SUPERSEDED by Bull. 938-B

37998

UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington

ZINC DEPOSITS OF GROUNDHOG BASIN, WRANGELL DISTRICT, SOUTHEASTERN ALASKA

By

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INTRODUCTION

Groundhog Basin is on the mainland of southeastern Alaska about 13 miles easterly from Wrangell (see fig. 1). A Forest Service trail to Lake Virginia starts a few hundred feet north of the mouth of Mill Creek on Eastern Passage, about 9 miles by water from Wrangell (see fig. 2). The trail leads to the southwest end of Lake Virginia, a distance of about 1 mile. Lake Virginia is about 2¼ miles long and ½ mile wide. In 1942 a trail was slashed out along its north side by Ventures Limited.

An old sledge trail cleared and repaired by Ventures Limited extends for about 5½ miles from the east end of Lake Virginia at the mouth of Porterfield Creek to a small cabin near the mouth of the South Fork of Porterfield Creek (see fig. 2). From the cabin a trail extends about 1 mile to the deposits in Groundhog Basin. A foot trail begins at Lake Virginia 2,000 feet north of the mouth of Porterfield Creek and joins the sledge trail 3½ miles from the lake. The sledge trail is preferable to the foot trail which crosses about 2 miles of muskeg.

The Forest Service trail to Lake Virginia is about 8 feet wide and with few improvements could be made suitable for trucks. The north side of Lake Virginia is more suitable for a road than the south side. From Lake Virginia to Groundhog Basin the best route for a road probably is near the base of the mountains north and west of Porterfield Creek.

Lake Virginia is about 110 feet above sea level. The average gradient of the lower 6 miles of Porterfield Creek is about 110 feet per mile. The South Fork of Porterfield Creek drains Groundhog Basin and drops about 2,000 feet in 1-1/3 miles. In 1942 the upper part of the valley of the South Fork of Porterfield Creek was covered by snow until late in August (see fig. 3).

Timber line in Groundhog Basin is at an altitude of about 1,000 feet. Near the cabin are good stands of spruce and hemlock suitable for general mine and camp use.

During the summer of 1942 the Geological Survey carried on a 2½-month investigation of the zinc deposits of Groundhog Basin. Prior to this investigation only brief studies of the deposits had been made.1/

During the winter of 1942-1943 Ventures Limited carried on an exploratory program (exploration work by Frobisher Exploration Company).2/ The diamond-drill cores obtained by Ventures Limited are in the cabin in Groundhog Basin. In the summer of 1943 the Geological Survey mapped the continuation of the ore beds south from the Groundhog Basin into the Glacier Basin, but a report on the results of this work has not yet been prepared. The diamond-drill cores obtained by Ventures Limited were logged by the Geological Survey in 1943.

The four patented claims in the Groundhog Basin are owned jointly by William D. Grant, Katherine S. Blackburn, B. Y. Grant and the Donald Sinclair estate of Wrangell, Alaska. Two mill sites have been located, one near the zinc deposits and one at tidewater near the mouth of Mill Creek. Most of the exploratory work was done more than 20 years ago.3/ Four tunnels were driven and are still in good condition. Tunnel no. 1 is the lowest tunnel and the only one on the southwest side of the valley. (See fig. 3.) It is at an altitude of 1,620 feet, is 16 feet long and cuts the no. 1 ore bed. Tunnel no. 2 (see figs. 3 and 4) is at an altitude of 1,870 feet and is crosscut 160 feet long. The nos. 2, 3 and 4 ore beds and a slightly metallized breccia vein are exposed in the crosscut. At the end of the crosscut a drift follows the no. 4 ore bed 20 feet northwesterly and 50 feet southeasterly (see fig. 4). At the southern end of the drift a crosscut southwesterly for 13 feet passes through the breccia vein and into the no. 3 ore bed.

The no. 3, or main tunnel, at an altitude of 2,075 feet, is 410 feet southeast of tunnel no. 2. Tunnel no. 3 is 170 feet long and cuts the no. 4 ore bed 100 feet from the portal. The no. 4, or upper tunnel is 75 feet vertically above tunnel no. 3 and 60 feet northeast. It is 16 feet long and cuts the no. 4 ore bed.

A representative of Ventures Limited briefly examined the Groundhog Basin zinc deposits in the spring of 1942, and collected twelve samples before the Survey began its examination. The company carried on a more extensive exploration program from November 1942 to March 1943. The work was greatly handicapped by an

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1/ Wright, F. E. and C. W., The Ketchikan and Wrangell mining districts: U. S. Geol. Survey Bull. 347, pp. 188-189, 1908.

Buddington, A. F., Mineral deposits of the Wrangell district: U. S. Geol. Survey Bull, 739, pp. 58-63, 1923.

2/ Smith, Alexander, Report on Groundhog Basin claims, Wrangell district, Alaska. (Private report, dated April 13, 1943).

3/ Buddington, A. F., op. cit.

unusually severe winter. Two diamond-drill holes were completed and a third drill hole was begun but discontinued before all of the ore beds were cut. A number of surface and underground samples were collected. The results of this investigation have been made available to the Geological Survey.4/

Diamond-drill hole no. 1 (see fig. 4) intersects the no. 3 and no. 4 ore beds and a basalt dike not exposed at the surface at about the same altitude as tunnel no. 2. Diamond-drill hole no. 2 intersects the no. 3 and no. 4 ore beds, the breccia vein, and the composite dike exposed on the surface 140 feet southeasterly from the portal of tunnel no. 2 at about the same altitude as tunnel no. 2. Diamond-drill hole no. 3 was not completed but intersects the no. 2 ore bed about 50 feet below the surface.

Chemical analyses have been made of a number of samples collected by the Geological Survey and by the Bureau of Mines. Specimens collected by the Geological Survey have been studied in the laboratory and some mineralogical and spectrographic determinations have been made.

GEOLOGY

The deposits are ore-bearing beds in a belt of metamorphic rocks and near a mass of quartz diorite. The metamorphic rocks originally were sediments which have been folded, dynamically metamorphosed, and intruded by a mass of quartz diorite. Dikes and sills of quartz porphyry and basalt cut the metamorphosed sediments and the quartz diorite.

A large sill of granite crops out along the southwestern slope of the mountain on the northeast side of the South Fork of Porterfield Creek (see fig. 2). In many places the contact of the sill with the older gneisses and schists is covered or inaccessible. The sill strikes northwesterly parallel to the cleavage and bedding of the gneisses and schists which it intrudes. It may continue for several miles northwesterly across the valley of Porterfield Creek but its southern end is northeast of, and above, the north end of the outcrop of the principal zinc deposits. At its southern end it terminates abruptly except for a few apophyses which continue southeasterly as sills. The granite sill is at least 1,000 feet wide.

The metamorphic rocks are fine-grained gneisses, schists and phyllites. The gneisses include hornblende, biotite-hornblende and pyroxene varieties. The schists consist of quartz-biotite, biotite-feldspar and biotite-muscovite varieties. Some gneisses and schists contain garnet. The ore beds are pyroxene granulites containing sulfide minerals and small amounts of amphibole. Fine-grained, banded, pyroxene hornstones are locally intercalated with the ore beds.

The quartz diorite is gray, coarse-grained, and is rudely foliated, at least near its contact with the metamorphic rocks. Plagioclase, biotite, hornblende and quartz are its essential constituents. The quartz porphyry sills and dikes

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4/ Smith, Alexander, op. cit.

are light colored. Those of basalt are dark green to black and the coarser grained and wider sills and dikes are generally porphyritic. The granite sill is light colored, coarse-grained, and comprised of feldspar, quartz and biotite. At the southern end of the sill, the granite grades into the quarts porphyry of the apophyses within short distances. Fluorite and topaz are widely distributed in the quartz porphyry sills and also are present in the large granite sill.

The bedding and cleavage of the metamorphic rocks are parallel and strike N. 15° - 45° W. The dip is commonly 60° to 70° northeasterly, but ranges from 45° to vertical. The contact of the metamorphic rocks with the quartz diorite is in general parallel to the bedding and dips steeply northeasterly. (See fig. 3.) The sills generally trend a few degrees more northerly than the bedding. The dikes ordinarily strike N. 15° - 30° E. and are vertical or nearly so. A breccia vein extends through the area about parallel to the bedding and lies between the no. 3 and no. 4 ore beds to the north and below the no. 3 bed to the south. Small faults, many occupied by quartz veins, cut the bedding.

ORE DEPOSITS

General Statement

The ore is of two general types, a solid-sulfide type and a disseminated-sulfide type. These two types grade into one another. The solid ore is black, dary gray, or dark brown and is composed principally of pyrrhotite and sphalerite with small amounts of galena, very little chalcopyrite and other sulfide minerals and some gangue. The gangue minerals are quartz and such metamorphic silicate minerals as hornblende, pyroxene, epidote and garnet. The ore is commonly banded and the bands are from 1 mm. to about 15 mm. thick. Each band is ordinarily made up predominantly of one sulfide mineral. The footwall boundary of solid ore is ordinarily well-defined but irregular. The hanging wall boundary is less distinct than the footwall but is more regular. The wall rocks nearest the ore are commonly light-colored, banded or ribboned hornstones.

The disseminated ore is dark green to brown and sphalerite is the only sulfide mineral which can be readily recognized, but other sulfide minerals, chiefly pyrrhotite, are present. The sulfide minerals in places are disseminated through the pyroxene granulite and in other places are concentrated in pods and discontinuous bands.

The mineralogy, continuity and structure of the ore and the proximity of a large granitic body suggest that the deposits were formed by replacement of certain beds in the metamorphic section by means of mineralizing fluids emanating from the large granitic body nearby.

Ore beds

Four zinc-bearing beds are known in Groundhog Basin and are herein designated nos. 1, 2, 3 and 4. The no. 1 bed, also known as the Lee bed, is stratigraphically the lowest. The no. 4 bed is stratigraphically the highest and is the "main vein" of the owners and of Buddington.5/

5/ Buddington, A. F., op. cit.

The no. 2 ore bed was not identified in drill holes nos. 1 and 2 and is a seam less than ½ inch thick in tunnel no. 2. A 1½-foot zone of disseminated ore was cut in diamond-drill hole no. 3 at a point (see fig. 4) where it can be identified as the no. 2 ore bed.

The no. 1, or Lee bed, was traced intermittently for more than 4,300 feet horizontally through a vertical range of almost 1,900 feet. The bed is zinc-bearing along its entire exposed length except for a 100-foot interval about 175 feet southwesterly from the right-angle bend in the South Fork of Porterfield Creek. At that place is about 1 foot of magnetite-bearing rock near the hanging wall. The magnetite makes up about 50 percent of the rock and is the only ore mineral identified.

Solid ore is exposed in the no. 1 tunnel but the ore thins abruptly both along the strike and upward. The 2 feet of ore in the tunnel is the widest observed in the no. 1 bed although several shoots 6 inches to 12 inches wide and 15 or more feet long crop out farther south. The sphalerite is commonly along the hanging wall of the no. 1 bed.

Three sills are closely associated with the ore beds (see fig. 3). The sills lie stratigraphically above the ore beds at the northern end of their outcrop. The lowest sill cuts the no. 4 bed about 850 feet southeasterly from tunnel no. 3 and the middle and highest sills cut it farther to the southeast. The lowest and middle sills split the no. 3 ore bed and are interwoven between sheets of the ore bed for at least 600 feet along its outcrop in the southern part of the mapped area before they cross the bed.

Mineralogy of the ore beds

Pyrite, pyrrhotite, sphalerite, galena, chalcopyrite and magnetite and probably tennantite, tetrahedrite and cubanite have been identified in the ore. Associated minerals are quartz, biotite, chlorite, hornblende, pyroxene, actinolite and small amounts of garnet and apatite.

Dark brown to black sphalerite of the iron-rich variety marmatite is the only zinc mineral known in Groundhog Basin. The index of refraction has not been determined precisely but all of the sphalerite tested has an index of refraction greater than 2.40 which is above that of ordinary sphalerite and in the range of marmatite.7/

The sphalerite carries abundant inclusions of chalcopyrite and pyrrhotite. The inclusions are rounded to angular and commonly are arranged in lines parallel to crystallographic directions in the sphalerite. Some of the inclusions are less than .001 mm. in diameter, but more than 50 percent are between .002 mm. to .005 mm.

7/ Index of refraction determinations by J. J. Glass, Geological Survey.

The no. 4 bed was traced for a horizontal distance of 3,700 feet through a vertical range of 1,500 feet (see fig. 3). The northernmost exposure of the no. 4 bed is in the north face of the drift in tunnel no. 2 where the ore is 4 feet wide. Diamond-drill hole no. 1 of Ventures Limited cuts the no. 4 bed about 80 feet north of this point. The northern 1,350 feet of the ore bed as mapped in 1942 and cut by diamond-drill holes no. 1 and no. 2 contains the solid ore, but the solid ore is not continuous in this interval. The vertical range of solid ore in this 1,350-foot interval is about 675 feet. This part of the bed is from 1½ feet to 8 feet wide and averages about 3 feet. The southern 2,225 feet is disseminated ore and the width ranges from 5 feet to 11 feet and averages about 6½ feet.

According to Buddington's map[6/] the ore bed extends about 1,200 feet northwesterly from, and about 250 feet lower than, the ore cut by diamond-drill hole no. 1, and extends about 1,450 feet northwesterly from the northernmost surface exposure seen in 1942. This 1,450-foot interval was covered by talus in 1942.

The no. 3 ore bed at its most northerly outcrop lies about 15 feet stratigraphically below the no. 4 bed and at its most southerly outcrop about 75 feet below. Part of this difference in stratigraphic distance between the beds is the result of the intrusion of sills between them. The no. 3 bed is not a continuous ore body although it contains some sphalerite along its entire outcrop. The northern one-third of the bed contains at least three shoots of solid ore. The remainder of this northern one-third is green and gray, banded gneiss with small lenses and pods of sulfide minerals. The southern two-thirds of the bed as exposed is disseminated ore similar to that in neighboring parts of the no. 4 bed.

Diamond-drill hole no. 2 intersects beds of solid ore and disseminated ore intercalated with gneiss (see fig. 4) both below and above the breccia vein. At the surface and in tunnel no. 2 a breccia vein lies above the no. 3 ore bed and below the no. 4 ore bed. Although the breccia vein cut by diamond-drill hole no. 2 is much wider than at the surface and in tunnel no. 2, it is believed to be the same vein. Therefore the intercalated ore-bearing beds and gneiss which lie respectively below and above the breccia vein in diamond-drill hole no. 2 are thought to represent the no. 3 and no. 4 beds, and, at the surface, in drill hole no. 1, and in tunnel no. 2, the easternmost ore bed is identified as the no. 4 ore bed.

Several interpretations as to the identity of the ore-bearing beds cut by diamond-drill hole no. 2 can be made. For example, the intercalation of ore-bearing beds and gneiss may result from faulting. The intercalation may also represent interbedding of material which the ore-bearing fluids did not replace.

The no. 2 bed lies 10 feet to 65 feet stratigraphically below the no. 3 bed and is 4 inches to 24 inches wide, averaging about 8 inches (see fig. 4). The northern 150 feet of its outcrop is partly solid ore and partly disseminated ore. Farther southeast the no. 2 bed is green banded gneiss, locally containing small amounts of sphalerite. The no. 2 bed is not shown on figure 3, and was not traced continuously as far as the other ore beds. It may be as continuous as they are.

6/ Buddington, A. F., op. cit., p. 59.

One sample of sphalerite contained 12.74 percent of iron.[8] The material analyzed was free of megascopically visible inclusions of other minerals. A second sample of sphalerite contained the following:[9]

	Percent
Zn	50.28
Fe	14.44
S	32.65
Cu	0.26
Cd	0.46
As	0.39
Mn	0.04
CaO	none
MgO	0.25
Dissolved SiO_2	0.18
Insoluble	0.66
Moisture, 110°	0.06
	99.67

A spectogram of this second sample shows Sn, In, and Tl in addition to the above listed components.[10]

Five additional samples of ore and one of sphalerite (selected, nearly pure material) were examined spectrographically. Elements identified in the ore and the sphalerite include titanium, tin, arsenic, calcium, cobalt, nickel, barium, manganese, antimony, cadmium, and silver.[11]

A little gold has been reported by the Bureau of Mines in samples collected by that bureau but was not identified spectrographically in material collected by the Geological Survey. The silver content varies roughly with the lead content, but, as some nearly lead-free material contains appreciable silver, some of the silver may be associated with sulfide minerals other than galena. The cadmium is in the sphalerite.

Breccia vein

The extensive breccia vein which passes through the area about parallel to the bedding lies between the no. 4 and no. 3 ore beds at their northern outcrops, but cuts the no. 3 bed about 200 feet northwest of the right-angle band in the South Fork of Porterfield Creek at an altitude of about 2,675 feet and is stratigraphically below the no. 3 bed south of the bend. The breccia vein in diamond-drill

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8/ Analyst, Samuel H. Cress, Geological Survey.

9/ Analyst, K. S. Murata, Geological Survey.

10/ Spectrographic determinations by K. S. Murata, Geological Survey.

11/ Spectrographic determinations by Cyrus Feldman, Geological Survey.

hole no. 2 is about 40 feet thick. It has not been identified in diamond-drill hole no. 1. That it may there lie stratigraphically above the no. 4 ore bed beyond the end of the drill hole is indicated by broken ground at the end of the drill hole[12/] and by the fact that elsewhere in the general vicinity the breccia vein in places cuts across the foliation at flat angles.

The breccia vein is made up of sheared and brecciated metamorphic rock. Along much of its outcrop it is silicified and is but by a reticulate network of drusy quartz veins. Many of the small cross faults which cut the metamorphic rocks and the quartz diorite also contain drusy quartz veins. The breccia vein in tunnel no. 2, however, is slightly metallized, sheared pyroxene rock. Here and there the breccia vein is slightly metallized with galena, pyrite, sphalerite and chalcopyrite. Fluorite is recognized in the breccia vein and in the small cross faults throughout Groundhog Basin but it is a conspicuous constituent only at altitudes above 2,500 feet. The fluorite generally occurs as crystals in the quartz veins.

Mineralized sills

Some of the quartz porphyry sills and apophyses of the large granite sill contain small amounts of sulfide minerals. Lack of time and the inaccessibility of the slopes prevented locating and tracing all of these sulfide-bearing sills. The sulfide minerals occur in patches or are disseminated in a dense, dull gray matrix throughout part of the width of the sills for distances along their strike of 25 feet to 100 feet. The sulfide-bearing sills which have been examined are not economically important. Pyrite, pyrrhotite, galena, and sphalerite have been identified in the sills. Garnet and pyroxene are associated with the sulfide minerals in one sill.

Molybdenite deposit.- A small deposit of molybdenite crops out about 1,500 feet N. 30° E. from tunnel no. 1 (see fig. 4) near the southern end of the large granite sill. Presumably this deposit is the one briefly referred to by Smith.[13/] Molybdenite is distributed through an observed vertical range of about 1,000 feet. The boundaries of the deposit were not mapped but the main molybdenite-bearing part of the sill is at least 100 feet long horizontally, lies between the altitudes of 2,400 feet and 2,600 feet and is about 300 feet north of the southern end of the sill. Fractures in the granite have a moderately regular pattern and are 4 to 8 inches apart. Molybdenite is irregularly distributed as coatings on the fracture surfaces and in the quartz veinlets which fill some fractures. No other sulfide minerals were seen with the molybdenite.

Some loose pieces of gneiss and schist found below the sill contain fractures coated with molybdenite or molybdenite-bearing quartz veinlets in fractures and along bedding planes, and indicate that the molybdenite mineralization spread outward slightly beyond the limits of the sill. This molybdenite deposit is probably economically unimportant.

12/ Smith, Alexander, personal communication, and Geological Survey log of core.

13/ Smith, P. S., Mineral Industry of Alaska in 1930: U. S. Geol. Survey Bull. 836, p. 81, 1933.

The Geological Survey tonnage estimates are believed to be minima and would probably be greatly increased by further exploration. The continuation of the ore beds northwest of diamond-drill hole no. 1 is suggested by the owner's sample mentioned above (p. 17). The extent in depth of the ore has been tested for about 100 feet only below the surface by the tunnels and drill holes.

Any estimate of reserves southeast from the place where solid ore passes into disseminated ore in the no. 3 and no. 4 beds would be hazardous. Disseminated ore is known to crop out southeast of Groundhog Basin for 2½ miles to Glacier Basin. Although fluorite occurs in Groundhog Basin at the lowest altitudes at which solid ore is exposed in the no. 3 and no. 4 beds, it is a conspicuous constituent of the breccia vein and small faults only above an altitude of about 2,500 feet. If the transition upward of solid ore to disseminated ore and the more conspicuous presence of fluorite above the same altitude, reflects mineral zoning, then solid ore might be expected farther southeast below the disseminated ore and the possible reserves would be much larger than estimated above.

Grade

The analytical results of surface, underground, and drill-core samples taken by the Geological Survey, by the Bureau of Mines,15/ and by Ventures Limited are given in the following table. Locations of these samples are shown on figures 3 and 4.

Analytical results on samples from the Groundhog Basin zinc deposits.

Surface Samples

Sample (1)	Length of cut in feet	Ore bed	Zn percent	Pb percent	Ag ounces per ton	Remarks
F-45	2.5	1	4.4	3.7	4.4	above tunnel No. 1
F-42	2.9	1	6.4	tr.	0.14	"
F-44	5.0	1	1.1	"	0.12	"
F-47	3.3	1	10.5	2.1	1.6	south of tunnel No. 1
F-46	1.0	1	8.4	4.7	2.1	"
F-48	1.3	1	4.1	0.1	0.1	"
F-49	1.2	2	6.3	tr.	0.06	
F-50	1.7	2	1.0	"	0.16	
F-51	2.7	2	2.5	"	tr.	
F-52	1.6	2	2.5	"	0.06	
F-53	2.2	2	14.1	"	0.10	
F-54	1.7	2	10.7	"	0.72	
F-55	2.5	2	tr.	"	0.14	

15/ Samples collected by R. L. Thorne, Bureau of Mines, August, 1942.

RESERVES

Tonnage

No ore has been produced from the Groundhog Basin and the estimates of reserves given below are mostly of indicated and inferred ore.

The solid ore of the no. 4 bed, as known at present, extends for 1,350 feet horizontally with an average width of about 3 feet. Using a factor of 8 cubic feet per ton there would be about 500 tons per foot of ore bed down the dip. On the basis of surface outcrops, however, about 22 percent of the bed is lean ore and waste. If this relationship is assumed to hold with depth, it reduces the indicated tons per foot down the dip to about 400. The known vertical range of solid ore in the no. 4 bed is 675 feet. The lowest exposure in solid ore is in diamond-drill hole no. 1. This ore continues for an unknown distance northward. The owners have reported a sample of material which probably was solid ore, taken about 1,000 feet northwesterly from the place where the no. 4 bed is cut by diamond-drill hole no. 1. Solid ore in the no. 1 bed is exposed in tunnel no. 1, 250 feet below tunnel no. 2. Therefore it seems reasonable that the solid ore in the no. 4 bed may continue for at least 600 feet down the dip of the ore bed from its known surface outcrop. Assuming that the tons per foot of depth are maintained through this 600-foot extent, there is a block of indicated ore containing about 240,000 tons. If the no. 4 ore bed continues northward to the point from which the owners have reported an assay, the block of ore described above is increased by about 180,000 tons of inferred ore with no greater inferred depth.

The no. 3 bed contains at least three shoots of solid ore. The southernmost of the three known shoots is 130 feet long and averages 5.5 feet wide; the second or middle one is 120 feet long and averages 2.8 feet wide; and the third or northernmost is exposed only in tunnel no. 2 and diamond-drill hole no. 1. The solid ore in the no. 3 bed in diamond-drill hole no. 2 may be the continuation in depth of the second shoot.

The first and second shoots may contain about 130 tons of ore per foot of depth down the dip.

The no. 2 bed apparently is not economically important. Although the no. 1 bed contains solid ore in tunnel no. 1, the tonnage of ore which can be estimated is very small.

The estimate by Ventures Limited of ore per vertical foot for both the no. 3 and no. 4 beds over a horizontal distance of 940 feet, is 481.7 tons.[14/] The 940 feet, however, does not include the southern 400 feet of solid ore used in the Geological Survey estimate, presumably because this interval was not tested by Ventures Limited. This company used a thickness of 3.90 feet for the no. 4 bed and 3.95 feet for the no. 3 bed over the 940-foot interval tested, whereas the Geological Survey used 3.0 feet over a 1,355-foot interval for the no. 4 bed and 4.2 feet for the no. 3 bed. Ventures Limited estimates that 75 percent of the no. 4 bed and 43 percent of the no. 3 bed is ore over the interval tested by that company.

14/ Smith, Alexander, op. cit., p. 11.

Sample	Length of cut in feet	Ore bed	Zn percent	Pb percent	Ag ounces per ton	Remarks
F-58	4.6	4	14.8	nil	0.32	D. D. H. No. 1
F-57	5.5	"	15.6	nil	0.34	D. D. H. No. 1
F-59	3.4	"	0.2	nil	0.10	D. D. H. No. 1
F-1	4.5	"	8.3	nil	0.32	Tunnel No. 2
F-2	5.5	"	2.5	nil	0.16	Tunnel No. 2
F-3	2.3	"	17.1	nil	0.40	Tunnel No. 2
F-4	3.0	"	11.4	nil	0.36	Tunnel No. 2
F-5	3.0	"	4.4	nil	0.08	Tunnel No. 2
F-6	3.5	"	1.6	nil	0.12	Tunnel No. 2
F-7	1.5	"	1.8	nil	0.38	Tunnel No. 2
F-63	1.3	"	1.4	tr.	0.72	D. D. H. No. 2
F-64	4.5	"	10.1	6.8	9.1	D. D. H. No. 2
F-11	9.5	"	5.9	6.6	4.6	NW wall, Tunnel No. 4
F-8	3.5	"	4.3	3.7	2.5	SE wall, Tunnel No. 4
F-9	2.0	"	3.4	1.5	1.8	"
F-10	3.5	"	7.1	6.6	4.2	"
F-24	5.0	"	12.2	2.7	1.8	NW wall, Tunnel No. 3
F-25	4.3	"	11.2	3.6	2.4	SE wall, Tunnel No. 3
B-1	3.25	"	8.3	0.1	0.35	NW end, tunnel 2
B-5	2.6	"	9.7	2.3	3.05	SE wall, tunnel 4
B-6	3.3	"	6.2	3.7	2.95	SE wall, tunnel 4
B-7	3.5	"	9.8	0.1	1.35	NW wall, tunnel 3
G-1	4.0	"	2.28	1.02		NW end, tunnel 2
G-3	1.6	"	3.97	none		SE end, tunnel 2
G-5	3.0	"	15.26	1.13		NW wall, tunnel 3
G-6	7.0	"	8.67	2.73		SE wall, tunnel 4

Miscellaneous samples of material other than ore

Sample	Length of cut in feet	Location	Zn	Pb	Ag	Remarks
F-43	13.0	below No. 1 ore bed	tr.	tr.	0.12	Above Tunnel 1
F-32	5.5	below No. 1 ore bed	0.7	tr.	0.12	Tunnel 1
F-60	grab	above No. 3 ore bed	tr.	nil	0.06	D. D. H. No. 1

Sample	Length of cut in feet	Ore bed	Zn percent	Pb percent	Ag ounces per ton	Remarks
G-8	8.4	2	10.44	None		composite of 7 samples 25 feet apart
F-29	1.6	3	9.5	tr.	0.86	
F-33	3.5	3	10.1	"	0.36	
F-34	3.2	3	4.7	"	0.16	
F-36	2.6	3	12.1	"	0.54	
F-37	2.4	3	12.0	"	1.3	
F-38	2.5	3	11.6	"	1.2	
F-39	1.2	3	15.0	"	0.38	
F-40	3.0	3	0.1	"	0.18	
F-41	3.9	3	10.5	"	0.4	
F-28	4.0	3	1.3	0.4	4.9	
F-11? (2)	5.0	3	11.5	nil	1.7	
F-23	5.5	3	5.5	7.1	2.4	
F-21	4.7	3	9.4	tr.	1.4	
F-22	3.0	3	tr.	0.4	2.9	south of tested interval.
B-2	2.0	3	11.0	0.1	1.00	
B-4	3.0	3	9.4	0.1	1.10	
G-9	2.6	3	5.35	0.45		
G-10	6.6	3	8.39	0.59		
F-13	2.9	4	8.7	5.8	3.7	
F-14	1.8	"	6.4	5.0	2.1	
F-16	1.7	"	7.5	6.1	3.3	
F-17	1.5	"	1.7	1.5	2.2	
F-18	3.5	"	5.5	3.5	2.8	
F-19	7.1	"	6.6	4.8	3.2	
F-20	2.9	"	18.4	3.2	2.3	
B-3	4.0	"	12.0	2.0	1.80	
G-11 (3)	2.4	"	9.96	3.49		
G-12	9.6	"	2.98	0.44		Silicate ore
G-13	6.5	"	1.03	0.37		" "
G-14	4.5	"	3.62	1.62		" "
			Underground samples			
F-30	2.0	1	6.1	9.3	8.0	SE wall tunnel no. 1.
F-31	3.0	"	1.6	tr.	0.2	SE wall tunnel no. 1.
G-7	3.8 (4)	"	8.84	0.68		NW wall, tunnel no. 1.
F-56	3.3	3	8.8	nil	0.22	D. D. H. No. 1
F-61	6.3	"	9.0	tr.	0.66	D. D. H. No. 2
F-62	1.5	"	6.1	0.3	0.24	D. D. H. No. 2
F-27	3.0	"	tr.	tr.	0.42	Tunnel No. 3
G-2	3.5	"	7.39	none		NW wall Tunnel No. 2

The gold content of the Bureau of Mines samples has been reported by that bureau to range from a trace to 0.01 ounce per ton. The iron content in the samples of solid ore collected by the Bureau of Mines ranges from 20.60 percent to 28.6 percent, and the copper content is about 0.03 percent.

The Geological Survey collected three samples of disseminated ore southeast of the sharp bend in the South Fork of Porterfield Creek at an altitude of about 2,700 feet. The zinc content of these three samples is much lower than that of the solid ore, but this lean ore, over an exposed length of about 1,500 feet, will probably average twice as thick as the solid ore farther northwest. The weighted average of the grade of disseminated ore in the no. 4 bed, using the three samples, is, zinc, 2.5 percent; and lead, 0.67 percent, over an average width of 6.9 feet.

A sample of the breccia vein in tunnel no. 2 contains 0.64 ounce of silver per ton and no gold. In places the breccia vein contains negligible amounts of zinc and lead.

RECOMMENDATIONS

The Geological Survey feels that any further exploration of the Groundhog Basin deposits should, in general, test (1) the extension of the no. 3 and no. 4 ore beds northwesterly from diamond-drill hole no. 1; (2) the extent in depth of ore in the vicinity already tested on the surface and insufficiently to a depth of about 100 feet; (3) zinc, lead, and silver content at the surface and the extent in depth of the 400-foot interval of solid ore in the no. 4 bed not known to have been previously systematically tested; (4) the grade of the disseminated ore at the surface in the no. 3 and no. 4 beds southeast of the solid ore; and (5) the metal content at depth of the no. 3 and no. 4 beds southeast of the solid ore.

(1) In order to satisfactorily explore the area northwest of diamond-drill hole no. 1 the beds should be exposed by test pits or their presence or absence otherwise determined at intervals of not more than 150 feet.

(2) Diamond-drilling to test the extent of ore in depth in the interval already tested would be complicated by the steep dip of the beds to the northeast away from the creek. Perhaps drill set-ups could be selected near the creek from which the beds might be tested to depths of a few hundred feet below their outcrops. As late as August there is usually some snow in the stream south of tunnel no. 2.

(3) The 400-foot interval of solid ore in the no. 4 bed is exposed along a cliff and special consideration would have to be given to methods of sampling it.

(4) The disseminated ore in the no. 3 and no. 4 beds southeast of the outcrop of solid ore is considerably thicker than the solid ore farther northwest. The grade of this disseminated ore should be more adequately determined although the few data available and inspection of outcrops indicate that it is of relatively low grade.

Sample	Length of cut in feet	Location	Zn	Pb	Ag	Remarks
F-35	2.4,	below No. 3 ore bed	tr.	tr.	0.04	Surface
F-15	3.0	below no. 4 ore bed	tr.	tr.	0.08	Surface
F-26	21.6	above No. 4 ore bed	tr.	tr.	0.01	Tunnel No. 3

(1) Letters preceding sample numbers indicate sample collected by F-, Ventures Limited; B-, Bureau of Mines; G-, Geological Survey.

(2) Map accompanying Ventures Limited report shows two samples numbered 11; in this table and figure 1, (?) distinguishes between them.

(3) Poor sample because of inaccessibility of outcrop.

(4) Sample cut across 2.4 feet of ore.

Using the analyses of the samples of solid ore in the no. 3 and no. 4 beds taken by the Geological Survey, by the Bureau of Mines, and by Ventures Limited, the weighted averages of the grade of ore for the no. 3 bed, the no. 4 bed, and the no. 3 and no. 4 beds together are given below:

Grade of ore from ore beds no. 3 and no. 4, Groundhog Basin zinc deposits:

	Ore bed no. 3	Ore bed no. 4	Ore beds no. 3 and no. 4
Zn (percent)	7.63	8.38	8.09
Pb (percent)	0.51	2.5	1.28
Ag (ounces per ton)	1.25	2.0	1.86

The grade of ore for the 940-foot interval tested by Ventures Limited as estimated by that company is given below. The grade as estimated by Ventures Limited is apparently a weighted average.

Grade of ore as estimated by Ventures Limited for the no. 3 and no. 4. ore beds, Groundhog Basin Zinc deposits.

	Ore bed no. 3	Ore bed no. 4	Ore beds no. 3 and no. 4
Zn (percent)	8.43	8.2	8.3
Pb (percent)	1.2	2.95	2.5
Ag (ounces per ton)	1.25	2.3	2

(5) The transition from solid ore to disseminated ore in the no. 4 bed at an altitude of about 2,500 feet and the more conspicuous appearance of fluorite in the breccia vein and small faults has been suggested as indicating a vertical mineral zoning. If such a zoning exists, solid ore may be present below the disseminated ore southeast of the outcrops of solid ore.

March, 1944.

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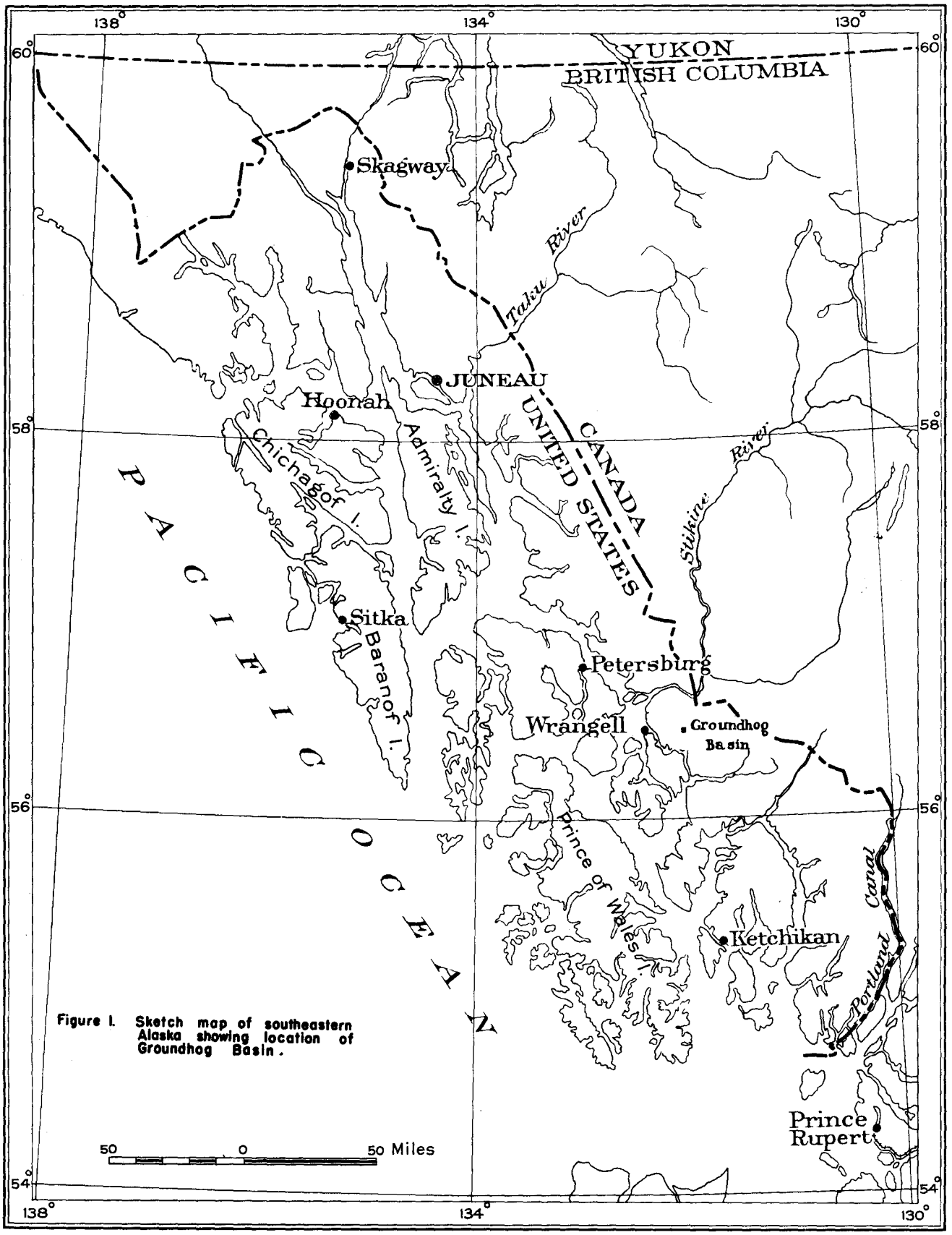

Figure 1. Sketch map of southeastern Alaska showing location of Groundhog Basin.

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UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WAR MINERALS INVESTIGATIONS
PRELIMINARY MAP

FIGURE 2

GEOLOGIC SKETCH MAP

OF AN AREA EAST OF

LAKE VIRGINIA, WRANGELL DISTRICT, SOUTHEASTERN ALASKA

SHOWING MAPPED AREAS IN
GROUNDHOG BASIN

2000 0 2000 4000

Scale in feet

Contour interval 500 feet

Datum is mean sea level as determined by aneroid

N

32°

True North

Magnetic North

EXPLANATION

Granite

Quartz diorite

Metamorphic rocks

LAKE VIRGINIA

EASTERN PASSAGE

MILL CREEK

PORTERFIELD CREEK

SOUTH FORK GROUNDHOG BASIN

NELSON GLACIER

GROUNDHOG BASIN

Mt. Waters
5220

Aaron Creek

Aaron Creek

to Horseshoe Basin

Topography in the vicinity of Lake Virginia and Mt Waters modified from Alaska Map 7 Geology and topography in Groundhog Glacier Basins by H.R Gault and others, 1942 and 1943.

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