

Some Lead-Zinc and Zinc Copper Deposits of the Ketchikan and Wales Districts, Alaska

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Some Lead-Zinc and Zinc Copper Deposits of the Ketchikan and Wales Districts, Alaska

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ZINC AND LEAD DEPOSITS OF SOUTHEASTERN ALASKA

G E O L O G I C A L S U R V E Y B U L L E T I N 9 9 8 - C

*A description of the deposits at
Moth Bay, Mahoney Creek, and
Dora Lake*



UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

PREFACE

As a part of its investigations in southeastern Alaska between 1941 and 1948, the U. S. Geological Survey studied in detail eight deposits that contain sphalerite or sphalerite and galena as the predominant ore minerals with lesser amounts of chalcopyrite in a few deposits. These deposits are at Tracy Arm, Groundhog Basin, Glacier Basin, the Lake claims east of Virginia Lake, Berg Basin, Moth Bay, Mahoney Creek, and Dora Lake. These deposits are described in the several chapters of this bulletin.

Zinc and lead minerals are also known or reported at the Hyder district, Whiting River, and Farragut River on the mainland, Cornwallis Peninsula on Kuiu Island, the Keku Islets north of Kuiu Island, Cholmondeley Sound and Beaver Mountain on Prince of Wales Island, Woewodski Island, Taylor Creek on Kupreanof Island, and Coronation Island. Some of these occurrences are noted elsewhere in the geological literature.

To date (1953) no major zinc or lead deposit in Alaska has come into production. Lead has been produced as a byproduct at the Alaska-Juneau gold mine and from the Riverside mine, Hyder district. In 1947 and 1948 about 70 tons of zinc and lead concentrates were shipped from Mahoney Creek to Kellogg, Idaho.

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ZINC AND LEAD DEPOSITS OF SOUTHEASTERN ALASKA

SOME LEAD-ZINC AND ZINC-COPPER DEPOSITS OF THE KETCHIKAN AND WALES DISTRICTS

PART 1. ZINC-COPPER DEPOSITS NEAR MOTH BAY, REVILLAGIGEDO ISLAND, KETCHIKAN DISTRICT

By G. D. ROBINSON

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ABSTRACT

The deposits at Moth Bay consist principally of zinc, copper, and iron sulfides that replace parts of favorable layers in the muscovite schist country rock. The ore, which commonly is banded, is discontinuous and forms pods some of which are localized along preexisting faults or folds. The mineralized beds reach a maximum thickness of 15 feet and extend for several hundred feet in length and depth. Three ore beds are recognized, but only one ore bed is sufficiently well known to warrant an estimate of reserves. The measured and indicated reserves at the Moth Bay deposits include 100,000 tons of ore containing about 7.5 percent of zinc and 1 percent of copper, and 3,600 tons of ore containing about 2 percent of zinc and about 0.5 percent of copper. About 100,000 additional tons, principally low-grade ore, is inferred.

INTRODUCTION

Moth Bay, which is locally known as Maiden Bay, is a narrow inlet on the north side of the entrance to Thorne Arm, a large bay near the southern end of Revillagigedo Island, southeastern Alaska. (See fig. 7.) It is about 16 miles by water southeast from Ketchikan, the

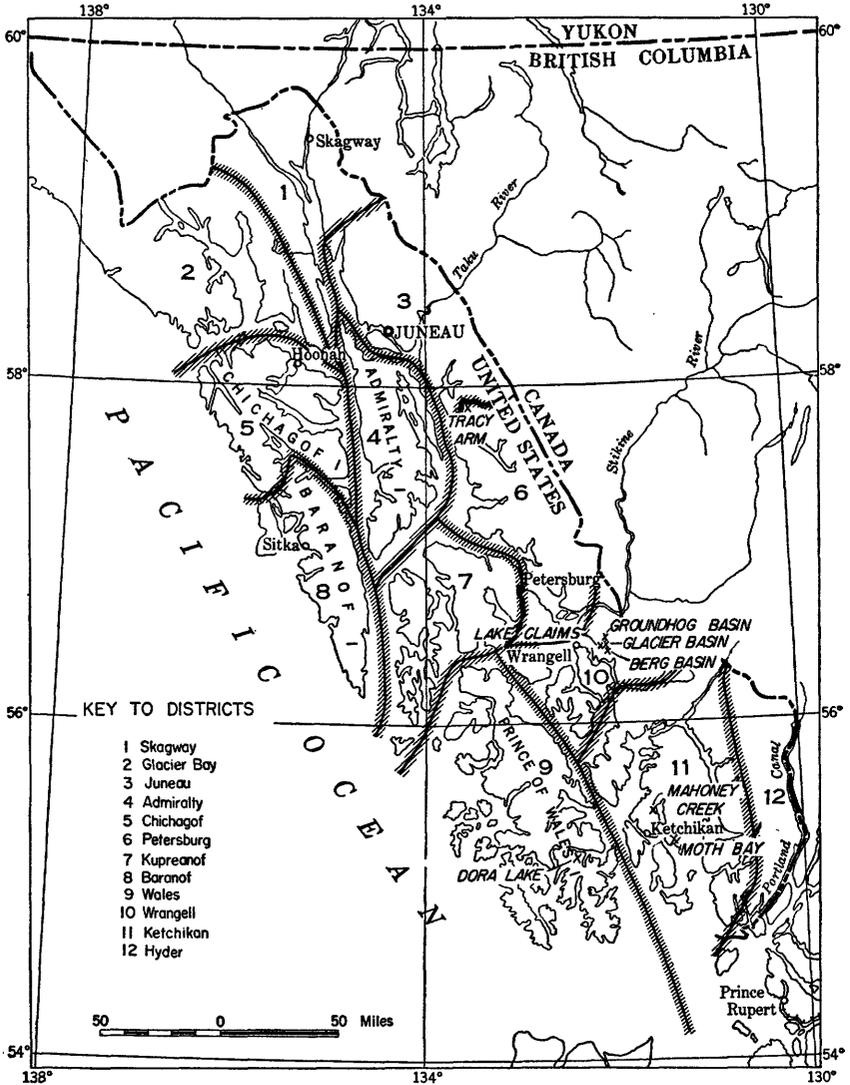


FIGURE 7.—Sketch map of southeastern Alaska showing location of some lead-zinc deposits.

nearest port. The zinc-copper deposits are about three-fifths of a mile north of the head of the bay, at altitudes ranging from about 250 to about 500 feet, and are accessible by a good trail from the bay. The deposits are near the southern end of a low northward-trending ridge that rises above a broad swampy lake-dotted muskeg. The muskeg is bordered on the east and west by smoothly rounded, densely wooded hills as much as 2,300 feet high. Vegetation and glacial till cloak most of the surface, and rock exposures are rare. Small timber and fresh water are available.

DEVELOPMENT

According to Smith (1914, p. 90-91) the first development work on the deposits was done from 1911 to 1913 by the Gold Standard Mining Co. An adit 75 feet long was driven and from it a steeply inclined winze 100 feet long was sunk. (See old adit, pl. 14.) The adit and the upper 40 feet of the winze are still accessible, but the lower part of the winze is now flooded. In later years the deposits were prospected on the surface by a series of opencuts, and an adit was driven into the ridge about 500 feet northwestward from the old one. (See main adit, pl. 14.) This adit penetrated ore 180 feet from the portal, and an exploratory drift was driven parallel to the strike of the rocks near the footwall of the ore. Nine short crosscuts were made to intersect the ore zone. The aggregate length of these workings is about 800 feet. All the workings are still in good condition. Stewart (1931, p. 18) reports that from 1929 to 1931 the development work "was undertaken by Mr. Jas. (James L.) Freeburn and associates of Ketchikan and Tacoma who secured for that purpose control of the property from the former owners, Messrs. Griswold, McGuire, and Dodge of Ketchikan."

Seven claims are reported to have been surveyed for patent (U. S. Mineral Survey 1590). No ore is known to have been shipped.

The deposit was examined briefly and described by Smith (1914) in 1913, and by Stewart (1931) in 1930. A more detailed examination was made by Townsend¹ in 1937. Analyses of more than 20 samples taken by Townsend have been made available to the Geological Survey.

The U. S. Bureau of Mines collected four moil samples from the main workings in 1942, and the analytical results are used herein.

The data presented below summarize the results of field work by G. D. Robinson, assisted by R. A. Harris, in the period September 8-28, 1943. Detailed maps of the deposit were made and chip samples of ore were taken from many localities.

In 1950 the Bureau of Mines took surface and underground samples, and put down seven diamond-drill holes (pl. 14) to test the deposit as much as 300 feet below the surface. W. S. Twenhofel, of the Geological Survey, examined the drill cores and reports (personal communication) that the results of the drilling confirm the structural interpretation shown in section A-A', plate 14, of this report.

GENERAL GEOLOGY

According to Buddington and Chapin (1929, pl. 1) the principal rocks in the vicinity of Moth Bay are phyllite and quartzite of prob-

¹Townsend, Harry, 1938 Report on the Maiden Bay prospect, Revillagigedo Island, Alaska, 4 p., map. [Private report.]

able Ordovician to Jurassic age, intruded by quartz diorite of Late Jurassic or Early Cretaceous age.

The present investigation indicates that the rocks containing the zinc-copper deposits are fine-grained to medium-grained mica schist and quartzite. (See fig. 8.) These rocks are structurally complex in

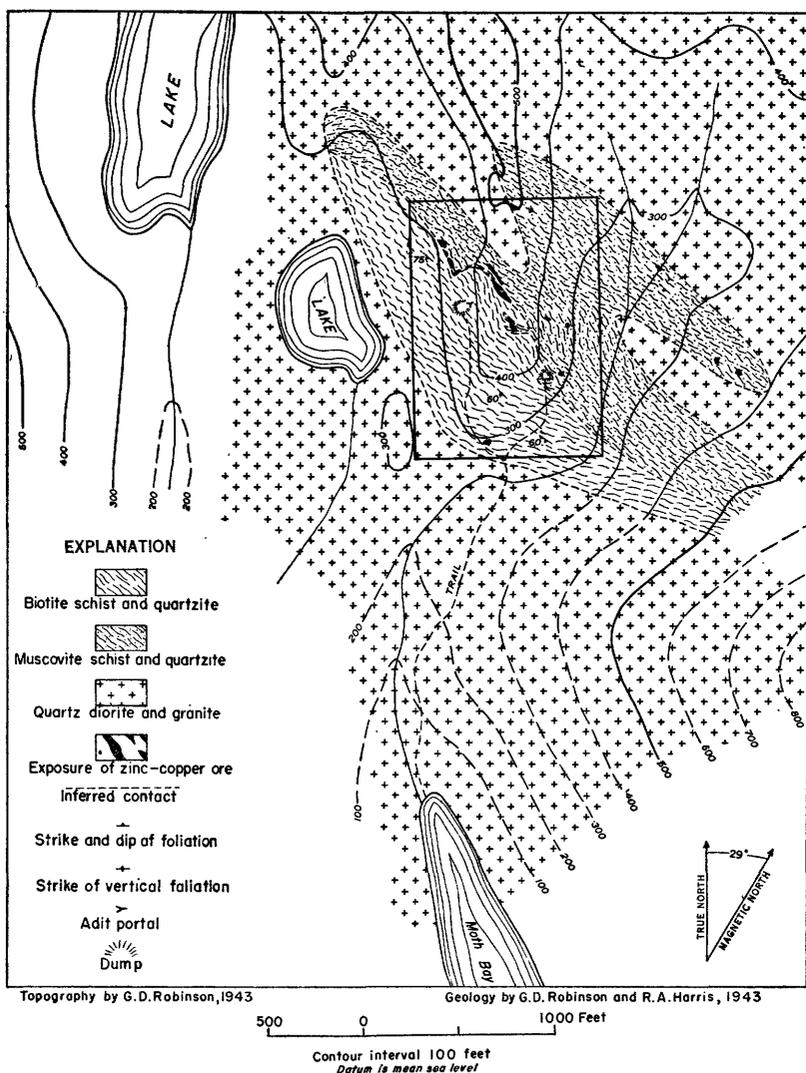


FIGURE 8.—Geologic sketch map of vicinity of Moth Bay zinc-copper deposits, Revillagigedo Island, Ketchikan district.

detail, but in general they strike about N. 60° W. and range in dip from 80° N. through vertical to 50° S. Foliation is generally parallel to the bedding. Two major groups of metamorphic rocks are recognized. The first group, comprised of biotite schist with some mus-

covite schist and impure quartzite, stratigraphically overlies the second group composed of muscovite schist that contains some quartz-muscovite-biotite schist, quartzite, and limestone. The maximum outcrop width of the biotite schist sequence is about 600 feet, and that of the muscovite schist is about 700 feet; because the rocks are probably folded and faulted, these outcrop widths may include some repetition of beds. In the central and northwestern parts of the area shown in figure 8, contacts between the two schist sequences commonly appear to be sharp. In the southeastern part, layers of muscovite schist are abundant in the basal part of the biotite schist sequence. Some of the apparent interbedding may be the result of small-scale isoclinal folding.

The ore deposits are thin layers of schist that are partly replaced by sulfide minerals. The thickest and most persistent of these layers is at the contact between the two schist types, but thinner ones are present at other places.

The metamorphic rocks have been intruded by thin dikes and sills that range widely in composition and texture, and by larger masses of quartz diorite, which contain a subordinate amount of granite and diorite. The metamorphic rocks are recrystallized and silicified near intrusive masses, and locally lit-par-lit gneiss is present. The metamorphic rocks form an irregularly bounded body about 1,300 feet wide and more than 3,000 feet long in a northwest-southeast direction. Intrusive rocks probably underlie the metamorphic rocks at depths of a few hundred, at most a few thousand, feet.

ZINC-COPPER DEPOSITS

ORE AND GANGUE

The ore minerals in the Moth Bay deposits include, in order of decreasing abundance, iron sulfides (principally pyrite with minor amounts of pyrrhotite), dark iron-rich sphalerite, copper sulfides (principally chalcopyrite with minor amounts of bornite and covellite), magnetite, galena, silver and gold. The ore minerals are generally in dense medium-grained aggregates. Magnetite, however, is in minute grains visible only under the microscope, and the presence of gold and silver is known only from chemical analyses.

The introduced gangue minerals, which are principally clear glassy quartz and gray calcite, commonly form an insignificant proportion of the ore.

The most common gangue material, which in many places constitutes more than half of the ore, consists of inclusions of slightly recrystallized muscovite schist country rock. The inclusions are commonly rodlike or tabular, and their elongate dimensions are in the plane of the bedding of the adjacent country rock. Many of the in-

clusions are angular, but their parallelism with the bedding indicates that they are not breccia fragments but are unreplaced remnants of schist beds.

The ore has an indistinct mineral banding that is parallel to the boundaries of each mineralized zone and to the adjacent bedding. Locally, sharp-walled veinlets of one or more ore minerals extend along, but rarely cut across, the bedding.

The proportions of the sulfide minerals vary widely and change abruptly within short distances. The proportions of each mineral seem to vary independently of the others. Pyrite generally makes up one-fourth to one-half of the ore; in some places it forms as much as 90 percent of it. As much as 50 percent of pyrrhotite, 30 percent of sphalerite, 10 percent of chalcopyrite, and possibly 2 percent of galena are present locally. Commonly, the ore contains less than 10 percent of pyrrhotite, from 3 to 15 percent of sphalerite, from 1 to 5 percent of chalcopyrite, and only traces of galena.

ORE BEDS

Although locally the ore is in isolated podlike masses, most of it is in layers having all the structural characteristics of the enclosing schist beds. With the exception of pyrite and magnetite, which are widespread in the metamorphic rocks and may in part be primary in those rocks, the ore minerals are rather closely confined to a few thin layers. No zinc or copper minerals are known in the adjoining intrusive rocks.

Large-scale differences in the mineral proportions of the ore beds along their strike are apparent from both analytical data and general field observation. Sphalerite is most abundant in the ore in the central part of the area mapped. (See pl. 14.) It is less common in the northwestern part and scarce in the southwestern part. Chalcopyrite is scarce in the northwestern part, but it becomes more abundant in the central part and most abundant in the southeastern part. Galena is practically absent in the northwestern and central parts but is common in the vicinity of the old workings. Both quartz and calcite are most abundant in the southeastern part.

The mineralized layers, or ore beds, are rarely more than 15 feet thick and generally less than 5 feet thick. A few ore beds may be continuous or nearly so for several hundred feet in length and depth; others probably do not persist for more than a few tens of feet.

The total number of ore beds is not known. Three beds are known from closely spaced exposures, and single exposures elsewhere suggest additional beds.

The greatest amount of ore in the area is in ore bed 1, which is exposed on the surface and in the main workings. (See pls. 14 and 15.)

Although treated as a single layer, ore bed 1 underground actually comprises a number of closely spaced bands in echelon, separated by schist partings a few feet thick. The ore bed is as much as 17 feet thick in the crosscuts near the southern end of the drift; in the crosscuts near the northern end the ore bed is little more than 2 feet thick. Ore is exposed in the northernmost crosscut, and presumably the ore bed exposed in the side of the cliff about 100 feet northwest of the end of the drift is a continuation of the same bed. The southern end of the ore bed in the drift is cut off by a fault. The ore bed in the old workings is here correlated with bed 1. On the surface, bed 1 has been exposed in several places by a series of opencuts throughout a distance of 600 feet between the cliff mentioned above and the portal of the old adit. The ore in the cuts northwest of the cliff probably should not be correlated with bed 1. The best evidence that the unconnected ore exposures labeled bed 1 are parts of a single ore zone is the similarity of their relation to the enclosing country rock: all the ore occurrences grouped in bed 1 are at, or within a few feet of, the contact between the muscovite schist sequence and the biotite schist sequence.

In the main workings bed 1 is exposed for 440 feet, in the old workings for 75 feet, and in the ridge cuts for 200 feet. The bed is absent from the northernmost of the ridge cuts and presumably is absent throughout much of the distance between the ridge cuts and the cliff to the northwest. Whether the bed is continuous on the surface between the ridge cuts and the old workings is not known, but it is present in the only opencut between them.

The known vertical range of bed 1 is about 200 feet. The distance along the dip between the ridge cuts at the surface and the main underground workings is 140 feet. The winze in the old adit is flooded below 40 feet, but bed 1 is continuous to at least that depth, and certainly somewhat farther, although the winze is not in ore for its entire length of 100 feet because, according to Smith (1914, p. 91), "the winze is driven at a flatter inclination than that of the vein."

Bed 2, which is stratigraphically below bed 1, is definitely known only in the ridge cuts. Three cuts here expose it 10 to 15 feet up slope from bed 1. It is probably continuous for at least 80 feet along its strike and most likely has an average thickness of 4 feet. The downward extension of bed 2 is not exposed in the main adit. In the last 20 feet of the main adit where this bed might be expected to occur the muscovite schist sequence is interrupted by a tongue or lens of biotite schist. Bed 2 may lie stratigraphically below the tongue of biotite schist on the main adit level, or bed 2 may not extend to this depth. The ore in the surface cuts northwest of the cliff may perhaps be correlated with bed 2.

East of the old adit dump, two surface cuts 50 feet apart (pl. 14) expose ore as much as 3 feet thick on the crest of a southeastward-plunging anticlinal drag fold. This ore bed stratigraphically underlies beds 1 and 2 and here is designated bed 3.

A number of relatively isolated exposures of ore other than those discussed above are shown on plate 14. Only local concentration is assumed for the ore at each of these exposures, but future development may disclose more extensive bodies. Much uncertainty exists regarding the location and number of opencuts about 1,000 feet east of the old adit because time was not available for mapping in the vicinity. Townsend's sample T2 (pl. 14) may not have been taken from the same cut as that from which the Geological Survey sample G315 was taken but may represent a cut nearby not seen by the writer. The writer did not see the cut from which Townsend's sample T1 was taken.

STRUCTURE

A generalized statement of the structure of the ore beds and the country rocks is given under a discussion of the general geology. Additional structural data and interpretations are given below.

The geologic map and section on plate 14 show the writer's interpretation of the meager data available. It is expected that any future development of the area will demonstrate much greater complexity than is illustrated on plate 14 or discussed herein.

The metamorphic rocks and the ore beds dip southwestward throughout the mapped area, except in the vicinity of the ridge cuts and near the main adit portal where the dips are vertical or steep to the northeast. The reversal of dip in the ridge cuts seems to indicate local overturning or drag folding of the beds. Data are insufficient to determine the significance of the reversal of dip near the main adit portal. The interpretation favored (see section, pl. 14) is that the reversal indicates a minor drag fold. On this basis it is inferred that the ore beds and schist dip consistently southwestward in the area between this drag fold and the western contact of the schist and quartz diorite.

It is possible, however, that the reversal of dip near the adit portal indicates the trough of a major syncline. If this interpretation is correct, the contact, presumably dipping northeastward, between biotite schist and muscovite schist should be repeated within a few hundred feet west of the portal of the main adit; an ore bed equivalent to bed 1 might be present along the contact. In any future exploration this possibility should be tested by trenching.

The relative ages of the intrusive masses and the ore deposits are not known. If the intrusive masses are younger, an interpretation

which the meager evidence favors, the ore beds obviously terminate at intrusive contacts; if the ore deposits are younger, they might persist within the igneous rocks beyond the contacts of the igneous and metamorphic rocks. However, no zinc or copper minerals have been noted in any of the intrusive masses or in their apophyses, not even in the old or main workings where the intrusive rocks are close to ore beds.

The ore bed near the southern end of the main workings terminates against a fault of unknown displacement that strikes N. 20° W. The fault is filled with gouge as much as 1 foot thick. The gouge has slumped or has been mucked out for 20 feet up dip; the dip of the fault is eastward, flattening from 80° at the floor to 65° at the west wall of the drift.

Several minor faults branch from the main fault. Displacements of dikes by these faults can be measured accurately and do not exceed a few feet either vertically or horizontally. One minor fault, which departs from the attitude of the principal fault and in part extends parallel to the bedding, has been traced throughout the drift. The fault appears to be a hinge fault, the west wall having moved down relative to the east wall near the north end of the drift and up relative to the east wall near the south end. The most simple explanation of observed displacements is that they are due to vertical rather than horizontal movement. Perhaps the movement on the principal fault was also mostly vertical rather than horizontal. The south end of the main workings is within a few tens of feet of the surface. Exposures are relatively abundant on the surface, but no evidence of faulting was found there, nor was any ore bed found that might represent the offset part of bed 1 on the east side of the fault. If the structural interpretation shown on plate 14 is correct, the contact between the schist sequences swings sharply to the northwest in this vicinity. Presumably bed 1 swings with the contact, and it is likely that only a small part of the ore bed could have been affected by the fault.

The country rocks had been altered and deformed essentially to their present state before ore deposition. The ore-bearing solutions probably rose up fault, joint, and bedding fractures and spread outward from the openings to replace the country rocks with ore and gangue minerals. The contact between the relatively dense, massive and little-fractured biotite schist sequence and the muscovite schist sequence apparently provided a principal channel for the rising solutions.

The ore in bed 3 is localized at least in part by an anticlinal drag fold. Other occurrences of ore, in which the attitude of the bedding is markedly different from the prevailing attitude in the area, may be localized in part by openings on drag folds.

RESERVES

The results of the analysis of 39 samples are shown on plates 14 and 15. Samples taken by Townsend are located only approximately. The grade averages computed are weighed accordingly to the length of each sample. All the samples were taken horizontally, with the exception of Townsend's sample T26 (crosscut *E*), which was taken vertically; therefore, none represents the true thickness of the ore beds.

Only bed 1 is sufficiently well known to warrant an estimate of measured and indicated reserves. Of the 39 analyses, 36 are of samples taken from bed 1; 30 are of samples taken from the main workings. The table below summarizes the grade data from the main workings.

Summary of chemical analyses of samples from main workings, Moth Bay deposits

	Sample locality (crosscut)	Strike length (feet)	Sampled width (feet)	Percent		Ounces per ton	
				Zn	Cu	Au	Ag
Townsend ¹	B-H	340	7.5	8.23	1.30	0.02	0.21
Mines ²	B-G	290	6.4	8.41	(⁴)	(⁴)	(⁴)
Survey ³	B-H	340	8.4	7.26	.83	(⁶)	(⁶)

¹ 17 analyses by A. L. Glover, Inc., Seattle, Wash. Analyses T4 (crosscut *A*) and T26 (crosscut *E*) omitted because not representative.

² Sampled width only approximate. Spacing of samples not known in crosscuts from which more than 1 sample was taken.

³ 4 analyses by Bureau of Mines Technical Service, Reno, Nev.

⁴ Not determined.

⁵ 9 analyses for Zn and Cu and 2 analyses for Au and Ag by S. H. Cress and Victor North, Geological Survey.

⁶ Negligible.

A number of lead determinations were made, but the lead content was consistently negligible and is therefore omitted from the table.

The divergences in the zinc and copper content, between Townsend's results and those of the Geological Survey, are probably due to differences in sampling. The Bureau of Mines analyses confirm the indicated zinc and lead tenor of the ore.

The writer cannot explain the differences in precious-metal content reported. Only two precious-metal analyses of samples from the main workings were made by the Geological Survey, and they do not provide an adequate check on Townsend's results, which are accepted for present purposes.

A majority of the Townsend and Survey analyses are grouped in the southern one-third of the underground workings, which contains the highest-grade ore. Therefore the true grade is probably lower than the mean between that of the two groups (7.835 percent of zinc, 1.065 percent of copper). The entire 400-foot length of bed 1 along the strike in the main workings is assumed to have an average thick-

ness of about 7.5 feet and to contain about 7.5 percent of zinc, 1.0 percent of copper, 0.02 ounce of gold per ton, and 0.20 ounce of silver per ton.

The few analyses of samples taken from bed 1 outside the main workings show that the zinc content near the limits of exposure as indicated by samples G314 from the northwest end and G313 from the old workings at the southeast end is much lower than the average in the main workings. The zinc and copper contents up the dip from the main workings as indicated by samples T6, T7, G312, and G311 are of the same order as in the main workings. The copper content is much greater in the old workings than elsewhere.

For estimating tonnage, the ore has been divided into high-grade zinc-copper ore, low-grade zinc-copper ore, and high-grade copper ore. High-grade zinc-copper ore is exposed for about 200 feet in the ridge cuts and for about 400 feet in the main workings. The ore on the surface presumably connects with the ore underground to form an ore body with a dip length of 140 feet between the levels of exposure and an average thickness of about 7.5 feet. The ore body outlined has a volume of about 315,000 cubic feet. Assuming a factor of 9 cubic feet to a ton, the mass comprises about 35,000 short tons of measured high-grade ore, containing about 7.5 percent of zinc, about 1.0 percent of copper, and small quantities of gold and silver. The body is assumed to persist down the dip from the main workings for at least half the strike length in the workings; an additional mass of ore 400 feet by 200 feet by 7.5 feet is indicated. This indicated high-grade ore mass has a volume of about 600,000 cubic feet and contains about 66,000 short tons.

Northwestward, the high-grade ore passes laterally into low-grade zinc-copper ore, for which it is difficult to estimate grade and tonnage. The ore bed is probably continuous on the main adit level from crosscut A northwestward to the cliff where the zinc and copper content is considerably lower than underground as indicated by sample G314. This part of the ore bed does not continue to the surface without interruption; it is absent from the northernmost of the ridge cuts. For estimating tonnage, a mass of ore, approximately triangular in shape, in the plane of the ore bed is postulated; the triangle is visualized as having a base 100 feet long and as wedging out about 100 feet up the dip. This part of the bed is assumed to have an average thickness of 3.5 feet and an average content of 2 percent of zinc and 0.5 percent of copper. The mass has a volume of about 17,500 cubic feet. Assuming a factor of 9.5 cubic feet to a ton, it contains about 1,800 short tons of indicated ore. The ore doubtless continues below the main workings, and it is assumed that a tonnage at least as great as that above the workings is indicated. Bed 1 northwestward from

the high-grade ore body is therefore estimated to contain about 3,600 tons of low-grade indicated ore.

The ore exposed in the old workings is herein regarded as high-grade copper ore. Hand specimens contain much pyrrhotite and pyrite, considerable chalcopyrite, a smaller amount of galena, and a minor amount of sphalerite. In the single analysis available, the sample (G313) is reported to contain 2.9 percent of copper but no zinc, lead, gold, or silver. The ore bed has an average thickness of about 3.5 feet for the exposed strike length of 75 feet; it probably grades northwestward into zinc-rich, copper-poor ore. The known continuation of the ore down the dip from the adit level is less than 100 feet but more than 40 feet (see p. 65); a minimum dip length of 70 feet is assumed. Measured ore includes that portion of the bed between the surface and 70 feet down the dip from the adit; a total dip length of 115 feet is assumed. This mass has a volume of about 30,000 cubic feet, and assuming a factor of 9.5 cubic feet to a ton, contains more than 3,000 short tons. For estimating indicated reserves, the bed is assumed to be continuous along the strike for at least an additional 75 feet, up the dip to the surface (about 85 feet), and down the dip for at least 105 feet (70 feet of known dip length plus 35 additional feet). About 50,000 cubic feet of ore, containing more than 5,000 short tons, is indicated.

In addition to the measured and indicated reserves estimated above, bed 1 is inferred to contain several thousand tons of low-grade zinc-copper ore and high-grade zinc-copper and copper ore in possible extensions of the bed along the strike and down the dip.

Several thousand tons of low-grade ore, comparable to that at the northwestern end of bed 1, is inferred in the other beds in the area.

In summary, the ore reserves in the Moth Bay deposits consist of about 100,000 tons of measured and indicated high-grade zinc-copper ore containing about 7.5 percent of zinc and 1 percent of copper; about 3,600 tons of measured and indicated low-grade zinc-copper ore containing about 2 percent of zinc and 0.5 percent of copper; about 10,000 tons of measured and indicated high-grade copper ore containing nearly 3 percent of copper but little or no zinc; and 100,000 tons of inferred ore, principally low-grade zinc-copper. The ore contains small amounts of gold and silver.

RECOMMENDATIONS

The Moth Bay deposits contain moderate tonnages of zinc-copper ore in a geologic and geographic environment favorable to their economic development. Townsend's² conclusion is shared by the

² Townsend, Harry, *op. cit.*, p. 4.

writer: "The . . . prospect is a property of doubtful value under present conditions but is an attractive prospect if an assured market for zinc concentrates on the Pacific coast is established."

In the event of future development, the following recommendations are made:

1. The continuity of bed 1 and other beds on the surface should be traced by closely spaced opencuts.

2. Bed 1 should be sought at greater depth by an adit driven north-eastward from the western base of the ridge, by a winze driven on the footwall of the bed from the main drift, or by diamond-drill holes.

3. One or more long northeastward-trending trenches should be made west of the adit portal to determine the nature of the reversal of dip in the main adit. If a contact is found between biotite schist on the east and muscovite schist on the west, the contact should be traced by closely spaced opencuts to determine the possible presence of an ore bed equivalent to bed 1.

4. The old workings should be further explored. The old adit should be extended as far as the continued presence of the ore bed warrants. The winze should be unwatered and an exploratory drift driven at its base if the ore bed is found there.

5. During exploration, the exposures of ore should be thoroughly and systematically sampled.

**PART 2. ZINC DEPOSITS OF THE LUCKY BOY CLAIMS, DORA LAKE,
PRINCE OF WALES ISLAND, WALES DISTRICT**

By **W. S. TWENHOFEL**

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ABSTRACT

The deposits at Dora Lake consist of several small sulfide-bearing quartz-calcite breccia veins that cut across the foliation of the schistose country rock. The principal metallic minerals are sphalerite, galena, chalcopryrite, and pyrite. Two deposits are known. The south deposit consists of 1 vein estimated to contain about 1,500 tons of material that averages about 3 percent of zinc and an insignificant amount of lead. The north deposit consists of 3 separate veins. Only 1 of these veins is sufficiently exposed to warrant a reasonable estimate of reserves. It is estimated to contain about 7,000 tons of material averaging about one-third of 1 percent of zinc and 1 percent of lead.

INTRODUCTION

The Lucky Boy group of eight claims is along the southeastern and southern shores of Dora Lake, which lies about one-quarter of a mile south of the head of Dora Bay, a small fiord extending south from Cholmondeley Sound on the east coast of Prince of Wales Island, southeastern Alaska. The claims are best reached from the head of Dora Bay by a good trail to the lower end of Dora Lake and thence across the lake by skiff to the upper end. (See figs. 7 and 9.)

I. C. Smith, S. V. Van Zandt, W. H. Roselle, and Clara Runge, all of Ketchikan, Alaska, are said to have located the claims about 1933 or 1934. Before that time the property is reported to have been claimed by Jack Westlake and to have been known as the Complex group of claims. Apparently the Lucky Boy claims include most, if not all, of the Lady of the Lake claims and the Oregon and Idaho claims mentioned by the Wrights (1908, p. 171-172).

GEOLOGY

According to the Wrights (p. 171) "limestone and schist constitute the principal bedrock exposures within this area, and on the west side of the bay these are intruded by a wide area of granite, which also forms the west shore of Dora Lake."

The mineral deposits are quartz-calcite breccia veins that cut across the foliation in the schist. The principal metallic minerals are sphalerite, galena, chalcopyrite, and pyrite. Only locally do these sulfide minerals exceed about 10 percent of the total vein material, and at most places they are estimated to constitute about 5 percent. Many partly replaced schist and limestone fragments occur within the veins.

The Lucky Boy claims cover 2 general mineralized areas, 1 about 750 feet south of the southern end of Dora Lake, and the other about 100 to 150 feet east of Dora Lake. (See figs. 9 and 10.)

SOUTH DEPOSIT

The south deposit was described by the Wrights as the Oregon and Idaho claims. The deposit is a quartz-calcite vein that strikes about N. 22° E. and dips about 35° E. (See fig. 11.) Surface cuts expose the vein for about 380 feet, approximately along the 125-foot contour of the east slope of the valley between Dora and Mineral Lakes. The vein is discontinuous on the tunnel level, but it can be traced in the underground workings for a strike distance of about 110 feet and for a dip length of about 60 feet. Only at the north end of the cross-cut has sphalerite been found in significant quantities. On the surface the vein is persistent and contains a relatively large amount of sphalerite. Near the face of the adit is an inclined raise about 85 feet long; sulfide minerals are sparse except in the upper part of the raise where the sphalerite content increases gradually toward the surface.

Two chip samples of vein material were collected for analysis. The first was from the northernmost prospect pit and the second from a pit about 90 feet farther south. (See fig. 11.) The samples contained 8.82 and 5.84 percent of zinc, respectively, but neither sample contained significant quantities of lead, copper, gold, or silver. These two samples represent material that is estimated to be the richest in the vein. Underground exposures of the vein are estimated to contain only one-third, and possibly only one-quarter, of the amount of sphalerite that is present in surface exposures.

In estimating reserves it is assumed that the mineralized zone is 380 feet long, 2 feet wide, and extends down the dip for about 20 feet. A figure of 20 feet is used because that part of the vein exposed in the raise and in the crosscut does not seem to be persistent or well mineral-

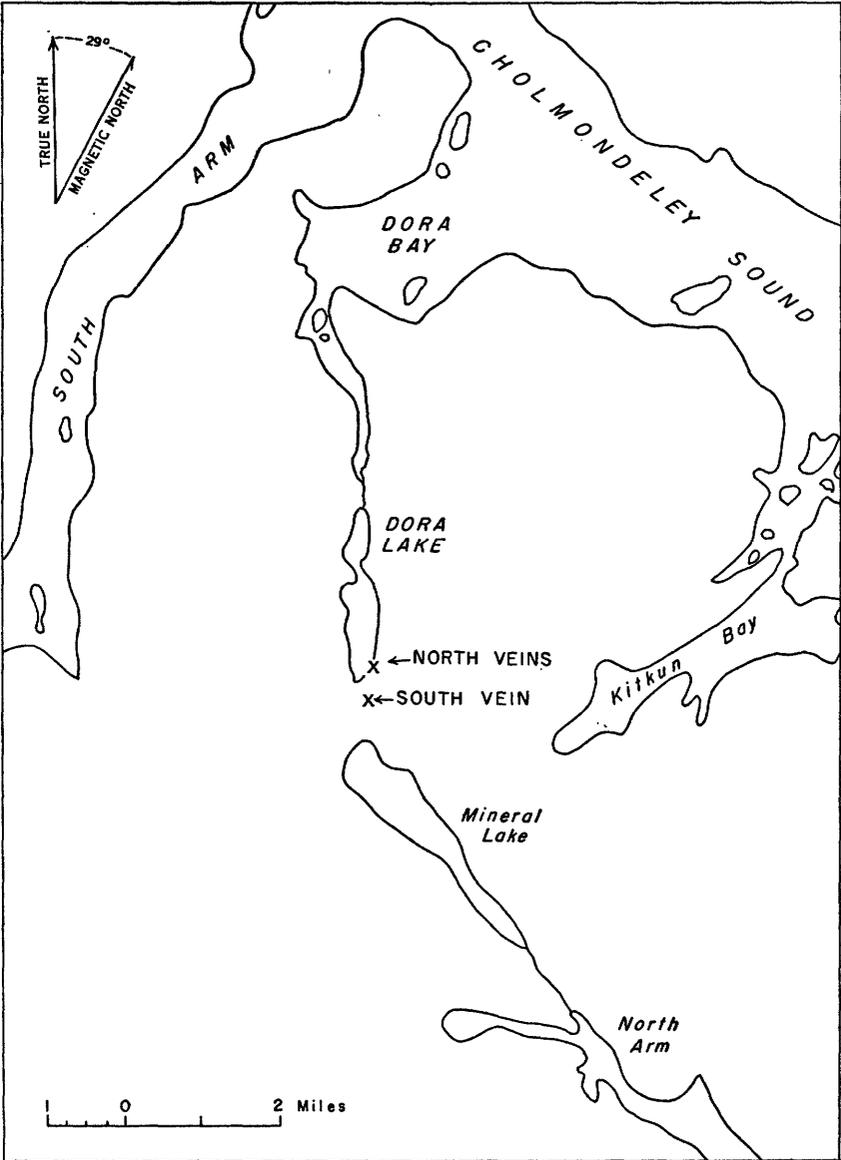


FIGURE 9.—Sketch map showing location of Lucky Boy zinc deposits, Dora Lake, Prince of Wales Island, Wales district.

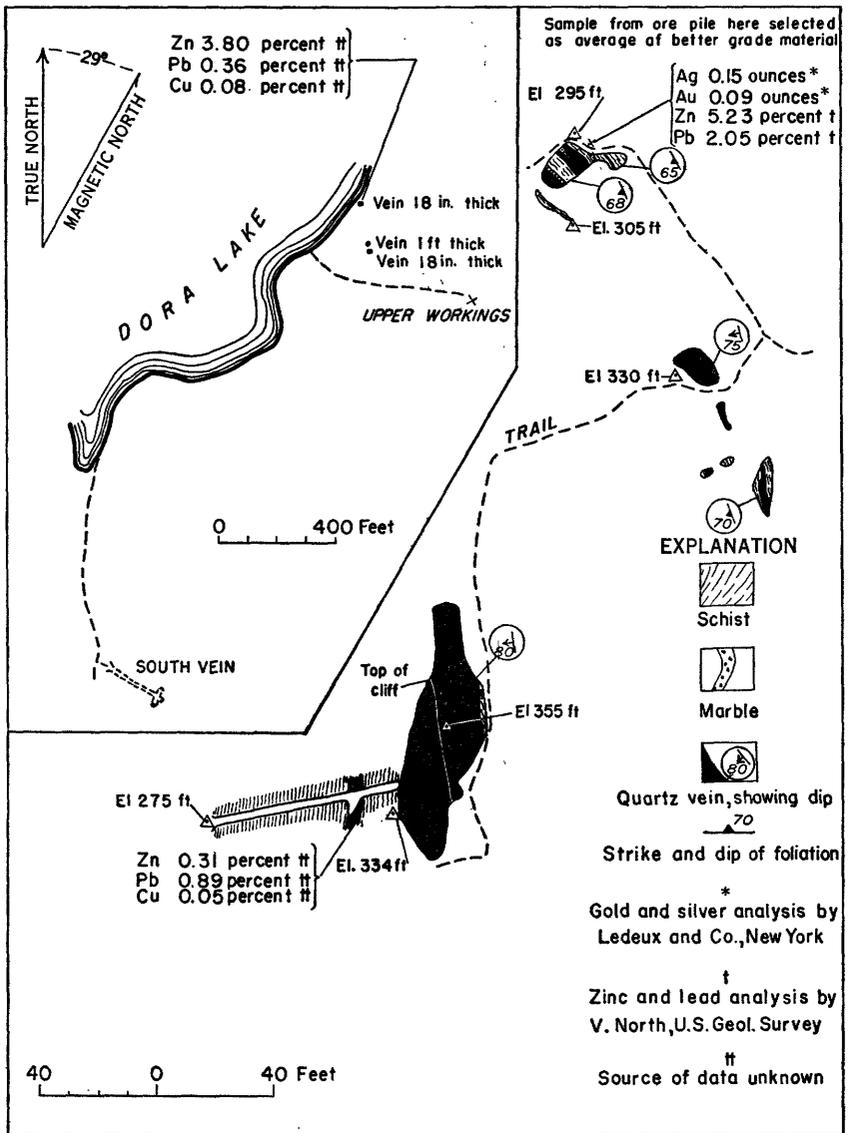


FIGURE 10.—Sketch map of north deposit, Lucky Boy deposits, Dora Lake, Prince of Wales Island, Wales district. (Geology by J. C. Reed and W. S. Twenhofel, 1943)

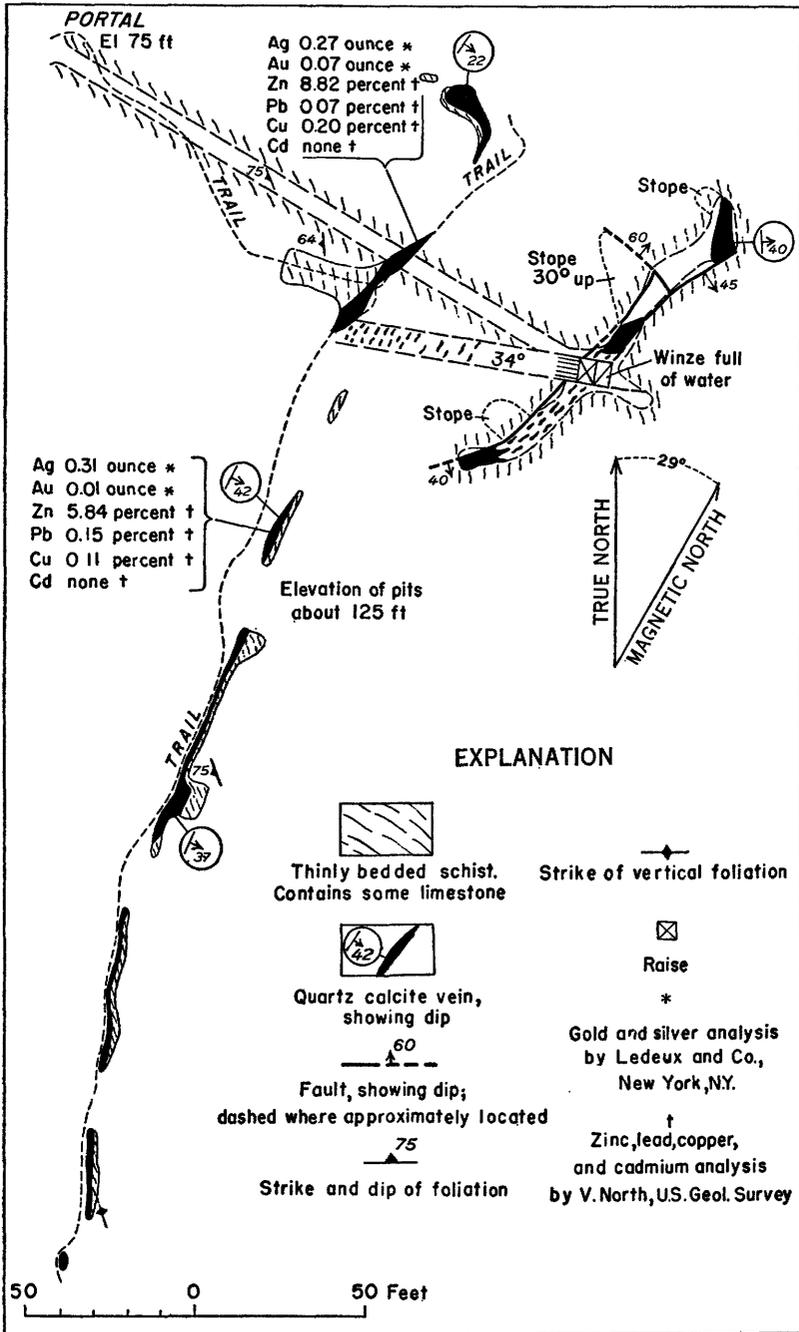


FIGURE 11.—Sketch map of south deposit, Lucky Boy deposits, Dora Lake, Prince of Wales Island, Wales district.

ized at depth. Because the two chip samples were taken from some of the richest parts of the vein, it is assumed that the average grade is much lower than the analyses indicate. The average content of zinc is probably not more than 3 percent. It is estimated that about 1,500 tons of 3-percent zinc ore are indicated in this deposit. No inferred tonnage has been estimated because the deposit is definitely limited in depth as shown by the nearly barren underground workings. If a larger tonnage is present it will probably be found by exposing the vein for a greater distance on the surface.

NORTH DEPOSIT

The northern deposit is composed of at least three quartz-calcite breccia veins that are slightly mineralized with sphalerite, galena, pyrite, and chalcopyrite.

A vein $1\frac{1}{2}$ feet thick that strikes N. 10° W. and dips 70° W. is exposed for about 160 feet at the beach along the east shore of Dora Lake and in two prospect pits. A chip sample taken across the vein at the beach contained 3.80 percent of zinc and 0.36 percent of lead.

Two other veins crop out at an altitude about 330 feet on the east side of Dora Lake nearly 400 feet southeast of the vein on the beach. The most northerly of the veins strikes about N. 35° W. and dips about 70° SW. It averages about 7 feet in thickness and is exposed at intervals for a distance of 150 feet. The other vein strikes nearly due north and dips about 80° W. It is about 20 feet thick on the surface and 5 feet wide as exposed in the 65-foot adit. It is exposed on the surface for a length of 85 feet and crops out over a vertical distance of 80 feet.

One sample was selected from a small ore pile near the northernmost of the two veins. It contained 5.23 percent of zinc, 2.05 percent of lead, and minor amounts of gold and silver. The sample was selected as the average of the better grade material. Undoubtedly, the entire vein averages much less than the sample indicates, probably about 2 or 3 percent of zinc and about 1 percent of lead.

A chip sample taken across the southernmost of the two veins in the 65-foot adit contained 0.31 percent of zinc and 0.89 percent of lead. This sample is probably representative of the average content of the vein.

Of the three veins in the northern area only the largest one cut by the adit is well enough exposed to warrant a reasonable estimate of reserves. On the basis of a length of 100 feet, a depth of 100 feet, a width of 7 feet, and a conversion factor of 10 cubic feet to a ton, it is estimated that there is about 7,000 tons of material containing about one-third of 1 percent of zinc, about 1 percent of lead, and minor amounts of gold and silver.

**PART 3. MAHONEY CREEK LEAD-ZINC MINE, GEORGE INLET,
REVILLAGIGEDO ISLAND, KETCHIKAN DISTRICT**

By **W. S. TWENHOFEL**

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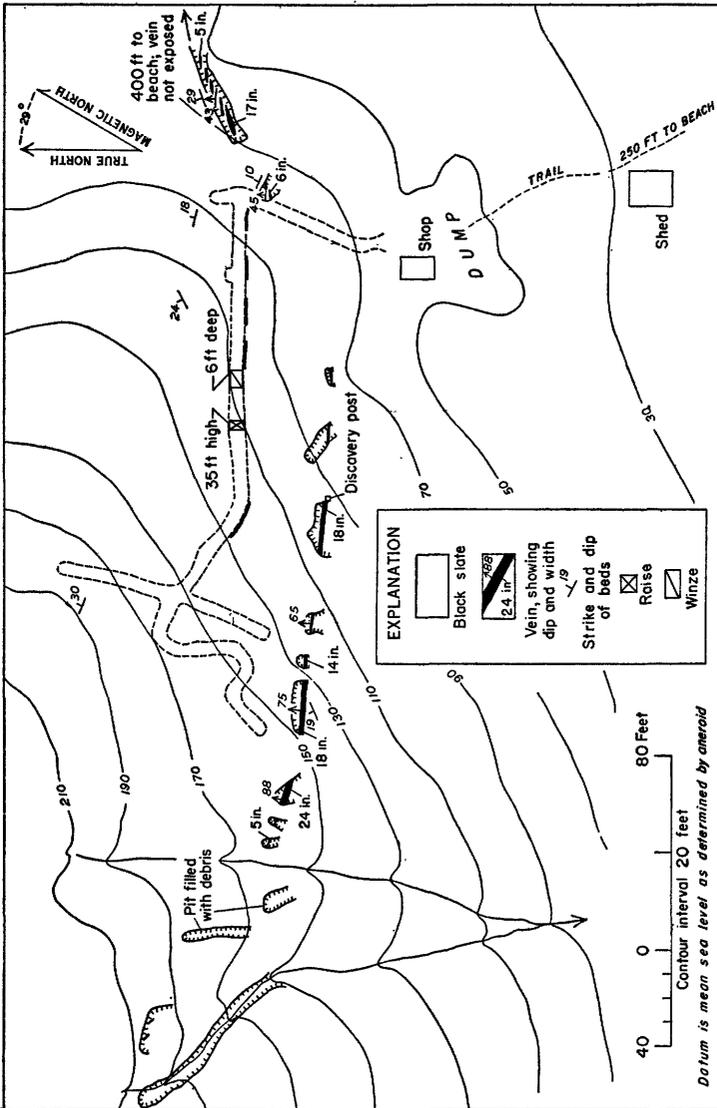
ABSTRACT

The deposit at Mahoney Creek is a small sphalerite- and galena-bearing vein in slate. The vein averages about 1 foot in width for a length of 350 feet and represents a fracture filling with some replacement of the country rock. It is estimated that the deposit contains about 2,500 tons of ore averaging 6 or 7 percent of lead and about 28 percent of zinc. Zinc and lead concentrates were shipped from the property in 1947 and 1948.

INTRODUCTION

The Mahoney Creek lead-zinc mine is on the west shore of George Inlet about 200 feet north of the mouth of Mahoney Creek. It is about 16 miles by boat from Ketchikan. (See fig. 7.) The mine property was formerly known as the Ashe's group (Brooks, 1902, p. 63-64; Wright and Wright, 1908, p. 150-151). It was discovered sometime before 1900 and a short crosscut and several opencuts were dug on the vein. Sometime between 1905 and 1942 additional underground work was done on the property and a drift was driven off the crosscut. In 1942 the prospect was restaked by Elmer Perkins, of Ketchikan, and was mapped and sampled by J. C. Roehm, of the Territorial Department of Mines.

The prospect remained idle until early in 1947, when it was taken over by A. W. Erickson and associates in the name of the Big Four Mining Co. of Ketchikan. The mine was actively developed; a small crusher, four bulk flotation cells, and a table were installed. Four to five hundred tons of ore were removed from the underground workings by the Big Four Mining Co. The mine was sold in the summer of 1948 to A. J. Theis and associates in the name of Montana Lead



Modified from map by J. C. Roehm, Territorial Department of Mines.
 FIGURE 12.—Sketch map of Mahoney Creek zinc prospect, George Inlet, Revillagigedo Island, Ketchikan district.

& Zinc, Inc. The mine is the first in the history of Alaska to produce zinc concentrates on a commercial basis, and the enterprise represents a milestone in the progress of Alaskan mining.

The writer visited the mine in 1943 and again in 1948.

GEOLOGY

The deposit (fig. 12) is a vein in black slate. The country rock strikes approximately east-west and dips northward from 10° to 30° . The attitude of the vein ranges from a N. 70° E. strike and a dip of 45° N. at its easternmost exposure to an east-west strike and a dip of 85° N. at the westernmost exposure. The width of the vein ranges from about 6 inches to at least 3 feet and averages slightly more than 1 foot. Opencuts and underground workings expose the vein at intervals for a horizontal distance of 350 feet and from 50 to 160 feet above sea level.

Underground the vein is discontinuous and pinches and swells within a distance of a few feet. The hanging wall and footwall are not well defined; therefore in mining it is very difficult to follow the vein.

The vein material consists of fine- to coarse-grained galena, sphalerite, a little sugary quartz, and some slate fragments. The ore minerals have filled fractures in the country rock and have also penetrated and replaced the country rock.

PRODUCTION AND RESERVES

Before 1947 no ore had been produced at the Mahoney Creek mine. During the summer of 1947 about 70 tons of concentrates were shipped to the smelter at Kellogg, Idaho; additional concentrates were shipped in 1948. The mill is designed to obtain a bulk flotation concentrate, which is then separated into zinc and lead concentrates on a table. The zinc concentrates contained about 43 percent of zinc and 15 percent of lead, and the lead concentrates contained about 55 percent of lead and 10 percent of zinc. If proposed development work in the mine reveals sufficient ore, the present operators plan to enlarge the flotation section of the mill and obtain a separate zinc and lead concentrate by means of flotation.

Eighteen samples collected in 1942 by J. C. Roehm from surface cuts and underground workings and analyzed by A. E. Glover, of the Territorial Department of Mines, show that the ore contains from 0.62 to 17.88 percent of lead and averages about 6.5 percent of lead. The zinc in the samples ranges from 11.72 to 50.15 percent with an average of about 28 percent. The gold content ranges from a trace to 0.03 ounce per ton; and the silver content ranges from a trace to 5.40 ounces per ton.

Assuming an average width of 1 foot for the vein, a length of 350 feet, a depth of 50 feet, and a conversion factor of 7 cubic feet per ton, the Mahoney Creek deposit is estimated to contain about 2,500 tons of indicated ore. Further exploration, especially along the strike of the vein, may be expected to increase ore reserve estimates.

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Zinc and Lead Deposits of Southeastern Alaska

G E O L O G I C A L S U R V E Y B U L L E T I N 9 9 8



UNITED STATES DEPARTMENT OF THE INTERIOR

Douglas McKay, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

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