UNITED STATES
DEPARTMENT OF THE INTERIOR
Geological Survey
Washington

THE NICKEL-COPPER DEPOSITS ON THE WEST COAST OF CHICHAGOF ISLAND, SOUTHEASTERN ALASKA.

By

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Introduction

The following report on three nickel-copper deposits on the west coast of Chichagof Island, Alaska (see fig. 1) supplements the Geological Survey report by Pecora 1/ and is based on new geologic information obtained by the Geological Survey in 1942 on a project carried out in conjunction with an exploratory project by the Bureau of Mines.

In the abstract in U. S. Geol. Survey Bull. 936-I Pecora has summarized the general geology of the area and the characteristics of the deposits as follows:

> "On the west coast of Chichagof Island, southeastern Alaska, are three nickel-copper deposits that consist of norite containing the sulfide minerals pyrrhotite, pentlandite, and chalcopyrite. The deposits are within less than a mile of each other and are, by water, 160 miles southwest of Juneau and 70 miles northwest of Sitka. The norite is part of a stock, about 5 square miles of which is above sea level. Other rocks of the stock are amphibolite, amphibolitic norite, gabbro, diorite, quartz diorite, monzonite, granite, pegmatites, quartz veins, and schist inclusions. The stock is intrusive into a Lower Cretaceous (?) graywacke formation and an Upper Triassic (?) greenstone formation, both of which are now metamorphosed to schist."
>
> "The deposits are of two kinds: (1) A disseminated-sulfide deposit, in which the sulfide minerals are distributed throughout the mass of the norite, and (2) concentrated-sulfide deposits, in which the sulfide minerals are in distinct podlike masses of sulfide-rich norite. The deposits of type 2 are coarser-grained, smaller, and higher in nickel and copper than those of type 1."
>
> "Two of the three deposits described are of the concentrated-sulfide variety."

1/ Pecora, W. T., Nickel-copper deposits on the west coast of Chichagof Island, Alaska: U. S. Geol. Survey Bull. 936-I, pp. 221-243, 1942.

One deposit is on the northern tip of Fleming Island, the other is about 3,000 feet southeast.

> "The deposit composed of norite with disseminated-sulfides is exposed about 1,000 feet southeast of the second deposit of concentrated sulfides."

Pecora's generalized geologic map of a part of western Chichagof Island and his geologic map of the stock near Davison Bay are given in figures 2 and 3.

During the latter part of the summer of 1942 the Bureau of Mines explored these nickel-copper deposits by diamond drilling, aided by members of the Geological Survey who gave such advice as comes within the field of the Geological Survey. Geological Survey members were at the Bureau of Mines project for an average of two days each week. Their guidance consisted of recommendations as to the location attitude, and length of the drill holes, logging of drill cores and the interpretation of geologic data obtained from them.

The nickel-copper deposits

Mineralogy

The sulfide minerals in the norite are pyrrhotite, pentlandite, and chalcopyrite. They are intimately intergrown. They were the last minerals to crystallize and are interstitial to the silicate minerals. Pyroxene, amphibole, and plagioclase feldspar are the chief gangue minerals. The ratio of sulfide minerals to silicate minerals in the rock ranges widely, but the ratios between the different sulfide minerals is fairly constant. The percentage of sulfide minerals is higher and they are more coarsely crystalline in the concentrated-sulfide deposits than in the disseminated-sulfide deposit.

Numerous small fractures in the norite are filled with graphite. The graphite may have come from carbonaceous graywacke inclusions in the norite.

Concentrated-sulfide deposit on Fleming Island

A small concentrated-sulfide deposit crops out on the northern tip of Fleming Island (see fig. 3, and plate 1,) and at high tide much of the body is flooded.

The Bureau of Mines explored this deposit by five diamond-drill holes. Old workings consist of a shaft and 150 feet of drifts and crosscuts. The shaft, about 50 feet east of the deposit, is reported by Healy 2/ to be 180 feet deep. At the time of the investigation during the summer of 1942 the shaft was flooded to within a few feet of its collar. Although the shaft is only about 60 feet from the ocean, the water in it is fresh. During a few days of moderate pumping the water-level was lowered by about 40 feet. Probably no undue difficulty would be experienced in unwatering the workings. The outcrop of the body measures about 30 feet by 40 feet. A thin covering of brick-red oxidized sulfides makes the outcrop readily distinguishable from the surrounding barren norite. A sketch map of the

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2/ Private reports on the property by J. C. Rogers and R. L. Healy were made available to the Geological Survey by the Bureau of Mines, and have been of value as they contain maps and descriptions of the now-flooded underground workings.

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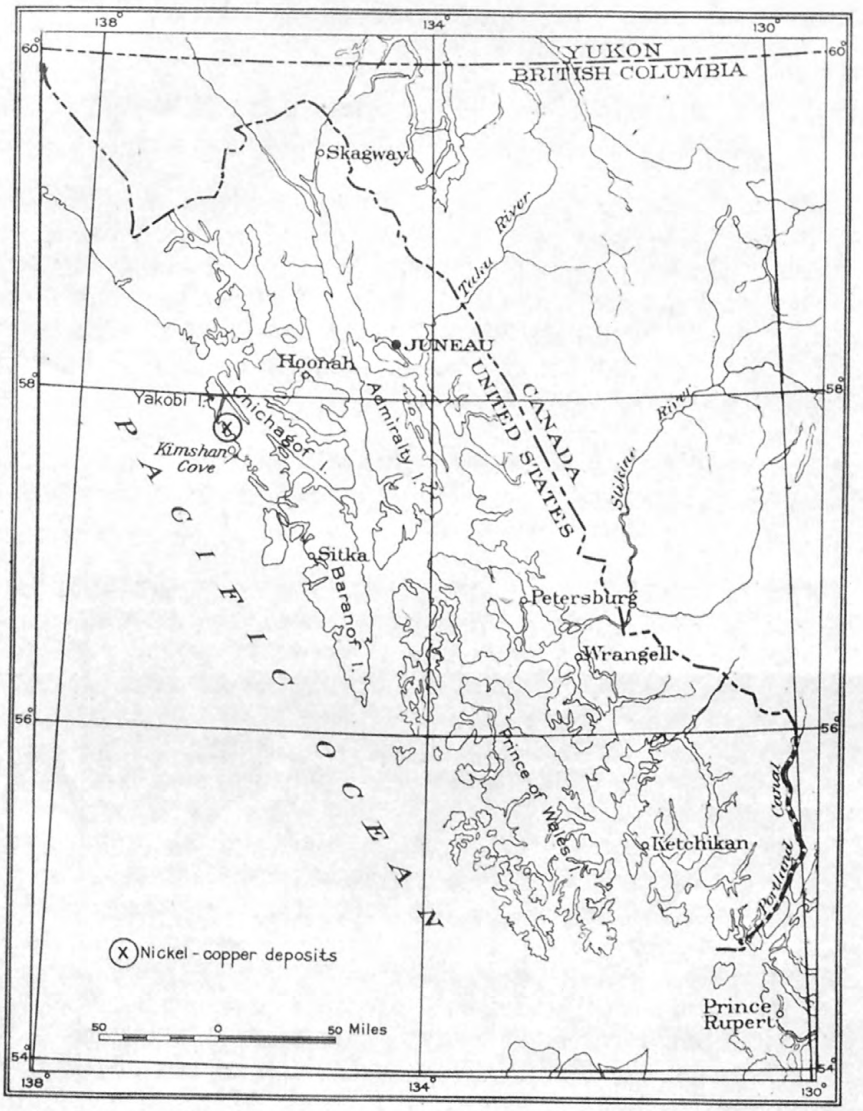

Figure 1. -- Index map of southeastern Alaska showing location of the nickel-copper deposits on the west coast of Chichagof Island

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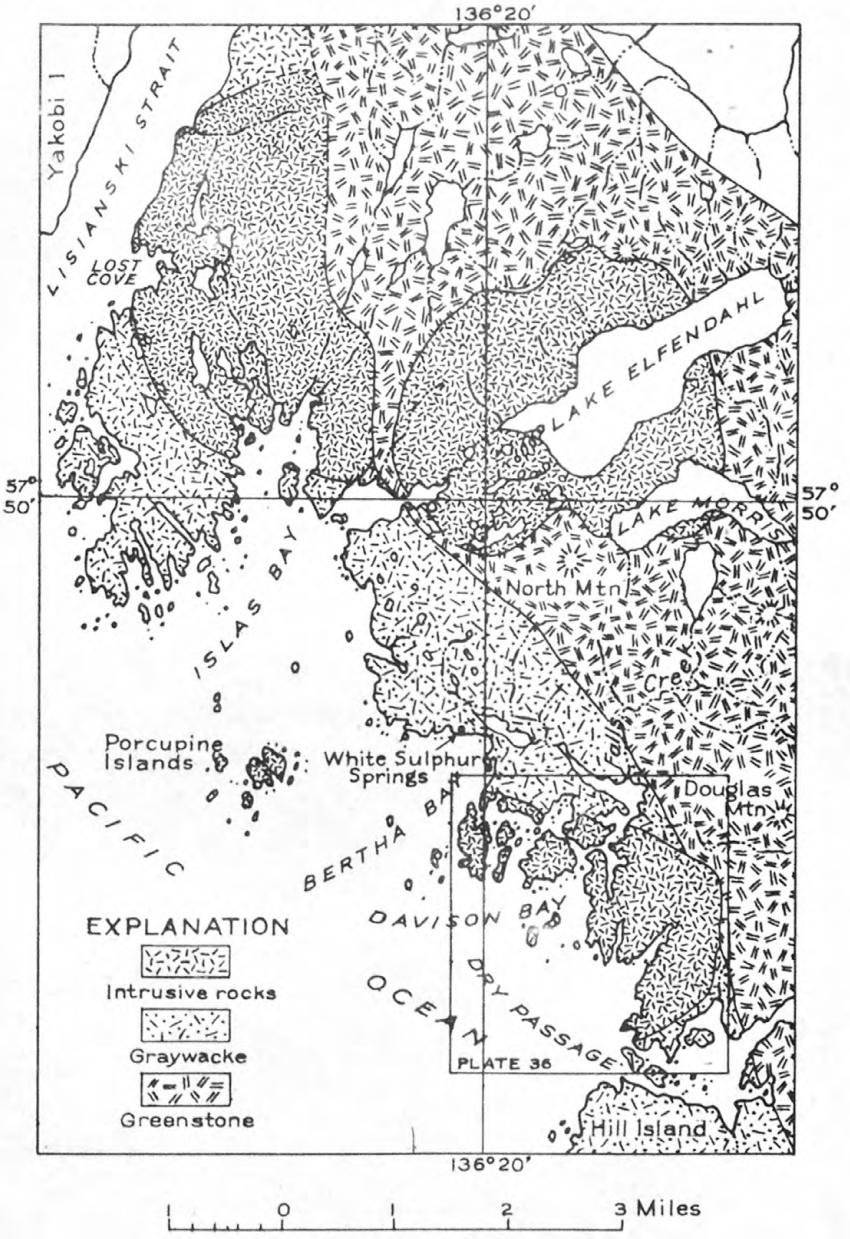
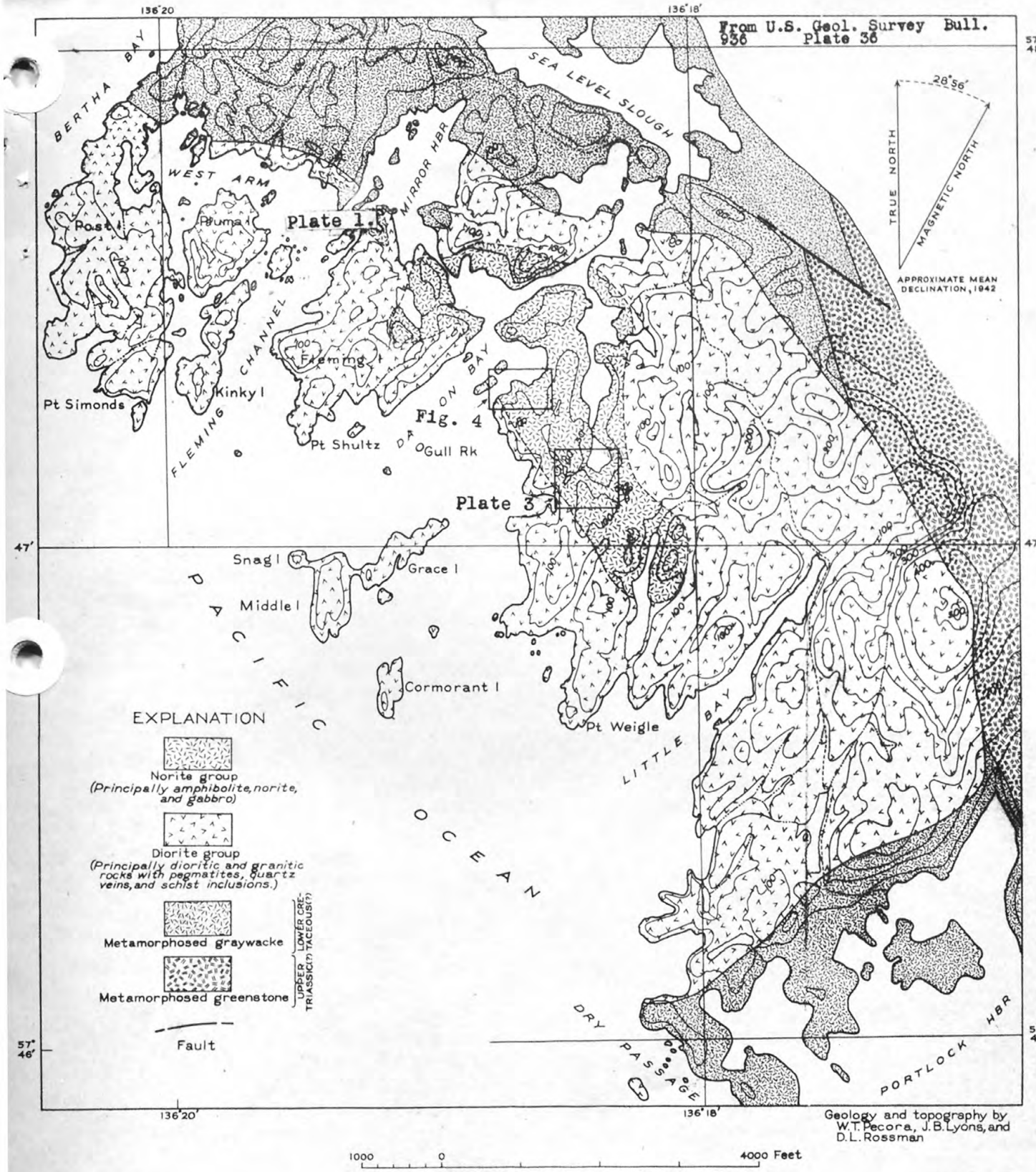


From fig. 23, U. S. Geol. Surv. Bull. 93

Figure 2 -- Generalized geologic map of a part of western Chichagof Island, Alaska



GEOLOGIC MAP OF THE STOCK NEAR DAVISON BAY, CHICHAGOF ISLAND, ALASKA

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FIGURE 3

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deposit, underground workings, and horizontal projections of the diamond-drill holes are shown on plate 1. The sulfides are largely concentrated into small pods surrounded by nearly barren norite. These pods are generally only a few inches in length. They contain an average of about 3 percent of nickel and 2 percent of copper, in contrast with the enclosing norite which generally contains less than 0.1 percent of nickel. Concentrated-sulfide pods appear to constitute a little more than $\frac{1}{2}$ of the body.

The maps prepared by Healy indicate that 37 feet of the workings on the 80-foot level are in concentrated sulfides. There is very little sulfide present in workings on the 180-foot level. A prominent fault, which strikes N. 80° E and dips 75° N, was mapped by Healy on the 180-foot level. This fault, it is believed, was intersected in diamond-drill holes 4, 5, and 6 (see plates 1 and 2) where zones 1 foot to 2 feet in width of finely comminuted rock were encountered.

Information from the diamond-drill holes, surface maps, and Healy's maps of the underground workings indicate that the sulfide-bearing body pitches southeasterly at about 75 degrees. Drill holes 4 and 6, which intersect the body near the 80-foot level, suggest that the cross-section of the body is slightly smaller at that level than on the surface, although the evidence is not conclusive. With the exception of $3\frac{1}{2}$ feet of concentrated sulfides intersected in hole 6, no sulfides were found on the footwall side of the fault. Holes 7 and 8 were directed to intersect the sulfide-bearing body beyond the fault, however, neither hole encountered the body. The body therefore is believed either to have been displaced a considerable distance along the fault, or to lens out a short distance below the fault.

Norite containing disseminated sulfides was reported by both Healy and Rogers on the 180-foot level on the footwall side of the fault. These disseminated sulfides possibly are part of a small low-grade body which has no connection with the body on the 80-foot level.

Concentrated-sulfide deposits near the head of Davison Bay

Concentrated-sulfide deposits crop out at three localities on the south shore of a protected cove near the head of Davison Bay (see fig. 4). These deposits are similar mineralogically to the one at Fleming Island, though much smaller.

At locality A (see fig. 4) a conspicuous outcrop of concentrated sulfides projects a few feet above the surrounding norite. This body consists of a few pods of sulfides, arranged in an erratic pattern in norite containing some disseminated sulfides (see fig. 5). A short diamond-drill hole, directed downward at an angle of 36 degrees, intersected 1.2 feet of concentrated-sulfides at a depth of 4 feet below the surface. The deposit is much too small to be of commercial interest.

Other even smaller concentrations of sulfides are present at localities B and C. A short drill hole directed under the outcrop of pods at locality B failed to intersect any sulfides.

Disseminated-sulfide deposit

A large disseminated-sulfide deposit lies about 1,000 feet southeast of the concentrated-sulfide deposit near the head of Davison Bay (see fig. 3). During the summer of 1941 numerous pits and trenches were dug by the claim owners, and the body was sampled by W. T. Pecora 3/ (see plate 3). The rocks exposed in these pits are, in the main, norite, gabbro, and amphibolite. The gabbro and amphibolite contain some sulfides, but their nickel and copper content is generally very low. Most of the sulfide minerals are contained in the coarse-grained phase of the norite. The outline of this disseminated deposit is very irregular, but in general extends up small stream valleys in such a manner as to suggest that the deposit is relatively flat-lying. A single hole was drilled in this deposit (see plate 3). In the vicinity of this hole the body appears to be about 100 feet thick and to dip southwesterly at an angle of about 20 degrees.

Origin of the deposits

Possibly immiscible sulfide droplets separated from the cooling norite magma at a time when most of the silicate minerals in the norite had crystallized. Some of these droplets were concentrated by gravity into zones and retained in the freezing norite to form the disseminated-sulfide deposit, while others were collected and in some cases injected into the partially solidified norite, to form the pipe-like concentrated-sulfide deposit of Fleming Island and the small irregular-shaped deposits of Davison Bay.

Reserves

Concentrated-sulfide deposits

The Fleming Island deposit has an outcrop area of about 750 square feet and is believed to extend to an average depth of about 110 feet and to be cut off by the fault shown on plates 1 and 2. According to this interpretation the deposit therefore contains about 80,000 cubic feet of concentrated-sulfide material. Assuming 10 cubic feet per ton, the body contains about 8,000 tons. Analyses of diamond-drill cores and of surface samples have been supplied by the Bureau of Mines. An average grade of 1.57 percent of nickel and 0.88 percent of copper is indicated by 72.5 feet of core from the parts of drill holes 4, 5, and 6 in the deposit. A channel sample 29 feet long from the outcrop of the body indicates an average grade of 1.52 percent of nickel and 0.68 percent of copper. The drill-hole information is believed representative of the lower portion of the ore body, and the channel sample of the upper portion. The indicated average grade is therefore 1.54 percent of nickel and 0.78 percent of copper. Pecora 4/ reports 0.58 percent of nickel and 1.15 percent of copper in material collected from the partly weathered outcrop. This sample is not included in estimates of grade of the deposit as it appears inconsistent with other samples, presumably because it contained weathered material.

The largest concentrated-sulfide deposit at Davison Bay contains only a few tons of sulfide-bearing material with a grade of approximately 1.5 percent of nickel and 0.8 percent of copper.

3/ Pecora, W. T., op. cit., pp. 236-237.
4/ Pecora, W. T., op. cit., p. 232.

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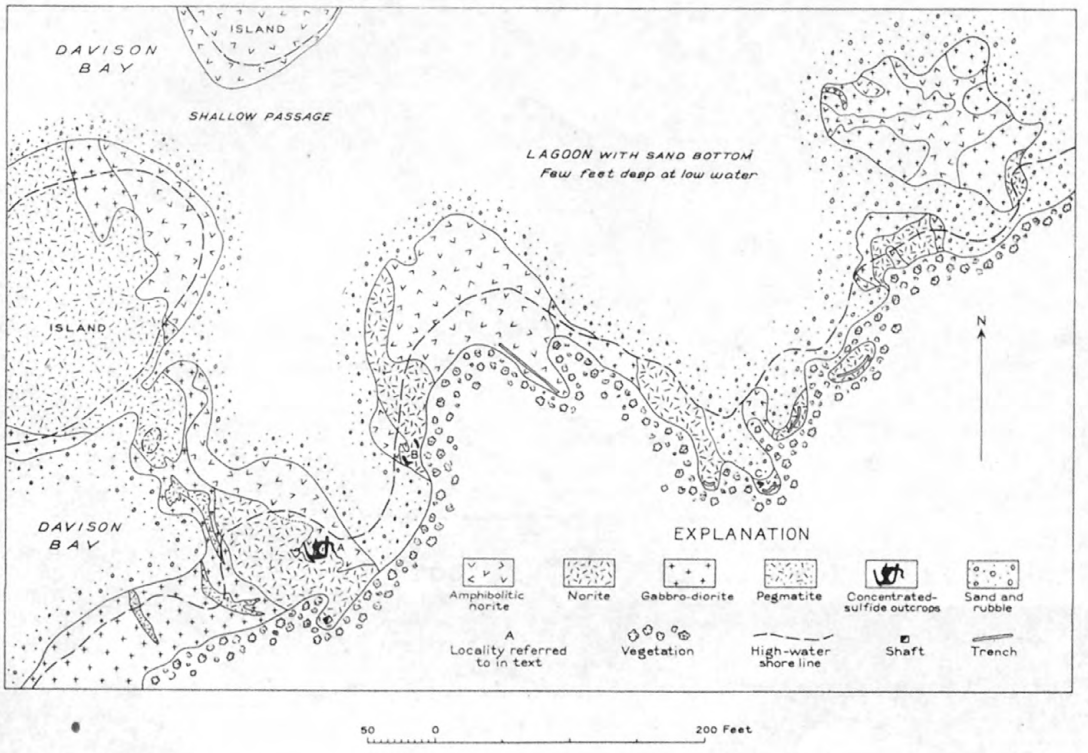
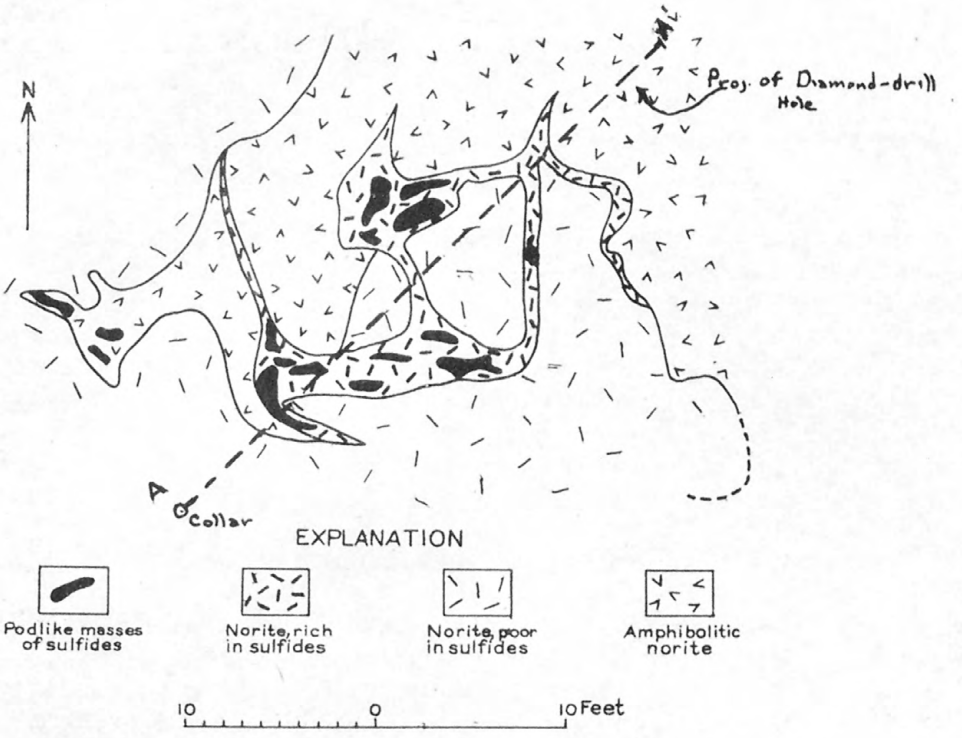


From fig. 25, U. S. Geol. Survey Bull. 936

Figure 4 -- Geologic map of the south shore of a protected cove near the head of Davison Bay, Chichagof Island, Alaska



From fig. 26, U. S. Geol. Survey Bull. 936

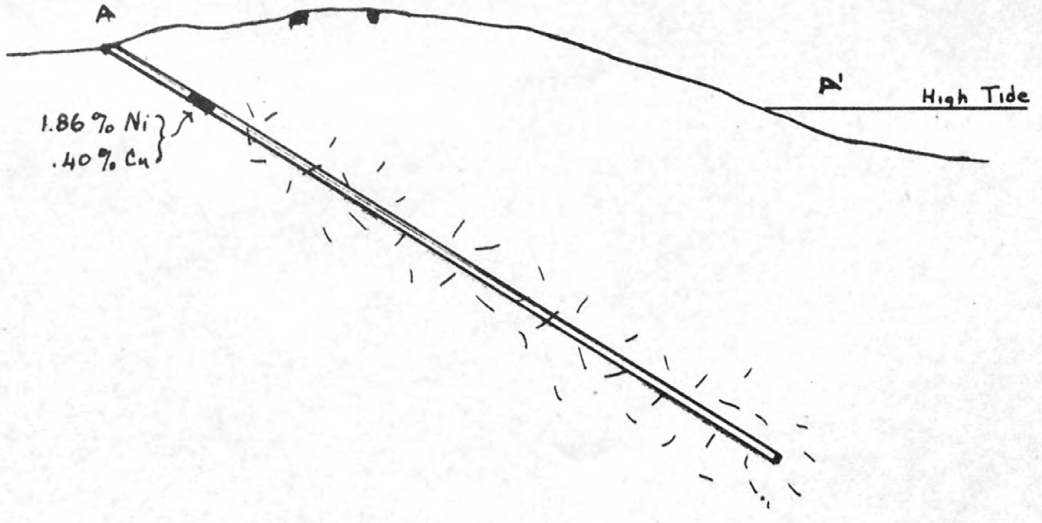


Figure 5 -- Sketch map and cross section through diamond-drill hole of concentrated-sulfide deposit, Davison Bay, Chichagof Island, Alaska

Disseminated-sulfide deposit

The disseminated-sulfide deposit has an outcrop area of several acres, and contains, according to Pecora, 5/ 13,500 tons of sulfide-bearing material per foot of depth. The deposit has been proven, by a single drill hole, to extend to a depth of about 60 feet, and it probably extends much beyond that depth. There are doubtless several million tons of sulfide-bearing material within this area.

This body has not been explored adequately enough to make an accurate estimate of its tonnage or grade. The sulfide-bearing material encountered in the drill hole contained an average of 0.03 percent of copper and 0.16 percent of nickel, as calculated from data furnished by the Bureau of Mines. Surface samples indicate that the average tenor of the sulfide-bearing body is considerably higher than is indicated by this drill hole. Pecora 5/ estimates an average grade of about 0.2 percent of nickel and 0.1 percent of copper. This estimate is based on samples taken from 34 test pits on the body. Check samples, cut by the Bureau of Mines corroborate these figures.

Recommendations for future work

No further exploration of these deposits is recommended. The Fleming Island deposit appears well enough known to form the basis of judgment as to whether or not it is minable. The larger disseminated deposit contains less nickel and copper, and is smaller than similar deposits on Yakobi Island about 15 miles northeast of Mirror Harbor.

5/ Pecora, W. T., op. cit., p. 241.