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NICKEL-COPPER DEPOSIT
AT FUNTER BAY
ADMIRALTY ISLAND, ALASKA

BY
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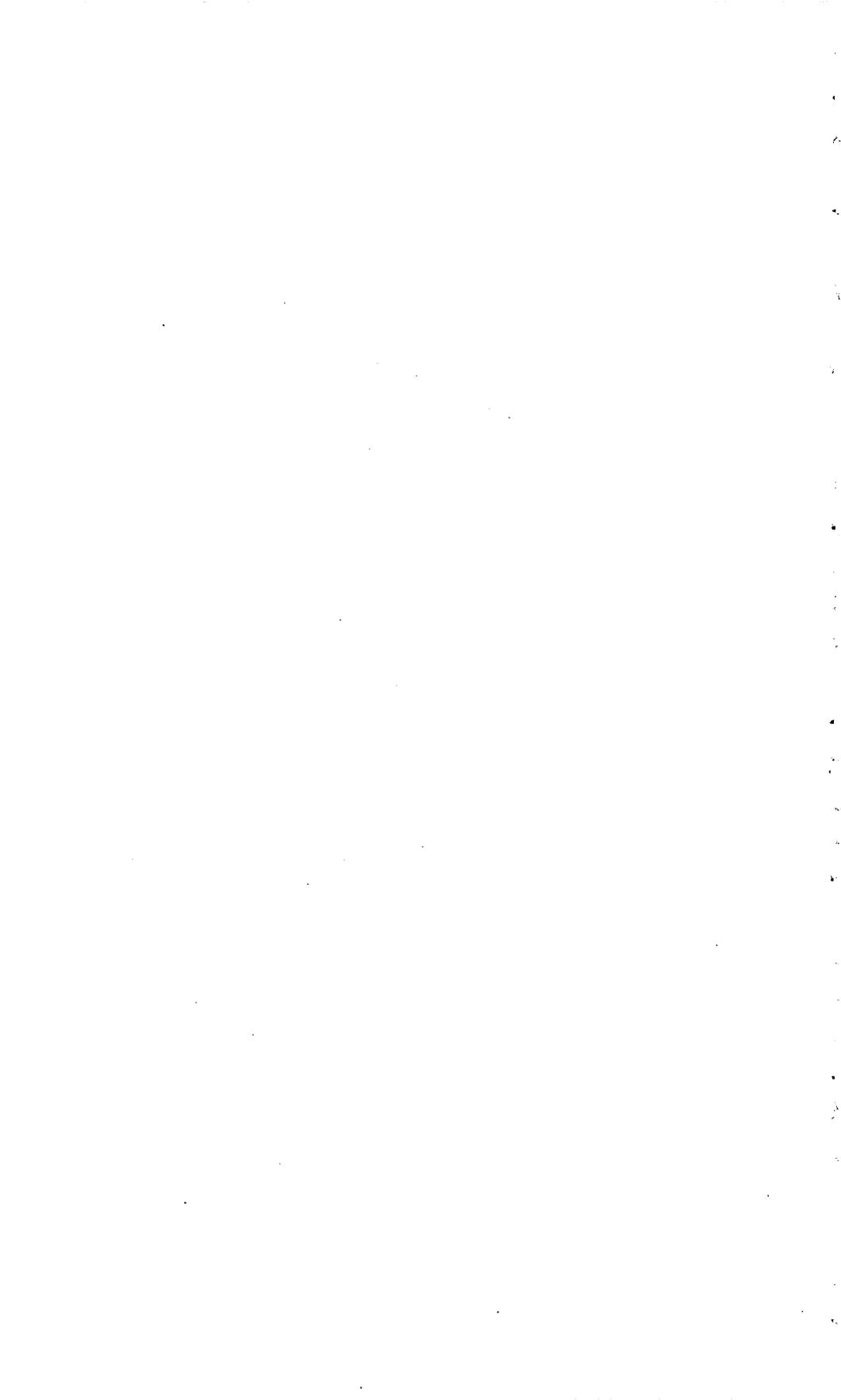


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NICKEL-COPPER DEPOSIT AT FUNTER BAY,
ADMIRALTY ISLAND, ALASKA

By John C. Reed

ABSTRACT

The nickel-copper deposit near the north end of Admiralty Island, about 18 miles in an airline west of Juneau, in southeastern Alaska, consists of a basic sill which averages somewhat more than 100 feet in thickness. The sill, which dips eastward, is intrusive into a thick sequence of phyllite and various types of schist.

The rock of the sill consists principally of the silicate minerals labradorite and olivine, but it also contains magnetite and the sulfides pyrrhotite, pentlandite, and chalcopyrite. It assays, on the average, about 0.34 percent nickel and 0.35 copper, which are doubtless mostly in the pentlandite and chalcopyrite respectively but are probably constituents of other minerals also. A significant proportion of nickel and copper is probably contained in the olivine and perhaps in the pyrrhotite.

The incomplete data available indicate a reserve of approximately 560,000 tons. Further exploration would probably show that the quantity is rather greater than this; but the average grade would probably not prove higher than that indicated above, although some ore of relatively high grade might well be found in places.

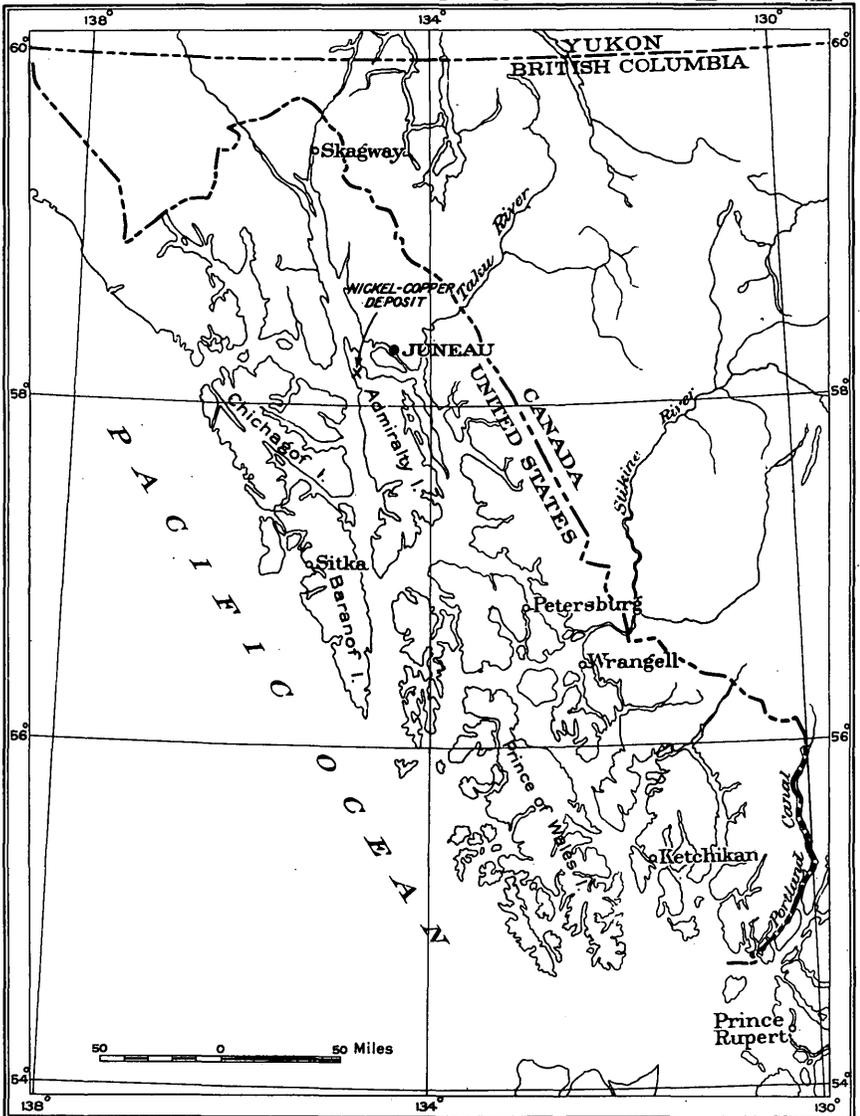
Although mining conditions are generally good, the nickel and copper content of the rock is so low that it appears very doubtful whether the deposit can be exploited successfully or contribute significantly to the Nation's nickel supply. Any further study and development of the deposit should be directed toward determining its full extent and toward more complete knowledge of the amount, distribution, and availability of the nickel and copper in the rock and in each of its constituent minerals.

INTRODUCTION

The nickel-copper deposit, known as the Mertie Lode, described in this report is on the west side of Mansfield Peninsula (see pl. 51), which forms the northernmost projection of Admiralty Island, one of the large islands of the Alexander Archipelago of southeastern Alaska (fig. 41). The deposit is on

the northwestern slope of Robert Barron Peak, southeast of Funter Bay.

Funter Bay is about 18 miles in an airline west of Juneau on the mainland. It is readily accessible by boat, and a steamer



lane passes close to its mouth, but the water distance from Juneau is about 55 miles. The bay is a well-protected harbor, much used by local fishing boats. In addition to several good

anchorage it has two docks, one at a cannery on the north side, where there is a post office, and another, which belongs to the owners of the Mertie Lode, on the southeast side.

A number of buildings, including cabins, a bunkhouse, a cook- and mess-house, an assay office, and a mill have been constructed near the dock on the southeast side of the bay. From the mill a narrow-gauge railroad extends southeastward about three-fourths of a mile over bench land, in part swampy, to the foot of the steep slope of Robert Barron Peak at an altitude of about 200 feet. From the southeast end of the railroad a long tunnel, driven in the search for gold deposits, extends southeastward into the mountain, and from a point nearby, two aerial tramways, now in disrepair, diverge from the railroad--one southeastward to a gold prospect and the other eastward to the Mertie Lode.

The nickel-copper deposit lies below timber line at an altitude of about 1,700 feet. It is about a mile southeast of the dock and about half a mile east of the junction of the tramways with the railroad, from which it is accessible by trail.

The Mertie Lode was discovered in 1919. It was named for J. B. Mertie, Jr., of the Geological Survey, who was one of the discoverers. It is on the War Eagle Extension No. 2 claim, which is one of a large group covering an extensive tract between Funter Bay and Hawk Inlet, which is farther southeast on the west coast of Admiralty Island. The War Eagle Extension No. 2 claim is owned by the Admiralty-Alaska Gold Mining Co. W. S. Pekovich was in charge of the affairs of the company on the ground when the property was examined, but no mining or development work was then being carried on, and no ore has been shipped from the lode. The deposit has since been examined for the Geological Survey by Buddington ^{1/} and by the author. Most of the investigation on which this report is based was carried on during the field season of 1937, but much of that season was

^{1/} Buddington, A. F., Mineral resources of Alaska, 1924: U. S. Geol. Survey Bull. 783, p. 46, 1926.

spent in the study of the general geology and of the numerous quartz veins and prospects in the vicinity. The property was also briefly examined in the summer of 1936 and again in 1938.

Many company records were made available by W. S. Pekovich, who also personally gave the author much pertinent information. Particular acknowledgment is due Rado Pekovich, who extended to the Survey party every facility of the camp at Funter Bay and accompanied the author on most of his trips to the nickel-copper deposit.

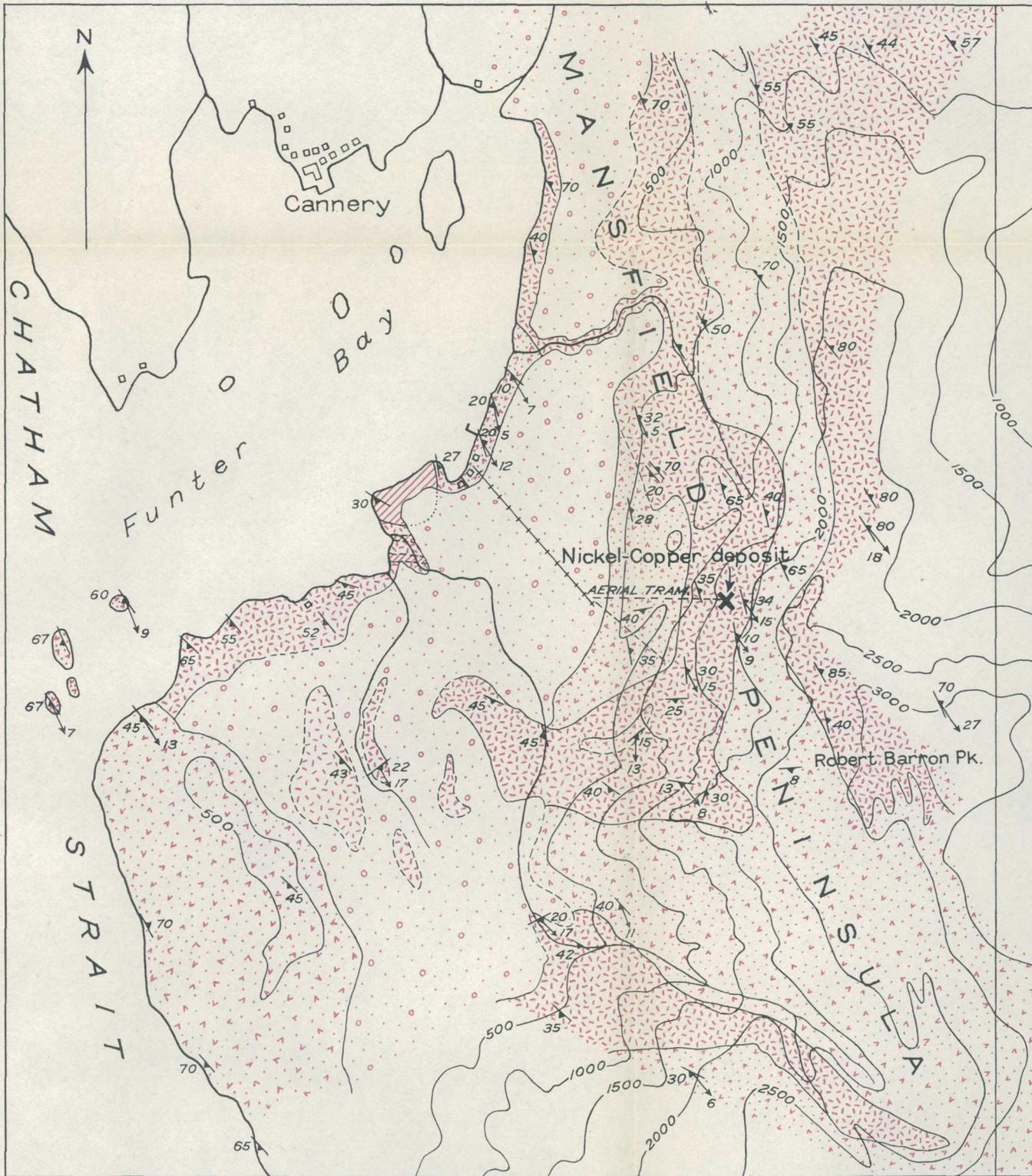
GEOLOGY

The country around Funter Bay is underlain by a thick sequence of metamorphic rocks. The age of these rocks is not definitely known, but on a map compiled by Buddington and Chapin,^{2/} they are designated as "Paleozoic sediments and volcanics." The sequence includes both sedimentary and igneous rocks, the latter being partly extrusive and partly intrusive types. All these rocks have undergone intense dynamic and igneous metamorphism, by which their original characteristics have been largely obscured or obliterated.

On plate 51 the bedded rocks have been grouped into three units--marble, greenstone, and phyllite. The oldest unit is the marble, which is light-colored and coarsely crystalline. It crops out only on and near the blunt promontory that projects into the bay west of the shore terminus of the railroad. The phyllite includes black, graphitic phyllite, light-colored siliceous schist, and some greenstone schist. The greenstone, which is exceptionally albitic, includes a great variety of greenstone schists, gneisses, and locally massive greenstones. Much of it was probably intrusive originally.

The phyllite and the greenstone are in part interbedded, and some layers of both are discontinuous. Much of the discon-

^{2/} Buddington, A. F., and Chapin, Theodore, *Geology and mineral deposits of southeastern Alaska*: U. S. Geol. Survey Bull. 800, pl. 2, 1929.



EXPLANATION

UNCONSOLIDATED
ROCKS



Glacial moraine



Phyllite

(Includes black graphitic
phyllite, light-colored schist,
and greenstone schist)



Greenstone

(Includes greenstone
schist, gneiss, and
massive greenstone)



Marble

15 ↗ 13

Strike and dip of foliation showing
direction and pitch of linear
structure and fold axis

Pleistocene
or Recent

Paleozoic (?)

Base modified from part of
Geological Survey map of Admiralty Island

134° 50'

GEOLOGIC MAP OF THE VICINITY OF ROBERT BARRON PEAK,
ADMIRALTY ISLAND, ALASKA

1 0 1 Mile

Contour interval 500 feet
Datum is mean sea level

tinuity appears to be due to structural movements, but it is doubtless due in part to differences in original discontinuities of the strata and of the intrusive bodies.

A basic sill and several dikes of widely varied composition were intruded into the metamorphic rocks after the metamorphism took place, being themselves unaffected by shearing or other drastic alteration. The relations of the dikes to the sill are unknown and being of no economic importance they will not be described and are not mapped. The sill, on the contrary, is of economic importance, for it constitutes the nickel-copper deposit which forms the main subject of this report. It is therefore described in some detail on pages 354-360 and its position is shown as well as available data permit on plate 52. The bench land between Funter Bay and the foot of the mountain is largely covered with glacial moraine.

Structure

The principal structural feature of the area illustrated by plate 51 is an anticline, the axial plane of which strikes northwest. The anticline pitches southeast at a low angle, and is in general a relatively simple fold, but it is modified at many places, particularly near its axis, by a multitude of smaller plications, some of which are to be measured in fractions of an inch.

The metamorphic rocks are all foliated. At most places the foliation appears to follow closely the stratification, which, however, cannot everywhere be identified. Besides the foliation, the rocks are widely affected by a linear structure, which is apparently parallel to the axes of both the large anticline and the small folds.

The rocks are cut by many well-defined and continuous joints, most of which trend northeastward and dip steeply to the northwest, nearly at right angles to the axis of the anticline.

NICKEL- AND COPPER-BEARING SILL

The nickel-copper deposit at Funter Bay is the basic sill mentioned on page 353. This sill crops out on the northeast limb of the anticline, not far from its axis; it strikes about N. 15° W. and dips about 38° E. It is in contact with rocks of the phyllite unit. It is about 138 feet thick at the outcrop but apparently thinner underground. The rock of the sill is nearly black, and for the most part coarse-grained, but it contains scattered finer-grained masses, the largest several inches across. It might be classified as a gabbro especially rich in olivine and poor in pyroxene; its chief constituents are labradorite, olivine, and pyroxene, which are partly altered to sericite, carbonates, brown hornblende, serpentine, talc, biotite, and chlorite.^{3/} The rock also contains the opaque minerals of metallic luster, which will be referred to as metallic minerals--magnetite ($\text{Fe}_2\text{O}_3 \cdot \text{FeO}$), pyrrhotite ($\text{Fe}_n\text{S}_{n+1}$), chalcopyrite (CuFeS_2), and pentlandite (sulfide of iron and nickel). Most of the copper and nickel is probably contained in the chalcopyrite and pentlandite, but significant quantities of both metals appear to be present in the olivine. A few samples taken from the sill on the walls of a short tunnel contain, on the average, 0.34 percent nickel and 0.35 percent copper.

The relative proportions of the constituent minerals differ widely from place to place, but on the average the exposed rock contains about 60 percent labradorite, 23 percent olivine, 2 percent pyroxene, 12 percent secondary minerals, and less than 2 percent metallic minerals. One specimen, collected to represent rock especially rich in sulfides, contains 29 percent labradorite, 30 percent olivine, 13 percent pyroxene, 10 percent alteration minerals and 18 percent, in all, of the metallic minerals.

^{3/} Reed, J. C., Nickel content of an Alaskan basic rock: U. S. Geol. Survey Bull. 897-D, 1939.

Not only the aggregate volume of the metallic minerals but also the relative abundance of these minerals differs widely in different specimens of the rock. The range in the constitution of the metallic minerals in three polished sections of the rock is illustrated in the following table.

Volumetric percentage of each metallic mineral as compared with the total volume of metallic minerals in specimens from a sill on Admiralty Island

Polished section	Pyrrhotite	Magnetite	Chalcopyrite	Pentlandite
1.....	80.1	5.1	9.5	5.2
2.....	63.6	12.9	15.9	7.5
3.....	54.8	33.2	8.8	3.2
Average.....	66.2	17.1	11.4	5.3

Apparently not enough time has elapsed since the outcrop of the sill was glaciated to permit the formation of more than a very thin weathered zone, which may be either richer or poorer than the original rock in such metals as nickel and copper. Limonite has formed in the joints of this rock at least as far underground as the face of the tunnel (see fig. 42), and near the tunnel portal weathering has spread widely from the joints, between which are boulderlike masses surrounded by weathered material. Fresh sulfide minerals can easily be exposed with a prospector's pick at many places over the outcrop of the sill.

Origin

The nickel-copper deposit is of magmatic origin. The basic magma from which the sill crystallized was probably differentiated at depth from a more silicic magma. The basic fraction apparently was then intruded into the already metamorphosed phyllite.

The sulfide minerals were among the latest in the sill to crystallize and consequently are now mostly interstitial to the

silicate minerals. Residual fluids released when the rest of the sill consolidated probably account for the partial alteration of the earlier formed silicate minerals and may also have moved the sulfide minerals for short distances and in small quantity.

Reserves

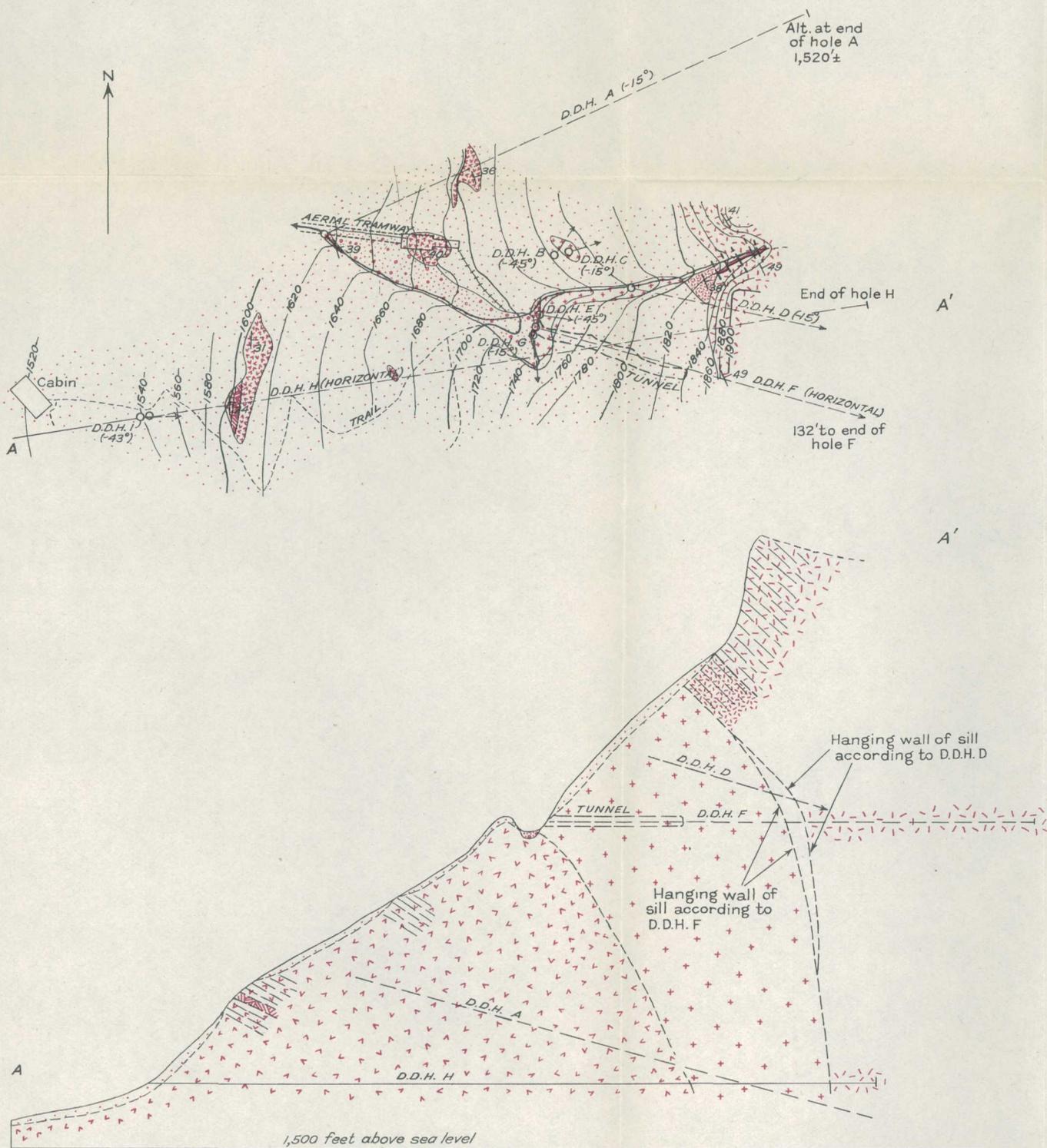
Size of the deposit

The whole sill is considered as the nickel-copper deposit. Further prospecting may indicate that this is too sweeping an assumption; some richer parts may eventually be considered workable and other parts be excluded as of too low grade.

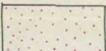
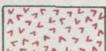
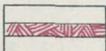
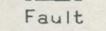
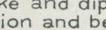
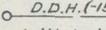
Calculations based on data and assumptions given below indicate that about 560,000 tons of material are available. The actual tonnage may be much larger but is probably not smaller than the figure given.

The total distance between the most northerly and the most southerly points of outcrop is about 84 feet and any greater extent is concealed beneath talus. The sill is exposed throughout a tunnel about 110 feet long, and it has been searched by a number of diamond-drill holes, some of which are in the sill for part of their lengths while others are not.

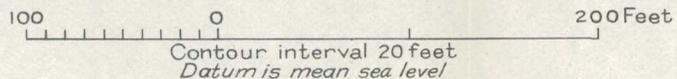
When the drill cores were examined in 1937, many of them were badly disarranged. The cores of holes F and H, which seemed to be still more or less intact, were logged and the logs are used in this report. But the reliance that might otherwise be placed in the data from the drill cores is tempered somewhat by the condition of the cores and records of holes other than F and H. Hole A could not be found on the ground; its location, direction, dip, length, and the fact that it does not anywhere encounter the sill were all accepted as reported to the author. The core of hole D was not logged and its reported length in the sill, when plotted, gives a slightly different measure of the



EXPLANATION

-  Landslide of November 1936
 -  Landslide, vegetation, talus, and soil
 -  Graphitic phyllite
 -  Light-colored schist (Not distinguished from phyllite in diamond-drill hole)
 -  Schist
 -  Unfoliated light-colored dike
 -  Quartz vein in schist
 -  Basic sill
 -  Fault
 -  Strike and dip of foliation and bedding
 -  Diamond-drill hole showing direction and dip (Dashed line shows projection of drill hole; solid line shows drill hole in plane of section)
- All of area represented by this plate is shown as phyllite on pl. 51

GEOLOGIC MAP AND SECTION OF VICINITY OF OUTCROP OF BASIC SILL
ON ADMIRALTY ISLAND NEAR FUNTER BAY, ALASKA



sill's thickness than is indicated by hole F (pl. 52). This difference depends on an apparent difference in the position of the hanging wall of the sill, but the position of the wall in hole D may have been wrongly reported. Hole F may have been drilled from a point within the tunnel and not from the portal as shown on plate 52.

At the surface, along the line of section A-A', the sill is about 138 feet thick. At the tunnel portal, a few feet farther north, it is a little thinner. The core of hole H, about 175 feet below the lowest point on the outcrop indicates that the sill at this level is a little less than 100 feet thick. Whether or not this indicates a general thinning with depth is not known.

Observations at the outcrop of the sill and in the metamorphic rocks above and below it along the creek show that there the sill strikes about N. 15° W. and dips about 38° E. Hole H indicates a considerably steeper general dip. In any case, if the sill extends northward with approximately the same strike and downward at any angle greater than about 40°, it should have been encountered in hole A. The fact that hole A is reported not to have encountered the sill indicates that the reported information on the hole is not correct, that the sill does not extend that far northward (approximately 140 feet from the line of section A-A'), or that the dip is less than 40° and much less than is indicated on plate 52. The last mentioned possibility is considered the most likely.

In order to estimate the possible tonnage of material available in the deposit to the level of hole H, it was assumed that the specific gravity of the average rock is 3 and that the sill continues with the same cross section area as is indicated on plate 52 for 100 feet north of the plane of section A-A' and for an equal distance south. If the sill actually terminates south of the line of hole A, then the assumption that it has the same cross section area for 100 feet northward is probably not

justified; but any error introduced by such an assumption would probably be compensated for by material below the level of hole H.

Tenor of the deposit

The distribution of nickel and copper within the sill is not known. Assay results of samples that have been taken indicate considerable variation from place to place but the sill is not widely enough exposed either on the surface or underground, nor have enough samples been cut, to permit the working out of the pattern of distribution of these metals.

The following discussion on the grade of the deposit is based on the results of analyses of samples and specimens collected by the author. All the material collected came from the tunnel, and it is assumed that the rock there exposed is representative of the sill. This assumption is supported by the fact that the core material from hole H appears similar to that in the tunnel. That wide extrapolations of grade from the small amount of sample material collected in the tunnel must be made with great caution is shown by the range in grade of the samples collected and by the fact that similar deposits elsewhere commonly show similar variations.

In the table below are listed the results of the analyses of six samples that were cut in the tunnel. The places in the

Percentages of copper and nickel in samples from sill
on Admiralty Island near Funter Bay, Alaska
[Analyst, R. C. Wells]

	1	2	3	4	5	6
Copper.....	0.26	0.27	0.36	0.25	0.61	0.45
Nickel.....	.28	.24	.34	.25	.61	.30

tunnel from which the samples came are shown on figure 42.

Sample 1 consisted of chips collected about 8 inches apart along

the inner 28 feet of the tunnel. All of the others were channel samples, but the channels were neither as wide nor as deep as would be necessary for precise results. Sample 6 was cut from weathered material near the portal of the tunnel to find out if weathering had produced any notable differences in the amounts or proportions of copper and nickel present.

The average content of nickel and copper in the rock of the sill as exposed in the tunnel and as represented by the samples is, if sample 6 is omitted because it is of weathered material, 0.34 percent and 0.35 percent respectively. The gross value of

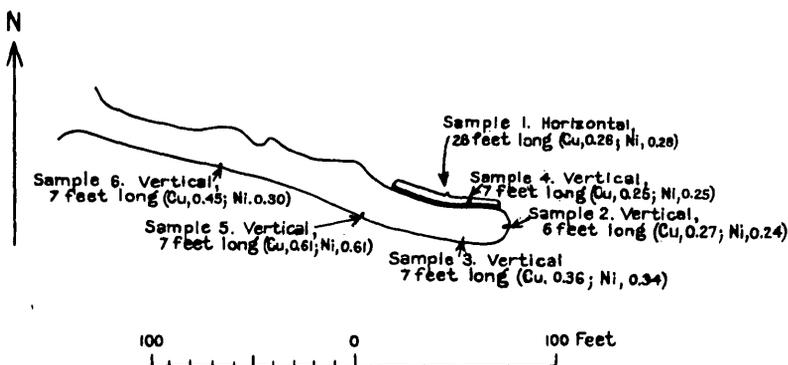


Figure 42.--Map of tunnel in nickel-copper deposit on Admiralty Island near Funter Bay, Alaska, showing places where samples were cut.

such material, at the assumed prices of 35 cents per pound for nickel and 12 cents per pound for copper, is \$3.22 per ton.

The results of petrographic studies of a few specimens from the nickel-copper deposit have been reported elsewhere in considerable detail.^{4/} The chief practical result was that the study did not reveal the presence of enough pentlandite and chalcopyrite to account for the quantities of nickel and copper shown by chemical analyses. The divergences between the chemical and the petrographic results are so great that they can scarcely be accounted for by assuming that the few thin and polished sections studied microscopically do not correctly represent the much larger volumes of material represented by the samples

^{4/} Reed, J. C., op. cit.

analyzed. It is therefore inferred that much of the nickel and copper is probably present in minerals other than pentlandite and chalcopyrite. Nickel is an appreciable constituent of many olivines.^{5/} Inasmuch as the deposit on Admiralty Island contains about 23 percent (probably about 34 percent before some of the olivine was altered) of olivine (p. 354), the olivine may contain a considerable part of the nickel. Whether or not the iron sulfide pyrrhotite in this rock contains significant amounts of nickel or copper or both is not known.

Economic considerations

It seems unlikely that material such as that constituting the nickel-copper deposit on Admiralty Island can be profitably mined at present prices or can be counted on to make significant contributions to the Nation's nickel supply. The grade of the material is low and the apparent tonnage is small. Further development work, such as more diamond drilling, might greatly increase the estimated tonnage and, as the nickel and copper content of the sill is not yet adequately known, might possibly reveal significantly higher grade ore at some places in the sill. An increase in the estimate of tenor, however, is thought to be much less likely than an increase in the estimate of size. If material such as that now known to be present should appear to warrant further investigation in the immediate or remote future, such investigation should include estimation of tonnages on a more precise basis than is now possible, the collecting of many samples in order to supply a more adequate knowledge of the amount and distribution of the nickel and copper content of the rock, and tests to determine what proportion of these metals would be recoverable by metallurgical processes.

^{5/} Ross, C. S., Shannon, E. V., and Gonyer, F. A., The origin of nickel silicates at Webster, N. C.: *Econ. Geology*, vol. 33, No. 5, pp. 528-552, 1928.

Wells, R. C., Relative abundance of nickel in the earth's crust: U. S. Geol. Survey Prof. Paper 197 (in preparation).

In general, mining conditions in the vicinity of Funter Bay are good. The area is readily accessible by steamer; in normal times an adequate labor supply is assured by the proximity to Juneau; a sufficient supply of timber is locally available; the climate is not rigorous, although at the altitude of the deposit heavy winter snows are frequent; and the topographic position of the deposit favors cheap mining. No adequate water supply for power is available close to the deposit, but Diesel power should not be unduly expensive.

