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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.

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, ARIZONA[1]

By Stanton L. Tainter[2]

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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 Bureau[3] 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

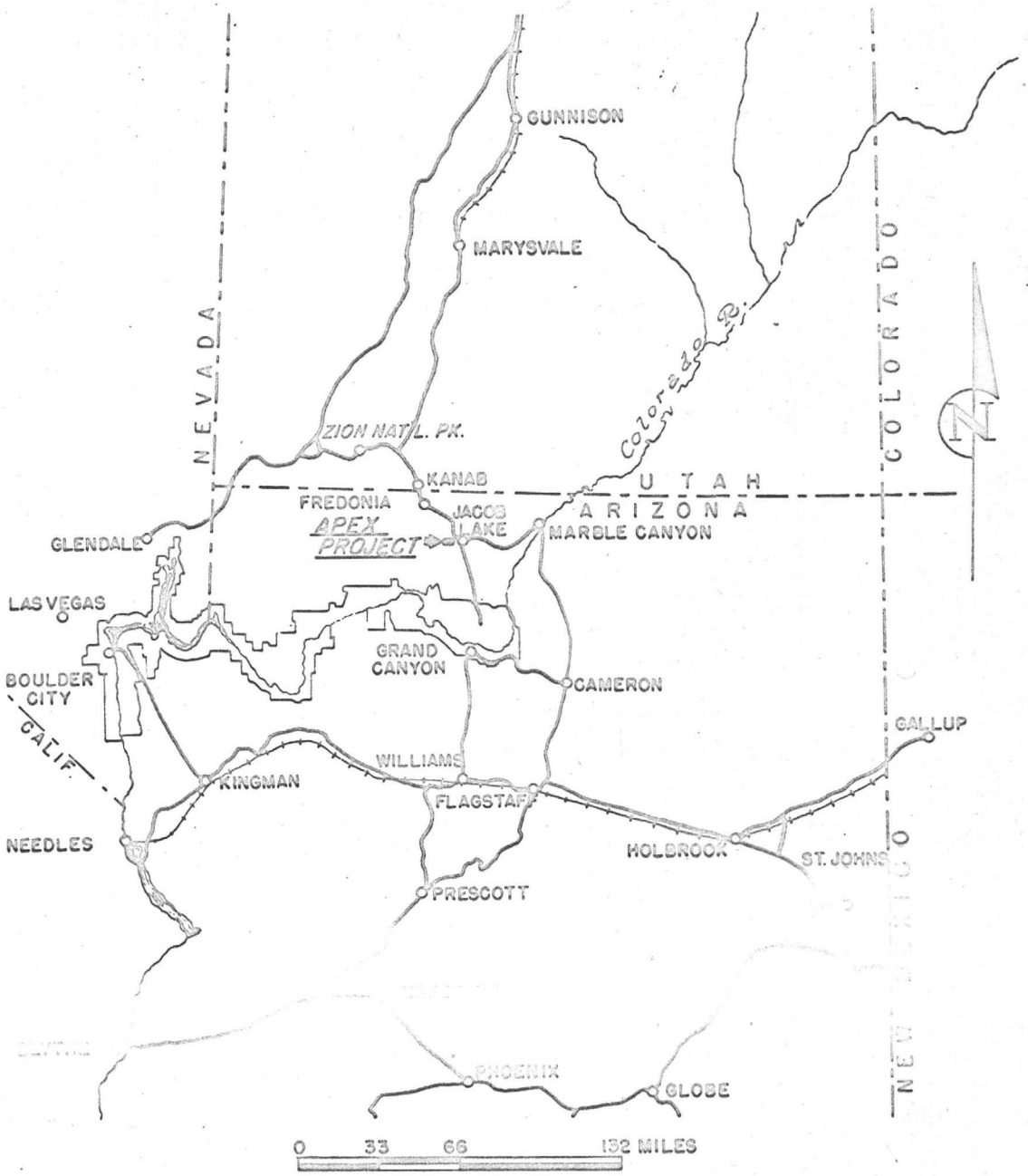


Figure 1.- Location map, Apex copper project, Coconino County, Arizona.

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 [illegible], who 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

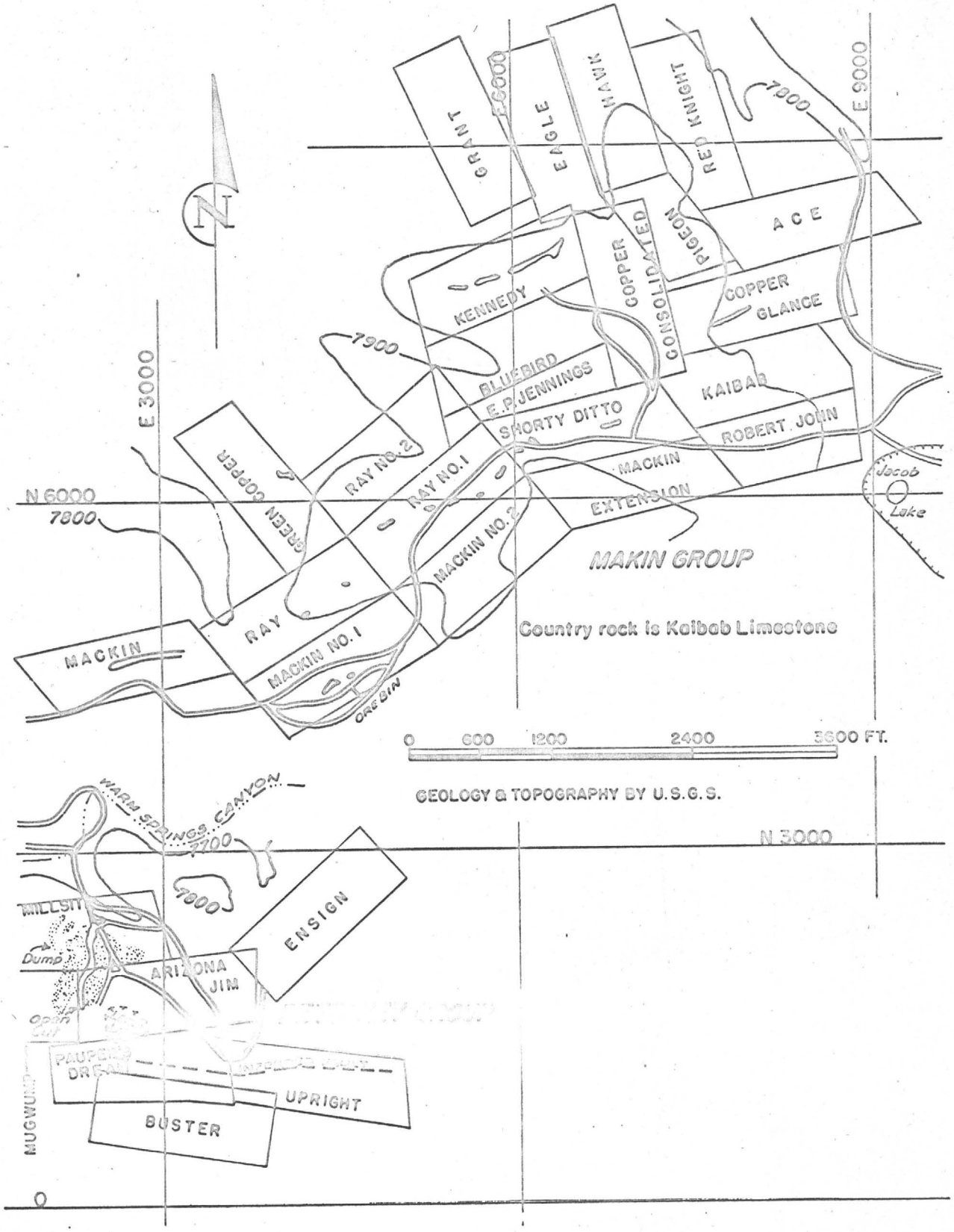


Figure 2.- Geologic plan, Apex copper project.

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

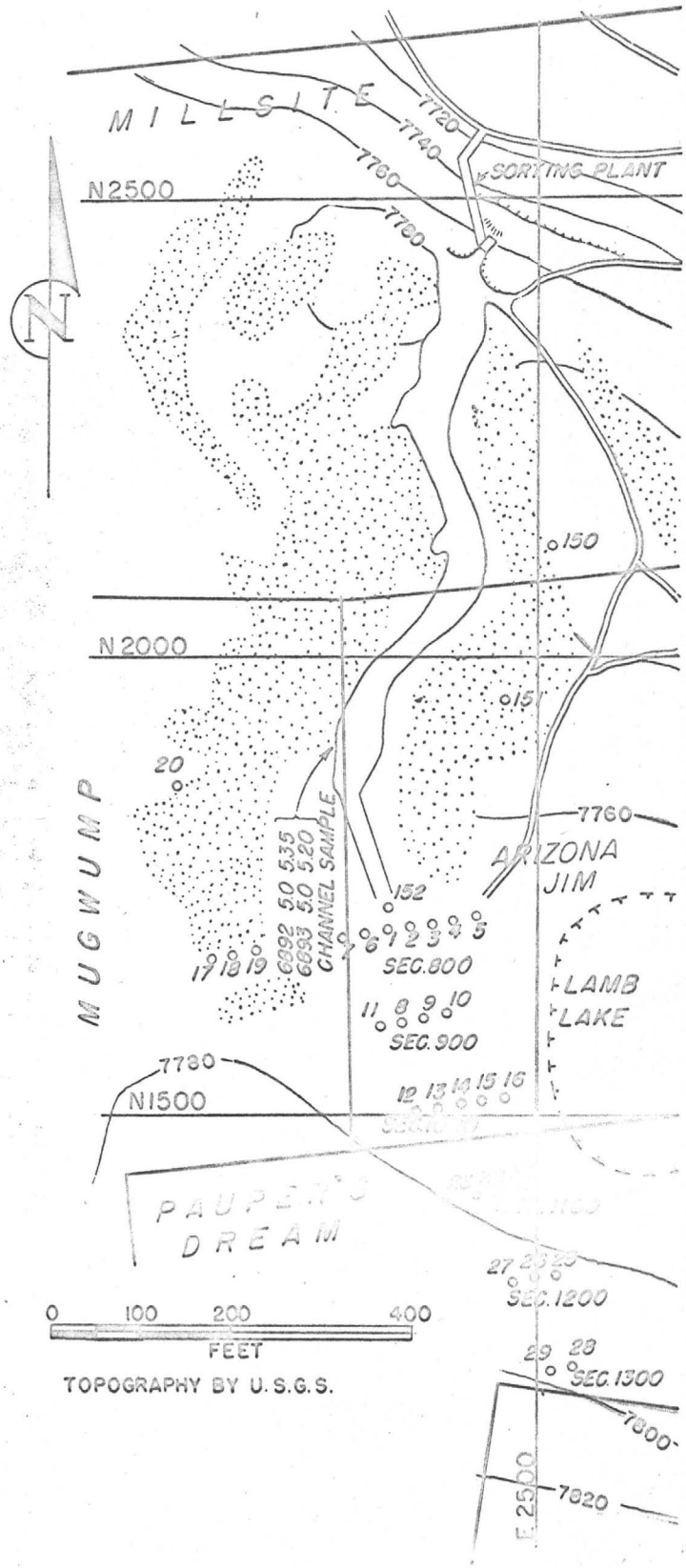


Figure 3.- Location of drill holes, Petoskey mine area.

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 JS-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 16-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 [illegible] sets of teeth were used during the season. [illegible] 3/4 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.

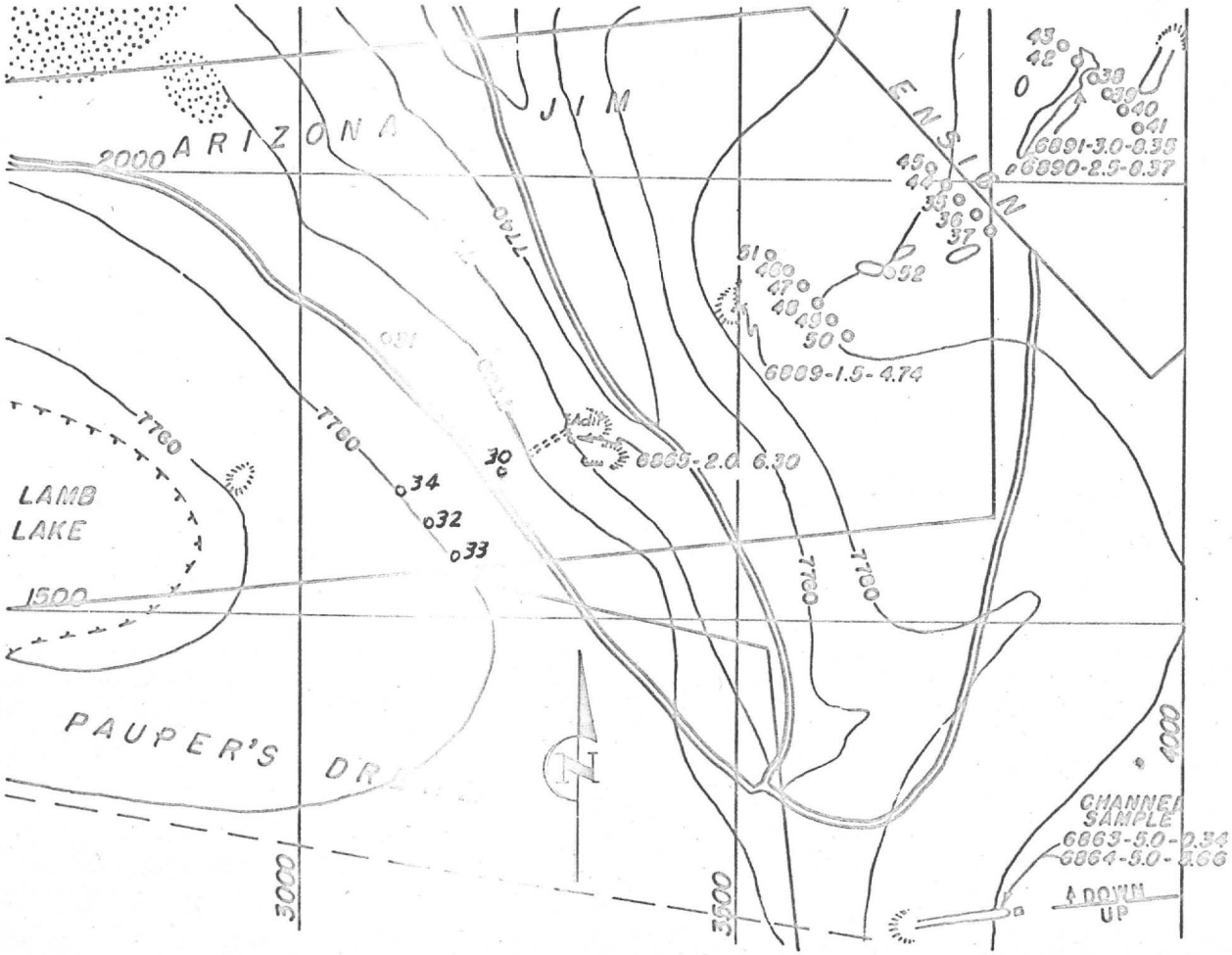
The ore was shipped by rail from Marysvale to the American Smelting & Refining Co. smelter at Garfield, Utah.

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



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

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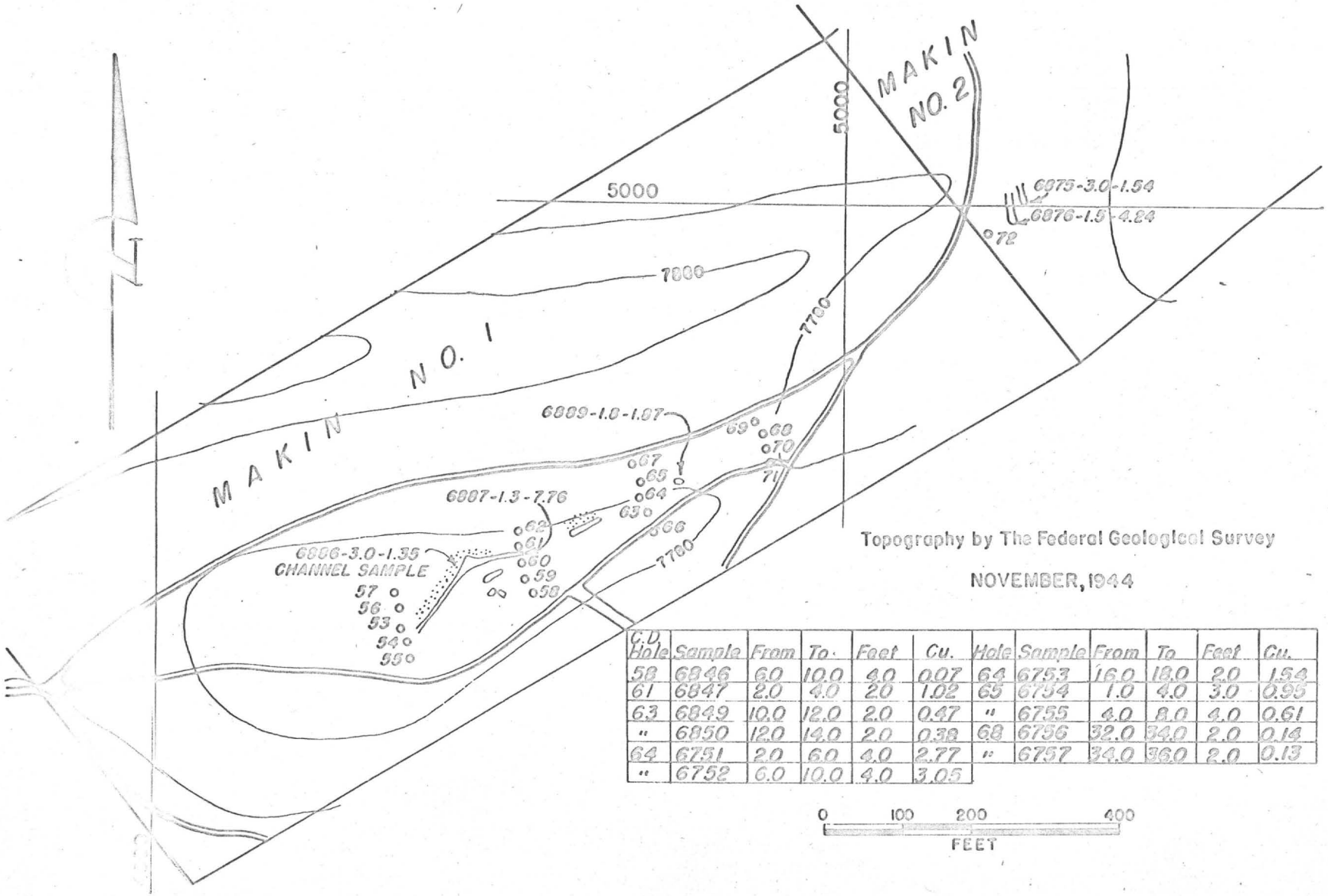
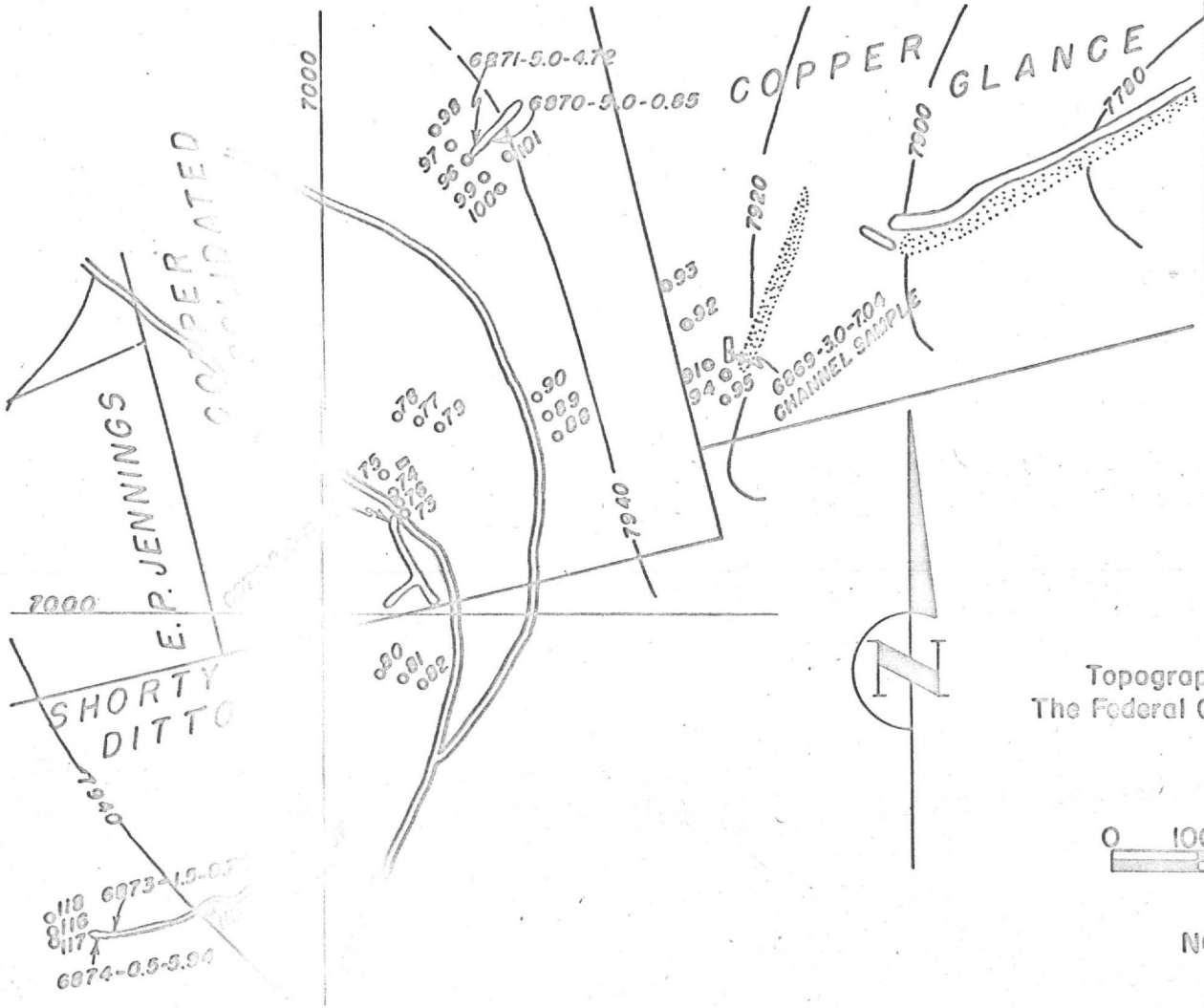
Topography by The Federal Geological Survey

Figure [illegible] - 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

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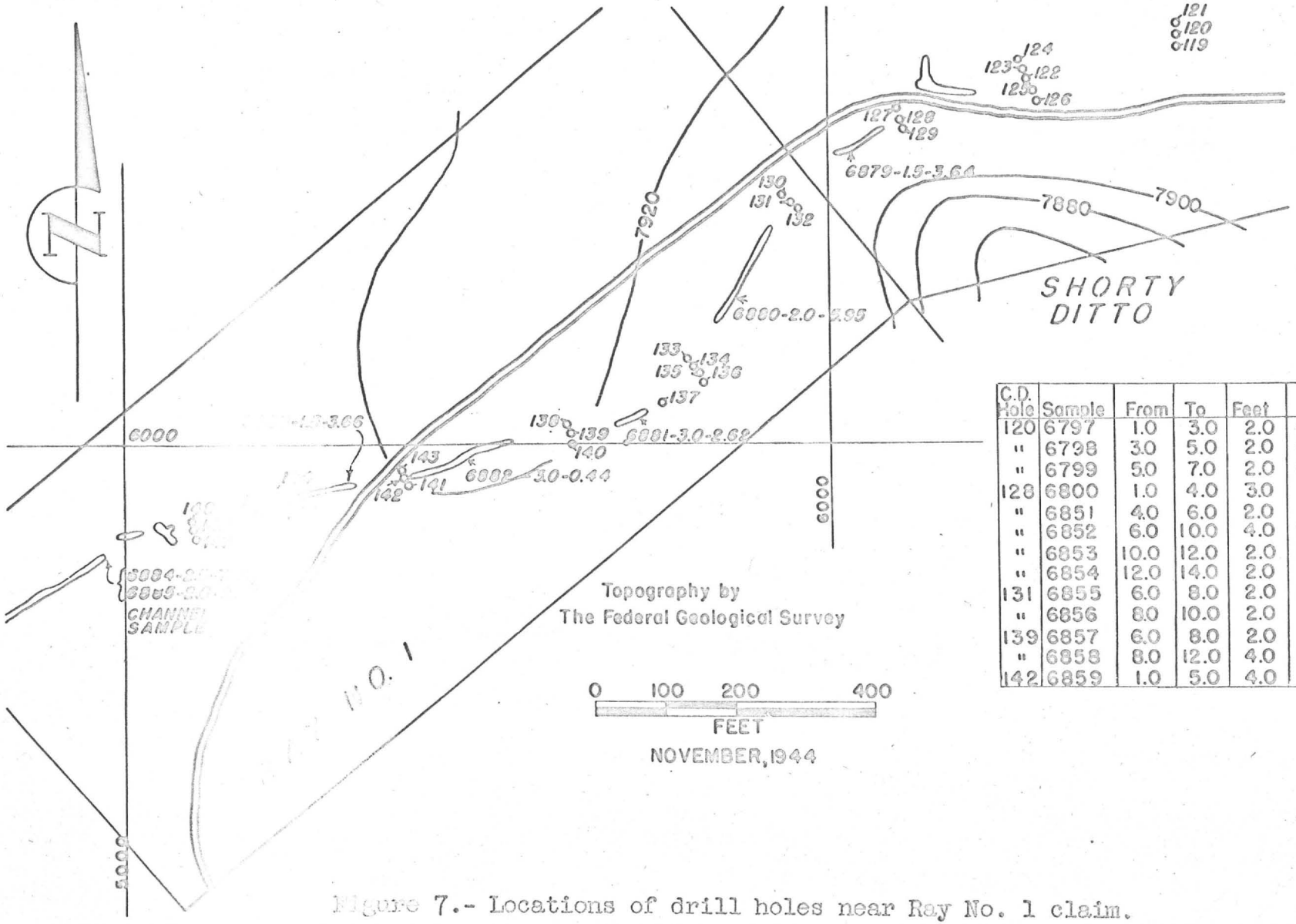
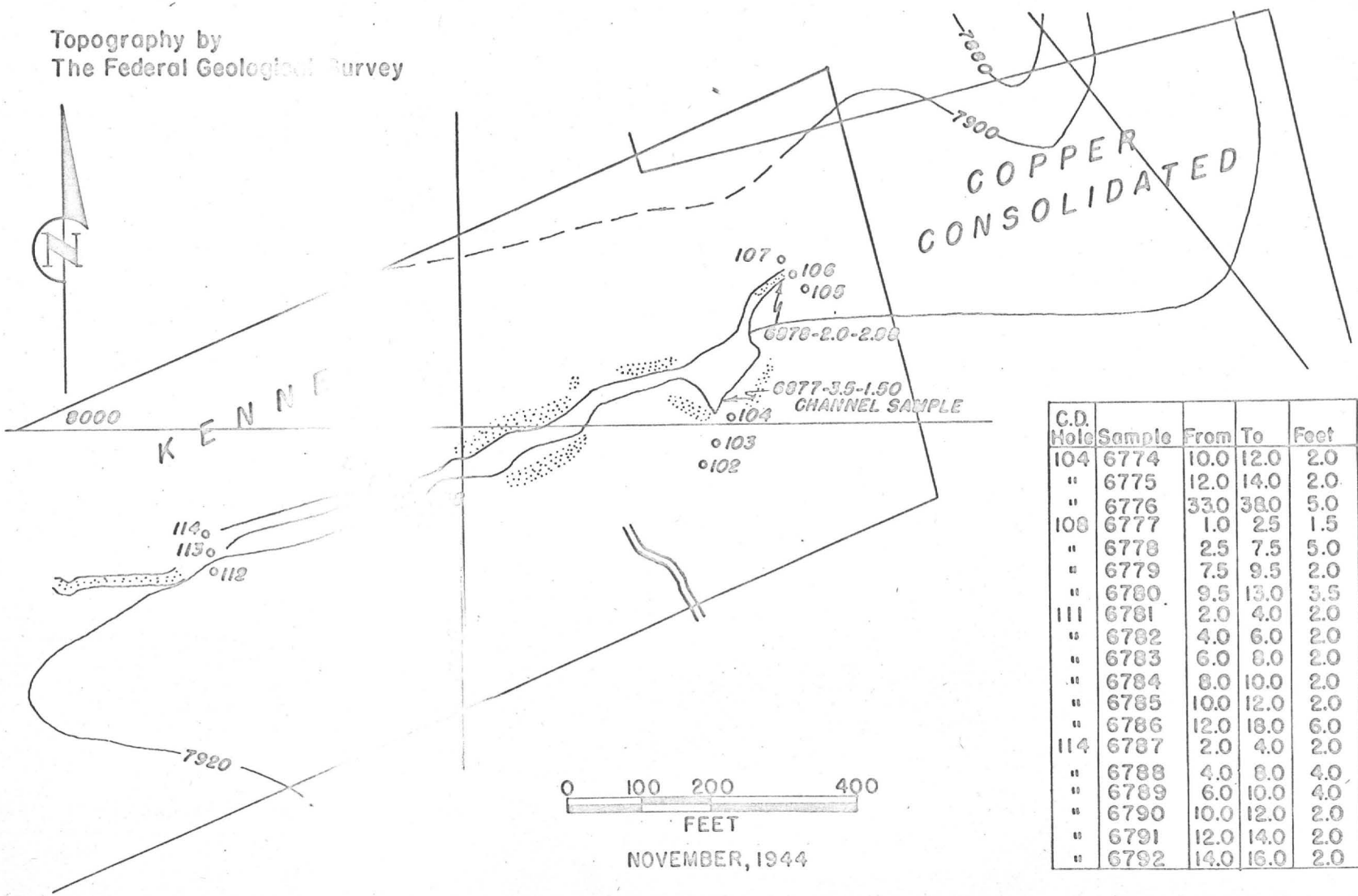
Fig. - Locations of drill holes near Copper Glance open cut.



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 [illegible] 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		Footage		Percent copper	Description and remarks
	Coordinates	Elevation, ft.	From-	To-		
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.	40.	3.76	Do.
			40.	50.		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.	[illegible]		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	[illegible]		[illegible]
			[illegible]	10.		[illegible] 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	7879.4	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	7906.6	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.	.56	Do.
			15.	17.		Do.
			17.	25.		Cherty-sandy limestone.
116	6673N [illegible]	[illegible]	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.

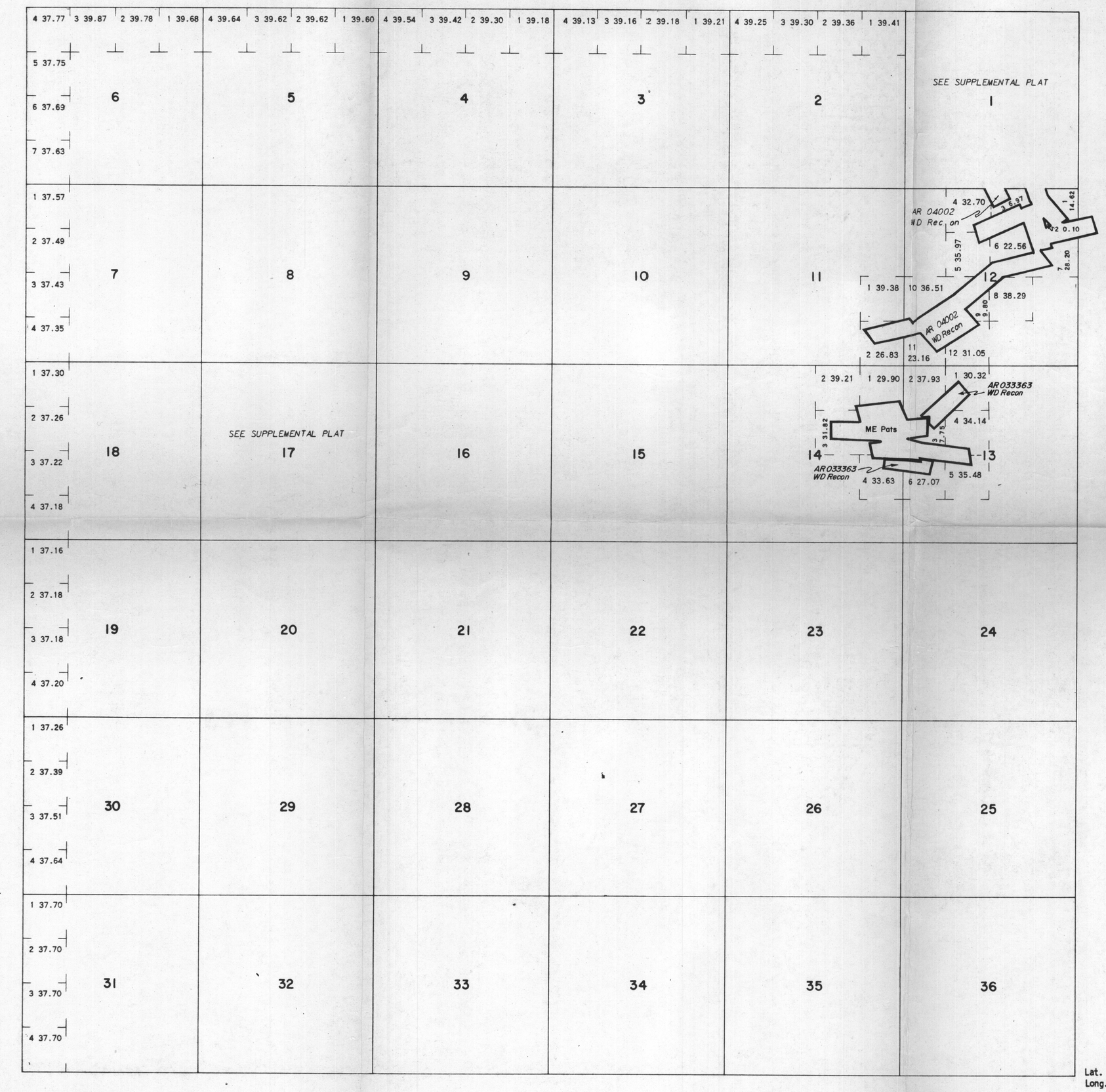
Hole No.	Collar Coordinates	Collar Elevation, ft.	Footage From-	Footage To-	Percent copper	Description and remarks
129	6452N - 6107E	7915.5	0	2.		Soil.
			2.	14.		Cherty sandstone.
			14.	17.		Cherty-sandy limestone.
130	6359N - 5937E	7916.0	0	2.		Soil.
			2.	18.		Clay and cherty sandstone.
			18.	20.		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.

TOWNSHIP 38 NORTH RANGE 1 EAST OF THE GILA AND SALT RIVER MERIDIAN, ARIZONA

COCONINO COUNTY

STATUS OF PUBLIC DOMAIN
LAND AND MINERAL TITLES



Lat. 36°38'29" N
Long. 112°14'55" W

SCALE
10 5 0 10 20 30 60
30 chains to the inch

INDEX TO SEGREGATED TRACTS				
RESURVEY	ORIGINAL SURVEY			
TRACT NO	T	R	SEC	SUBDIVISION

FOR ORDERS EFFECTING DISPOSAL OR USE OF UNIDENTIFIED LANDS WITHDRAWN FOR CLASSIFICATION, MINERALS, WATER AND/OR OTHER PUBLIC PURPOSES, REFER TO INDEX OF MISCELLANEOUS DOCUMENTS.

All Tp. included in Wdl. Kaibab N.F., EO 909 7/2/1908

All Tp. included in Wdl. Grand Canyon National Game Preserve, Proc. 11/28/1906

ALL TP INCLUDED IN AR 033939 PL 167

CURRENT TO	BY

1966 SEP 9 PM 2 26

BUREAU OF LAND MANAGEMENT
PHOENIX, ARIZONA
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T. 38 N
R. 1 E