U. S. DEPARTMENT OF THE INTERIOR
U. S. GEOLOGICAL SURVEY

The Salt Chuck Copper-Palladium Mine, Prince Of Wales Island, Southeastern Alaska

by
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With Preface
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Open-File Report 92-293

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Table of Contents

Illustrations

The Salt Chuck Copper-Palladium Mine, Prince Of Wales Island, Southeastern Alaska

Preface
by Robert A. Loney

The following report, "The Salt Chuck copper-palladium mine, Prince of Wales Island, southeastern Alaska" by H. R. Gault and Clyde Wahrhaftig, was written as a War Minerals Report for the Federal War Agencies in 1943, and classified "Confidential" for national security reasons. An open-file report (Open-File Rep. 46-19) on the same subject by Gault released in 1946, lacked many of the sections through the mine that are contained in the present report. Therefore, it seems appropriate at this time, in view of the economic interest in the mine and in the platinum group elements in general, to make this information available to the public. The report is reproduced here with only a slight change in format and no change in the original words or data.

The Salt Chuck Copper-Palladium Mine, Prince Of Wales Island, Southeastern Alaska

by H.R. Gault and Clyde Wahrhaftig

Introduction

This report summarizes the field results of a 3 1/2-month investigation of the Salt Chuck copper-palladium mine in the winter of 1942-43. The Salt Chuck mine is on a salt-water lagoon at the head of Kasaan Bay, Prince of Wales Island, southeastern Alaska about 43 miles by water WNW of Ketchikan, Alaska (fig.1). It can be reached by boat or by plane.

The lagoon, known as the Salt Chuck, can be entered only by small boats and barges an hour or so before and after high-tide. Steamers can operate to within about five miles of the entrance to the Salt Chuck.

The Geological Survey field party consisted of two geologists and a camphand. The accessible mine workings were mapped in detail using the backsight method with open-sight and telescopic alidades, transit, steel tape and stadia rod. The backsight method was necessary because of local variations in the direction of magnetic north, both on the surface and underground.

A generalized geologic map of a part of the Salt Chuck group of claims was made by pace traverses from claim corners using a mining-claim map as a base, but this map is not included in this preliminary report.

The property consists of a large number of claims and two millsites, all unpatented, which extend northerly from high-tide level. A mill is located on the water front, and the mine is about 1/2 mile north of the mill on a knoll nearly 400 feet high.

In addition to the present work and published material by Wright[1] and Mertie [2], access was had to earlier private reports and maps on the property. These private reports included one on an exploration program by the Solar Development Company in 1930. Seven diamond-drill holes were put down by this company. The cores from these holes are still available and were logged. The directions of the holes were determined by turning angles between the drifts and the holes. Information obtained from the Solar Development Company's core logs and from some of the maps in the private reports has been incorporated in this report and accompanying maps. The numbering of the diamond-drill holes on the maps in this report is that used by the Solar Development Company.

Mine description

The mill has been examined by engineers of the Bureau of Mines and therefore no description is given here. The mine consists principally of three levels and a large glory hole which narrows downward into three smaller glory holes and the old No. 1 stope (see figs. 2-4). The levels and glory holes are connected by numerous raises, ore chutes and stopes (see figs 6 and 9-25). The 300-, or lowest, level (fig. 4) is about 105 feet above high tide. The portal is approximately 1,300 feet from the mill ore bins and the main, or 300-drift, is 1,380 feet long.

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[1]Wright, C.W., Geology and ore deposits of Copper Mountain and Kasaan Peninsula: U.S. Geological Survey, Prof. Paper 87, p. 99, 1915.

2 Mertie, J.B., Jr., Lode mining in the Juneau and Ketchikan districts: U.S. Geological Survey, Bull. 714, pp. 121-127, 1921.

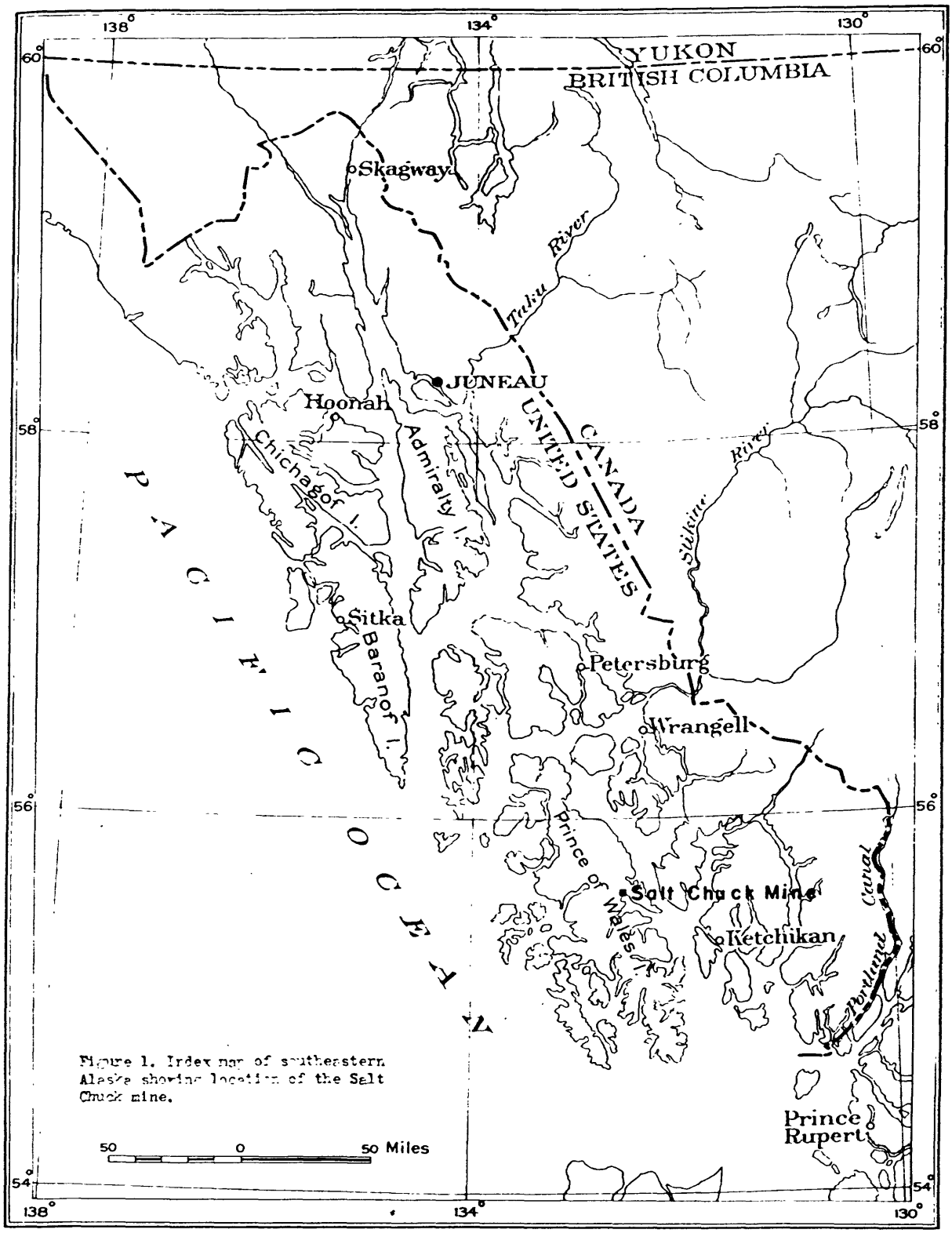

Figure 1. Index map of southeastern Alaska showing location of the Salt Chuck mine.

The west drift is turned westerly from the 300-drift at 1,000 feet from the portal and the 315- and 316-drifts are at 1,150 feet. Another drift is turned easterly from the 300-drift, 1,050 feet from the portal and rejoins the 300-drift about 1,160 feet from the portal. From this easterly drift the 311-, or southeast, drift and the 312-, 313-, and 314-drifts extend easterly and southerly.

The 200-level (see fig 3) is 110 feet above the 300-level and includes remnants of several drifts around the small glory holes as well as a north drift, a west drift, and a drift along the east side of the mine. The 200-level is connected with the 300-level by a raise from the 314-drift which opens into the 200-level on the east side. The 200-level is connected with the surface by a raise from a point near the north end of glory hole No. 1 and reaches the surface between the glory hole and the stripped area on the north ore body.

A "corkscrew" raise from the 311-drift enters the 308-stope on the south side and a short raise at the northeast corner of the 308-stope leads to the southeast end of the 200-level. From this point on the 200-level an almost vertical raise reaches the surface on the southeast side of the glory hole. This raise was not examined during the Geological Survey examination.

A third raise from the 300-level, at the intersection of the 300- and 314-drifts, opens into a small grizzly chamber which connects with the stope directly below glory hole No. 1. Two ore chutes, one emptying into this stope and the other into the grizzly chamber connect with the 201-stope. Several openings and old ore chutes connect the 201-stope with the old No. 1 stope. An ore chute and another opening at the east end of the 201-stone lead to the 308-stope.

A fourth raise from the 300-level connects the 313-drift with two small stopes below the 308-stope and with the No. 5 stope. The No. 4 and No. 5 stopes are inaccessible but are directly below glory holes No. 2 and No. 3 respectively. A raise and an ore chute, now filled with broken rock, connect the old No. 1 stope on the 100-level with the 200-level in the vicinity of the stope under glory hole No. 1.

The 100-level is 90 feet above the 200-level. All that remains of this level is a 120-foot adit from the surface to the northeast wall of glory hole No 1 across the glory hole from the old 100-level stope (No.1 stope). An ore chute from the north ore body passes under the raise between the 200-level and the surface and empties onto a grizzly on the west side of the 200-level below glory hole No. 1.

The positions of inaccessible drifts and stopes have been inferred from sections and maps by Lane[3] and from information gathered during the present examination.

Geology

The ore deposits are in pyroxenite and gabbro which form part of a large body of intrusive rocks at the upper end of Kasaan Bay [4]. The pyroxenite and gabbro are large irregular masses (figs. 5,6,7, and 8) which have been intruded according to no known pattern although observed contacts generally dip steeply to the south.

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[3]Lane, T.P., Private maps and sections furnished the Geological Survey by the Bureau of Mines, Maps and sections dated 1925.

[4]Wright, C.W., op. cit., pl. XV.

In the mine and the area immediately adjacent to it, the upper surface of the gabbro forms a steeply pitching trough which is filled with pyroxenite. The walls of the trough are nearly vertical and, in places, are overturned. Fingers and lobes of gabbro jut into pyroxenite and pyroxenite into gabbro. Southeast of the mine the strike of the gabbro-pyroxenite contact on the surface swings from about N to about E. The fingers and lobes of pyroxenite are more prominent and the pyroxenite is narrower in the southern part of the ground opened by the mine away from the bottom of the trough. Some evidence indicates that similar structures probably are present elsewhere in the area.

North of the glory hole, across a muskeg area, is a group of knolls and hills underlain by a brecciated porphyry which has been called augite porphyrite [5]. The contact between the "augite porphyrite" and the gabbro north of the glory hole is concealed beneath the muskeg. Small basic dikes, probably basalt, and thin, light-colored dikes, possibly aplite, cut the other rocks. Basic dikes are exposed in the western part of the mine at intervals from the surface to the 300-level. These may be parts of a single dike.

The pyroxenite is dark green and coarse grained and a pyroxene, probably augite, is the principal constituent. The pyroxenite contains minor amounts of feldspar. Magnetite is a common accessory mineral locally making up almost 10 percent of the rock. Chlorite and epidote are common alteration products. The typical gabbro is dark gray and coarse-grained containing feldspar and a dark mineral in about equal proportions. A gabbroic pyroxenite containing more feldspar then the normal pyroxenite, but less than the typical gabbro, is common near the gabbro-pyroxenite contact. South and west of the glory hole, the gabbro seems to grade into a lighter and finer-grained rock which for the purposes of mapping is called diorite. An altered gabbro, lighter colored than the typical gabbro and containing appreciable amounts of pyrite is exposed at the north end of the 300-drift and at the north end of the north drift on the 200-level.

The "augite porphyrite" is a fine-grained dark green or brown rock containing phenocrysts of augite or fragments of porphyry.

Throughout the area are bodies of altered pyroxenite and gabbro, and gabbro pegmatite. The basic dikes are fine grained, gray rocks. The aplites are white to pink.

A number of faults with small displacements can be traced through the mine. They are 4 inches to 24 inches wide and in the area of the main workings contain, in addition to fault gouge, considerable carbonate and chalcopyrite. These faults appear to fan out northward toward the trough from the narrow part of the pyroxenite body which fills the gabbro trough in the vicinity of the south end of the main workings. Other small faults and fractures are present throughout the mine and some contain carbonate veins, aplite, or very thin basic dikes. Wherever observed at the gabbro-pyroxenite contact the faults displace the contact. Known displacements are small.

The gabbro and pyroxenite appear to be almost contemporaneous differentiates of the same magma. The gabbro seems to be a little younger and to have intruded the pyroxenite.

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[5]Stewart, R.H., Report on the Salt Chuck mine, Dec. 2, 1921. (Private report furnished by A.L. Howard.)

Ore Deposits

The principal ore mineral at the Salt Chuck mine is bornite. Small amounts of chalcopyrite are locally associated with bornite. Chalcopyrite is the principal sulphide in the mineralized fault zones. Small flakes of native copper are widespread throughout the mine but are economically unimportant. Chalcocite and covellite have been reported as alteration products [6] and copper carbonates stain some weathered surfaces and fractures. Associated with the copper sulphides are gold, silver, and palladium in recoverable amounts, as well as a little platinum.

Pyroxenite and gabbro ore are recognized. The pyroxenite ore is massive pyroxenite with unevenly distributed, small to large, irregular grains of bornite. Bornite commonly occurs on fracture surfaces without penetrating far into the pyroxenite.

The gabbro ore is generally of lower grade than the pyroxenite ore and the sulphide grains are smaller and more evenly distributed through it.

The glory holes and stopes probably represent the general positions and shapes of the ore shoots which have been mined. In detail, the shoots probably were smaller than thus represented and contained barren zones. A number of small patches of ore in stope walls and small pillars represent remnants of these shoots. The ore shoots are more or less pod-shaped with their longest dimensions pitching steeply southeasterly. The ore shoots seem to become smaller and more irregular in the southern part of the main workings. Descriptions of the ore as it was mined suggest that the ore was richest near the center of each shoot [7].

Gabbro crops out northwest of glory hole No. 1 (fig. 2). The gabbro there contains disseminated bornite and some chalcopyrite and is known as the north ore body. The ore is leaner toward the edges of the outcrop and barren gabbro is exposed in the ore chute connecting the north ore body with the 200-level. Low-grade ore is exposed in portions of the raise from the 200-level to the surface between the north ore body and the glory hole. Scattered bornite grains are present in otherwise typical gabbro and in the gabbro containing disseminated pyrite near their contact at the north end of the north drift on the 200-level.

Figure 4 shows the ore on the 300-level. The Solar Development Company drill hole No. 2 cut about 60 feet of ore which apparently is the continuation of the ore between the 300-, 313-, and 314-drifts, herein called the middle ore body.

The gabbro on the southeast or 311-drift just east of the gabbro-pyroxenite contact, designated the southeast ore body, appears to be the continuation of the gabbro ore on the south side of the 308-stope.

At the south and west end of the glory hole and the old No. 1 stope the gabbro contains disseminated bornite but the estimated copper content is less than 0.5 percent (fig. 2).

A number of surface outcrops east and west of the mine have been reported to contain bornite and some of them were examined (fig. 5). South and east of the glory hole near the gabbro-pyroxenite contact, scattered bornite grains are present in the gabbro. An occasional grain of bornite is present in a ledge of pyroxenite near the two small gabbro areas 400 feet SSE of the glory hole

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[6]Mertie, J.B., Jr., op. cit., p 122.

[7]Howard, A.L., and Shepard, J.G., personal communications.

(fig. 5). This pyroxenite ledge is almost directly above the end of the southeast or 311-drift (figs. 4 and 6). Several trenches and prospect holes in pyroxenite 400 feet to 600 feet SSE from the glory hole are reported to contain bornite. A few grains of bornite were seen in specimens which presumably came from these trenches. The pyroxenite also contains a little bornite a few hundred feet farther to the east.

Several gabbro outcrops 400 feet to 700 feet west of the glory hole (fig. 5) contain scattered grains of bornite and it occurs also in the pyroxenite area south of Lake Three.

Two small adits, about 1,400 feet SW of the glory hole are in gabbro. The upper adit is partly caved but is about 30 feet long and entirely in gabbro. The lower adit is 115 feet long with two short side drifts and two winzes now filled with water (fig. 26). About 15 feet from the face of the lower adit is a gabbro-pyroxenite contact, which at the surface is a short distance north and uphill from the adit portal. Low-grade gabbro ore is exposed for about 30 feet along the adit walls near the contact.

The ore shoots in the mine apparently were controlled by the gabbro-pyroxenite boundary and by fractures and faults radiating into the steeply pitching, pyroxenite-filled gabbro trough. The pyroxenite in the mine and in its immediate vicinity may represent a local center of differentiation. The bornite was deposited from rising thermal fluids which presumably were differentiates of the same parent magma. The bornite was deposited in the pyroxenite after it was fractured.

The ore-bearing fluids followed the contact and spread into the fractured pyroxenite and into less-fractured gabbro. The more prominent fault zones, which where metallized now contain principally chalcopyrite, seem to have been the main channels for the dispersion of the copper-bearing fluids to the smaller faults and fractures and thence to the microscopic fractures reported by Mertie [8] The ore shoots are not bounded by the main fault zones but seem to lie in the vicinity of the fault zones which now contain carbonate and chalcopyrite.

The bornite in gabbro and pyroxenite east and west from the glory hole is, with one possible exception, near a gabbro-pyroxenite contact. The shape of the contact at these locations appears similar to the shape of the boundary in the mine.

Fault zones comparable in size to those in the mine cut many outlying outcrops but the faults distant from the mine are not mineralized, or are only slightly mineralized, with carbonate and sulphides. This lack of mineralization of outlying faults may indicate that bornite mineralization away from the mine is not of great significance.

Three small magnetite bodies 1 foot to 2 feet across and at least 20 feet long are exposed southeast of the glory hole. One body is in pyroxenite and the other two are in gabbro. They are not of economic importance.

Production and Reserves

The Salt Chuck mine, originally called the Goodro mine and also known as the Joker group [9], has been operated intermittently since 1910. At present it is controlled by the Alaska Gold and Metals Company under the direction of A.L. Howard but has nor operated since early in 1941.

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[8]Mertie, J.B., Jr., op. cit., p. 125..

[9]Wright, C.W., op. cit., p. 99.

Total production to 1941, based on incomplete records, is estimated to have been a little more than 300,000 tons of milling ore. The greater part of the production has been from pyroxenite ore.

The approximate average tenor of ore produced, estimated roughly from available records, is copper, 0.9 percent; and gold, 0.02 ounce, silver, 0.10 ounce, and palladium 0.05 ounce per ton. The amount of platinum recovered in negligible.

The positions of indicated and inferred ore bodies are shown on figures 2 to 4, and 9 to 25. In view of the limited data available no definite estimates of the tonnage of reserves are hazarded at this time. Exploration work, such as that recommended below, will furnish information for such estimates. However, the examination on which this report is based suggests inferred reserves of one fifth to one third of the ore so far mined. Larger reserves may be present. The grade of the inferred reserves may be lower than the average grade of the ore thus far mined. The following table presents the available analytical data on ore remaining in the mine.

Analyses of ore: Salt Chuck mine

Sample (number by Geol. Survey)	Location	Ore Body	Length of sample in feet	Cu (%)	Au (oz. per ton)	Ag (oz per ton)	Pd (1) (oz. per ton)
B-T (2)	surface	North	15	1.25	0.01	0.15	n.d. (3)
B-1 (4)	300-level	Southeast	10	trace	0.01	0.10	none
B-2	"	"	10	0.33	0.015	0.12	none
B-3	"	"	10	0.56	0.015	0.14	0.015
B-4	"	"	10	0.84	0.01	0.10	0.03
B-5	"	Middle	6	2.31	0.15	0.93	0.11
B-6	"	"	15	0.30	0.01	0.10	trace
B-7	"	"	6	0.64	0.05	0.25	0.05
B-8	Mill heads			0.77	0.02	0.18	0.015
B-9	concentrates			35.45	0.88	5.64	1.22
B-10	tailings			0.13	0.01	0.11	trace
S-1 (5)	D.D.H. No.2	Middle	3	0.24	trace	trace	
S-2	"	"	5	1.14	0.03	0.25	
S-3	"	"	5	0.39	0.02	0.12	
S-4	"	"	5	nil	trace	trace	
S-5	"	"	5	0.49	trace	0.12	
S-6	"	"	5	0.90	0.04	0.24	
S-7	"	"	5	0.28	trace	trace	
S-8	"	"	1	5.50	0.06	1.30	
S-9	"	"	0.5	1.04	0.04	0.48	
S-10	"	"	5	1.02	trace	0.10	
S-11	"	"	5	0.22	trace	0.10	
S-12	"	"	5	0.79	trace	0.20	
S-13	"	"	2.5	0.60	0.01	0.17	

(1) Reported as platinum group.
(2) Sample taken by R.L. Thorne, Bureau of Mines, 1942 (fig.2).
(3) n.d.; not determined.
(4) Samples B-1 to B-10 taken by S.P. Holt and R.L. Thorne, Bureau of Mines, 1942 (fig. 4).
(5) S-1 to S-13, analytical results of samples from Solar Development Company diamond-drill cores, 1930 (fig. 4).

The analysis of sample B-T from the north ore body shows a higher copper content than that estimated from the outcrop of this body. Average grade of the north ore body as estimated by the present operator [10] is copper 0.90 percent; and gold, 0.02 ounce, silver 0.10 ounce, and palladium, 0.05 ounce per ton.

Locations of samples from the middle and southeast ore bodies are shown on figure 4. Sample B-5 is richer than other samples of the middle ore body (B-6 and B-7). Comparison of the exposures from which these samples were taken suggests that sample B-5 is not representative of the middle ore body. Samples B-1 and B-2 from the southeast ore body were taken along a fault in gabbro ore exposed in the 311-drift.

None of the portions of the drill cores analyzed by the Solar Development Company are available.

Recommendations

If the demand for copper in the present emergency and the availability of a mill warrant further investigation of copper deposits of the size and grade of the Salt Chuck deposits, the following recommendations are made for the exploration of the ore bodies described above. Further recommendations and estimates of reserves will depend upon the results of the program outlined below.

The directions, inclinations, and lengths of the proposed drill holes are summarized in the following table. It is suggested that the holes be drilled in the sequence in which they are discussed below.

Summary of proposed drill holes, Salt Chuck mine

Hole	Bearing	Inclination	Length	Ore Body
A	N 28 W	-60°	80 feet	Middle
B	N 64 W	-45°	150	Middle
C	N 63 E	+30°	100	Southeast
D	S 54 E	-45°	150	Southeast
E	S 47 W	-50°	150	Southeast
F	N 12 E	horizontal	180	North
G	N 38 W	"	140	North
H	N 62 W	"	160	North

The collars of the drill holes directed downward are in the floors of the drifts and the collar of the hole directed upward in the back of the drift. The three horizontal holes start from the same point in the raise in the western part of the mine between the 200-level and the surface. The lengths of the holes given in the table are believed to be sufficient for locating the boundaries of the ore bodies but geologic data revealed during drilling may indicate the desirability of increasing or decreasing the suggested lengths. Projections and intersections of the proposed holes on the maps and sections are shown on figures 3,4, and 9 to 25.

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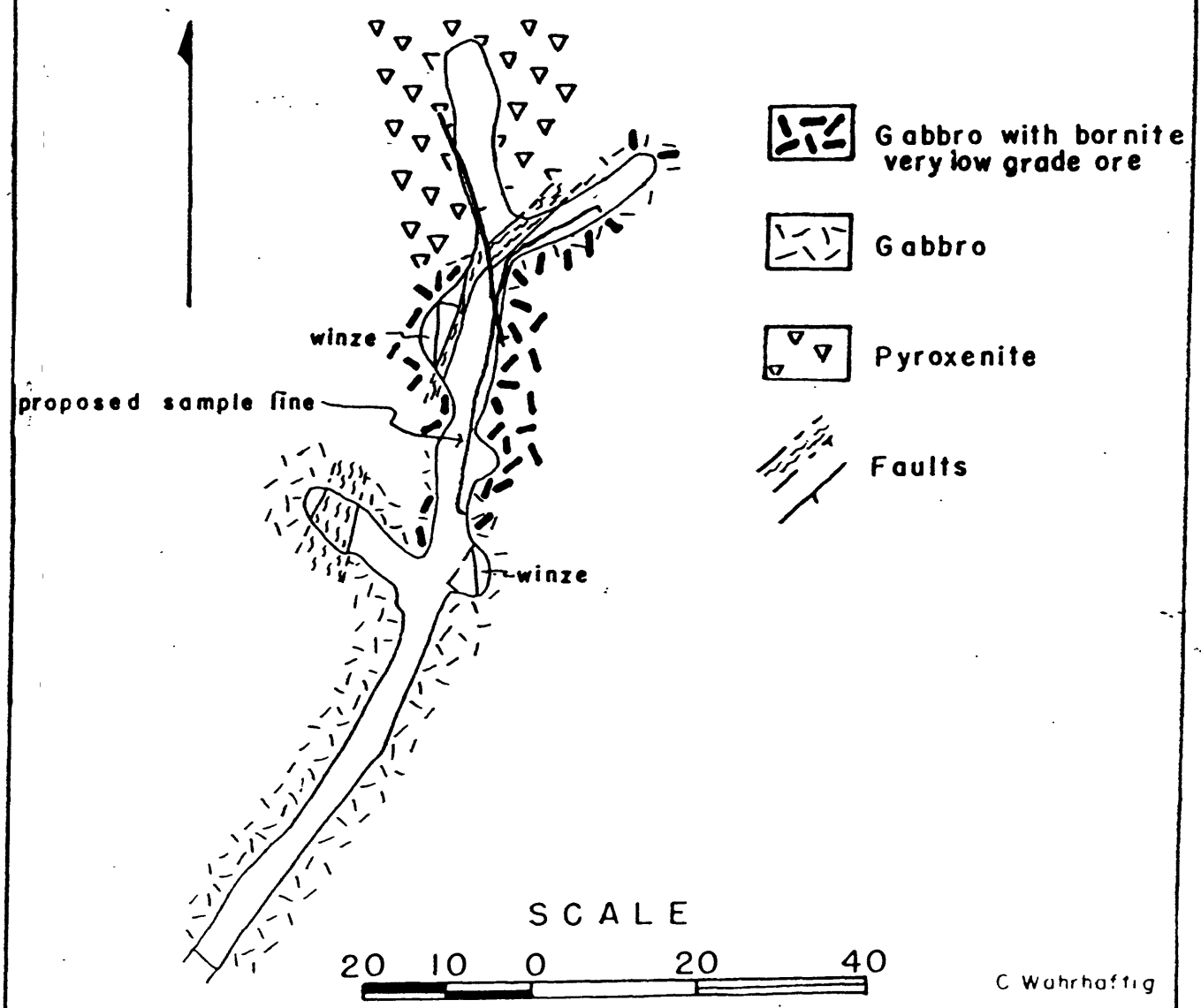
[10]Howard, A.L., Private report on the Salt Chuck mine, Jan. 7, 1935.

FIGURE 26

GEOLOGIC MAP OF LOWER ADIT,

WEST OF THE SALT CHUCK MINE



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North ore body

In conjunction with the diamond-drill holes, it is recommended that 8 lines of samples be cut on the surface (fig.2). Sample cuts 1-6 should be continued beyond the stripped area as far as bornite is found to continue. Sample cuts 7 and 8 are suggested to determine the extent of bornite beyond the east and west ends of the stripped area and should be continued as far as bornite is found.

Diamond drill holes F,G, and H are planned to locate the east and west edges and the upper and lower boundaries of the north ore body 70 feet above the 200-level and 35 to 75 feet below the surface outcrop. Further drilling of the north ore body will depend upon the information yielded by holes F,G, and H. One or more basic dikes will probably be encountered in hole H and possibly in hole G. The exposures on the 200-level suggest that the north ore body does not continue to the depth of this level, except perhaps as very low-grade material.

Middle ore body

Holes A and B are recommended to locate the upper and lower boundaries of the middle ore body. These two holes, in conjunction with the Solar Development Company hole No. 2, will explore this ore body to a depth of about 100 feet below the 300-level.

Southeast ore body

The proposed drill hole C is directed so as to determine the southern extent and the NE and SW edges of the southeast ore body. This ore body is inferred for only a short distance below the 300-level on figures 9,10,11, and 25, but holes D and E are recommended to determine the depth to which this body continues and to locate its upper and lower boundaries.

Other exploration

Although it has been suggested (p.6) that the exposures of bornite distant from the mine may not be significant, the low-grade gabbro ore in the lower adit about 1,400 feet west of the glory hole may justify sampling (fig. 26). If the analyses of such samples suggest that further exploration is worthwhile, recommendations can be made.

Other occurrences of bornite away from the immediate vicinity of the mine have been described above, but no exploration appears justified. Small amounts of bornite have also been observed, or reported at a number of places in the mine, such as at the end of the west drift on the 300-level and 170 feet from the end of the 311-drift, but here also there is no geologic evidence to warrant exploration.

Bornite may be found from time to time at other places on the surface and in the mine. Some of these places which may be found in the course of mining or prospecting might be sufficiently attractive to make systematic exploration desirable. However, the Geological Survey feels that, in the light of the present evidence, exploration should be confined to the 3 ore bodies discussed in this report and probably should be along the lines suggested herein.