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NICKEL-COPPER DEPOSIT AT SNIPE BAY BARANOF ISLAND, ALASKA

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ABSTRACT

At Snipe Bay, on the outer coast of Baranof Island, about 46 miles southeast of Sitka in southeastern Alaska, is a nickel-copper deposit that consists of a mass of basic rock intruded into quartzite and quartz schist. Neither the size nor the grade of the deposit is adequately known. Natural exposures and those in a few prospect openings indicate that to an assumed depth of about 130 feet below the lowest point on the outcrop there is a reserve of about 430,000 tons of low-grade nickel-bearing material, which, to judge from available assays and from comparison with similar material from other places, probably does not contain more than 0.3 percent each of nickel and copper. The deposit thus appears too small and of too low grade to permit the recovery of the nickel and copper except at a considerable financial loss; but as the location is favorable for large-scale, low-cost development, further prospecting may be justified, in the hope that a moderate amount of surface stripping, plus a few diamond-drill holes, might indicate that the deposit is larger, and possibly of higher grade, than it is safe to infer from the available data.

INTRODUCTION

The nickel-copper deposit discussed in this report is at Snipe Bay (see fig. 36), a northeastward-trending indentation of the west coast of Baranof Island, southeastern Alaska, about 20 miles northwest of Cape Ommaney, at the southern tip of the island. Snipe Bay is about 46 miles by airline southeast of Sitka, the nearest town of considerable size, and not very much farther by boat. The deposit lies at an altitude of about 450 to 600 feet near the head of a small, short stream that empties into the first small bight east of the entrance on the north

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side of the bay. Although Snipe Bay is deep and fairly well protected, thus making a favored anchorage for small fishing boats. the deposit lies too near the entrance of the bay to be

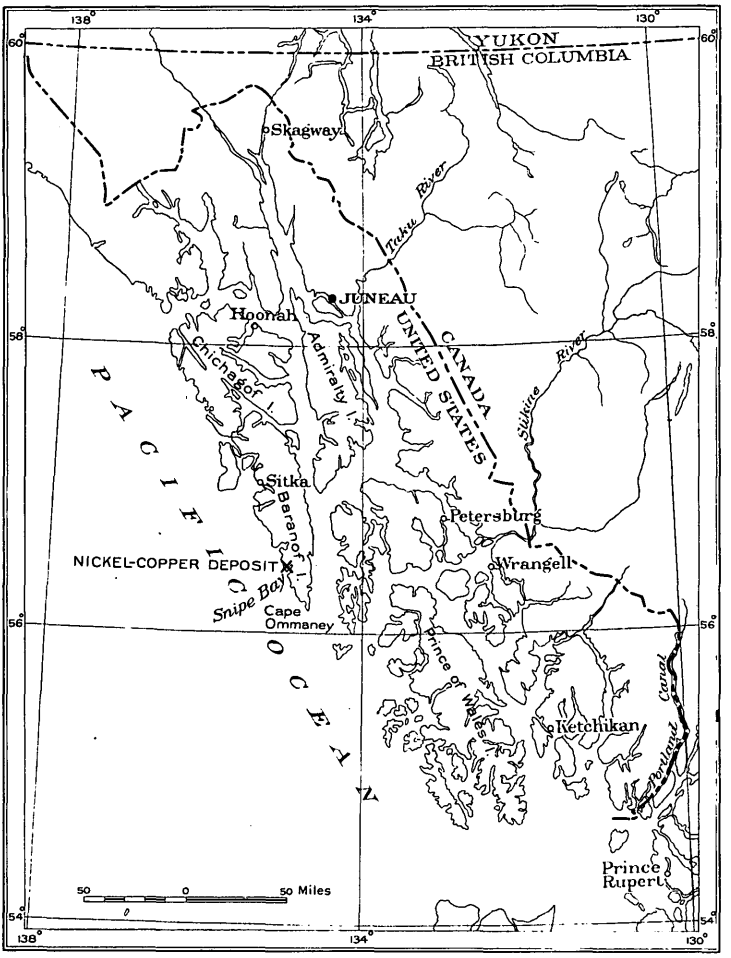


Figure 36.--Index map of southeastern Alaska showing the location of the nickel-copper deposit at Snipe Bay, Baranof Island.

well sheltered, so that to land nearby is difficult in even moderately rough weather and impossible during bad storms. There are no docking facilities. The bay is never entered by steamer, although this would be possible, but can be reached by small

boat, except in times of rough water. The best anchorage is said to be in a cove on the south side of the bay about 1½ miles inside the entrance.

The surrounding slopes are, for the most part, very steep, and camp sites near the beach are scarce. An abandoned camp, which evidently served as a base headquarters for the prospecting work that was done on the deposit in 1941, is located near the beach on the west side of the stream near the head of which the deposit lies. A steep trail leads from the camp site to the deposit.

According to Buddington,[1/] who examined the deposit in 1923, claims were first staked on the deposit by I. Myre Hofstad in 1922. Ten claims, including some of Hofstad's old claims, are said now to cover the deposit and its vicinity. The claims are held by S. H. P. Vevelstad, and all of them except those formerly held by Hofstad were staked in 1939. No ore has been shipped from the property.

The examination on which this report is based was made on June 29 and 30, 1941. F. C. Calkins and H. G. Ferguson, of the Geological Survey, offered many helpful suggestions during the preparation of the report.

GEOLOGY

The principal country rocks in the vicinity of Snipe Bay are biotitic quartzite and biotite-quartz schist. These rocks are part of a graywacke formation, believed to be of Lower Cretaceous age, which is widespread on Chichagof and Baranof Islands. The graywacke formation, and the predominantly volcanic formations that underlie it, are cut by a variety of intrusive igneous rocks, which are thought to be mainly of Cretaceous but possibly in part of Tertiary age.

1/ Buddington, A. F., Mineral resources of Alaska, 1923: U. S. Geol. Survey Bull. 773, pp. 106, 107, 1925.

The quartzite and schist are cut by a dark, coarse-grained, igneous mass whose boundaries are largely concealed; this mass constitutes the deposit here described (see pl. 48). The mass at the surface is at least 265 feet long and 125 feet wide. The rock, which before alteration was probably gabbro or norite, now consists mainly of brown hornblende, albite, and magnetite, and contains apatite in unusual abundance. The alteration appears to have been the product of soda-rich hydrothermal solutions.

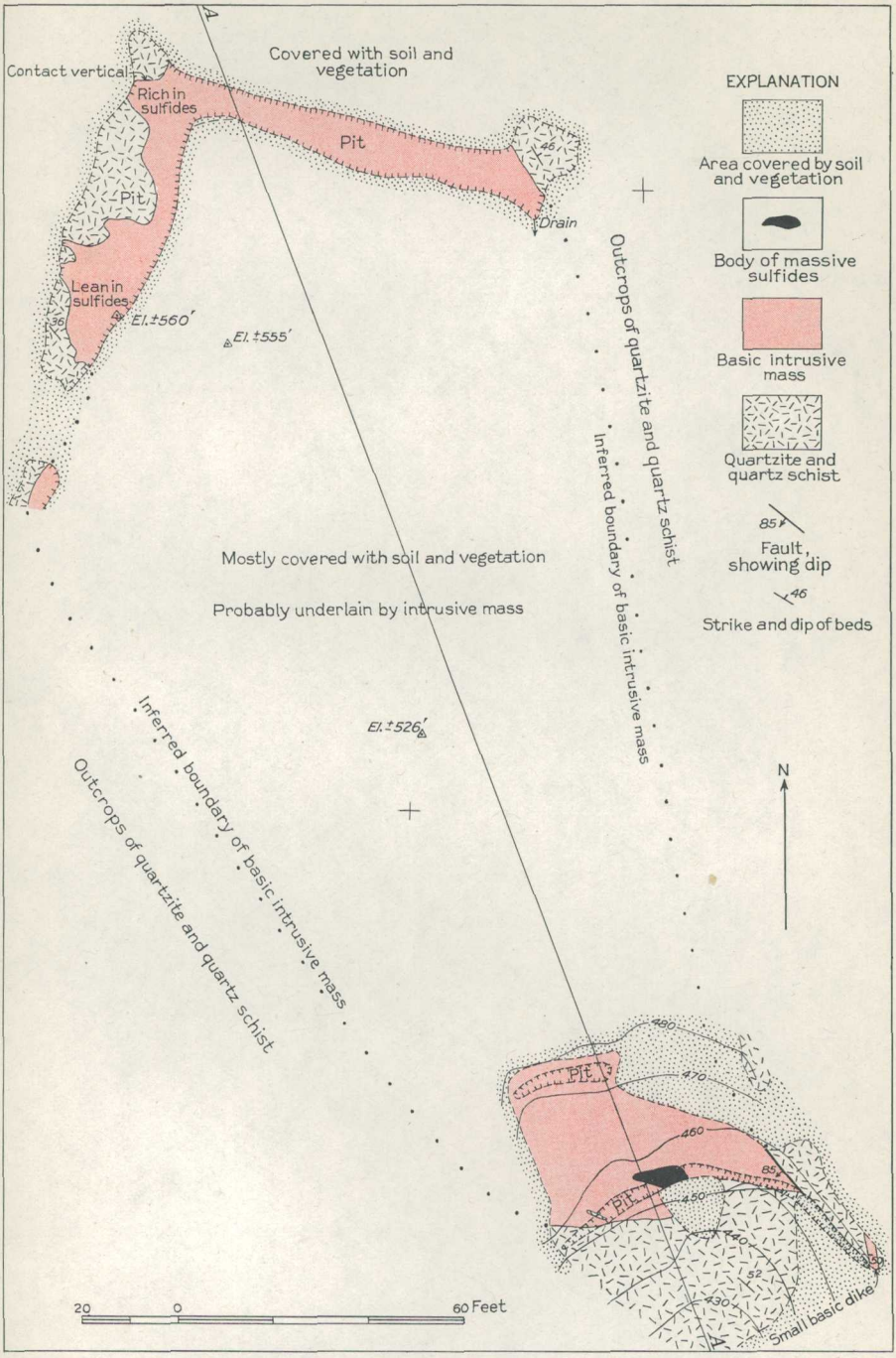
The quartzite and quartz schist strike northwestward and dip northeast. The longer surface dimension of the intrusive mass appears to be roughly the same as the general strike of the wall rocks, but it can be seen in prospect pits that the mass at least locally crosscuts the stratified rocks.

ORE DEPOSIT

The nickel and copper at Snipe Bay occur in the intrusive igneous mass just mentioned. The igneous rock contains a nickel-bearing sulfide mineral, probably pentlandite, and the copper-bearing sulfide chalcopyrite. The amounts of these ore minerals in the rock differ widely at different places, but so far no pattern of their distribution has been recognized, and the whole intrusive mass is therefore considered as the deposit. The surface exposures are so poor that the shape and attitude of the mass, and hence any estimates of the volume to any specified depth, are largely matters of conjecture.

Mineralogy

The metallic minerals in the deposit include principally the iron oxide magnetite, the iron sulfides pyrrhotite and pyrite, the iron-copper sulfide chalcopyrite, and the iron-nickel sulfide pentlandite. Of these only the chalcopyrite and the pentlandite are of economic significance. The silicate minerals include brown hornblende associated with a pale amphibole derived



GEOLOGIC SKETCH MAP OF THE NICKEL-COPPER DEPOSIT AT SNIPE BAY, BARANOF ISLAND, ALASKA

from it, a soda-rich plagioclase feldspar (albite or albite-oligoclase), and a more calcic plagioclase feldspar (andesine or labradorite). Apatite constitutes perhaps 1 or 2 percent of the rock.

At most places the brown hornblende or its alteration products make up more than 50 percent of the rock. The next most abundant mineral is albite or albite-oligoclase, but locally most or even all of the feldspar present may be the more calcic plagioclase. The apatite appears to be confined largely to the soda-rich feldspar in the rock. The magnetite is distributed as small crystals and rounded, sickle-shaped, or irregularly shaped grains throughout all the other minerals including the sulfides. The magnetite varies widely in abundance but in general probably forms between 10 and 25 percent of the rock.

The sulfide minerals are very closely associated. Pyrrhotite is by far the most abundant. The principal nickel mineral is pentlandite. Buddington [2/] mentions the presence of pentlandite and of a nickel mineral secondary after pentlandite. One polished section of relatively high grade material collected by the authors was examined microscopically, but no pentlandite could be identified in it. An undetermined metallic mineral occurring sparsely in the polished section may be the secondary nickel mineral mentioned by Buddington. The few available analytical data indicate that in general the chalcopyrite and the pentlandite are present in roughly equal quantity. Pyrite is very scarce. The proportion of the rock made up of the combined sulfides ranges from less than 1 percent to nearly 100 percent. Where the proportion of the combined sulfide minerals is high, the ratio of pentlandite to chalcopyrite, and hence of nickel to copper, appears to be high also (see table p. 329).

2/ Buddington, A. F., op. cit., p. 107.

Origin

The deposit has many features in common with other nickel-copper deposits farther north, on the west coast of Chichagof Island [3] and on Yakobi Island.[4] From examination of those deposits and from a brief petrologic study of the deposit at Snipe Bay the following origin has been inferred:

The quartzite and quartz schist were invaded by an igneous mass of unknown shape which crystallized probably as norite or as gabbro. The rock of the mass probably was a basic differentiate of a more silicic magma. The sulfides of the rock were, for the most part, among the latest minerals to crystallize. Later, soda-rich emanations from less basic parts of the magma apparently permeated the norite and converted the original pyroxene to the brown hornblende and, still later, partially converted the brown hornblende to pale amphibole with the release of some iron as magnetite. The same emanations have replaced the original moderately calcic plagioclase with albite or albite-oligoclase. The sulfides apparently were moved about to a minor extent by late fluids to form tiny veinlets and fracture-fillings in the igneous mass and, more rarely, in the adjacent wall rocks.

Localization

Some parts of the igneous mass appear to be entirely barren of sulfide minerals and therefore do not contain appreciable quantities of either nickel or copper. Other parts are relatively rich in sulfides, disseminated in irregular blebs interstitial to the other minerals. One body is made up almost entirely of sulfides.

The intrusive mass is poorly exposed and has been so little prospected that the general distribution of the sulfides in it is not known.

3/ Pecora, W. T., Nickel-copper deposits on the west coast of Chichagof Island, Alaska: U. S. Geol. Survey Bull. 936-I (in press).

4/ Reed, J. C., and Dorr, J. V. N., 2d, Nickel deposits of Bohemia Basin and vicinity, Yakobi Island, Alaska: U. S. Geol. Survey Bull. 931-F, 1942.

Size and grade

The greatest observed length of the deposit, on the surface, is about 265 feet, and its greatest observed width about 125 feet (see pl. 48). The figure for the length is somewhat, and perhaps a great deal, too small, for at the north end the rock disappears beneath a cover of vegetation and soil. The shape of the body in depth is of course even more uncertain. The mass may extend to a considerable depth, have nearly vertical walls and a horizontal section similar to its surface plan, or the attitude of the walls and the form of the horizontal section may change markedly with depth.

In view of all these uncertainties, any estimate of tonnage is hazardous. An estimate is offered, however, that is based on certain assumptions. Figure 37 is a rough longitudinal section of the deposit showing inferred continuation to a considerable depth. In figure 37 and in the following calculations, the deposit, for convenience, has been considered as extending vertically downward. It seems more likely that it actually extends downward more or less parallel to the dip of the graywacke. It is further assumed that the deposit extends to a depth equal to half the outcrop length below the lowest point on the outcrop with the same area (22,000 sq. ft.) as indicated on plate 48. If this were true, the volume of the deposit would be that above the lowest point on the outcrop plus the product of the measured area of outcrop and half the outcrop length, or

$$\frac{22{,}000 \times 125}{2} = 1{,}375{,}000 \text{ cubic feet}$$

$$1{,}375{,}000 + (22{,}000 \times 132) = \text{approximately } 4{,}300{,}000 \text{ cubic feet},$$

where 22,000 square feet is the measured area of outcrop, 125 feet the difference in altitude between the highest and lowest known points on the outcrop, and 132 feet half the outcrop length.

Assuming that the specific gravity of the rock is such that it would take about 10 cubic feet to make a ton, 4,300,000 cubic feet would equal 430,000 tons to the depth assumed, which is about 300 feet above sea level. But the above estimates can hardly be too large and may be much too small; much more than 430,000 tons may be available at depths greater than 132 feet.

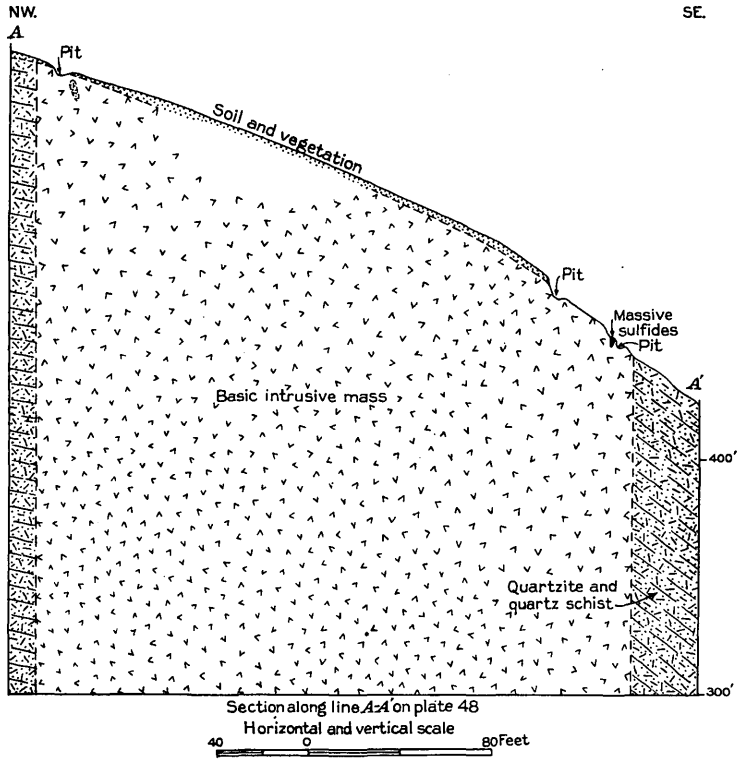


Figure 37.--Diagrammatic section of the nickel-copper deposit at Snipe Bay, Alaska.

The one small body composed almost entirely of sulfides is about 12 feet long by 4 feet wide and is roughly elliptical. If it extends in depth a distance equal to half its longer dimension, it contains about 30 tons of relatively high grade material.

The grade of the deposit is not known. Only a few analyses have been made of material from it and only three, of which two were collected by Buddington and one by the authors, were both collected and analyzed by the Geological Survey. Two of these

three samples were from the small, high-grade body, and the other, which was collected by Buddington to represent the metallized rock, contained much more copper than is thought to be present in the average rock.

Nickel and copper in samples from the deposit at Snipe Bay, Alaska

Sample	Collector	Nickel (percent)	Copper (percent)
From body of massive sulfides.	Buddington	3.67	2.87
Do	Reed and Gates.	4.08	.79
Metallized gabbro	Buddington	.43	3.44

At best, the deposit as a whole seems unlikely to yield more than about 0.3 percent each of nickel and of copper. This estimate is based partly on the very inadequate analytical data but mostly on comparison of the material with similar material from the deposits on Yakobi and on Chichagof Island, the metal content of which is better known. Channel samples, cut in each of the three principal pits, might be expected to indicate the content of nickel and copper in the rocks close to these pits, but in order to make a reliable estimate for the entire deposit, it would be necessary to assay many samples from additional pits or from diamond-drill cores or from both.

Reserves

The foregoing discussion indicates that the nickel-copper deposit at Snipe Bay contains reserves of possibly a few hundreds of thousands of tons of material that may contain a few tenths of a percent each of nickel and copper. Within this larger mass is at least one body of a few tons which probably carries about 4 percent of nickel. Practically no ore is actually in sight, and the nickel and copper tenor of the material exposed is largely inferred.

Economic considerations

At an assumed price of 35 cents per pound for nickel and 12 cents per pound for copper, the material may contain values in these metals of about $2.80 per ton. It seems doubtful that such material could be mined, milled, shipped, and smelted at a profit even if it were present in much larger quantity than is now indicated.

Systematic stripping of the surface of the deposit, or test pitting where the cover is too deep for stripping, would determine the size and the shape of the outcrop. Adequate sampling should be carried on along with the stripping, in order to determine the average grade of the deposit and its range in grade. If the results indicated a promising deposit, a moderate amount of carefully planned diamond drilling would furnish the information necessary to indicate the general shape and attitude of the deposit below the surface, and assays of core samples would indicate the tenor.

Mining conditions are such, on the whole, that operations could be carried on at low cost if a sufficiently large tonnage is available. A good mill site could be found between the deposit and the nearby beach, but lack of harbor and docking facilities would present a considerable, but by no means insurmountable, obstacle. There is no local supply of labor with mining experience, but to bring in such a supply for a projected operation would not be unusually difficult.

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CORRECTIONS for Geological Survey Bulletin 936–N

Page 340, Figure 39.

On the bar scale the small divisions should be 7½ feet and the large divisions 37½ feet, instead of 5 feet and 25 feet as shown.

Page 343, Figure 40.

The scale is incorrect and should be canceled.

Page 344, Last paragraph, 2d line.

Change "40-foot drift" to "50-foot drift."