UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

BUREAU OF MINES
R. R. Sayers, Director

War Minerals Report 447

JUMBO BASIN
PRINCE OF WALES ISLAND
SOUTHEASTERN ALASKA

Iron, Copper

WASHINGTON: 1945

The War Minerals Reports of the Bureau of Mines are issued by the United States Department of the Interior to give official expression to the conclusions reached on various investigations relating to domestic minerals. These reports are based upon the field work of the Bureau of Mines and upon data made available to the Department from other sources. The primary purpose of these reports is to provide essential information to the war agencies of the United States Government and to assist owners and operators of mining properties in the production of minerals vital to the prosecution of the war.

WAR MINERALS REPORT
UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

W.M.R. 447 – Iron, Copper October 1945

JUMBO BASIN
Prince of Wales Island
Southeastern Alaska

SUMMARY

As part of a general investigation of iron-copper deposits on Prince of Wales Island, Alaska, the Jumbo magnetite deposit was sampled and mapped by the Bureau of Mines in the summer of 1944.

The ore is mostly confined to one lenticular block 1 to 40 feet thick lying on a slope of about 52 degrees. Examination disclosed 95,150 long tons of measured ore and 148,250 long tons of indicated ore containing 43.4 percent iron, 0.67 percent copper, 0.012 ounce per ton gold, and 0.90 ounce per ton silver. In addition, 68,500 long tons of ore of similar grade is inferred.

Beneficiation tests indicate that the ore, if ground to minus 65 mesh, is amenable to concentration by flotation and magnetic separation for the purpose of producing a magnetite concentrate of high iron and low sulfur content as well as a marketable copper sulfide concentrate.

Additional exploration by the Bureau of Mines is not contemplated at this time.

INTRODUCTION

Preliminary examinations, some of them followed by detailed exploration, of iron and copper deposits on Prince of Wales Island have been conducted by the Bureau of Mines from early in 1942 until the end of 1944. One of the properties investigated was the Jumbo magnetite deposit, which was visited by an engineer[1] of the Bureau of Mines during a preliminary examination of the Copper Mountain and Jumbo areas September 15 to 18, 1943. During the months of June, July, and August 1944, a more detailed examination, consisting essentially of mapping and sampling, was made by engineers[2] of the Bureau of Mines working in conjunction with a geologist[3] of the Federal Geological Survey. Geological, topographical, and dip-needle contour maps were made of the area, and 97 channel samples were cut.

1 Stephen P. Holt.
2 Wilford S. Wright and Earl L. Fosse.
3 George C. Kennedy.

At the time of the preliminary examination, valuable information concerning the property was furnished by B. D. Stewart, Territorial Commissioner of Mines and former general manager of the Jumbo mine, and by Duncan Campbell, Ketchikan, Alaska, former mine superintendent of the Jumbo mine.

LOCATION AND ACCESSIBILITY

The Jumbo group of claims is at lat. 55° 15' N., long. 132° 38' W., on the west slope of a ridge between Mount Jumbo and Copper Mountain on Prince of Wales Island, Alaska. The property is 1-1/2 miles east of Hetta Inlet, a deep embayment connected to the Pacific Ocean through Cordova Bay off the west coast of the southeast end of the island, as shown in figure 1. Hetta Inlet is navigable by steamships to a point at its head near the site of the abandoned mining camp of Sulzer. At one time Hetta Inlet was connected at its head with Cholmondeley Sound by a 4-mile road over which light freight and mail were delivered to Sulzer and Coppermount. Ketchikan, the nearest city and source of hardware, fuel, and lumber, is 120 miles by water and 40 miles by airline east of the property. By arrangement, a mail boat will make weekly delivery of supplies to Jumbo Harbor, as it does to Hydaburg, a small fishing village 8 miles west.

The old Jumbo workings, once connected to the beach by an aerial tram, can be reached by a foot trail about 2 miles in length. A new trail, constructed by the Bureau of Mines, branches from the old trail about 3/4 mile from the beach and leads northwest to the main magnetite deposit. This deposit lies at an elevation of 1,600 feet 1/2 mile north of the old Jumbo copper mine, which was the main source of production of the Alaska Industrial Co., the original operators. At an elevation of 3,400 feet half a mile southeast of the old Jumbo mine, is the upper Copper Mountain workings, property of the Copper Harbor Co. The Jumbo group of patented claims with a total of 860 acres extends from the beach to a point near the ridge crest. The Jumbo property is in the Ketchikan mining district and consists of 55 patented claims.

The freight rate from Ketchikan to Seattle on ore worth $60 or less is $4.50 a ton plus a 16 percent surcharge, which is effective only during the war. If cargo is transshipped at Ketchikan the wharfage is $2.20, and at Seattle it is $1.40 if cargo is transferred to open railroad cars. At one time marble was transported by barge from Dall Island to Seattle at $0.90 a ton. It is reasonable to estimate that iron ore can be transported to the Puget Sound area at $1.50 a long ton.

PHYSICAL FEATURES AND CLIMATE

The west shore line of Prince of Wales Island is broken by many bays and inlets, which are protected from the Pacific Ocean by small seaward islands. The topography of the island is not as rugged as that of the mainland but is characterized by rounded mountains, deep streams, channels, U-shaped valleys and a few jagged peaks. The Jumbo property lies on the steep slope of a U-shaped basin resembling a cirque. The basin faces Hetta Inlet, from which slopes rise gently for three-quarters mile and increase gradually from 20 to 50 degrees to the crest of an arc-shaped ridge at 2,500 to 3,800 feet. Jumbo Creek, which originates in snow-covered areas above the timber line, forms a series of falls and rapids in its descent to the valley. This creek and two lakes on the east and southeast sides of Copper Mountain are potential sources of power for mining operations. Lake Josephine, 1-1/4 miles long and half a mile wide, is three-quarters mile east of Copper Mountain at an elevation of 1,840 feet. Lake Mellen, a smaller body at 876 feet elevation, is half a mile south of Copper Mountain and one mile east of Copper Harbor, a one-mile embayment on the east side of Hetta Inlet.

Precipitation in the area probably closely approximates the recorded annual average of 150.89 inches at Ketchikan. Even in midsummer, mist and fog usually enshroud the rim of Jumbo Basin, where snow remains on the north-facing slopes the year around. Mild climatic conditions prevail, as winter temperatures are rarely as low as 0° F., and summer temperatures seldom reach 90° F.

The area below 2,000 feet is covered with a heavy growth of spruce, hemlock, and cedar, all of which make satisfactory mining timbers. An abundance of ferns, alders, and berry bushes form a dense undergrowth in the valley.

LABOR AND LIVING CONDITIONS

The labor supply, though normally plentiful, is scarce at this time (1945) by reason of war emergency demands. Fishing, the principal occupation in this part of Alaska, affords employment in summer for all available workmen. Prevailing hourly wage rates exceed prewar rates by roughly 25 percent. In 1943 the following basic wage rates were established for the area by the War Labor Board:

	Per hour
Blacksmith	$1.565
Carpenter	1.50
Drill runner	1.315
Foreman drill runner	1.45
Laborer, unskilled	1.015
Miner	1.40
Motorman	1.315
Tractor operator	1.75

Time and a half must be paid for time over 8 hours a day and 40 hours a week, as well as double time for the seventh consecutive day.

Aside from two small one-story cottages on the beach, there are no living quarters on the property. Water for domestic purposes is available in numerous small streams.

HISTORY AND OWNERSHIP

Mineral deposits were discovered at Jumbo Basin in 1897 by Aaron Shellhouse, and claims were recorded in the following spring. In 1899 William Sulzer, recognizing the value of the deposits for their copper content, organized the Alaska Industrial Co. to develop them. The company held 29 claims in the Jumbo group and located 14 on Green Monster Mountain. Exploratory and development work on the Jumbo group was begun in 1902 and continued in succeeding years with the driving of adits and sinking of test pits. The work was done mostly on claims 1, 1A, and 2 on the west flank of the Jumbo-Copper Mountain ridge at 1,500 to 1,900 feet and on claims 4 and 14 at 1,700 and 2,050 feet, respectively. An aerial tram 8,250 feet long was erected for the transportation of ore to the beach, where ore bins of 4,000-ton capacity and a wharf with a 150-foot frontage were built. The company made its first shipment of ore to the Tyee smelter in British Columbia in 1907, and operated intermittently in the following years until 1919, when a low copper price and lack of ore reserves caused them to close the mine. The total value of copper and gold produced at the property is not known, but it is reported to exceed $1,000,000. All claims of the Jumbo and Green Monster groups formerly held by the Alaska Industrial Co. now belong to the estate of William Sulzer, of which Clara Sulzer, 6479 Morris Park Road, Overbrook, Pa., is administratrix. Leon B. Ginsberg, 11 West 42d St., New York City, is attorney for the estate.

MINERAL DEPOSITS

A granitic mass in the form of a batholith occupies the central portion of an area, roughly 5 miles square, east of Hetta Inlet and south of Portage Bay. The main rock type in this mass is a hornblende diorite, though at some places monzonite and diorite are found. Surrounding the intrusive body is an almost unbroken belt of intensely folded limestone and greenstone schists. The surface geology of the area is shown in figure 1. An inclusion of limestone and schists forms the upper 400 feet of Copper Mountain and extends northwestward into the Jumbo Basin area. Tongues of the granitic intrusive extend into the schists, and in some places small igneous bodies are isolated in the older formations. Near the intrusive contacts in Jumbo Basin the schists are silicified and garnetized, and the limestone is marmarized. The belt of contact metamorphic rocks ranges up to 500 feet in width and is very irregular in outline. The principal minerals in the contact rocks are garnet, amphibole, pyroxene, epidote, and calcite.

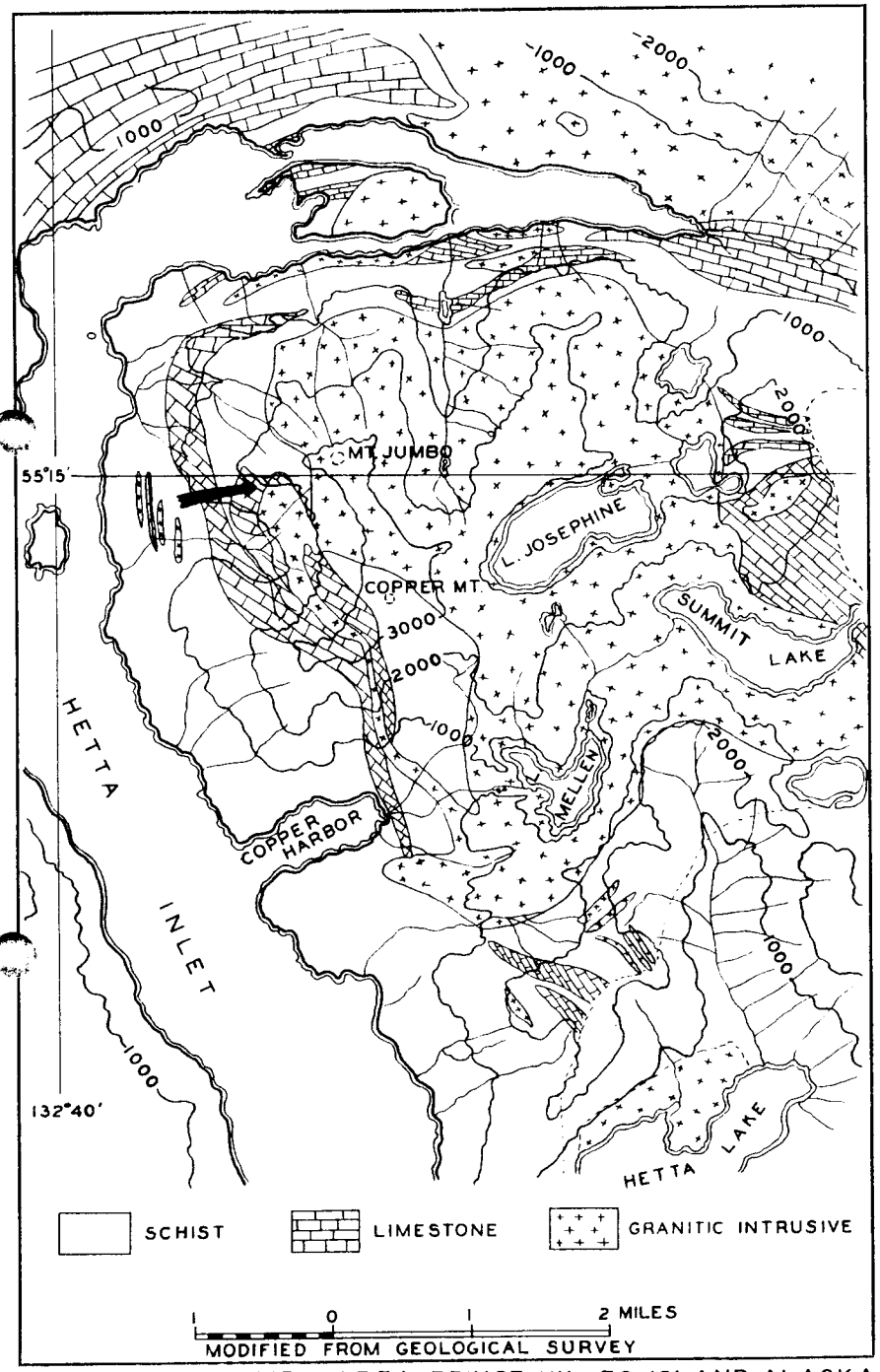


FIG. 1. MT. JUMBO AREA PRINCE WALES ISLAND ALASKA

Dip of the intruded rocks, except in a few places, conforms to the attitude of the contact surface of the batholithic mass - about 70 degrees. Jointing planes in the diorite have nearly vertical dips, and no faults or structural breaks were found within the intrusive mass. The stratified deposits are intensely compressed and folded.

ORE DEPOSITS

Ore deposits in the Jumbo Basin belong to the contact type and may be divided, on the basis of mineral composition, into two classes - (1) the chalcopyrite group and (2) the magnetite-chalcopyrite group. The chalcopyrite deposits were extensively exploited before 1919 by the Alaska Industrial Co., which left no ore of this class in the old stopes. The part of the contact zone in which these deposits were found have been so thoroughly explored by drifts, crosscuts, raises, and winzes that further exploration in this area is unwarranted. Scattered patches of disseminated chalcopyrite and pyrite remained in No. 3 adit, and a small remnant of massive chalcopyrite was observed in the roof of No. 2 adit near the portal, though ore in minable quantity was not found. On the surface near the portal of No. 2 adit a small amount of molybdenite is exposed in irregular pattern in close association with secondary silicates. Garnet, epidote, calcite, diopside, hornblende and pyroxenite are the principal gangue minerals.

The magnetite-chalcopyrite deposits on which all Bureau of Mines exploration was conducted are situated above an altitude of 1,400 feet on Jumbo claims 1, 1A, and 2. The main ore body, a lenticular mass with two sides almost entirely exposed, overlies the diorite intrusive on a slope of 52 degrees. Exposure of formations at the surface and in adit M-3 suggests that the lower part of the ore body is overlain by limestone. Irregular in outline, the exposed portion is roughly 300 feet wide by 270 feet long, as measured on the slope and, including three narrow branches of the main body, has an area of roughly 90,000 square feet. An unreplaced band of greenstone schist between elevations 1,550 and 1,610 appears almost completely to separate the ore body into two blocks. At the base of the outcrop, where the magnetite appears to dip under the white marmarized limestone, the contact is very sharp.

On the southeast, the magnetite outcrop is bordered by a band of diorite fully exposed for a width of 200 feet and a slope distance of several hundred feet. On this side, a portion of the magnetite body appears to have broken apart from the existing block, leaving an almost vertical wall 20 to 70 feet high. The average thickness of the deposit on this side is 28 feet. It is assumed that glacial action has forced a portion of the magnetite body apart from the remaining mass, carried it away, and left the underlying diorite exposed. Further evidence of glacial action is the broad slightly dish-shaped gulch in this area.

About midway of the ore body, at an elevation of 1,540 feet, adit M-2 exposes the following material: 19.5 feet of magnetite ore containing 47.5 percent iron and 0.57 percent copper, 4.75 feet of greenstone schist, 24.75 feet of magnetite ore containing 36.0 percent iron and 0.24 percent copper, and 3.5 feet of diorite.

Projecting these distances normal to the dip, the two ore sections are separated by 3.75 feet of greenstone and have a combined thickness of 35 feet. At 1,460 feet a 62.5-foot adit, M-3, exposes 53 feet of limestone and 9.5 feet of magnetite. The west half of the drift face shows hornblende, garnet, and a low percentage of magnetite. Geological structure and dip-needle readings indicate that one lens of ore lies beyond this face and, in this area, extends a short distance downward.

Surface trenching and outcrops indicate that the ore body is progressively thinner west and northwest of adit M-2. Beyond the limits of the main ore body are found intermingled patches of skarn, marble, greenstone, diorite, and magnetite. The contact minerals forming skarn rock are abundant in this area, particularly at the contact of the diorite dikes with the greenstone.

The upper or northeast side of the deposit is likewise wedge-shaped and at one place extends 100 feet up the mountainside in a narrow, thin neck. A much thicker band of magnetite 85 feet long and 50 feet wide branches from the main body on the east.

On the north a small lens of magnetite is separated from the main body by a 40-foot band of diorite. On the opposite side it is in contact with a small isolated limestone outcrop. This deposit, though only 50 feet wide, is believed to have formed along the contact of a spur of the main dioritic intrusive and extends downward a considerable depth.

Farther up the slope, between 1,850 and 1,950 feet, is a small outcrop of magnetite lying in contact with chalcopyrite-bearing skarn rock. An adit, M-1, 52 feet long penetrates chalcopyrite-bearing skarn for a distance of 38 feet and exposes only 14 feet of magnetite-chalcopyrite ore, which can be assumed to extend downward a distance equal to the difference in elevation to the highest outcrop and the adit elevation, or about 100 feet. The magnetite outcrop here is 100 feet wide and 50 feet long on the slope.

Half a mile east a few outlying magnetite cappings are scattered over a comparatively large area, but all are too small to be mined economically.

DIP-NEEDLE SURVEY

Numerous dip-needle readings were taken in the contact zone in an attempt to find a continuation of the main ore body or unexposed outlying deposits. Fairly strong negative anomalies were recorded at the upper and lower limits on the west side of the main outcrop. It is partly because

of the greater magnetic intensity in these areas that oreshoots are assumed to extend to moderate depths beneath them. Lesser readings were recorded as much as 250 feet beyond the northwest limits of the outcrop, but trenching in this area showed these to be caused by shallow, isolated, magnetite cappings. The main area of positive anomalies is on the north side of the large outcrop, as would be expected, but it is interesting to note that few of the needle deflections are as much as 30 degrees. Greater deflections were obtained in a few small areas where it is believed that minor deposits are covered by skarn, limestone, or greenstone. One such area is in the southeastern corner of the large outcrop, where the magnetite appears to dip under the limestone. The positive anomalies here are taken as criteria that the magnetite extends to a moderate depth along the contact at this point.

Dip-needle readings were taken over the entire upper area, and, with the exception of one small spot, deflections were obtained only in the vicinity of magnetite cappings. The readings indicated no important ore bodies in this area.

SAMPLING AND ASSAYING

The main ore body does not have an exposed face normal to the main axis that can be sampled safely. The nearest approach to the desired condition is found in adit M-2, which lies 38° off the normal position. Loose overhanging slabs prevented sampling the upper east face, but on the lower east face sample channels were staggered in "stair-step" pattern to obtain the equivalent of a continuous channel across the vein. Aside from these two series, all channels on the main ore body were cut from top to bottom of the slope. In cutting most of these channels, the samplers used pulley blocks, ropes, and chairs with underslung canvas-covered platforms. All samples were cut from 2- by 6-inch channels that were 3 to 10 feet in length, depending upon the iron content of the material. A few breaks occurred in the continuity of the channels where diorite dikes or bands of greenstone lay across the line of samples. It is assumed that by selective mining and sorting this material can be kept out of the ore.

The ore body lying 270 feet up the slope from the main deposit was sampled by one channel (J-1-2) on the surface and by two samples, J-1-T-1 and J-1-T-2, in adit M-1. No other samples were taken outside the main ore body.

All samples were dried, crushed in a laboratory jaw crusher to minus 1/4 inch, and passed through a Jones splitter. One portion of each sample from the splitter was submitted for iron and copper analysis to the assay office of the Territorial Department of Mines at Ketchikan. The other portion was again split into two parts, one of which was combined with samples of the same series to form a composite. The other part was

retained for future analysis if necessary. There were 97 cut samples and 10 composite samples. The average lime, insoluble, phosphorus, titanium oxide, sulfur, gold, and silver content of the ore is based upon a weighted average of the 10 composite samples as shown in table 1.

TABLE 1

Composite sample series	Length, feet	Percent							Oz. per short ton	
		Cu	Fe	CaO	S	P	Insol.	TiO_2	Au	Ag
J-1-A . .	31	1.67	54.0	4.50	2.20	Trace	11.66	Trace	0.02	0.90
J-2-A . .	18	.83	43.4	10.44	5.4	Trace	18.94	Trace	Trace	.70
J-2-B . .	17	.20	40.6	9.95	2.46	Trace	28.1	Trace	0.01	.80
J-2-T . .	44	.50	45.8	4.00	2.04	Trace	25.4	Trace	Trace	.90
J-2-C . .	137	1.32	41.7	9.60	2.36	Trace	23.3	Trace	0.01	.90
J-2-D, 1-16. .	80	.40	37.4	3.33	.86	0.01	34.97	Trace	.02	.80
J-2-D, 17-31 .	89	.29	58.9	.30	.35	Trace	13.4	Trace	.01	.70
J-2-D, 32-47 .	126	1.17	49.1	.20	1.32	Trace	23.0	Trace	.01	.70
J-2-D, 47-54 .	45	.75	50.3	.35	2.80	Trace	21.6	Trace	.01	.70
J-2-F . .	36	.57	42.9	.20	.76	Trace	33.7	Trace	.01	1.00
Weighted average				1.84	1.67	Trace	21.6	Trace	*0.012	*0.90

*Per long ton.

ORE RESERVES

The measurable portion of the main ore body lies east of adit M-2 and at an altitude between 1,540 and 1,700 feet. This represents a block 195 feet long on the slope by 168 feet average width, except that portion occupied by a 140-foot greenstone band lying between 1,540 and 1,610 feet. The east side of the magnetite block is exposed and measurable. The east flank is 28 feet thick, and in the tonnage calculation is combined with the 35-foot width represented by exposed magnetite in adit M-2. On the basis of 8.25 cubic feet per long ton, the block contains 95,150 long tons of measured ore. The analysis of this ore, based upon the weighted average of samples, is 46.1 percent iron and 0.75 percent copper.

Indicated ore reserves are represented by four blocks bordering the measurable portion and the two smaller outcrops lying at elevations of 1,670 to 1,740 feet and 1,900 to 1,950 feet, respectively.

It is inferred from magnetic anomalies and geological structure that magnetite ore extends downward on the contact 75 feet below adit M-1, that the ore has a width equal to that of the outcrop (160 feet), and that its thickness is 15 feet.

A similar inference is made from conditions surrounding the magnetite capping 40 feet north of the main ore body. There the deposit outcrops a slope distance of 60 feet and, by inference, it is hidden by diorite an additional depth of 110 feet. The width is assumed to be that of the outcrop - 50 feet.

An inferred block of ore also exists below M-3 which extends 70 feet below the adit and has an average thickness of 28 feet. The width of this block is assumed to be that of the main outcrop, 240 feet.

The Jumbo magnetite deposit is estimated to represent a reserve of 243,400 long tons of indicated and measured ore containing 43.4 percent iron and 0.67 percent copper. Total reserves, including inferred ore, amount to 311,900 long tons.

DEVELOPMENT

Adit M-1, with a bearing of N. 26° E., penetrates the skarn and magnetite of the J-1 ore body a distance of 42 feet at elevation 1,850 feet. Aside from a very small amount of surface excavation, no other work was done in this area.

Adit M-2, at an elevation of 1,540 feet and 54 feet in length, extends across the main ore body on a bearing of N. 40° E. and exposes the underlying diorite. Adit M-3, 80 feet lower, is 62.5 feet long and has a bearing N. 30° E.

Adit M-4 is situated 300 feet northwest of the main ore body at 1,650 feet. It has a bearing of N. 31° E. for 88 feet, but at 78 feet from the portal a 20-foot branch to the right has a bearing of N. 50° E. The adit penetrates limestone and skarn but no magnetite.

These four adits comprise the workings on Jumbo claims 1, 1A, and 2. The ore and country rock are hard and firm. No faults or seams were observed, and timbers had been used only at the portal of adit M-3.

EQUIPMENT

The powerhouse at the beach contains a Pelton water wheel belted to an electric generator. The wheel is equipped with a regulator and appears to be in good condition. It is considered suitable for the development of 100 horsepower at 2,300 volts, but the wooden pipe line has deteriorated, and there is no dam in Jumbo Creek for impounding water.

A 2-stage compressor is inside No. 4 adit of the old copper mine. Its condition could not be determined, as it was surrounded by water, but, judging from its size, it would be capable of delivering 800 cubic feet of free air a minute.

No other usable equipment was found on the property.

MILLING

A beneficiation test was made in the Rolla laboratory of the Bureau of Mines on a composite of equal weights of five samples of ore taken from the Jumbo magnetite deposit at the time of the preliminary examination. Analysis of the composite sample was as follows:

	Percent		Percent
Fe	38.39	Al_2O_3	3.02
Cu	.38	CaO	2.28
S	1.19	TiO_2	.55
P	.039	Mg	1.12
SiO_2	16.05		

The sample was divided into four parts, each of which was ground to minus 8, minus 28, minus 100, and minus 200 mesh. Portions of the different size fractions were roasted for 30 minutes in hydrogen gas at 550° C. Roasted and unroasted samples were treated in a Davis tube magnetic separator to determine if a reducing roast prior to magnetic separation would increase the iron recovery. Results indicate iron recovery is not increased materially by a reducing roast.

The magnetic and nonmagnetic products from the unroasted material of minus 28- and minus 100-mesh sizes showed the following analyses, weights, and recoveries.

Product	Weight, percent	Analysis, percent					Percent of total				
		Fe	Cu	S	P	SiO_2	Fe	Cu	S	P	SiO_2
-28-mesh magnetic	56.8	63.2	0.05	1.0	0.02	3.7	93.6	8.6	50.3	46.7	12.8
-28-mesh nonmagnetic	43.2	5.7	.70	1.3	.03	33.2	6.4	91.4	49.7	53.3	87.2
-100 mesh magnetic	53.3	68.6	.05	0.87	.03	1.1	93.8	7.3	42.7	40.6	3.6
-100-mesh nonmagnetic	46.7	5.2	.72	1.33	.05	33.6	6.2	92.7	57.3	59.4	96.4

Treatment of minus 8-mesh unroasted material produced a 59.2 percent iron concentrate. The test demonstrates the improvement in grade of the magnetic product with finer grinding, though it is doubtful whether the advantage of a 68.6 percent iron concentrate over one containing 63.2 percent iron would be worth the cost of grinding all material to pass 100 mesh.

A sample of ore was ground to minus 100 mesh and floated with 0.125 pound per ton of potassium pentasol xanthate and 0.12 pound per ton of methyl amyl alcohol. The rougher concentrate was cleaned twice. The tailing from this test was passed through the Davis tube to concentrate the magnetite. Results of flotation followed by magnetic concentration of the tailing are as follows:

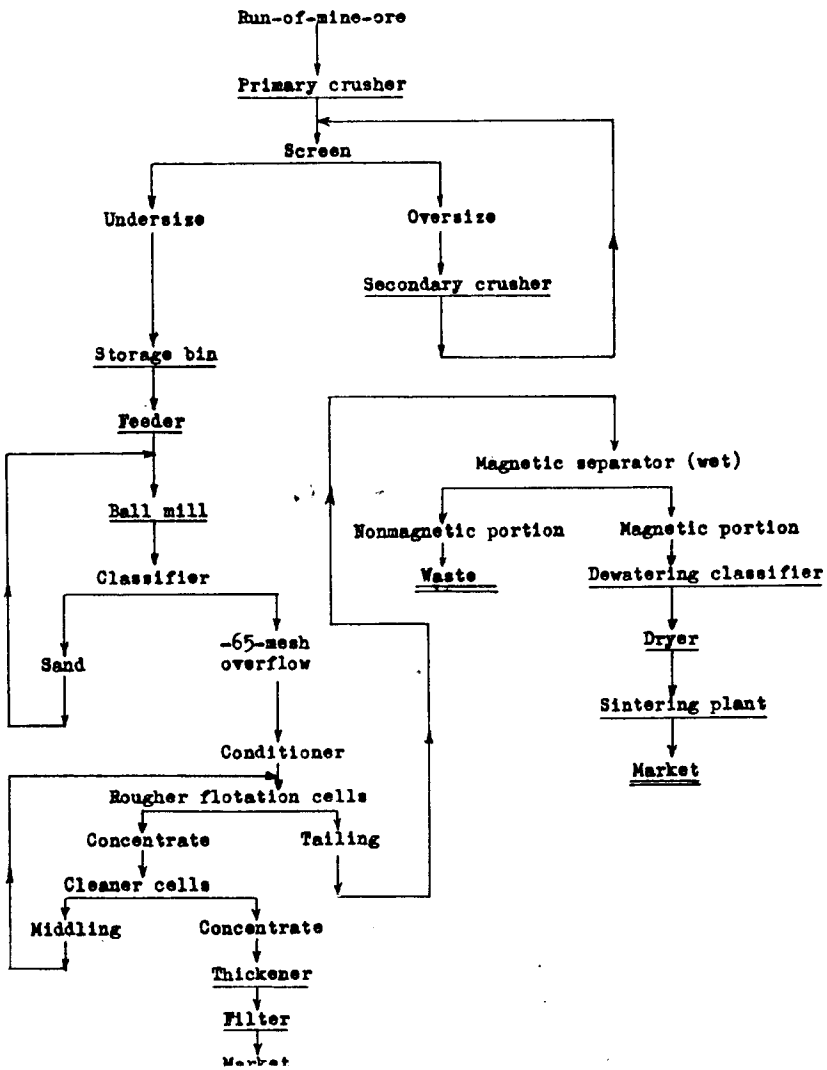
Product	Weight, percent	Analysis, percent					Percent of total	
		Fe	Cu	S	P	SiO_2	Fe	Cu
Copper concentrate	1.63	35.2	19.8	-	-	-	1.48	84.94
Copper middling	2.54	2.83	1.12	-	-	-	1.82	7.49
Magnetic concentrate	51.63	69.0	.03	0.61	0.05	0.90	92.20	4.08
Nonmagnetic tailing	44.20	3.9	.03	.17	.07	43.5	4.46	3.49
Composite	100.00	38.6	.38	.41	.06	20.5	100.00	100.00

The foregoing tests indicate that magnetic concentration of 100-mesh material before flotation pulls 7.3 percent of the copper into the magnetic material. In the test in which the material was first treated by flotation and the magnetite tailing was concentrated in the Davis tube, only

4.08 percent of the copper was contained in the magnetic concentrate. This is a serious consideration in an ore of 0.63 percent copper content, hence the more advantageous flow sheet probably would be one in which flotation preceded magnetic separation. Though the test was made on minus 100-mesh material, the grain size of the chalcopyrite indicates that the grade of the copper concentrate and the copper recovery would not be greatly impaired if the material were floated at minus 65-mesh size.

The sintered magnetite would comprise about 55 percent of the original mass. Of the remainder, less than 2 percent would be a marketable copper-gold-silver concentrate.

A suggested flow sheet for recovering the iron and copper is as follows:



A sintered product containing 69 percent iron, 5 percent insoluble material, 0.02 percent sulfur, and 0.02 percent phosphorus can qualify as a premium ore suitable for reduction in electric furnaces or it can be used to increase the output of open-hearth furnaces. Cheap electric power from Bonneville or Grand Coulee hydroelectric plants would favor the use of electric furnaces in the Puget Sound area. According to D. B. Gillies of the Republic Steel Corp.,[4] Adirondack magnetite concentrated and sintered is worth $0.1058 per unit of iron at the furnace.

CONCLUSIONS

The Jumbo magnetite deposit is a lenticular ore body between elevations of 1,400 and 1,700 feet overlying a diorite intrusive at a slope of 52 degrees southwest. Detailed mapping and sampling show a measured ore reserve of 95,150 long tons, an indicated reserve of 148,250 tons, and 68,500 tons of inferred ore containing 43.4 percent iron, 0.67 percent copper, 1.84 percent lime, 1.67 percent sulfur, trace of titanium oxide, 21.6 percent insoluble, 0.012 ounce per long ton gold, and 0.90 ounce per long ton silver.

Beneficiation tests indicate that flotation of ore ground to minus 65 mesh followed by magnetic separation of the flotation tailing will produce a magnetic concentrate containing 69 percent iron and permissible amounts of impurities, as well as a flotation copper concentrate containing 19.8 percent copper. The over-all recoveries of copper and iron were 84.94 percent and 92.2 percent, respectively.

4 Mining and Metallurgy, November 1943, Adirondack Mining Issue, p. 479.

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