.
496.0	503.5	7.5	7.5	100	90	do.	Do.
503.5	504.5	1.0	.2	20	90	do.	Do.
504.5	510.5	6.0	6.0	100	90	do.	Do.

Int. - Bu. of Mines, Pgh., Pa.

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Toronto, Ontario
September, 1961.

ROY A. MARTIN GRUBSTAKE 1960 - 1961
REPORT ON EXAMINATION OF PROSPECTS IN
NEVADA AND MONTANA, U. S. A.
JUNE 12 - JUNE 27, 1961.

G E N E R A L

Following instructions received from the Martin Grubstake members at a meeting held June 5, 1961, in the Gunnex office, Roy Martin, Grubstake Prospector, W. F. Dix, Gunnex Limited and W. E. Clarke, Rayrock Mines Limited, proceeded to Nevada and Montana on June 12th and completed the following examinations.

1. Rawhide Gold Prospect, Rawhide, Nevada
   June 14 - 19, 1961.

2. Newman Gold, Silver, Lead, Copper Prospects,
   Silliston, Montana, June 21 - 23, 1961.

3. Mike Horse Gold, Silver, Lead, Zinc Prospect near
   Helena, Montana, June 24, 1961.

4. Comet Silver Prospect, Polaris, Montana,
   June 25, 1961.

A S S A Y I N G

The Rawhide samples were assayed by the Mineral Assay Office, Mina, Nevada, and Nevada Mineral Laboratories, Reno, Nevada; the Newman and Mike Horse samples by Goodall Brothers, Helena, Montana; and the Comet samples by Heys and Son, Toronto. Re-check assays of a large number of the pulps from the Rawhide prospect were also run by Heys and Son and Technical Service Laboratories, Toronto. Good checks were obtained on the assays from the Mineral Assay Office, Mina, but in almost every case the assays done by the Nevada Mineral Laboratories, Reno, were found to be high and consequently have not been used in any grade calculations.

R A W H I D E P R O S P E C T

General

This gold prospect comprises a number of old surface and underground workings whose histories go back to 1906 when Lease Mining was

started. At that time Rawhide was a thriving community and mill concentrates from several operations were shipped for treatment. During the depression years, many of the old dumps and numerous placer diggings provided dry, washed gold. In recent years Kennecott Copper and Yuba Consolidated have in turn examined this area, the latter company completing much of the underground sampling and surface mapping. Results of this work were made available and some assays from the Yuba sampling were used in grade calculations.

Property

Property information is incomplete due to the time and legal advice required to determine same. Attached Map No. 1 shows the approximate location of Rawhide relative to neighbouring cities and towns, and Map No. 2 gives some detail on the area examined. Fifty patented claims are held by the Grutt Brothers and a Mrs. Sheeline of Reno, Nevada. Mr. H. A. Weiler of Mina, Nevada has a verbal option on the Grutt and Sheeline ground besides holding ten unpatented claims of his own tying on to the north of the Grutt ground.

Terms for optioning or acquiring the property were not discussed with Mr. Weiler or the property owners, but it is understood that the total purchase price would be $750,000.00 payable out of royalties after deducting milling costs. The royalty payments would be 6 per cent to the owners plus 2 per cent to Mr. Weiler. There is some reason to believe that the royalty payments might be reduced, but no indication that the end purchase price would be changed.

Geology

No geological information regarding this part of Nevada is available from government sources. Mr. Jack C. Bishop of Yuba Consolidated has mapped the area in some detail and was very helpful in

conducting a tour on the first day of the examination.

The mineralized area is one of moderate relief with Hooligan, Grutt, Baloon and Murray Hills rising approximately 200 feet above the valley floor, which lies at an elevation of 5,000 feet. This valley rises generally northward from a broad flat "sink" some six miles south of Rawhide and 700 feet below it in elevation. An adequate water supply for mining and milling operations would be available from this "sink".

Hooligan Hill is composed of medium grained quartz feldspar porphyry of two types, one a relatively fresh greenish porphyry occupying the north part of the hill, the other an altered fractured and pyritized porphyry underlying the south part of the hill and part, at least, of the lower elevation to the south. The contact between these porphyries is marked by some interfingering with several dikes of the greenish type intruding the altered porphyry.

The most marked fracture pattern within the altered porphyry strikes north 58° east and dips north at 70 to 75°. Cross-fracturing is also prominent. Alteration of the feldspars has resulted in strong kaolinization. Pyrite has been introduced along fracture plains in the porphyry, and surface weathering has changed this to limonite. Gold values are apparently associated with the pyrite content and there is, therefore, a direct relationship between gold values and the degree of fracturing.

Grutt, Baloon and Murray Hills are composed of interbedded siliceous breccia, banded chert and felsitic rock. These horizons apparently strike parallel to the elongated axis of the hills, and dips are to the east and northeast at moderate angles. All except the banded cherty horizons are apparently of volcanic origin. The breccia is con-

sidered to be a pyroclastic and not a structural or pipe like breccia.

Gold values in Grutt, Baloon and Murray Hills are associated with a fracture pattern developed normal to the formational strike. These fractures strike north-easterly on Murray and Ballon Hills and north on Grutt Hill. Fractures are rather widely spaced, but show some concentration over a 200 foot width in the Bauld Hornet shaft area on Murray Hill, and on Grutt Hill over a 100 foot width extending north from the Marigold shaft. Elsewhere, talus and overburden obscure the fracture pattern. However, judging from the number of shafts and underground workings, other fracture systems trending north-easterly probably exist.

Faulting in two directions has been developed in the Rawhide area and is best exposed in the Baloon Murray Hill section. A near strike fault, visible on the east side of Murray Hill, trends west of north toward Baloon Hill where it apparently branches and angles westward toward the valley bottom. This fault dips westerly at 60°. Below this fault on Murray Hill, rocks are highly Kaolinized and little breccia can be observed. Faulting and deep surface weathering characterize much of the north part of Baloon Hill. Much detailed mapping is required to clarify the geological picture in the Baloon Hill area. Two cross-faults striking north-easterly lie between Murray and Baloon Hills. These have resulted in a total of 250 feet of lateral offset of the strike fault zone, with the north side moving east. The Fault mapping and interpretation was done by Bishop.

Economic Mineralization

In sampling this prospect, the fact that only low cost open pit mining would be feasible, was kept in mind. Samples were taken in ten foot sections where ever it was possible to reach bedrock over

significant widths. The accompanying maps Nos. 2 to 5 show the results of all available sampling. Original assays taken during the examination are circled in red, while check assays are circled in green. Yuba assays are uncircled.

Of the four hills examined, surface sampling of Murray Hill most closely checked results from underground sampling and diamond drilling carried out by Yuba. Map Nos. 2 and 3, plan and vertical longitudinal section show a compilation of the available data. A total of 38 samples were cut on Murray Hill. At the top of the hill 10 samples, each 20 feet long, averaged $2.66 over a zone width of 200 feet. Five samples, 220 feet to the southeast, averaged $1.77 over a 100 foot width, and at the base of the hill 23 samples averaged $1.56 over a 240 foot width. The amount of brecciation and intensity of north east trending fracturing appears to control the mineral concentration.

From underground and surface sampling a potential zone of 500 feet long, 300 feet wide and 200 feet deep, or 2,500,000 tons is indicated averaging $2.70 per ton.

The structural control on Mooligan Hill is the most readily recognized and possibly the strongest in the area. Surface sampling results were disappointing when compared with previous underground and surface work. This discrepancy may in part be due to the relative intensity of surface weathering and leaching. Map Nos. 2 and 4, plan and vertical longitudinal section, show a compilation of the available data. A total of 73 samples were cut from outcrop, or near outcrop, and 9 grab samples were taken from old shaft and pit dumps. The 73 surface chip samples gave an average assay of $1.25.

A potential zone 600 feet long, 180 feet wide and 200 feet deep is indicated by previous underground work. An average of underground

assays and applicable surface assays averaged $2.98 for 1,800,000 tons.

On Grutt Hill only one 150 foot section was amenable to surface chip sampling and 15 samples averaged $1.05. In addition seven samples were taken from shaft and open cut dumps. No grade estimate is feasible, but the lack of underground information and the grade of dump samples in the most heavily fractured area makes this fill intriguing. Old workings and fracture zones indicate that a zone 800 feet long, 300 feet wide and 100 feet deep, containing 2,000,000 tons, may be potential. Map Nos. 2 and 5, plan and vertical longitudinal section, show a compilation of the available data.

Two sections at the south end of Balcom Hill were sampled. In all, 32 chip samples were taken and averaged $1.14. Two chip samples in old workings were low, as was one dump sample at an old shaft. This hill appears the least likely of the four areas.

An area of minimum dimensions 2,000 feet long and 600 to 800 feet wide west and south of Hooligan Hill was dry washed for gold in earlier days, and could provide approximately 2,000,000 tons of cheap mill feed. The grade of this material is largely unknown, but 4,000 yards is reported to have yielded$6,000.00 in gold.

Conclusions

Until confirmation of underground assays is available on Hooligan Hill workings, the most interesting area is on Murray Hill and even here the grade is marginal.

The depth and persistence of mineralization, controlling structures and favourable horizons can only be inferred from rather limited underground workings. A comprehensive diamond drilling program would be necessary to obtain decisive grade and tonnage information.

The following suggested program of drilling would give sufficient depth information to decide what further exploration and development steps are warranted. The summary lists the drilling areas in order of priority and the results of early drilling should influence the continuation of the program.

Diamond Drilling Program Summary

Location	No. of Holes	Length of Hole	Dip	Footage	Cost/Ft.	Total Cost
Murray Hill	5	450 ft.	-30°	2,250ft.	$4.00	$9,000.00
Hooligan Hill	6	300 ft.	-45°	1,800 ft.	4.00	7,200.00
Grutt Hill	8	150 ft.	-30°	1,200 ft.	4.00	4,800.00
	8	200 ft.	-30°	1,600 ft.	4.00	6,400.00
Placer (Dry Wash Area)	30	50 ft.	Vertical	1,500 ft.	2.00	3,000.00
Totals —	57			8,350 ft.		$30,400.00

NEWMAN GOLD PROSPECTS

ELLISTON - MONTANA

The various groups of claims cover a series of sub-parallel, roughly east-west striking and steeply northerly dipping vein zones. The veins in most locations are associated with aplite dykes intruding a monzonite batholith. In a number of instances faulting is associated with the veins and aplite and movement may be pre ore, post ore, or more likely, both.

I. Ontario Vein System

This in reality is a series of sub-parallel vein or shear zones in monzonite covered by the West Ontario, Ontario, Gladstone Senator, Landmark, Blue Bird and New Era Claims, and is the most southerly group examined.

The New Era claim is situated on a vein zone approximately 600 feet south of the main Ontario zone. The dump around an old shaft indicated that the vein was associated with a highly altered, rusted and leached aplite dyke in monzonite. Fine colors were obtained in panning the leached and rusted material. The vein was not well exposed, but a grab sample of representative dump material assayed 0.15 oz. Au. and 0.702 Ag.

A 500 feet long bulldozer trench exposed the main Ontario vein and 3 additional shear zones between 240 feet and 310 feet to the north. The bulldozer trench is at the east end of the claim group and extends northerly onto property not presently held by Newman Brothers. The Ontario vein is 8 feet wide at this point, while the other veins vary from 3 feet to 6 feet wide, and all are associated with faulting and aplite dykes.

Rusted vein material panned five colors from the Ontario vein and the centre vein of the group of three.

The East Landmark vein lies about 600 feet north of the Ontario vein. It is poorly exposed in a bulldozer trench and an old shaft or pit on the top of O'Keefe Mountain is supposed to be on the same structure. This vein attained a width of 15 feet according to report, but values in Au., Ag., Pb. and Zn. were low.

No production is recorded from the Ontario vein system.

II. Sure Thing Vein

The vein is covered along strike by the Total Wreck, Pearl, Sure Thing, Exhibition and Martin claims, and is the only vein which was examined underground. It lies about 1,800 feet north of the Ontario vein.

On the Total Wreck Claim, the most westerly of the group, the vein is poorly exposed in a bulldozer trench and two 20-foot shafts, neither of which were in condition for effective sampling. Exposures of andesite were noted in the immediate area and it may be expected that the vein zone would weaken as it passes from monzonite into andesite. It was reported that Au. and Ag. values were obtained across a 60 foot width when the bulldozer trench was dug. The vein, as found on the shaft dumps, was of a breccia type, with some tourmaline and ruggy quartz. Sulphide minerals were pyrite and minor galena and sphalerite. A grab sample from the dumps assayed TR in Au. and 0.502 Ag.

On the Sure Thing Claim, 2,000 feet to the east, the vein was exposed in several old surface pits and trenches, non of which were in condition for anything but grab samples from dumps.

A grab sample across 20 feet of vein material with three 1-foot sections of bedrock exposed assayed 0.03 oz. Au. and 0.902 Ag. 150 feet further west another grab, from a cut and mainly on float material, assayed 0.05 oz. Au. and 2.102 Ag. A shaft had been sunk to a depth of 400 feet, but only the 90 foot level was available for examination as the portal had been recently opened up. It had been anticipated that this level, plus a sub-level 40 feet above, would be accessible for sampling but timber and ground conditions would not permit examination and sampling of the sub-level.

On the 90 foot level drifting had been carried out along the H.W. of the zone for 560 feet. Two x-cuts were driven to the footwall and these were sampled. The main drifted portion of the vein could not be sampled due to timber support. The vein zone is in monzonite controlled by fairly strong faulting. Secondary quartz has been introduced and appears as lenticular bodies, while the remainder of the zone is brecciated or highly sheared monzonite. Sulphide mineralization occurs as fairly narrow streaks and lenses up to 1 foot in width and composed essentially of pyrite, with minor galena and sphalerite. Some copper staining was noted. The vein zone varies from 5 feet to 24 feet in width. A compass-pace survey of the 90 foot level and sample location is shown on the accompanying map. Not including the drifted section of the vein, the more easterly x-cut averaged 0.019 oz. Au. and 0.60 oz. Ag. across 19.5 feet, while the x-cut 30 feet to the west averaged 0.165 oz. Au. and 4.3 oz. Ag. across 8.0 feet. Four other samples were taken in accessible locations, but ore grade material was not indicated.

Considerable bulldozing was done on the Exhibition claim 1,100 feet to 1,380 feet east of the shaft. Vein material was uncovered by bulldozing during the examination and a grab sample assayed 0.05 oz. Au. and 1.00? Ag.

Another vein, about 400 feet south of the Sure Thing is opened up on the Millie Claim, adjoining the Total Wreck to the south and not owned by Newman Brothers. The vein is reported to be similar in character to the Sure Thing and, from the dump around an old shaft, showed chiefly pyrite mineralization in quartz and tourmaline. A grab sample from this dump material assayed 0.05 oz. Au. and 3.9 oz. Ag.

There is no record of production from the Sure Thing.vein zone.

III. Lilly Vein

This vein is located about 1,000 feet north of the Sure Thing vein and is covered along strike by the Moonlight, Lilly and Orphan Boy claims. The strike of the vein is about 25° north of east with a steep dip to the north.

The most westerly exposure of the vein is at an old shaft on the Moonlight claim. The shaft was inaccessible but the vein material on the dump was a quartz tourmaline breccia type, associated with an aplite dyke. Sulphide mineralization was in the order of 5%, being pyrite, galena and sphalerite. A grab sample of this material assayed 0.04 oz. Au., 3.9 oz. Ag., 3.8% Pb. and 2.1% Zn.

A 300 foot adit was driven 500 feet further west but reportedly did not hit the main vein. The adit was inaccessible. A compass pace survey indicated that an additional 50 feet or

more of x-cutting would be required to reach the Lilly vein. A parallelling vein structure was encountered in the adit, lying north of the Lilly vein, and this material was sampled from the adit dump. Aplitic vein material with disseminated sulphides assayed 0.07 oz. Au. and 1.5 oz. Ag. Massive sulphides, pyrite, galena and sphalerite, reportedly from the same vein zone, assayed 0.24 oz. Au., 12.7 oz. Ag., 3.6% Pb. and 3.0% Zn. It is note known what width of massive sulphides were encountered.

The most extensive work on this zone was done on the Lilly claim, with a shaft of unknown depth and development and stoping carried out to 200 feet below surface. The accompanying map, traced from a map supplied by Newman, indicates that only small tonnages were mined to about 125 feet below surface. The bottom or 127 Level did not make ore. The longest shoot was 145 feet on the Adit Level. Channel samples from the 39 and Adit levels, taken by other interests on a previous examination, suggest that the ore grade averaged 0.205 oz. Au., 3.98 oz. Ag., 2.34% Pb. and 2.67% Zn. over an average width of 5.0 feet.

IV. Annie R Vein

This vein is located about 2,200 feet north of the Lilly vein and is traced by various shaft and bulldozer trenches for a length of over 4,000 feet. The Champion, Annie R, Hattie M, Copper Queen, Copper King and Fort Knox claims cover the vein on strike.

A shaft was sunk on the Annie R claim to a depth of 55 feet and a 140 feet length was reported mined with a grade of 0.50 oz. Au., 10.0 oz. Ag. Newman shipped oxidized ore from surface which netted $25,000. The favourable structure is a fault zone about 15 - 20 feet wide with narrow mineralized quartz filled fractures

angling across the fault zone from hanging wall to footwall. Ore values are only found in the cross fractures. The workings were not accessible for examination. A grab sample from the dump, which could be representative of primary mineralization, assayed 0.04 oz. Au., and 5.3 oz. Ag. Rusted material from the fault zone exhibited light panning.

On the Hattie M. claim mining from an adit was reported over a 2-foot width and with similar grade to the Annie R. A second adit 200 feet vertically below the first adit failed to encounter the vein which has apparently been faulted to the south. A bulldozer cut picked up the vein 600 feet to the west and a grab sample across the vein zone assayed 0.05 oz. Au. and 0.6 oz. Ag.

An adit was driven 40-45 feet on a fault zone on the Copper Queen claim, east of the Hattie M. Newman reports that the vein was not located although mineralized quartz was found on the dump. Panning of the fault material showed a few colors.

The most easterly exposure of the Annie R vein was on the Fort Knox claim. Two shafts were put down to a depth of 40 feet or so. The width of the vein is unknown, but quartz vein material, mineralized with pyrite, was noted on the dumps. A grab sample of this material from both dumps assayed 0.07 oz. Au. and 5.4 oz. Ag. A bulldozer cut at the east end of the claim exposed a zone mineralized with magnetite, but the Annie R vein was not located.

V. <u>Julia Mine Area</u>

A grou pf 8 claims are held by location approximately 1.3 miles northwest of the Annie R vein zone and covers at least 4 separate veins of which the Julia vein has been the most important to date. The veins strike approximately east-west and dip steeply

to the south, and are quartz filled fractures and shears associated with aplite dykes intruding monzonite. The quartz filling varies from 6 inches to 3 to 4 feet wide, and in some sections the fractures are almost entirely filled with pyrite and minor galena and sphalerite. Copper staining was noted in some locations.

The most southerly vein is located on the Victory claim. Old workings include a tunnel and shaft, both of which are inaccessible. The dump from the tunnel shows quartz vein material mineralized with pyrite, grey copper, galena and sphalerite. A grab sample from the dump assayed 0.02 oz. Aug., 3.1 oz. Ag., and 0.2% Cu. A bulldozer cut below the tunnel exposed a 1 foot wide aplite dyke with no quartz.

On the Invasion claim, adjoining the Victory on the north, a tunnel was driven on a 2 foot wide aplite dyke. No mineralization of interest was noted.

The Julia vein lies on the D-Day and Freedom claims. In this location the contact between greenstone and monzonite lies west of the main underground workings of the Julia Mine and it is reported that the vein weakens as it passes from monzonite into greenstone, although other old reports suggest that faulting on the monzonite greenstone contact cut off the vein.

In Julia Mine, development and stoping were carried out to 345 feet below surface, although drifting on the 345 foot level was limited to 100 feet east and west of the shaft, possibly indicating that the bottom of the ore shoot had been reached. Assay information on the 300 and 345 Levels is not available. An assay longitudinal section of the upper levels by D.D. Muir, Jr. is attached and the average of all ore sections gave the following

assays: 0.218 oz. Au., 14.06 oz. Ag., 2.92 % Pb, 1.16% Cu. over an average width of 1.45 feet. A grab sample from the dump of massive pyrite assayed 0.08 oz. Au., 1.5 oz. Ag., and TR. Cu. Three contiguous samples were taken from the dump over a length of 43 feet averaged 0.07 oz. Au., 8.3 oz. Ag. and 0.2% Cu.

The next vein located approximately 500 feet north of the Julia vein is covered by the Hi-Ore and Hi-Way claims. The vein zone was exposed in a bulldozer trench on the Hi-Way claim with minor quartz associated with an aplite dyke. The exposure was very poor and a grab sample assayed 0.02 oz. Au., 0.5 oz. Ag. and no copper or lead.

The most northerly vein zone is located on the Big Boy and Big Boy Extension claims. The zone strikes due east-west with a dip of 75° south. This strike is slightly more easterly than the other veins in the area. On the Big Boy claim the vein zone is exposed as 4 parallel veins approximately 50 feet apart. The property was worked over 60 years ago and nothing is known of its past history. Only one of the 4 veins was sufficiently well exposed to sample and an assay of 0.12 oz. Au., 3.0 oz. Ag., and no copper was obtained.

To the east on the Big Boy Extension claim only one of the 4 veins has been located and it appears as a faulted altered 3 foot wide aplite dyke with 3 feet of silicious material in the centre. A 5 foot chip sample was cut across the mouth of the old tunnel which assayed 0.03 oz. Au., 0.5 oz. Ag., and 0.1 % Cu.

SUMMARY

In general, veining in the Elliston area appears to be associated with and controlled by persistent fault zones, along which aplite dykes have been intruded, with later quartz and sulphide introduction probably as a late state of widespread monzonite intrusion.

It is possible that the type of material available for sampling may be lower grade than that encountered in early mining due to near surface leaching and high percentage of waste material left on dumps. Experience to date would indicate that ore lenses are small, relatively shallow and widely separated.

It was reported that Pb.-Zn. production was important in previous operations, but little evidence of economical quantities of these metals was noted.

MIKE HORSE PROPERTY
HELENA AREA, MONTANA

Property and Location

This is a block of 71 mining claims located at Mike Horse, 22 miles northwest of Helena, Montana. The property is accessable by good gravel road, is serviced by electricity and there is an ample water supply. A number of camp and plant buildings, including machine shop, dry and mill building are in a fair state of repair. A sketch of the claim group is shown on Map No. 10.

History

The property has had a history of production of silver, lead, zinc and copper, prior to 1942 and most of this work was done by local mining people. No production records for this period are available.

In 1942, American Smelting and Refining Company Limited acquired the property and is understood to have carried on production until 1954. During this period a 300 ton mill was in operation. No A.S.& R. records are available.

From 1954 to 1959 the property was held under lease by Norman Rogers Mining Company, Box 1719, Helena, Montana, who carried on high grading operations both underground and on surface. In 1959 a new lease was negotiated by Norman Rogers with A.S. & R., which lease expires in 1979. Since 1959 there has been no activity on the property.

Production

From 1954 to 1959 Norman Rogers Mining Company produced 6,270 tons of ore that gave an average net smelter return of $20.06 per ton. Smelter penalties imposed by A.S. & R. were

Silver	-	Less 1 oz
Lead	-	Less 1.5%
Copper	-	Less 1%

Moisture scaled to weight.

$6.00 per ton smelter charge
10% royalty to A.S. & R.

Geology

The property is underlain by a gently dipping series of sediments that vary between Varve-Lake argillaceous rocks to ferruginous sandstones, all of Precambrian age. Feldspar porphyry dikes are intrusive into these rocks, their emplacement probably determined by pre-existing faults. The dikes are in width up to 25 to 30 feet and are generally dipping at angles between 60 and 80 degrees. Later faulting along certain of the pre-existing structures has developed shearing and strong alteration within some of the dikes. Quartz veins carrying base and precious metals were then developed in the sheared, altered porphyry. Gabbro was noted on the hanging wall of one of the mineralized dikes.

Mineralization within the veins comprises pyrite, galena, sphalerite and chalcopyrite. Leaching and alteration along the vein systems has resulted in strong kaolinization plus the development of secondary base metal carbonates. These alteration products are said to be confined to the top forty to seventy five feet of the vein system and that below this depth primary mineralization continues and has been developed in all of the underground workings.

Map No. 10 is attached showing a rough orientation of the several vein systems known to exist on the Mike Horse property. These would appear to be subsidiary to a major fault trending slightly east of north through the west part of the property. This conclusion is an entirely speculative and would require confirmation by detailed mapping.

At least 12 veins have been recognized on the property, all associated with altered, sheared, feldspar porphyry dikes. Two of the veins, the Mike Horse and Little Nell have been developed over a vertical

range of 900 feet and it is from these veins that the bulk of production has come. The Little Nell was developed over a maximum length of 1,600 feet and from inspection of longitudinal sections, the ore shoots showed good continuity along strike and bottomed above the eighth level. The Mike Horse was developed over a maximum length of 2,000 feet and bottomed at approximately the same elevation, but individual ore shoots were shorter than on the Little Nell. The Little Nell dips steeply to the north while the Mike Horse dips steeply to the south.

Three other veins, the Porter, Intermediate and a vein approximately 400 feet north of the Little Nell vein have been cut in underground workings, but have had very little development work done on these. It may be inferred that they are not well mineralized. There is no record of diamond drilling having been carried out by A. S. & R. to test these veins at other horizons or to check for parallel structures. A long crosscut on the 8th level from the Mike Horse vein north to the Little Nell gives no indication that the Intermediate or Porter veins were intersected, and if they were, mineralization must have been too weak to warrant development.

Detailed assay records or smelter returns for the underground production are not available. The Little Nell vein was sampled on surface and the central section where massive sulfides reportedly occurred at depth, assayed 0.01 oz gold, 19.6 oz silver, 11.0% lead, 0.5% copper and Nil zinc, over a width of 2.5 feet. The leached dike material on either side of the core of the vein, combined width of 12.5 feet, assayed 0.005 oz gold, 1.2 oz silver, 2.2% lead, 0.1% copper and Nil zinc.

The following values for the 200 level of the Mike Horse vein are recorded by Norman Rogers.

Length		Width	Oz/T Ag	% Pb	% Zn	% Cu
45'		4.8'	5.6	4.6	4.8	1.8
35'		4.4	1.5	3.3	4.1	0.56
40'		5.0	6.4	5.2	4.0	0.87
65'		2.3	3.4	5.5	4.1	.66
60'		4.7'	2.1	4.8	4.6	.95
480'		6.7	2.6	6.3	3.0	.39
120'		2.1	4.5	8.0	5.6	.67
835'	Average	5.4'	3.0	6.0	3.5	0.5

NOTE - 15' to 30' waste in between all shoots.

The other veins on the property have been located by side hilled bulldozer trenching and a portion of Roger's production was obtained from some of these open cuts. Massive sulfides were seen in the bottom of a few of the cuts, but the majority of the surface production came from the zone of weathering. Two of the veins of apparently similar dimensions and mineralization to the Mike Horse and Little Nell veins (surface exposures compared) lie approximately 600 feet and 1,000 feet south of the Mike Horse vein. A similar situation occurs north of the Little Nell vein, although evidence for the more northerly structure is not as well defined. Careful surface mapping would be necessary to locate these veins accurately.

Terms

Norman Rogers proposes a two year free option to develop enough ore to warrant repair of mill and purchase of equipment. During production Norman Rogers and Optionee would split the smelter returns, after A. S. & R. receive the initial ten per cent of net smelter returns and after capital and preproduction expenditures have been returned to the optionee. Norman Rogers' agreement with A.M.S. & R. does not specify any deduction for milling charges in calculating net smelter return.

CONCLUSIONS

Insufficient assay and production data available to estimate grade. This plus any geological information should, if possible, be obtained from A. S. & R. before considering any deal or exploration program.

The 300 level (adit level) is reported to be in fair condition and with only minor expense could be used as a base for underground diamond drilling to explore the vein structures parelleling the Mike Horse and Little Nell veins. A minimum of 4,000 to 6,000 feet of underground diamond drilling would be necessary as an initial program to determine if further work was warranted.

Considering the number and appearance of the veins, previous production, buildings, power and equipment (other than mill) available, this should be a better than average exploration bet which could readily be put into production. On the other hand the suggested terms of the deal are too tough. Mining costs would likely be high considering the width of the low grade sheared dike material that would have to be supported in mining the higher grade three foot to six foot central core of the zone.

COMETSILVER PROSPECT
DILLON, MONTANA

Property and Location

The property is located approximately 35 miles north west of Dillon, Montana and is readily accessible by road from this town. a truck road traverses the last few miles. The ground is now held as unpatented claims by Roger Pierce, Wellington Street, Dillon, Montana, covering a total of 6,000 feet along the strike of the zone.

Geology

The Comet Mine fault system occurs within a body of massive quartz monzonite that forms an offset portion of the Helena Butte Bathelith , lying to the northeast. The narrow quartz filled fault system, with numerous branching faults and attendent fracturing trends north 60° east and dips north westerly at 70° and carries sporadic high silver values. The fault system has been traced by adits and surface cuts for a strike length of 2,200 feet over a vertical interval of approximately 1,000 feet. Map No. 11 shows the location of adits and trenches examined. The main fault and many of the branch faults are marked by 1 to 2 inches of gouge. The monzonite adjacent to these faults and for a few feet in both walls shows considerable alteration. This, in part, may be due to surface weathering.

Quartz stringers and lenses occur sporadically along the fault system and are generally best developed at the junction and along one or more of the secondary structures. Considerable altered monzonite and chloritic material may be contained within the quartz. Lead and copper bearing sulfides occur with the quartz in high grade streaks over narrow widths, and also as scattered disseminations. Silver values are directly associated with the sulfides.

Workings

The main adit is at elevation 8865. A 60 foot shoot giving excellent silver values over a maximum width of ten feet is located in the footwall of the fault system, where branching structures appear to have definite control over the ore deposition. See Map No. 12. This shoot has been partially blocked out by slashing. The best values of 531.1 oz silver were obtained over a one foot width with an adjoining 7 feet averaging 51.8 oz. silver.

Values at the extremities of the shoot are low to nil. Galena and malachite accompany the silver values.

A second adit at elevation 8945 exposes the up dip mineralization developed in the main adit. A sample was cut at this location and assayed 2.04 oz silver across 8.5 feet and 63.93 oz. silver across 0.25 feet. This further confirms the lensy nature of the better grade values.

At the northeast end of the Comet zone and 1,200 feet from the main adit at elevation 9,400, a short adit and 25 foot winze expose a fractured quartz vein ten feet in width, shearing at the contacts and within the quartz itself. Poor ground hampered proper sampling of these workings. Three samples taken at the portal averaged 5.15 oz silver across 9.9 feet. Of this the central 1.4 feet assayed 25.72 oz silver.

Conclusions

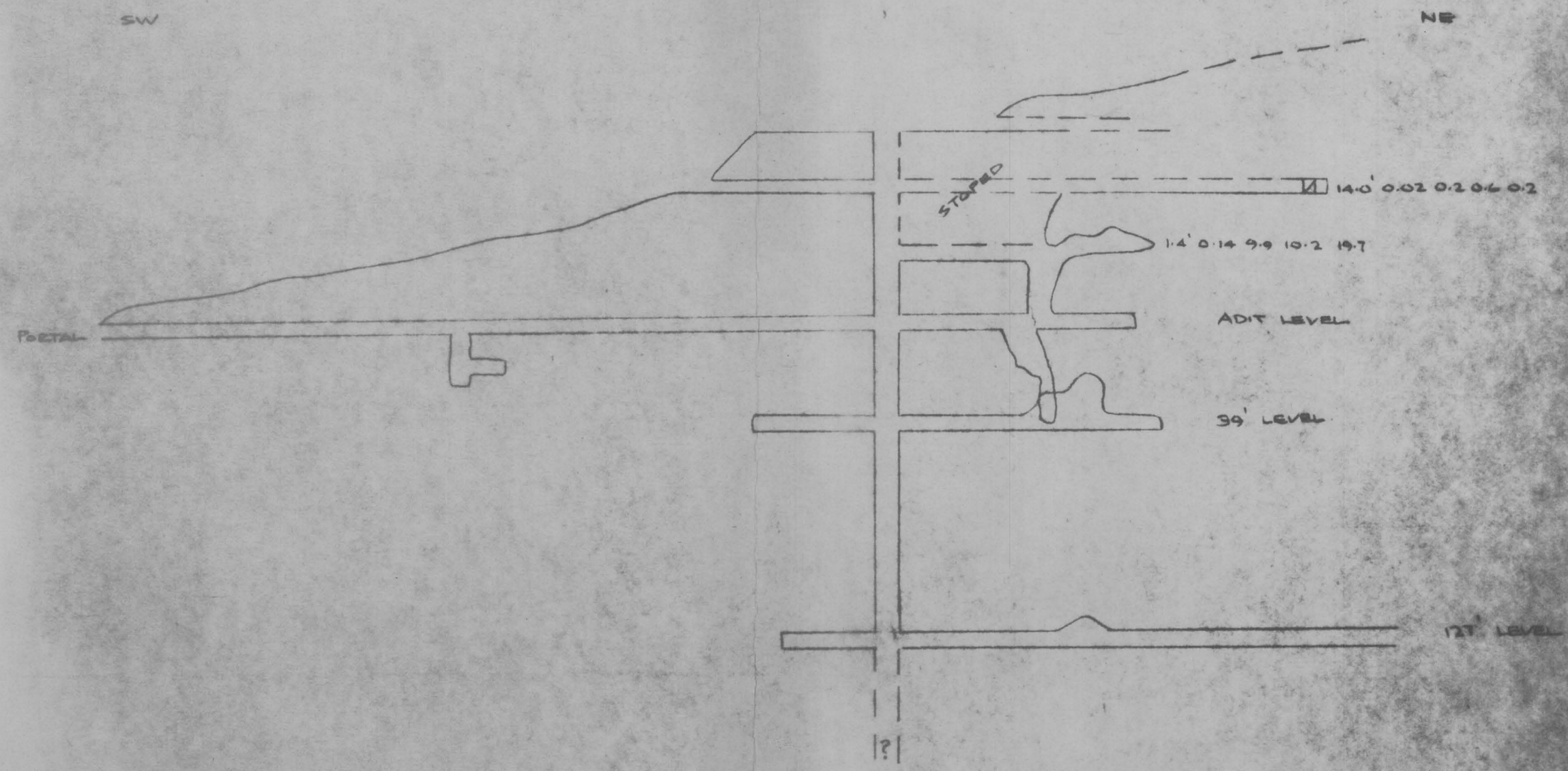
This prospect lacks the necessary width and continuity of ore grade values necessary to an economic mining operation. No further development is warranted.

W. F. Dix
Manager, Gunnex Limited

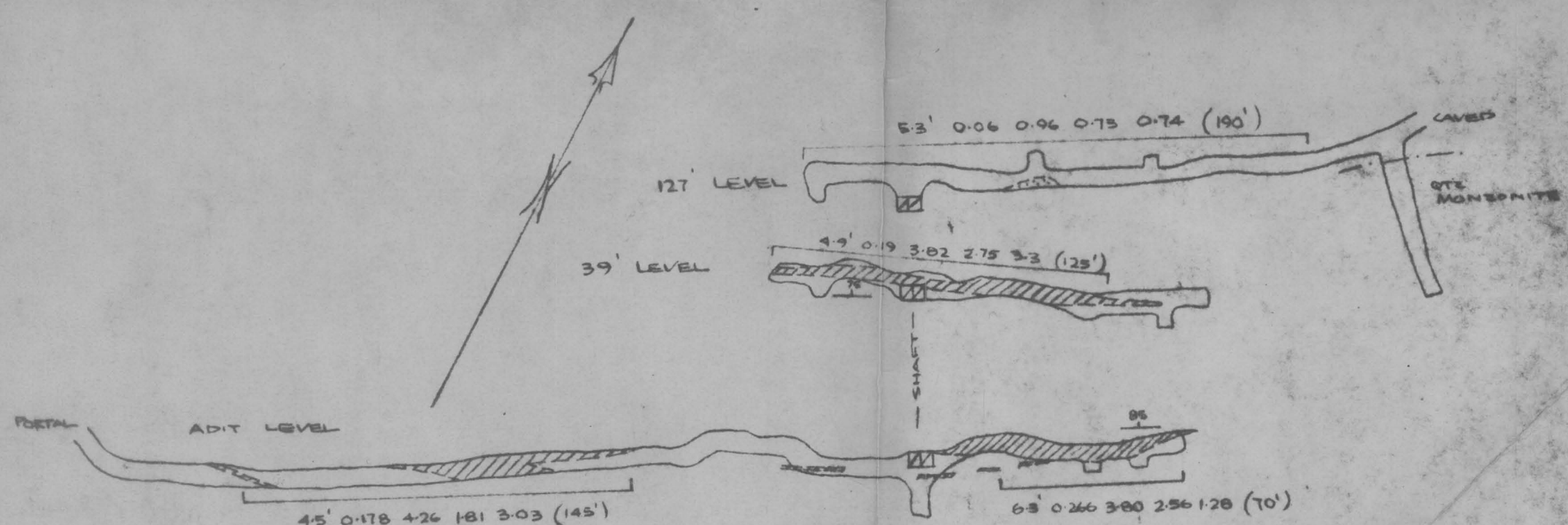
Walter E. Clark
Exploration Manager
Mayrock Mines Limited

Toronto, Ontario
September 1961.

MIKE HORSE
COMET
Montana
COMPANY (INDIANA)
Great Falls
Helena
East Helena
Butte
Missoula
Bozeman
Anaconda
Philipsburg
Deer Lodge
Dillon
Hamilton
Townsend
Conrad
Choteau
Lincoln
Stevensville
Three Forks
Manhattan
Belgrade
Wisdom
Jackson
Polaris
Armstead
Monida
Lima
Dell
Salmon
Seeley Lake
Ovando
Garnet
Drummond
White Sulphur Springs
Augusta
Cascade
Wolf Creek
Marysville
Boulder
Whitehall
Twin Bridges
Sheridan
Virginia City
Ennis
Alder
Cameron
Emigrant
Gardiner
B R O A D W A T E R
B E A V E R H E A D
U.S. Interstate Highways
by Rand McNally & Company
Printed in U.S.A.



LONGITUDINAL SECTION



PLAN

MAP NO. 8

R. MARTIN GRUBSTAKE 1960 - 1961

NEWMAN PROSPECTS - LILLY MINE

ELLISTON AREA MONTANA

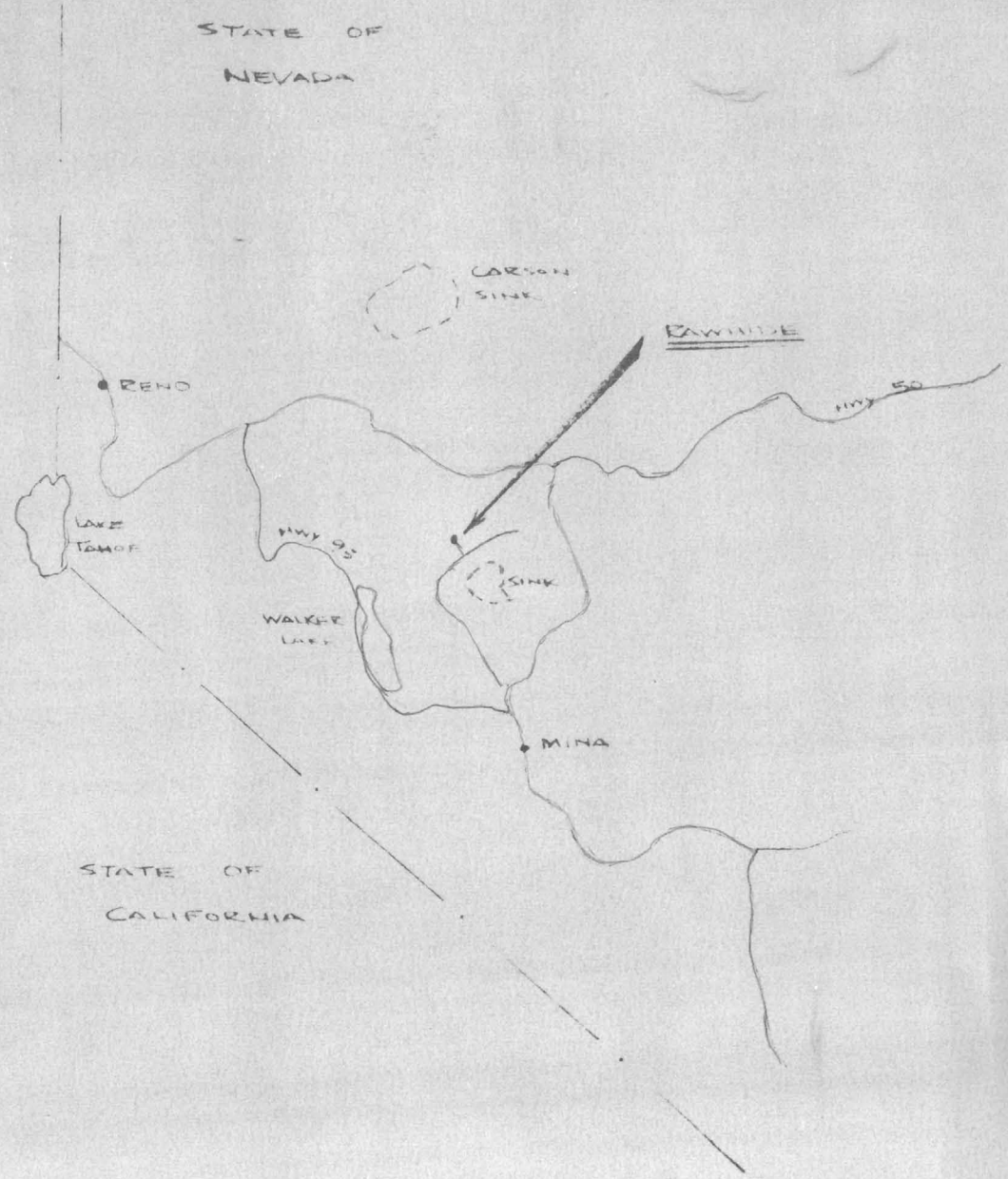
SCALE 1" = 50'

JULY 10

MINERALIZATION

ASSAYS AU AG PB ZN

NOTE: ASSAYS FROM MAP SUPPLIED BY NEWMAN

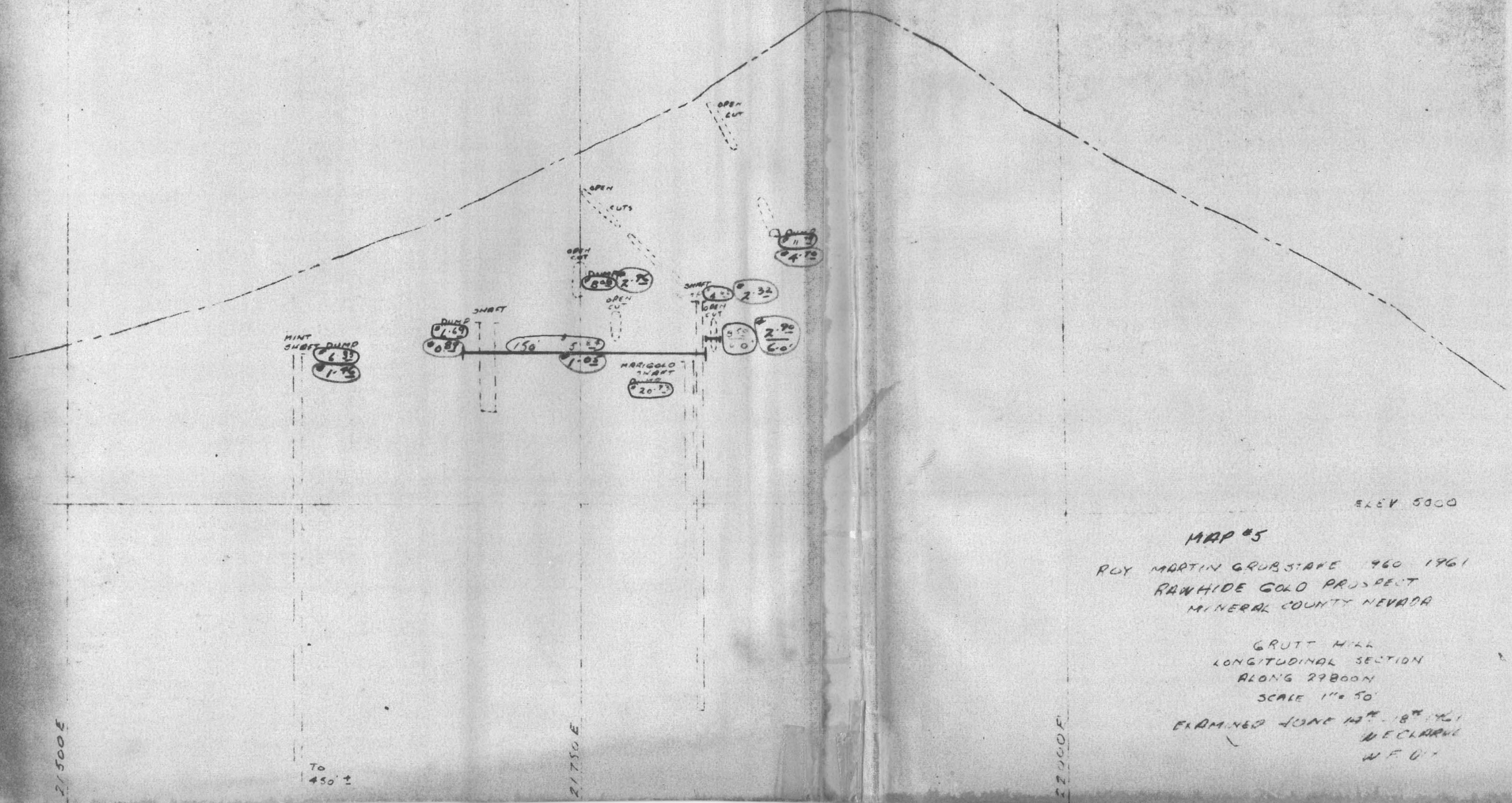


MAP NO. 1

ROY MARTIN GRUBSTAKE 1960-1961

RAWHIDE GOLD PROSPECT

SCALE 1" = 40 MI



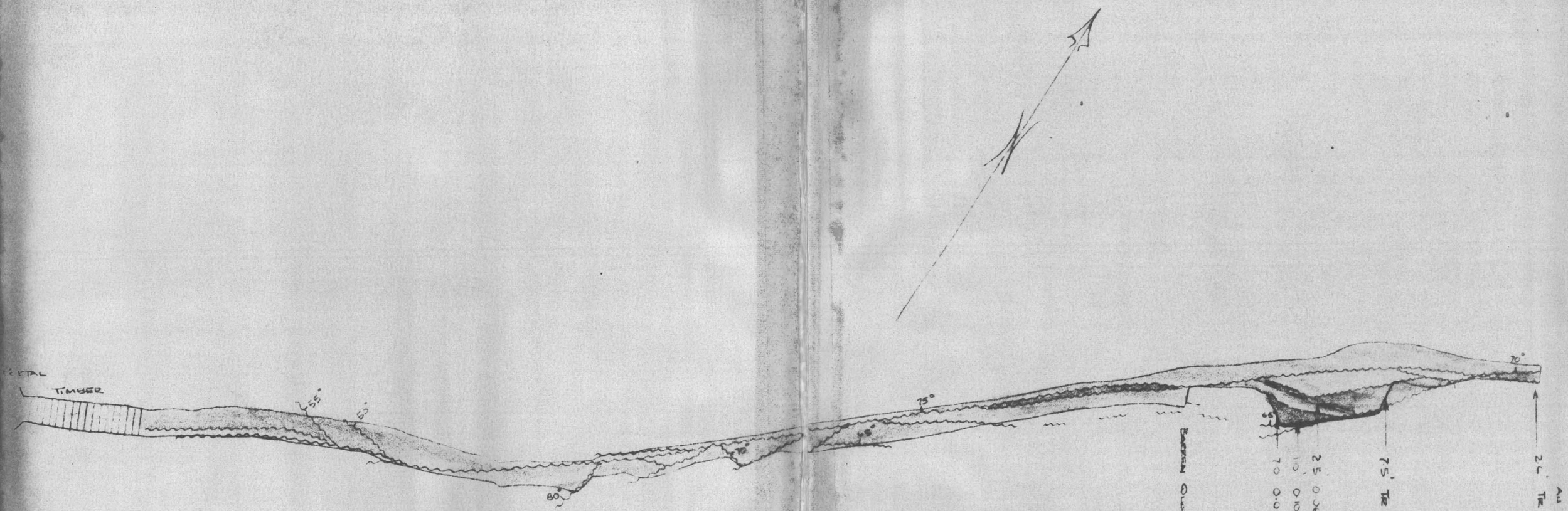
ELEV. 5000

MAP #5

ROY MARTIN GRUBSTAKE 1960 1961
RAWHIDE GOLD PROSPECT
MINERAL COUNTY NEVADA

GRUTT HILL
LONGITUDINAL SECTION
ALONG 29800N
SCALE 1" = 50'

EXAMINED JUNE 14TH - 18TH 1961
W E CLARKE
W F O'



QUARTZ

HIGH GRADE MINERALIZATION

QUARTZ MONZONITE

FAULT - FRACTURE

ASSAY: AU OZ AG OZ

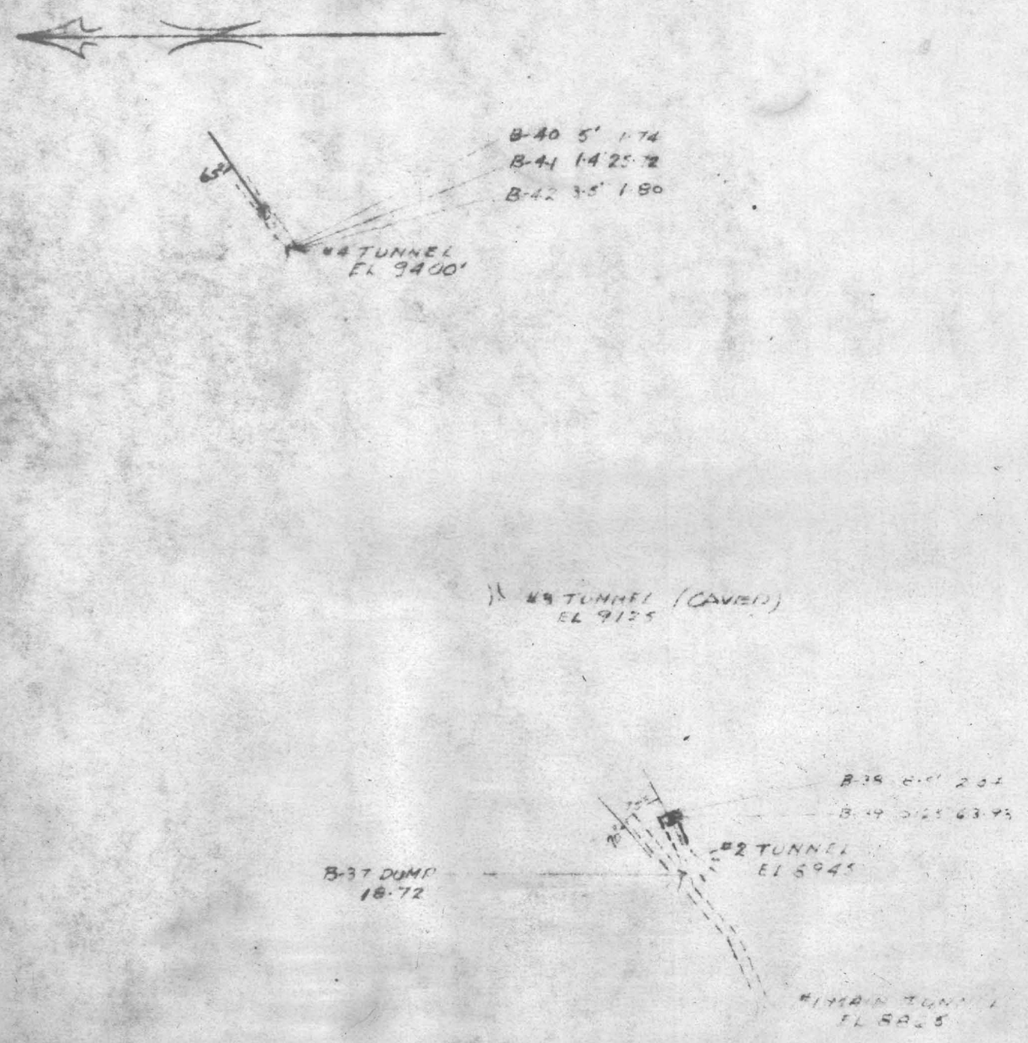
MAP NO. 12

ROY MARTIN GRUBSTAKE - 1960 - 1961

COMET SILVER PROSPECT

DILLON AREA MONTANA

SCALE 1" = 20'



MAP NO 11

Roy MARTIN GRUBSTAKE 1960 - 1961

COMET SILVER PROSPECT

DILLON AREA MONTANA

SCALE 1" = 200'

Assays : Ag oz

ROBERTS COPPER MINE

NORTHWESTERN NEVADA

FRANK W. ROBERTS

COPY

July 11, 1959

Mr. Frank W. Roberts
Box 186
Winnemucca, Nevada

Re: Oxide Copper Ore Deposit
Advertized in "Mining Record"

Dear Sir:

We have done considerable work on processing of non-sulphide type copper ore and have a large deposit of this type ore in Arizona. We are interested in looking at other properties of this type.

Would you please send us a copy of all the data that you have on this mine, that is, engineers reports, maps, assays etc. Would you also outline, briefly, the type of deal that you would be interested in on the property that you advertized in the "Mining Record".

Very truly yours,

G. A. Freeman, Manager
TRANSARIZONA RESOURCES, INC.

GAF/lh

Telephone Madison 3-2703

c/ Lee Case
P. O. Box 186
Winnemucca, Nevada.

July 16, 1959

Mr. G. F. Freeman
Transarizona Resources, Inc.
917 East Fort Lowell Road
Tucson, Arizona.

Dear Mr. Freeman:

Your letter of July 11th received, asking for a copy of the report on my Copper Mine. The Data which I am sending to you is a summary of investigations of a number of Mining Engineers also it covers the findings of the prospecting work which has been done. The inclosed map of the property shows the Shear-zone, which is several thousand feet in length and some 300 feet in width, Ore out-crops in a number of places along the shear. The longest continuous ore-out-crop is 1200 feet long, 5 to 15 feet wide on the surface, and has widened to 15 to 35 feet in the bottom of the drill holes, at a depth of 130 to 178 feet. This continuous ore-out-crop is on the foot wall of the shear. By the prospecting work that has been done we now know that there are other parallel ore bodies with in the width of the Shear. The structure of the shear is such that at depth the width of the shear could be all ore. The thought of some Engineers is that the Hanging wall side of the shear which is also a contact zone could be richer than the ore which out-crops on the foot wall. This shear being so large is sure to go to great depth, and at depth produce much higher grade ore than is now in sight.

As a start on a development program our Engineer advises that we start an 800 foot tunnel in the gulch below the large ore-out-crop, at a depth to cut the ore bodies below the present drill holes, This tunnel will cross the ore body where it is 35 feet wide, also will cross the parallel ore bodies within the 300 foot width of the shear-zone, From this tunnel a drift can be run some 150 feet to the south to ore-block 3-4, in which the width of ore is 15 feet, at a depth of 130 feet, and averages 5.37% copper and 4 ounces silver. This tunnel will block out enough ore for a Milling Plant on the ground, also will open up the ore-bodies across the shear-zone so that the future of the Mine can be planned.

Please keep in mind the work and expense of opening the ore bodies under present drill holes is not a gamble, It is a sure bet. As we know the ore is there, as it shows in the drill holes.

I just received a letter from the Harney Electric Cooperative, Inc. of Burns, Oregon, they are interested in bringing electric power line into the Mine Territory,

Yours very truly,

Frank W. Roberts

Roberts' Realty Holdings
Room 4, Union Block Bldg.
P. O. Box 754
Caldwell, Idaho

The Deal

Roberts Copper Mine is offered for Sale by a per cent of Production as follows -

With the execution date of Contract, a cash sum of three thousand dollars, as an earnest down installment payment on Contract.

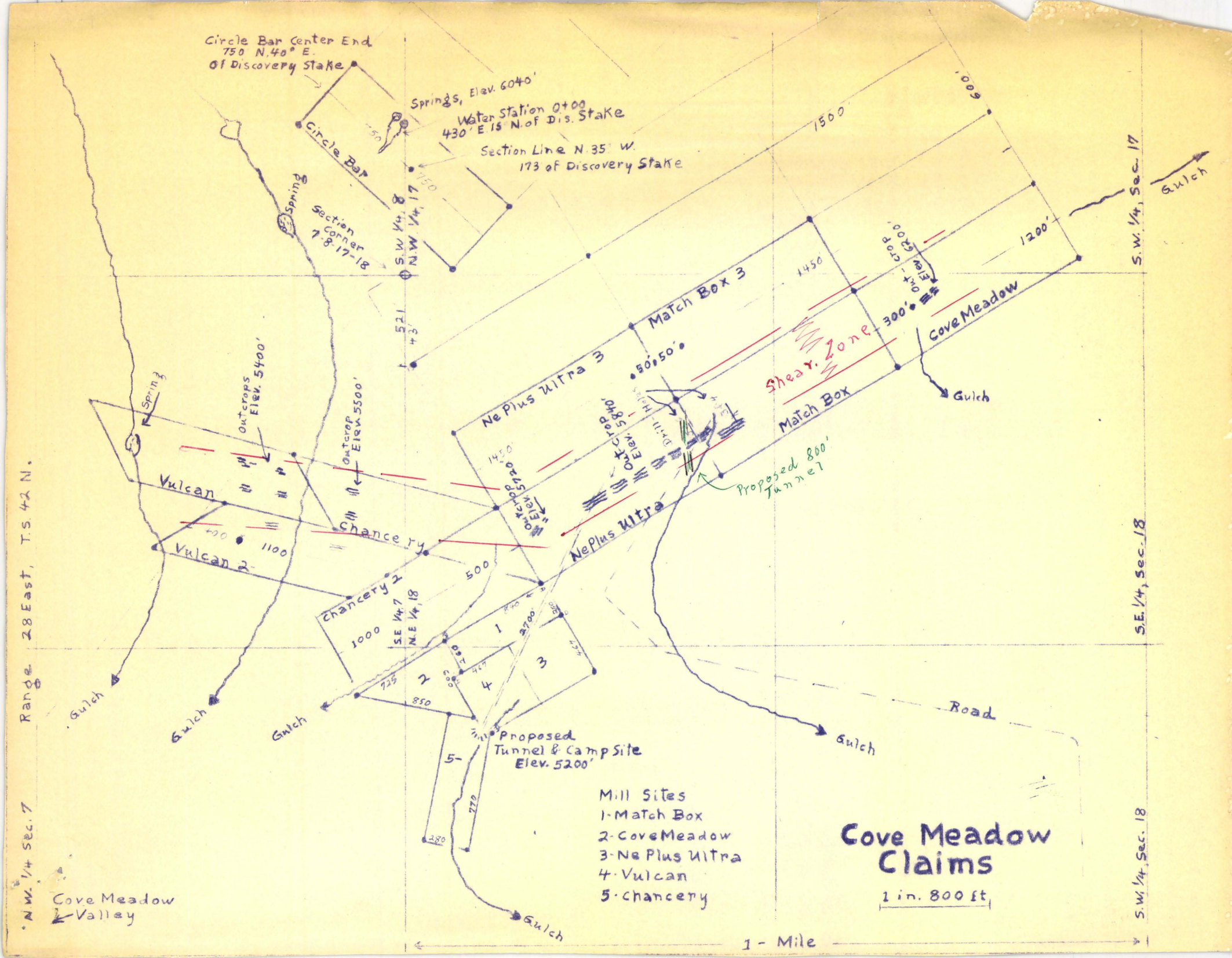
Contract to call for a development program to get the Mine in production or $400 per month for each month that such work is stopped.

After_____months time to get development of the Mine in production then Contract to call for production payments to equal Seven per cent of the gross dollar value of all Mine products which are sold or taken off the Mine property, of which must equal a minimum monthly sum of one thousand dollars or over or a cash payment to make up the minium monthly payments for the property.

All payments made to Owners shall apply upon the purchase price of the property, of which the total purchase price is Three hundred thousand dollars.

The Commission

Commission to Agent that consummates a deal to sell the Mine, this commission to be ten per cent of the payments which are made and as they are made on the property. Owners retain the right to sell the property through the first Agent that finds a ready buyer ready to cl close a deal.


Circle Bar Center End
750 N.40° E.
Of Discovery Stake
Springs, Elev. 6040'
Water Station 0+00
430' E 15 N. of Dis. Stake
Section Line N.35° W.
173 of Discovery Stake
Circle Bar
Spring
Section Corner
7-8-17-18
S.W. Qr. 8
N.W. 1/4, 17
Spring
Outcrops
Elev. 5400'
Outcrop
Elev. 5500'
Vulcan
Vulcan 2
Chancery
Chancery 2
S.E. Qr. 7
N.E. 1/4, 18
Ne Plus Ultra 3
Match Box 3
Ne Plus Ultra
Match Box
Cove Meadow
Shear Zone
Outcrop
Elev. 5720'
Outcrop
Elev. 5840'
Outcrop
Elev. 5200'
Proposed 800' Tunnel
Proposed
Tunnel & Camp Site
Elev. 5200'
Gulch
Road
Range 28 East, T.S. 42 N.
N.W. 1/4 Sec. 7
S.W. 1/4, Sec. 17
S.E. 1/4, Sec. 18
S.W. 1/4, Sec. 18
Cove Meadow
Valley
1 - Mile
Mill Sites
1-Match Box
2-Cove Meadow
3-Ne Plus Ultra
4-Vulcan
5-Chancery
Cove Meadow
Claims
1 in. 800 ft

ROBERTS COPPER SILVER MINE

Location:

The location of the property is in the mountains between the north end of the Black Rock Range and the south end of the Pine Forest Range, on the southeast side of Cove Meadow Valley. The Mine is 100 miles northwest of Winnemucca, Nevada. To get to the property - follow U. S. Highway 95, thirty-two miles to the Denio road junction, then follow Denio Highway 8-A, thirty-eight miles to Leonard Creek road junction, turn off on the Leonard Creek gravel road thirty-two miles south and westward to the Leonard Creek Ranch, then on to the south and westward to the south entrance of Cove Meadows, at which place turn off the County road eastward two miles up the mountain to the Mine.

Climate and Elevation:

The climate in the area is semi-arid, Sagebrush and desert grass is the main vegetation in the vicinity. December, January and part of February are the stormy months of the year. The altitude at the Mine is 5800 feet. The Black Rock Desert at the east base of the mountain five miles from the Mine is 4100 feet Elevation.

Property & History:

The property consist of four patented and six unpatented Mining Claims also Milling sites. The Mine was discovered in the late 1870's. The plats of the patented Claims are dated July 10, 1883. At the time an attempt was made to get a shipment of high-grade copper-silver ore to a Smelter. The ore was carried off the mountain by packhorses to the Desert, then transferred to wagons for the trip south through the Black Rock Desert. On reaching the Quinn River sink the wagons bogged down, so further attempts to ship ore was given up. It was not until 1948 and 1957 that roads were constructed up the mountain to the Mine and the oiled Highway constructed to Denio. In the future a 30 mile road will be constructed south through the Black Rock Desert from the Piute Ranch to the Western Pacific Railroad.

Geology:

The rocks of the area consist of andesite, which is on contact with granodiorite on the northeast. The andesite in the central part of the property is intruded by a dense, fine-grained diorite. A schistose structure has been developed along a shear-zone in the andesite. This shear-zone has a general strike of N. 45° W. and dips 50° to 60° northeast. The zone is comprised of silicified schistose material and andesite, parts of which have been more or less altered to chlorite.

The oxidized minerals near the surface are comprised of limonite, cuprite, malachite, azurite and chrysocolla in a highly silicified gangue. Traces of native copper were found in the drill cores 150 feet below the surface. Complementry fractures occur parallel to the direction of the shearing. Areas adjacent to these fracture lenses have been developed where mineralization is more concentrated; thus a rib structure has been formed within the shear-zone.

The copper mineralized zone is several miles in length; from the Cove Meadow side of the mountain, elevation 5800 feet, to the Black Rock Desert side, elevation 4100 feet. For many miles along the mountain Ranges copper minerals out-crop in places. The deepest work in the territory comprises of the drill holes at the Roberts Property.

Walls of the shear-zone:

A drill hole sunk 79 feet into the foot wall showed a metamorphic andesite rock, very hard, with disseminated magnetite and occasional sulphide particles. The contact hanging wall some 300 feet northeast of the large ore out-crop is a granitic rock. Between the walls are parallel ore bodies.

Ore out-crops:

The large shear which contains the ore cuts through all the gulches and covers the entire length of the property, five Mining Claims. Along this strike copper out-crops in many places. The longest continuous ore out-crop showing is over twelve hundred feet. 55 samples from this out-crop averaged 3.69 per cent copper. From this out-crop two cars of ore have been shipped to the Smelter. One car, 46 tons, averaged 2.85 per cent copper and 1.87 ounces silver per ton of ore. The other car, 42 tons, averaged 7.50 per cent copper and 3.30 ounces of silver per ton of ore. This ore also contained 63 per cent SiO_2 and 8.9 per cent iron.

1400 feet northerly of the drill holes, ore out-crops, samples, one foot 9.00 per cent copper and four feet 5.70 per cent copper.

1700 feet southerly of the drill holes, ore out-crops, samples, four feet 5.40 per cent copper.

The ore is thus shown by out-crops, test holes, drill holes, incline shaft, for a distance across the property of over seven thousand feet along the strike of the shear.

Difficulties were encountered by the Bureau of Mines in the attempt to drill the brecciated shear-zone. Caving ground necessitated cementing 44 per cent of the footage drilled. The core drill samples which were recovered averaged only 35.8 per cent of the holes. Much of the values of the sludge samples were lost because of the sludge escaping into the fissures around the drill holes, so the samples do not show the full value of the copper content of the ore. In none of the drill holes was the sulphide ore zone reached. Near Cove Meadow Valley level is the probable depth to find the sulphide ore.

A great many ore samples have been taken from the ore out-crop, 40 foot shaft, 80 foot tunnel, Diamond Drill Holes. Such work was done by the U. S. Bureau of Mines, The Navy Dept. (for evaluating the value of the Territory to get some idea what its cost would be to buy for a Gunnery Range) and Mining Engineers in checking on the property and the Property Engineers in checking, so all samples shown of the Mine assay map comprise of very careful work. The results of all this work shows a much higher average grade ore than the average U. S. Copper Mines.

Ore-blocks for immediate Production:

The following is a summary of an average values from Drill holes, Shaft and Tunnel assay records. See Mine assay map for complete samples.

Average value of ore per ton in block 3-4,	4.22% copper, 2.77 oz. ag.
Depth to bottom of hole four, 130 feet	
Width of ore in bottom of hole, 15 feet	
Average value of ore in bottom of hole,	5.37% copper, 4.00 oz. ag.
Average value of ore per ton in block 5-6,	3.18% copper, 2.05 oz. ag.
Depth to bottom of hole six, 178 feet	
Width of ore in bottom of hole 35 feet	
Average value of ore in bottom of hole -	
35 feet width,	1.68% copper, - 1.87% cu.
15 feet width,	3.95% copper, 2.40 oz. ag.
Average value of ore in 40 ft. shaft,	4.16% copper, 3.05 oz. ag.
Average value of out-crop samples,	3.69% copper,

Two hundred feet up the side of the mountain above ore blocks 3-4 and 5-6, in a prospect hole, another or parallel ore body (Number 2) has been uncovered, this ore block is unexplored.

The vicinity of the ore-blocks may be the making of an open-pit Mine. To explore this ground or the 300 foot width of the shear-zone and at a depth of 200 feet below the out-crop and 29 feet below the bottom of No. six drill hole, will require an 800 foot tunnel. Such a tunnel will give access to millions of pounds of copper. From the access tunnel drifts on the ore can be run along the ore zone strike both to the north and to the south.

To get 700 to 1000 feet depth on the Shear-zone, a 3000 foot cross-cut tunnel can be driven in from the Chancery Mill-site. Proposed location for main Camp & Mill.

Water:

Water for Camp can be had by putting in a pipe line to Springs 4000 feet up the mountain from the Mine. The drop from Springs to Mine is 296 feet.

A well drilled in fault zone at drill hole No. 7 should produce water.

The deep tunnel which is planned to cut the shear-zone at 700 foot depth should produce more than enough water for a large Mill, as the zone being 7500 feet long and 300 feet wide should hold a very large amount of water.

The Camp, Mill and Deep tunnel sight as planned, to be on the edge of Cove Meadow Valley. Wells sunk in the Valley floor will produce large amounts of water.

Milling:

In regard to Milling the ores now marked as in sight, there is plenty of extra good value ore in blocks 3-4, 5-6 and No. 2, to start a Pilot Mill; such a Mill built so that it can be enlarged as development on the Mine progresses. Many tons of ore that is exposed on the surface can be open-pit mined, and milled as the development work on the 800 foot access tunnel is carried on. Such a program can put the Mine in quick operation and keep it in continuous production.

A Milling test was made of the surface Oxide Copper Ore by the Southwestern Engineering Co., 4800 Santa Fe Ave., Los Angeles 58, California.

****

A large sample was taken from many places along the ore out-crop. This sample assayed 4.12 per cent copper. The ore was crushed to 1/4 inch and leached with a five per cent sulphuric acid solution by percolation for a period of 120 hours. The copper recovery was 93.19 per cent of the copper content of the ore.

A Milling test was made by the Booth Co. of Salt Lake City 15, Utah.

****

From another large ore sample taken from many places along the ore out-crop, this sample assayed 5.26 per cent copper. To evaluate a new flotation technique on the out-crop oxide ore, this test No. 4, Lot No. 299 showed a copper recovery of 86.33 per cent. Producing a rougher concentrate of 17.68 per cent copper. On the basis of past experience it is expected this rougher concentrate to clean up to 20 per cent copper. More Milling test on the ore needs to be carried on as new methods are bringing about many changes.

Depth of the Ore-bodies:

No deep exploring has been done in the Territory but the mountain structure from observations and study of the surface gives a good picture. First observe the surface of the ends of the shear-zone, on the Black Rock Desert side some 2000 feet in elevation below the Mine are found copper minerals and sulphides. On the Cove Meadow Valley side 700 feet in elevation below the Mine, large mineralized oxidized zones out-crop. The side of the mountain at the Mine shows a large shear-zone which cuts across the entire side of the mountain, several thousand feet in length, with walls of the zone some 300 feet apart, within this zone are the parallel ore bodies. This large disturbed area offered a good channel for the circulating waters and which was favorable to ore deposition, the slowness of circulation enforced by the obstructed passage made the percolation thorough and offered every chance for precipitation. The surface part of the shear-zone as proven by drill holes is brecciated. The foot wall of the zone is very hard with occasional sulphide particles showing. In such a formation at depth, is where the main mineralization will be found. The Cove Meadow Valley level is the most probable depth to find the water level of the mountain. Near this depth can be the secondary enriched zone of the ore-body. Below this depth the deeper primary ores, which should be of a higher grade ore than the partly leached surface ore. For these reasons this copper deposit should go to a great depth and prove to be a large producer.

Frank W. Roberts

Mine Ore Samples: taken along 3300 feet of Shear-zone strike.

Ore from Out-crops - 1400 feet northerly of Shaft, ore out-crops, samples, one foot 9.00 per cent copper and four feet 5.70 per cent copper.

Ore from out-crops - 1700 feet Southerly of Shaft, ore out-crops, samples four feet 5.40 per cent copper.

Ore from out-crops - 1200 feet of continuous ore out-crop, average of 55 samples, 3.69 per cent copper.
From this out-crop two cars of ore have been shipped to the Smelter.
One car, 46 tons averaged 2.58 per cent copper and 1.87 oz. silver per ton.
The other car, 42 tons averaged 7.50 per cent copper and 3.30 oz. silver.
This ore also contained 63 per cent SiO2 and 8.9 per cent iron.

Shaft samples. Shaft some 40 ft. in depth, no hanging wall in sight.

North side,	Sample width 5 ft.	depth 5 ft.	3.98% cu.,	3.40 oz. ag.
South side,	Sample width 4 ft.	depth 12 ft.	3.78% cu.,	3.40 oz. ag.
	Sample width 5 ft.	depth 17 ft.	2.96% cu.,	4.20 oz. ag.
South side,	Sample width 2.8 ft.,	depth 23 ft.	.81% cu.,	1.00 oz. ag.
South side,	Sample width 3.6 ft.,	depth 23 ft.	1.91% cu.,	2.20 oz. ag.
	Sample width 3.5 ft.,	depth 25 ft.	7.44% cu.,	1.78 oz. ag.
North side,	Sample width 4 ft.	depth 33 ft.	4.29% cu.,	1.80 oz. ag.
	Sample width 5 ft.	depth 35 ft.	8.16% cu.,	6.70 oz. ag.
Averages	width 4 ft.		4.16% cu.,	3.05 oz. ag.

Drill holes 3-4 -

Surface,	Sample width 9 ft.,	top of out-crop,	3.38% cu.,	2.05 oz. ag.
Tunnel,	Sample width 10 ft.,	depth 50 ft.	4.87% cu.,	2.50 oz. ag.
Hole 3,	Sample width 8 ft.,	depth 80 ft.	3.28% cu.,	2.55 oz. ag.
Hole 4,	Sample width 15 ft.,	depth 130 ft.	5.37% cu.,	4.00 oz. ag.
Averages	width 10 ft.,		4.22% cu.,	2.77 oz. ag.

Drill holes 5-6 -

Surface,	Sample width 5 ft.,	top of out-crop,	2.84% cu.,	1.60 oz. ag.
Hole 5,	---------- 90 ft. level -			
" "	Sample width 10 ft. hanging wall		2.17% cu.,	1.30 oz. ag.
" "	Sample width 5 ft. foot wall		3.00% cu.,	2.60 oz. ag.
Hole 6,	---------- 178 ft. level -			
" "	Sample width 10 ft. hanging wall		3.43% cu.,	3.50 oz. ag.
" "	Sample width 5 ft. foot wall		4.47% cu.,	1.30 oz. ag.
Averages	for width 15 ft.		3.18% cu.,	2.05 oz. ag.

Hole 6, Sample width 35 ft. Bottom of hole 1.68% cu., - 1.87% cu.

To check the surface of the leached out-crop Sample No. 224, width 4 ft. was taken assayed 0.49% Cu., then 3 ft. of surface rock was removed and bottom of hole sampled, assayed 5 ft. width, 1.70% cu. and 2 ft. 3.00% cu. This sample shows how much leaching out of copper there has been from the surface.

See Mine assay map and date for complete samples. Frank W. Roberts

FRANK W. ROBERTS
113½ South Kimball
Caldwell, Idaho

Ore values of different widths to 172 foot depth, Holes 3, 4, 5, 6,

Owing to loss of so much of the drill cores, only an approximate average can be figured. True average should be higher.

HOLE No. 3 - **********

28 - 30 ft. depth,	c	4.53% cu.	2 ft. ore 4.53% copper
62 - 67 ft. depth,	c	2.40% cu.	
67 - 70 ft. depth,	c	4.17% cu.	8 ft. ore 3.28% copper

HOLE No. 4 - **********

95 - 100 ft. depth	c	6.75% cu.	
100 - 105 ft. depth	c	3.87% cu.	
105 - 110 ft. depth	c	5.49% cu.	10 ft. ore 5.37% copper
110 - 115 ft. depth	s	2.28% cu.	15 ft. ore 4.59% copper
115 - 118 ft. depth	c	1.43% cu.	
118 - 120 ft. depth	c	1.23% cu.	
120 - 125 ft. depth	c	1.27% cu.	25 ft. ore 3.16% copper

HOLE No. 5 - **********

92 - 97 ft. depth	c	2.17% cu.	
97 - 102 ft. depth	c	2.10% cu.	10 ft. ore 2.13% copper
102 - 107 ft. depth	c	1.17% cu.	15 ft. ore 1.81% copper
107 - 112 ft. depth	c	.93% cu.	
112 - 117 ft. depth	c	1.35% cu.	
117 - 122 ft. depth	c	3.00% cu.	30 ft. ore 1.62% copper

HOLE No. 6 - **********

122 - 127 ft. depth	s	3.40% cu.	
127 - 132 ft. depth	c	3.43% cu.	10 ft. ore 3.41% copper
150 - 155 ft. depth	c	4.47% cu.	
155 - 161 ft. depth	c	2.07% cu.	
161 - 167 ft. depth	c	1.02% cu.	17 ft. ore 2.80% copper
122 - 172 ft. depth			50 ft. ore 1.87% copper

FRANK W. ROBERTS
113½ SOUTH KIMBALL
P. O. BOX 754
CALDWELL, IDAHO

GOLD -

640 feet northwesterly of Shaft, In the Shear-zone, in a three foot cut trench on the Copper ore out-crop, the dump of the trench pans a very fine free Gold. Dump assays-

Lumps of Copper ore -	3.38 per cent copper
Fines from dump -	.135 ounces gold

This area needs exploring.

An Engineer suggests that when the water pipe line and tank is constructed from the Springs to Mine, that the dirt above bed-rock on Shear-zone be washed off to expose any surface ore which may out-crop.

A general average sample from off the surface oxidized ores from several places along the ore out-crop. Sample assayed 4.12 per cent copper. From a sulphuric acid leaching Milling test on this ore the copper recovery was 93.19 per cent of the copper content of the ore.

The estimated daily copper recovery of 100 tons of ore per-day, in the form of cement copper on a varying heads assay, would be approximately:

3.0% ore	3.5% ore	4.0% ore
5400 lbs.	6400 lbs	7400 lbs.

Estimated gross daily income, from milling 100 tons of ore per day:

Copper at	3.0% ore	3.5% ore	4.0% ore
33¢	$1782	$2112	$2442
30¢	1620	1920	2220
27¢	1458	1728	1998

FRANK W. ROBERTS
113½ SOUTH KIMBALL
P. O. BOX 754
CALDWELL, IDAHO

STATISTICS: Copper

The United States is the largest producer and consumer of Copper producing about 31 per cent of the total and consuming about 45 per cent of the world's copper; however, consumption of copper continues to grow and the return of the United States to a position of self sufficiency is not likely under forseeable conditions.

The supply of copper known to remain in the ground in the United States is estimated at about 25,000,000 tons of recoverable metal. The present major producing Mines have from ten to thirty years of productive life.

Country	Production percentages	Consumption percentages
United States	31%	45%
Africa	20%	
Chile	14%	1%
Canada	10%	4%
Soviet Union	11%	16%
Rest of the World	14%	34%

The following Nations use copper but their production is very small - Belgium, France, Germany, England, Sweden, Norway, Italy, Turkey, India, Japan, China, Australia and other Nations. The next few years will see these Countries increasing the use of Copper to the extent that they may find it difficult to get enough copper for their requirements.

United States' population is increasing around three million each year. With the World's population increasing and the standards of living demanding more things, the future supply of copper may not equal the demands for the metal.

The United States may before long drop from first place to third place in the production of copper. The main reason is the leaner quality or lower grade ore our Mines will soon be producing. Most of the ore now being mined averages less than one per cent copper or less than 20 pounds of copper to the ton of ore. This lower grade ore will increase the cost of production of copper.

90 per cent of the World's unmined copper is in Africa, Chile and United States. Most of the copper produced in the United States comes from Utah, Arizona, Montana and Nevada.

African deposits average 3% or 60 pounds of copper to ton of ore.
Chilean deposits average 2% or 40 pounds of copper to ton of ore.
U. S. deposits average 1% or 20 pounds of copper to ton of ore.
U.S.S.R. deposits average 1% or 20 pounds of copper to ton of ore.

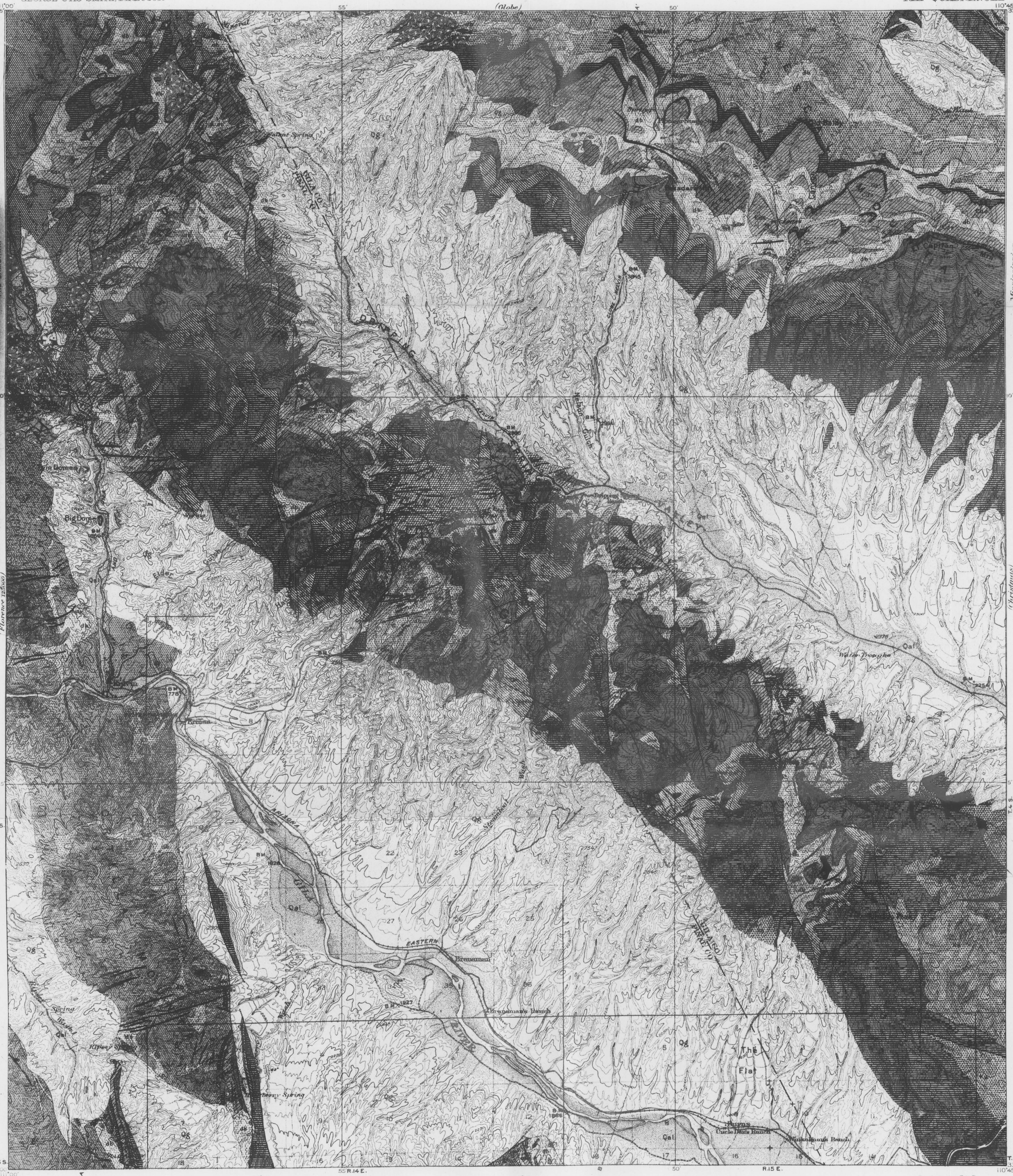
Copper is so widespread in nature that almost every country has some, 36 Nations produce some copper and a few others may have undiscovered deposits; yet the majority of the world's copper is concentrated in few places. Probably no two mining people could agree on a listing of the World's copper deposits in order of magnitude. One reason is that some of the deposits have not been fully explored.

Economic conditions cause the price of copper to change very rapid.

DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, SECRETARY
U.S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

AREAL GEOLOGY

ARIZONA
RAY QUADRANGLE



EXPLANATION

SEDIMENTARY ROCKS

(Areas of subaqueous deposits are shown by patterns of parallel lines; subaerial deposits by patterns of dots and circles, metamorphism is indicated by hachures)

QUATERNARY

Recent

Qal — **Alluvium** (gravel, sand, and silt along present stream ways)

Pleistocene

Qg — **Gila conglomerate** (fluviatile conglomerates, coarse in places near the mountains, grading into fine silts, probably in part lacustrine, in wide valleys; includes some beds of tuff and infusorial earth)

UNCONFORMITY

TERTIARY

Tw — **Whitetail conglomerate** (subangular fragments chiefly of diabase and limestone accumulated by streams and hillside wash)

UNCONFORMITY

CARBONIFEROUS

Mississippian and Pennsylvanian

Cr — **Tornado limestone** (light gray limestone thick-bedded in lower part, thinner bedded in upper part. Fossils abundant in upper beds)

DEVONIAN

Dm — **Martin limestone** (thin bedded, yellowish to dark gray, somewhat magnesian limestone; upper part fossiliferous; some yellow arenaceous beds in lower half)

UNCONFORMITY?

CAMBRIAN AND POSSIBLY ALSO ORDOVICIAN AND SILURIAN

Apache group

Ꞓr — **Troy quartzite** (cross bedded pebbly quartzite, chiefly thick-bedded, but thin flaggy beds, marked with worm casts, in upper portion)

Ꞓm — **Mescal limestone** (thin bedded, white to buff limestone, in part dolomitic, with abundant knotty layers of chert. Includes, as mapped, an overlying flow of vesicular basalt)

Ꞓds — **Dripping Spring quartzite** (fine grained, ripple marked and sun cracked, arkosic quartzite, much of it banded dark red and gray)

Ꞓb — **Barnes conglomerate** (coarse, well rounded, quartzose pebbles in arkosic matrix)

Ꞓp — **Pioneer shale** (dark, reddish brown spotted with yellow, arenaceous shale, grading into arkosic quartzite at base. Includes, as mapped, underlying thin Scanlan conglomerate)

GREAT UNCONFORMITY

PRE-CAMBRIAN

Metamorphic rocks

pe — **Pinal schist** (chiefly fine grained quartz-sericite schist; metamorphosed fine arkosic sediments. Includes some metamorphosed grits and a little schistose igneous material)

IGNEOUS ROCKS

(Areas of igneous rocks are shown by patterns of triangles and rhombs)

LATE TERTIARY ?

Dacite (thick extensive flow with a little tuff at base, in northwestern part of quadrangle)

EARLY TERTIARY ?

Tr — **Rhyolite porphyry** (rhyolite porphyry dikes east of Tom o' Shanter Peak)

P — **Quartz diorite porphyry** (dikes and small intrusive masses, particularly abundant near Troy and Tornado Peaks)

Gd — **Granodiorite** (intrusive mass in Troy Basin)

Tmp — **Teapot Mountain porphyry** (dikes and irregular intrusive masses of quartz monzonite porphyry near Ray)

Gm — **Granite Mountain porphyry** (irregular intrusive masses of quartz monzonite porphyry near Ray)

Q — **Quartz diorite** (dikes and comparatively small intrusive masses)

Explanation is continued on the left margin.

R. B. Marshall, Chief Geographer.
T. G. Gerdine, Geographer in charge.
Topography by Pearson Chapman, C. F. Eberly, and reduced from map of Ray and Vicinity.
Control by T. M. Bannon and Thos. Winsor.
Surveyed in 1907-1908.

TRUE NORTH
MAGNETIC NORTH
14½°
APPROXIMATE MEAN DECLINATION 1922

Scale $\frac{1}{62500}$

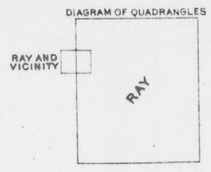
1 ½ 0 1 2 3 4 Miles

1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 50 feet.
Datum is mean sea level.

Edition of Oct 1922

DIAGRAM OF QUADRANGLES

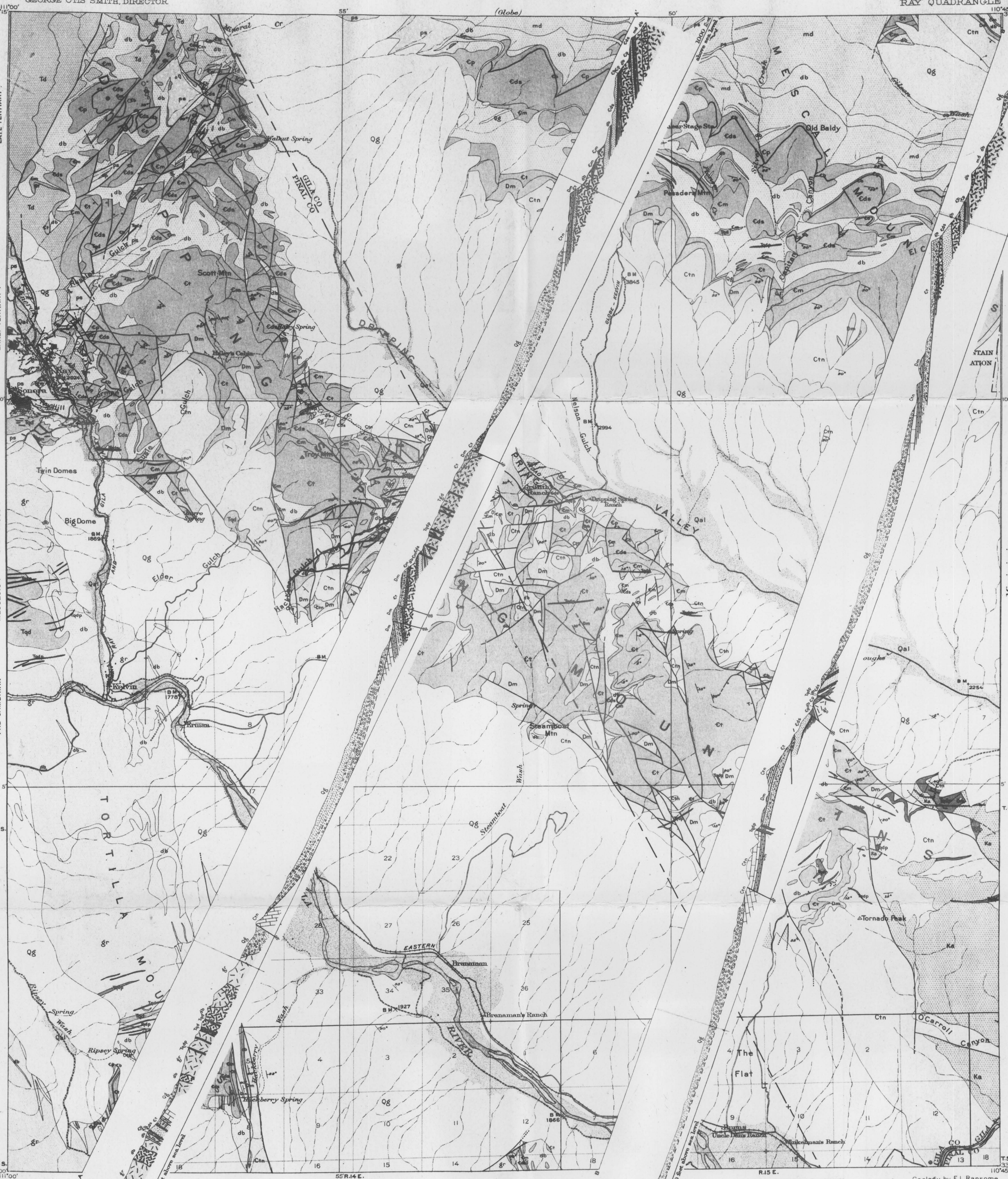


Geology by F. L. Ransome and J. B. Umpleby.
Surveyed in 1910 and 1911.

DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, SECRETARY
U.S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

STRUCTURE SECTIONS

ARIZONA
RAY QUADRANGLE



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EXPLANATION

SEDIMENTARY ROCKS

SHEET SYMBOL — SECTION SYMBOL

QUATERNARY

Recent

Qal — **Alluvium** (gravel, sand, and silt along present stream ways)

Pleistocene

Qg — **Gila conglomerate** (Variable conglomerate, coarse in places near the mountains, grading into fine silts, probably in part lacustrine, in wide valleys; includes some beds of tuff and infusorial earth)

UNCONFORMITY

TERTIARY

Tw — **Whitetail conglomerate** (subangular fragments chiefly of diabase and limestone accumulated by streams and hillside wash)

UNCONFORMITY

CARBONIFEROUS

Mississippian and Pennsylvanian

Ctn — **Tornado limestone** (light-gray limestone thick-bedded in lower part, thinner bedded in upper part. Fossils abundant in upper beds)

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UNCONFORMITY?

CAMBRIAN AND POSSIBLY ALSO ORDOVICIAN AND SILURIAN

Apache group

Ct — **Troy quartzite** (cross-bedded pebbly quartzite, chiefly thick-bedded, but thin, flaggy beds, marked with worm casts, in upper portion.)

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Cds — **Dripping Spring quartzite** (fine-grained, ripple-marked and sun-cracked, arkosic quartzite, much of it banded dark red and gray)

Cb — **Barnes conglomerate** (coarse, well-rounded, quartzose pebbles in arkosic matrix)

Cp — **Pioneer shale** (dark, reddish-brown, spotted with yellow, arenaceous shale, grading into arkosic quartzite at base. Includes, as mapped, underlying thin Scotian conglomerate)

GREAT UNCONFORMITY

PRE-CAMBRIAN

Metamorphic rocks

ps — **Pinal schist** (chiefly fine-grained quartz-sericite schist; metamorphosed fine arkosic sediments. Includes some metamorphosed grits and a little schistose igneous material)

Explanation is continued on the left margin.

EXPLANATION (Continued)

IGNEOUS ROCKS

SHEET SYMBOL — SECTION SYMBOL

LATE TERTIARY ?

Dacite (Quartz-bearing flow and tuff at northwestern corner of quadrangle)

Rhyolite porphyry (Porphyry dikes near Shanter Peak)

Tqdp — **Quartz diorite porphyry** (Dikes and small intrusives, particularly near Pinnacle Peak)

Granodiorite (Irregular masses in Dripping Springs)

Spot Mountain porphyry (Dikes and irregular intrusive masses of porphyritic monzonite near Ray)

Granite Mountain porphyry (Irregular intrusive masses of porphyritic monzonite near Ray)

Tqd — **Quartz diorite** (Dikes and comparatively small intrusive masses)

EARLY TERTIARY ?

CRETACEOUS ?

Andesite tuff and breccia (Partly consolidated volcanic material with igneous intrusives; temporarily includes some lava flows)

MESOZOIC ?

db — **Diabase** (Dikes and sills of medium texture, ophitic diabase. Irregular sills with many branch connections; most abundant in the Troy limestone)

PRE-CAMBRIAN

md — **Madera diorite** (Dikes of diorite, diorite porphyry, resulting from the granodiorite intrusive; monzonite, in the Pinal schist intruded by the Pinal schist in the Pinal Range)

gr — **Granite** (Dikes of granite, generally coarsely porphyritic; crumbling. Batholithic intrusive mass extensively exposed in the Pinal Range)

Known fault

Probable fault

Concealed fault (covered by younger deposits)

T.4 S.

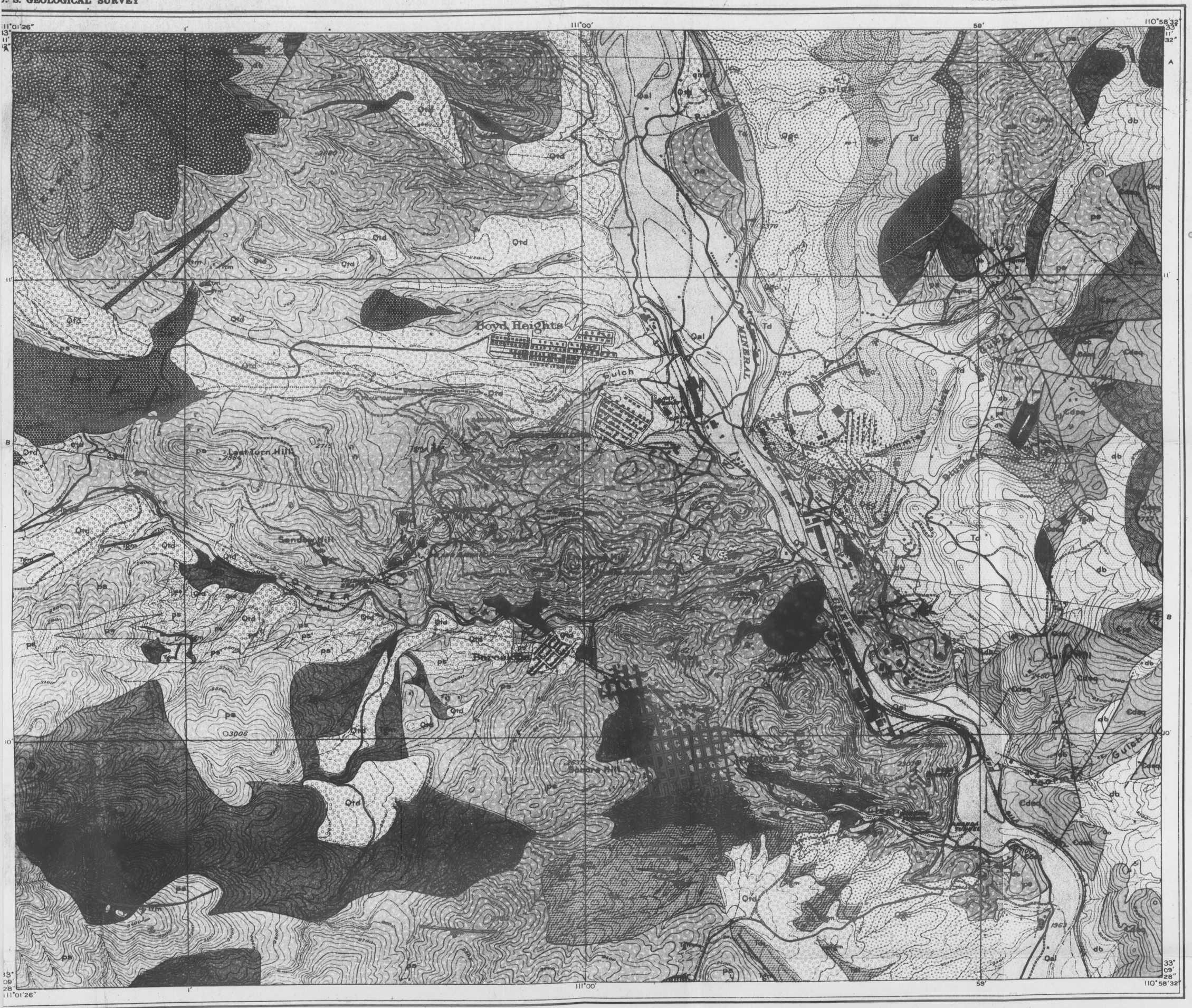
Dip of fault plane

Overthrust side of thrust faults

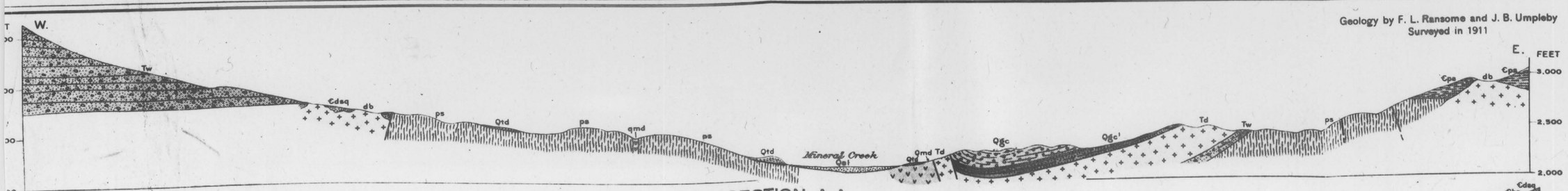
Strike and dip of stratified rocks

Strike of vertical beds

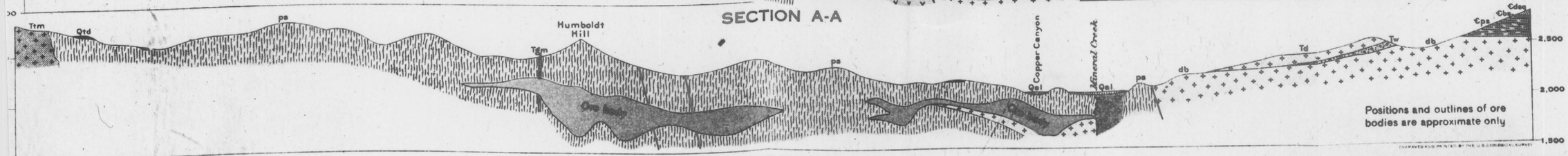
Horizontal beds



Geology by F. L. Ransome and J. B. Umpleby
Surveyed in 1911



SECTION A-A



Positions and outlines of ore bodies are approximate only

SECTION B-B

GEOLOGIC MAP AND SECTIONS OF THE RAY DISTRICT, ARIZONA

Scale $\frac{1}{12000}$

0 ¼ ½ ¾ 1 Mile

1000 500 0 1000 2000 3000 4000 Feet

200 100 0 500 1000 Meters

Contour interval 25 feet.

Datum is mean sea level.

1919

EXPLANATION

QUATERNARY

Qal — Alluvium
(Gravel, sand, and silt along present streamways)

Qtd — Terrace deposits
(Unconsolidated angular and gravelly detritus derived from adjacent hill slopes and dissected by present streams)

Qgc' Qgc — Gila conglomerate
(Local basal portion of well-stratified tuff and pumiceous beds, Qgc' The normal poorly stratified heterogeneous deposit of rock waste, Qgc)

LATE TERTIARY (?)

Td — Dacite
(A thick and formerly extensive lava flow with, in places, a little tuff at its base. Faulting and erosion have greatly reduced its area)

Tw — Whitetail conglomerate
(A roughly bedded deposit of more or less angular rock detritus. Very variable in thickness.)

EARLY TERTIARY (?)

Tqmd — Quartz monzonite porphyry and quartz diorite porphyry dikes

Granite Mountain porphyry
(Irregular intrusive masses and small dikes of quartz monzonite porphyry)

Teapot Mountain porphyry
(Intrusive masses of irregular shapes and dikes of quartz monzonite porphyry)

Quartz diorite
(Intrusive mass)

MESOZOIC (?)

db — Diabase
(Intrusive sheets and irregular masses)

CAMBRIAN, POSSIBLY ALSO ORDOVICIAN AND SILURIAN

Ꞓtq — Troy quartzite

Ꞓdeq — Dripping Spring quartzite

Ꞓbc — Barnes conglomerate

Ꞓps — Pioneer shale

PRE-CAMBRIAN

qmd — Quartz-mica diorite (Madera diorite)
(Intrusive into Pinal schist)

gr — Granite
(Intrusive into Pinal schist)

ps ps' — Pinal schist
(Normal variation; chiefly sericite schist, ps An uncommon variety probably an altered rhyolite, ps')

Fault

General outline of ore-bearing area

Note: The sections accompanying this map are not to be regarded as expressive of fully ascertained fact. They are largely interpretations of incomplete data and, as such, are more or less inferential.

B. Marshall, Chief Geographer.
G. Gerdine, Geographer in charge.
Topography by W. M. Beaman.
Control by T. M. Bannon and Thomas Winsor.
Surveyed in 1910.
Culture revised in 1917 by W. M. Beaman.

ENGRAVED AND PRINTED BY THE U. S. GEOLOGICAL SURVEY

EXPLANATION

QUATERNARY

Qal — **Alluvium**
(Gravel, sand, and silt along present streamways)

Qgc — **Gila conglomerate**
(A variable fluviatile deposit of irregularly bedded conglomerate with imperfectly rounded pebbles and boulders. Very coarse in certain localities near the mountains but grades into fine silts in the wider valleys, where deposition was probably in part lacustrine. Contains some beds of tuff and infusorial earth. Thickness very variable; over 2,000 feet north of Miami and may be much thicker between Miami and Globe)

LATE TERTIARY (?)

Td — **Dacite**
(A thick and formerly extensive lava flow with, in places, a little tuff at its base. Faulting and erosion have greatly reduced its area)
a — Landslide material

EARLY TERTIARY (?)

Tdp — **Quartz diorite porphyry**
(Small decomposed dike in Pinal schist)

Ts — **Schultze granite**
(Irregular intrusive mass. Chiefly granite but grades into porphyry near margins. Closely associated with the copper ores)

MESOZOIC ?

db — **Diabase**
(Intrusive, irregular sills with many cross-cutting connections in the Paleozoic and older rocks. The prevalent sill form not so well shown in this area as elsewhere in region. Typically a medium-grained ophitic olivinitic diabase or dolerite)

Tw — **Willow Spring granite**
(Small intrusive mass. Age relation to diabase and Schultze granite uncertain)

CAMBRIAN

Scanlan conglomerate and Pioneer shale
(Remnants in part included in diabase)

PRE-CAMBRIAN

ps — **Pinal schist**
(Quartz-sericite schist with locally some biotite. The principal copper-bearing rock in the Miami district)

Fault

GEOLOGIC MAP OF THE MIAMI DISTRICT, ARIZONA

R.B. Marshall, Chief Geographer.
T.G. Gerdine, Geographer in charge.
Topography by Albert Fike and P.W. Berry.
Control by A.H. Thompson and Thomas Winsor.
Surveyed in 1910.

Scale $\frac{1}{12000}$

0 — 1 Mile
1000 — 500 — 0 — 1000 — 2000 — 3000 — 4000 Feet
200 — 100 — 0 — 500 — 1000 Meters

Contour interval 25 feet.
Datum is mean sea level.

1919

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION 1910.

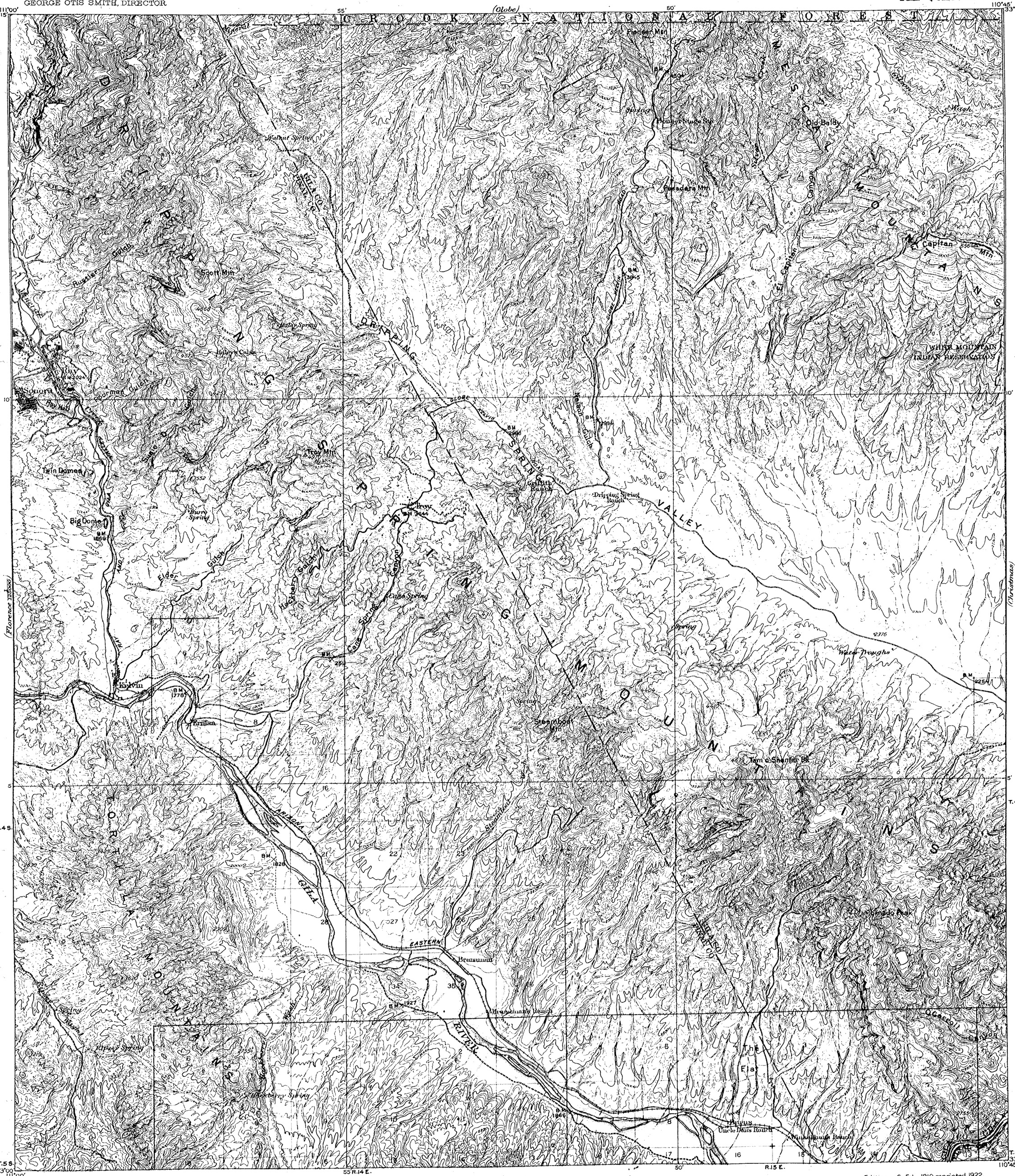
ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

Geology by F. L. Ransome and J. B. Umpleby
Surveyed in 1911

DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, SECRETARY
U. S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

TOPOGRAPHY

ARIZONA
RAY QUADRANGLE



EXPLANATION

RELIEF
printed in brown

5520 — Altitude *above mean sea level instrumentally determined*

Contours *showing height above sea, horizontal form, and steepness of slope of the surface*

Stream wash

DRAINAGE
printed in blue

Streams

Intermittent streams

Spring

CULTURE
printed in black

Roads and buildings

Poor road

Trail

Railroad

Ford

U.S. township and section lines and located corner

County line

Reservation line

Triangulation station

BM ×2994 — Bench mark giving precise altitude

R.B. Marshall, Chief Geographer.
T.G. Gerdine, Geographer in charge.
Topography by Pearson Chapman, C.F. Eberly, and reduced from map of Ray and Vicinity.
Control by T.M. Bannon and Thos. Winsor.
Surveyed in 1907-1908.

APPROXIMATE MEAN DECLINATION, 1922.
TRUE NORTH
MAGNETIC NORTH
14½°

Scale $\frac{1}{62500}$

1 ½ 0 1 2 3 4 Miles

1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 50 feet.
Datum is mean sea level.

Edition of Feb 1910, reprinted 1922.

The Arizona Hercules Copper Mining Co. is capitalized at $10,000,000, with shares of $10 par value. It owns about 250 acres of mining claims and a mill site; the most valuable part of the mining ground is inclosed by the property of the Ray Consolidated Copper Co. Details of the organization of the Ray Hercules Copper Co. are not at hand. The company is reported to be building a concentrator near Kelvin.[1]

[1] Since this was written the Ray Hercules Copper Co., now owning more than 99.9 per cent of the stock of the Arizona Hercules Copper Co., has issued its first annual report, in which it is stated that the company has developed 9,500,000 tons of 1.77 per cent ore. The company has carried out extensive underground work and has equipped the mine for production on a large scale. At Belgravia, a new settlement just north of Ray Junction and about 6 miles from the mine, a concentrating mill with a capacity of 1,500 tons a day has recently been completed and is now in operation.

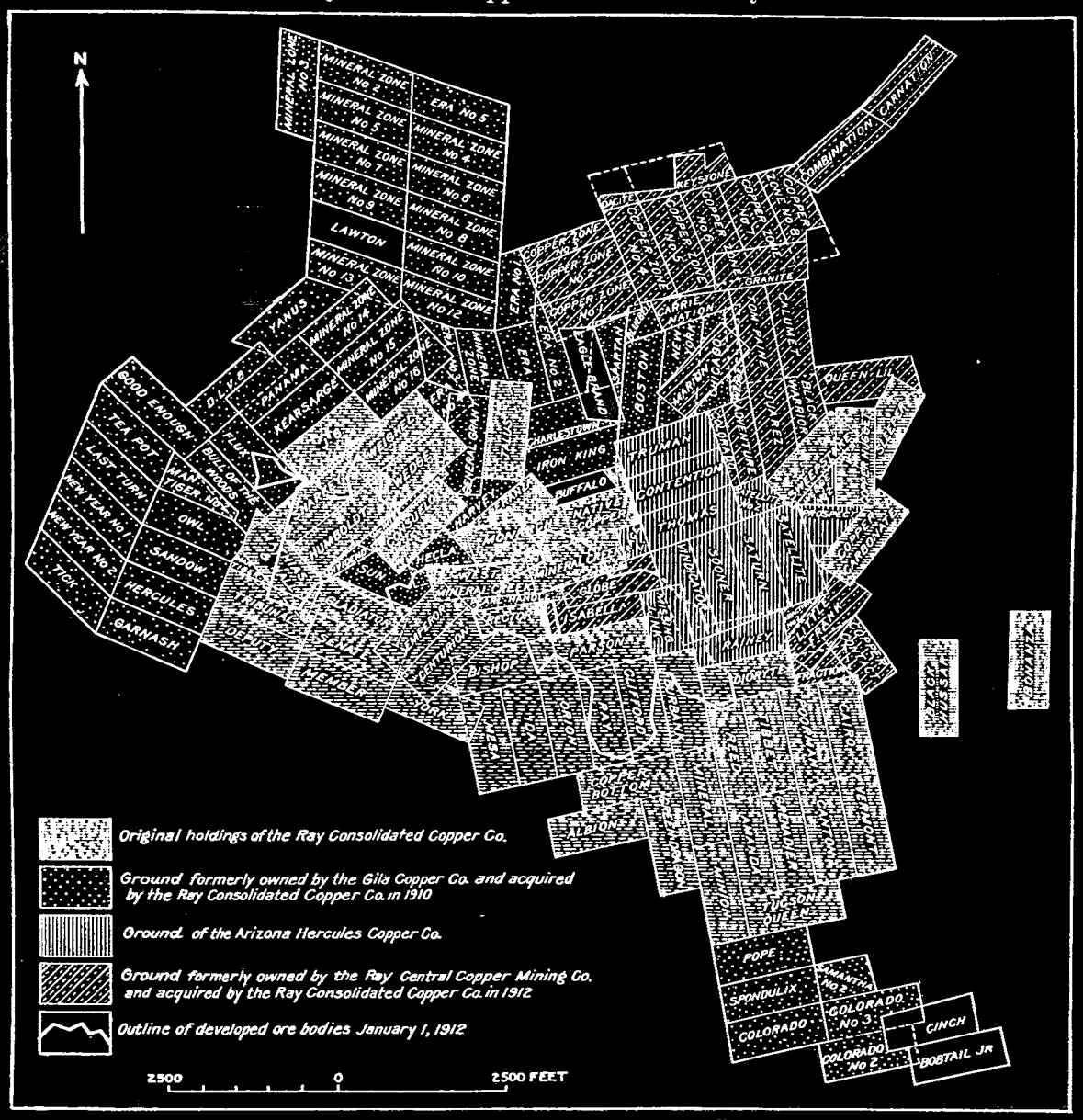


FIGURE 14.—Claim map of the central part of the Ray district.

DRILLING.

Prior to extensive underground work the ore-bearing area at Ray was explored by churn drilling, the holes as a rule being situated at the intersections of rectangular coordinate lines 200 feet apart. The Ray Consolidated Copper Co. tested in this way an area of about 185 acres. The total number of holes drilled is 353, and their average depth is 418 feet. The average thickness of capping or overburden, as calculated by the company's engineers, is 252 feet, and the average thickness of the ore 101 feet. Although drilling had been discontinued in 1912, the extreme limits of the ore body, particularly in its western part, have not yet been fully ascertained.

slipping, which, however, does not appear to coincide in strike and dip with the main fissure. Underground workings show that the ground west—that is, in the footwall—of what has been considered to be the main fissure is badly cut up by many subsidiary faults, some of which are nearly horizontal.

The general effect of the Bulldog fault zone has been to displace the ore body so that the ore of the Inspiration mine, east of the dislocation is from 450 to 500 feet lower than the ore of the Keystone mine, west of it.

West of the Keystone shaft faulting is structurally important, as is evident from the distribution of the rocks shown in Plate XXXIX. The structure in the vicinity of the Live Oak No. 2 shaft has some very puzzling features and can probably be best described by reference to the accompanying diagram (fig. 18), which was constructed from the geologic map (Pl. XXXIX) and is of the same scale. The map and diagram should be used together. One of the larger faults of this part of the district is indicated on the diagram as the Live Oak fault. Its general course is nearly north, but its intersection with the surface is an irregularly curved line, the deviations being due in part to the combination of a westward dip with strong topographic relief. The dip, as determined by drill records, appears to be about 75°, but there are no exposures of the fault surface. West of this fault the structure, so far as can be seen from the surface, is comparatively simple. There is a broad mass of the Gila conglomerate which rests along its northern edge on dacite and along its southern edge for the most part on schist. East of the fault lies a mosaic of small fault blocks, in which appear fragments only of the dacite and conglomerate which are so

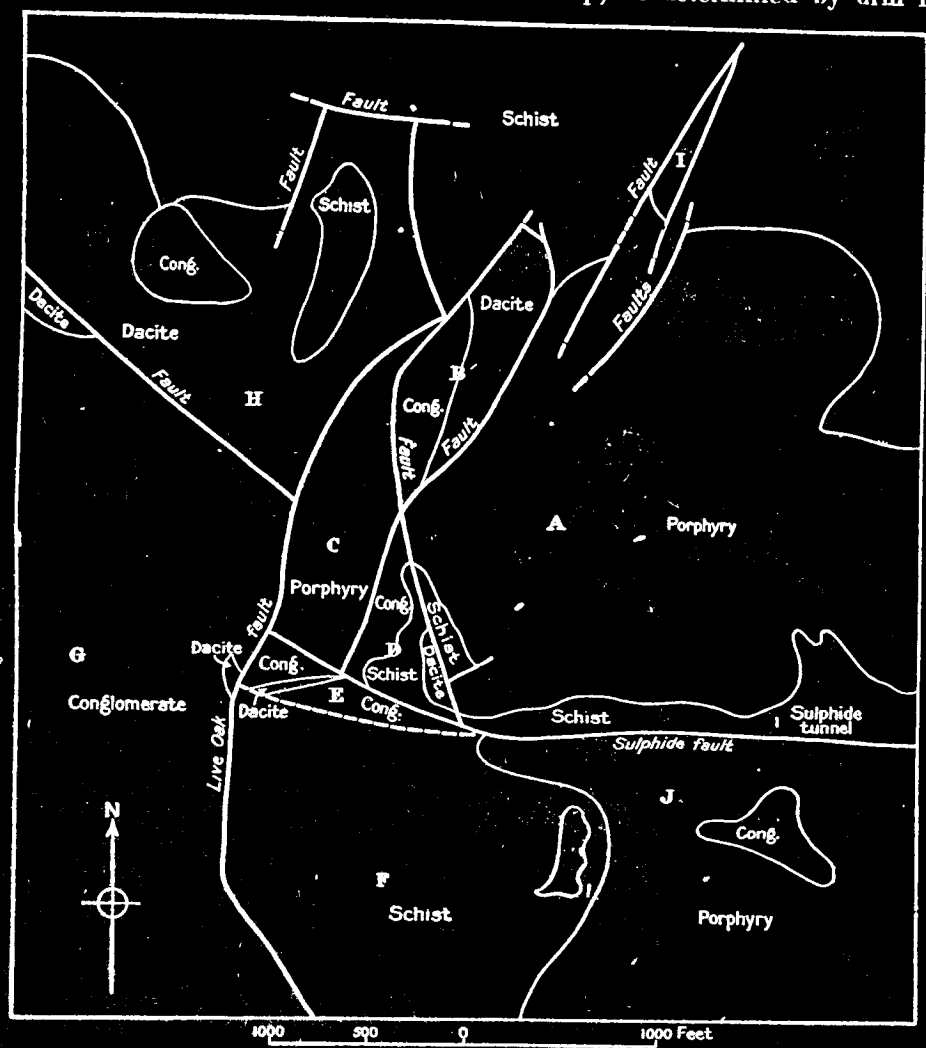


FIGURE 18.—Diagram showing surface relations of rocks near the Live Oak No. 2 shaft.

CHAPTER IV.—MINES AND MINING.

PURPOSE OF CHAPTER.

Although at first thought it might be supposed that the discussion of the geologic details of the two districts described should, in accordance with logical order, immediately follow the account of the general geology of the region, it will soon be apparent that an understanding of local geologic relations requires some knowledge of the mine workings. This supplies such justification as may be necessary for the present arrangement.

It is not to be expected that a geologic report should particularly concern itself with the financial and technical problems that are being solved in the mining of disseminated copper ores. Nevertheless, descriptions of the deposits themselves are likely to be more readily comprehended if introduced by a concise account of property boundaries, company organization, underground workings, and general mining methods. The present chapter is intended to give the reader such a preliminary survey of the local industry from its practical side as may enable him to realize the industrial importance of the deposits, to understand the general mode of their exploitation, and to follow readily subsequent descriptions in which there will of necessity be reference to the various companies by name and to their respective mining operations. Details of mining or milling technique and of mechanical equipment will be omitted or will receive but brief mention.

MIAMI DISTRICT.

MINING COMPANIES AND CLAIM GROUPS.

The ore bodies of the Miami district, so far as they are at present known, are confined to a rather irregular east-west ridge that separates Webster Gulch on the north from Liveoak Gulch on the south. This may conveniently be referred to as Inspiration Ridge, from the mine of that name. The average breadth of the ridge is about 1 mile, and its height above the bottoms of the gulches mentioned ranges from 400 to 600 feet. The ore bodies lie on an arc, concave to the south, of a horizontal circle of about 1½-mile radius. This curve in general coincides with the crest line of the ridge, but at its west end it sweeps southward toward Liveoak Gulch. The total length of the known ore belt, or bow, as it may be suggestively called, is 2 miles, and its greatest breadth, near the middle of the curve, is about 1,500 feet.

The situations of the principal claim groups with reference to each other and to the ore bow may be seen from figure 6, or in greater detail from Plate XXXI.

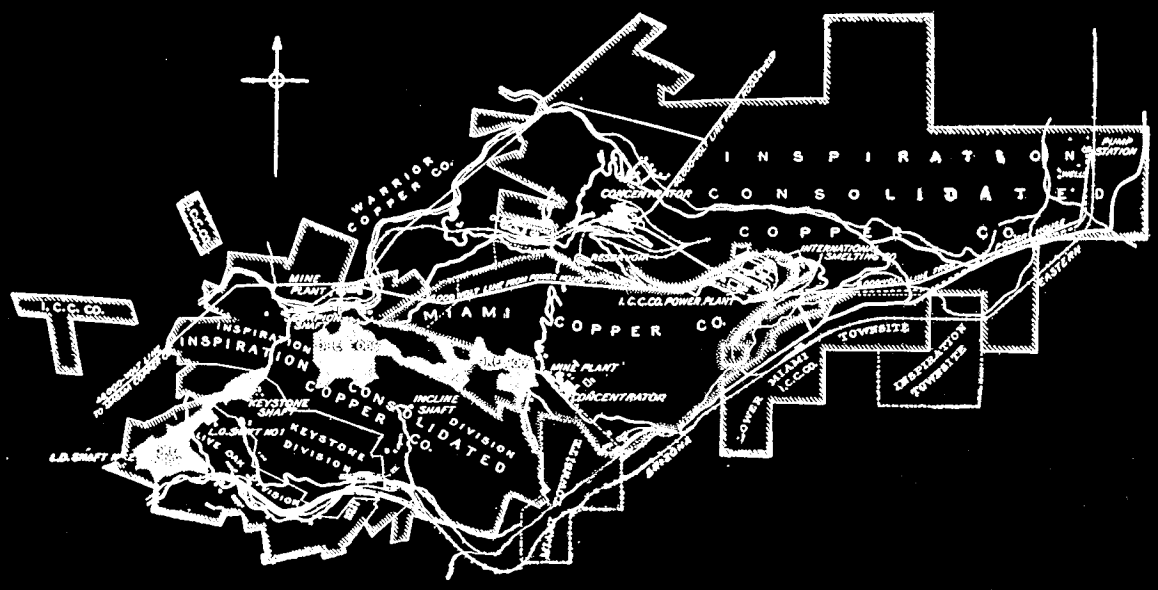


FIGURE 6.—General plan of land ownership, ore bodies, and reduction works in the Miami district. Reduced from a map prepared by the Inspiration Consolidated Copper Co. in 1916. Scale approximately 4,300 feet to the inch.

CHAPTER XI.—PRACTICAL DEDUCTIONS.

Certain surface features, not only in the two districts here described but elsewhere in arid or semiarid regions, are generally recognized as indicating the presence of copper ores due to enrichment. Given the fundamental association of a granitic rock, usually a granitic porphyry, intrusive into rocks favorable for pyritic dissemination and subsequent enrichment, the most obvious suggestion of the existence of ore is likely to be a general rustiness of the rock outcrops, due to the presence of limonite, and probably other hydrous oxides of iron, left behind in the oxidation of pyrite. Experience seems to show that intense redness is not a very favorable sign. At what are called the Red Hills north of Ray and in the part of the Miami district just west of the No. 3 shaft of the Miami mine drilling has shown practically no enrichment or only thin and low-grade ore beneath the conspicuously red surface. On the typical surface above an ore body the prevailing hue is brown or yellow, the general effect produced by the presence of iron oxide as films on or along innumerable fractures in a rock that has itself been bleached nearly white. Although it is possible that enriching solutions may have moved laterally and in some places accomplished enrichment beneath rock that does not at the surface show any notable oxidation or leaching, yet it is very doubtful whether any large masses of ore occur in such situations. This, of course, does not mean that ore may not be found under unaltered rocks that are younger than the period of hypogene mineralization or that may have been shoved by faulting over previously metallized rock.

In attempting to estimate the probability of the existence of ore under an oxidized surface, search should be made for the presence of quartz stringers in the oxidized material. Abundant small quartz stringers indicate that the rock was at one time fissured and permeable and that it has been traversed by silica-bearing solutions such as might have deposited cupriferous sulphides. If the quartz shows cavities recognizable as having once been filled by pyrite, the probability of the presence of an ore body is increased.

The surface may not everywhere show the presence of copper minerals, such as malachite or chrysocolla, but in both the Ray and the Miami districts there are places where before any prospecting was done the rocks displayed unmistakable evidence, in the form of green stains, that copper-bearing solutions had been active.

Experience at Miami shows that the possibility of considerable changes in underground water level since the ores were deposited must be kept in mind. It can not, for example, be safely concluded, unless the geologic history of the district is well known, that if water is reached at a depth of only 100 feet enrichment in a zone above water level could not have gone on in rocks now far below the present water table.

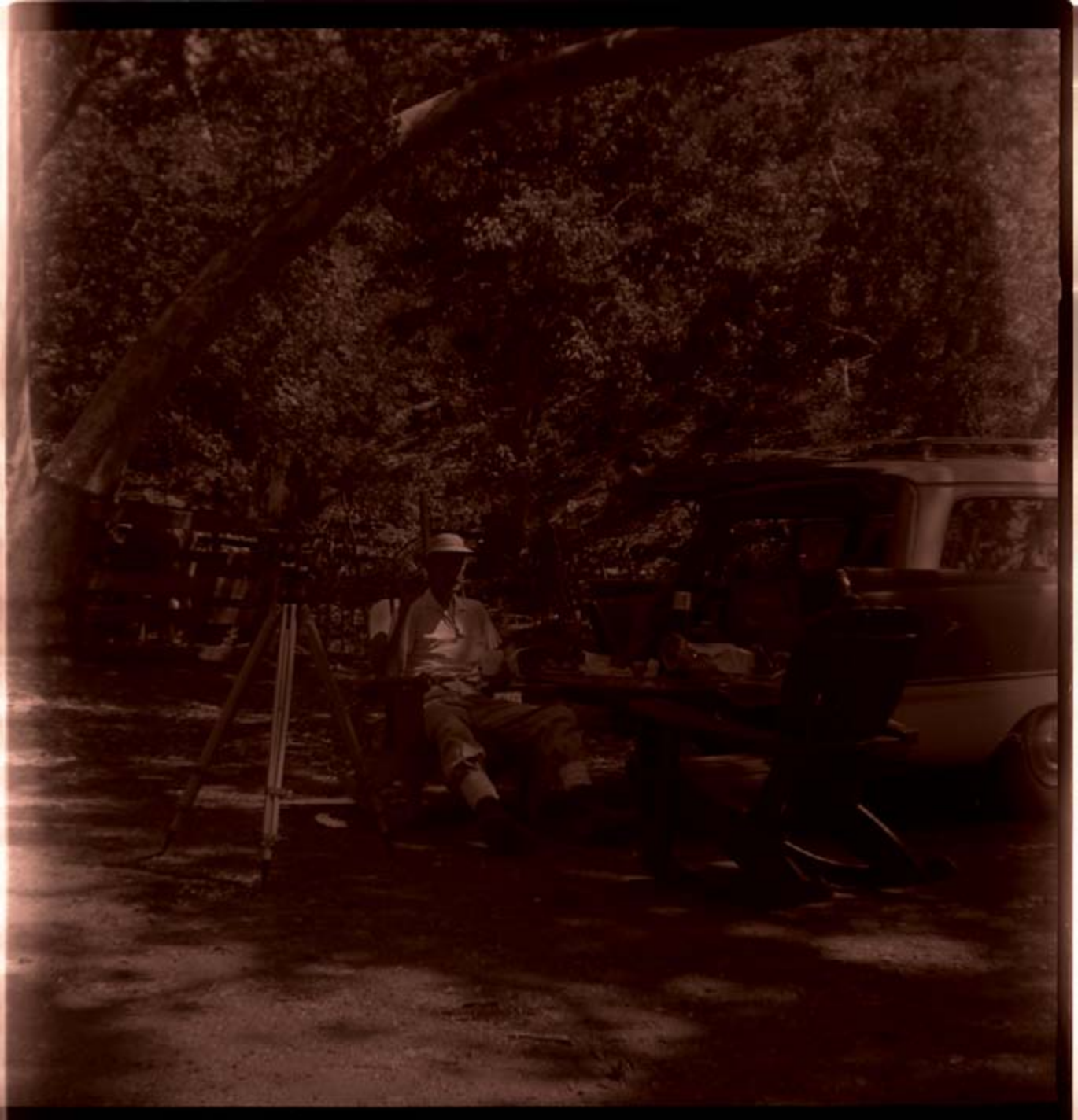
The conclusion reached with regard to the Miami and Ray ores that enrichment took place before the accumulation of the Whitetail formation carries the very important corollary that ore may occur under this and the two later formations, the dacite and the Gila conglomerate. Such a possibility obviously opens the door for ventures of highly speculative character, although consideration of all available geologic facts must show that the possibilities of the occurrence of ore are much better under certain areas of conglomerate or dacite than under others. For example, there is nothing to indicate the presence of ore under the large area of Gila conglomerate southeast of the Miami district, between Globe and the main Pinal Range. On the other hand, the manner in which the Miami ore body ends at the Miami fault, considered in connection with the occurrence of the Old Dominion and other copper deposits due east of the Miami ore body and on the other side of the conglomerate area, suggests that an attempt to explore the inter-

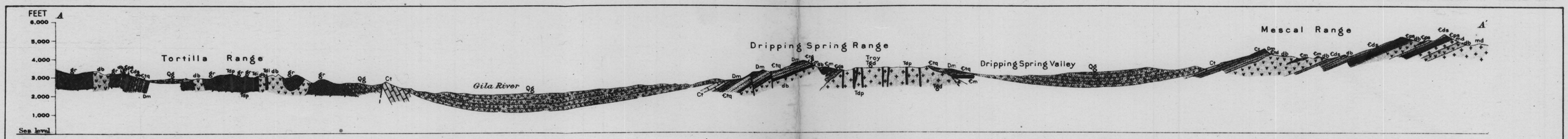
vening area by drilling through the conglomerate, dacite, and possibly some of the Whitetail formation would be by no means a forlorn hope. As noted on page 96, the Miami Copper Co. attempted to drill through the conglomerate but had to abandon the hole at 2,050 feet without having reached the ore-bearing schist or porphyry. The Old Dominion Co. also bored some holes west of Pinal Creek. One of these, 1,000 feet deep, penetrated the Gila conglomerate and was abandoned in the Madera diorite. It is possible, however, that this is some of the same broken overthrust material exposed at the base of the Gila conglomerate near the Old Dominion mine and is not in its normal position in relation to younger rocks.[1] If so, the hole if continued deeper might go through dacite and possibly into ore, although this comment is not made as a prediction. The Van Dyke Copper Co. has also begun to explore by drilling the conglomerate-covered ground just south and east of the property of the Miami Copper Co. Although the outcome of the explorations mentioned in this paragraph is highly problematic, none of the efforts are without reasonable expectation of possible success.

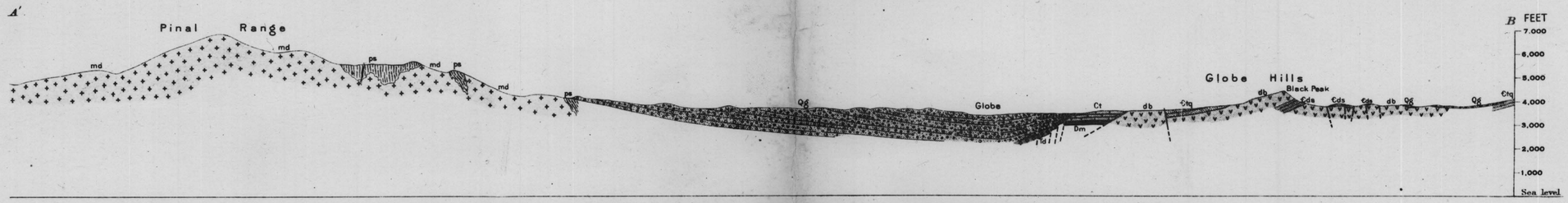
The search for ore under the Gila conglomerate between Miami and Globe would be greatly facilitated if the direction and amount of displacement on the Miami fault were known. The present investigation gave no clew to this much-desired information, and although special study devoted to this particular problem might possibly lead to its solution, it is difficult to see what line of attack would be likely to yield definite results. One suggestion is that a careful study be made to determine the character and amount of the displacement of the main porphyry dike in the Miami workings. This is cut off, of course, by the Miami fault, and it is as difficult to predict where its eastern continuation may be found as to determine the position of a possible continuation of the Miami ore body beyond the fault. The dike, however, is crossed by other faults in the footwall of the Miami fault, and by doing a little additional development work under the direction of a geologist it should be possible to determine how the dike has been shifted by these faults. Probably the movement along the Miami fault has been of the same kind and direction as that in the minor faults in its footwall, and data obtained in the manner shown would at least indicate whether the search for ore east of the fault is more likely to succeed to the north or south of the latitude of the known ore.

Those planning to drill would also like to know the thickness of the Gila conglomerate and dacite overlying the older rocks at any locality selected for operations. There appears to be no way to determine this except by actual drilling. The conglomerate covered an uneven surface and is known to be exceedingly variable in thickness. It contains, so far as known, no persistent stratum that can be recognized over large areas, and consequently there is nothing in the appearance of the deposit at any particular place to indicate how much more conglomerate lies below it.

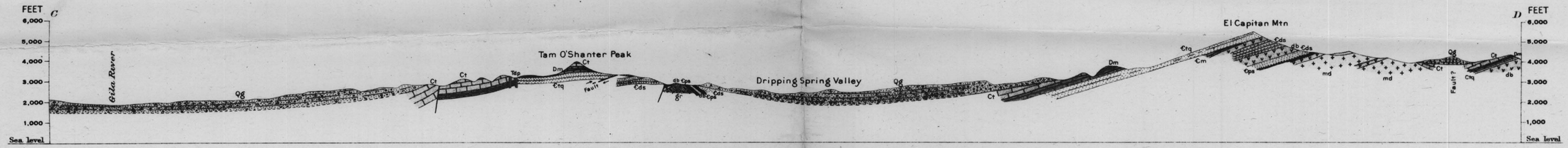
[1] Ransome, F. L., Geology at Globe, Ariz.: Min. and Sci. Press, vol. 100, p. 257, 1910.





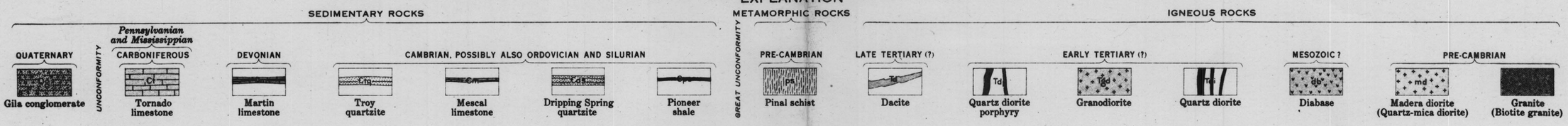


A-A'-B. SECTION FROM THE TORTILLA RANGE, IN THE SOUTHWEST CORNER OF THE RAY QUADRANGLE, TO THE GLOBE HILLS, IN THE NORTHEASTERN PART OF THE GLOBE QUADRANGLE



C-D. SECTION FROM THE GILA RIVER, IN THE SOUTHERN PART OF THE RAY QUADRANGLE THROUGH TAM O'SHANTER PEAK AND EL CAPITAN MOUNTAIN

EXPLANATION



Horizontal scale

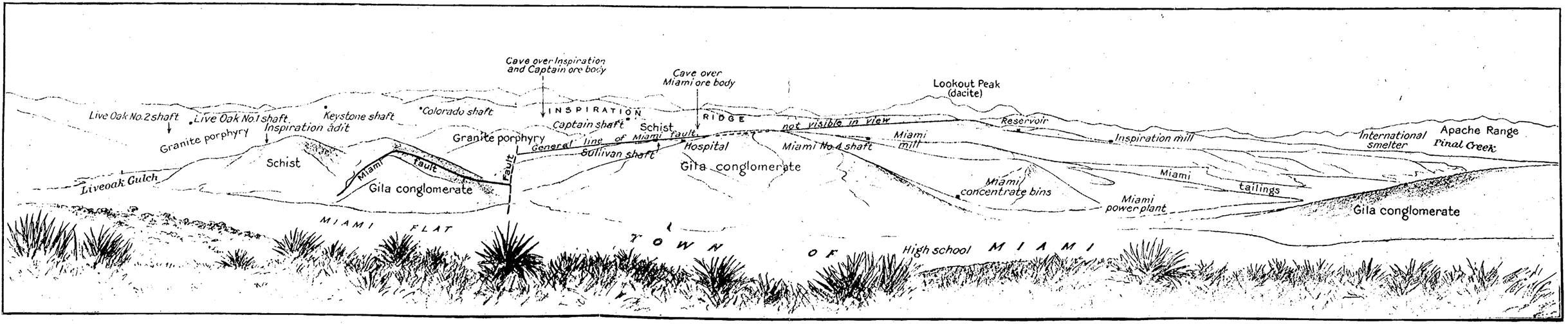
1 ½ 1 2 3 4 5 Miles

1919

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY

GEOLOGIC SECTIONS IN THE RAY AND GLOBE QUADRANGLES, ARIZONA

GENERAL VIEW OF THE MIAMI DISTRICT FROM THE SOUTH.



DEPARTMENT OF THE INTERIOR
ALBERT B. FALL, SECRETARY
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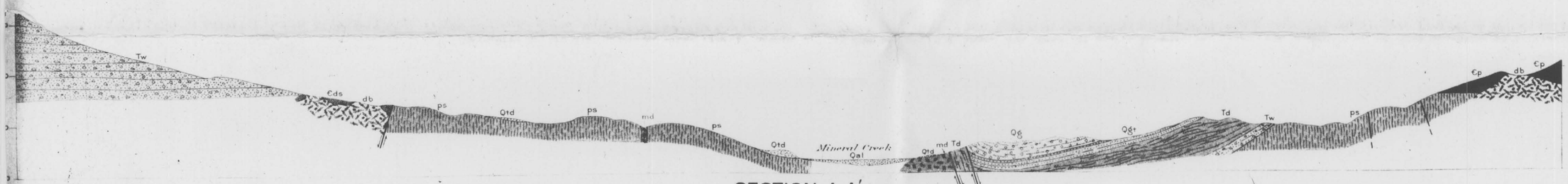
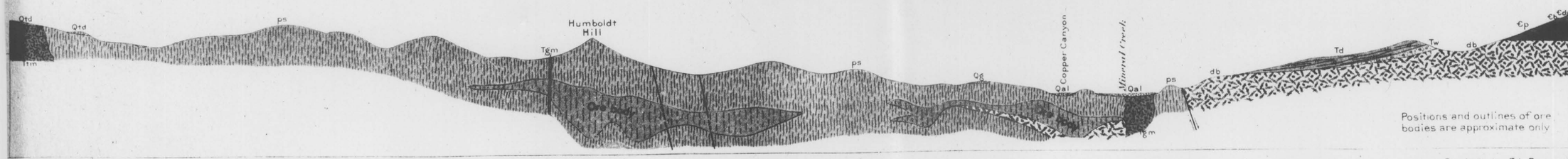
GEORGE OTIS SMITH, DIRECTOR

ECONOMIC GEOLOGY

ARIZONA
(PINAL COUNTY)
RAY AND VICINITY



SECTION A-A'



Positions and outlines of ore bodies are approximate only

SECTION B-B'

R.B. Marshall, Chief Geographer.
T.G. Gardine Geographer in charge.
Topography by W.M. Beaman.
Control by T.M. Bannon and Thomas Winsor.
Surveyed in 1910.
Culture revised in 1917 by W.M. Beaman.

TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION 1922.

Scale $\frac{1}{12000}$

0 1/8 1/4 1/2 1 Mile
1000 500 0 1000 2000 3000 4000 Feet
200 100 0 500 1000 Meters

Contour interval 25 feet.
Datum is mean sea level.
Edition of April 1922.

Geology by F.L. Ransome and J.B. Umpleby.
Surveyed in 1910 and 1911.

EXPLANATION

SEDIMENTARY ROCKS

(Areas of subaqueous deposits are shown by patterns of parallel lines; subaerial deposits by patterns of dots and circles; metamorphism is indicated by hachures)

QUATERNARY

Recent

Qal — **Alluvium** *(gravel, sand, and silt along present stream ways)*

Qtd — **Terrace deposits** *(unconsolidated angular and gravelly detritus derived from adjacent hill slopes and dissected by present streams)*

Pleistocene

Qg / **Qg'** — **Gila conglomerate** *(fluviatile conglomerates, coarse in places near the mountains, grading into fine silts, probably in part lacustrine, in wide valleys; local based portion of well stratified tuff and pumiceous beds, Qg')*

UNCONFORMITY

TERTIARY

Tw — **Whitetail conglomerate** *(subangular fragments chiefly of diabase and limestone accumulated by streams and as hillside wash)*

UNCONFORMITY

CAMBRIAN AND POSSIBLY ALSO ORDOVICIAN AND SILURIAN

Apache group

€t — **Troy quartzite** *(cross bedded pebbly quartzite, chiefly thick bedded, but thin, flaggy beds, marked with worm casts in upper portion)*

€ds — **Dripping Spring quartzite** *(fine grained, ripple marked and sun-cracked, arkosic quartzite, much of it banded dark red and gray)*

€b — **Barnes conglomerate** *(coarse, well-rounded, quartzose pebbles in arkosic matrix)*

Pioneer shale *(dark, reddish brown, spotted with yellow; arenaceous shale, grading into arkosic quartzite at base. Includes, as mapped, underlying thin Scanlan conglomerate)*

GREAT UNCONFORMITY

PRE-CAMBRIAN

Metamorphic rocks

ps — **Pinal schist** *(chiefly fine-grained quartz sericite schist; metamorphosed fine arkosic sediments. An uncommon variety, probably an altered rhyolite, psr)*

IGNEOUS ROCKS

(Areas of igneous rocks are shown by patterns of triangles and rhombs)

LATE TERTIARY ?

Td — **Dacite** *(thick extensive flow with a little tuff at base)*

EARLY TERTIARY ?

Tqmd — **Dikes of quartz monzonite porphyry and quartz diorite porphyry**

Tqm — **Teapot Mountain porphyry** *(dikes and irregular intrusive masses of quartz monzonite porphyry)*

Tgm — **Granite Mountain porphyry** *(irregular intrusive masses of quartz monzonite porphyry)*

Tqd — **Quartz diorite** *(intrusive mass)*

MESOZOIC ?

db — **Diabase** *(typically a medium grained, ophitic, olivinitic diabase or dolerite. Irregular sills with many cross-cutting connections)*

PRE-CAMBRIAN

md — **Madera diorite** *(quartz mica diorite, apparently grading locally into granodiorite or quartz monzonite, in places gneissoidal. Irregular batholithic intrusions in the Pinal schist of the Pinal Range)*

gr — **Granite** *(biotite granite, generally coarsely porphyritic and crumbling. Batholithic intrusive mass extensively exposed in the Tortilla Range)*

Approximate outline of ore-bearing area

Known fault

Probable fault

Concealed fault *(covered by younger deposits)*

Dip of fault plane

Overthrust side of thrust fault

Strike and dip of stratified rocks

Mine shaft

Mine tunnel

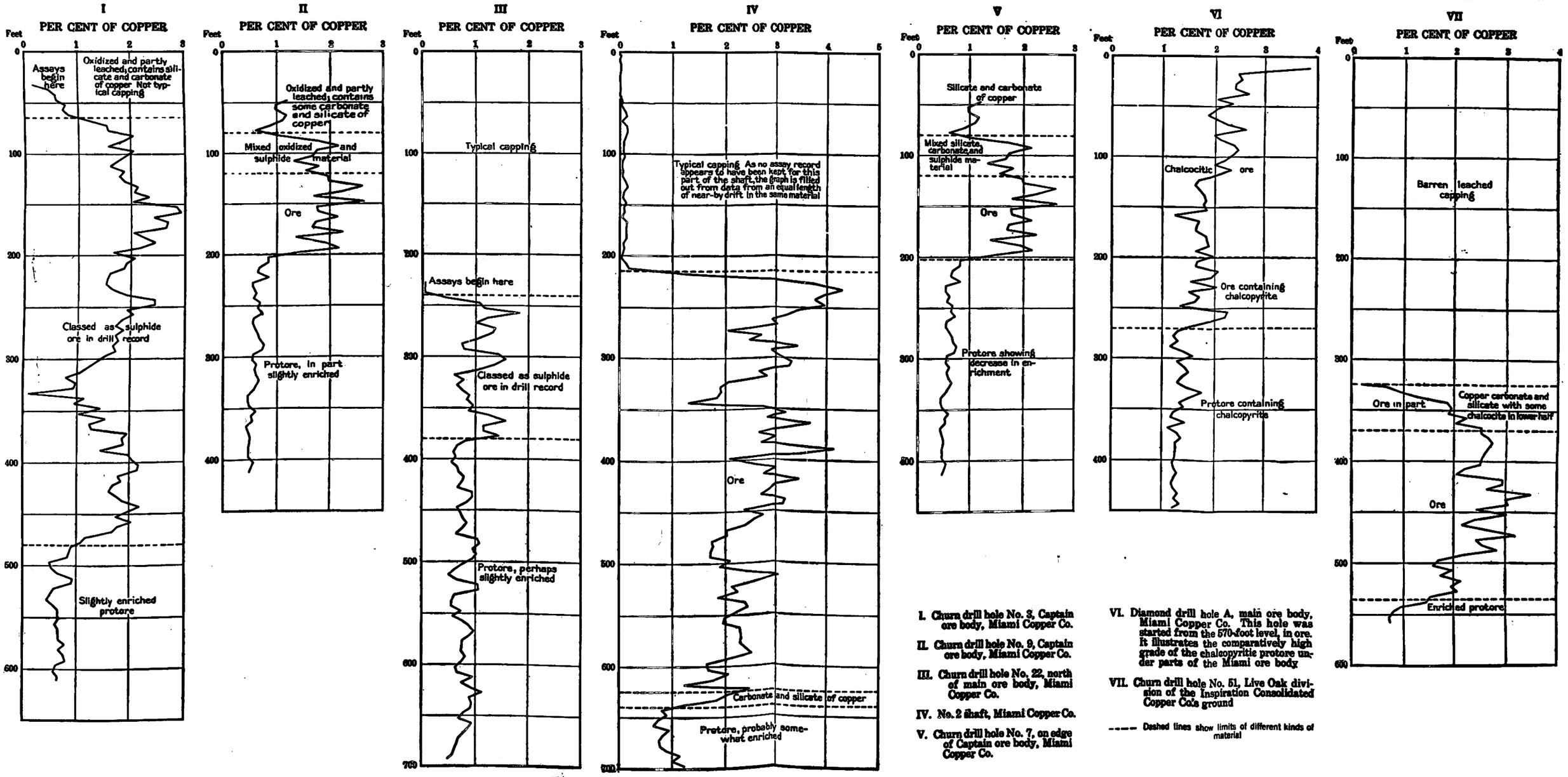
Prospect

Doc 2 Pg. 129

Doc 2 Pg. 130

Box 2 Pg. 131

Doc 2 Pg. 32-001
TO
32-002



I. Churn drill hole No. 3, Captain ore body, Miami Copper Co.

II. Churn drill hole No. 9, Captain ore body, Miami Copper Co.

III. Churn drill hole No. 22, north of main ore body, Miami Copper Co.

IV. No. 2 shaft, Miami Copper Co.

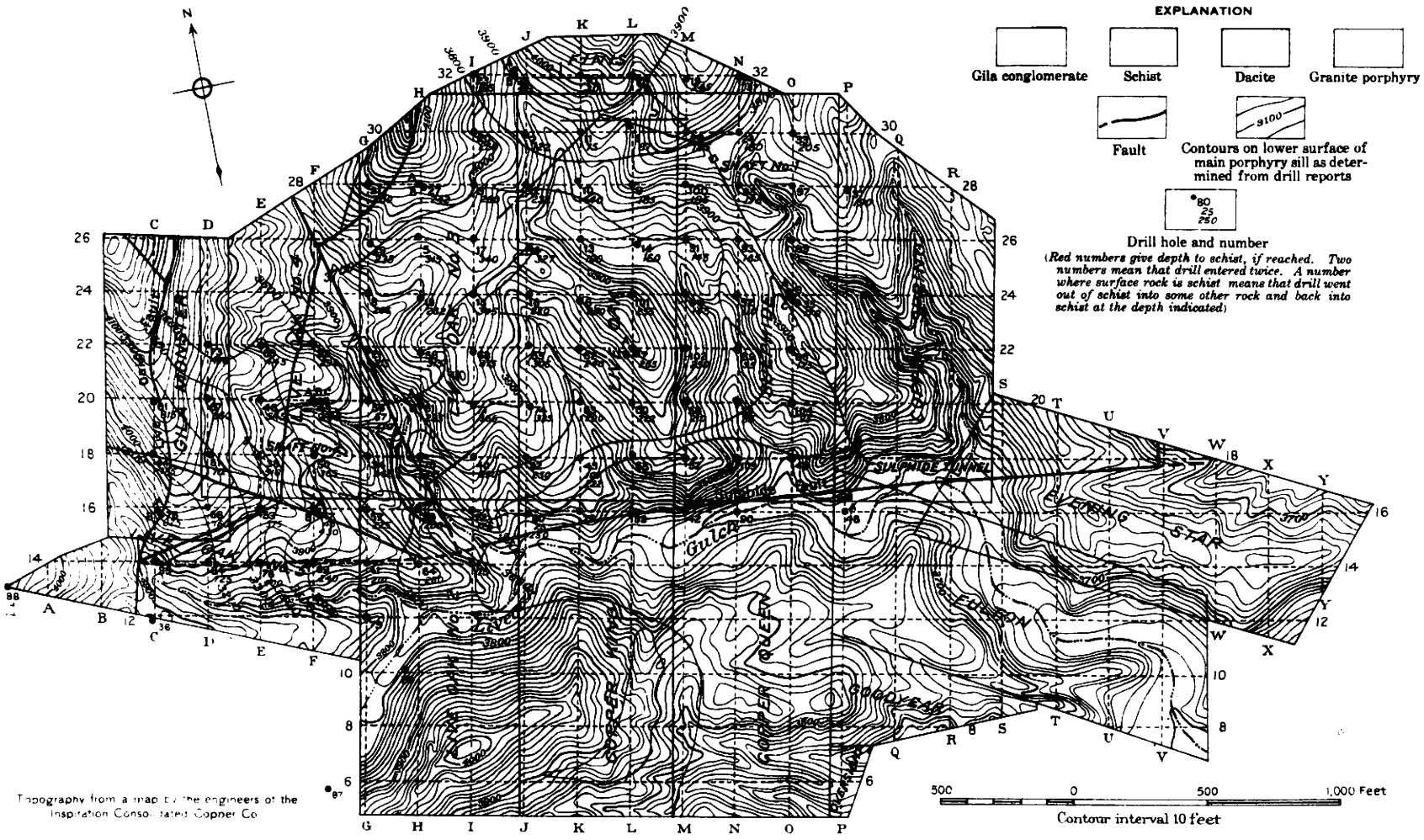
V. Churn drill hole No. 7, on edge of Captain ore body, Miami Copper Co.

VI. Diamond drill hole A, main ore body, Miami Copper Co. This hole was started from the 570-foot level, in ore. It illustrates the comparatively high grade of the chalcopyritic protore under parts of the Miami ore body

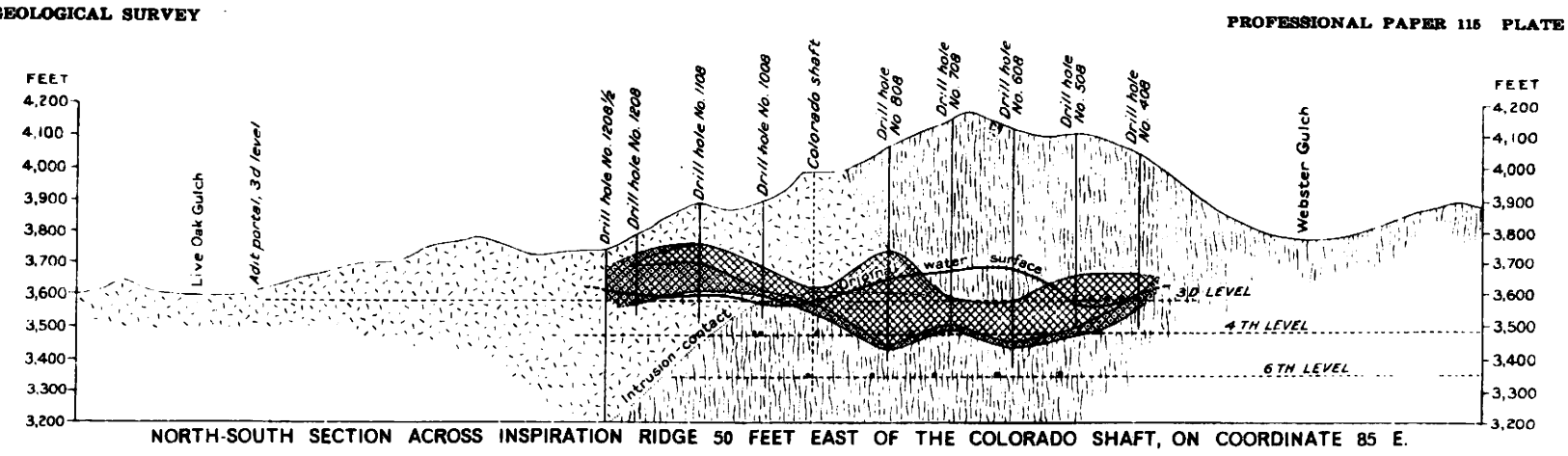
VII. Churn drill hole No. 51, Live Oak division of the Inspiration Consolidated Copper Co.'s ground

---- Dashed lines show limits of different kinds of material

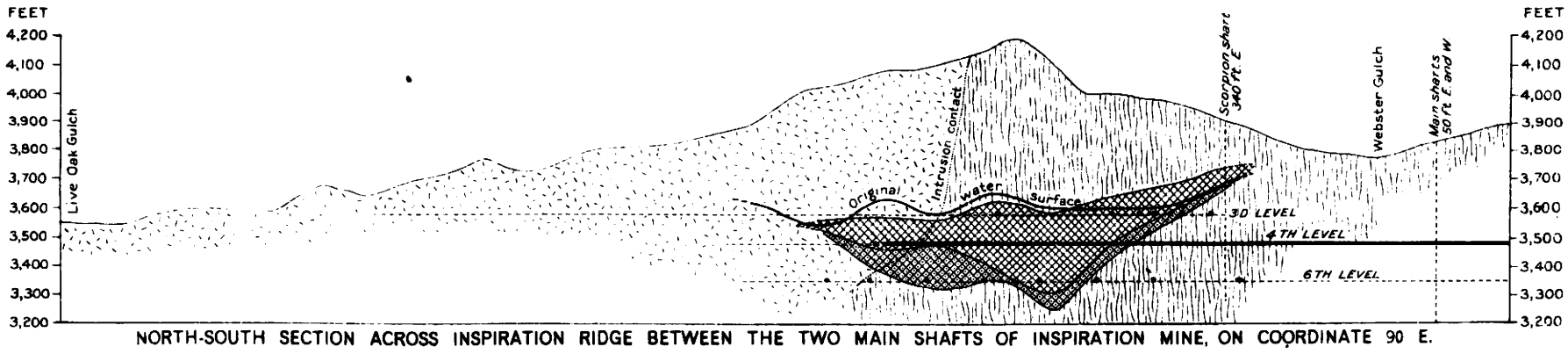
ASSAY GRAPHS OF CHURN-DRILL HOLES IN THE MIAMI DISTRICT.



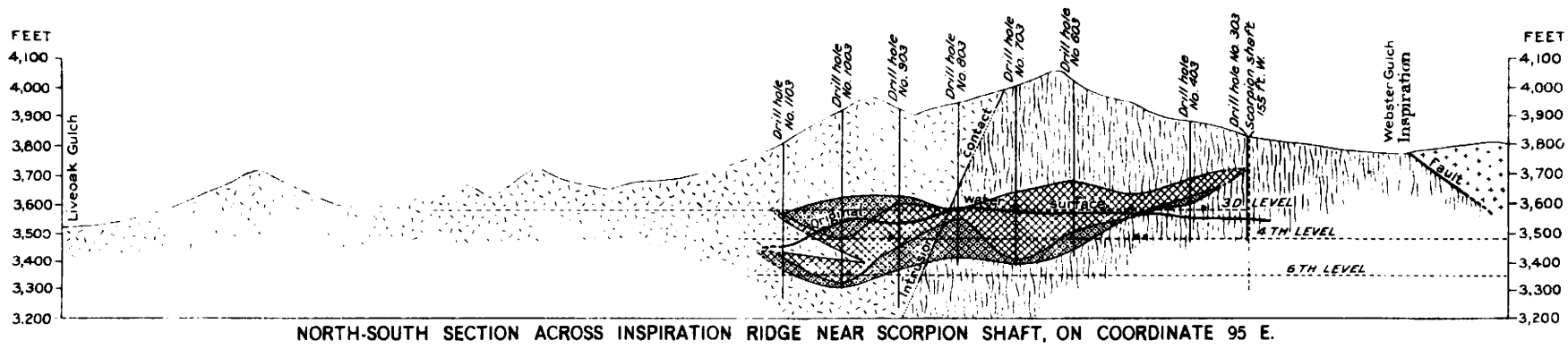
GEOLOGIC MAP OF THE LIVE OAK DIVISION OF THE INSPIRATION CONSOLIDATED COPPER CO.'S GROUND



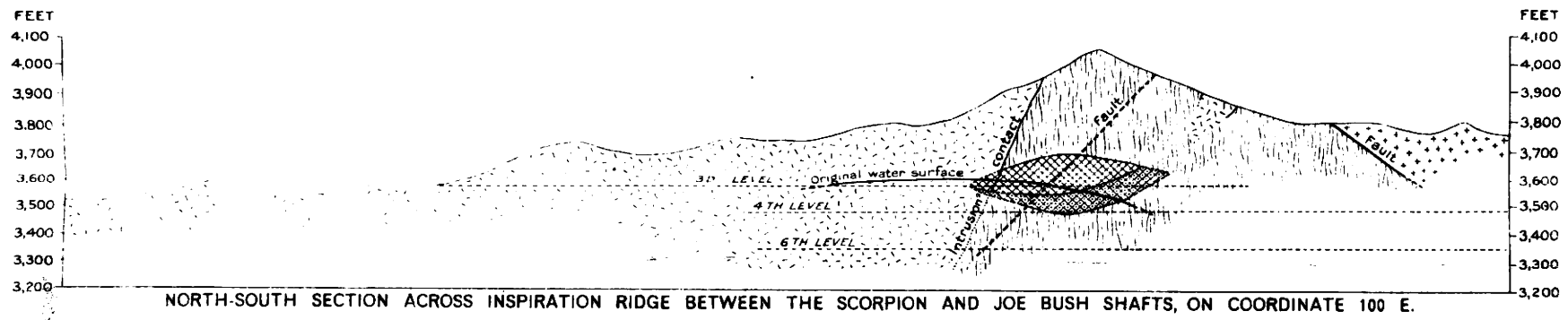
NORTH-SOUTH SECTION ACROSS INSPIRATION RIDGE 50 FEET EAST OF THE COLORADO SHAFT, ON COORDINATE 85 E.



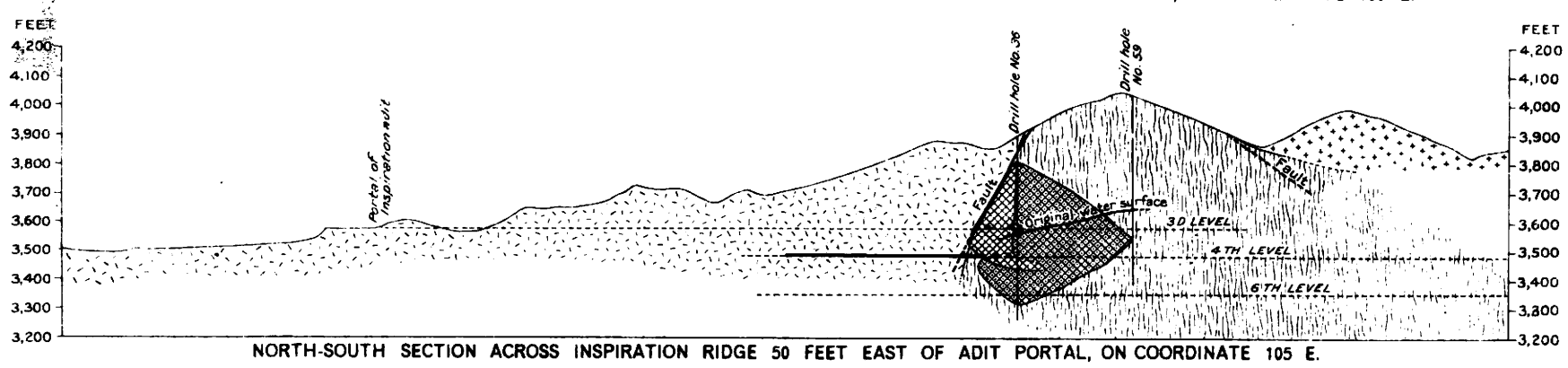
NORTH-SOUTH SECTION ACROSS INSPIRATION RIDGE BETWEEN THE TWO MAIN SHAFTS OF INSPIRATION MINE, ON COORDINATE 90 E.



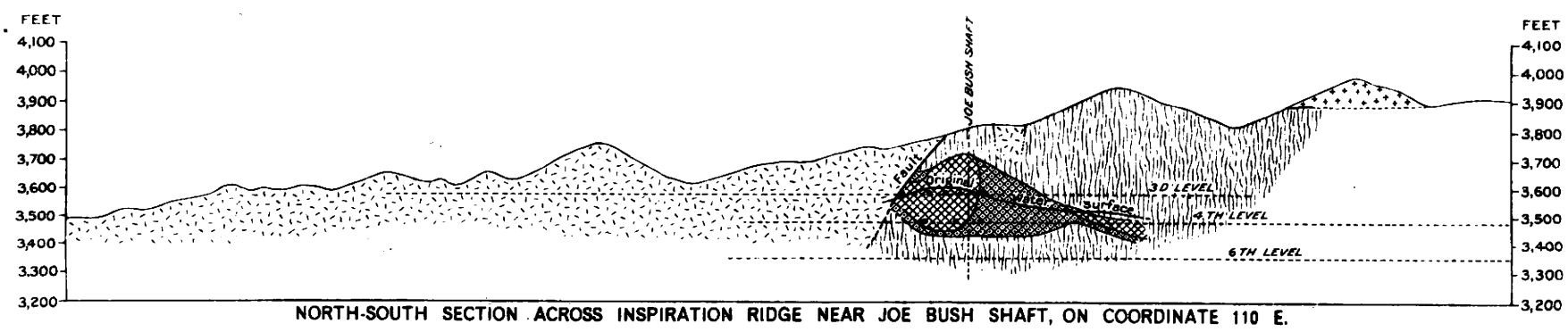
NORTH-SOUTH SECTION ACROSS INSPIRATION RIDGE NEAR SCORPION SHAFT, ON COORDINATE 95 E.



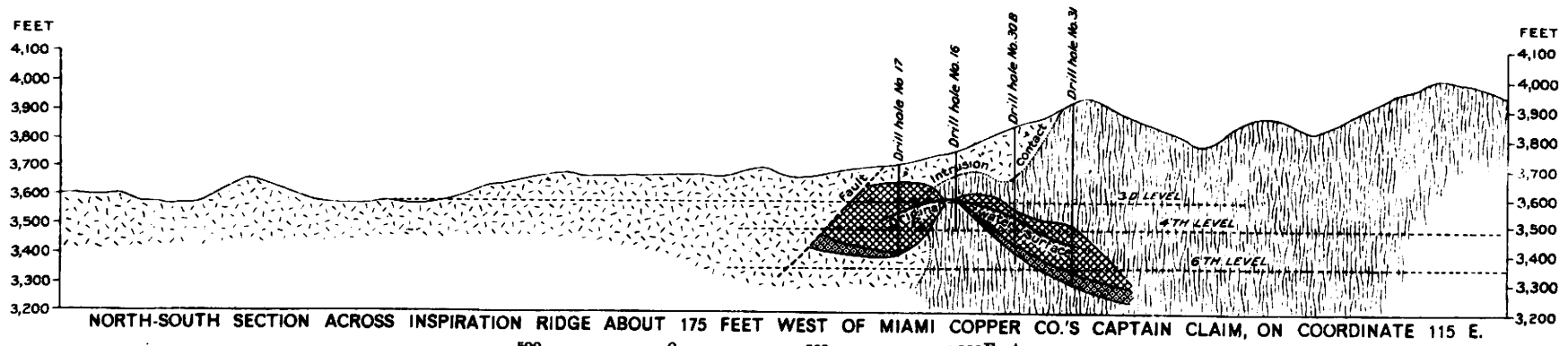
NORTH-SOUTH SECTION ACROSS INSPIRATION RIDGE BETWEEN THE SCORPION AND JOE BUSH SHAFTS, ON COORDINATE 100 E.



NORTH-SOUTH SECTION ACROSS INSPIRATION RIDGE 50 FEET EAST OF ADIT PORTAL, ON COORDINATE 105 E.



NORTH-SOUTH SECTION ACROSS INSPIRATION RIDGE NEAR JOE BUSH SHAFT, ON COORDINATE 110 E.



NORTH-SOUTH SECTION ACROSS INSPIRATION RIDGE ABOUT 175 FEET WEST OF MIAMI COPPER CO.'S CAPTAIN CLAIM, ON COORDINATE 115 E.

500 0 500 1,000 Feet

EXPLANATION

Dacite — Granite porphyry — Schist — Ore, 2 per cent or higher — Ore, less than 2 per cent

SECTIONS ACROSS INSPIRATION RIDGE SHOWING RELATION OF ORE BODIES TO TOPOGRAPHY AND COUNTRY ROCK