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PRINTED: 05/30/2002

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: PETOSKEY GROUP

ALTERNATE NAMES:
- BUSTER MS 3694
- ENSIGN MS 3706
- MUGWUMP MS 1655
- PAUPERS DREAM MS 1655
- UPRIGHT MS 1655
- APEX COPPER

COCONINO COUNTY MILS NUMBER: 224C

LOCATION: TOWNSHIP 38 N RANGE 1 E SECTION 13 QUARTER W2
LATITUDE: N 36DEG 41MIN 32SEC LONGITUDE: W 112DEG 14MIN 57SEC
TOPO MAP NAME: JACOB LAKE - 15 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
- COPPER OXIDE
- COPPER SULFIDE
- MANGANESE OXIDE
- IRON HEMATITE
- SILVER

BIBLIOGRAPHY:

- ADMMR PETOSKEY GROUP FILE
- ADMMR "U" FILE COCONINO Cu-1
- US DEPT. INTERIOR WAR MINERAL RPT. #436
- TAINTER, S.L., USBM RI 4013, P. 5
- US-AEC 172-479
- MOORE, R., AZBM BULL. 180, P. 190
- BLM MINING DISTRICT SHEET 24
- CLAIM EXTENDS INTO SEC. 14 - BIG SPRINGS QUAD

02/12/91

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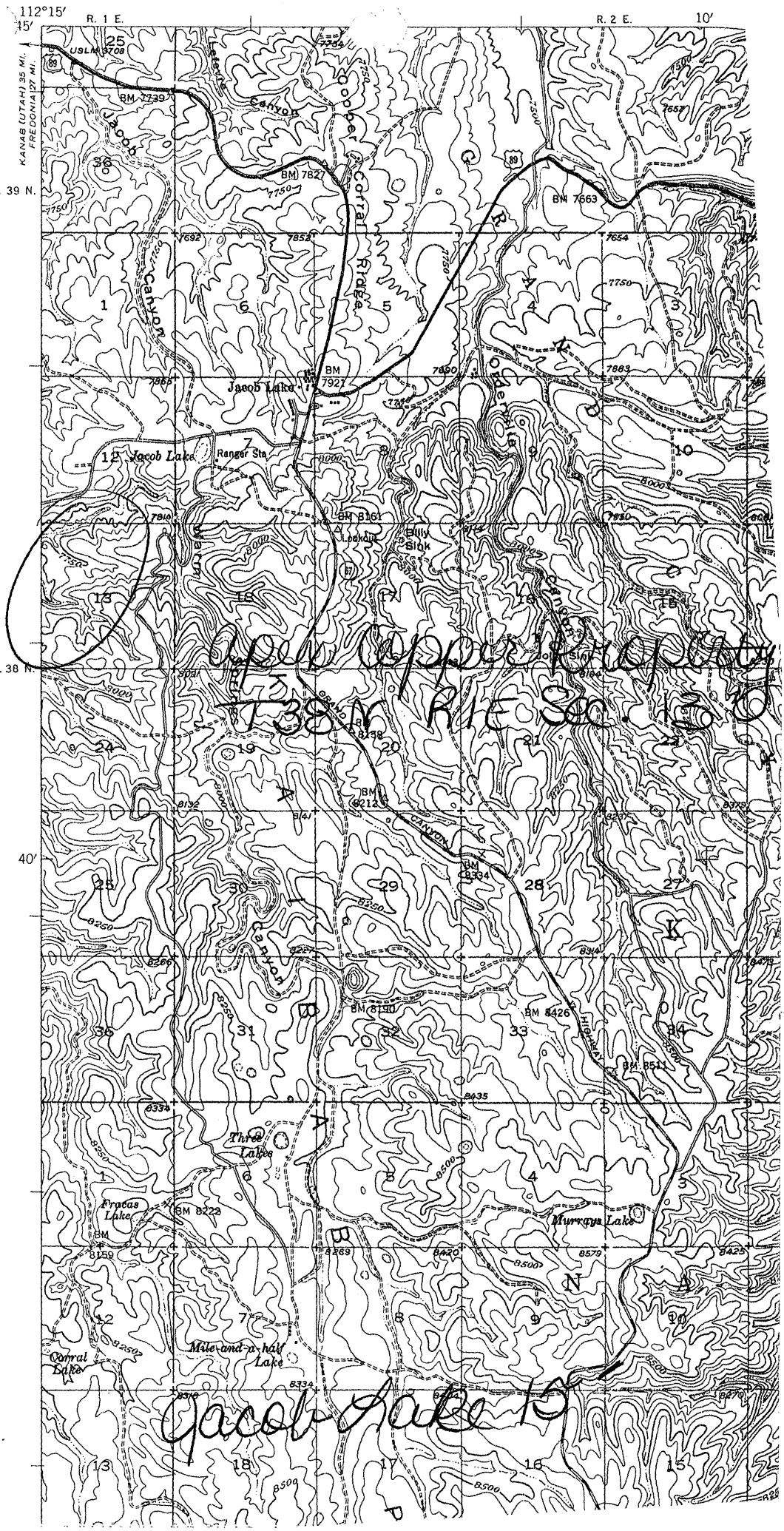
CLAIM EXTENDS INTO SEC. 14 - BIG SPRINGS QUAD

GEOLOGICAL SURVEY



APEX COPPER PROPERTY

COCONINO COUNTY
WARM SPRINGS DIST.
T38N R1E Sec. 13

AEC 172-479 p. 60

USGS Bull. 260

RI 4013

ABM Bull. 180, p. 151

MAPS - upstairs in the flat storage area in the first (top) drawer.

Coconino County MILS Index #224C

AKA: Buster MS 3694, Ensign MS 3706, Mugwump MS 1655, Paupers dream MS 1655, Upright MS 1655, Arizona Jim MS 1655, Petoskey, Petroskey Group

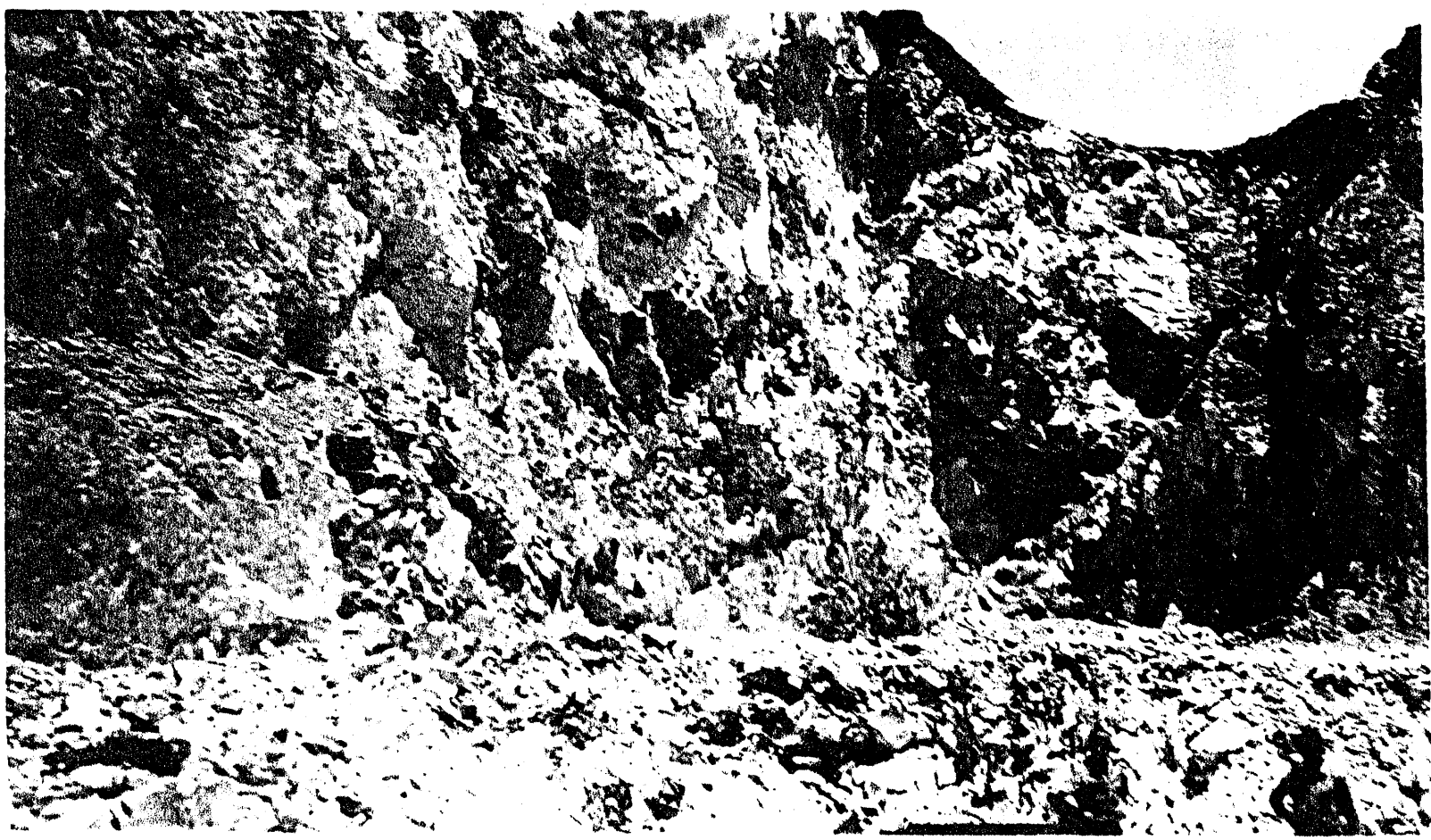
BLM Mining District Sheet 24

US Dept Interior War Mineral Rpt #436

"U" Files

Jacob Lake, AZ 15' topo (included in file)

A-101-1 KAIBAB 1948



A-101-4 KAIBAB 1948

R. I. 4013 FEBRUARY 1947

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

REPORT OF INVESTIGATIONS

APEX COPPER PROPERTY
COCONINO COUNTY, ARIZ.

DEPARTMENT MINERAL RESOURCES
MINERAL BUILDING
FAIR GROUNDS
PHOENIX 7, ARIZONA

BY

STANTON L. TAINTER

R. I. 4013,
February 1947.

REPORT OF INVESTIGATIONS

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

APEX COPPER PROPERTY, COCONINO COUNTY, ARIZONA1/

By Stanton L. Tainter2/

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INTRODUCTION

When the disruption of gold mining stopped the usual source of siliceous flux needed by copper smelters, sandstone copper deposits in northern Arizona offered possibilities as a source of the flux during the war emergency. The Federal Geological Survey, while making a comprehensive survey of sandstone copper deposits, investigated the Warm Springs mining district in north-central Coconino County in August 1943. A month later, J. H. Hedges, chief of the Tucson Division, Mining Branch, Bureau of Mines, examined the operations in connection with an application for an access road.

Both investigations concluded that the district, as an emergency source of copper-bearing siliceous flux, had considerable merit, provided high prices for copper continued in effect.

Early in 1944, V. M. Ryan and S. B. Atherley requested assistance from the Bureau in exploring various deposits on their property.

The Bureau3/ drilled 152 holes, aggregating 3,756 feet, on the Petoskey and Mackin groups of claims. This report is based upon churn drilling done under contract from October 7 to November 25, 1944.

1/ The Bureau of Mines will welcome reprinting of this paper provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Report of Investigations 4013."
2/ Mining engineer, Bureau of Mines.
3/ Stanton L. Tainter, project engineer.

ACKNOWLEDGMENTS

In its program of exploration of mineral deposits, the Bureau of Mines has as its primary object the more effective utilization of our mineral resources to the end that they make the greatest possible contribution to national security and economy. It is the policy of the Bureau to publish the facts developed by each exploratory project as soon as practical after its conclusion. The Mining Branch, Lowell B. Moon, chief, conducts preliminary examinations, performs the actual exploratory work, and prepares the final report. The Metallurgical Branch, R. G. Knickerbocker, chief, analyzes samples and performs beneficiation tests.

With respect to the investigations reported in this paper, the functions of the Mining, and Metallurgical Branches were carried out under the direction of J. H. Hedges, district engineer for Arizona, and S. R. Zimmerly, regional engineer, respectively. The Federal Geological Survey mapped the geology, recommended drilling sites, and logged the drill holes.

LOCATION AND ACCESSIBILITY

The property is approximately 2 miles west of Jacob Lake Post Office in the Warm Springs or Jacob Lake mining district, Coconino County, Arizona. (Fig. 1.) The claims are accessible by a gravelled access road from Jacob Lake, which is 167 miles north of Flagstaff, Ariz., and 159 miles south of Marysvale, Utah, over paved highway U. S. 89. Marysvale is the terminus of a branch line from Salt Lake City of the Denver & Rio Grande Western Railroad, and Flagstaff is on the Atchison, Topeka, & Santa Fe Railway.

PHYSICAL FEATURES AND CLIMATE

The claims are on the Kaibab Plateau near the western margin of the uplift, at an altitude of 7,900 feet. The topography of the area is characterized by series of ridges and canyons. The Mackin and Petoskey groups of claims are separated by Warm Springs Canyon, a deep gulch draining westward. Jacob Lake is immediately southeast of the Mackin group, and Lambs Lake is on the Petoskey group.

Water is a problem on the Kaibab Plateau, for there are no flowing streams, and the small basins fed by melting snow form intermittent lakes, which dry up during the summer months. A number of seeps and springs are found along the western edge of the plateau, of which Big Springs, 7 miles south of Ryan, is perhaps the largest.

The plateau supports marketable timber. Pinon and juniper grow at an altitude below that of Jacob Lake. Ponderosa pine grows in the vicinity of Jacob Lake, and Engelmann spruce, Douglas, white, and Alpine firs grow at higher altitudes. The greater part of the timbered area is within the Kaibab National Forest.

Snowfall prohibits open-cut operations from January to May. During 1944, snow remained on the ground after November 12. No trouble has been

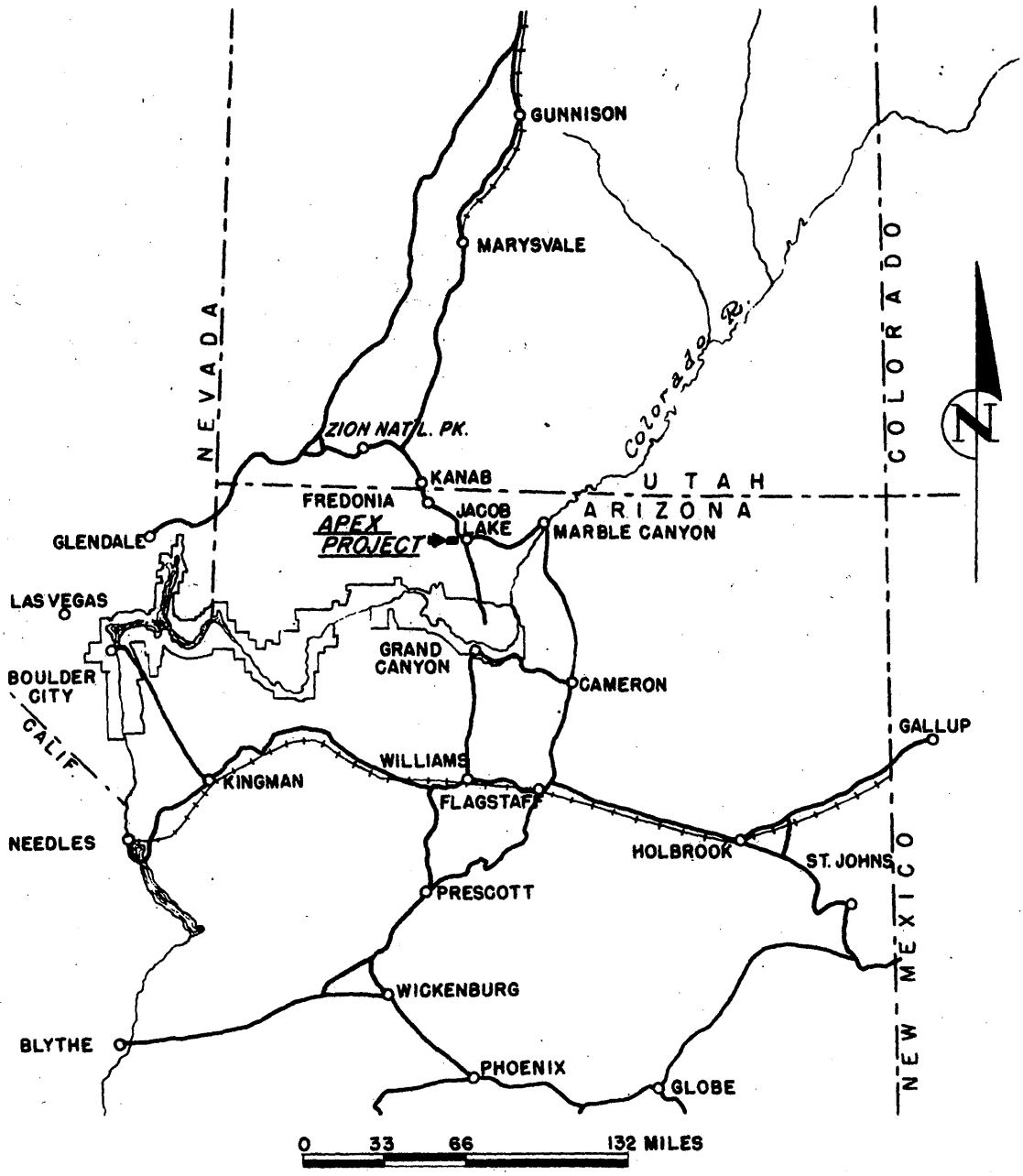


Figure 1.- Location map, Apex copper project, Coconino County, Arizona.

experienced from surface waters flooding the open-cuts during two seasons of operations.

Climatic data recorded by the Federal Weather Bureau over a six-year period at Bright Angel, 41 miles south of Jacob Lake, is shown in the following table. The winters at Jacob Lake are a little warmer than at Bright Angel.

Month	Temperature, °F.					Precipitation, inches	Snowfall, inches
	Average	Average maximum	Average minimum	Highest	Lowest		
Jan.	20.4	34.4	6.4	56	-23	2.69	24.4
Feb.	29.4	42.6	11.8	55	-20	3.34	22.2
Mar.	29.8	44.0	15.7	57	-14	2.02	16.6
Apr.	38.2	51.4	25.0	69	- 4	2.93	14.1
May.....	46.0	61.1	30.8	76	12	1.26	4.4
June.....	54.6	72.9	36.4	88	23	1.10	T
July.....	60.1	75.8	44.4	87	26	2.27	.0
Aug.	57.7	72.8	42.6	84	27	2.47	.0
Sept.	51.5	66.5	36.6	80	18	2.93	.0
Oct.	42.3	57.3	27.3	71	10	1.86	5.2
Nov.	31.1	45.0	17.3	61	-10	1.83	12.7
Dec.	20.0	37.4	7.3	53	-12	2.15	19.7
Annual.....	40.1	55.1	25.1	88	-23	26.85	119.3

HISTORY

The first development work was done south of Warm Springs Canyon by the Petoskey Mining Co. Between 1900 and 1902, the company acquired five patented claims, built a steam pumping plant in Warm Springs Canyon near a spring 3 miles from the millsite, and finished construction of a leaching plant. Copper was to be dissolved from the ore with dilute sulfuric acid and precipitated upon scrap iron. Before the process was tried, fire destroyed the plant and operations ceased.

In 1901, the Coconino Copper Co. located a group of claims, predecessor to the Mackin group, north of Warm Springs Canyon. A small tonnage of ore was treated in a reverberatory furnace at Ryan, 7 miles west of the property. The smelter failed because of the high silica content of the ore. A plant was then erected to use the Neill and Burfeind process. This was probably the first attempt to leach copper by using sulfur dioxide as a leaching reagent. About 1902, a patent was issued on the process, which consisted of exposing the ore to the action of sulfur dioxide, removing the dissolved copper in solution from the ore, and driving off the excess sulfurous acid by heating the solution and precipitating the copper as sulfite. The process was discontinued because of the instability of the copper compounds. Later, the plant was leased to the Esmeralda Precipitation Co. of Chicago, which experimented unsuccessfully with the ore.

The Buckskin Mountain Copper Co., in 1907, attempted experimental leaching. Eight additional claims were patented, and in 1916 a few tons of selected ore was shipped. This was followed by a period of considerable

stock promotion, but there was little mining activity in the district until 1928. The Kaibab Copper Co. was organized 1919. Later that year, the company was reorganized as the Kaibab Smelting Co., and in 1921 it was merged with other companies to form Allied Mines & Recovery Co.

About 1928, the Saint Anthony Copper Co. was organized to mine the ore by steam-shovel methods. Considerable trenching and test-pitting was done on the Mackin group. A railroad was built to Ryan to a newly constructed 100-ton blast furnace. Fire destroyed the plant about 1929, and operations were suspended. About 1,000 tons of 8-percent copper ore was shipped to the smelter at Garfield. Later, the Los Angeles Exploration & Metal Co., Ltd., obtained title to the St. Anthony Co.'s holdings.

In 1939, the United States Metals Corp. acquired control of the properties. The mines were reopened under a leasing system, but production was small and sporadic until 1943, when Harry W. Patterson and Arthur W. Simmons, operating as the Apex Mining Co., leased the property. Open-cut mining was started in July on the Mackin deposit, and later that year operations were shifted to the Petoskey claim group. Mining was halted by heavy snowfall in December. Production amounted to 5,192 tons of 4.98-percent copper ore during the season.

In the spring of 1944, V. M. Ryan and S. B. Atherley subleased the Petoskey and Mackin groups and mined 9,246 tons of 7.13-percent copper ore from the Petoskey open cut, Copper Glance, and Kennedy claims to December of that year.

PROPERTY AND OWNERSHIP

Three claim groups comprise the property - the Petoskey group of 7 patented claims, the Mackin group of 12 patented and 11 unpatented claims, and the Phantom group of 5 claims, of which one is patented (fig. 2). The Phantom group, about 4 miles north of the Petoskey group, was not investigated by the Bureau.

Thirty of the claims are owned and five are held under lease and option by the United States Metals Corp., 510 West 6th Street, Los Angeles, Calif. Roy S. Gangestad is president and Vincent G. Dodds is vice president of the corporation.

GEOLOGY AND ORE OCCURRENCE

Kaibab limestone of Permian age covers the plateau, and only areas cut into by deep erosion expose the underlying Coconino sandstone and Supai formations. Kaibab limestone in the district consists of calcareous sandstone, cherty limestone, and chert.

The ore bodies are ribbonlike, irregular runs lying nearly flat and following the stratification. They appear to have formed at the intersection of favorable beds and vertical fissures. They vary in width from 10 to 50

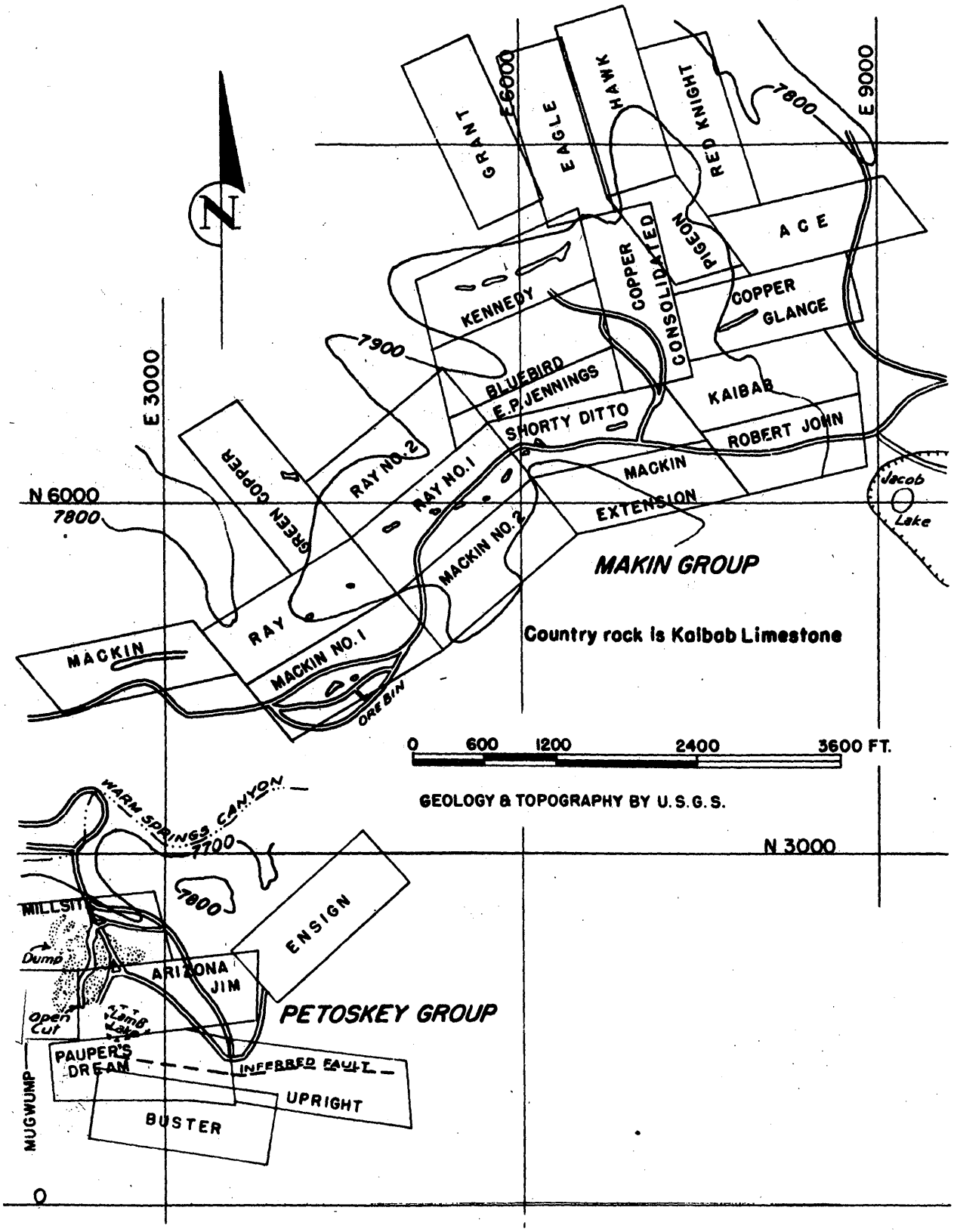


Figure 2.- Geologic plan, Apex copper project.

C.D. HOLE	SAMPLE NO.	FROM	TO	FEET	% Cu
1	6110	3.3	6.8	3.5	5.06
"	6111	6.8	13.3	6.5	4.90
"	6112	13.3	18.3	5.0	8.14
"	6113	18.3	20.3	2.0	6.94
"	6114	20.3	24.8	4.5	3.96
	6115	24.8	27.8	3.0	1.10
2	6116	1.0	5.0	4.0	2.5
"	6117	5.0	11.5	6.5	0.68
"	6118	11.5	15.0	3.0	0.40
3	6119	1.5	5.0	3.5	1.09
"	6120	5.0	8.0	3.0	2.25
"	6121	8.0	10.5	2.5	0.38
4	6122	17.3	17.6	3.2	0.91
6	6123	11.5	15.0	3.5	0.70
"	6124	15.0	19.0	4.0	1.41
"	6125	19.0	22.5	3.5	0.31
"	6126	22.5	27.0	4.5	0.13
8	6127	15.0	18.5	3.5	12.65
"	6128	18.5	19.5	1.0	13.34
"	6129	19.5	24.0	4.5	8.05
"	6130	24.0	27.0	3.0	4.00
"	6131	27.0	30.0	3.0	2.00
"	6132	30.0	33.0	3.0	0.50
9	6133	8.5	10.0	1.5	2.76
"	6134	10.0	13.0	3.0	9.70
"	6135	13.0	16.0	3.0	3.27
"	6136	16.0	19.0	3.0	1.58
13	6137	12.0	16.0	4.0	0.92
"	6138	16.0	19.0	3.0	8.84
"	6139	19.0	21.0	2.0	10.98
"	6140	21.0	23.0	2.0	9.52
"	6141	23.0	26.0	3.0	9.86
"	6142	26.0	29.0	3.0	10.59
"	6143	29.0	33.0	4.0	10.60
"	6144	33.0	36.0	3.0	7.61
"	6145	36.0	38.0	2.0	3.76
14	6146	10.0	12.0	2.0	1.69
"	6147	12.0	15.5	3.5	3.91
"	6148	15.5	18.5	3.0	6.03
"	6149	18.5	23.5	5.0	2.30
"	6150	23.5	28.5	5.0	1.75
"	6801	28.5	32.0	3.5	1.55
15	6802	15.0	18.0	3.0	2.22
"	6803	18.0	23.0	5.0	1.29
"	6804	23.0	28.0	5.0	1.90
"	6805	28.0	32.0	4.0	2.20
"	6806	32.0	37.0	5.0	1.60
"	6807	37.0	42.0	5.0	1.20
22	6808	22.0	24.0	2.0	7.71
"	6809	24.0	26.0	2.0	7.35
"	6810	26.0	28.0	2.0	7.18
"	6811	28.0	31.0	3.0	2.17
"	6812	31.0	34.0	3.0	8.90
"	6813	34.0	37.0	3.0	8.46
"	6814	37.0	40.0	3.0	4.04
24	6815	23.0	25.0	2.0	0.87
"	6816	25.0	27.0	2.0	1.37
26	6817	22.5	25.0	2.5	0.89
"	6818	25.0	28.0	3.0	0.84
"	6819	28.0	31.0	3.0	1.32
"	6820	31.0	35.0	4.0	3.86
"	6821	35.0	37.5	2.5	4.71
"	6822	37.5	42.5	5.0	6.49
"	6823	42.5	48.0	5.5	3.39
152	6860	5.0	10.0	5.0	1.19
"	6861	10.0	15.0	5.0	0.49
"	6862	15.0	20.0	5.0	0.33

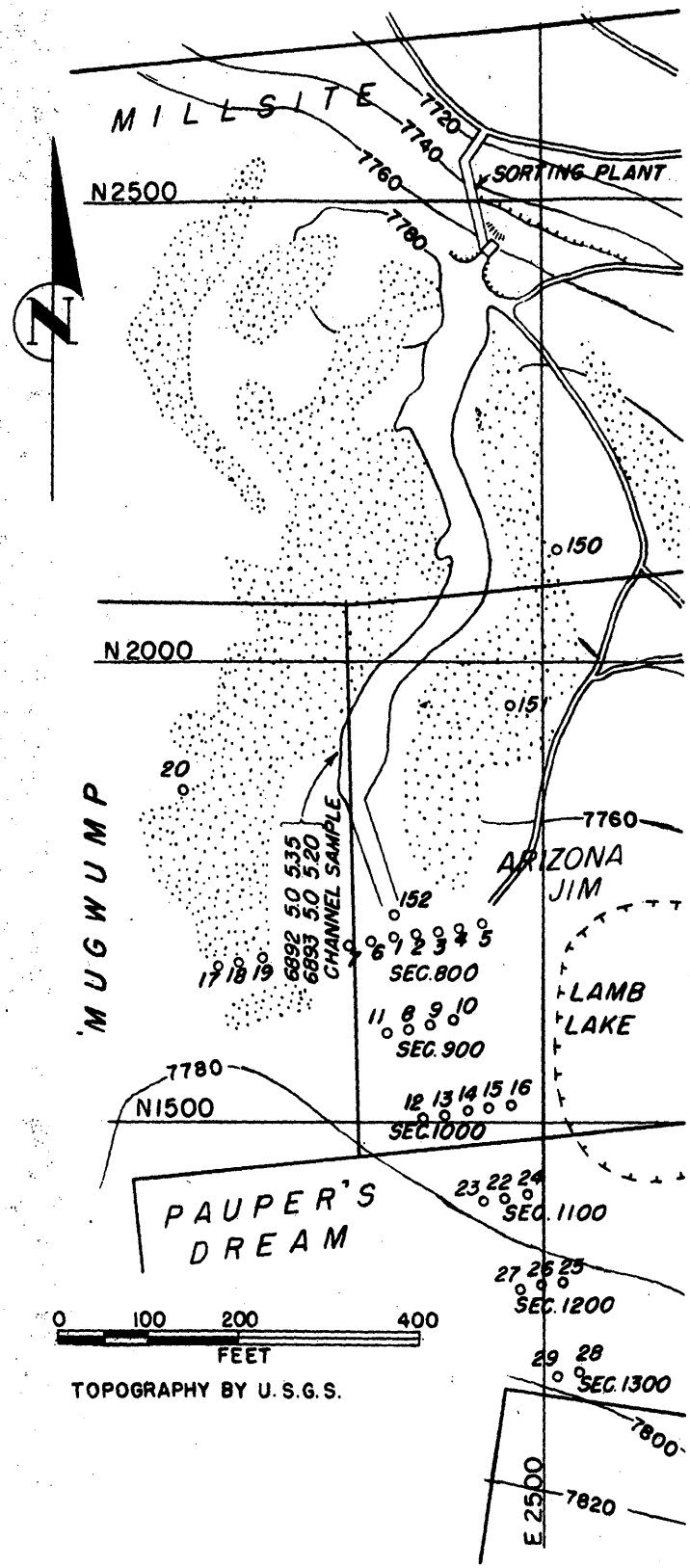
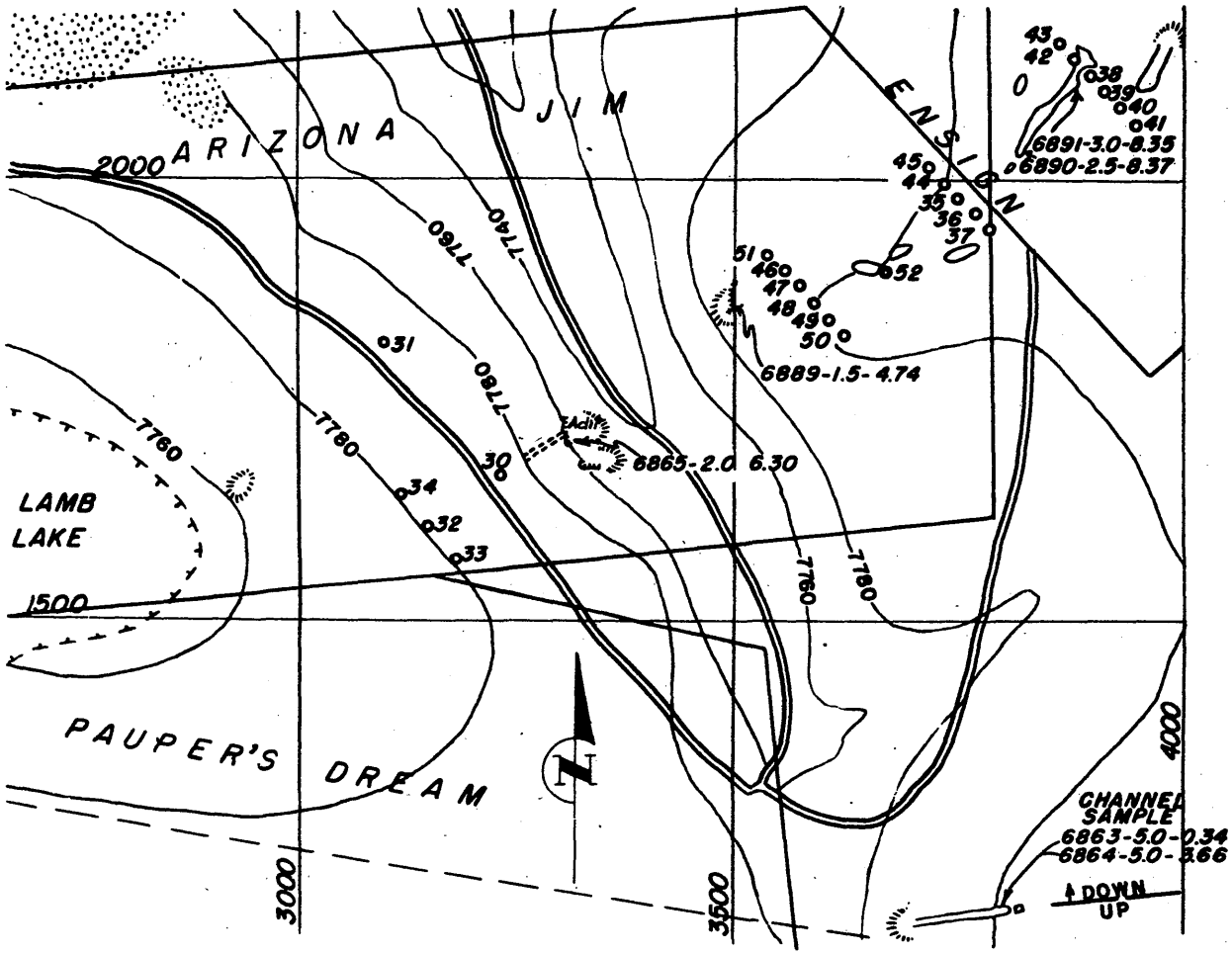


Figure 3.- Location of drill holes, Petoskey mine area.

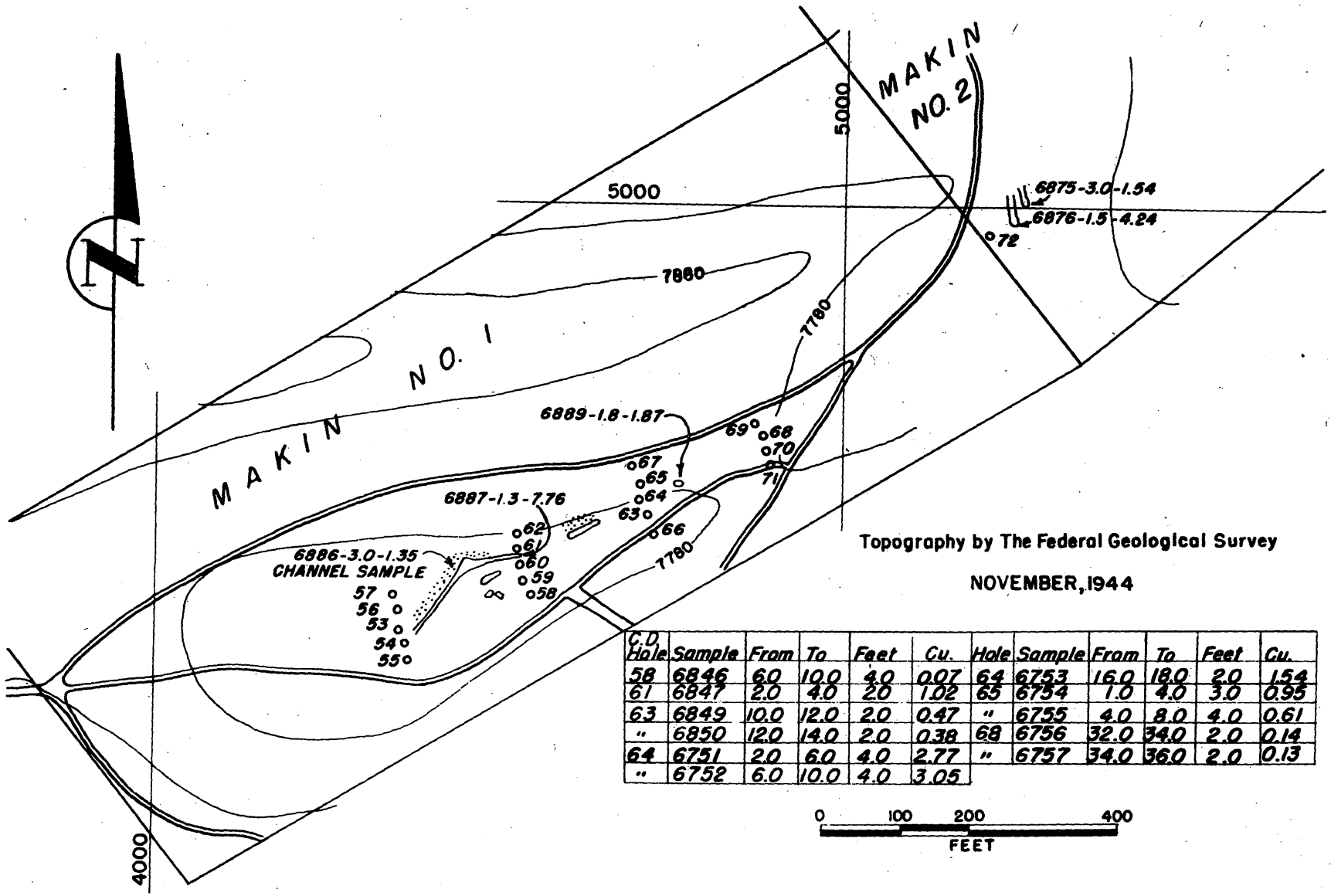


CD Hole	Sample	From	To	Feet	Cu.
30	6824	30.0	33.0	3.0	1.40
"	6825	33.0	36.0	3.0	1.31
"	6826	36.0	40.0	4.0	0.96
"	6827	40.0	44.0	4.0	2.24
"	6828	44.0	47.0	3.0	1.63
"	6829	47.0	49.0	2.0	0.55
39	6830	5.0	8.0	3.0	1.42
"	6831	8.0	10.0	2.0	1.00
"	6832	10.0	12.0	2.0	0.42
46	6833	0.0	4.0	4.0	0.87
"	6834	4.0	8.0	4.0	0.53
"	6835	8.0	12.0	4.0	1.55
"	6836	12.0	14.0	2.0	1.11
"	6837	14.0	16.0	2.0	0.73
47	6839	8.0	10.0	2.0	1.57
"	6840	10.0	15.0	5.0	1.40
"	6841	15.0	18.0	3.0	0.78
52	6842	5.0	7.0	2.0	2.70
"	6843	7.0	10.0	3.0	1.82
"	6844	10.0	12.0	2.0	1.01
"	6845	12.0	14.0	2.0	0.67

0 100 200 400
FEET

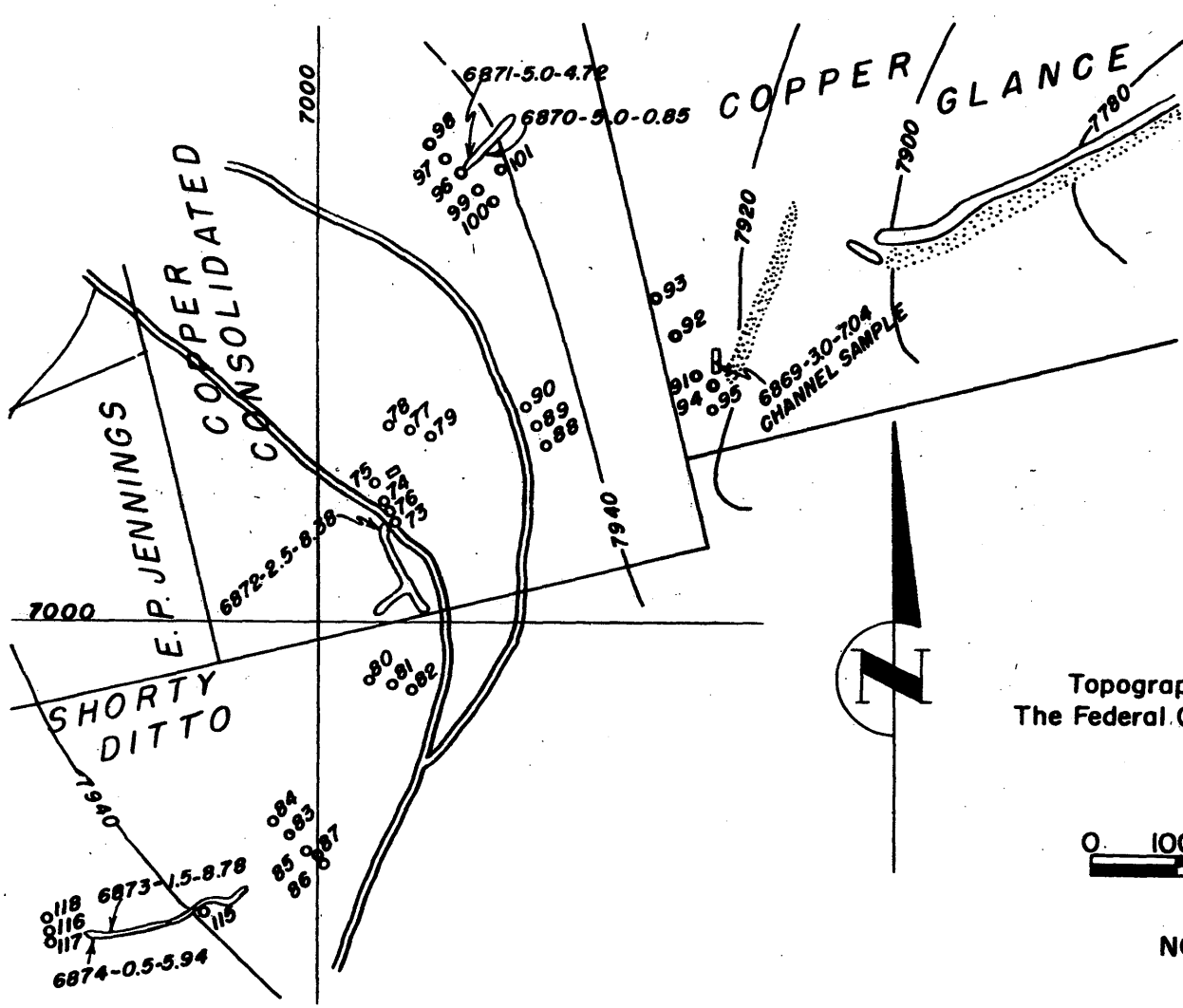
Topography by The Federal Geological Survey

Figure 4.- Locations of drill holes, Arizona Jim-Ensign claims.



C.D. Hole	Sample	From	To	Feet	Cu.	Hole	Sample	From	To	Feet	Cu.
58	6846	6.0	10.0	4.0	0.07	64	6753	16.0	18.0	2.0	1.54
61	6847	2.0	4.0	2.0	1.02	65	6754	1.0	4.0	3.0	0.95
63	6849	10.0	12.0	2.0	0.47	"	6755	4.0	8.0	4.0	0.61
"	6850	12.0	14.0	2.0	0.38	68	6756	32.0	34.0	2.0	0.14
64	6751	2.0	6.0	4.0	2.77	"	6757	34.0	36.0	2.0	0.13
"	6752	6.0	10.0	4.0	3.05						

Figure 5.- Locations of drill holes, Makin Nos. 1 and 2 claims.



C.D. Hole	Sample	From	To	Feet	Cu
74	6758	4.0	8.0	4.0	3.03
"	6759	8.0	10.0	2.0	0.94
76	6760	4.0	6.0	2.0	3.18
"	6761	6.0	8.0	"	3.92
"	6762	8.0	10.0	"	2.09
"	6763	10.0	13.0	3.0	1.43
81	6764	8.0	11.0	3.0	0.95
"	6765	11.0	13.0	2.0	1.03
"	6766	13.0	15.0	2.0	2.22
"	6767	15.0	17.0	"	1.12
"	6768	17.0	19.0	"	0.56
"	6769	19.0	21.0	"	0.25
"	6770	21.0	25.0	4.0	0.17
85	6771	8.0	10.0	2.0	0.29
"	6772	10.0	12.0	"	0.19
87	6773	4.0	6.0	"	1.81
"	6848	6.0	8.0	"	1.77
115	6793	11.0	13.0	"	0.61
	6794	13.0	15.0	"	0.43

Figure 6.- Locations of drill holes near Copper Glance open cut.

feet. The only ore bodies wider than 20 feet are the Kennedy and Petoskey. The thickness ranges from a knife edge to 14 feet, although thickness in excess of 4 or 5 feet is uncommon. Mineralized beds occur to a depth of 30 feet below a sandstone capping, but the base of the runs is seldom over 15 feet below the capping. Where erosion has removed the capping, the tops of the runs sometimes crop out, but usually they are covered by a thin mantle of soil and forest debris. Limonite-stained cherty sandstone fragments are generally the only surface indications of copper mineralization.

Malachite and azurite are the principal ore minerals. Chalcopyrite and chalcocite occur locally. Gangue consists mainly of chert and sandstone. The average specific gravity of the ore is 2.6. The copper content varies greatly within the ore zone. The limits of mineralization are sharp in cherty sandstone replacements and are gradational in zones of brecciated chert. Gold and silver occur in small quantities. An increasing amount of silver has been noted in shipments from the Petoskey pit as it has advanced southward.

MINE WORKINGS

Past Operations

The claims have been prospected by numerous shallow test pits and trenches. R. B. Brinsmade wrote, in the Engineering and Mining Journal in 1907, that considerable drilling had been done in the district previous to the trenching and test pitting. The property was worked by open cuts in 1943-44 without additional development. There are three abandoned pits - Mackin No. 1, Copper Glance, and Kennedy.

Present Operations

Petroskey Group. - About 90 percent of the ore shipped from the claims during the summer of 1944 was produced from the Petoskey open cut (fig. 3). Mining operations were begun on the northern end of an ore run on the crest of the south slope of Warm Springs Canyon. The cut, 20 to 50 feet wide and about 20 feet deep, has been advanced southward 715 feet across relatively flat terrain. The sorting bin, sorting belt, and chutes were located near the mouth of the cut. About 75 tons of ore was shipped daily, which required the removal of about 3 tons of overburden for each ton of ore shipped.

Stripping of overburden was carried on immediately ahead of the ore face, which was mined in benches at right angles to the trend of the run. Several feet of soil was removed with a bulldozer. The sandstone capping was then drilled and blasted and cast aside with the bulldozer. The greatest depth of overburden stripped to December was 12 feet. The capping was removed from 6 to 12 feet beyond the side mining limits of the open cut. Exploration consisted of drilling jackhammer holes and noting the color of the cuttings. Compressor capacity was too limited to permit extensive prospecting by this method. In may cases the bottom and side limits of the ore were not properly delimited, and as a consequence it has been necessary to recast overburden several times.

The caterpillar-Diesel, model RD-8, tractor equipped with a 12-foot blade, employed in stripping, was also used for pushing broken ore from the benches to the shovel, making and maintaining roads free of snow, and clearing timber. Trees up to 12 inches in diameter were uprooted by pushing, and larger trees were removed in the same manner after digging around the roots.

Air for drilling was supplied at 100 pounds gage pressure by two portable Ingersoll-Rand (models 315A and 210A), 2-stage, air-cooled compressors. The 135-cubic-foot unit was connected by a 2-inch air line to a 2-1/2- by 4-1/2-foot air receiver, from which 3/4-inch air hoses led to the drills. The 210-cubic-foot unit was moved around as needed.

Drilling was done dry with 6 Ingersoll-Rand, model JB-5, blower-type jackhammers. One jackhammer was kept in reserve as a spare. The ore was broken by blasting bench holes. The usual round consisted of three rows of holes across the bench, spaced 2-1/2 feet apart in holes and rows. Holes were staggered in successive rows. The holes were drilled to grade and were 6 to 10 feet deep. Drilling advance per 8 hours was 75 feet in ore and 115 feet in waste.

Hexagon, 1-inch, hollow drill steel was purchased shanked and threaded in 2-foot changes from 2 to 10 feet. Ingersoll-Rand 4-point jackbits were used in 5 sizes. Starter bits were 2-1/8 inch, and the gage reduction was 1/8 inch. Side-hole bits were necessary for blowing the holes with a minimum of plugging. Bits were reground once before discarding. No blacksmithing was done at the mine.

Holes were loaded with Gold Medal No. 4 bag powder; 10-foot holes were loaded with 2 pounds, 8-foot holes with 1-3/4 pounds, and 6-foot holes with 1-1/4 pounds of powder. The holes were shot with No. 6 electric detonators in a stick of 7/8- by 8-inch, 30-percent gelatin dynamite placed on the bottom of the hole. Firing was done with a duPont No. 50 blasting machine. Fines from the pit were used for stemming. Boulder shots were loaded with 30-percent gelatin dynamite and detonated with No. 6 caps and fuse. The maximum thickness of the ore was 14 feet, and the face was worked on two benches. Occasionally "hard bottom" interfered with the shovel at the toe of the lower bench.

In December 1944, and Ingersoll-Rand model FM-2 wagon drill mounting equipped with an Ingersoll-Rand DA-35 drifter drill was used to drill a 12-foot bench. Jackbits were used. Starter size was 3-inch and decreased 1/8-inch per change on 1-1/8-inch round steel in 2-foot changes. Holes were spaced 5-1/2 feet apart in line and rows.

A Northwest, model 25, full-revolving, 3/4-yard shovel with an 18-foot boom loaded the trucks. The shovel was mounted on caterpillar crawls and was powered with an 85-horsepower gasoline engine. Gasoline consumption per 8 hours was 20 gallons. The front and bottom of the dipper were made of manganese steel. Dipper teeth were worn out in 2 weeks. The digging cable was 3/4-inch cast steel, 6 by 19, regular lay. The life of a cable was 8,000 tons.

The shovel faced the bench, and trucks were loaded behind the shovel. Loading time was 3 minutes for 3 tons. Waste boulders were set aside by the shovel, and occasional boulders were broken or chipped to recover included ore. Normally two trucks transported ore from the shovel to the sorting bin. During December, the time of a trucking cycle from the shovel to the sorting bin was 11 minutes.

Trucks from the pit dumped the ore onto a grizzly of inverted rails inclined at 32 degrees and spaced 5-1/2 inches apart. Oversize fell into a chute equipped with a down-cut steel arc gate. Undersize from the grizzly passed over a sloping wire screen of 1-inch openings. The minus 1-inch material passed to drop-board chutes. The plus 1-inch material, which comprised about 50 percent of the total ore, was fed to a 20-inch sorting belt. The flow was regulated by a gate-tender. The sorting belt, 79 feet long between the head and tail pulleys, was driven by a Chevrolet 4-cylinder engine at a speed of 30 to 50 feet a minute. Three men picked waste from the belt. It is estimated that 5 to 8 percent of the material was thrown out.

Three trucks hauled the ore from the sorting chutes to the shipping bin. The haul was 1-1/2 miles, and the maximum grade against the load was 13 percent where the road crossed Warm Springs Canyon. Each truck carrying about 4 tons of ore made an average of 5 trips, or a maximum of 7 trips per shift. Trucks were 3 cubic-yard end-dump, dual rear-wheel, 6- and 8-cylinder models. All were equipped with cab protectors.

The shipping bin, constructed of logs and lined with 2-inch plank, was built on a side-hill slope. Trucks from the mine dumped from an earth fill ramp, and the ore was discharged from the bin through four drop-board chutes 2-1/2 feet wide by 2 feet high. The bottom of the bin sloped at 35 degrees and discharged freely about 175 tons.

During November the crew consisted of 20 men - 1 foreman, 1 master mechanic, 1 shovel operator, 1 bulldozer operator, 1 powderman, 5 drillers, 1 mechanic, 5 truck drivers, 3 ore sorters, and 1 laborer.

Mackin Group. - The Copper Glance and Kennedy claims of the Mackin group were worked from August to December under a sublease from Ryan and Atherley. Through November 1944, 926 tons of ore was shipped, which yielded 4.22 percent copper. The ore formation was directly beneath the soil in runs that averaged 10 feet in width and 1 to 4 feet in thickness.

Ore and waste were dug with a full-revolving, Universal-Lorain, model 40, 3/4-yard gasoline shovel powered with an 85-horsepower engine and mounted on caterpillar crawls. The dipper was made of mild steel with a manganese-steel front and was equipped with four detachable teeth. Six sets of teeth were used during the season. Digging cables were 5/8 inch. Four gallons of gasoline was consumed per hour.

The overburden was stripped with the shovel, and the spoil was cast on both sides of the run. The exposed ore was drilled with one Thor-Cochise

model 75 jackhammer. Rows and holes were spaced equal to the depth of the holes. Detachable, 2-inch, side-hole, Timken bits were used on 7/8-inch, hollow, hexagon steel. Bits were discarded after drilling 50 feet. A Le Roi model 2P85V portable compressor supplied air at 110 pounds pressure. About 1-1/2 gallons of gasoline was used per hour.

Holes were loaded with 40 percent gelatin EZ load in 1-1/8- by 8-inch sticks. Powder consumed was 4 to 5 pounds per ton of ore shipped. The explosive charges were fired with No. 6 caps and fuse.

After blasting, the ore was sorted and piled with the shovel, and the waste was cast aside. While trucks were being loaded with the shovel, several men sorted out waste from the trucks between swings of the dipper. The ore was difficult to sort clean because the friable chert produced considerable fines.

A normal crew consisted of one shovel operator, one powderman, and two miners. One shift was worked 6-1/2 days a week. An average daily loss of about 1/2 man-shift was caused by absenteeism.

Hauling

The ore from both operations was trucked 159 miles to Marysvale, Utah, by separate contractors.

Ore from the Mackin group claims was moved in two 9-cubic-yard, 10-wheel trucks hauling 12 to 15 tons per trip.

Two 150-horsepower, 20-ton-capacity, 18-wheel, end-dump, Kenworth Diesel tractor-trucks capable of hauling 25 tons each transported the ore from the Petoskey group.

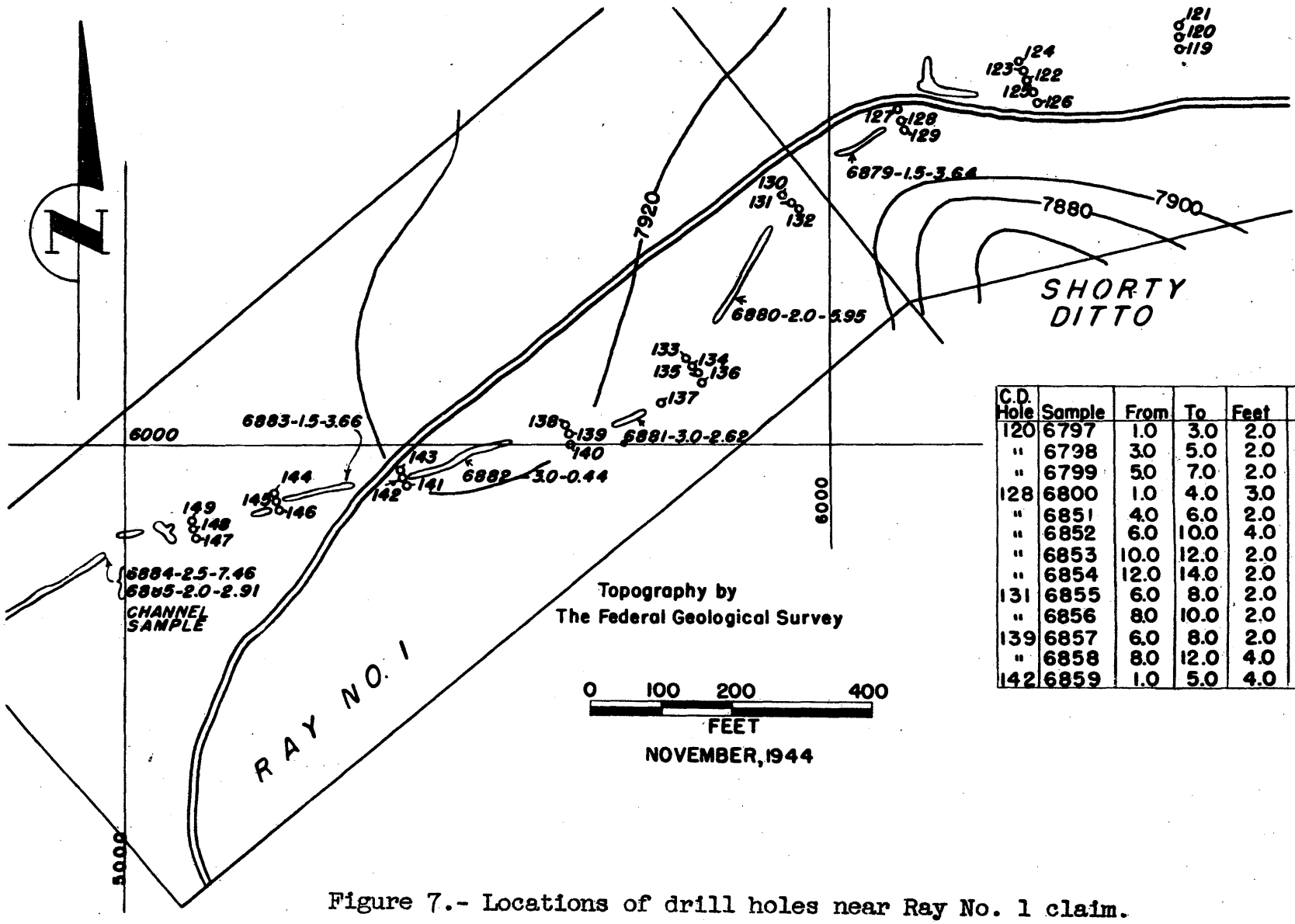
The ore was shipped by rail from Marysvale to the American Smelting & Refining Co. smelter at Garfield, Utah.

WORK DONE BY THE BUREAU OF MINES

Two abandoned Bureau of Public Roads camp buildings near Jacob Lake were repaired for use as an office and warehouse, before drilling started.

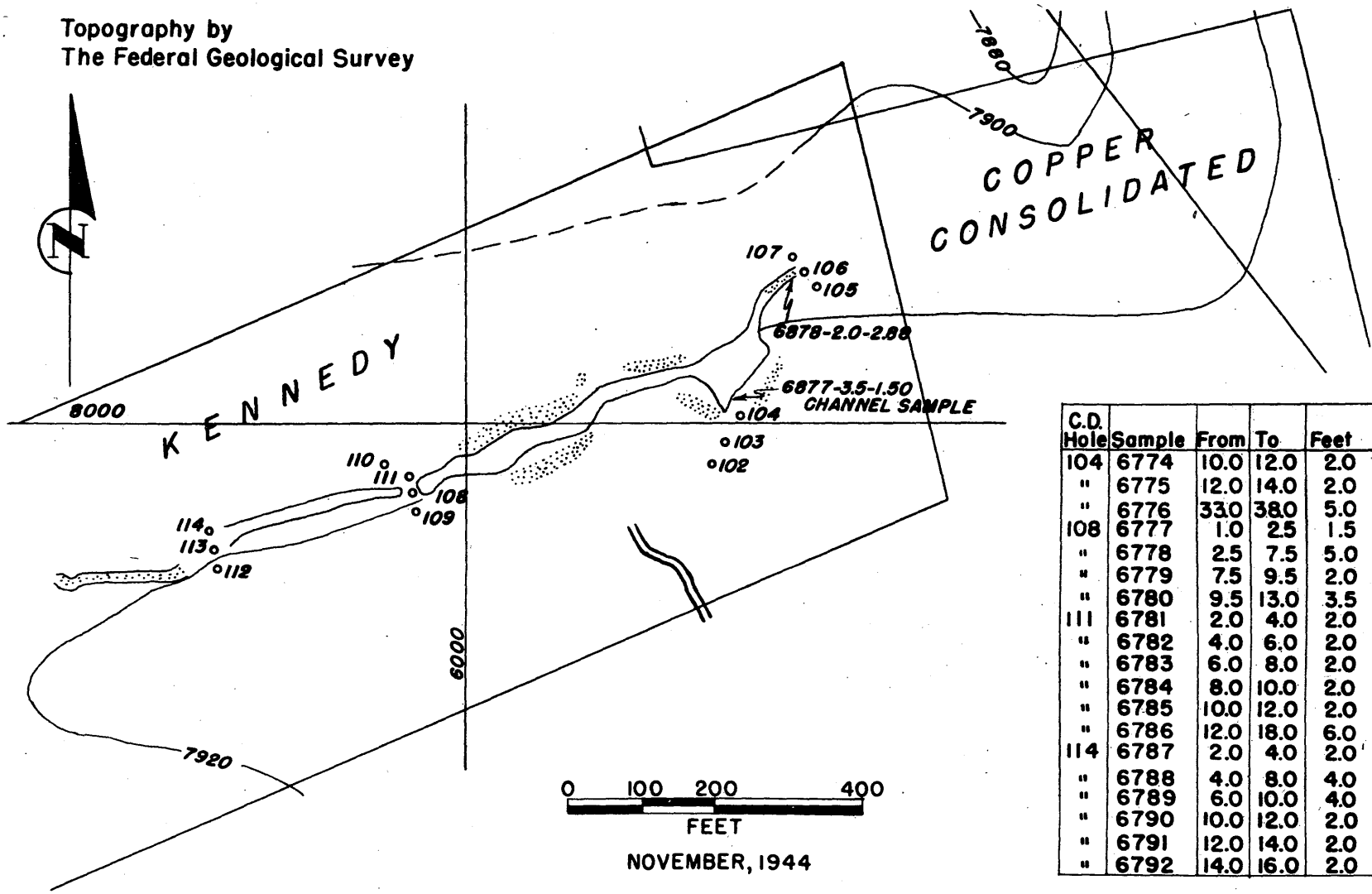
During the period October 7, 1944, to November 25, 1944, 152 churn-drill holes totaling 3,756 feet were completed. Drilling was done under contract, and the drill used was a model 29-W Armstrong mounted on crawls and driven by a Ford 85-horsepower gasoline engine. All holes were 8 inches in diameter and cased with 10-inch standpipes to depths of 2 to 5 feet. The formation below the standpipe was firm enough to permit drilling without casing.

The holes were located in accordance with recommendations of the Federal Geological Survey (figs. 3 to 8). Drilling was started south of



C.D. Hole	Sample	From	To	Feet	Cu
120	6797	1.0	3.0	2.0	2.25
"	6798	3.0	5.0	2.0	0.74
"	6799	5.0	7.0	2.0	0.26
128	6800	1.0	4.0	3.0	1.35
"	6851	4.0	6.0	2.0	1.70
"	6852	6.0	10.0	4.0	2.81
"	6853	10.0	12.0	2.0	2.65
"	6854	12.0	14.0	2.0	1.49
131	6855	6.0	8.0	2.0	6.30
"	6856	8.0	10.0	2.0	1.48
139	6857	6.0	8.0	2.0	1.31
"	6858	8.0	12.0	4.0	0.46
142	6859	1.0	5.0	4.0	3.09

Figure 7.- Locations of drill holes near Ray No. 1 claim.



C.D. Hole	Sample	From	To	Feet	Cu
104	6774	10.0	12.0	2.0	1.05
"	6775	12.0	14.0	2.0	0.70
"	6776	33.0	38.0	5.0	0.10
108	6777	1.0	2.5	1.5	0.64
"	6778	2.5	7.5	5.0	1.37
"	6779	7.5	9.5	2.0	0.57
"	6780	9.5	13.0	3.5	0.25
111	6781	2.0	4.0	2.0	1.05
"	6782	4.0	6.0	2.0	0.32
"	6783	6.0	8.0	2.0	1.84
"	6784	8.0	10.0	2.0	1.21
"	6785	10.0	12.0	2.0	0.91
"	6786	12.0	18.0	6.0	0.57
114	6787	2.0	4.0	2.0	4.11
"	6788	4.0	8.0	4.0	6.13
"	6789	6.0	10.0	4.0	2.95
"	6790	10.0	12.0	2.0	1.61
"	6791	12.0	14.0	2.0	0.84
"	6792	14.0	16.0	2.0	0.54

Figure 8.- Locations of drill holes in Kennedy open-cut area.

the Petoskey open cut, on the Mugwump-Arizona Jim claims, and progressed southward onto the Pauper's Dream claim. Holes were drilled in rows at 100-foot intervals, and the holes were spaced 25 feet apart in the rows.

On the Mackin group, the Mackin No. 1, Ray No. 1, Shorty Ditto, Copper Consolidated, Copper Glance, and Kennedy claims were drilled. Holes were drilled in rows at intervals of approximately 200 feet and were spaced about 25 feet apart in the rows.

The Bureau took 153 churn-drill samples. Sections of the holes averaging 3 feet and not exceeding 5 feet were bailed, and if the cuttings showed copper mineralization, the sludge was dumped into a three-way sample splitter. Thirty-two channel samples aggregating 85.4 feet were cut from the surface workings on the deposits.

Roads and drilling sites were cleared by bulldozer. The Bureau built 5,360 feet of road 13 feet wide and repaired 830 linear feet of existing roads. In preparation for the new roads, areas totaling 1,440 square yards were cleared of trees up to 8 inches in diameter.

Condensed logs of holes, prepared by the Federal Geological Survey, are attached to this report.

CONDENSED LOGS OF CHURN DRILL HOLES

(Geology by Federal Geological Survey)

Hole No.	Collar: Coordinates	Collar: Elevation, ft.	Footage: From-	Footage: To-	Percent copper	Description and remarks
1	1699N - 2335E	7755.1	0	3.3		Soil.
			3.3	20.3	6.12	Cherty sandstone.
			20.3	24.8	3.96	Do.
			24.8	27.8	1.14	Do.
			27.8	50		Clay, cherty-limy sandstone.
2	1703N - 2360E	7754.7	0	1.		Soil.
			1.	5.	2.51	Cherty sandstone.
			5.	15.	.58	Do.
			15.	20.		Cherty-limy sandstone.
3	1707N - 2384E	7754.7	0	1.5		Soil
			1.5	8.	1.62	Cherty sandstone.
			8.	10.5	.38	Do.
			10.5	15.		Cherty-limy sandstone.
4	1711N - 2409E	7755.0	0	4.4		Soil.
			4.4	14.3		Cherty sandstone.
			14.3	17.6	.91	Do.
			17.6	20.7		Cherty-limy sandstone.
5	1715N - 2434E	7755.4	0	5.7		Soil.
			5.7	19.7		Cherty-limy sandstone.

Hole No.	Collar: Coordinates	Collar: Elevation, ft.	Footage: From-	Footage: To-	Percent copper	Description and remarks
6	1695N - 2310E	7755.4	0	3.		Soil.
			3.	11.5		Cherty sandstone.
			11.5	19.	1.08	Do.
			19.	27.	.21	Do.
			27.	31.		Cherty-limy sandstone.
7	1691N - 2285E	7757.4	0	1.8		Soil.
			1.8	30.		Cherty-limy sandstone.
8	1600N - 2351E	7760.4	0	2.5		Soil.
			2.5	15.		Cherty sandstone.
			15.	24.	10.42	Do.
			24.	27.	4.00	Do.
			27.	30.	2.00	Do.
			30.	33.	.50	Do.
			33.	35.		Cherty-limy sandstone.
9	1604N - 2376E	7758.8	0	4.0		Soil.
			4.	8.5		Cherty sandstone.
			8.5	10.	2.76	Do.
			10.	13.	9.76	Do.
			13.	16.	3.27	Do.
			16.	19.	1.58	Do.
			19.	30.		Cherty-limy sandstone.
10	1608N - 2401E	7757.0	0	3.		Soil.
			3.	30.		Cherty and limy sandstone.
11	1596N - 2327E	7762.1	0	3.		Soil.
			3.	30.		Cherty and limy sandstone.
12	1502E - 2368E	7770.1	0	12.		Soil and sandy clay.
			12.	32.		Cherty and limy sandstone.
13	1506E - 2392E	7767.0	0	4.		Soil.
			4.	12.		Sandy clay.
			12.	16.	.92	Cherty sandstone.
			16.	36.	9.70	Do.
			36.	38.	3.76	Do.
			38.	40.		Cherty-limy sandstone.
14	1510E - 2417E	7764.8	0	5.		Soil.
			5.	10.		Sandy clay.
			10.	12.	1.69	Cherty sandstone.
			12.	15.5	3.91	Do.
			15.5	18.5	6.03	Do.
			18.5	32.	1.90	Do.
			32.	35.5		Cherty-limy sandstone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
15	1514N - 2442E	7763.0	0	11.		Soil and sandy clay.
			11.	15.		Cherty sandstone.
			15.	42.	1.68	Do.
			42.	45.		Cherty-limy sandstone.
16	1518N - 2466E	7761.3	0	5.		Soil.
			5.	38.		Clay, cherty and limy sandstone.
17	1666N - 2138E	7768.6	0	5.		Soil.
			5.	35.		Clay, cherty and limy sandstone.
18	1670N - 2163E	7767.9	0	4.		Soil.
			4.	30.		Clay, cherty and limy sandstone.
19	1674N - 2187E	7766.7	0	3.		Soil.
			3.	26.		Clay, cherty and limy sandstone.
20	1856N - 2101E	7765.5	0	2.5		Soil.
			2.5	30.		Clay, cherty and limy sandstone.
21	2060N - 2151E	7762.4	0	8.		Soil and sandy clay.
			8.	24.		Clay, cherty and limy sandstone.
22	1415N - 2458E	7775.4	0	5.		Soil.
			5.	22.		Clay and cherty sandstone.
			22.	37.	6.86	Cherty sandstone.
			37.	40.	4.04	Do.
			40.	43.		Cherty-limy sandstone.
23	1411N - 2433E	7777.9	0	4.		Soil.
			4.	29.5		Clay and cherty sandstone.
			29.5	32.5		Trace copper in cherty sandstone.
			32.5	35.		Cherty-limy sandstone.
24	1419N - 2483E	7772.4	0	12.		Soil and clay.
			12.	23.		Clay and cherty sandstone.
			23.	27.	1.12	Cherty sandstone.
			27.	32.		Cherty-limy sandstone.
25	1325N - 2524E	7781.4	0	13.		Soil and sandy clay.
			13.	30.		Clay, cherty and limy sandstone.

Hole No.	Collar: Coordinates	Collar: Elevation, ft.	Footage: From-	Footage: To-	Percent copper	Description and remarks
26	1321N - 2499E	7783.5	0	2.5		Soil.
			2.5	22.5		Clay and cherty sandstone.
			22.5	31.	1.02	Cherty sandstone.
			31.	35.	3.86	Fractured cherty sandstone.
			35.	42.5	5.90	Do.
			42.5	48.	3.38	Do.
			48.	53.		Do.
						Soil in open fissure.
27	1316N - 2473E	7784.5	0	2.		Soil.
			2.	35.		Clay, cherty and limy sandstone.
28	1226N - 2540E	7792.8	0	2.		Soil.
			2.	40.		Clay, cherty and limy sandstone.
29	1222N - 2515E	7793.0	0	2.		Soil.
			2.	35.		Clay, cherty and limy sandstone.
30	1665N - 3231E	7788.1	0	2.		Soil.
			2.	30.		Cherty sandstone.
			30.	47.	1.52	Do.
			47.	49.	.55	Do.
			49.	50.5		Cherty-limy sandstone.
31	1814N - 3098E	7787.9	0	4.		Soil.
			4.	35.		Clay, cherty and limy sandstone.
32	1608N - 3150E	7781.5	0	4.		Soil.
			4.	30.		Clay, cherty and limy sandstone.
33	1568N - 3179E	7782.5	0	3.		Soil.
			3.	30.		Clay, cherty and limy sandstone.
34	1644N - 3118E	7781.3	0	5.		Soil.
			5.	30.		Clay, cherty and limy sandstone.
35	1980N - 3747E	7801.8	0	8.		Soil and clay.
			8.	20.		Cherty and limy sandstone.
36	1962N - 3764E	7802.9	0	2.		Soil.
			2.	22.		Clay, cherty and limy sandstone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
37	1944N - 3781E	7805.3	0	2.		Soil.
			2.	10.5		Clay, cherty and limy sandstone.
38	2118N - 3892E	7804.7	0	2.		Soil.
			2.	8.		Clay and cherty sandstone.
			8.	10.		Trace copper in cherty sandstone.
			10.	22.		Clay and limy-cherty sandstone.
			22.	25.		Fractured cherty-sandy limestone.
39	2100N-3909E	7806.5	0	5.		Soil and sandy clay.
			5.	10.	1.25	Cherty sandstone.
			10.	12.	.42	Do.
			12.	18.		Cherty-sandy limestone.
40	2082N - 3927E	7807.8	0	3.		Soil.
			3.	17.		Clay and cherty sandstone.
			17.	22.		Cherty-sandy limestone.
41	2064N - 3944E	7809.2	0	3.		Soil.
			3.	18.		Clay and cherty sandstone.
			18.	20.		Cherty-sandy limestone.
42	2136N - 3875E	7802.2	0	2.		Soil.
			2.	17.		Clay and cherty sandstone.
			17.	20.		Cherty-sandy limestone.
43	2154N - 3858E	7801.9	0	3		Soil.
			3.	10.		Clay and cherty sandstone.
			10.	13.		Cherty-sandy limestone.
44	1998N - 3730E	7800.0	0	2.		Soil.
			2.	10.		Clay and cherty sandstone.
			10.	12.		Cherty-sandy limestone.
45	2016N - 3713E	7798.3	0	3.		Soil.
			3.	12.		Clay and cherty sandstone.
			12.	13.		Cherty-sandy limestone.
46	1879N - 3567E	7796.0	0	16.	.97	Cherty sandstone.
			16.	18.		Do.
			18.	30.		Cherty-sandy limestone. Fissure 23-29 feet.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
47	1897N -3550E	7792.8	0	2.		Soil.
			2.	8.		Clay and cherty sandstone.
			8.	18.	1.25	Cherty sandstone.
			18.	22.		Do.
			22.	24.		Cherty-sandy limestone.
48	1861N - 3585E	7799.1	0	3.		Soil.
						3.0 - 8.0 trace copper.
			3.	16.		Clay and cherty sandstone.
			16.	18.		Cherty-sandy limestone.
49	1843N - 3602E	7800.2	0	2.		Soil.
						18.0 - 21.0 trace copper.
			2.	21.		Clay and cherty sandstone.
			21.	24.		Cherty-sandy limestone.
50	1825N - 3619E	7800.2	0	2.		Soil.
			2.	12.		Clay and cherty sandstone.
			12.	15.		Cherty-sandy limestone.
51	1915N - 3533E	7792.8	0	2.5		Soil.
			2.5	15.		Clay and cherty sandstone.
			15.	18.		Cherty-sandy limestone.
52	1895N - 3665E	7801.8	0	5.		Soil and cherty sandstone.
			5.	12.	1.84	Cherty sandstone.
			12.	14.	.69	Do.
			14.	16.		Cherty-sandy limestone.
53	4373N - 4355E	7887.2	0	2.		Soil.
			2.	12.		Cherty sandstone.
			12.	14.		Cherty-sandy limestone.
54	4354N - 4363E	7887.4	0	2.		Soil.
			2.	18.		Clay and cherty sandstone.
			18.	20.		Cherty-sandy limestone.
55	4324N - 4367E	7886.8	0	3.		Soil.
			3.	10.		Clay and cherty sandstone.
			10.	12.6		Cherty-sandy limestone.
56	4403N - 4351E	7885.7	0	2.		Soil.
			2.	10.		Clay and cherty sandstone.
			10.	12.		Cherty-sandy limestone.
57	4422N - 4346E	7885.6	0	4.		Soil and clay.
			4.	15.		Cherty and sandstone.
			15.	19.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
58	4423N - 4547E	7885.1	0	2.		Soil.
			2.	6.		Cherty sandstone.
			6.	10.	.07	Do.
			10.	20.		Cherty-sandy limestone.
59	4447N - 4537E	7885.7	0	2.		Soil.
			2.	16.		Cherty sandstone.
			16.	20.		Cherty-limy limestone.
60	4470N - 4530E	7884.8	0	2.		Soil.
			2.	18.		Cherty sandstone.
			18.	21.		Cherty-sandy limestone.
61	4495N - 4527E	7881.1	0	2.		Soil.
			2.	4.	1.02	Cherty sandstone.
			4.	15.		Do.
			15.	20.		Cherty-sandy limestone.
62	4515N - 4525E	7879.5	0	2.		Soil.
			2.	23.		Cherty sandstone.
			23.	26.		Cherty-sandy limestone.
63	4544N - 4713E	7880.7	0	2.		Soil.
			2.	10.		Cherty sandstone.
			10.	14.	42	Do.
			14.	16.		Cherty-sandy limestone.
64	4568N - 4704E	7880.1	0	2.		Soil.
			2.	10.	2.91	Cherty sandstone.
			10	16		Cherty sandstone trace of copper.
			16.	18.	1.54	Cherty sandstone
			18.	38.		Cherty sandstone and clay.
			38.	42.		Cherty-sandy limestone.
65	4590N - 4704E	7878.4	0	1.		Soil.
			1.	8.	.76	Cherty sandstone.
			8.	13.		Cherty-sandy limestone.
66	4520N - 4721E	7880.7	0	2.		Soil.
			2.	15.		Cherty sandstone.
			15.	20.		Cherty-sandy limestone.
67	4616N - 4690E	7873.1	0	2.		Soil.
			2.	6.		Cherty sandstone.
			6.	10.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
68	4661N - 4881E	7878.3	0	3.		Soil.
			3.	32.		Clay and cherty sandstone.
			32.	36.	.14	Cherty sandstone.
			36.	40.		Clay and cherty sandstone.
			40.	42.		Cherty-sandy limestone.
69	4682N - 4870E	7877.3	0	2.		Soil.
			2.	10.		Clay andcherty sandstone.
			10.	18.		Cherty-sandy limestone.
70	4638N - 4883E	7879.0	0	2.		Soil.
			2.	18.		Clay and cherty sandstone.
			18.	27.		Cherty-sandy limestone.
71	4615N - 4895E	7879.0	0	2.5		Soil.
			2.5	19.		Clay and cherty sandstone.
			19.	24.		Cherty-sandy limestone.
72	4955N - 5208E	7832.8	0	13.		Soil and clay.
			13.	16.		Cherty sandstone.
			16.	40.5		Clay and cherty-limy sandstone.
73	7118N - 7089E	7944.5	0	2.5		Soil.
			2.5	16.		Cherty sandstone.
			16.	20.		Cherty-sandy limestone.
74	7140N - 7078E	7944.9	0	2.		Soil.
			2.	4.		Cherty sandstone.
			4.	8.	3.03	Do.
			8.	10.	.94	Do.
			10.	20.		Do.
			20.	24.		Cherty-sandy limestone.
75	7163N - 7067E	7945.1	0	3.		Soil.
			3.	6.		Cherty sandstone - trace copper.
			6.	16.		Cherty sandstone.
			16.	20.		Cherty-sandy limestone.
76	7129N - 7084E	7944.7	0	4.		Soil and sandstone.
			4.	10.	3.06	Cherty sandstone.
			10.	13.	1.43	Do.
			13.	17.		Do.
			17.	20.		Cherty-sandy limestone.
77	7226N - 7107E	7945.3	0	2.5		Soil.
			2.5	15.		Cherty sandstone.
			15.	20.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper-	Description and remarks
78	7232N - 7083E	7945.3	0	2.		Soil.
			2.	15.		Sandy clay and cherty sandstone.
			15.	17.		Cherty-sandy limestone.
79	7221N - 7131E	7945.3	0	2.		Soil.
			2.	14.		Sandy clay and cherty sandstone.
			14.	16.		Cherty-sandy limestone.
80	6929N - 7061E	7946.2	0	2.5		Soil.
			2.5	20.		Cherty sandstone.
			20.	25.		Cherty-sandy limestone.
81	6923N - 7085E	7946.4	0	2.		Soil.
			2.	8.		Cherty sandstone.
			8.	17.	1.29	Do.
			17.	25.	.29	Do.
						Fissure 21-25 feet.
82	6917N - 7110E	7945.6	0	2.		Soil.
			2.	4.		Trace copper in cherty sandstone.
			4.	20.		Cherty sandstone.
			20.	23.		Cherty-sandy limestone.
83	6742N - 6965E	7945.7	0	2.		Soil.
			2.	17.		Cherty sandstone.
			17.	20.		Cherty-sandy limestone.
84	6758N - 6946E	7944.9	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	20.		Cherty-sandy limestone.
85	6726N - 6985E	7946.5	0	2.		Soil.
			2.	8.		Cherty sandstone.
			8.	12.	.24	Do.
			12.	16.		Do.
			16.	20.		Cherty-sandy limestone.
86	6711N - 7004E	7947.3	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	17.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
87	6719N - 6995E	7946.9	0.	2.		Soil.
			2.	4.		Cherty sandstone.
			4.	8.	1.79	Do.
			8.	10.		Do.
			10.	15.		Cherty-sandy limestone.
88	7208N - 7268E	7934.6	0	2.		Soil.
			2.	12.		Cherty sandstone.
			12.	16.		Cherty-sandy limestone.
89	7230N - 7256E	7935.7	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	17.		Cherty-sandy limestone.
90	7253N - 7245E	7936.5	0	2.		Soil.
			2.	15.		Cherty sandstone.
			15.	21.		Cherty-sandy limestone.
91	7297N - 7444E	7921.7	0	2.		Soil.
			2.	15.		Cherty sandstone.
			15.	20.		Cherty-sandy limestone.
92	7342N - 7421E	7924.4	0	2.		Soil.
			2.	15.		Cherty sandstone.
			15.	20.		Cherty-sandy limestone.
93	7386N - 7399E	7926.6	0	2.		Soil.
			2.	16.		Cherty sandstone.
			16.	19.		Cherty-sandy limestone.
94	7279N - 7464E	7918.5	0	2.5		Soil.
			2.5	17.		Cherty sandstone.
			17.	20.		Cherty-sandy limestone.
95	7252N - 7466E	7918.0	0	2.		Soil.
			2.	17.		Cherty sandstone.
			17.	20.		Cherty-sandy limestone.
96	7532N - 7167E	7944.4	0	2.		Soil.
			2.	16.		Cherty sandstone.
			16.	25.		Cherty-sandy limestone.
97	7548N - 7148E	7944.7	0	2.		Soil.
			2.	20.		Cherty sandstone.
			20.	25.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
98	7563N - 7129E	7944.8	0	2.		Soil.
			2.	18.		Cherty sandstone.
			18.	20.		Cherty-sandy limestone.
99	7516N - 7187E	7944.1	0	2.		Soil.
			2.	15.		Cherty sandstone.
			15.	20.		Cherty-sandy limestone.
100	7500N - 7206E	7944.5	0	3.		Soil.
			3.	17.		Cherty sandstone.
			17.	20.		Cherty-sandy limestone.
101	7535N - 7215E	7944.3	0	2.		Soil.
			2.	17.		Cherty sandstone.
			17.	20.		Cherty-sandy limestone.
102	7946N - 6330E	7922.2	0	14.		Soil and sandy clay.
			14.	17.		Cherty sandstone.
			17.	20.		Cherty-sandy limestone.
103	7978N - 6349E	7921.0	0	6.		Soil and sandy clay.
			6.	25.		Cherty sandstone.
			25.	29.		Trace copper in cherty sandstone.
			29.	36.		Cherty-sandy limestone.
104	8010N - 6368E	7919.8	0	10.		Soil and sandy clay.
			10.	14.	.87	Cherty sandstone.
			14.	18.		Cherty-limy sandstone.
			18.	20.		Cherty-sandy limestone.
105	8182N - 6470E	7908.6	0	2.		Soil.
			2.	33.		Clay and cherty sandstone.
			33.	38.	.10	Clay, cherty-sandy limestone.
			38.	40.		Do.
106	8202N - 6454E	7906.0	0	2.		Soil.
			2.	30.		Sandy clay and cherty sandstone.
			30.	33.		Clay and cherty-sandy limestone.
107	8221N - 6439E	7905.0	0	2.		Soil.
			2.	25.		Sandy clay and cherty sandstone.
			25.	29.		Clay and cherty sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
108	7908N - 5927E	7919.5	0	1.		Soil.
			1.	9.5	1.05	Cherty sandstone.
			9.5	13.	.25	Do.
			13.	25.		Cherty-sandy limestone.
109	7883N - 5932E	7920.7	0	2.		Soil.
			2.	14.		Clay and cherty sandstone.
			14.	25.		Cherty-sandy limestone.
110	7943N - 5888E	7917.9	0	1.		Soil.
			1.	15.		Cherty sandstone.
			15.	25.		Cherty-sandy limestone.
111	7932N - 5923E	7917.2	0	2.		Fill.
			2.	12.	1.07	Cherty sandstone.
			12.	18.	.57	Do.
			18.	38.		Cherty-sandy limestone.
			38.	66.		Red cherty clay.
			66.	100.		Clay and cherty-sandy limestone.
112	7808N - 5662E	7919.6	0	2.		Soil.
			2.	16.		Cherty sandstone.
			16.	25.		Cherty-sandy limestone.
113	7832N - 5658E	7917.0	0	4.5		Fill.
			4.5	14.		Cherty sandstone.
			14.	25.		Cherty-sandy limestone.
114	7857N - 5653E	7916.5	0	2.		Fill.
			2.	6.	5.12	Cherty sandstone.
			6.	12.	2.50	Do.
			12.	16.	.69	Do.
			16.	28.		Cherty-sandy limestone.
115	6650N - 6862E	7941.4	0	2.		Soil.
			2.	11.		Cherty sandstone.
			11.	15.	.50	Do.
			15.	17.		Do.
			17.	25.		Cherty-sandy limestone.
116	6631N - 6682E	7931.8	0	2.		Soil.
			2.	8.	.51	Cherty sandstone.
			8.	17.		Do.
			17.	30.		Cherty-sandy limestone.
117	6616N - 6683E	7931.6	0	2.		Soil.
			2.	18.		Cherty sandstone.
			18.	20.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
118	6646N - 6680E	7932.1	0	2.		Soil.
			2.	17.		Cherty sandstone.
			17.	20.		Cherty-sandy limestone.
119	6572N - 6491E	7922.5	0	4.		Soil.
			4.	20.		Cherty sandstone.
			20.	25.		Cherty-sandy limestone.
120	6587N - 6491E	7922.7	0	1.		Soil.
			1.	3.	2.25	Cherty sandstone.
			3.	7.	.50	Do.
			7.	13.		Do.
			13.	17.		Cherty-sandy limestone.
121	6602N - 6490E	7923.0	0	2.		Soil.
			2.	20.		Cherty sandstone.
			20	25		Cherty-sandy limestone.
122	6523N - 6281E	7917.0	0	4.		Soil.
			4.	35.		Clay and cherty sandstone.
			35.	40.		Clay and cherty-sandy limestone.
123	6536N - 6275E	7916.7	0	3.		Soil.
			3.	18.		Clay and cherty sandstone.
			18.	21.		Clay, cherty-sandy limestone.
124	6550N - 6269E	7916.5	0	3.		Soil.
			3.	14.		Clay and cherty sandstone.
			14.	16.		Clay and cherty-sandy limestone.
125	6509N - 6287E	7916.5	0	2.		Soil.
			2.	12.5		Clay and cherty sandstone.
			12.5	15.		Clay and cherty-limy sandstone.
126	6495N - 6293E	7916.2	0	2.		Soil.
			2.	18.		Clay and cherty sandstone.
			18.	20.		Cherty-sandy limestone.
127	6480N - 6097E	7915.9	0	2.		Soil.
			2.	18.		Cherty sandstone.
			18.	20.		Cherty-sandy limestone.
128	6466N - 6102E	7916.1	0	1.		Soil.
			1.	14.	2.07	Cherty sandstone.
			14.	22.		Cherty-clayey sandstone.
			22.	25.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
129	6452N - 6107E	7915.5	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	17.		Cherty-sandy limestone.
130	6359N - 5937E	7916.0	0	2.		Soil.
			2.	18.		Clay and cherty sandstone.
			18.	20.		Cherty-sandy limestone.
131	6350N - 5948E	7915.4	0	2.		Soil.
			2.	6.		Cherty sandstone.
			6.	8.	6.30	Do.
			8.	10.	1.48	Do.
			10.	14.		Do.
			14.	16.		Cherty-sandy limestone.
132	6340N - 5960E	7914.4	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	16.		Cherty-sandy limestone.
133	6129N - 5800E	7918.3	0	2.		Soil.
			2.	18.		Clay and cherty sandstone.
			18.	20.		Cherty-sandy limestone.
134	6116N - 5808E	7917.9	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	17.		Cherty-sandy limestone.
135	6104N - 5817E	7917.5	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	16.		Cherty-sandy limestone.
136	6093N - 5802E	7918.0	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	17.		Cherty-sandy limestone.
137	6062N - 5764E	7918.8	0	2.		Soil.
			2.	16.		Cherty sandstone.
			16.	18.		Cherty-sandy limestone.
138	6032N - 5627E	7921.4	0	1.		Soil.
			1.	16.		Cherty sandstone.
			16.	20.		Cherty-sandy limestone.
139	6018N - 5613E	7921.3	0	2.		Soil.
			2.	6.		Clay and cherty sandstone.
			6.	8.	1.31	Cherty sandstone.
			8.	12.	.46	Do.
			12.	18.		Do.
			18.	20.		Cherty-sandy limestone.

Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
140	6003N. - 5635E	7921.0	0	2.		Soil.
			2.	18.		Clay and cherty sandstone.
			18.	20.		Cherty-sandy limestone.
141	5941N - 5403E	7920.5	0	2.		Soil.
			2.	20.		Cherty sandstone.
			20.	22.		Cherty-sandy limestone.
142	5956N - 5398E	7921.0	0	1.		Fill.
			1.	5.	3.09	Cherty sandstone.
			5.	16.		Cherty and limy sandstone.
143	5970N - 5394E	7921.3	0	2.		Soil.
			2.	16.		Clay, cherty and limy sandstone.
144	5936N - 5211E	7918.0	0	2.		Soil.
			2.	16.		Clay and cherty sandstone.
			16.	18.		Cherty-sandy limestone.
145	5921N - 5213E	7918.7	0	2.		Soil.
			2.	16.		Cherty sandstone.
			16.	18.		Cherty-sandy limestone.
146	5907N - 5216E	7918.3	0	2.		Soil.
			2.	16.		Cherty sandstone.
			16.	18.		Cherty-sandy limestone.
147	5864N - 5097E	7915.7	0	1.		Fill.
			1.	14.		Cherty sandstone.
			14.	18.		Cherty-sandy limestone.
148	5879N - 5094E	7915.7	0	16.		Cherty sandstone.
			16.	18.		Cherty-sandy limestone.
149	5893N - 5091E	7915.7	0	2.		Fill.
			2.	16.		Cherty sandstone.
			16.	18.		Cherty-sandy limestone.
150	2122N - 2517E	7778.2	0	6.		Sandy clay.
			6.	20.		Clay and cherty sandstone.
			20.	25.		Cherty-limy sandstone.
151	1951N - 2463E	7768.8	0	12.		Sandy clay and cherty sandstone.
			12.	24.		Cherty-limy sandstone.
152	1724N - 2335E	7752.9	0	5.		Cherty sandstone.
			5.	10.	1.19	Do.
			10.	20.	.41	Do.
			20.	35.		Cherty-limy sandstone.
			35.	55.		Clay and cherty-limy sandstone.
			55.	100.		Cherty-limy sandstone.

[redacted]

Engineering and Mining Journal—Vol. 149, No. 11

November 1948

RYAN, Vincent M. Kanab, Utah
Grand Canyon Route
Jacobs Lake, ~~Arizona~~ 9-13-43
Coconino Co., Arizona
See APEX KAIBAB ACCESS ROAD - Re road survey.
See PETOSKY GROUP - Re Engineer's Report 9-24-43

[redacted]

SEP 13 1944

APEX GROUP COCONINO COUNTY

Interview with Virgil Denning

Virgil Denning reported that one part of the Apex Group is owned by R. W. Whiting, Box 247, Holbrook (Ensign and Buster claims) and remaining part is owned by Ed Hatch, Fredonia (Arizona Gem, Paupers Dream, Millsite, Upright and Mugwump Claims). Denning obtained this in information from the County Recorder of Coconino County. Denning has run into a problem there, where the surface rights are apparently owned by one party and the mineral rights by others.
Memo LAS 4-17-63

Mr. Denning was in the office - he has been to Fredonia and talked with Mr. Hatch who owns both the surface and minerals on the claims* but he is not interested in leasing them for mining. Seems to feel the oil and gas drilling will be more profitable to him. Mr. Whiting also has both the surface and minerals in his claims according to all information available to Mr. Denning.

* In which Mr. Denning was interested LP 5-2-63

Interviewed Mr. V. Denning, at Jacobs Lake, learned he never worked the claims that he had trouble with the forestry over. Instead he got a lease from Ed Hatch of Fredonia on part of the Apex Group. At the time of visit Mr. Denning was getting ready to move back to Yuma. Memo EGW WR 9-17-63

US Forest Service acquires by exchange M.S. #1655 consisting of 98.03 acres. (letter from Ariz. State Office, Joe Fallini, April 26, 1972)

Jerry Irvin called for information on the Petoskey claim status in Coconino County near Jacob Lake. He was brought up-to-date. Hal Susie, USBLM, called regarding the Petoskey group of patented claims which the Page Land & Cattle Company have traded to the BLM or U.S. Forest Service for other lands. Due to some false statements made in the Forest Service application to the BLM for withdrawal, it was suggested that our office raise an objection to the withdrawal. Mr. Graham of Computing Associates was called and a suggestion was made that his client also raise an objection to the withdrawal application.
GW WR 7/13/72

Went to the BLM office to research documents regarding the Petoskey claims near Jacob Lake, then wrote a letter to Mr. Fallini, State Director of the USBLM objecting to the Forest Service application for withdrawal of the land from mineral entry. GW WR 7/14/72

See: Dept. of Interior, Bureau of Mines, War Minerals Report, #453, (Nov. 1942) 8 pages, 5/3/77 a.p.

PETOSKEY, KAIBAB, MACKIN CLAIMS COCONINO COUNTY

Interviewed Budge Porrit, employee at the Jacobs Lake Resort. He reported that the patented Jacobs Lake property formerly Apex Mining Co. (Petoskey, Kaibab, Mackin Claim groups) has been sold to an individual for non-mining purposes.
TPL WR 5-19-59

October 22, 1943

Mr. George W. Adams
1124 I. N. Van Nuys Building
210 West 7th Street
Los Angeles, California

Dear Mr. Adams:

Many thanks for your letter of October 20. I have noted carefully your remarks and, whereas I have not made an intensive examination of the sandstone copper in the vicinity of Jacobs Lake, I was on one of the groups, namely, the Mackin and the Petosky now being operated by the Apex Mining Company in company with Mr. A. C. Nebeker of the War Production Board and Mr. V. M. Ryan, superintendent.

The ores are of higher grade than the occurrence on the White Mesa which is the property owned by the Mardun Company. The occurrences seem to be more localized than on the White Mesa but the general type of ore occurrence seems quite similar. The Mardun Company of San Francisco has developed a dry consentrating process wherein the ore is disintergrated gently and in doing this the copper minerals which fill the interstices between the sandstone grains, is liberated in the form of fine powder which is readily concentrated by a controlled vacuum treatment. Mr. O. F. Marvin, who is located on the property and can be reached by mail at The Gap via Cameron, Arizona, has developed this process and I would suggest that you submit to him a typical sample of the ore and discuss with him how it would respond to the treatment of the ores on his property. The low cost of treatment of the White Mesa Ores makes it very attractive for post war work. I believe the question of treating the Jacobs Lake ore is well worthy of your investigation.

Yours very truly,

J. S. Coupal
Director

JSC:JES

LAW OFFICES
ADAMS & ADAMS
~~408 SOUTH SPRING STREET~~ 1124 I. N. Van Nuys Bldg
LOS ANGELES 210 West 7th Street
TRINITY 0047

GEORGE W. ADAMS
JOHN Q. ADAMS

October 20, 1943

DEPT. MINERAL RESOURCES
RECEIVED
OCT 22 1943
PHOENIX

Mr. J. S. Coupal, Director
Arizona Department of Mineral Resources,
Phoenix, Arizona.

Dear Mr. Coupal:

The company of which the writter hereof is one of the executive officiers, is the owner in fee simple of the copper property at JACOBS LAKE, Coconino County. We have owned this property for several years and the same is now producing in a satisfactory way.

Our attention has been called to the clipping from Los Angeles Times, which I am herewith enclosing. The fact seems to be however that the Wiseman-Mudd organization has abandoned its lease (am so informed by Mr. Phillip Wiseman) for the reason that the copper ore has been found to be of too low grade to enable these interests to operate at a profit.

Of course we regret that their tests have shown up so unfavorable (if it is a fact). Nevertheless the officiers of our own company, United Metals Corporation, are much interested in the statement attributed to yourself, in the enclosed clipping, to the effect that much copper can be pro~~vided~~duced from these particular deposits with relatively low expenditures in cost of production, etc.

We therefore take it for granted that you, as an Arizona official, have intimate knowledge of our particular property; and we would like to have an expression from you at this time as to how you would "classify" this JACOBS LAKE (Kaibab Forest) property. Have you ever make a personal examination of it? What method of handling the ore do you recommend (we are shipping direct to smelter, and the ore runs from 6% to 8% copper.) Why should there be so great a difference between our property and that covered by the Wiseman-Mudd lease, as to the copper content of the ore?

Our engineer's report states that at least one and one-quarter million tons of ore are available on our said property: Quite extensive examinations were made at different times, through excavations, trenches, etc., but no core or churn drilling test has been made.

It goes without saying, Mr. Coupal, that we do not wish to impose upon you or take your valuable time, in this matter, so please consider our inquiries as being made solely for the purpose of having a brief opinion, and possibly some advise, from you as to the

actual extent of this sedimentary copper deposit and as to the best method of handling the ore (shipping direct to smelter or treating same on the ground).

Thanking you in advance, I am

Yours sincerely

George W. Adams

Vice-Pres., U. S. Metals Corp.

GWA:S
Encl

WAR PRODUCTION BOARD

WASHINGTON, D. C.

October 1, 1943

IN REPLY REFER TO:

LH:LH

DEPT. MINERAL RESOURCES
RECEIVED
OCT 5 1943
PHOENIX, ARIZONA

Mr. J. S. Coupal
Director
Department of Mineral Resources
413 Home Builders Building
Phoenix, Arizona

Dear Mr. Coupal:-

Your report on the "Petosky Group" under date of September 24, 1943 has been received and is very much appreciated. This report is excellent support of our recommendation that an access road be constructed quickly to the Kaibab Mine.

Incidently, I today sent Charlie Willis some correspondence regarding this road which you may want to read.

Cordially yours,

Lynn Hersey

Lynn Hersey
Assistant Chief
Primary Production Branch
Copper Division

FOR VICTORY
BUY UNITED STATES WAR BONDS AND STAMPS

MEMORANDUM

To: John H. Jett, Director

From: Mike Greeley, Field Engineer

Subject: Apex copper property, Jacobs Lake area, Coconino Co., AZ.

Date: October 12, 1978

A conversation on July 6, 1978, with Mr. Dennis Lund of the Kaibab National Forest supervisor's office in Williams, AZ., provided the following information concerning mineral rights on the Apex property.

1. The U.S. Forest Service acquired on Oct. 28, 1952, via land exchange, title to land of the Mackin (Makin) Group including the following claims: Mackin, Mackin No. 1, Ray, Ray No. 1, Shorty Ditto, Kennedy, Copper Consolidated, Pigeon, Grant, and Hawk. Minerals are reserved by the U.S. Metals Corp. until Jan. 26, 2000.

2. The U.S. Forest Service acquired on May 7, 1965, title to land of the Petoskey Group via Mr. R. W. Whiting (?) through land exchange. Claims included are the Buster and Ensign. Mineral rights are reserved by the U.S. Metals Corp. until Jan. 26, 2000.

3. The U.S. Forest Service acquired on July 1, 1971, title to land of the Petoskey Group via Mr. R. W. Whiting (?) through land exchange. Claims included are the Mugwump, Pauper's Dream, Arizona Jim, and Millsite. Mineral rights are reserved by the United States Government. There is some question about who reserves the oil and gas rights; these rights may belong to the U.S. Metals Corp. until Jan. 26, 2000.

The Arizona Corporation Commission informed me that the charter of a United States Metals Corp. was revoked on Sept. 25, 1959.

RECEIVED
OCT 13 1978
DEPT. MINERAL RESOURCES
PHOENIX, ARIZONA

MEMORANDUM

To: John H. Dett, Director
From: Mike Greeley, Field Engineer
Subject: Apex copper property, Jacobs Lake area, Coconino Co., Az.
Date: October 12, 1978

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

RECEIVED
JUN 1 3 1956
DEPT. MINERAL RESOURCES
PHOENIX, ARIZONA

Mine ~~Petocky~~ Petoskey Mines Date June 8, 1956

District Kiabab Engineer Mark Gemmill

Subject: Present activity

A group of 5 patented claims known as the ~~Petocky~~ Petoskey Mines, located about 5 miles southwest of Jacob Lake is being operated by the Jacob Lake Mining Co. Jacobs Lake, Arizona. John F. Howland heads the operation and Vernon Davis is Engineer in charge.

The mineral is copper and in irregular fissures which seem to be more or less vertical and cut the flat lying beds of lime and lime sandstone . In places the fissures are as wide as 25 or 30 feet and consist of silicious cherty material in which the ore is formed. It has always been thought that all of copper minerals in the ore were secondary. However recent work has exposed some specimans of Chalcopyrite. Consequently the operators expect do some prospecting at depth.

During the World War 11 about 5,000 tons of ore was mined and shipped to Smelters. The ore averaged around 6 % copper with no other pay mineral. Some was hauled to Marysville, Utah for shipment to Salt Lake Smelters and some to Flagstaff for shipment to Clarkdale.

Present operators have recntly shipped about 400 tons to Salt Lake. This ore averaged about 5% copper. They plan to make their next shipments to Arizona Smelters to determine which is best.

Mr. Davis stated that drilling had proven about 10,000 tons of 5 % ore, which they intend to mine immediately. They also plan continued exploration work.

The property is well equipped with suitable machinery.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Apex

Date Sept. 20, 1954

District Warm Springs

Engineer Mark Gemmill

Subject: Present Status

The property is well described in Bureau of Mines Bulliten R. I. 4013 which gives information of drilling operations carried on by the Bureau in 1944.

The property has been idle for some time past although there are reports from time to time that it will put in operation again.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine	PETOSKY GROUP	Date	September 24, 1943
District	Jacobs Lake, Coconino County	Engineer	J. S. Coupal
Subject:	Access Road		

OBJECT: The object of this examination was to determine the feasibility of and the justification for an access road, applied for by the Apex Mining Company on the Petosky group of mining claims.

PROPERTY: The Apex Mining Company, a limited partnership of which H. W. Patterson, 1828 Liberty Bank Building, Buffalo, New York, is the major interest, and V. M. Ryan, Jacobs Lake, Coconino County, Arizona, Superintendent, holds lease and option on the Mackin and Petosky groups of mining claims located at Jacobs Lake, Arizona.

This company operated the Apex Mine at St. George, Utah, and after extensive development and exploratory work closed down that operation and took over the Mackin and Petosky groups at Jacobs Lake, continuing to operate under the same name. An R.F.C. development loan of $30,000 had been approved on the Apex Mine at St. George, Utah, but was declined when exploratory work did not show it was justified.

MINE OPERATIONS: The major work to date has been done on the Mackin group, from which 2,000 tons of highly siliceous copper ore has been shipped. Part of this ore was shipped to the smelter at Garfield, Utah, and part to the smelter at Clarkdale, Arizona.

A new ore body is now being opened up on another claim on the Mackin group and preliminary work has been started on the major showing on the Petosky group.

The deposits occur close to the surface and are mined by open cut methods.

ORE BODIES: The ore body from which the 2,000 tons have been recently shipped occurs on the crest of a gentle hogback or syncline in limestone. The mined area is a long open cut 700 feet in length, 12 to 40 feet in width and from 2 to 12 feet in thickness. The commercial ore is limited to these dimensions under present conditions and tapers off into lower grade ore or of widths too narrow to mine and bottoms on a limestone bed. Some selective work is done as the ore occurs in kidneys and a small amount of waste is thus eliminated.

The ore body mentioned has been abandoned and new work started on a nearby claim. The new ore shows a width of 15 to 20 feet, where opened up a thickness of 4 to 6 feet and the cut is about 30 feet in length. Extensions of the ore in other dimensions have not as yet been determined as the ore is just being opened up.

PETOSKY WORKINGS: The major ore body exposed in the group is the one to which the access road is desired.

The ore occurs in a similar hogback as the occurrences on the Mackin group, although this ore body is in sandstone rather than in limestone.

There is an open pit from previous workings exposing an ore zone 40 to 50 feet in width, and a thickness to the floor of the pit of from 6 to 8 feet. At one edge of the pit a shaft, claimed to be 50 feet in depth, is partially filled with muck to a point about 20 feet below the surface. At 20 foot depth 18 to 20 inches of 18 percent copper is reported. There is about 3 feet of overburden on barren silicified lime at the collor of shaft and the balance of the shaft is reported as 3 to 5 percent copper.

The walls of the open pit show from 3 to 6 feet of ore under the overburden which varies from 1 to 3 feet in thickness and the floor of the cut shows ore.

From the limited development work on this ore body no estimate of the tonnage to be expected can be made.

It is my opinion, however, that development will open up sufficient ore to justify the normal expenditure for the access road.

ROAD: The present road from the Petosky workings to the ore bin has several hundred yards of 27 percent grade road and is impractical for hauling. The proposed road from the workings to the ore bin is 7,000 feet. Of this 7,000 feet, 3,500 feet will require a small amount of side hill rock work and the major part can be handled by ripper and bulldozer. The other 3,500 feet will be on a 30° side hill and can all be made by bulldozer. A rough alignment indicates a 5 percent grade can be maintained. In addition to the 7,000 feet of new road 2.1 miles of old road should be improved and graveled. Slight realignment can be made to improve the road, drainage should be provided and a heavy surfacing of gravel placed.

There is a gravel pit available, 0.9 miles from the highway end of the 2.1 miles of road to the ore bin.

The cost of road is estimated at about $9,000.

EQUIPMENT: The company has a No. 7 bulldozer somewhat out of repiar and too light for the heavy road work required. The pit work and loading is done by a 1/2 yard gasoline driven shovel which is on the job under contract. The hauling is also contracted. In addition, the company has a portable compressor, rock drills, wagon drill, full shop and repair equipment, assay office and light trucks.

REPORTS: The property has been examined and reported on by B. S. Butler of Tucson, Arizona, for the U. S. Geological Survey.

ACCESS ROAD APPLICATION: Application for the access road has not followed the orthodox procedure. Contacts have been made by the operator with the Grazing Service, the Public Roads Administration and the Bureau of Mines, but I believe the prescribed routine of filing application disregarded.

On instructions from W.P.B. at Washington, D. C., A. C. Nebeker, Technical Advisor for the W.P.B. at Phoenix, Arizona, and J. S. Coupal, Director of the Department of Mineral Resources, examined the property and proposed road on September 21, 1943.

COMMENTS: The ore is highly siliceous and is needed at the copper smelters. A 23.5 cent per pound price of copper has been granted by the Quota Committee to make it possible to haul the ores to the smelters.

The Jacobs Lake area has a heavy snow fall and in order to get out early production direct action should be taken on this access road.

J S Coupal.

COPPER DEPOSITS OF THE KAIBAB PLATEAU

E P JENNINGS, Salt Lake, Utah.

New York Meeting, Oct. 1903.
(A. I. M. E.)

The ore occurrence is on the top of the Kaibab Plateau which extends from the north edge of the Grand Canyon yo near the Utah State line. From Jacobs Lake 30 miles south of the Utah line, to the edge of the Canyon, outcrops have been found, but practically no development has been done. The Kaibab Plateau is a great uplift 90 miles long from north to south and ten to twenty miles from east to west. The elevation of the Plateau is 6,000' to 8,000'.

The structure is shown by the west fault and by the Canyon. The 500' of Aubrey limestone is underlain by 1,000' of red sandstone. The mountain Mass cut by the fault and Canyon shows no mineralized veins or mineralization above the Pre-Cambrian. All paleozoic strata as shown in the fault and Canyon are barren until the Copper Beds at the top of the Plateau are reached. The possibility of connection betweenthe copper veins and dikes of the Pre-Cambrian is remote.

The ore beds are composed of white chert impregnated with malachite and azurite. Small amounts of earthy cuprite, copper glance, and chalcopyrite have been observed. The ores range from 2% to 40% copper, average 7%. Silver and gold are present in minute quantities. The ores are too silicious for smelting but are good leaching ores. The ore is covered by a few inches of soil and often outcrops. The upper portions of the beds have been leached leaving a mass of honeycombed iron-stained rock. The beds are intersected by many minor faults. The beds near these faults have been crushed and recemented by silica and copper, showing the period of deposition to have been long.

The quantity of ore cannot be estimated accurately because of the small amount of development work but it is believed that 1,000,000 tons of 7% copper ore can easily be put in sight in the Jacob Lake beds alone.

The ore is evidently a replacement of the limestone by silica and copper. The ore-bearing solution was a descending carbonated alkaline water which dissolved both silica and copper from the Permean and Mesozoic measures that an former times covered the carboniferous. This theory is rendered more probable by the fact that Triassic sandstones to the north and east are copper-bearing and sufficiently so to be mined at a profit.

There are no known erruptives that could furnish copper except the Pre-Cambrian a mile below the present horizon. I consider it a case of solution from a great mass of superimposed rock and the precipitation by chemical means at one horizon, the Aubrey limestone being the precipitant.

The deposit can be considered a horizontal bedded vein. The hanging-wall or roof and also much of the ore has been removed by erosion.

The beds are similar in physical characteristics to the iron deposits of the Mesabi. The taconite or iron chert of the latter corresponding to the chert of the Kaibab. The chemistry ~~enrichment~~ of the two may be alike, but the Kaibab ores lack the subsequent enrichment the iron ores have received.

Apex (Jacobs Lake) Coconino Co.

STATE OF ARIZONA)
) ss. AFFIDAVIT OF
County of Pima) ROBERT B. CRIST

ROBERT B. CRIST, being first duly sworn, deposes and says: That he is Manager of Lands for ASARCO, Inc., P. O. Box 5747, Tucson, Arizona 85703, and is the custodian of records of the Company; that he has examined the files of ASARCO, Inc., related to the Jacobs Lake or Buckskin Mountain's operations in Coconino County, Arizona; and that the correspondence and reports attached hereto are from such files, which files are maintained in the regular course of the business of ASARCO, Inc.

DATED this _____ day of August, 1982.

_____
Robert B. Crist

Subscribed and sworn to before me this _____ day of August, 1982, by Robert B. Crist.

My commission expires: _____

_____
Notary Public

Aa. 3a. 10.16

FIELD TRIP REPORT - REED F. WELCH - NORTHERN ARIZONA JULY 17 - 20, 1963

6. Denning and Trigg Mining Co., producers of siliceous flux for the Ajo smelter, have during the summer months moved to Jacobs Lake area to ship siliceous copper ore to our Hayden Plant. Their work is on the Petrosky claims where they are producing about 2 to 3 cars per week assaying 3.5 - 4% Cu with around 75% SiO_2, 3% Fe, 3.5% CaO, 1.5% Al_2O_3.

This mineral occurrence lends itself to breakage in large boulders which causes much difficulty in handling at Hayden for crushing and sampling. Because the ore breaks in such large pieces that it requires secondary crushing, Denning and Trigg, in trying to cooperate with our request, find the operation is not profitable. Mr. Trigg has just advised me by telephone they are giving up the operation. A few railroad cars of ore at Darling will be loaded for Hayden delivery within the next few days which will conclude shipments from Jacobs Lake.

This is the same property operated by Kachal Copper et al (39.23.0)

Sout. est Productions
Year 1956

Jacob Lake Mining Co. in June started shipment to El Paso Plant from the Petrosky (Kaibab) claims near Jacob Lake, Coconino County, Arizona. This is desirable siliceous fluxing ore carrying 4-5% Cu. During the period June-October El Paso received 1390 tons from this property. Operations are forced to shut down for the winter months, but it is expected shipments will be resumed when weather conditions permit.

Salt Lake City, Utah
August 26, 1944

MINING DEPT.

AUG 29 1944

TUCSON

Mr. H. A. Guess, Vice President
American Smelting & Refining Co.
120 Broadway
New York 5, New York

ST. ANTHONY COPPER CO.
FORMERLY
BUCKSKIN COPPER CO.
COCONINO CO., ARIZONA

Dear Mr. Guess:

Noting your letter of the 21st to Mr. Robert Livermore, would advise that Atherley & Ryon, leasers, have shipped the following tonnages of oxide copper ore to Garfield from that area, under the incentive of the normal $.05 per lb. premium on copper plus a special $.10 per lb. premium, or a total of $.27 per lb. of copper, with a zero quota.

Date		Au	Ag	Cu	SiO_2	Fe	CaO
May 1944	419 ✓	.006	.24	6.57	72.2	3.3	2.9
June "	1313 ✓	.004	.19	6.23	75.0	3.7	2.1
July "	1100 ✓	.005	.28	5.6	74.7	4.3	2.8

The above for file information.

Yours very truly

J. FRED JOHNSON

JFJ:ES
cc WHLoerpabel

Aug	1116 tons	7.76
Sept	966	6.74
Oct	1345	6.97
Nov	2672	8.02
Dec	1875	8.14

Salt Lake City, Utah.
January 15, 1945.

Mr. H. Y. Walker, Vice-President,
New York City.

Dear Sir:

This refers to your memorandum of January 4th regarding shipments of 2692 tons of 8% copper ore from Atherley & Ryan, Jacobs Lake, Arizona.

For a good many years we have received shipments from this property, the first being made by Mr. H. J. Holt on a very small basis. In 1942 Mr. Greeley Snyder, a cousin of George and Ed Snyder, acquired a lease from the owners, the U. S. Metals Corporation of Los Angeles, and shipped under the name of the Line Ore Company. He attempted to operate on too close a margin, and had to give up the operation. It was later taken up by Mr. Patterson of Buffalo, N.Y., who thought he could mine a large tonnage with a steam shovel and make a profit under existing premium metal payments. His operation lasted throughout 1943, when his superintendent, Mr. Ryan, and Atherley Brothers of Eureka, took over and have been shipping since.

The operation consists of blasting overburden, which is removed with a bulldozer, then blasting and loading the ore with a steam shovel. The ore has to be sorted to keep the grade above 5%, which is the lowest that can be profitably shipped. I am giving below a summary of the shipments from 1940 on:

			Average Assay			
		Tons	Gold	Silver	Lead	Copper
1940	H. J. Holt	482	.008	.38	-	7.62
1941	"	181	.011	.41	-	8.81
1942	"	296	.006	.29	-	5.98
	Total	959				
1940	H. J. Holt and John Kitchen	266	-	.40	-	8.94
1941	John Kitchen	83	.012	.30	-	8.47
1941	Woodard & Spencer	(565	.005	.52	-	6.38
1942	" "	(355	.013	.40	-	3.83
		920				
1942	H. G. Snyder (Line Ore Co.)	1130	.008	.46	.06	5.08
1943	Apex Mining Co. (H.W.Patterson)	2595	.002	.28	-	5.32
1944	Atherley & Rayan	10826	.005	.51	-	7.25
	Grand Total	16779				

Ever since Greeley Snyder brought the property to us in 1942 we have kept track of the operations, and Mr. Johnson, and also Mr. Welch, have visited the property. We thought at one time that the ore could be mined on a large scale, but the values are so spotty that it was necessary to do selective mining and sorting besides.

Yours truly,

Mr. W.H. Loerpabel -- with two files on BUCKSKIN MT.or ST.ANTHONY COPPE

SOUTHWESTERN ORE PURCHASING DEPARTMENT
Tucson Arizona

October 7,1943

MINING DEPT.
OCT 8 - 1943
TUCSON

Mr. J. Fred Johnson
American Smelting and Refining Co.
700 McCornick Bldg.
Salt Lake City, Utah

APEX COPPER COMPANY, JACOB'S LAKE, COCONINO CO., ARIZONA

Dear Sir:

I acknowledge receipt of your letter of September 25th enclosing the Tucson and Salt Lake files on Buckskin Mt. Copper and St. Anthony Copper Company. I am now turning these files over to Mr. Loerpabel.

Mr. J. H. Hedges, Supervising Engineer of the U.S. Bureau of Mines at Tucson, has just returned from examination of this district. He came to my office the other day, looked through these files, and advises that the Buckskin Mountain or St. Anthony Copper property is the one now known as Apex Copper Company, reported to be owned by the United States Metals Corporation, 510 West Sixth Street, Los Angeles, and under lease to H. W. Patterson, 1328 Liberty Bank Bldg., Buffalo, N.Y. This operation is under the supervision of Mr. V. E. Ryan, formerly superintendent at Mrs. Hazel K.Ward's Keystone Mine near Kingman.

Mr. Hedges has given me the following information regarding operation by Apex Copper Company, with which you and Mr. O'Connor may be familiar.

Garfield Shipments: During August and September 1943 Ryan shipped fifteen cars of ore to Garfield averaging around 7.0% copper. The lowest assay, shipper's lot 3, was 4.37% Cu; the highest, Lot 9, was 8.37% Cu. I understand these were settled at Garfield on a $2.00 base charge with silica credit 50¢ per ton. The ore contains in excess 70% insoluble. Delivery charges to Garfield include $6.00 hauling to Marysville, Utah, plus $1.60 freight, or total $7.60 per ton.

Clarkdale Shipments: During the same period--August and September--7 cars were consigned to the Phelps Dodge Corporation at Clarkdale, with through truck haul $8.80 per ton. For this type of ore Clarkdale usually deducts 8 pounds copper from assay and pays for remainder at wire bars less 2.5¢ per pound, with base charge $2.75 for values to $7.50 plus 10% of excess and silica credit of 1 cent per unit for silica in excess of alumina times ten.

Mining Operations: Mr. Hedges tells me that the Makin claim from which these 22 cars of ore were shipped is now worked out and Mr. Ryan is at present developing a new ore body on the Petrosky claim. He is stripping the overburden and has uncovered a body of ore averaging about 5 feet in width.

For the shipments above referred to I understand that approximately 120 tons of rock were mined per day from which about 45 tons of fines were screened, leaving 75 tons per day average production. Mining costs are rather high with the type of equipment being used and the necessity of screening out the lower grade ore that will not pay to ship.

Yours very truly,

BRENT N. RICKARD

cc: W.J.O'Connor
W.H.Loerpabel with 2 files
R.D.Bradford

Kaibab Copper Smelting & Mng Co.
Buckskin Mountain Property,
Coconino County, Arizona.

Mr. H A Guess,
Vice-President, AS&R Co.,
New York.

Dear Sir:

I am handing you herewith for your files digest of information on the Buckskin Mountain Copper Deposit of the Kaibab Copper Smelting & Mining Company situated in Coconino County, Arizona.

The very complete report on the leaching of the carbonate ores of this property by the Dorr Company and H. A. Tobelmann was recently presented to me by Mr. Frank F Tate, of San Anselmo, California. Mr. Tobelmann was one of the metallurgists who played a part in working out the leaching process at Ajo, Ariz.

The general statement is to the effect that the property contains in the neighborhood of one million tons of 8% carbonate ore occurring at the surface as a flat bed of copper impregnated sandstone with an average thickness of approximately 4 ft. Tests show that 90% of the values can be leached during a two hour contact with 5% free sulphuric acid solution. It is estimated that this can be done at a cost of 11¢ per pounr, which would indicate a gross profit at 13¢ copper of $2,880,000.00. The property, however, is situated 130 miles from Cedar City, Utah, the nearest railroad station and to operate it on a substantial production basis with a fleet of motor trucks would be in my opinion out of the question. To build the cheapest kind of a narrow gauge railroad would involve an expenditure of at least $1,300,000.00, and an additional outlay for plant and power facilities would mean another million dollars, so that at best the outcome would simply mean, with good luck, swapping dollars. I therefore returned the report to Mr. Tate with the advice that we would not be interested in going any further in the matter.

In addition to sending you a digest of the Tobelmann-Dorr report, I am also sending you a digest of an article on the subject of, "Copper Deposits of Kaibab Plateau", by E. P. Jennings, which appeared in the American Institute of Mining Engineers Transactions, 1903.

Yours truly,

ORIGINAL SIGNED:
J. KRUTTSCHNITT, JR.

Enclosure.

160
9
144,000,000.0
.02
2,880,000.00

Digest of Report
on
Leaching of Copper Carbonate Ore from the Kaibab Copper Smelting & Mng Co's Property, Coconino County, Arizona.
By
Henry A Tobelmann.

MINING PROPERTY.

Location:

The property is located on the Kaibab or Buckskin Plateau near Jacobs Lake Ranger Station, Coconino County, Arizona. The nearest railroad is at Cedar City, Utah, about 130 miles to the northwest,

Property.

The property consists of two groups, one of eight patented and two unpatented claims, and the other of seven claims about 300 to 350 acres in all.

Equipment.

1 mill building 200'x250', equipped with ore bins.
1 10"x20" Allis Chalmers jaw crusher.
1 set 26"x15" primary rolls.
1 set 26"x15" secondary rolls.
1 6' Huntington mill.
Shaking screens,etc.
Power Plant.
2 80-HP Fraser Chalmers Marine Boilers.
1 80-HP Ideal engine.
1 Boiler feed water heater.
1 Boiler feed pump.
1 air compressor.
Shop
1 Pipe threading machine.
1 Planer and lathe.
Smelter.
1 smelter building 40'x30'.
1 new 42" circular water-jacketed blast furnace with pipes,blowers, fore hearth,slag pots,and charging buggies.
1 Building 15'x25' used as a laboratory contains some apparatus and chemicals.

The office building,boarding-house,bunk-house,stables,etc. are all serviceable. There is also 100 tons of sulphur and several tons of lead ingots and fittings.

Water.

Water can be obtained from three sources:-

(1) Big Springs, 7 miles distant from the mill has constant flow of 22 miners inches, or 250 gals. per minute. There is a pipe line from these springs to the mill that is in need of repair.

(2) Mangum Spring 4.5 miles distant 40 gals. per minute with 600 ft.head.

(3) Warm Spring 2-1/4 miles distant, 5 gals. per minute with 300' head.

Fuel and Power.

It is stated that there is a power site on the Thunder River 50 miles distant from the mill that is capable of producing a minimum of 5,000 HP.

The most available fuel is wood, which costs about $3.50 per cord at the mill. A good grade of coal is mined 55 miles from the mill from 4' seams

and there is said to be a good road from the coal mines to the mill.

Labor.

The labor in this section is all American and can be had at the rates prevailing in Southern Utah.

Climate.

The climate is temperate, cool summers and light snow falls in winter. Elevation at mine is 7,600' and 6,300' at the mill.

LEACHING TESTS

Introduction.

Because of the transportation difficulties it is imperative that copper buillion be produced at the property. Smelting direct would not be profitable because of the lack of flux. A study of conditions indicated that a sulphuric acid leach followed by electrolytic deposition of the copper and its production in the state of greatest purity and in the most marketable form is the only economic possibility.

The Ore.

A 200# sample was taken from a pile of 1,000 tons at the mill. This ore came from the different open cuts and is considered as representative.

Inspection shows the copper to be present in the form of malachite and azurite with only small amounts of chrysacolla.

Analysis.

The sample was shipped to the Dorr Company where the tests were conducted. A sample cut from the 200 lbs. gave the following analysis.

Copper	7.12%
Iron Oxide	6.92%
Alumina	2.23%
Lime	0.20%
Insol.	73.21%
Carbon Dioxide	2.08%

Results of the Tests.

The tests showed the following:-

1- The copper in the ore is readily soluble in dil.sulphuric acid.
2- An average extraction of 90% or better may be expected.
3- A 5% free H2SO4 sol. in contact with the ore for 2 hours will probably give the best results.
4- There will be a gross consumption of 1.75 to 2.00 Lbs. of 100% acid per pound of copper dissolved.
5- About 20 Lbs. of iron per ton of ore treated will be dissolved which will necessitate the discarding of 7,000 to 15,000 gal. of sol. per 24 hours, depending on which part of the process would show the most profitable discard.

Basis of Estimates.

A - Production of the mine.

There are to be delivered at the mill 125 tons per day six days per week of ore averaging 8% copper.

B - Production of the plant.

Crushing: There must be crushed to minus 20 mesh with the minimum of fines and slimes 125 tons per day.

Leaching: The leaching plant must have a capacity of 100 tons per 24 hrs. seven days per week. The ore to have a 2 hr. contact with a 5% free sulphuric acid solution.

Electrolysis: The tank house to operate at 12 amp. per sq.ft. 95% of all copper dissolved is to be precipitated as cathode copper and 5% by another method and returned for electrolysis.

Reduction: The copper solution from the leaching plant is to be reduced with SO2 gas in a standard gas washing apparatus, thus reducing ferric iron and generating acid.

Power: The total power requirements is about 1.5 Kw per Lb. of copper produced, 900 Kw or 1200 HP.

Wood, Coal, and Oil are available as fuel.

Wood Cost: $3.50 per cord, about 60 cords per day required.

Coal Cost: $12.50 per tonat mill, 20 to 25 tons per day required.

Oil Cost: $2.50 to $3.00 at Cedar City, or $5.00 at the mill, 70 to 75 brls per day required.

Sulphuric Acid: Four to five tons per day commercial acid required, cost $15.00 to $20.00 per ton at Cedar City, $30 to $35 at mill. Acid could also be produced at the mill from elemental sulphur which can be obtained at Beaver, Utah, for $10 per ton or $30 to $35 per ton at the mill.

Water: The total volume of solution in the plant would be 100,000 gals., of this amount 7,000 to 15,000 would be discarded and 6,000 gals. lost in the tailings per day. The power plant would require 30,000 gals and 4,000 gals. would be used for other purposes, or a maximum of 55,000 gals or 38 gal. per minute which is about 15% of the Big Springs capacity.

ESTIMATED COST OF PLANT AND EQUIPMENT.

1 -	Mining Equipment: Steam shovel, air compressors, piping, drills, etc	$25,000
2 -	Crushing Equipment: present equipment to be used and in addition one rod mill, ore bins, screens, etc	$25,000
3 -	Dorr classifiers, thickeners, sol. tanks, conveyor belt, etc	$35,000
4 -	Electrolytic tank house	175,000
5 -	Dryer	5,000
6 -	Discard plant	5,000
7 -	Sulphur dioxide plant	5,000
8 -	Power plant	100,000
9 -	Water storage and betterments to roads and camp	5,000
10 -	Trucking equipment	50,000
	TOTAL	440,000
	For unforseen conditions	60,000
	ESTIMATED TOTAL COST	500,000

The above estimate is for a plant to treat 100 tons of 8% copper ore per 24 hours, recovering 90% of the copper and producing 14,400 lbs. of electrolytic copper per day.

COST OF PRODUCING COPPER.

Mining	$1.00	per ton ore milled.
Transportation	$1.00	
Crushing	.50	
Leaching	.75	
Reduction of sol and generation of acid.	1.00	
TOTAL COST PER TON	$4.25	

Cost per pound of copper in solution	$0.0295
Electrolysis	$0.0400
Discard	$0.0015
Transportation to railroad	$0.0065
Transportation to market New York	$0.0075
Overhead, Taxes, Amortization, Depreciation, etc	$0.0250
	$0.1100

On a 15¢ copper market, the profit per day will be about $575.00; on a larger tonnage, the costs dependent on tonnage alone would be reduced. If a larger tonnage was considered, the power-site on Thunder River should be investigated.

The entire mineralized area on the Kaibab Plateau should be examined before deciding on a plant as it is possible that there is a much larger tonnage that has been reported. The area can be easily drilled and sampled as the ore bed is just below the surface.

(Signed) Henry A Tobelmann.

January 21, 1924.

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KAIBAB SMELTING CO. or BUCKSKIN MOUNTAIN COPPER COMPANY

Found conditions as described by DeCamp, but property now apparently owned by John Mackin, 515 North State St., Chicago, Ill. Visited August 20, 21st, 1924, G. M. Colvocoresses.

REPORT: Elevation of Jacob's Lake---7,500 ft.

Distance from Fredonia---33 miles.

From Kanab---40 miles. Road fair.

Distance from Lee's Ferry 055 miles, via Rouse Rock Hill which is very bad and might often be impassable, or 128 miles via Kanab and road between Lee's Ferry and Kanab also reported pretty bad.

Distance from Cedar City approximately 140 miles. Railroad now at Cedar City.

Cost of trucking would be extremely heavy, but road is rapidly being improved and railroad will probably be extended to St. George in the near future.

Took samples as follows:-

#1 Good grade ore sorted out near the house. Copper 23.2%.

#2-Lower grade ore from same location, 9.9%.

#3-Sample of average ore extracted from long trench on Mackin Claim. Copper 15.2%. (?)

It was especially noted that the ore occurrence is similar to the deposit near Anita, south of the Grand Canyon, and here, as there, the better grade ofore is very silicious.

The ore occurs in the seams and fissures in the limestone with only occasional outcrops on the surface, as there is generally from one to two feet of overburden.

There does not appear to have been any special indication to point out the location of the mineralized fractions and it seems reasonable that cross trenching or stripping the overburden from the surface might serve to discover a number of additional bases of ore.

The upper bed of limestone is approximately only from 10 to 18 ' in thickness and is underlaid by sandstone, which appears to be barren of copper. Comparing this deposit with those at Anita it should be recalled that near Anita there are extensive beds of

limestone and sandstone and some of the lower beds of limestone contain copper ore.

Exploration work at Buckskin should probably consist of additional cross trenches in the surface of the upper bed of limestone, in the expectation of finding additional fissures and also a shaft or drill holes should be put down thru the excessive beds of limestone and sandstone, in order to explore the lower levels of lime which might very well contain ore bodies.

CONCLUSION: Since the ore in the upper bed is obviously confined to narrow fissures and no where appears to have a width of more than 20 feet or a thickness of more than 18 ft. the tonnage is obviously limited by the number of fissures which may be discovered and the length which they could be followed.

At the present time there are a few hundred tons of good grade ore which might average 6% copper, piled up along side the trenches and there are indications that additional work might serve to produce a few thousand tons of similar ore from these trenches already partially opened. There are no indications of substantial body of low grade ore between the fissures and it is highly improbable that any very large tonnage of high grade ore will be found on these claims unless thru exploration of the lower beds of lime.

Transportation conditions make development unattractive at present, but some further exploration might be justified and if substantial additions to the present tonnage were proved it seems possible that this deposit might later be worked with profit either by leaching or volatilization and the costs of the latter process would then be considerably less than estimated by DeCamp.

GMC.

EAGLE-PICHER M. & M. CO.

KAIBAB SMELTING CO. (Buckskin Mountain Group)

DISTRICT: Fredonia, Coconino County, Arizona (North of Grand Canyon)

Property: Buckskin Mountain Group

Location: 20 miles south of Arizona--Utah Boundary line; and about 150 miles from Marysville Terminal of D. & R. G. R. R. Wagon road to the property. Coal Mine 40 miles north.

Owners and Operators: Kaibab Smelting Co. Head office 705 Marsh Strong Bldg. Los Angeles, California. Hold lease and option on 8 patented and 2 unpatented claims, formerly known as the Coconino, later as the Buckskin Mountain and now as the Kaibab Smelting Co.

NOTES: Taken from prospectus, not dated, but evidently written in the fall of 1918. Regarding extent and character of ore deposit quotes from reports of Hollis Overpeck, E. M. ;E. P. Jennings, the American Institute of Mining Engineers Transactions, 1903, pp. 839-841; and the U. S. Geological Survey's "Contribution to Economic Geology" Bulletin 285, Page 103.

The gist of these excerpts is that there is a blanket deposit of oxidized copper ore, mostly copper oxide and carbonates with practically no silicate, covering a very large area. "The ore beds are white chert impregnated with Malachite and Ozurite."

The average of a number of samples by E. P. Jennings of the General Engineering Co., Salt Lake City, to accompany his report of Novemberl, 1900, showed Cu. 7.7%, silica 73.8%; Gold Trace, Silver 0.9 oz. Ore said to be uniformly deposited over many hundred acres, to vary in thickness from 1 to 16 feet, with an average thickness of 3 to 5 feet. Ore is overlaid by a few inches to 3 feet or so of soil and barren rock. "There is exposed in the property by means of cuts and trenches more than one million tons of ore of this grade (7% copper) These trenches are sunk thru the orebody and extend in various directions for 400 to 500 in length, and show the ore body to be enormous and uniformly mineralized."

It is also said that there areother similar but smaller deposits within 20 miles of the Buckskin Mountain property.

A. Burnett tells me that the process of the Kaibab Smelting Co. contemplates crushing the ore to 1/2 inch, heating to 1000 degs. C. (1800 degs. F. A. B.) thereby reducing the copper carbonates to globules of metal. The discharge of the furnace would then be ground and the copper concentrated after cooling furnace discharge.

Burnett doubts if the Kaibab Smelting Co. will succeed in their financing to the point of completing and starting to operate a plant. Promoters have held out 60% of the stock and are asking the public to put up all the money for a 40% interest.

Said to be 5000 tons of ore on dumps that will average over 7% copper.

E. S. Smith, May 27, 1919

REPORTS ON

Kaibab Smelting Co.
and
Petosky Mining Co.

District Warm Springs.

Location On the Kaibab Plateau better known as Buckskin Mountain, west and north of Jacobs Lake about half a mile. 45 miles south of Kanab, Utah and 33 miles south of Fredonia, Ariz. and in Coconino County, Arizona.

Reached by good wagon road from Fredonia or by good road from Lees Ferry. Best means of going into this district is by way of Lees Ferry.

Name Kaibab Smelting Co. Mr. C. Timmons, Supt. at Kanab, Utah., the man on the ground. Home office Los Angeles, Cal. Timmons will keep us posted regarding developments their process.

Elevation 7800 to 8000 feet, and about 3000 feet higher than Kanab.

Claims Eight, patented, four unpatented; latter owned by a Mr. Levy and John Mackin of Chicago.

History Property was located in 1896 and called the Coconino Copper Co. Relocated in 1907 by the Buckskin Copper Co. Optioned for $1,000,000 to Kaibab Smelting Co. recently.

Original owners put in a small smelter in 1901 after doing a small amount of trenching on some of the claims. This smelter used Charcoal for fuel but was a failure. No iron for fluxing purposes or sulphur obtainable.

In 1905 and 1906 the Esmeralda Copper Co. took an option on the property and attempted to leach the ore, precipitating by means of gas pressure in tanks containing steam coils. First using sulphurous acid gas for bringing the copper into solution. For this purpose they obtained sulphur from Beaver, Utah. and installed sulphur burners. This process was a failure altho the company made about 1,000 lbs. of copper.

Present operators have started installation of Agnew Direct Reduction Process plant with which company they have a contract for construction of the plant of fifty tons daily capacity.

The present plant will undeniably be a failure, since they are trying to obtain a reducing action in a circular furnace by supplying air for combustion of the charcoal fed with the ore. Mr. Timmons however intends to try the system out for a few weeks to prove conclusively that the process is a failure after which he intends placing a central chamber within outer casing of furnace and will heat to 1700 degrees in a reducing atmosphere. For the first work however he intends trying to use CO gas obtained from charcoal burners to supply the air for combustion. This will no doubt fail.

Geology

Ore occurs as a replacement of Limestone wherein alkaline solutions descending and carrying copper and silica in solution have replaced an upper layer of the carboniferous limestone which underlies the Permian and Mesozic beds which have been mostly erroded. These upper beds are probably the source of the copper.

Minerals consist of small amounts of chalcocite with considerable malachite, asurite chrysocolla and some Cuprite and Native copper, often associated with iron oxide derived from a secondary specularite which in turn was probably secondary from original iron oxide.

Mineralizing solutions have taken natural lines of least resistance and deposition has been confined entirely to fracture zones in the limestone. These fracture zones vary in width from ten to twenty feet and occasional cross fractures show mineralization extending laterally for ten to twenty feet. Depth of ore zone does not depend on depth of lime but may be cut off by some bed of intercalated clay or by some other layer of limestone the bedding places of which have allowed escape for the solutions, literally. The result of the leaching and redeposition has been a very siliceous cherty material, no lime indicated.

Development

Consists entirely of trenches which in every case where ore was found have been driven along fracture zones. These trenches vary in width from two feet to eighteen feet in depth. In some cases they have merely uncovered the ore bearing formation and no depth has been indicated. In other cases they have been driven partly thru the ore while again they may have been driven to the bottom of the ore and in some cases have exposed as much as eighteen feet of ore. Sampling of the sides of these trenches at the present time would not give an idea of the value of ore extracted since the better portion has already been removed and piled alongside the openings.

The general strike of the fracture zones in which the ore occurs is north forty-five degrees east as shown on the accompanying map.

Development of Claims

Going West from Jacobs Lake about half a mile the first claim is the Copper Con. This claim shows one shallow trench about six feet in depth showing four feet of ore and two feet of overburden. Since this claim strikes at right angles to the fracture zone there is little mineral showing.

COPPER GLANCE

The course of this claim is at a slight angle to course of fracture zones and two distinct zones are in evidence, one striking into the center of the Copper Con and the other crossing the corner of the Copper Con and striking thru the Shorty Ditto diagonally. In one case the ore outcrops on this claim and at other points shows two feet of overburden with a maximum thickness of ore showing in one pit of eight ft.

KENNEDY CLAIM — This claim is trenched for a thousand feet showing continuous ore for that distance. This main line trench shows from four to ten feet of ore. Apparently about one third of the ore mined was thrown out as waste, and the balance either piled alongside of the trench or in the center, or carted away.

SHORTY DITTO CLAIM — Shows two distinct fracture zones and ore from four to six feet in thickness.

RAY NO. 1 CLAIM — Three distinct fracture zones tho not continuous, numerous pits and cuts with four feet of ore showing.

RAY CLAIM — Numerous small cuts with evidence of two fracture zones but only two to three feet of ore showing.

MACKIN NO. 2 — One fracture zone with few shallow pits and cuts but six feet of overburden and only two to three feet of ore showing.

MACKIN NO. 1 — This claim on a ridge and along center; a well defined fracture zone showing six feet of ore.

MACKIN — This claim has probably the best showing on the property and has trenches for seven hundred feet showing continuous ore with a maximum thickness of 14 feet. Pits sunk thirty feet from side of trench show no ore whatever.

Aside from the work listed above there is very little development in ore on outlying property. Indications point to a very spotty ore except in main fracture zones.

CONCLUSION RE. MINERAL VALUE

Without doubt the report by Emmons made several years ago in which he claims about one million tons of ore of an average grade of seven percent for these deposits is greatly exaggerated, probably due to the fact that at that time there was not sufficient work done to determine the lateral extent of the deposits. At various points shallow pits have been sunk to the sides of main trenches and 10 to 30ft. away - in no case do these pits show lateral extension of ore.

At the present time it is impossible to arrive at an accurate estimate of the tonnage available since other areas may produce ore as yet undeveloped. The actual tonnage on the Kaibab property assuming continuous fracture zones thru all of the claims could not exceed 93,000 tons of ore of approximately seven percent. Erosion further limits this and an estimate of 62,500 tons would probably be the maximum obtainable tonnage, and in order to determine this fully numerous shallow pits would have to be sunk at various points to the sides of the present trenches.

The estimate of the percent value is probably correct but the irregularity and spotty character of the ore would require careful mining and sorting methods which would mean a high cost.

The ores can undoubtedly be handled by the Chloridizing Volatilization process and in the event that it is considered necessary a ton of the average ore can be obtained at Kanab, Utah from Mr. J. Brown by paying transportation to Marysvale at rate of two cents per pound and by rail from there to Humboldt.

I consider the property of no further interest to the Western Metallurgical Co. for the above and following reasons:

C O S T S

Haul two way, Marysvale, Utah, 170 miles per ton	$ 35.00
Oil cost Marysvale Utah per Bbl	3.00
Salt Cost " " " ton	7.50
Coal Cost Johnson " "	5.00
Cost Haul Coal to Mine 80 Miles, ton	18.00
Coke cost not obtainable	
Coke if made at Johnston cost P.T.	12.00
Coke Haul " to Mine P.T.	18.00
Limestone obtainable at Mine " "	1.00

COST OF TREATMENT

Assuming a 7% ore with plant located at Mine.
Power obtainable from use of steam, wood fired.

Salt Consumption	5%	Per ton	100 #'s	
Lime "	5%	" "	" "	
Oil "	10 gal.	" "	75 #'s	
Coke "	.5%	" "	10 "	

FOB Mine costs 150 tons day.

Mining	Per ton	$ 3.00	
Salt 5% of $42.50	" "	2.12	
Lime " " 1.00	" "	.05	
Oil " " 43.00	" "	2.16	
Matte Haul 90% recovery assume high grade matte 70% 126#'s Cu. per ton of ore recovered or 180#'s		3.15	
Freight, refining and marketing matte on 6¢ per pound copper basis		7.56	
Pumping		.05	
Crushing Cost		.35	
Administration, etc.		1.00	
Depreciation, 6% 5 years 80% $160,000.00		.60	$ 20.04
Recoverable value at 90% extraction in one ton 7% ore at 21.5¢ per # PT			27.09
Total Net Return per ton			$ 7.05

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gme.

KAIBAB #5.

Cost of Treatment, cont.

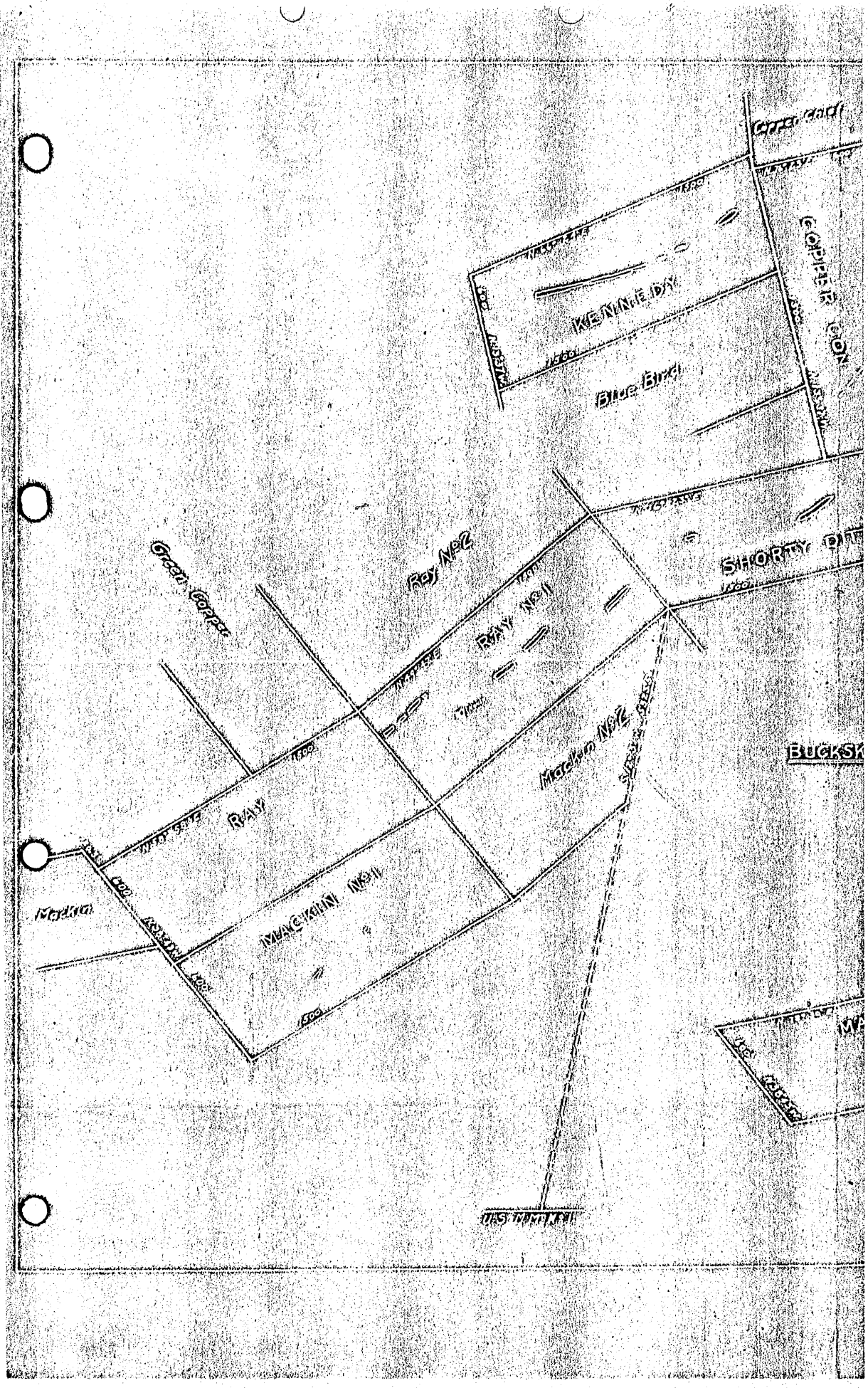
Recoverable ue of 62,500 ton $ 440,625.

Present owners are as g $ 1,000,000 fo heir property.

B hipping high grad blister copper it
m t be possible to e a reduction in
c altho this would insufficient to
j ify price on prop y.

W. R. & Camp.

Humboldt/
EH/ Dec 9,19/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Copper Boy
Ike Nine Day
Blue Bird
Shorty
Green Copper
Ray No 2
Ray No 1
Madison No 2
Ray
Madison
Mancikin No 1
Buckski
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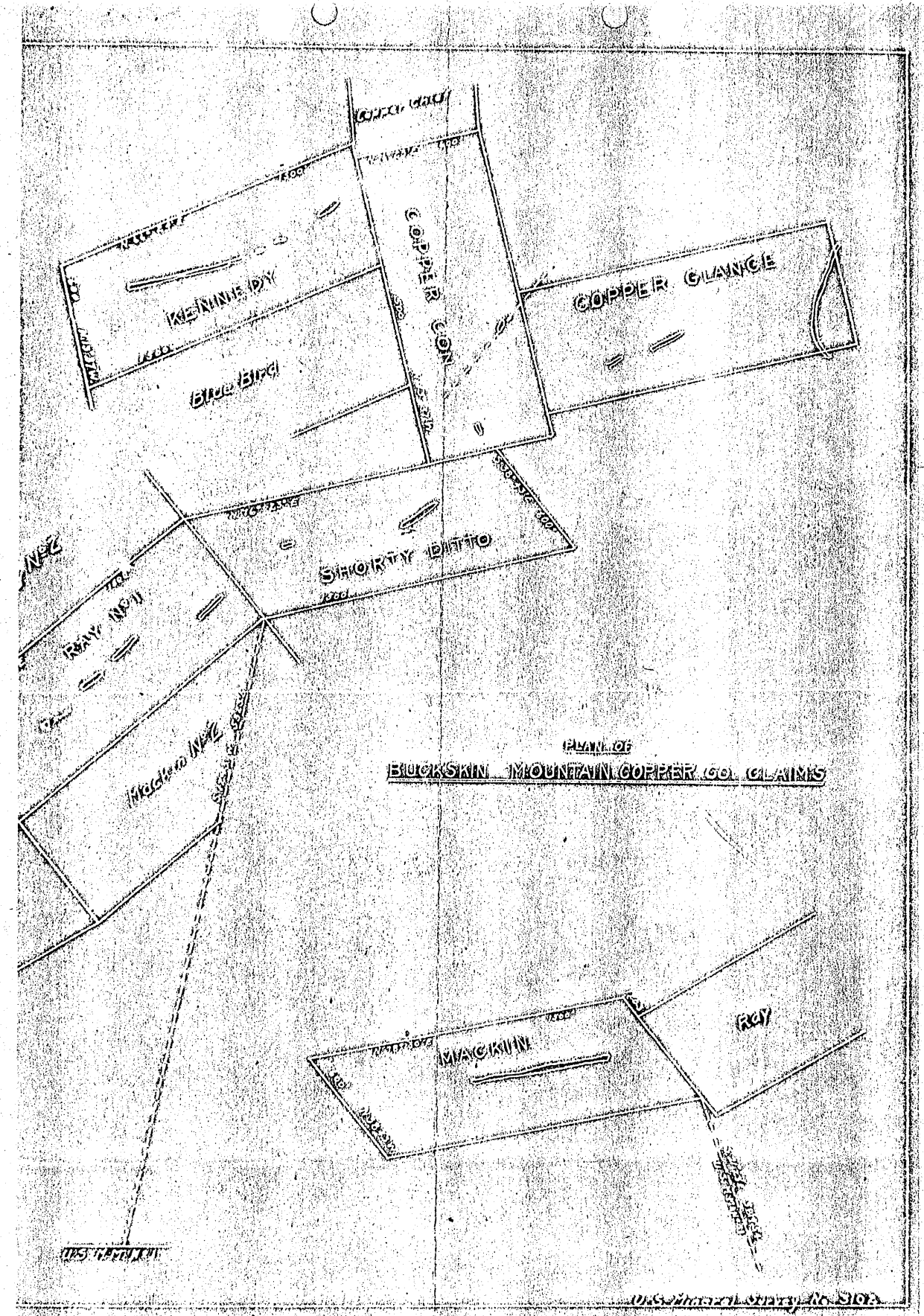

PLAN OF
BUCKSKIN MOUNTAIN COPPER CO. CLAIMS

amc

November 13, 1943

FDP/bjl

Mr. J. H. Hedges,
U. S. Bureau of Mines,
Box 4097, University Station,
Tucson, Arizona.

Dear Mr. Hedges:

Mr. Lasky believes that you were sent two copies of a report on a copper property near Jacobs Lake, Arizona. One copy should have been sent to this office. If you have two copies of this report, will you please send us one?

Very truly yours,

PAUL T. ALLSMAN,
Principal Mining Engineer.

cc SL WR DF

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
SOUTHWEST EXPERIMENT STATION

ARIZONA DISTRICT
WESTERN REGION

BOX 4097
UNIVERSITY STATION
TUCSON, ARIZONA

November 20, 1943

Mr. P. T. Allsman,
U. S. Bureau of Mines,
Salt Lake City, 1, Utah.

Dear Paul:

As requested in your letter of November 13, the extra copy received by this office of the Survey report on the Jacob Lake Mining District is being sent you herewith.

Yours very truly,

J. H. Hedges

J. H. Hedges,
District Engineer.

Enclosure 2708181

1—038 a

ENCLOSURE 2708181

DEPARTMENT OF THE INTERIOR

G.P.O. 6—0945

The Warm Spring or Jacob Lake Mining District, Coconino County, Arizona

A report based on a Preliminary Examination

by

C. B. Read
R. D. Sample
H. H. Sullwold, Jr.
E. E. Gould

September, 1943.

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Summary

The Warm Spring or Jacob Lake Mining District is in northern Coconino County, Arizona, at an elevation of slightly less than 8,000 feet on the eastern margin of the Kaibab Plateau. It consists of 42 patented and unpatented claims, is 168 miles north of Flagstaff, Arizona, and 350 miles south of Salt Lake City, Utah.

A number of attempts have been made to mine the copper deposits, but unfavorable geographic location and inadequate transportation facilities have, in the past, been obstacles. The development of the surfaced U. S. Highway 89 from Flagstaff to Salt Lake City has now opened the general area and with recent advances in the copper prices it is possible that the district may produce ore. Operations are being attempted by the Apex Mining Company.

The copper ore consists mainly of malachite and azurite with minor quantities of oxides and sulfides. The bodies, which are distributed along northeast-southwest trending fractures, are bedding plane deposits with occasional vertical shoots along joints. Many are shallow and can be mined in open cuts. The average thickness of ore is from 3 to 5 feet. Copper content varies up to about 20% with an expectable average of 6-8%. Silica content is over 70% and lime, iron, aluminum, and manganese are low. Recent shipments to Garfield Smelter have received favorable rates because of fluxing qualities.

Approximately 2,000 tons of ore are considered measurable, 20,000 indicated, and 80,000 inferred.

It is recommended that the possibilities of Federal prospecting in the area be considered in an effort to block the indicated and inferred siliceous copper ore if there is need of a fluxing ore source in northern Arizona.

Introduction

The Warm Spring or Jacob Lake Mining District is in northern Coconino County, Arizona, T. 38 N., Rs 1 and 2 E., and is approximately 2 miles west of Jacob Lake P. O., which is on U. S. Highway 89, about 168 miles north of Flagstaff, Arizona, and 350 miles south of Salt Lake City, Utah. The district is at an elevation of slightly less than 8,000 feet near the eastern margin of the Kaibab Plateau, the surface of which has, in this vicinity, a relief of about 320 feet. The area is heavily wooded. The climate is one of mild summers and severe, snowy winters which seriously interfere with open pit mining operations.

There are 17 patented and 25 unpatented claims in good standing in the district. These fall into three groups, the Mackin with 12 patented

and 12 unpatented claims, the Petoskey with 5 patented and 2 unpatented claims, and the Derby with 11 unpatented claims (see map). All of these properties were examined during the course of the Geological Survey work and the Mackin and Petoskey groups were mapped.

In addition, there is an outlying group of 5 claims constituting the Phantom area approximately 6 miles to the north. These claims were not examined. The U. S. Forest Service has applications for a large number of additional claims in the district, but final action on these had not taken place at the time of the present work.

Field work which forms the basis for this report was undertaken during the week of August 1-7, 1943. C. B. Read was in charge of the party which included R. D. Sample, H. H. Sullwold, Jr., and E. E. Gould. The purpose of the investigation was to inquire into the possibilities of siliceous copper ore production in the district.

Acknowledgment is here made to the officials of the Apex Mining Company and the U. S. Metals Corporation for the data supplied. Mr. V. M. Ryan of the Apex Company extended the hospitalities of the company camp to the party and in all possible ways aided in the work.

History, Production and Development

The Warm Spring and Jacob Lake Mining District has produced less than 300,000 pounds of copper, although numerous attempts have been made to develop the claims, many of which are of long standing. The early history of the district is unknown, but it is believed that there was some production during the period 1916-20.

In 1928 the St. Anthony Copper Company acquired some of the properties in the area and built a smelter at Ryan, Arizona, which is approximately 10 miles northwest of the district. A railroad was constructed to transport ore to Ryan, but due to the destruction of the smelter by fire, no ore shipments were made. The company suspended operations in 1929 and data on ore mined are not available.

Sporadic, but futile attempts were made to remove shallow ore in open cuts during the period 1930-39. In 1939, R. S. Gangstad, President of the U. S. Metals Corporation, acquired the Mackin and Petoskey groups of claims. Several of these claims were leased on an operational basis to miners in 1940 and 1941, but in 1942 all of the properties were leased to the C. W. T. Copper Company which attempted operations during the year.

In 1943 the Apex Mining Company, a partnership of H. H. Patterson and A. C. Simmons, subleased the Mackin group from C. W. T. but, due to cancellation of the C. W. T. lease, is now dealing directly with

the U. S. Metals Corporation, and has the Mackin and Petoskey claims leased on a 12½ % royalty basis. The Apex Company has likewise leased the Derby group from F. A. Heaton and Warren Ross.

Operations in the district have been restricted, with but few exceptions, to the development of shallow open cuts. The distribution of these is shown on the accompanying map. A shallow adit has been developed on the Upright claim, and a shaft sunk on the Arizona Jim.

The Apex Mining Company, after a brief period of prospecting and sampling, began mining operations in late July, 1943. At the time of the investigation, the company was cleaning out the long open pit on the Mackin claim and was stripping shallow ore with a power shovel. According to V. M. Ryan, superintendent, daily ore shipments are varying from 50 to 75 tons, and it is expected that production will reach 200 tons per day when additional equipment is obtained.

The ore, which is mined selectively, but not hand picked, is loaded into trucks and dumped into an adjacent ore bin. Shipments by large truck are made to Marysville, Utah, and from there by rail to the Garfield Smelter near Salt Lake City. Total carrier charges are $8.25 per ton. Ore will be trucked south to Clarkdale, Arizona, as soon as facilities are available. Transportation charges will be about $8.00 per ton.

Smelter charges at Garfield are $1.50 per ton for Jacob Lake ore, and will be $3.25 with a $.75 bonus for fluxing qualities at Clarkdale. Present mining costs are $3.00 per ton, but the operators believe that this will decrease to $2.00 on a 200 ton daily basis.

The Apex Company receives $.22 per pound for copper under a B bonus contract, and feels that it can operate on ore averaging approximately 5% Cu. Smelter returns from shipments made in 1942 by the C. W. T. Copper Company indicate that this average grade may be expected.

Table 1

Assays of carload lots, Jacob Lake ore.

Lot	Au oz.	Ag oz.	Cu %	As %	Fe %	Sb %	CaO %	Insol. (mainly SiO_2)
1 Mackin	.01		9.32	15	5.2	.30	0	71
2 Mackin	.01	1.0	9.45	15	3.2	.30	0	71
3 Mackin	not determined		9.32	Not	determined.			

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Table 1
(continued)

Lot	Au oz.	Ag oz.	Cu %	As %	Fe %	Sb %	CaO %	Insol. (mainly SiO_2) %
4 Mackin			9.45					
5 Mackin			9.67					
6 Mackin			9.66					
7 Mackin			6.77					
8 Mackin			6.65					

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Geology

The Warm Spring or Jacob Lake Mining District is a short distance west of the prominent north trending monocline which forms the eastern margin of the Kaibab Plateau. The surface rock in the area examined is the Kaibab limestone of Permian age with occasional remnants of red siltstone which are tentatively referred to the Moenkopi formation of lower Triassic age. The Kaibab limestone in the district consists of alternations of chert and cherty limestone, thin calcareous shales, and occasional sandy beds. A section of the upper portion of the Kaibab limestone which is mineralized is shown in figure 2. The contained chert is frequently brecciated and recemented.

The Kaibab limestone is broken by an east-west trending fault on the Upright and Pauper's Dream claims and is gently folded into broad undulations throughout the district. Thus strata carrying copper ore at less than 7,800 feet on the Arizona Jim and Ensign claims, rise to over 7,900 feet in the Mackin group, and then descend to the north. Owing to the fact that the plateau surface is a karst or sink-hole topography it is not entirely clear whether these structural features are related to solution of the Kaibab limestone or to regional movements which have formed the monocline to the east.

North-northwest and east-west to southwest-northeast trending fractures constitute the master joint system of the district. In the time available for the field examination it was impossible to map large numbers of these.

Ore Deposits

Copper ore occurs in limestone and chert on most of the claims in the district. The observed bodies are bedding plane deposits but at

some points mineralization occurs in vertical joint fissures which cut the tabular bodies. The ore occurs as replacements of limestone, in zones of brecciated chert, and in beds of calcareous sandstone.

The most abundant ore minerals are the copper carbonates, malachite and azurite. The sulfides chalcocite and bornite occur locally, as do the oxides cuprite (?) and copper pitch. Chysocolla was noted at some points.

Chert constitutes the common gangue and is often stained with limonite. Gossan bodies appear to be surface indications of ore bodies and have, in consequence, been outlined. An examination of the map indicates that on the basis of the workings and gossan the tabular ore bodies of the district have a definite east-west to southwest-northeast trend. This coincides, in a general fashion, with one of the prominent sets of master fractures of the district. At the shaft on the Arizona Jim claim nearly vertical points trending N. 85°E. and N. 35°W. are locally mineralized.

The tabular ore bodies vary in thickness from a knife edge to over 6 feet and will probably average 3-5 feet on the Mackin, Arizona Jim, Kennedy, Ray, and Ray No. 1 claims. They vary in size from small pods which contain a few tons of ore to large masses which may be over 1,500 feet in length. The width of these larger bodies has not been proven but it seems probable that few will exceed 200 feet.

Grade varies from a trace to over 20% copper with an expectable average for several of the deposits of 6-8% on the basis of past shipments. It is possible that selective mining may increase this to 10% higher.

The copper deposits of the district are believed to be telethermal in origin, although it is possible that they may be adequately explained by precipitation from meteoric solutions. The presence of small quantities of arsenic and antimony in the oxidized bodies strongly suggests an original sulfide suite which is most common in ore bodies of hydrothermal origin. The present position of the deposits at or near the surface of the Kaibab Plateau has resulted in almost complete oxidation of the sulfides which are believed to have originally comprised the major portion of the ore.

Reserves

There is no proven ore in the district beyond the present faces of the shallow pits and in consequence the measurable ore does not exceed 2,000 tons. Ore indicated in reasonable extensions of these exposed deposits is no more than 20,000 tons. If the gossan, which is widely exposed at the surface in the vicinity of open cuts showing ore

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can be taken as an indication of the presence of underlying copper ore bodies, then a minimum of at least 80,000 tons of ore or mineralized rock of undetermined grade may be inferred, and it is possible that this estimate may be exceeded if the area is thoroughly tested by drilling.

On the basis of observed faces, the ore may be expected to average from 3 to 5 feet in thickness. The grade, as previously indicated, will vary widely, but past shipments suggest that a grade of at least 5% may be maintained if selective open cut practices are followed. This ore, it is worthy of note, has a highly siliceous gangue and is low in calcium carbonate. It is believed that proper mining practice may produce shipments of fluxing quality.

Outlook

With the present copper prices, it is probable that the Apex Mining Company may succeed in its operations in the district. The ore recovered on the Mackin claim is of good grade and should carry the developments if expansion is not too rapid. The Kennedy, Ray, Ray No. 1, Mackin No. 1, Copper Glance, Shorty Ditto, and Green Copper claims show promise in the Mackin group. The Millsite, Arizona Jim, and Ensign claims in the Petoskey group may be expected to yield profitable ore. There has been little prospecting on the Derby claims, and their possibilities cannot be determined.

Carrier charges for movement of ore to smelter are from $8 to $8.25 per ton, and when mining and miscellaneous operating costs are considered in addition, an average carload grade of at least 5% must be maintained to permit successful operation. Smelter returns indicate that this may be expected.

A major obstacle to year round open pit operations is the heavy winter snowfall of the district. It is expected that operations will cease about January 1, and will not be resumed until late April or May. The Apex Company officials feel that the high water content of ore recovered during this season will prevent profitable operations. However, they expect to stockpile ore in nearby valleys characterized by low precipitation, and shipments will be made from these recovered reserves during winter months.

It is believed that attempts to concentrate the ore would be unprofitable. According to the Apex Company the rock is slow leaching and losses may be high. The water supply at Jacob Lake is from Warm Springs. The U. S. Forest Service is of the opinion that the volume is insufficient for milling operations. Water might be piped from Big Springs, a distance of 12-15 miles and a lift of 1,500 feet, but proven reserves do not justify such a development.

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Recommendations

In view of the relatively high grade of the Jacob Lake ore and its high silica content which makes it desirable as flux, it is suggested that consideration be given to further prospecting the district in an effort to determine the quantity of minable reserves.

The district has a geographic position which makes it a possible siliceous ore source for both Garfield and Clarkdale smelters. It is near a surfaced highway and a minimum of access road construction is required. Operations which might result in recovery of considerable tonnages of ore will require little expensive machinery, and costs, on a large daily tonnage basis, should be low. The copper content of the ore is relatively high for siliceous flux and an appreciable quantity of metal may be recovered.

Copper deposits of the White Mesa District, northern Arizona, have been considered as siliceous ore mining possibilities. The Jacob Lake district, while the inferred reserves are far lower, should be considered as an alternative fluxing ore source in the general area, and has definite advantages as regards accessibility, ore grade, and possibilities of immediate recovery.

The Apex Company, for financial reasons, has been unable to prospect extensively. According to the superintendent the plan is to drill only in immediate advance of operations.

A Federal financed prospecting program, if considered, should be prefaced by a somewhat more thorough examination than the present reconnaissance, although there is a definite limit to results which may be expected from surface mapping in the heavily wooded area characterized by poor outcrops. Actual prospecting should consist of trenching and churn drilling/ to depths which will rarely exceed 40 feet and in many cases will be less than 20 feet. Claims which are favorable for immediate stripping operations and which, therefore, merit prospecting are the Mackin No. 1, Ray, Ray No. 1, Shorty Ditto, Kennedy, Copper Glance, Copper Consolidated, Arizona Jim, Millsite, and Ensign. It is believed that such prospecting may result in the blocking of considerable reserves of siliceous ore which can be profitably shipped to smelters with existing prices. Any prospecting program which may be undertaken should be with the understanding that, while the district has good possibilities for siliceous ore discovery and recovery, some risk is involved.

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/ Experience by the Apex Company indicates that core drilling is not successful in the district.