Some Pegmatite Deposits in Southeastern Alaska

GEOLOGICAL SURVEY BULLETIN 1024-G

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By C. L. SAINSBURY

MINERAL RESOURCES OF ALASKA

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A description of the geology of two areas that contain pegmatite bodies of possible commercial significance

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SOME PEGMATITE DEPOSITS IN SOUTHEASTERN ALASKA

By C. L. Sainsbury

ABSTRACT

A pegmatite deposit about 600 feet in diameter crops out on a high bluff less than half a mile east of a small unnamed cove between Redfish and Byron Bays, on the west coast of Baranof Island, southeastern Alaska. The deposit, which comprises several pegmatite bodies, consists of quartz, albite-oligoclase, microcline, and mica, listed in the order of abundance. Feldspar and quartz crystals in some places attain a length of more than 1 foot. Muscovite mica as much as 2 inches in diameter occurs, but the major part of the mica is concentrated in deposits, many of which are as large as 10 feet across, that contain mica flakes half an inch in diameter. Ruby mica of commercial grade has been obtained from float from this deposit.

Pegmatite bodies containing large books of mica locally are found in a belt of intensely feldspathized granulite and gneiss along the west margin of intrusive rocks of the Coast Range complex in the vicinity of Sitklan Passage near the mouth of the Portland Canal in southeastern Alaska. These deposits occur along two distinct zones in which sill-like bodies of gneissic pegmatitic rock several hundred feet wide can be traced along the regional strike for several miles. Locally, smaller dikes of pegmatite crosscut the structure of the granulite. The deposits consist almost entirely of albite-oligoclase feldspar, granular quartz, and subordinate mica. The structural characteristics of the deposits indicate that the pegmatite is probably in part synkinematic with the late stages of the Coast Range orogeny in the Ketchikan area.

Mica of commercial size and grade has been obtained from several pegmatite deposits in the Sitklan Passage area, and two prospect pits in a large pegmatite deposit on Sitklan Island have disclosed relatively large books of mica. The tectonic history of many of these pegmatite deposits indicates that they were emplaced under a stressed environment and probably do not contain mica of commercial size and grade, but the abundance and areal distribution of the pegmatite bodies are such that detailed prospecting of the area is warranted. Pegmatite deposits discordant with the structure of the enclosing gneiss and granulite are the only ones in the area thus far known to contain mica of commercial grade.

The preliminary examination of the Sitklan Passage and Baranof Island pegmatite deposits disclosed none of the rarer minerals, such as beryl, columbite-tantalite, or cassiterite, that often occur in pegmatite veins. One small concentrate sample obtained by panning stream sands from the Baranof Island area contained a few grains of cassiterite. No radioactivity anomalies were detected in the stream concentrates or in any of the pegmatite in either area.

INTRODUCTION

This report describes the geology of two areas in southeastern Alaska that contain pegmatite deposits large enough to be of economic interest. The deposits discussed in the first part of the report are near a small bay between Redfish and Byron Bays (fig. 17) on the west coast of Baranof Island, southeastern Alaska (fig. 16). The deposits are about 60 miles by air southeast of Sitka, the nearest established port. William Hanlon, Sr., and Glenn Morgan of Sitka, who own the pegmatite claims, called the deposits to the attention of the writer in 1952. These claims were staked as possible gold lodes about 1906 by Hanlon and Edward and Thomas C. Haley of Sitka, but no exploratory work on the lodes has been done since.

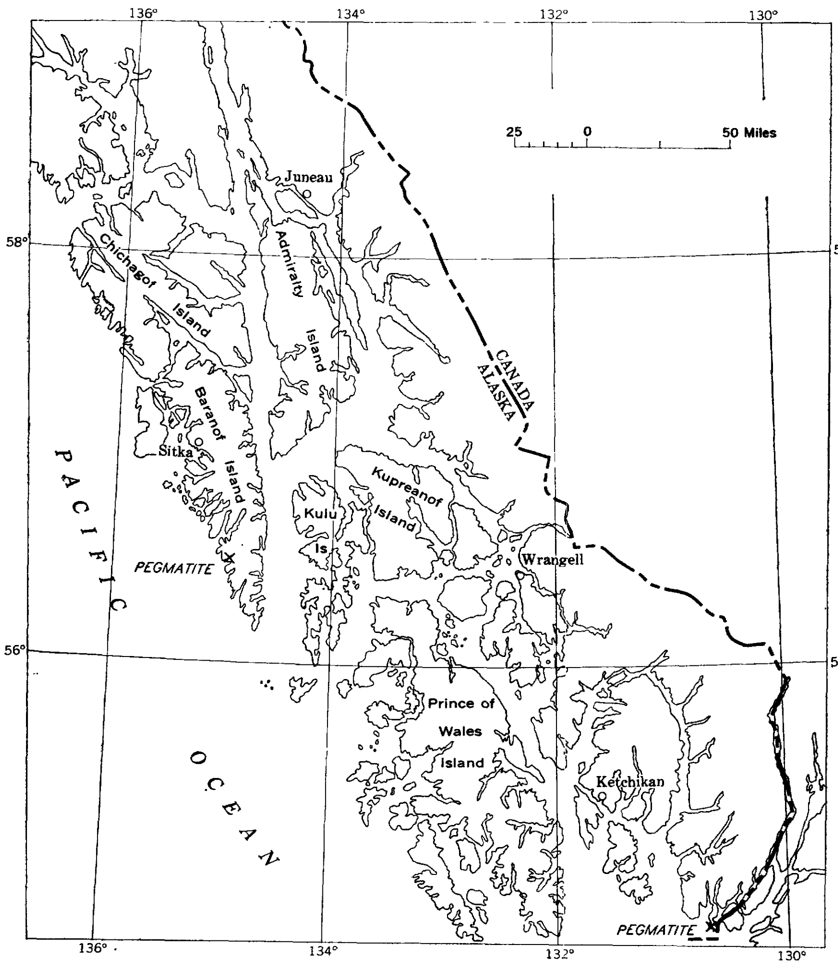

FIGURE 16.—Index map of southeastern Alaska showing location of two pegmatite areas.

No reference to these deposits appears in the literature concerning the mineral resources of Alaska, and, according to Hanlon, the deposits had not been examined by a geologist before the writer's visit. This report briefly discusses the general geology of the deposits and of the adjacent area, concerning which little additional information is available at present.

The writer spent September 13–16, 1953, in the general area of Redfish Bay and a part of that time at the pegmatite deposits. The deposits were revisited in August 1954 to obtain additional information on the internal structure of the pegmatite and to examine the west face of the outcrops.

The writer wishes to acknowledge the able field assistance of Glenn Morgan and to thank especially the pilot, Dick Pherson of Sitka, for transporting the party by air in unusually bad weather.

The deposits discussed in the second part of this report are in the vicinity of Sitklan Passage at the mouth of Portland Canal.

The field work in the area near Sitklan Passage was done May 28–31, 1953, and September 1–3, 1954. During the first examination the writer, accompanied by R. L. Thorne of the U. S. Bureau of Mines, completed a rapid ground reconnaissance of parts of Sitklan Island, Kanagunut Island, and the mainland north of Sitklan Passage. The prospects near Sitklan Passage were mapped by the writer at this time. In September 1954 the writer was accompanied by Fred Barker and R. S. Velikanje of the U. S. Geological Survey; the newest workings on the pegmatite deposits were examined and mapped, and the south end of Sitklan Island was examined. During the second examination B. W. W. McDougall, consulting engineer and geologist for a Canadian mining concern, accompanied the party on Sitklan Island. The geologic data and conclusions expressed in this report are based entirely upon the writer's observations.

At the time of field work in 1953 the prospects were being actively explored by a partnership consisting of Frank Blasher, Paul J. Ater, Louis Pearson, and J. H. O'Leary, all of Seattle or vicinity. All except Ater were on the property during the examination; they were accompanied by Robert O'Connor of Seattle. In late 1953 or early 1954, their claims were sold to B. C. Mica Mines, Ltd., a Canadian company, and much additional prospecting of some pegmatite deposits had been accomplished by the time of the writer's visit in September 1954. Ovela Cote, agent for the company, was on the property during the second examination. The writer wishes to acknowledge the assistance of all these men and to express his appreciation for the many favors extended by them.

PEGMATITE DEPOSITS NEAR REDFISH BAY, BARANOF ISLAND

AREAL GEOLOGY

Very few geologic data pertaining to the regional geology of the southern part of Baranof Island are available. Knopf (1912, pl. 1) shows an intrusive batholith or stock in the general area of Big Branch Bay, and Buddington and Chapin (1929, pl. 2) also show a batholith that intrudes sedimentary and volcanic rocks of Paleozoic age in this region. Reed and Gates (1942, p. 323–324) discuss a basic nickeliferous intrusive body at Snipe Bay, about 20 miles north of Redfish Bay, and state:

> The principal country rocks in the vicinity of Snipe Bay are biotitic quartzite and biotitic-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.
> The quartzite and quartz-schist strike northwestward and dip northeast.

Guild and Balsley (1942, p. 174–178) discuss the geology of the chromite deposits at Red Bluff Bay, on the east coast of Baranof Island about 30 miles north of Redfish Bay. The schist of this region includes folded and faulted phyllite and greenstone schist of Triassic(?) age. The schist strikes northwestward and dips northeastward, and the beds are overturned. Fold axes trend about N. 30° W. and plunge 10°–50° SE., and a prominent set of joints cuts the rocks almost perpendicularly to the axes of folding. Shear zones are abundant in the ultramafic rocks, and follow two general directions: one striking about north, and the other striking northeastward.

GEOLOGY OF THE PEGMATITE-BEARING ROCKS AT REDFISH BAY

INTRUSIVE ROCKS

Quartz diorite and related types.—The bedrock along the eastern shore of the small unnamed cove near the pegmatite deposits consists of a massive, unfoliated intrusive rock. The composition of the rock ranges from muscovite-granite through biotite-quartz monzonite to a biotite-quartz diorite (fig. 17) which at places contains xenoliths of paragneiss consisting predominantly of felsic minerals. Locally the gneiss comprises as much as 30–40 percent of the bedrock, but these areas of gneissic rocks are restricted in extent, except near the borders of the intrusive mass.

At the west contact of the pegmatite body, the rock is a granite of the mineralogic composition shown in table 1.

The intrusive rock on the north tip of the small cove northwest of the pegmatite deposits is a granodiorite or quartz diorite containing

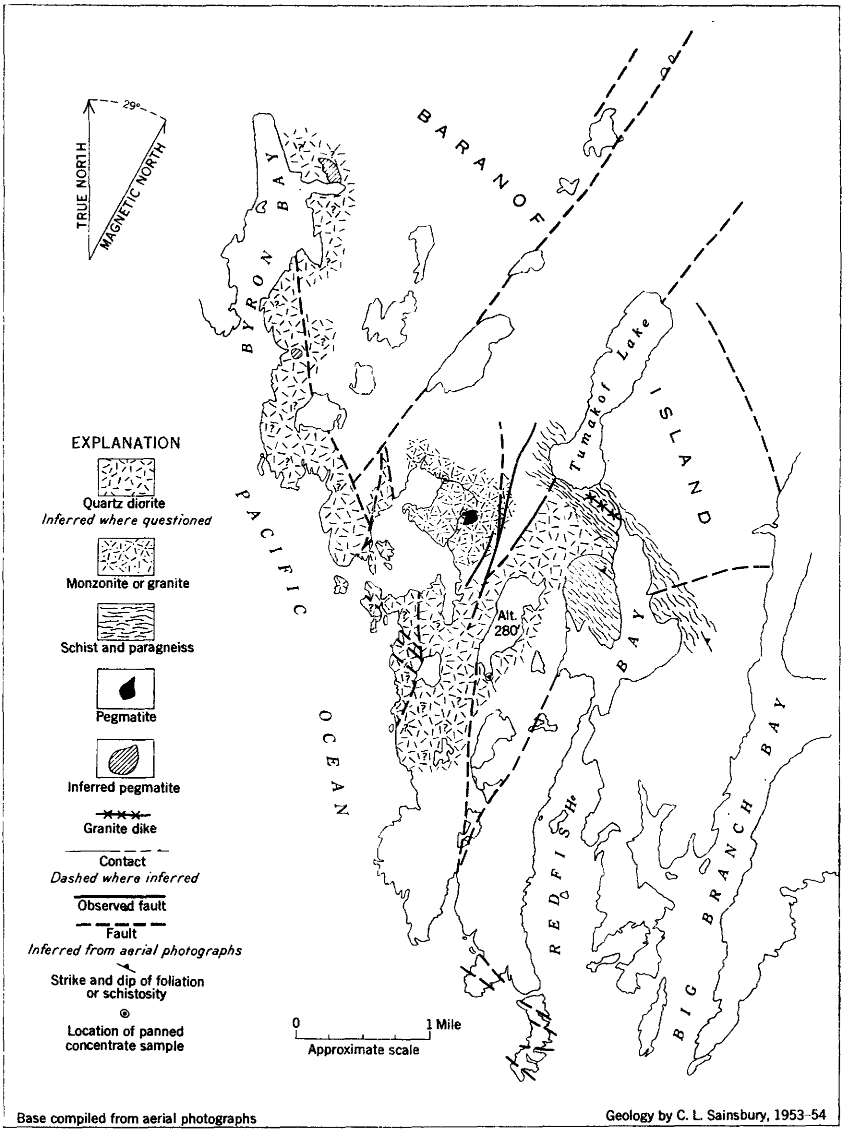

FIGURE 17.—Geologic sketch map of area near pegmatite deposits, Baranof Island, Alaska.

abundant quartz, many zoned crystals of plagioclase, and some microcline, biotite, and muscovite. Apatite, chlorite, bleached biotite, garnet, sphene and an opaque mineral (magnetite or ilmenite) are the minor constituents.

South and southeast of the pegmatite deposits, in the area near the large lake at altitude 280 feet, the intrusive body is a massive quartz diorite containing about 20–25 percent of the mafic minerals biotite and hornblende, about 50 percent of plagioclase feldspar,

TABLE 1.—*Mineralogic composition of granite at pegmatite deposit at Redfish Bay*

[Based on Rosiwal analysis of two thin sections]

Mineral	Volume percent	Weight percent
Quartz	21.9	22.0
Albite [1]	17.6	17.4
Oligoclase [1]	18.4	18.5
Microcline	34.0	32.0
Muscovite	2.5	2.6
Chlorite	4.6	4.7
Other [2]	1.1	1.8
Total	100.1	99.0

[1] The relative proportions of albite and oligoclase may differ slightly from these figures, owing to the albite contained in perthitic intergrowth in the microcline.
[2] Includes garnet, apatite, sphene, ilmenite or magnetite.

25 percent of quartz, 1 percent of hornblende pleochroic to blue green, and minor accessory minerals including apatite, sphene, magnetite, or ilmenite, and a few needles of sillimanite. The quartz is fractured and strained and contains abundant trains of inclusions; the biotite commonly is grouped about remnants of hornblende; and the opaque minerals are associated with the biotite or hornblende. The zoned plagioclase crystals contain as much as 60 percent anorthite in the cores and as much as 40 percent in the rims. Apatite commonly is included in the calcic cores of the zoned plagioclase crystals.

The rock types listed above represent related facies of the quartz diorite, but it is not known whether the rock types are gradational or whether they are distinct intrusive bodies with sharp boundaries. The microscopic examination of thin sections of each rock type shows a distinctive progressive mineralogic change from quartz diorite to granite. These changes are: a progressive increase of microcline and albite; a progressive bleaching of biotite and a conversion of all biotite to muscovite or chlorite; destruction of apatite; subtraction of calcium from the plagioclase, leading to the destruction of zoned crystals and the conversion of andesine to oligoclase or albite; and removal of iron by the destruction of biotite, magnetite, or ilmenite, hornblende, and pyrite, although some iron probably was incorporated in the few very small red garnets.

The volume percentage of free quartz in the microcline granite is no greater than the volume percentage in the quartz diorite. The solutions that converted large amounts of plagioclase to microcline or albite apparently were in equilibrium in relation to the free quartz in the quartz diorite. The changes outlined indicate a magmatic alteration, probably deuteric stage, rather than hydrothermal alteration.

Alaskite dikes.—Small alaskite dikes cut the major intrusive rocks and the schist and gneiss to the east. These dikes of coarse-grained pegmatite normally are less than 2 feet thick and locally contain muscovite flakes as much as 1 inch in diameter. The dikes appear to be more abundant in the quartz diorite south and southeast of the main pegmatite area than in the schist and gneiss east of the intrusive body. This may be more apparent than real because the alaskite dikes are light colored in contrast to the darker quartz diorite and gneiss. Many alaskite dikes were tested with the Geiger counter, but none was noticeably radioactive. The alaskite dikes are not favorable zones for commercially valuable mica or feldspar, unless dikes much thicker than those observed can be found.

Granite dike.—One granite dike about 200 feet thick was observed where it intrudes hornblende-biotite gneiss at the head of Redfish Bay. In hand specimen it consists of felsic minerals, including much muscovite, and appears to be identical with the granite near the pegmatite body. The dike has sharp boundaries and it crosscuts the foliation of the enclosing gneiss at a small angle. This dike is important because it indicates that the area was invaded by a magma chemically similar to that which produced the granite near the pegmatite body.

METAMORPHIC ROCKS

Schist and paragneiss.—The metamorphic rocks immediately north and east of Redfish Bay (fig. 17) comprise hornblende-biotite paragneiss, quartz-mica paragneiss, quartzite, slate, and feldspathic graywacke. Paragneiss is most abundant in the small peninsula on the northwestern shore of Redfish Bay. The gneiss grades abruptly to the east into metamorphosed sedimentary rocks whose original composition is still readily discernible. The schist strikes northwestward (N. 10°–50° W.) and generally dips northeastward at high angles, although reversals in dip are common. Fold axes in the schist and gneiss generally plunge southeastward from 10° to 70° but local variations are common.

FAULTS

The faults observed in the field are shown in figure 17 as solid lines and those plotted from aerial photographs, as dotted lines. In general, the faults belong to two systems: one striking northward, and one striking northeastward. This arrangement of faults apparently has controlled erosion in this part of Baranof Island because most of the larger bays, indentations, and lakes trend either northeastward or northward.

One fault, too small to be shown on the map, cuts the north boundary of the massive pegmatite body. The shattering of some of the larger clear quartz crystals in the pegmatite possibly was contemporaneous with the faulting.

PEGMATITE DEPOSITS

The massive pegmatite deposit about 600 feet in diameter crops out less than half a mile southeast of the eastern shore of the unnamed cove (fig. 17). It can be reached most easily from the northeast arm of the bay by the trail along the south bank of the small creek. The deposit has been glaciated, as seen from roches moutonnees and glacial striations preserved on the surface of the pegmatites, but only slight weathering has taken place. The complete lack of soil cover would allow easy prospecting of the pegmatite bodies.

The surface of the pegmatite slopes northward and (or) eastward. It is bounded on the west by a vertical cliff at least 60–75 feet high and on the north by a steep gulch eroded along a small fault.

STRUCTURE OF THE PEGMATITE

The outcrop suggests that the pegmatite is a large, almost circular body, in which pegmatite minerals are distributed at random. Exposures on the west cliff reveal, however, that the pegmatite is a compound body consisting of two or more dikelike pegmatite deposits striking northward and dipping eastward. The largest pegmatite is at least 30–40 feet thick, and several smaller bodies lie above and below it. It appears to pinch out near the center of the cliff, and another thick pegmatite having about the same attitude, but stratigraphically lower, appears to continue northward. The major pegmatite bodies are underlain by quartz monzonite containing a band of paragneiss about 20 feet thick, and both rock types are cut by irregular patches and dikelets of granite and pegmatite. The paragneiss band strikes about N. 30° W. and dips 25° NE.

Another pegmatite about 15 feet thick, not continuous with either pegmatite exposed in the west cliff, crops out in the steep bluff on the north side of the pegmatite area. It too strikes northward, and dips about 30° E.

ZONING OF THE PEGMATITE

Each of the pegmatite deposits examined has marked zoning. In the large deposit the zones are distinct, but less so in the smaller ones. Each pegmatite contains a core of quartz or of quartz and microcline. Succeeding zones differ in different pegmatite bodies (fig. 18). The quartz core may be succeeded by a core-margin zone of perthite, quartz, graphic granite, and granular mica; of pure microcline-perthite; or of perthite, granular mica, and quartz. Succeeding zones are not easily recognized, but the wall zone generally is quartz and graphic granite. No distinct border zone was recognized in any deposit.

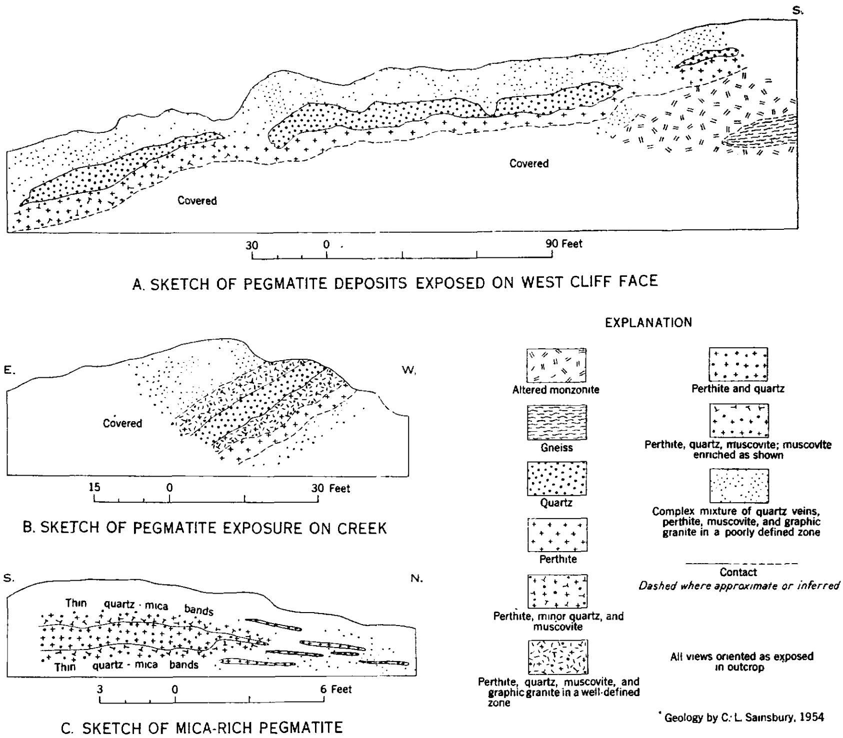

FIGURE 18.—**Geologic sketches of several pegmatite deposits, Baranof Island, Alaska.**

The mineral of chief economic interest in the pegmatite is microcline-perthite, occurring in each of the larger pegmatite veins as a core-margin zone ranging from 4 feet to 10 feet in thickness (fig. 18*A*, *B*). In two of the larger pegmatite veins the perthite is almost pure, and in one it is admixed with minor amounts of granular mica and small pods of quartz. The most continuous zone of perthite is at least 120 feet long and averages from 6 to 8 feet in thickness (fig. 18*A*). Another zone of perthite containing only minor amounts of quartz and granular mica is at least 60 feet long and 8 to 10 feet thick. In a third deposit of pegmatite exposed across the strike, the pure microcline-perthite forms a solid zone ranging from 4 to 6 feet in thickness (fig. 18*B*).

Petrographic studies indicate that albite occurs along twin planes and cleavages in the perthitic microcline in such thin bands that coarse grinding in the mortar frees only a few fragments of albite. Thin sections show that the albite is segregated along cleavages, fractures, and twin planes in the microcline, and may aggregate as much as 15 percent of the total volume. No chemical analysis of the microcline was made, but the writer believes that the massive perthite zones can produce substantial tonnages of ceramic-grade potash feldspar.

Two varieties of mica occur. In one small pegmatite deposit (fig. 18*C*) "rum mica" occurs as wedge-shaped books as much as 2 inches long. These books are intergrown in such a manner as to suggest the three common faces of a tetrahedron. This mica occupies a distinct zone, possibly a core-margin zone, around a core of quartz and perthite. In mica-bearing zones of other pegmatite deposits, the mica generally occurs as thin, rounded green flakes as much as half an inch in diameter, and locally it may aggregate 50 percent of the rock in a zone of several feet across. No mica deposit of sufficient size to furnish even the smallest "punch mica" was observed, although Hanlon obtained strategic mica from float in this area that trimmed to sheets 3 inches by 4 inches.

Large euhedral quartz crystals were observed at several places in the pegmatite. They usually were oriented with the *c* axis perpendicular to the dip of the deposit. The largest crystal measures 27 inches in length and is found in the quartz core of the pegmatite exposed on the west cliff. Other crystals as much as 5 inches in diameter were observed. These crystals of quartz are remarkably clear. All this clear quartz is shattered, but fragments as much as three-eighths inch thick may be found that are so clear that typewritten words may easily be read through them. Some quartz of optical grade might be obtained during exploitation of the deposits for feldspar.

MINOR CONSTITUENTS

The only minor constituent of the pegmatite deposits that can be identified in hand specimen is red garnet. It usually occurs in the quartz zones as small euhedral crystals that attain a maximum size of one-eighth inch.

Small amounts of heavy-mineral concentrates were obtained from three areas: a stream that heads in the pegmatite area, a stream that drains an area of quartz-monzonite, and the outlet of the large lake southeast of the pegmatite deposits. The mineralogic and spectrographic composition of these concentrates is summarized in table 2.

Although these concentrates were obtained in relatively small amounts without digging deeply into the stream channels, the writer believes that the results are diagnostic enough to indicate that few of the minor constituents of pegmatite veins, such as beryl, columbite-tantalite, or cassiterite, occur in detectable quantities in the major pegmatite body. The samples containing tourmaline and the grains provisionally determined as cassiterite were from the areas of granite or altered quartz diorite relatively near the main pegmatite body. No radioactivity anomalies were detected in any of the samples.

TABLE 2.—*Mineralogic and spectrographic composition of stream concentrates, Redfish Bay, Baranof Island*

[Analyst, J. J. Matzko]

Sample No.[1]	Mineralogic composition	Spectrographic composition		
		Greater than 5 percent	Less than 5 percent	Not detected
1	Garnet, hornblende, quartz, tourmaline, zircon, muscovite epidote, sphene, magnetite, cassiterite(?).	Fe, Al, Ti, Mn	Na, Mg	Sn, Pb, Cu, Zn, Ni, Co, F
2	Garnet, hornblende, quartz, ilmenite(?), tourmaline, zircon, hematite.	Fe, Al, Ti, Mg, Na	Mn, Ca	Sn, Pb, Cu, Zn, Ni, Co
3	Garnet (limonite-stained), hornblende, quartz, biotite, ilmenite.	Fe, Al, Mg, Mn, Ca	Na, Ti	Sn, Pb, Cu, Zn

[1] Samples (locations shown on fig. 17):
1. From a small creek that drains the pegmatite area.
2. From a small stream flowing into north arm of cove.
3. From outlet of large lake southeast of pegmatite zone.

INFERRED PEGMATITE AREAS

Two other areas that possibly contain pegmatite were selected from aerial photographs and are shown in figure 17.

Several large pegmatite(?) dikes were seen from the air along the beach cliffs between Redfish Bay and Byron Bay. This area was not traversed on foot by the writer, and the size, extent, and mineralogy of these dikes are unknown. The writer recommends detailed prospecting throughout the outcrop area of the quartz-diorite stock and the schist and gneiss zones.

ECONOMIC ASPECTS OF PEGMATITE DEPOSITS, BARANOF ISLAND

The following factors indicate that the major pegmatite deposits of Baranof Island constitute a commercially valuable body of feldspar, and possibly of mica and optical quartz:

1. Large tonnages of pegmatite are available and could be mined by open-pit methods, or perthite zones could be mined by shallow underground openings in an easterly direction, sloping at about 25°–30°.

2. The principal deposit is less than half a mile from tidewater in a relatively sheltered cove, the entrance of which is protected by several small, rocky islands. An aerial tram could be built at low cost, and loading facilities for large barges could easily be constructed, although

in stormy weather the exposed coastline of Baranof Island is battered by large waves and entrance to the small cove is impossible.

3. The deposit is near the regularly traveled sealanes, permitting shipment to markets in the United States at low freight rates.

4. Abundant timber is available on the wooded slopes of the cove for mine and mill use.

5. The deposits, although probably containing few of the rarer and more valuable minerals that often occur in pegmatite deposits, are free from deleterious constituents, such as iron, high calcic plagioclase, and manganese. The mica could easily be tabled or floated from a ground millfeed.

PEGMATITE DEPOSITS NEAR SITKLAN PASSAGE, SOUTHEASTERN ALASKA

GEOLOGY

BEDDED ROCKS

The bedded rocks of Sitklan Island, Kanagunut Island, and the adjacent mainland to the north comprise high-rank metamorphic rocks, provisionally of Mesozoic and Paleozoic age or older, derived from a sequence of predominantly clastic beds possibly of marine origin. This origin is favored because of the thin, continuous units, the lack of conglomerate beds, and the few thin but persistent limestone beds in the sequence.

The beds have been tilted steeply eastward and regionally metamorphosed to garnet-biotite-hornblende-quartz-plagioclase granulite. Red garnet as much as 1 inch across is conspicuous in a wide belt of garnetiferous schist and granulite on the western part of Kanagunut Island and Port Tongass (fig. 19). The garnets commonly are euhedral, but fractured.

A smaller dark-red to black garnet is associated with the red garnet. These garnet beds are estimated to contain as much as 30–40 percent garnet locally. The garnet sands along the west coast of Kanagunut Island are beach placers derived from the schist. Thin, persistent beds of coarsely crystalline and pure limestone or marble occur in the garnet granulite on Kanagunut Island, and a few beds of quartzite are found opposite Tongass Island.

To the east, and overlying the garnet granulite, is a belt of hornblende-biotite-garnet granulite in which green hornblende is much more conspicuous and garnet is much smaller and less conspicuous than in the underlying rocks. This belt appears to be generally less schistose than the underlying rocks.

The hornblende-biotite-garnet granulite grades eastward into a belt of rocks that was mapped as a "zone of feldspathization" because it appears to be a greatly feldspathized facies of granulite and paragneiss containing rocks that originally were similar to the underlying hornblende-biotite-garnet granulite. In places, the feldspathization is so intense that a coarse-grained rock consisting of quartz and feldspar is produced. This rock is so similar in mineralogy to the pegmatite

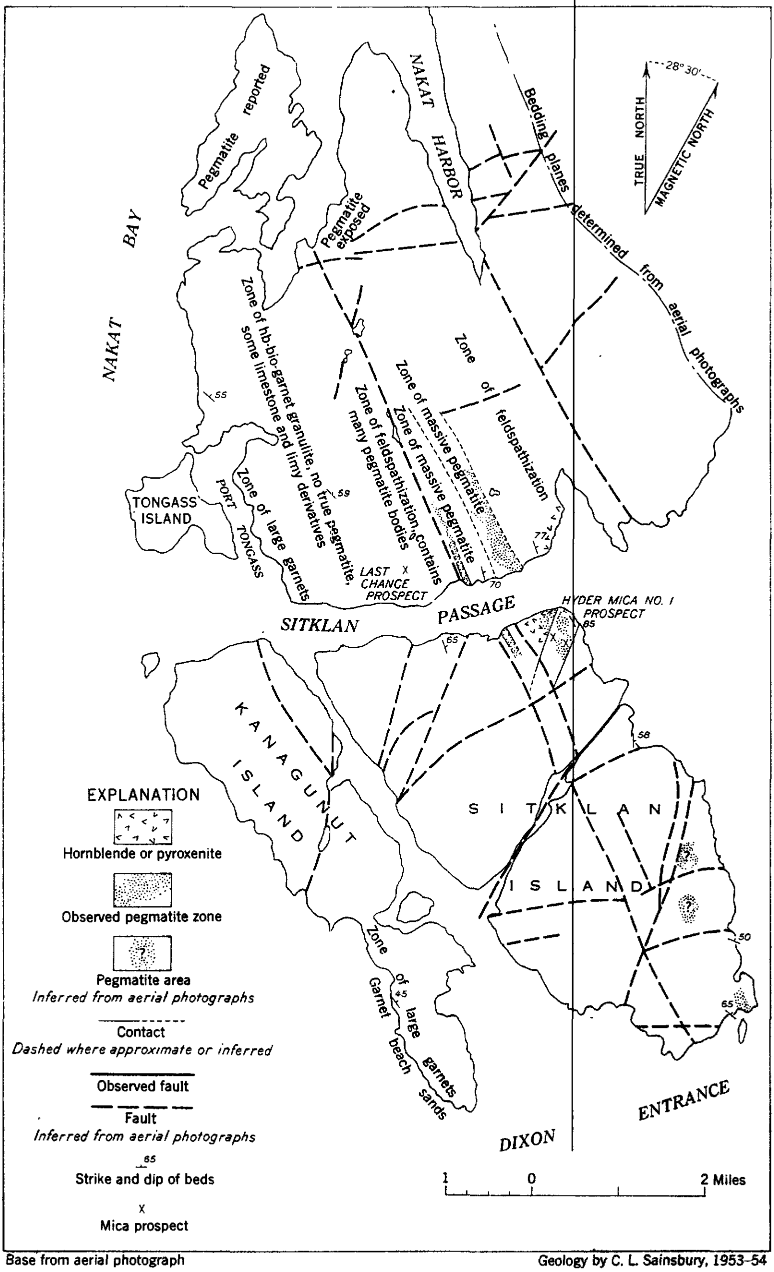

Figure 19.—Generalized geologic map of pegmatite area near Sitklan Passage, southeastern Alaska.

veins that it has been called "pegmatite" by some of those people interested in the mica prospects. In this report, rock of this type is called "pegmatitic rock." At places the pegmatitic rock grades into coarser-grained bodies of quartz, feldspar, and mica that retain features suggesting relict bedding. These coarser-grained bodies are referred to in this report as replacement pegmatite bodies. The feldspathization is probably caused in part by higher-rank metamorphism that locally produced a gneissic texture and in part by the introduction of soda feldspar. Without exception, the true pegmatite bodies are confined to this belt of feldspathized rocks. The claims staked on Sitklan Island, on the mainland north of Sitklan Island, and on Nakat Bay are in this zone of pegmatite-bearing, feldspathized rock. This is important in considering the genesis of the pegmatite bodies. The feldpathized rocks locally contain recrystallized limestone beds as much as 20 feet thick.

Many pegmatite bodies that apparently represent replaced gneiss or schist were observed. Such deposits show relict planar structures of the same thickness as the contacting granulite or gneiss, are concordant, and consist of albite or albite-oligoclase intergrown with granular vitreous quartz and minor amounts of muscovite mica in small flakes. These deposits are well exposed on the northern shore of Sitklan Passage and on the southeastern part of Sitklan Island.

Coarser grained, poorly foliated pegmatite bodies of similar mineralogy that contain muscovite flakes as large as 1½ inches in diameter possibly are the next stage in the formation of replacement pegmatite. Such deposits are common, and they too are roughly concordant with the contacting schist, gneiss, or granulite. None of these pegmatite bodies was proved to be formed by replacement, however, and the proof of their origin must await additional detailed mapping.

FOLDING OF THE BEDDED ROCKS

No major folds were seen in the metamorphic rocks, although the strike of the beds ranges from N. 5° W. to N. 60° W. An abrupt change in strike from N. 30° W. to N. 5° W. was probably caused by the eastward-trending fault on the east side of Sitklan Island. Drag folds are abundant in the limestone and commonly plunge steeply down the dip of the beds.

INTRUSIVE ROCKS

PEGMATITE

Intrusive pegmatite bodies as much as 30–40 feet thick, and from a few to several hundred feet long, occur in two distinct belts in the zone of feldspathization on Sitklan Island and on the mainland to the north (fig. 19). An aerial reconnaissance showed that pegmatitic rocks west of Nakat Harbor were a continuation of one or more of these belts. Exposures in the mountains north of Sitklan Passage show two distinct zones of pegmatitic rocks that possibly are continuations of those exposed on Sitklan Passage and Sitklan Island.

Discordant pegmatite bodies within the pegmatitic rock are composed essentially of pearly-white albite or oligoclase intergrown with vitreous massive or granular quartz. Locally, muscovite mica forms books that reach a maximum diameter of 8 inches, but most of the pegmatite contains little or no mica. Minor amounts of biotite, chlorite, and muddy-green epidote crystals, attaining a maximum length of several inches, occur in some of the pegmatite deposits. These crystals have reaction rims composed of muscovite, chlorite, and a little magnetite. A rusty fracture in one sample of pegmatite contained specks of free gold.

The pegmatite veins classed as intrusive are generally discordant; they tend, however, to be elongate in the direction of the foliation of the enclosing rocks. No zoning was observed in any of the pegmatite veins. Twenty samples of feldspar selected at random from the pegmatite veins were examined in the laboratory by crushing and immersion in oil. In 19 samples the indices of refraction were bracketed by oils of index 1.53 to 1.545, indicating that all the feldspar was albite-oligoclase. Each sample contained intergrown glassy quartz. One sample consisted of microcline. None of the rarer minerals commonly associated with pegmatite was found, and no anomalous radioactivity was detected by the Geiger counter.

BASALT DIKES

Basalt dikes intrude the metamorphic rocks and the pegmatite bodies. They were injected generally along the well-defined joint system, which strikes about N. 30°–50° E. The basalt dikes have chilled borders and the enclosing rocks are altered. In one exposure basalt dikelets filled fractures in a large pegmatite body. The flow lineation and displaced pegmatite xenoliths in this dike indicate that magma had perhaps flowed from west to east. Some of the basalt dikes have phenocrysts of plagioclase feldspar 1 centimeter long, and one dike contains smaller phenocrysts of basaltic hornblende. Pyrite, magnetite, and pyrrhotite are common accessory minerals. The dikes are not metamorphosed or deformed, indicating that igneous activity took place after regional deformation. The relationship also indicates that the pegmatite bodies are older than the basalt dikes.

FAULTS

The dotted lines in figure 19 designate faults inferred from aerial photographs. Only one major fault was seen in the field. Small faults occur near the pegmatite deposits at the Hyder Mica No. 1 prospect on Sitklan Island. Pyrite and pyrrhotite were introduced into the enclosing rocks along the faults. One fault contact of the pegmatite and massive hornblendite or hornblende-granulite was observed, indicating that some faulting occurred after the emplacement of the pegmatite rock. It is not known whether the basalt dikes are faulted.

INDIVIDUAL PROSPECTS

In this report, the term "prospect" applies only to mica-bearing pegmatite bodies that have been explored by trenching or drilling and that show mica books of commercial size.

LAST CHANCE PROSPECT

The Last Chance prospect is on the mainland about 1,500 feet from the beach camp in a north-northwesterly direction (fig. 19). It consists of a small trench about 4 feet long on a pegmatite deposit about 2–3 feet thick. The pegmatite contains silvery mica in thin books as much as 1½ inches in diameter that surround albite crystals. The mica books have a crude foliation, and their resemblance to many similar exposures elsewhere leads the writer to conclude that the mica deposit is not of commercial grade or is not large enough to yield any but the smallest of punch mica. The estimated mica content of the pegmatite is less than 10 percent; the mica is distributed at random, and the pegmatite is so thin that it probably could not be mined economically. The enclosing country rock is a quartz-biotite paragneiss.

A Territorial Department of Mines engineer collected a powder box of commercial-grade mica from a pegmatite body in this area, but the collection has not been duplicated since and the location of the pegmatite is unknown.

HYDER MICA NO. 1 PROSPECT

Hyder Mica No. 1 prospect is on the northeast corner of Sitklan Island about 300 feet from the beach at an altitude of about 140 feet (fig. 20). Opencuts 30–40 feet long were made on two massive pegmatite bodies that intrude unfoliated hornblende rock. Four of the five larger trenches expose pegmatite containing mica plates as much as 8 inches across (pl. 19). Small pits on other outcrops of pegmatite disclose no mica.

Broken and bent books of mica predominate over those from which sheets could be cut, although Frank Blasher has cut many perfect sheets measuring 3 by 4½ inches from some of the better books. Most of the deformed books are ruled. In many places an intersecting cleavage forms "*A*" mica. The mica is dark grayish green to muddy green, and some samples from this prospect submitted by the Territorial Department of Mines and by Blasher to the General Services Administration were classed as "strategic grade muscovite mica." Other samples of the mica tested partly by the General Services Administration, by the Varlacoid Chemical Co. of New York, and by Associated Laboratories of Portland, Oreg., have been described, respectively, as "surface samples not suitable for grading," "mine-run

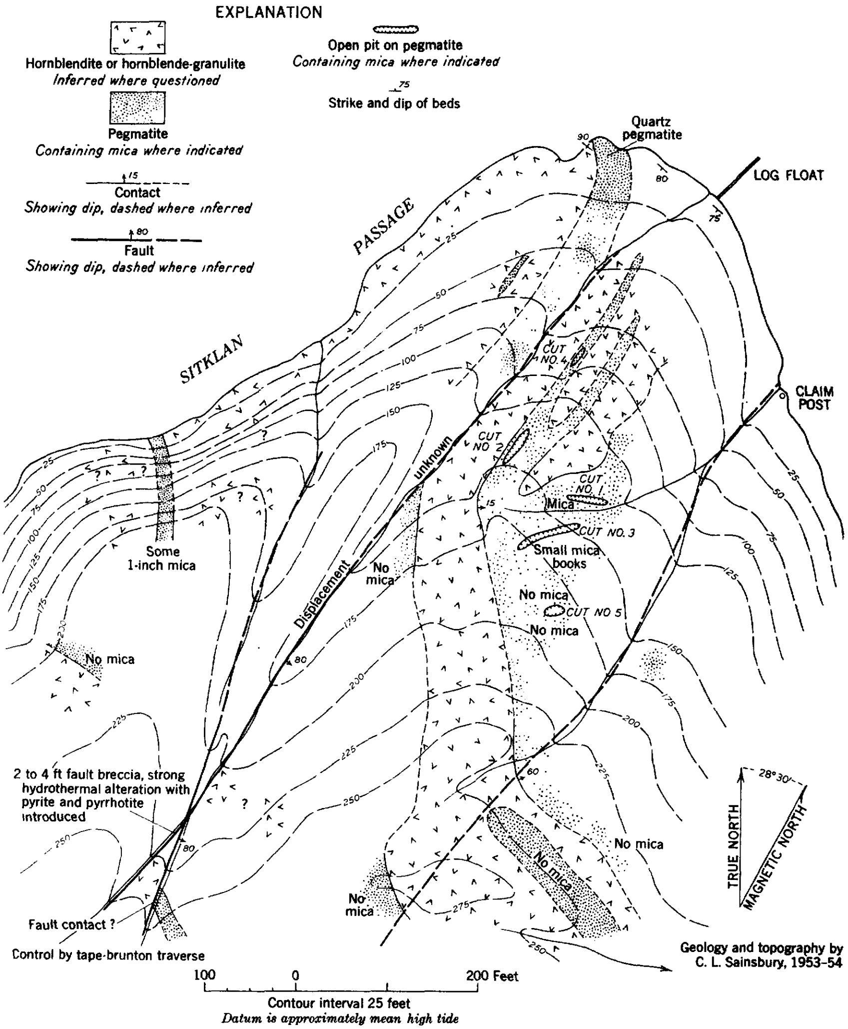

FIGURE 20.—Geologic sketch map of pegmatite deposits at Hyder Mica No. 1 prospect, Sitklan Island, Alaska.

ruby muscovite mica," and "muscovite mica, non-ruby, stained *A* quality, A. S. T. M. size grade 5½ and 6, heating loss 0.17 percent." All the characteristics of the mica from this deposit have not been determined.

Other pegmatite bodies crop out in the area near the prospect pits. Many outcrops were examined, and a few smaller mica books were found, but the mica content is generally very small. In some, the alinement of the mica books makes a foliated pegmatite. The pegmatite bodies are similar to those exposed on the beach and consist of albite or albite-oligoclase and quartz, including minor muscovite and epidote, except near contacts where some pegmatite contained hornblende xenoliths altered to biotite. J. C. Roehm[1] of the Territorial Department of Mines ascribed the formation and localization of mica to amphibolite-pegmatite contacts where amphibolite had been ingested. For the following reasons this genesis is not accepted by the writer who examined the contacts in detail: mica was not observed near any of the contacts, nor was it found abundant near any of the hornblende xenoliths; a chemical reaction between iron-bearing hornblende and pegmatite to produce iron-free muscovite mica, without evidence of associated alteration minerals, would seem improbable; and mica occurs sporadically in many of the pegmatite veins with apparently no close relationship to hornblende rock-pegmatite contacts. It seems most likely that the mica is merely a local concentration, common in all mica-bearing pegmatite deposits.

Prospect pits that expose pegmatite have been dug at scattered points in a line striking southwestward from the larger trenches. The present owners of the property believe these pits are on one continuous pegmatite body several thousand feet long striking southwestward (Ovela Cote, oral communication). The writer found many outcrops of hornblende rock and hornblende granulite in the creek bed that parallels the line of pits, and concludes that the pits were located upon outcrops of many pegmatite bodies rather than a continuous one. The dense cover of timber, brush, and rotting vegetation prohibits the tracing of contacts, and care is urged in extrapolating individual pegmatite bodies without close bedrock control. Mica reserves in such pegmatite deposits should not be computed until sufficient trenching has been done to give reliable data.

Two fault zones, both of which strike northeastward and are hydrothermally altered, were mapped near the open pits. Pyrite was introduced into the wall rocks near the faults, and some of the massive hornblende rock was altered to biotite or vermiculite. Hydrothermal solutions from one of these faults or from the pegmatite probably formed the biotite or vermiculite in the hornblende rock on the footwall of the pegmatite body exposed near the northwestern opencut. One probable fault contact between pegmatite and hornblende rock was observed near the intersection of the faults (fig. 20).

The massive hornblende rock could be a facies of the normal hornblende granulite recrystallized under the influence of heat from the pegmatite deposits, and not an altered intrusive body, for the following reasons: the contacts of the pegmatite and the hornblende rock at many places strike and dip parallel or almost parallel to the regional bedding, thus maintaining the sill-like attitude of the pegmatite; gradations from the massive rock showing decussate structure into a foliated hornblende-garnet granulite were observed; and a similar

[1] Roehm, J. C., Preliminary report of investigations and itinerary of J. C. Roehm in the Ketchikan and Hyder mining precincts July 14 to August 18, 1945. Manuscript report in files of Territorial Department of Mines.

PHOTOGRAPH OF LARGER MICA BOOK FROM PROSPECT ON SITKLAN ISLAND. SILVER DOLLAR INDICATES SCALE

massive hornblende rock at one other locality was found to be a contact phase between hornblende-garnet granulite and pegmatite.

A small outcrop of pyroxenite on the northern shore of Sitklan Passage clearly has an intrusive form, thus confirming the occurrence of ultrabasic intrusive rocks in the area. Possibly the hornblende rock observed near the main prospects is a facies of the pyroxenite, but determination of the origin must await further field mapping.

ZONING OF THE PEGMATITE

No zoned pegmatite bodies were found in the area examined. Because of the economic implications, special attention was given to this matter during the second field examination. Although none of the pegmatite bodies is completely exposed, enough exposures were examined to establish firmly the fact that the deposits generally are not zoned. If the pegmatite bodies are zoned, the mineralogic and physical variations between zones are so slight as to be undetectable in the field. The mica exposed in the prospect pits bears no relation to its position in the pegmatite, and the pegmatite does not vary perceptibly in composition.

The feldspar of the pegmatite deposits is almost entirely albite-oligoclase, with only minor amounts of microcline. Granular, vitreous quartz is intergrown with all feldspar observed, and no concentrations of quartz were found that indicated quartz cores. The texture may vary among pegmatite deposits and within the same ore; such variations, however, are not consistent and are not accompanied by mineralogic changes.

GENESIS OF PEGMATITE

Pertinent observations regarding the genesis of the pegmatite deposits are summarized below.

1. The deposits are generally sill-like bodies lying in the plane of the bedding of metamorphic granulite along a zone of feldspathization. No pegmatite deposits were seen outside of this zone. Some have crosscutting contacts and some have gradational contacts, but their long axes are always parallel or subparallel to the regional strike of the rocks.
2. The deposits altered some of the host rock.
3. The deposits contain only quartz, feldspar, epidote, and mica associated with muscovite in composition.
4. In many places the flakes of muscovite create a foliation almost parallel to that of the enclosing rocks. The mica is bent around augenlike albite crystals.
5. The quartz of the pegmatite is broken and fractured to such an extent that it breaks down into a mass of fine grains upon weathering.

6. The pegmatite is intruded by basalt dikes injected in a northeasterly direction along a well-defined joint system.

7. Most of the larger mica observed was cleaved and ruled. Some fairly large unruled sheets can be obtained although they are a very small part of the total mica observed at any of the pits. Some mica of commercial size and grade can be obtained.

The above observations suggest that the pegmatite was intruded as heated bodies of soda-rich fluids into the enclosing rocks during the late stages of the Coast Range orogeny. The pegmatite bodies probably were derived, in part at least, from syngenetic fluids created from the rocks in the zone of feldspathization under the influence of the heat of regional metamorphism at depths well below the present position of the pegmatite. No genetic relationship to the exposed intrusive rocks of granitoid composition can be shown.

The pegmatite bodies were injected before the formation of the strong northeastward-trending joints when the bedding or foliation of the granulite was the easiest channel of entrance. Widespread feldspathization probably was contemporaneous with the formation of the pegmatite deposits so that some gradational contacts resulted.

The foliation of the pegmatite and the granulation of the quartz indicate that the pegmatite bodies were subjected to some dynamic metamorphism after their formation. No evidence has been found of deformation after the injection of the basalt dikes and the later faulting.

ECONOMIC ASPECTS OF PEGMATITE DEPOSITS, SITKLAN ISLAND

From the preliminary field work it is concluded that pegmatite bodies and intensely feldspathized metamorphic rocks are common throughout a zone at least 1 mile wide that occupies the east part of Sitklan Island and continues northward on the mainland for several miles. The pegmatite deposits locally contain mica books of commercial size and grade, but the events of the tectonic history of the rocks caused many pegmatite bodies to be crushed or become foliated. The writer does not believe the geologic environment favors the occurrence of the large, slowly cooled, unstressed pegmatite bodies that are the usual hosts of minable deposits of commercial-grade mica. Not enough prospecting has been done to determine the content of minor constituents of the pegmatite bodies.

The pegmatite consists predominantly of albite or albite-oligoclase and quartz in fine intergrowths. Although a large tonnage of material is available, the separation of quartz and feldspar would require special beneficiation and the resulting feldspar would not be usable in the many industries that consume potassic feldspar. The deposits are located near tidewater on or near regular sealanes so that transportation to market would be relatively cheap.

Additional field work is recommended, especially on Sitklan Island where the larger, discordant pegmatite deposits appear to be more abundant. Prospecting to the north among the feldspathic and pegmatitic rocks in the zone of feldspathization should be directed toward outlining unfoliated, mica-bearing pegmatite bodies. A few surface trenches should show the type, grade, and amount of mica present.

The pegmatite deposits in which mica is oriented so as to give a crude foliation are not considered to be a favorable host rock for mica of commercial size and grade and do not warrant extensive exploration.

Some prospecting for economic deposits of vermiculite is recommended along the contacts between pegmatite and hornblendite or pyroxenite.

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