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UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

ORE DEPOSITS ON NORTHWESTERN CHICHAGOF ISLAND, ALASKA

By

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[illegible]

This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

ILLUSTRATIONS

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ABSTRACT

The area mapped includes most of northwestern Chichagof Island. The work, started in 1946, is a continuation of the geologic mapping done in the adjoining Chichagof mining district by Reed and Coats. The gold-bearing zone recognized by these writers continues through the area mapped by the writer to the northern shore of Chichagof Island.

Stratified rocks ranging in age from Paleozoic through Early Cretaceous were intruded by gabbro, quartz diorite, norite-gabbro, and by younger quartz diorite.

The igneous rocks from oldest to youngest are: gabbro, diorite, quartz diorite, the rocks associated with the nickel deposits, which include gabbro-norite and quartz diorite, and basalt. The diorite is believed to have been formed during Early Cretaceous time, and the gabbro is older by an unknown amount. The gabbro and diorite are believed to be, over large areas, recrystallized older rock. The oldest group of quartz diorite intrusives in places cuts the diorite and is therefore younger. The quartz diorite is generally somewhat foliated and slightly metamorphosed.

The igneous rocks associated with the nickel deposits are the youngest of the major igneous rock groups. They intruded the Cretaceous graywacke after it had been folded to essentially its present position.

Gold is the most economically important mineral commodity mined to date. The Apex and El Nido are the two largest mines in the area, but some gold has been recovered from the Baldwin and Cobol properties and small amounts from some other prospects. In addition to gold the area includes nickel-copper deposits at Mirror Harbor on Chichagof Island and at Bohemia Basin on Yakobi Island. Copper mineralization occurs in the area north of [illegible].

An attempt has been made to outline areas favorable for prospecting, based on the regional geology and, on the number and kind of known mineral deposits. In general the best areas for prospecting appear to be along a northwesterly trending belt which extends from the head of [illegible] Bay to the northern end of [illegible] Peninsula.

INTRODUCTION

This report is part of a more comprehensive report titled, "Geology and Ore Deposits of Northwestern Chichagof Island, Alaska," [illegible] it was deemed desirable to release that part of the report dealing with [illegible] as possible.

[illegible]

Gold is the only mineral that has been profitably mined in the area. [illegible] and tungsten [illegible], and [illegible]-bearing deposits have been explored at Bohemia Basin on Yakobi Island and near [illegible] on Chichagof Island. Although Chichagof Island has been prospected since [illegible], the interior is still largely unprospected, and economically important ore deposits probably remain to be discovered. [illegible] the other hand, the extensive [illegible] largely [illegible] districts, [illegible] that [illegible] [illegible] within the [illegible] area.

[illegible]

[illegible] by members of the [illegible]. [illegible] of gold at Chichagof was first [illegible] of Island. [illegible] visited Chichagof [illegible] became the property of the Chichagof [illegible] of Chichagof Island, as well as [illegible].

Wright (1907) subsequently wrote a short report on the general geology of parts of Baranof and Chichagof Islands, and on the mining and prospecting activities in the Chichagof mining district. Adolf Knopf (1912 in Bibliography, 32 p.) spent 3 weeks in 1909 examining the Chichagof mine and studying the geology of the surrounding area. Between 1909 and 1917 the U. S. Geological Survey made no geologic investigations on Chichagof Island. In 1917, R. M. Overbeck (1919, p. 91-136) spent two months examining the rocks along the west coast of Chichagof Island and along Peril Strait. His report describes the regional geology and ore deposits in somewhat more detail than do the earlier reports. The next geologic investigation was by A. F. Buddington (1923, p. 95-105; 114-125) who spent a few days investigating mineral deposits on Chichagof and Yakobi Islands. In his reports he described several important ore deposits that had been discovered between 1917 and 1923. In 1929, A. F. Buddington and Theodore Chapin published a bulletin (1929, 394 p.) in which is assembled the important geologic facts known at that time about southeastern Alaska. Reed (1938, p. 52-80; and 1939, 20 p.) visited Chichagof Island several times between 1936 and 1938 and published two reports of mining developments in the area. During the summer of 1938 Reed made a detailed investigation of the geology and mineral deposits of the Chichagof and Hirst Chichagof mines, and in 1939 Reed and Coats (1941, 148 p.) mapped the Chichagof district. This work was the first serious attempt at systematic geologic mapping on Chichagof Island. Although the area mapped by them includes only about 200 square miles, many of the geologic interpretations and inferences are applicable to the area discussed in this report.

In 1940, Reed assisted by J. Van Dorr 2d (1942, p. 105-138), mapped about 5 miles centering around the nickel deposits on Yakobi Island. W. T. Pecora (1942, p. 221-243) mapped the nickel deposit at Mirror Harbor in 1941. During 1942, G. C. Kennedy (1946, p. 29-33) covered most of Yakobi Island in search for possible nickel-bearing deposits.

Present investigations

When the present investigation started in 1946, it was planned to continue the geologic mapping of that part of Chichagof Island that lies north of Chichagof mining district and south of the valley between Idaho Inlet and Tenakee Inlet. Later, the scope of the project was increased to include all the northern part of Chichagof Island as far as longitude 135° 20' W., exclusive of the areas previously mapped by other Survey geologists.

Acknowledgments

Many residents of northwestern Chichagof Island aided the project materially. Mr. A. S. Thompson, in the fall of 1947, carried most of the party's field equipment, without charge, from Pelican to Juneau. The Pelican Cold Storage Co., under the supervision of Mr. Gene Torkilsen, helped the writer on many occasions. During the winter of 1947-1948 the boats used by the writer were stored without

charge by the Pelican Cold Storage Co. At times Mr. Torkilsen also provided transportation for the party. Mrs. J. H. Cann, in charge of the Apex-El Nido Mining Co., permitted the writer to map and study the property and to use many of the mine and assay maps. The U. S. Forest Service and the U. S. Coast Guard both assisted the party; their help is gratefully acknowledged.

Geography

Northwestern Chichagof Island is a mountainous, glaciated, coastal area. Fiords, carved by glaciers, penetrate well into the central part of the island. Mountains rise directly from the waterways in steep, nearly unscalable slopes of bare unweathered rock. Many of the streams that course down the mountainsides flow over an almost continuous series of waterfalls. Everywhere evidence of recent glaciation is seen--in the spires and arêtes which rise above the former level of the old ice cap, in the cirques which lie on every major mountain peak, in the abundant U-shaped valleys, and in other bedrock landforms sculptured by the action of glacial ice.

The major peaks rise to altitudes ranging from 3,000 to 3,600 feet above sea level. Most peaks are snow covered and in one of the highest a small glacier remains, sheltered from the sun by the steep backwell of a deep cirque.

The topography of the area is controlled by the underlying rock. The softest and most easily eroded rocks form the lowest and most subdued landforms, and the hard resistant rocks form the mountains and upland area.

Vegetation in the area is dense. Gravel-filled valleys and the more gentle mountain slopes are heavily timbered. Moss hangs from the trees, and in heavily wooded areas it forms a thick mantle over the ground and fallen trees. Except in the thickest forest, undergrowth is dense, and a tangle of fallen trees, brush, and other plants covers much of the area below 2,000 feet in altitude. Below timberline, talus-covered slopes and old landslides and snowslides are covered with a dense, almost impenetrable growth of salmonberry bushes and gnarled alders. Above timberline little brush is encountered and the mountains are covered with heather and other small mountain plants such as lupine, Indian Paintbrush, and various grasses and sedges. Low flat areas are covered with muskeg, a type of swamp formed by mosses and grasses decaying into a peatlike mass which is almost impervious to water.

Trails are almost obliterated and those still present are nearly impassable. Much of the country below timberline is most easily penetrated by following the streambeds.

Pelican, Elfin Cove, and the village on Idaho Inlet are the only permanent settlements within the mapped area. The largest village, Pelican, has a permanent population of several hundred persons. It is located on the north shore of Lisianski Inlet, 14 miles southeast of Cross Sound. The principal industry centers around a cold storage plant and a salmon cannery. The town also has a sawmill, one or more restaurants, and several grocery stores. Elfin Cove is a small fishing village in a sheltered harbor on the west coast of Inian Peninsula.

The unnamed village on the east side of Idaho Inlet, 3½ miles southeast of Shaw Island consists of several families. Shaw Island, Inian Islands, George Islands, Three Hill Island, and Porcupine Islands have been used in the past as fox farms.

The climate of northwestern Chichagof Island has a marked influence upon the country and upon the human activities within it. The most important single feature is the rainfall, which is heaviest in October, decreases markedly in November, and gradually diminishes each month until the end of June. The rainfall normally increases progressively each month thereafter up to November. Several graphs that show the variation in precipitation and temperature have been prepared from records published by the United States Weather Bureau's climatological data (1941-1946)(fig. 2). A marked difference in the total rainfall occurs at points separated by only a few miles. In general the areas most exposed to winds from the ocean are the warmest and wettest. All the weather stations are outside the mapped area, with the exception of the station at Gull Cove. The station at Spencer is located at Cape Spencer on the north side of Cross Sound. Gustavus is on the north side of Icy Strait a few miles east of the entrance to Glacier Bay. Radioville is on a small island at the southern edge of the Chichagof mining district (fig. 1). The weather station at Sitka on Baranof Island is about 30 miles from Pelican. It is the only weather station listed in which the weather data are possibly not directly applicable to the weather of Chichagof Island. It is thought, however, that the weather on northern Chichagof

Island is sufficiently similar to that at Sitka to warrant inclusion of the climatological data from Sitka. The weather station at Gull Cove has recorded the highest average precipitation on NW Chichagof. A significant part falls as snow. On the other hand, this station has recorded the fewest days with over .01 inch of precipitation, the most cloudy days, the fewest partly cloudy days, and the most clear days. Gustavus is swept by cold winds from Glacier Bay which contact the warmer air from the ocean over Icy Strait. Accordingly Gustavus has a relatively large number of partly cloudy days.

Cross Sound receives a great deal of cold glacial meltwater from Brady Glacier and from Glacier Bay. The moist air warmed by contact with the ocean upon sweeping over the cold water of Cross Sound has its moisture condensed into fog which often besets the adjacent land, but does not penetrate far inland. The top of the fog usually does not exceed 2,000 feet altitude.

Geology

The area mapped on northwestern Chichagof Island is underlain almost entirely by highly recrystallized rocks of Mesozoic and Paleozoic age, and by extensive bodies of igneous rock that are dominantly dioritic in composition. Within the mapped area, the regional trend of the rocks is northwest, parallel to the axis of an anticlinorium that involves most of the bedded rocks in the northern end of southeastern Alaska (Buddington, 1929, p. 31 -[illegible]). The thick succession of Mesozoic rocks that crops out in the southwestern part of the mapped area represents the eastern flank of a geosyncline to the west of the anticlinorium. These Mesozoic rocks consist mainly of greenstone, slate, schist, and graywacke. The anticlinorial core lies to the east of the mapped area on eastern Chichagof Island and in the central part of the Glacier Bay area. The exposed rocks are dominantly limestone and argillite. The only rocks believed to be of Paleozoic age within the mapped area are now highly recrystallized sediments that crop out as isolated bodies within the diorite.

The main period of intrusion probably took place during the latter part of Early Cretaceous time. The dioritic body itself consists of multiple injections of magmas which were dioritic in composition. Probably the intrusions were related to the major structures now present in the area. The magma was widely intruded into the area of the Coast Range of Alaska and Canada, and the diorite in the mapped area occurs as an elongate tongue which extends as far south as southern Baranof Island. From its areal distribution it seems to die out in that direction. To the north, the tongue of diorite is exposed almost continuously in a wide irregular shaped band as far as the head of Glacier Bay. Beyond this point the geology is unknown, but from examination of existing geologic maps, it is reasonable to assume that this body joins the main Coast Range batholith somewhere within a few tens of miles north of the northern boundary between southeastern Alaska and Canada.

Within the mapped area, and as far north as the head of Glacier

Bay, the diorite has almost everywhere [illegible] itself [illegible] the [illegible] dividing the [illegible] and [illegible]. The reason for this is not fully understood.

The main period of intrusion was followed by small but widely distributed [illegible] of [illegible]. Still later, the [illegible] were intruded by a [illegible]. This [illegible] followed by intrusion of [illegible].

Some of the [illegible] appear to be related to the [illegible] of the quartz diorite intrusive [illegible]. At some places such as [illegible] Harbor on [illegible] Island and [illegible], the [illegible] to the [illegible] parts of the [illegible].

[illegible]

[illegible] Mill [illegible] property of the [illegible] Mining Company and were [illegible] by Mrs. [illegible] of Seattle.

The mines are [illegible] miles [illegible] of [illegible] on the south side of [illegible] Inlet [illegible] the [illegible]. A road, [illegible] by [illegible] mine mill. It is about [illegible] miles [illegible] a moderate grade, [illegible] the upper end [illegible] feet above sea level. Above

[illegible]

[illegible]

[illegible]

The Apex and El Nido veins both lie in well-defined faults--the Apex and the El Nido faults (fig. 3). The El Nido fault strikes about N. 60° E. and dips 30°-[illegible]° SE.; and the Apex fault strikes N. 45°-60° E. and dips 30°-40° NW. Another important fault lies between the Apex and El Nido faults. It intersects the El Nido fault near the projected junction of the El Nido fault and the Apex fault, and approximately bisects the angle the two ore-bearing faults form at the surface. This fault strikes N. 60° E. and is essentially vertical. The main ore veins and their respective offshoot veins make up in plan a composite structural pattern of remarkable symmetry. The plane of the large vertical fault is the symmetry plane.

Offshoot veins southeast of the strong vertical fault strike N. 50° E. and dip 50°-80° SE., and those northwest of the fault strike N. 40° E. and dip 50°-80° NW. It is not known what bearing, if any, this structural vein pattern has on the control of ore deposition.

Apex mine.--The Apex mine is located on a fissure-type quartz vein that crops out in the cliff face constituting the backwall of a cirque. The Apex vein is in a fault which strikes N. 42°-60° E. and dips 30°-[illegible]° NW. The average dip is about [illegible]°. The vein is not as persistent along the strike as it was reported to be by Buddington (1923, p. 118), but pinches out at the surface about [illegible] feet south of the highest tunnel portal. The plane of the Apex vein has a wavy, stairlike structure. The steep portions dip as much as 90° and the flat portions dip as little as [illegible]°. The thickness of the vein is not entirely dependent upon the degree of dip, but in general the steep portions are the thickest. Because records on richness of the ore were not available to the writer and because the mine was not accessible underground, below or above the main working level, little is known concerning the size and extent of the main ore shoot. It plunges to the northeast at about 55°. Several offshoot veins have been mined near their intersections with the Apex vein. An offshoot vein, containing gold and traces of scheelite, branches from the Apex vein just above the highest tunnel; it extends about 700 feet due south of the tunnel. Beyond this point the vein is covered. A vein, which may be an extension of this offshoot, is exposed in an isolated outcrop within the covered area and also farther southwest, beyond the covered area. Beyond the covered area, the offshoot vein, or another vein on strike with the offshoot vein has a structure that strongly resembles the structure of the Apex vein. The dip is about the same as that of the Apex vein, and steeply dipping offshoot veins branch from it in the same manner as do those of the Apex vein.

The most common metallic minerals other than gold in the Apex vein are, in order of decreasing abundance, pyrite, arsenopyrite, chalcopyrite, galena, sphalerite, and tetrahedrite. Arsenopyrite, pyrite, and chalcopyrite are more abundant in the offshoots than in the main vein. The offshoots contain traces of scheelite, but none was found in the Apex vein itself. Free gold occurs along fractures and shear zones in the quartz veins and is one of the last metallic minerals to be deposited.

The amphibolite, which is the wall rock, is hydrothermally altered from 6 inches to 10 feet out from the vein. The altered rock is purplish gray to gray on freshly fractured surfaces; on weathered surfaces it is gray or rust brown. Pyrite and magnetite can be recognized in the altered rock, and some gold is present. One sample of altered amphibolite taken [illegible] feet from an adjacent vein contained [illegible] ounce of gold and [illegible] ounce of silver to the ton. Rock closer to the vein probably contains greater amounts of gold and silver. In thin sections the altered rock is seen to consist of a mass of isotropic material intimately mixed with a carbonate, probably calcite. Outlines of relict hornblende crystals generally are not visible.

Unfortunately, the writer was unable to examine much of the underground workings because the condition of the timbers rendered extensive underground mapping unsafe. The main working level and the small tunnel [illegible] feet below the main level were examined. The inclined raise was examined for a short distance below the small tunnel, and a crosscut from the raise toward the Apex vein was examined. The entire lower adit tunnel was mapped.

Even from this [illegible] examination, however, it is evident that the main ore shoot plunges northeast at about [illegible]. Plans for future exploration should take this into account. Another possible source of ore is in the area southwest of the present mine. Some of the steeply dipping veins southeast of the Apex vein might justifiably be explored.

<u>El Nido mine</u>.--The El Nido mine, like the Ajax, is located on typical fissure-type quartz veins along the El Nido fault. The El Nido veins and fault strike N. [illegible]° E. and dip [illegible]. One or more aplite dikes occur within the fault over most of its known length, and the quartz veins are on either or both sides of the dike. The El Nido fault can be traced for approximately [illegible] feet on the surface by means of intermittent outcrops. Quartz containing free gold has been collected, by the writer, from isolated outcrops over a linear distance of [illegible] feet along the fault. The part of the vein that has been developed [illegible] far discovered, but the vein may continue this [illegible] for some distance to the southeast beyond the end of the [illegible].

Many veins [illegible] from the El Nido vein. [illegible] the El Nido vein, when projected [illegible] the lower level, [illegible] beyond the southeastern [illegible] of the lower [illegible]

A [illegible] dike [illegible] farther northeastward than the quartz vein. The dike has an average thickness of about [illegible] in the vicinity of the mine, [illegible]

Based on the examination with the ultraviolet lamp, the authors stated:

> "....the vein on the lower adit level between the crosscut and the raise may carry about 0.2 percent of WO_3 and that the relatively high grade part of the vein near the face may contain about 3 percent WO_3. The scheelite content of the vein in the upper level, except locally, is probably less than 0.2 percent of WO_3. These estimates may be widely in error".

The wall rock on both sides of the vein has been altered, and the rock-forming minerals are extensively replaced by a carbonate mineral. The visible effect of alteration is not as prominent in the diorite along the El Nido veins as it is in the amphibolite at the Apex vein. The altered diorite, however, can usually be distinguished from the unaltered rock by differences in texture and color. The altered rock is iron stained on weathered surfaces, and has a greasy appearance on unweathered surfaces. Well-developed cubes of pyrite and some gold occur in the altered diorite and in the dike.

The known ore reserves at the Apex mine are not large. Although the tenor of the quartz at the El Nido mine is not known, there remains unmined a considerable amount of quartz. In some of this, the writer has found free gold, and in places it appears to be present in significant concentrations. Exploratory work at the El Nido mine, to the southwest along the fault, and downward seems justified.

<u>Fault zone between Apex and El Nido mines</u>.--The fault zone that lies between the Apex and El Nido veins may contain gold-bearing quartz veins of significant thickness. The fault zone is in the bottom of a boulder-filled gully, and any veins present are concealed.

The rock on both sides of the gully is highly altered, similar to the altered rock along both the Apex and El Nido veins. Several large pieces of quartz vein material as much as 3 feet long and 2 feet thick, were found in the boulder bed of the stream below the gully. They very likely came from a concealed vein in the fault zone. These pieces of quartz contain abundant sulfides, but no free gold was observed. The most favorable area for exploration of this possible vein appears to be in the area along the fault at, or just below, the mouth of the gully.

Goldwin property

The Goldwin property, a group of [illegible] unpatented claims, is in a gulch on the south side of Lisianski Inlet, 1½ miles south of Miner Island. The claims extend southeast from sea level on Lisianski Inlet to the top of the ridge at an altitude of approximately 2,000 feet (fig. [illegible]). The claims were first staked in 1920 by Schotter, [illegible], and [illegible] as the Paramount group. Between 192[illegible] and 1947 a number of persons held partnerships in the claims but the exact history regarding ownership is not known to the writer. In 1947 the claims were held by an association formed in 1938 by August [illegible], [illegible], [illegible], [illegible] Thompson, and Frank Schotter. The property was named the Goldwin property in 19[illegible] by the present association. A. F. Buddington ([illegible], p. 12[illegible]-124) visited the prospect in 1923 and wrote a short description of it; in 193[illegible], [illegible] Reed visited the property, and his report is included in Bulletin [illegible] ([illegible], p. [illegible]).

The Goldwin group of claims contains several gold-bearing veins. The veins lie along minor fractures in the same diorite batholith that contains the Apex and El Nido veins. The lowest vein on the Goldwin property is at an altitude of [illegible] feet and lies about [illegible] feet from tidewater.

The vein strikes N. [illegible] E. and dips [illegible] NW. It has a known maximum thickness of about [illegible] feet, but pinches out entirely at a few places; the average width is about [illegible] inches. The vein has a known length of about [illegible] feet. An adit has been driven northward along the vein for about [illegible] feet. North of the adit portal, the vein has been exposed in a series of pits and trenches for about [illegible] feet. The quartz is milky white, but includes altered diorite fragments. The fragments are [illegible], and consist principally of [illegible]. Pyrite and chalcopyrite are sparsely disseminated through the quartz, and are most concentrated near the included masses of altered diorite.

A second vein crops out about [illegible] feet southeast of the adit along the western side of a small gulch. [illegible] A small [illegible] the prospect with the beach. The vein [illegible] fault that strikes N. [illegible] E. and dips [illegible]. The vein [illegible] be lenticular. In places the vein is over 2 feet thick, but at other places along the fault it is missing. The quartz resembles that in the vein at the lower prospect; it is milky white and contains some fragments of altered diorite. In [illegible] some of the rich gold-bearing quartz was mined from the surface, as the parts of the vein now visible are either narrow or of low grade. In general, the vein contains more

[illegible]

[illegible]

[illegible] walls, [illegible] the walls from the environment. The upper [illegible]

[illegible] at the edge of [illegible]

[illegible]

wall rock appears to be unaltered. Free gold occurs in the quartz, and many rich specimens have been taken from the talus at the foot of the cliff below the vein.

Koby prospect

The Koby prospect was formerly known as the Koby and Shepard prospect. In 1939, Reed and Coats (1941, p. 141) examined the property. The prospect is 1.6 miles southeast of the head of Lisianski Inlet. A road, now impassable except by foot, connects the prospect to the Inlet. The prospect is on the east side of a small creek, at less than 100 feet altitude. The workings consist of an underground adit and crosscut totaling about 280 feet in length, and several surface pits and trenches (fig. 7).

The gold-bearing material consists of lenticular bodies of quartz enclosed in a shear zone. Adjacent rock is a chlorite-quartz schist that strongly resembles the upper part of the greenstone formation and the lower part of the schist formation. A fault zone on which the veins are located strikes about N. 20°-30° W. and dips from 80° E. to vertical. Individual quartz bodies are as much as 7 feet thick. Stripping and trenching shows that the quartz extends along the fault for at least 300 feet, but that it is not everywhere present, even within this short distance. The main adit is 40 feet below the main mineralized zone, and was driven from a point near the stream northeast for about 240 feet. It failed to intersect significant amounts of quartz. A crosscut 115 feet from the portal was driven northwest along a minor fault zone. The face of the crosscut exposes several quartz lenses.

Most of the quartz is milky white and is cut by short irregular fractures containing talc and calcite. Some masses of chlorite schist altered to irregular-shaped masses of chlorite are included in the quartz. About 1 percent of sulfides, including arsenopyrite, pyrite, sphalerite, and galena, is present. Free gold is reported, by the owners, but none has been found by the writer. The material in the shear zone and in the adjacent quartz schist shows no discernible alteration in the hand specimen, and as far as is known, all the gold occurs in the quartz.

If further exploration is done on this prospect, an effort should be made to ascertain the amount and grade of the quartz exposed at the rock surface, before resorting to further underground work. As the rocks have been glaciated recently, and are only slightly weathered, the character and grade of the quartz at the surface should be essentially the same as that which could be expected for a short distance below the surface.

Cobol mine

A small amount of gold has been mined from a fissure-type quartz vein at the Cobol mine. The property consists of nine unpatented claims located on the west side of Mine Mountain, about 4 miles north of the head of Goulding Harbor. The mine is at an altitude of about 750 feet. A light-rail tramway once connected the mine to Goulding

Harbor, but it is now unusable.

The vein was discovered in 1921 by Frank and Ed Cox, Ollie Loberg, and George Bolyan. In 1922 and 1923 the property was leased to the Pinta Bay Mining Co., who built the rail tramway. The claims reverted to the discoverers, who in 1933, mined and milled about 135 tons of ore. According to Mr. Bolyan, $3,500 worth of gold was recovered.

The underground workings were mapped in 1939 by Reed and Coats, and a sketch map and description of the mine have been published. (Reed and Coats, 1941, p. 142, 143). The mine lies on a contact between quartz diorite and greenstone. The vein is intersected about 75 feet in from the portal and is followed to a point about 80 feet northeast where it pinches out. The vein appears to have a strong tendency to form in contact with the diorite, and narrows down or is missing where the fault is in greenstone.

A short discussion of the geology in the vicinity of the mine may be of value to any person attempting to mine or prospect in the area. A small diorite stock crops out on top of Mine Mountain. The rock, as seen under the microscope, is quite different from that in other diorite bodies on Chichagof Island.

Gold-bearing quartz veins are known to occur in the western half of the stock. Most veins are near diorite or quartz diorite contacts. All the veins known to the writer that trend from the diorite or quartz diorite into greenstone, do not extend more than a few feet into the greenstone. At most places the rock adjacent to the veins is hydrothermally altered for distances ranging from 1 to 5 feet from the contact. In general, alteration of the wall rock along veins or fractures is a favorable indicator of the presence of gold, and faults and veins so altered should be carefully prospected for possible ore deposits. In outcrop the altered rock is tan, gray, or light brown. Ordinarily the original texture of the rock is destroyed--the rock assuming a massive appearance.

AREAS REGARDED AS FAVORABLE FOR PROSPECTING

During the course of the geologic mapping on northwestern Chichagof Island, the writer made an effort to ascertain those factors influencing the deposition of valuable minerals, and to outline areas likely to contain mineral deposits. A sketch map, figure 8, outlines areas considered to be favorable for ore deposits. A distinction is made between areas favorable for prospecting and areas thought to be highly favorable for prospecting. Areas considered to be highly favorable for prospecting include only those areas known to contain gold-bearing quartz veins in some degree of abundance, and in which it is felt that some gold-bearing veins remain undiscovered. All areas, whether favorable or highly favorable for prospecting, were delineated through evaluation of the number and type of quartz veins present, and geologic conditions believed to influence the deposition of the gold-bearing quartz veins. For example, some of the igneous rocks such as the quartz diorite and some of the diorite may have controlled ore deposition, and were taken into account in compiling the map.

In delineating areas favorable for prospecting for other minerals, such as copper, nickel, and iron, greater reliance can be placed upon geologic environment than for prospecting for gold. The only area thought to be worthwhile for prospecting for copper is northwest of Goulding Harbor, in the greenstone and schist formations. This area contains one copper deposit and many small prospects. Magnetite occurs at many places where limestone and greenstone have been highly metamorphosed by the intrusion of quartz diorite (fig. 8).

A nickel deposit occurs at Mirror Harbor, and mafic rock that might logically be associated with nickel deposits makes up the Lost Cove stock. But many prospectors, as well as the writer and several other geologists, have thoroughly examined these rocks and believe that there is little chance that either the Mirror Harbor or the Lost Cove stock contains other easily discoverable nickel-bearing deposits. Those areas left blank on figure 8 indicate that the chances of finding important ore deposits within them are considered poor.

Area 1

An area encompassing most of the northwest end of Althorp Peninsula is believed to warrant careful prospecting. The parts believed to be most favorable are shown on figure 8. In this area, many quartz veins have been observed, but undoubtedly the number seen is only a small fraction of those existing in the area. Most of the veins that were observed are less than a foot thick, and tend to be lenticular or only a few tens of feet long. Many fill joints instead of faults. Some prospecting has been done. The largest prospect is owned by M. [illegible] Marvitz, and was examined by [illegible] C. Reed in 1936 ([illegible], p. [illegible]). Another vein, reported to the present writer to contain free gold, is about a quarter of a mile east of Column Point. The vein was not found by the writer although it was carefully searched for. It is reported to crop out on level ground at a low altitude.

The beach gravel at the mouth of a stream that flows into Cross Sound about 1 mile east of Column Point contains a small amount of placer gold. The vein from which the gold is derived is probably on the northeast face of the cliff west of the stream. The vein must crop out at an altitude of about [illegible] to 1,000 feet. Other veins occur in the area, but only those mentioned above are known to the writer to contain gold. The veins at the Marvitz prospect are associated with dikes, and in general dikes near veins can be taken as favorable indicators of the presence of gold. At no place was altered wall [illegible] observed adjacent to veins, but any vein or fault that is associated with wall-rock alteration should be carefully examined.

Area 2

Another area considered highly favorable for prospecting extends along the south side of Lisianski Inlet from a point half a mile southeast of Gunn Creek to Lisianski Strait (p. 19). The only type of vein in the area that is known to be gold bearing is characteristically less than 2 feet wide and no more than a few hundred feet long. The veins occur along weak faults which generally show little topographic expression. The strike of the faults, and hence of the veins, is generally northeast; the dips are generally steep. Faults that vary in dip are more likely to contain valuable deposits of gold-bearing quartz than faults of constant dip. The quartz commonly contains inclusions of altered diorite. Locally the veins contain calcite which readily dissolves when exposed to weathering, and leaves tabular-shaped cavities in the quartz. The vein quartz is commonly milky white or translucent, and it is generally barren. Although most veins when seen in outcrop appear to be of little value, some contain considerable amounts of gold concentrated in small lenticular pockets or small ore shoots. Chalcopyrite and pyrite in the vein almost invariably indicate the presence of gold. Some veins contain gold without being accompanied by sulfides, and in the field these are difficult to distinguish from barren veins unless the gold can be seen in the hand specimen.

The mineralized fault zone was found along the contact between diorite and quartz that occur along the south shore of Lisianski Inlet. A sample from an outcrop near Gunn Creek contained traces of gold. A small vein estimated to contain as much as 1 ounce of gold to the ton was discovered by the writer about 1 mile due west of the mouth of Gunn Creek, at an altitude of about 700 feet. The vein is 6 to 12 inches wide and crops out intermittently over a distance of 35 feet. It strikes north and dips 80° W. Probably the vein is too small to be of commercial value, but other veins occur in the vicinity, and some may be found to be large enough to mine.

Prospectors should keep the following points in mind when prospecting in area 2. (1) The veins are scarcely distributed, and are thin and lenticular. (2) They are deceptive in respect to their appearance. The veins resemble those described by most prospectors as "bull quartz", or quartz that is "watery". (3) Veins occur in minor faults that have little topographic expression and, hence, are difficult or impossible to detect when covered by even a thin mantle of overburden. (4) The sulfides, chalcopyrite and pyrite, are almost certain indicators of gold, but high concentrations of gold have been found in quartz unaccompanied by sulfides. (5) Alteration of wall rock along the margins of veins or faults is a favorable indicator of gold, but, unfortunately for the prospector, the type of alteration of the wall rock in this area is inconspicuous in the outcrop. (6) Gold concentration in the altered rock near the veins, at most places is too slight for profitable extraction; but the possibility should not be overlooked that in some places the altered rock might contain significant amounts of gold.

Area 3

Area 3 encompasses a northwest-trending zone that extends from a point about 1 mile south of Apex Mountain, across the upper half of

[illegible]

[illegible]

[illegible]

[illegible]

vein was found along a persistent fault about 1 mile S. 20° E. of the head of Lake Elfendahl. The quartz is typical fissure-type quartz, and contains considerable amounts of pyrite, chalcopyrite, sphalerite, and galena. An assay has not been made, but the material in the vein probably contains some gold inasmuch as the presence of galena and sphalerite in this area is usually an excellent indicator of gold. Similar veins are known to be present in other parts of area 4, particularly near the small diorite body that crops out in the top of Mine Mountain. Gold-bearing quartz float also was found in the headwaters of the east fork of Stag River. In the headwaters area of Saltry River, a mineralized zone was found which, upon analysis, was shown to contain 0.01 ounce of gold to the ton. Area 4 is probably the most favorable area for gold prospecting that has been mapped on northwestern Chichagof Island.

Area 5

For many years a mineralized zone has been recognized in the area north of Goulding Harbor (fig. 8). The zone lies within rocks of the greenstone and schist formations. Copper, in the form of chalcopyrite, is the principal mineral and is disseminated in the greenstone. Many dikes cut the rock, and although the copper may be derived from this greenstone, the dikes appear to have played some part in its concentration. The area has been intensively prospected but no ore has been mined. Probably no large deposits other than those already discovered are exposed in the area.

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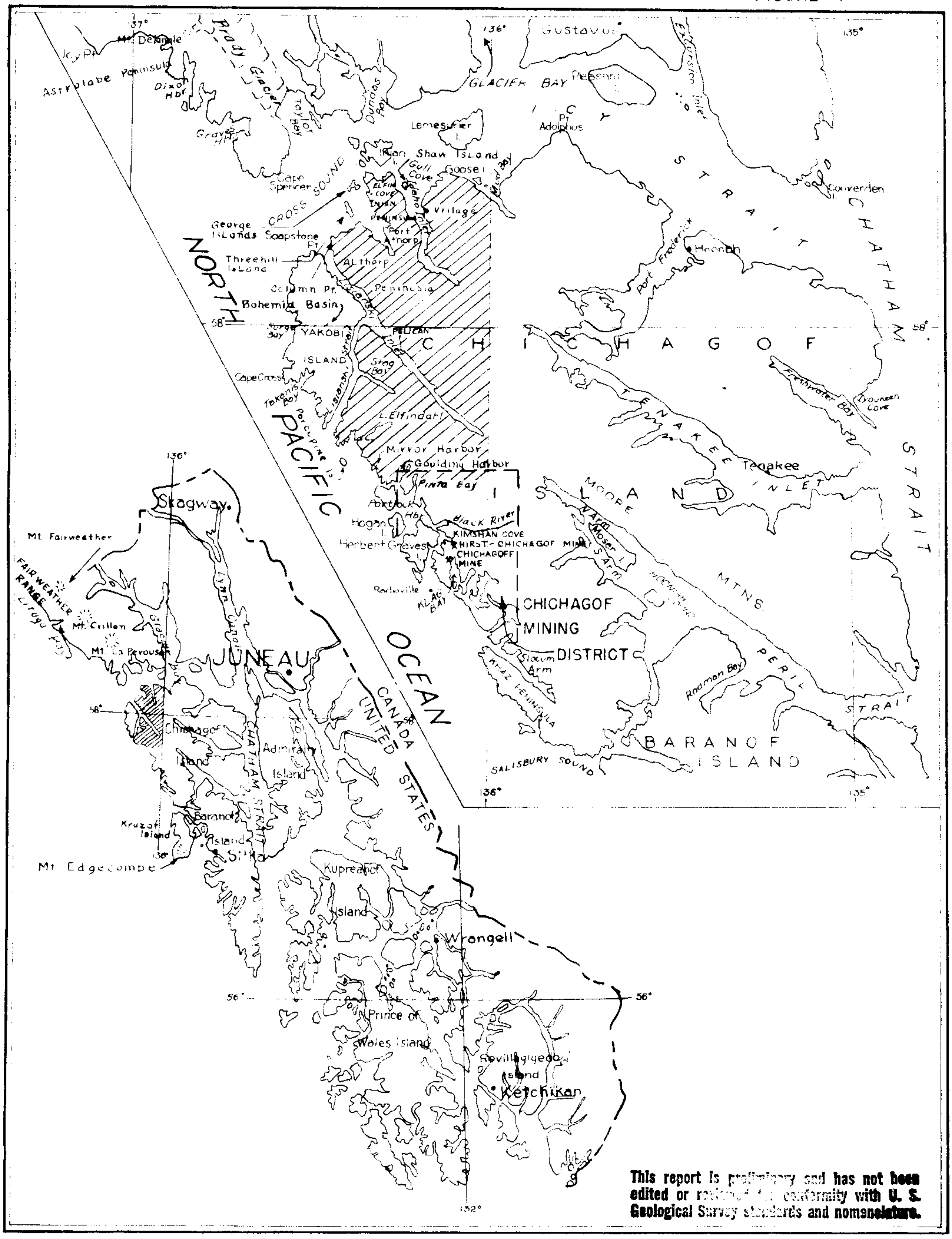

Figure I. Index map of southeastern Alaska showing location of mapped area