RI bureau of mines
report of investigations 6737

# TIN-LODE INVESTIGATIONS, CAPE MOUNTAIN AREA, SEWARD PENINSULA, ALASKA

By John J. Mulligan

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF MINES

1966

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by

John J. Mulligan[1]

With Section on Petrography by Walter L. Gnagy

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ABSTRACT

The Bureau of Mines investigated the tin deposits of the Cape Mountain area during July and August 1962 to test the effectiveness of detrital-cover sampling in permafrost areas as a relatively cheap and simple means of guiding mine development and exploration. Results indicate that systematic detrital-cover sampling can be used effectively to delineate obscure deposits with sufficient accuracy to permit sampling with a minimum of trenching or drilling. Extensions of known outcroppings were traced in sufficient detail to guide lode sampling and several previously unknown tin-bearing lodes were found and sampled. Lode sampling was limited to the minimum needed to establish the reliability of detrital-cover sampling results. The results of previous lode and placer investigations are summarized and detrital-cover sampling methods and results are described in detail.

## INTRODUCTION

The Bureau of Mines has been investigating the lode- and placer-tin resources of the western part of the Seward Peninsula, Alaska, intermittently since 1942 (fig. 1). The various investigations are described in Bureau of Mines publications listed chronologically in the bibliography at the end of this report.

This report describes an investigation made in the Cape Mountain area July and August 1962. Primarily, this was a research project to test the effectiveness of detrital-cover sampling as a method for delineating and evaluating tin lodes buried under frozen detritus in permanently frozen areas. Detrital-cover sampling methods were developed during investigations in the Potato Mountain area (27);[2] this was the first use of these methods in another area. The principal lode deposits of the Cape Mountain area and an outlying

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[1] Mine examination and exploration engineer, Area VIII Mineral Resource Office, Bureau of Mines, Juneau, Alaska.

[2] Underlined numbers in parentheses refer to items in the bibliography at the end of this report.

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Work on manuscript completed June 1965.

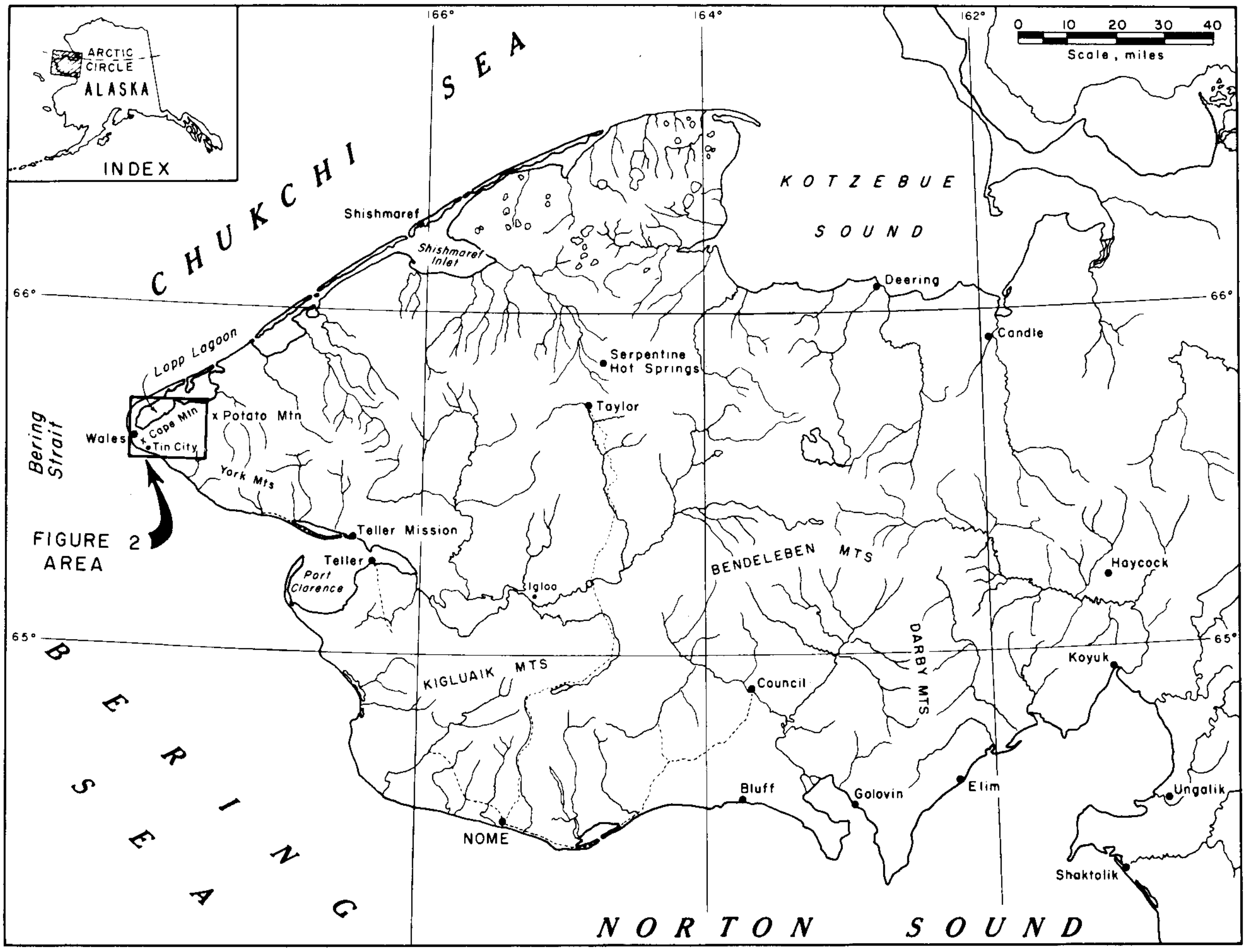


FIGURE 1. - Seward Peninsula, Alaska.

fringe of lesser deposits were readily located. Lode sampling was limited to the minimum necessary to indicate the general nature of the deposits.

Results of this investigation make it evident that a few weeks of systematic detrital-cover sampling would have saved the mining companies that worked in the Cape Mountain area many thousands of dollars and years of effort in their attempts to locate and develop the tin lodes.

The detrital-cover sampling methods used during this investigation are simple adaptations of well-known methods that should be useful in evaluating the numerous other tin occurrences reported in northern and central Alaska. The evaluation of these tin deposits is a matter of both national and local concern; therefore, the sampling theory, methods, and results are described in detail.

## ACKNOWLEDGMENTS

The Bureau of Mines Area VIII Mineral Resource Office at Juneau, Alaska, administered and coordinated the investigation of Seward Peninsula tin deposits. Chemical and petrographic analyses were made in the Bureau of Mines laboratories in Juneau. A list of claims in the Cape Mountain area was furnished by the Alaska Division of Mines and Minerals, Department of Natural Resources; additional data on ownership was furnished by the Division of Lands. Historical notes and general geological data were compiled principally from Bureau of Mines and Geological Survey publications listed in the bibliography.

The United States Air Force, Alaskan Air Command, has an installation in the Cape Mountain area; both the military and civilian personnel materially assisted the Bureau field party. Particular thanks are due to Major Albert L. Seaver, the Air Force commander, and to Mr. Ernest M. Garner, station supervisor, Radio Corporation of America. The U.S. Army Corps of Engineers, Office of the Alaska District, furnished a detailed map of the area that was most helpful to the field party. This map includes current records of property included in the military reservations.

Geographical nomenclature in this report follows usage on the Geological Survey maps available when the work was done. Therefore, names of minor geographic features may differ from those appearing in older reports. Two "Village Creeks" in the area have been designated No. 1 and No. 2 (fig. 2). Village Creek No. 1 flows into the Bering Sea at Wales Village. Village Creek No. 2 flows into the Lopp Lagoon at Rock Island. If a feature was not named on the Geological Survey maps, local usage was followed, if known; if local usage was not known, the feature was designated by a letter. Nomenclature has not been reviewed by the Board on Geographic Names.

Base maps were adapted principally from Army Map Service maps distributed by the Geological Survey. Figure 1 is adapted from the 1:1,000,000 scale map entitled "Nome." Figures 2, 6, 8, and 9 are modified from the Teller (C-6 and C-7) quadrangle maps. Figure 3 includes data from the plats of patent surveys, and figure 5 was adapted from a geologic map by J. B. Mertie and Robert F. Lyman of the Geological Survey; in both cases details not pertinent to this report have been omitted. Figure 7 was mapped during this project, but claim locations were taken from maps in Bureau of Mines Report of Investigations 3978 (18).

## LOCATION AND ACCESS

Cape Mountain (latitude 65°35' N, longitude 168°00' W) is on the east side of the Bering Strait, 65 miles south of the Arctic Circle and 105 miles N 45° W of Nome, Seward Peninsula, Alaska (fig. 1). The village of Wales, on the west side of Cape Mountain, is the only nearby permanent settlement. Tin City, on the east side of Cape Mountain, is the site of a small military installation (fig. 2). There are no permanent inhabitants in the roughly triangular area included between Tin City, Shishmaref (70 miles northeast), and Teller (50 miles southeast).

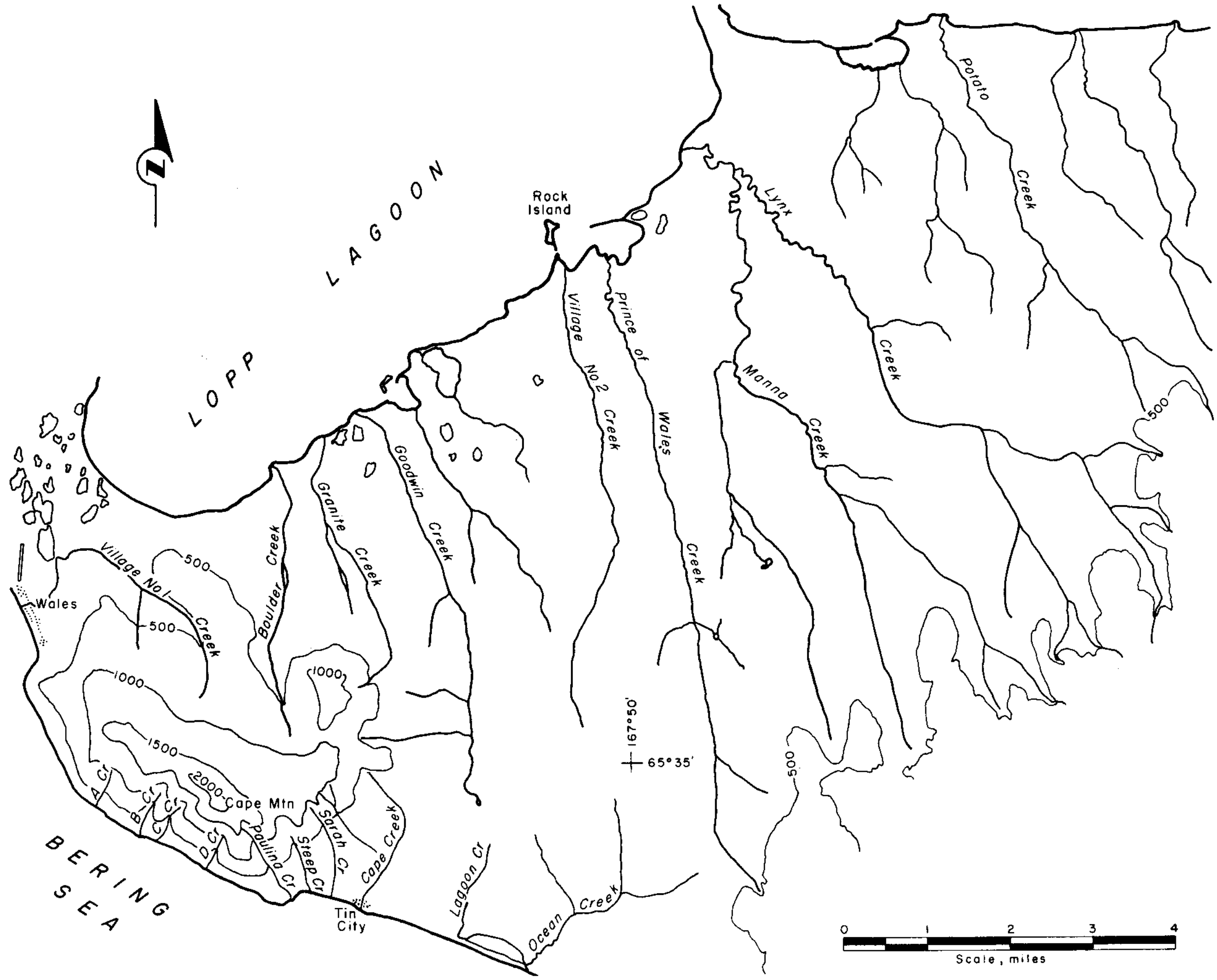


FIGURE 2. - Cape Mountain Area.

The Cape Mountain area is readily accessible by air from Nome, the center of air traffic for the Seward Peninsula. Nome is served by daily scheduled flights from Anchorage and Fairbanks. The Tin City military installation maintains an airfield suitable for large commercial and military cargo planes. Two small airfields at Wales are used by bush planes carrying 1,000 to 2,000 pounds of cargo.

Freight too heavy or bulky for air transport can be landed from ships at Tin City beach. No docks or freight handling facilities are available; vessels are beached and unloaded on the sand. Eskimo skin boats capable of carrying up to a few tons, ordinary barges of 50 to 200 tons burden, and various military-type landing craft have been used successfully.

Persons visiting the Tin City area or planning to work near the military installations should make prior arrangements with the commanding officer, 710 AC and W (Aircraft Control and Warning) Squadron, U.S. Forces, Alaska.

## LABOR

The population of the western part of the Seward Peninsula (fig. 1) is listed in table 1. A high percentage of the population is available for hiring because of the lack of industrial development. The Eskimo and white residents include unskilled, semiskilled, and many types of skilled labor.

TABLE 1. - Population of the western part of the Seward Peninsula[1]

| | 1950 | [2]1960 |
|---|---|---|
| Diomede | 103 | 88 |
| Igloo | 64 | ([3]) |
| Nome | 1,876 | 2,316 |
| Shishmaref | 194 | 217 |
| Teller | 160 | 217 |
| Teller Mission | 109 | 109 |
| Wales | 141 | 128 |
| Total | 2,647 | 3,075 |

[1] Settlements are shown on figure 1, except Diomede which is on Little Diomede Island, about 25 miles N 65° W of Wales.

[2] There is a continuing tendency for the people to move to the larger communities to take advantage of schools and other community services.

[3] Settlement abandoned.

## LIVING CONDITIONS

Modern communications and transport facilities have practically eliminated the isolation of the Arctic and sub-Arctic areas. Small communities and field parties in the western Seward Peninsula communicate with Alaska Communication System (ACS) stations in Nome and Teller by radiotelephone. Food, clothing, and hardware are stocked by stores in Nome or Teller; both Wales and Shishmaref have small general stores. Supplies, repair parts, and perishable food can be delivered by plane as required. Items not available locally can be ordered by telephone or telegram and obtained by air in a few days from distributors in the larger cities or from the factory.

Sturdy, insulated, and heated houses are essential during the winter, but tents or light uninsulated houses are adequate for summer use. A common expedient is to mount a light cabin on skids (locally termed a wanigan) and tow it about with a tractor as needed. Ordinarily, dwellings are heated by oil stoves, and cooking is done with either oil, bottled gas, or gasoline stoves.

## PROPERTY AND OWNERSHIP

Three groups of patented lode claims are listed in table 2 and the approximate locations are shown on figure 3. No unpatented lode claims were known to be in force but one, the Percy claim, has been included on the map. Claim ownership is listed, if known, but a detailed title search was not made. The placer claims in the area are described in Bureau of Mines Information Circular 7878 (24).

TABLE 2. - Patented lode claims, Cape Mountain area[1]

| Mineral survey | Company[2] | Patent number | Patent date | Lode claims | Millsite claims |
|---|---|---|---|---|---|
| 336 A&B..... | Bartels Tin Mining Co[3] ....... | 198,633 | 5/17/11 | 28 | 1 |
| 337 A&B..... | Bartels Tin Mining Co[4] ....... | 292,826 | 9/20/12 | 7 | 1 |
| 409 A&B..... | U.S. Alaska Tin Mining Co[5] ... | 301,775 | 11/23/12 | 3 | 1 |
| Total.. | ............................ | - | - | 38 | 3 |

[1] No unpatented lode claims were known to be in force in 1962.

[2] The patents were granted to the companies listed. The United States Government has since acquired title or right of access to a large number of claims or portions of claims occupied by various military installations and access roads. The Corps of Engineers, Office of the Alaska District Engineer, maintains a current real estate map of the Tin City military reservation.

[3] Deed, Bartels Tin Mining Co. to John F. Downey recorded v. 85, p. 296, Port Clarence recording district records; Deed, John F. Downey to Empire Tin Mining Co. recorded v. 90, p. 36. A Declaration of Ownership filed by the Empire Tin Mining Co. on June 26, 1946, lists claims included in Survey 336 A and B in the following order:

Champion
North Star Fraction
North Star
Lucky Queen
Tremont
Bronx
Daisy
Birthday
Venus
Mars
Jupiter
Saturn
Excelsior
Aurora
Elgin
Washington
Adams
Jefferson
Madison
Monroe
Planet
Fourth of July
Martha
Mispickel
Noble
Tin Quartz
Rusty Lode Mining
Northwestern Millsite.

[4] Declaration of Ownership for the Comstock, Canoe, and Sun Drum claims filed Aug. 12, 1947, by Empire Tin Mining Co.; no record of ownership of remaining claims of Survey 337 A and B: The Aspen, Arctic, Fairview, and Sunrise lode claims and the Bartels millsite claim.

[5] All claims included in Mineral Survey 409 A and B (Dieter No. 1, Dieter No. 2 and Dieter No. 3) were foreclosed by the State of Alaska, Nov. 10, 1959.

The United States Government has acquired either title or right of access to various land areas occupied by military installations on Cape Mountain and in the vicinity of Tin City. Purchase or access agreements were negotiated with the owners if these areas were included in lode or placer claims. Because of the ever-changing nature of active military installations, this report does not include a description of the areas covered. However, it is

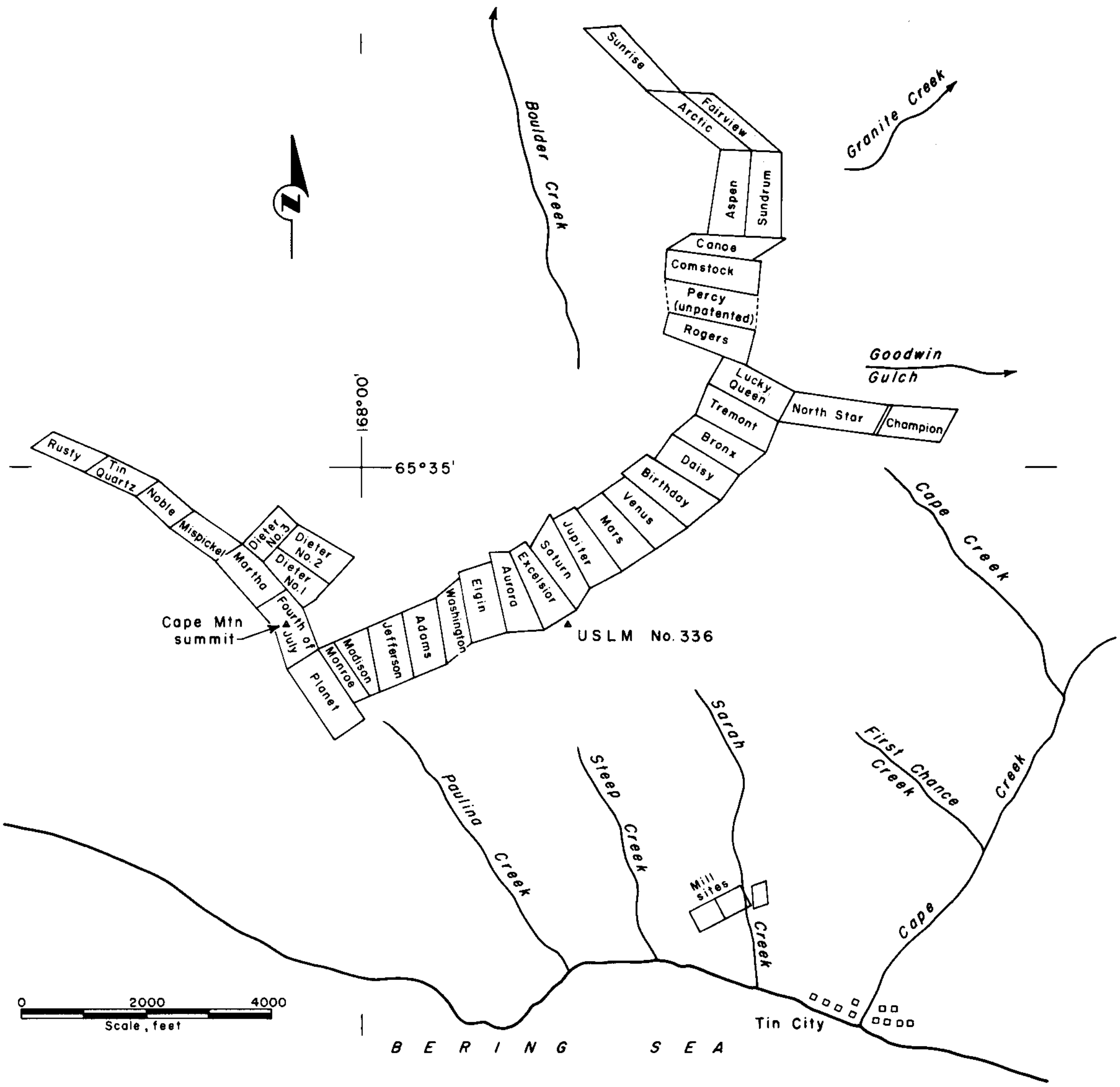


FIGURE 3. - Lode Claims, Cape Mountain Area.

apparent that an agreement with the military command should be made before starting any work in the Cape Mountain area.

The western slopes of Cape Mountain are in the Wales Village native reservation. The eastern boundary of this reservation is a north-south line (longitude 168° W) that passes through the summit of Cape Mountain and extends from the Bering Sea to Lopp Lagoon.

## HISTORY

Lode tin was discovered on Cape Mountain in 1902 by W. C. J. Bartels. Active exploration and development continued for about 10 years. A camp named

"Tin City" was built, numerous pits, trenches, shafts, and adits were dug, and two stamp mills were erected. Thirty-eight lode claims and three millsite claims were granted patents in 1911 and 1912 (fig. 3). Records indicate that about 6 tons of tin were produced.

Placer tin was first reported in 1918; placer-tin mining started about 1924 and continued until 1941. Over 640 tons of tin were recovered from the gravels of Cape Creek and Goodwin Gulch (table 3). No tin has been produced since 1941.

TABLE 3. - Recorded tin production, Cape Mountain area

| Year | Lode | | Placer | | Remarks |
|---|---|---|---|---|---|
| | Tin, short tons | Dollar value | Tin, short tons | Dollar value | |
| 1906....... | 6.0 | 6,819 | - | - | Bartels lode mine. |
| 1924....... | - | - | 4.34 | 4,357 | Goodwin Gulch. |
| 1925....... | - | - | 9.75 | 11,290 | Do. |
| 1926....... | - | - | 7.05 | 9,165 | Do. |
| 1927....... | - | - | 14.48 | 31,516 | Do. |
| 1928....... | - | - | 38.83 | 38,830 | Goodwin Gulch and Cape Creek. |
| 1929....... | - | - | 36.65 | 32,985 | Do. |
| 1930....... | - | - | 10.87 | 8,718 | Do. |
| 1931....... | - | - | 3.66 | 1,464 | Goodwin Gulch. |
| 1933....... | - | - | 2.90 | 2,300 | Goodwin Gulch (?). |
| 1934....... | - | - | 4.14 | 4,300 | Do. |
| 1935....... | - | - | 46.25 | 46,250 | Cape Creek and Goodwin Gulch. |
| 1936....... | - | - | 99.00 | 91,080 | Do. |
| 1937....... | - | - | 154.02 | 166,341 | Do. |
| 1938....... | - | - | 105.00 | 88,200 | Cape Creek. |
| 1939....... | - | - | 25.84 | 25,840 | Cape Creek and Goodwin Gulch. |
| 1940....... | - | - | 43.29 | 43,289 | Cape Creek. |
| 1941....... | - | - | 49.63 | 51,615 | Do. |
| Total... | 6.0 | 6,819 | 655.70 | 657,540 | - |

The Cape Mountain area tin deposits have been examined and studied by many geologists and mining engineers both in government and private employment. Table 4 lists examinations or investigations that have been described in reports widely available to the public.

TABLE 4. - Investigations of tin deposits in the Cape Mountain area[1]

| Date of work | Organization | Person or persons | Scope of work | Reference numbers in bibliography |
|---|---|---|---|---|
| 1900...... | Geological Survey. | Brooks..... | Discovered tin in York area.. | 1, 2 |
| 1901...... | do...... | Collier.... | Geologic and geographic reconnaissance. | 3 |
| 1903...... | do...... | do...... | Brief reconnaissance......... | 5 |
| 1905...... | do...... | Hess....... | do..................... | 8 |
| 1907...... | do...... | Knopf...... | Geologic study of the tin-bearing area. | 11 |
| 1920...... | do...... | Steidtmann and Cathcart. | Geologic study of the western Seward Peninsula tin-bearing area including Cape Mountain area. | 16 |
| 1936...... | do...... | Smith...... | Description of placer mining methods. | 17 |
| 1942-44-48 | Bureau of Mines. | Heide and Rutledge. | Lode and placer sampling..... | 18, 19 |
| 1952-53... | do...... | Mulligan and Thorne | Churn-drill placer sampling.. | 24 |

[1] Includes only investigations described in reports generally available to the public.

## PHYSICAL FEATURES

### Topography and Vegetation

Cape Mountain is an isolated peak that rises 2,289 feet from sea level to form a prominent landmark on the east side of Bering Strait (fig. 1). The mountain is drained by a number of short creeks that flow a few miles to the Bering Sea or Lopp Lagoon (fig. 2). A region of low rounded hills extends 8 or 10 miles eastward from Cape Mountain to Potato Mountain and the York Mountains.

Frostbroken rock detritus covers the hills and mountains. Patches of bedrock are exposed at scattered locations, usually on streambanks, steep hillsides, or near the tops of ridges. A picturesque and noteworthy feature of the ridges and upper slopes of Cape Mountain are granite pinnacles or "spires," that rise 20 to 50 feet or more above the surrounding rock debris and may be up to 20 or more feet in diameter. The spires are unfractured remnants of the granite bedrock left by the frost wedging that removed the surrounding rock.

Tundra and alpine-type vegetation thrive from sea level to about 800 feet altitude and a gradually thinning growth extends many hundreds of feet higher. There are no trees, but sparse groups of willow bushes may grow to a height of 3 or 4 feet in some of the valleys. A dense blanket of vegetation covers the low hills east of Cape Mountain, but the soil derived from the limestones and granites of Cape Mountain supports a noticeably sparser growth.

## Climate

The climate of the Cape Mountain area is sub-Arctic modified by the position between the Chukchi Sea and the Bering Sea (fig. 1). During the summer the temperature at sea level usually ranges from 33° to 50° F. The wind blows persistently; often it is accompanied by fog or drizzling rain, although the total annual rainfall is low. During the winter the weather is windy but proximity to the sea prevents the extremely low temperatures characteristic of inland locations at the same latitude. The weather statistics for Wales are summarized in table 5.

TABLE 5. - Weather statistics[1]

| | Wales |
|---|---|
| Average annual temperature | 21.8° F |
| Months when average temperature is above 32° F | 4 months |
| Average annual precipitation | 11.98 inches |
| Average annual snowfall | 51.7 inches |
| Prevailing wind direction | North |
| Highest recorded temperature | 75° F |
| Lowest recorded temperature | -41° F |

[1] Data from Federal Weather Bureau, Anchorage, Alaska:

Average breakup:

| | |
|---|---|
| Bering Strait | June 7 |
| Port Clarence | June 12 |
| Arctic Ocean | June 18 |
| Shishmaref Inlet | June 20 |

Average freezeup:

| | |
|---|---|
| Arctic Ocean | November 6 |
| Port Clarence | November 7 |
| Shishmaref Inlet | November 9 |
| Bering Strait | November 29 |

## Water Supply

A dependable supply of fresh water is difficult to obtain in the Cape Mountain area. Rain and melt water from snow drain rapidly; no evidences of water channels in the permanently frozen bedrock were noted. Streamflow fluctuates rapidly and widely, but the streams draining the rolling tundra-covered hills east of Cape Mountain do not fluctuate as much as the streams draining the steep rocky slopes of Cape Mountain. Streamflow in winter was not investigated; probably, all streams dry up shortly after freezeup and do not flow again until spring. At the Tin City military installation water is collected during the summer and stored in heated tanks for winter use. Residents usually obtain household water from ponds or streams; snow and ice are melted when such sources are not available.

During the summer, water for a small camp or for limited exploratory drilling can be obtained on the slopes of Cape Mountain almost to the summit. The water usually is not visible on the surface but trickles through the frost-broken detritus in the bottom of gulches and gullies. To obtain water, a pit

1 to 5 feet deep (to permafrost or bedrock) is dug by hand or bulldozer to expose the water; a small dam is erected to impede the flow; and a pipe or trough is used to carry the water to where it is needed. During the investigation, water for panning and for camp use was obtained in this manner. One such water collector, about 300 feet northwest of the Lucky Queen adit, was observed for 2 weeks in August. On a sunny day with a temperature of about 45° F, the flow averaged about 10 gallons per minute; the flow increased greatly during rains and decreased when the average temperature dropped. Except during rains, the water appeared to derive from the melting of ice and snow in the interstices of the frostbroken rubble cover. Drifting snow refills the voids every winter. Undoubtedly, flow ceases when the daily average temperature drops below freezing.

The lack of water forced miners who worked the Cape Creek and Goodwin Gulch tin placers to transport the gravel to stationary recovery plants. The principal recovery plant, on the beach at Tin City 500 feet east of the mouth of Cape Creek, utilized salt water pumped from the Bering Sea. A smaller plant on Goodwin Creek at the mouth of Goodwin Gulch used water from Goodwin Creek.

## Permafrost

The bedrock and the detrital cover throughout the Cape Mountain area remain permanently frozen, except for the top few feet that thaw during the summer. Surface waters that penetrate to great depths, or other less obvious sources of heat, may produce thawed zones within permafrost areas, but no such thawed zones were recognized at Cape Mountain. In the absence of percolating surface waters or other sources of heat, the ground temperature 30 to 50 feet below the earth's surface remains almost constant throughout the year and about equals the average annual surface temperature. The average annual surface temperature probably is reasonably close to the average annual air temperature, about 22° F (table 5). The geothermal gradient varies considerably, but the worldwide average is about a 1° F increase in temperature for a depth of 70 feet. Therefore, freezing temperatures can be expected to extend about 700 feet below the earth's surface. This rough estimate of the depth of permafrost could not be verified.

## Detrital Cover

The principal primary agent of erosion is frostbreaking which takes place where thawing and freezing occur. The depth of summer thaw varies widely; it may penetrate to great depths where surface water percolates through porous strata, but on flat, well-drained, or impervious surfaces, the thaw may not penetrate more than 1 or 2 feet. A cover of vegetation that insulates the surface from the sun's heat tends to inhibit thawing. No exact measurements were made, but in August the average depth of thawed ground in sample pits was estimated to be about 2.5 feet.

The nature of the frostbroken detrital material depends on the composition of the source rock. Water enters all available openings; it freezes, expands, and breaks the rock; the resultant debris may vary in size from blocky fragments many feet in diameter to individual crystals or fragments of crystals. Most igneous rocks and many sedimentary rocks break into coarse angular fragments that can support little plant life. The debris derived from most shales and schists forms a firm soil that can support a vigorous growth of plants and mosses. Where vegetation is abundant, a layer of peat, varying in thickness from a few inches to a few feet, may form on the surface. Calcareous rock debris, even if it breaks down into a soil, tends to inhibit the growth of tundra plants, which apparently thrive best in an acidic environment.

The surface evidences of a rock outcropping depend on the nature of the rock. A rock that resists frostbreaking may protrude through the overlying mantle or may be marked by large angular fragments. Rocks of moderate resistance to frostbreaking ordinarily do not form protruding outcroppings, but the outcroppings may be indicated by fragments in the overburden. Relatively soft or foliated rocks normally are eroded slightly below the nearby more resistant rocks. The material derived from the softer outcrop usually breaks down into small fragments that mix with larger fragments of the more resistant rocks to form an indistinguishable cover. Deposits containing tin minerals usually are less resistant than surrounding rocks; tin-bearing deposits are rarely visible.

The frostbroken material moves downhill as an earthflow that follows regular paths (float lines) perpendicular to the elevation contour lines. Practically all movement of material takes place in a near-surface "zone of movement" (fig. 4) that develops because the ground thaws downward nearly to an equilibrium point early in the summer. A narrow transitional zone, that thaws gradually as the summer advances, underlies the zone of movement. The transitional zone merges into an underlying zone of broken but normally frozen material that remains essentially in place except for some downhill creep resembling glacial flow. This broken zone in turn merges gradually into unbroken permanently frozen bedrock.

The lighter material is more readily carried off in the zone of movement than the heavier material. Thus a residual concentration of heavier minerals develops on outcroppings. Ultimately, however, much of the heavy material also is removed. The heavy material is carried along with the lighter material in the zone of movement; there appears to be a churning or mixing action that prevents heavy material from sinking but results in some lateral dispersal. The mass flows into the stream valleys. Stream action carries off the smaller particles and lighter materials, and a stream placer deposit develops.

A residual concentration of the heavy minerals was found on the frostbroken tin outcroppings in every case that could be checked. The concentration was directly over the outcrop and extended slightly downslope. The ratio of concentration varied widely; the broken material might contain up to 10 times as much tin as the unweathered lode. The weathered material could not always be distinguished from unweathered bedrock, particularly where clay alteration was extensive.

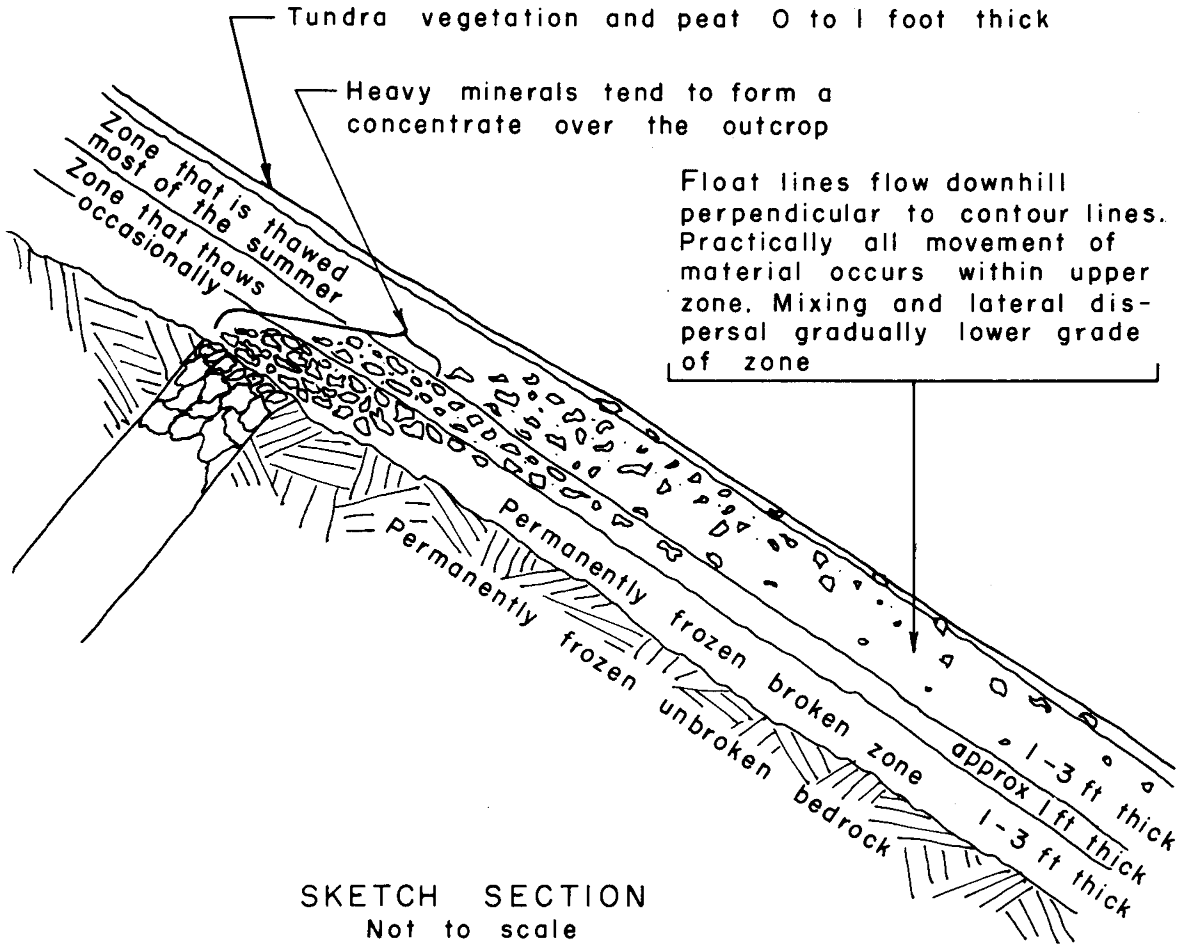


FIGURE 4. - Frostbreaking and Transport of Material From a Typical Outcrop in a Permafrost Area.

## GENERAL GEOLOGY

The oldest rocks in the Cape Mountain area are a metasedimentary series of early Paleozoic or pre-Paleozoic shales, phyllites, schists, quartzites, and limy shales locally referred to collectively as "black slates" (fig. 5). The black slates are overlain by a series of generally gray middle to late Paleozoic metalimestones and marbles that either include or are overlain by relatively thin schist and quartzite beds.

Three distinct periods of igneous activity are evident. The first is represented by mafic dikes, sills, and stocks, locally termed "greenstones" that intrude the black slates but apparently do not intrude the limestones. The greenstones are abundant a few miles east of Cape Mountain but were not recognized on Cape Mountain. The second period of igneous activity is represented by granitic stocks, sills, and dikes that intruded both the slates and the limestones. Being more resistant to erosion than the surrounding rocks, the granitic stocks and the associated halo of dikes, sills, and contact-metamorphosed sediments tend to form mountains with an exposed granitic core;

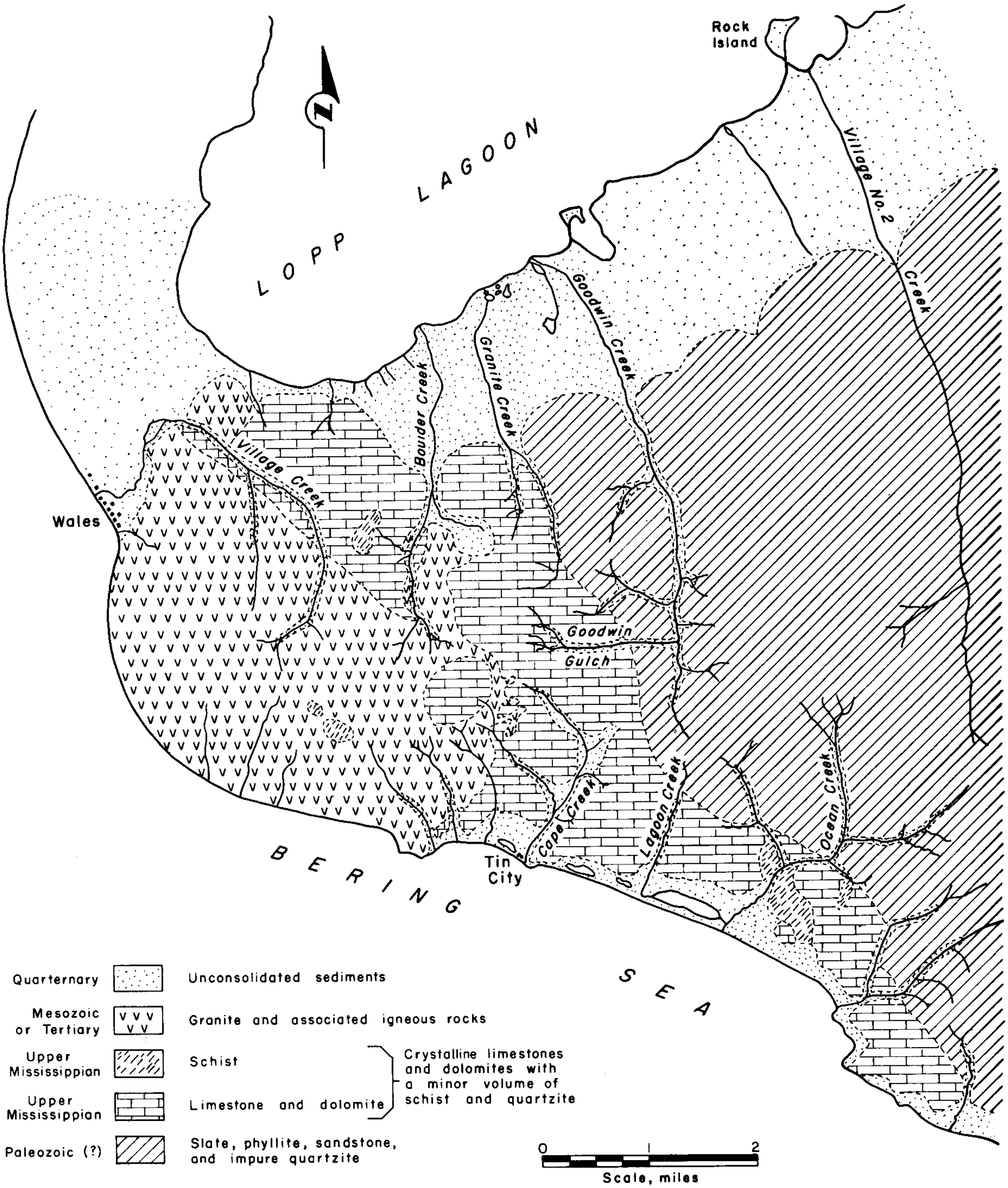


FIGURE 5. - General Geology, Cape Mountain Area.

Cape Mountain is a prominent and typical example. The third period of igneous activity is represented by hard black mafic dikes, up to 10 feet in width, that cut both the limestone and the granite near the head of Cape Creek. These mafic dikes do not appear to be either abundant or of great linear extent; however, they were not traced or studied because they have no discernible connection with the tin minerals except proximity.

The general distribution of the granite and the metasediments is shown on figure 5 but the figure shows neither the late mafic dikes nor the many granitic dikes and sills that protrude from the granite mass into the metasediments. More detailed descriptions of the geologic features of the area can be found in the Geological Survey reports listed in the bibliography.

## WORK BY THE BUREAU OF MINES

### Nature and Extent

The investigation was made to delineate tin-bearing lodes that normally have no visible surface expression. The mineralized lodes were outlined by sampling first the placer gravels and then the detrital cover. Sampling the placer gravels indicated the general location and extent of the tin-bearing area. Sampling the detrital cover delimited the tin-bearing zones within this area. Limited specimens and samples from outcroppings in the tin-bearing zones roughly indicate the general tenor. Data from previous investigations were used whenever possible.

The sampling procedures are described as they pertain to the succeeding steps in the investigation. Many placer samples and all detrital-cover samples were roughly evaluated in the field. Some placer samples, and all lode samples having quantitative value, were analyzed in the Bureau of Mines laboratory at Juneau, Alaska. Tin analyses data are included with the descriptions of the various deposits. Selected typical specimens and samples were analyzed petrographically. Petrographic descriptions and analyses for metals other than tin are in special sections following the descriptions of the tin deposits. Sketches and maps supplement the descriptions.

### Placer Investigations

The first stage of this investigation was to estimate the relative abundance of tin in the stream placer deposits. Most of the estimates were based on data abstracted from the publications listed in the bibliography. If no data were available, the gravels were sampled by digging test pits at sites favorable for the accumulation of a placer deposit. The pits were dug in or near the stream channels, preferably with a bulldozer, but often by hand. The pits were in thawed gravels; samples were taken close to bedrock whenever possible; and evaluation was limited to roughly estimating the grade. This was adequate for the purpose. Obviously, the resultant estimates are not a measure of the minable tin in the placers because the estimates include mined-out tin and both sampling method and sample spacing have been disregarded.

### Detrital-Cover Sampling

#### Sampling Method

Samples of the detrital cover were taken from pits dug by hand or by gasoline-powered posthole auger. The usual practice was to drill down to permafrost or bedrock (usually 2 to 3 feet) with a 6-inch posthole auger, stop the machine, and pull up the auger. About one 16-inch gold pan of material could be obtained from the scroll; this was the sample. On steep rocky hillsides or where boulders were abundant, a sample of the same size could be obtained more rapidly from hand-dug pits.

The samples were concentrated by panning. The panning water was in two No. 3 washtubs. The sample was first washed and screened through a gold pan in which a close pattern of 3/8-inch round holes had been drilled. The oversize was inspected for "nuggets" and discarded. Clay, soil, ice, and vegetable matter were washed from the undersize and decanted off; then the heavy minerals were concentrated by the usual panning techniques.

The sampling was done by two samplers using a tractor and sled to haul equipment and panning water. If terrain made it possible to bring the tractor and equipment close to the sample sites, two skilled men could drill, sample, concentrate, evaluate, and mark 30 to 40 holes during an 8-hour day. Cleaning and concentrating the samples is hard, tedious labor that requires more than half the total time. Mechanical concentration of the samples was considered but was found to be impractical with any available equipment because of the great variation in the size range and the condition of the sampled material.

## Sample Evaluation

The objective of detrital-cover sampling was to find the lode sources of the tin placer deposits. The first step was to sample the detrital cover along the streambanks in areas from which the placer deposits could have been derived. Sample pits were dug on the sides of the valleys, 5 to 50 or more feet above the valley floor (high enough on the hillside to make reasonably certain that any material found had come from the hill above rather than being transported by stream action). The line of sample pits roughly paralleled the stream at intervals that ranged from 30 to more than 100 feet. The longer intervals were used until some tin was found, then shorter intervals were used. Sampling was continued on both sides of a valley to the headwaters.

The grade of the panned samples was estimated visually. The results were recorded as: 0--no tin; 1 or x--trace of tin-bearing concentrate; 2 or xx--more than a trace but less than an ounce of tin concentrate; 3 or xxx--more than an ounce of tin concentrate. A more exact evaluation was found to be unnecessary. Sample sites and sample maps were marked in a manner that indicated the amount of tin found. Obviously, the only tin detectable by this means occurs as cassiterite in crystals large enough to be visible. The identity of cassiterite was verified by placing crystals in hydrochloric acid in the presence of zinc; then a tin plate formed on the cassiterite crystals.

The sampling results indicated where the cassiterite-bearing float lines enter the placers. Normally, an area of interest along a streambank would be indicated by tin minerals in practically every sample for at least several hundred feet. Nothing more was done in areas that contained no tin or only an occasional trace.

The sampling process was repeated a couple of hundred feet up the slope from any areas of interest encountered. The second row of holes roughly paralleled the first and was continued until no cassiterite was found at either end. Additional lines of holes were put in at successively higher elevations until no more tin minerals were found or the summit was reached. This procedure outlined an area in which the detrital material contained tin. Within the tin-bearing area, intermediate lines of samples were taken to form an irregular grid pattern. Zones of higher-than-normal concentrations within this grid roughly delineated the lode deposits. If no zones of concentration were found, it was considered to indicate that the tin was derived from low-grade disseminations or scattered veinlets.

## Lode Sampling

Lode sampling was limited to the minimum required to indicate the probable grade of typical outcroppings in the mineralized zones delineated by detrital-cover sampling. A more accurate evaluation of the Cape Mountain tin lodes presented complex problems beyond the scope of this investigation. Some data from previous investigations has been included.

### Bulldozer Trenching

Bulldozer trenches exposed typical outcroppings delineated by detrital-cover sampling. The thawed material on the surface was scraped off. This exposed frozen material which would thaw from an inch or two to a foot or more per day. The process was repeated about once a day until bedrock was exposed. The outcrop was cleaned and sampled after it had thawed. Uniform channels were cut in the clay-quartz and into other soft deposits with a prospector's pick and an iron spoon. Harder rocks required the use of a hammer and moil. Chip samples were taken across obviously low-grade deposits.

### Diamond Drilling

No diamond drilling was done during this investigation, but results of some drilling by the Bureau of Mines in 1948 are included. During the 1948 investigation, five EX (1.5 inches) holes were drilled to depths ranging from 40 to 68.5 feet in the granite-limestone contact zone. Sludge samples were not taken.

### Sampling Underground Workings

None of the underground workings were reopened during this project. The Lucky Queen, North Star, and lowest adit of the Bartels mine have been described in Bureau of Mines Report of Investigations 3978 (18). Some of the other prospects are described briefly in this report.

# DESCRIPTION OF THE DEPOSITS

## Tin-Placer Deposits

The alluvial tin concentrations in the Cape Mountain area are stream placers. The deposits appear to have developed under present-day conditions, and present erosion continues to add tin to the placer deposits. There is evidence that one or more advance and retreat of the sea may have displaced placer accumulations in the lower sections of the streams. A relatively recent elevated beach deposit (24, pp. 17, 45, and 54) that may be contemporaneous with the intermediate beach at Nome,[3] has been identified on Boulder Creek at an altitude of about 80 feet. Beach gravels and shells also have been reported from Village Creek[4] at an altitude of 43 feet. No similar beach gravels were recognized on Cape Creek or on other streams in the area. However, gravel and overburden over 100 feet deep at the East Fork-Cape Creek intersection (24) suggest that some radical change in erosional conditions caused the channel to fill more rapidly than the stream could remove the material.

The placer sampling data (fig. 2 and table 6) indicates that, although traces of tin are widely distributed, only seven streams contain 0.1 pound of tin or more per cubic yard of gravel. Of these seven streams, all except one drain Cape Mountain. Of the streams draining Cape Mountain, only four (First Chance Creek, Cape Creek, Goodwin Creek-Goodwin Gulch, and Boulder Creek) contain one pound or more of tin per cubic yard in the placer gravels. The remaining work was confined to the drainage basin of these four streams.

The tin in the First Chance Creek placers and the Cape Creek placers could have been derived from either bank of the streams upstream from the mouth of First Chance Creek. However, on First Chance Creek the grade of the placer gravels dropped to a trace 1,500 to 2,000 feet upstream from the mouth. Therefore, all of First Chance Creek valley except the lower 2,000 feet was eliminated from further consideration. The placer deposits of Cape Creek extend to the extreme head, but the East Fork drainage contains comparatively little tin. Therefore, it was assumed that tin could have been derived from either bank of Cape Creek from the mouth of First Chance Creek to the extreme head but not from East Fork valley.

The Goodwin Creek-Goodwin Gulch placers were considered as a single unit. On Goodwin Creek, a narrow placer-tin deposit extends from the mouth of Goodwin Gulch downstream and grades down to a trace a short distance below Wales Creek. Only traces of tin occur in Wales Creek or in Goodwin Creek upstream from Goodwin Gulch; therefore, most of the tin in Goodwin Creek must have been derived from Goodwin Gulch. Goodwin Gulch was mined from the mouth upstream to the headwaters forks. It was assumed that tin might have been derived from either bank of Goodwin Gulch above the intersection with Goodwin Creek.

The tin-bearing placer gravels on Boulder Creek form an alluvial fan where the stream debouches on the coastal plain. It was assumed that the tin could have been derived from either bank upstream from this fan.

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[3]Hopkins, Dave (geologist, Geological Survey). Letter dated Nov. 12, 1959, available on request from Area VIII Mineral Resource Office, Bureau of Mines, Juneau, Alaska. No published reference is known.

[4]No published reference is known but shells and beach sands were noted in original churn-drill logs signed by Otto Worm and William Bourgault, churn-drill operators, who drilled on Village Creek in 1943. Copies of logs available on request from Area VIII Mineral Resource Office, Bureau of Mines, Juneau, Alaska.

TABLE 6. - Relative abundance of tin in the placer deposits of the Cape Mountain area[1]

| Creek | Tin, average lb per cu yd[2] | Number and type of samples | Source of data[3] | Remarks |
|---|---|---|---|---|
| Village No. 1. | 0.1 | 8 churn-drill holes. | RI 4345 | This Village Creek flows into the Bering Sea at Wales Village. The placer tin occurs where the stream debouches from steep mountain gorge onto flats. Only occasional scant traces above or below this point. |
| Boulder.. | 1.0 | 22 churn-drill holes. | IC 7878 | This average includes only holes in the downstream end of the restricted valley. |
| Boulder[4]. | .5 | 54 churn-drill holes. | do... | This average includes only holes where the stream gravels spread out on the coastal plain downstream from the restricted valley. |
| Granite.. | Trace | 21 churn-drill holes. | RI 4345 | Check panning revealed only an occasional scant trace of very fine cassiterite. |
| Wales[5]... | Trace | 6 shovel pits. | - | Shovel pits along the channel contained scant traces of tin. |
| Goodwin Gulch. | 2 to 5 | Estimated..... | - | This creek was mined from the junction with Goodwin Creek upstream to the headwaters forks. Panning during this project revealed abundant tin in the south headwaters tributary from the upstream end of the placer pits to the extreme head. Only traces of tin were found in the north headwater tributary. |
| Goodwin.. | 4.0 | 2 churn-drill holes. | RI 4345 | Apparently a narrow pay streak extended about 1,000 feet down Goodwin Creek from the mouth of Goodwin Gulch. Only scant traces of tin were found above Goodwin Gulch. |
| Goodwin[6]. | 1.0 | 3 churn-drill holes. | do... | This placer tin deposit extends about 1,000 feet downstream from the mouth of Wales Creek. |
| Village No. 2. | 0 | 1 bulldozer trench. | - | This creek flows into Lopp Lagoon. |
| Prince of Wales. | Trace | 2 bulldozer trenches. | - | About 0.01 lb tin per cu yd. |
| Manna.... | 0 | 2 bulldozer trenches. | - | One trench on each principal tributary. |
| Lynx..... | Trace | - | - | About 0.03 lb tin per cu yd. |

See footnotes at end of table.

TABLE 6. - Relative abundance of tin in the placer deposits of the Cape Mountain area--Continued[1]

| Creek | Tin, average lb per cu yd[2] | Number and type of samples | Source of data[3] | Remarks |
|---|---|---|---|---|
| Gulch "J" | 0.2 | 1 bulldozer trench. | - | Tributary Potato Creek. |
| Gulch "H" | Trace | do....... | - | Do. |
| Gulch "G" | 0 | do....... | - | Do. |
| Potato... | 0 | 5 churn-drill holes. | RI 4418 | Headwaters of Potato Creek. |
| Do.... | Trace | 1 bulldozer trench. | - | Left limit above gulch "H," below gulch "G." |
| Do.... | .2 | 15 churn-drill holes. | RI 4418 | Below gulches "H" and "J." Apparently the principal source of tin in Potato Creek is the drainage basin of gulch "J." The tin in this tributary, in Lynx Creek, and gulch "H" indicates a lode source on the ridge between Potato Creek and Lynx Creek. |
| Creek "E" | 0 | 1 shovel pit.. | - | First creek east of Ocean Creek (not on fig. 2). |
| Ocean.... | Trace | do....... | - | Very scant trace. |
| Lagoon... | Trace | 2 shovel pits. | - | Do. |
| East Fork | .1 | 15 churn-drill holes. | IC 7878 | East fork of Cape Creek. |
| Cape..... | 4.5 | 48 churn-drill holes. | do... | Cape Creek above the valley of First Chance Creek (above drill-hole line 3A). The placer deposit starts at extreme head of Cape Creek and extends down to a point between churn-drill hole lines 3A and 4. Very little tin occurs in the gravels between this point and line 3. The tin in Cape Creek between lines 2 and 1A is considered to be, at least in large part, derived from First Chance Creek valley and is averaged with the First Chance Creek samples. |
| First Chance. | 1.0 | 20 churn-drill holes. | do... | Includes the lower 1,500 feet of First Chance Creek and lines 2 through 1A on Cape Creek. |
| Do.... | Trace | 5 pits........ | - | Both hand-dug and bulldozer pits put down on First Chance Creek at intervals from 2,000 feet above mouth to headwaters revealed only scant traces to very minor amounts of cassiterite. |

See footnotes at end of table.

TABLE 6. - Relative abundance of tin in the placer deposits of the Cape Mountain area--Continued[1]

| Creek | Tin, average lb per cu yd[2] | Number and type of samples | Source of data[3] | Remarks |
|---|---|---|---|---|
| Cape..... | 0.2 | 32 churn-drill holes. | IC 7878 | Deltalike deposit in the beach gravels at the mouth of Cape Creek. |
| Sarah[7]... | 0 | 1 bulldozer trench. | - | One bulldozer trench across the channel near the base of Cape Mountain. |
| Steep.... | 0 | 6 shovel pits. | - | - |
| Paulina.. | Trace | 4 shovel pits. | - | Barely perceptible trace. |
| "A" Creek | .1 | do...... | - | "A" through "D" Creeks are on the southwest slopes of Cape Mountain. |
| "B" Creek | Trace | do...... | - | |
| "C" Creek | do. | do...... | - | |
| "D" Creek | do. | do...... | - | |

[1] Includes mined-out tin and is not indicative of recoverable tin.

[2] Estimated average grade of pay streak.

[3] Work was performed during this project if no publication or other references are cited.

[4] Boulder Creek was churn drilled in 1938 by the Molybdenum Corporation of America from the deposits described in IC 7878 (24) downstream to the mouth. Also five holes were drilled through the ice along the edge of Lopp Lagoon. Reportedly, very little tin was found at any place. Letter from W. R. VanCampen, former American Tinfields, Inc., Tin City, Alaska, supervisor, Nov. 31, 1942. Available upon request from Area VIII Mineral Resource Office, Bureau of Mines, Juneau, Alaska.

[5] George Waldhelm, a miner who formerly worked in this area, reported that several hundred pounds of tin concentrate had been recovered from a small basin-like depression at the headwaters forks.

[6] A section of Goodwin Creek extending about 15,000 feet downstream from the mouth of Wales Creek was sampled by 28 churn-drill holes in 13 lines by Pacific States Mining and Development Co. and Bering Straits Tin Mines, Inc., in 1935. Results are not known. No additional work was done and the claims have since reverted to the public domain. (Data from maps originally collected by T. C. Christensen.)

[7] Five churn-drill holes were drilled across the channel where Sarah Creek enters the beach gravels. No tin was found. Data from conversation with Jack Thiessen, churn driller. No written records were kept.

## The Detrital Cover

### First Chance Creek

Widespread traces of tin were found in the detrital cover bordering First Chance Creek in the area where the grade of the stream placer deposits dropped (fig. 6). The tin in the placer gravels must have been derived from this area. Additional sampling did not reveal any large concentrations in the detrital cover but one float line more prominent than the others was traced to the outcropping of an acidic dike (trench FC-1).

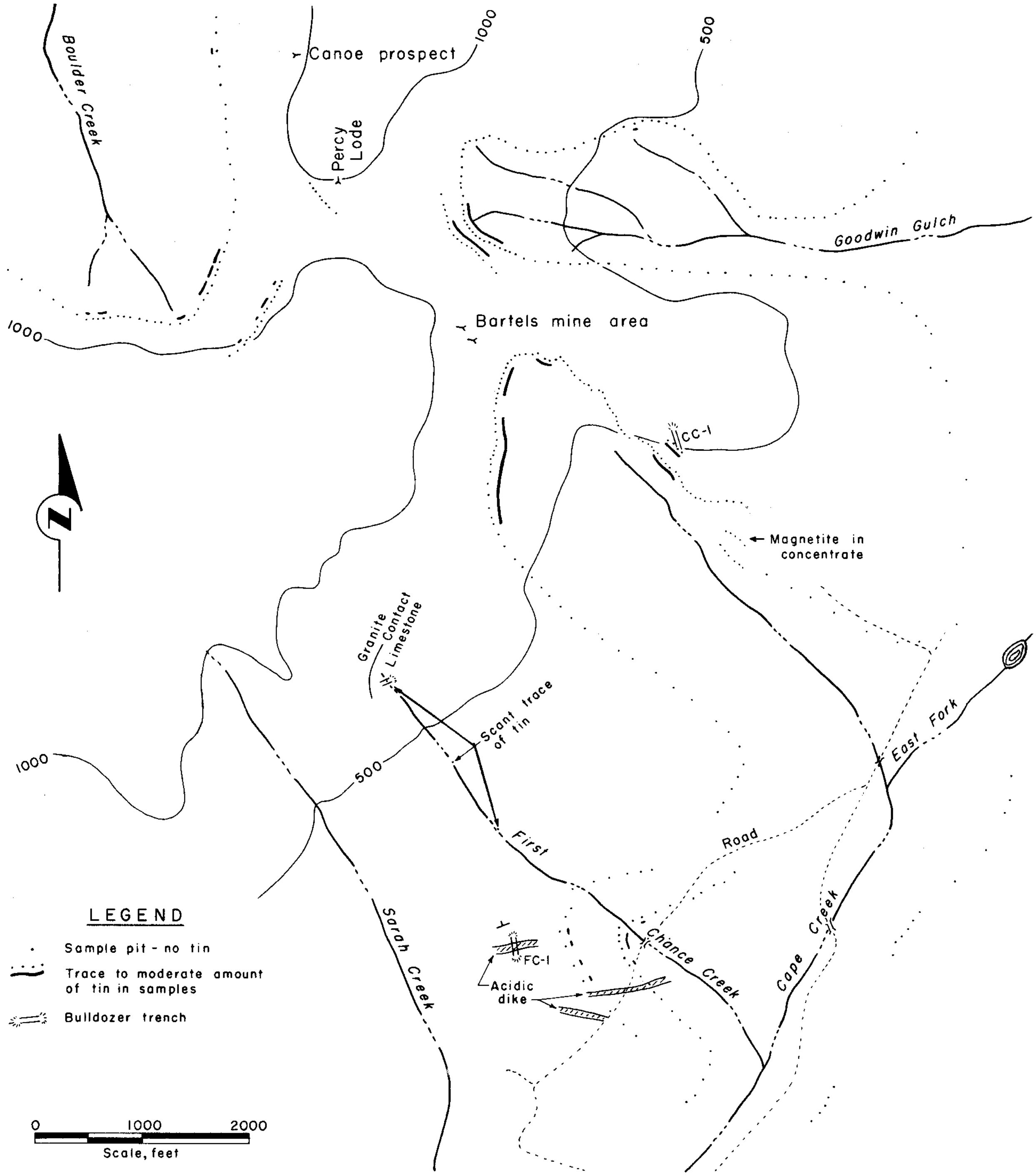


FIGURE 6. - Detrital Cover Sampling, Cape Mountain Area.

## Cape Creek

Sampling both banks of Cape Creek indicated that practically all the tin in the placer deposits came from the general vicinity of the Bartels mine at the extreme headwaters (fig. 6). A small amount of tin also was derived from a previously unknown outcropping on the north (left limit) bank, 3,750 feet upstream from the mouth of East Fork (trench CC-1). No tin was found on either bank below this point.

### Goodwin Gulch

Detrital-cover sampling revealed that the tin placer deposit in Goodwin Gulch was derived from a very small area at the extreme head of the south headwaters fork (fig. 6). A placer deposit of unknown grade extends from the mining pit upstream to the head of this fork. Typical cassiterite specimens including "nuggets" that exceed 1 inch in diameter were traced from the placer deposit to the granite-limestone contact downslope from the Lucky Queen adit. Careful observation while sampling did not reveal any evidence of tin deposits in the limestone downslope from the mineralized contact zone.

### Boulder Creek

The detrital cover on both banks of Boulder Creek, including tributaries, were sampled from the coastal plain to the headwaters. Results were negative except at the extreme headwaters (fig. 6) where widespread traces were found. The amount of tin in the detrital cover left no doubt that this was the source of the Boulder Creek placer deposits, but the dispersed traces indicated that the tin minerals were derived from many scattered sources. Some of the numerous prospects in this valley are described briefly in the section on miscellaneous lode prospects.

### Summary of Detrital-Cover Sampling Results

The detrital-cover sampling (fig. 6) indicated that a mineralized zone at the head of the Cape Creek and Goodwin Gulch drainage basins is the source of practically all placer tin in both drainages. This zone will be referred to hereafter in this report as the Bartels mine area. The Boulder Creek drainage basin extends to the margin of the Bartels mine area; apparently the placer tin in this drainage basin is derived from scattered and relatively minor tin occurrences in the margins of the Bartels mine area. The tin in the First Chance Creek placers is derived from a group of acidic dikes in First Chance Creek valley about 2,000 feet from the mouth.

## Tin-Lode Deposits

### Bartels Mine Area

Practically all the tin outcroppings at the head of Cape Creek and Goodwin Gulch are in an area about 2,000 feet from north to south and 800 feet from west to east that includes the Bartels mine (fig. 7). Within this mineralized area investigations were limited to two centers of abundance: A granite-limestone contact zone centered about 200 feet north of the Lucky Queen adit and a zone of fracturing and clay alteration in granite about 1,100 feet south of the Lucky Queen adit. A third zone in the vicinity of the North Star and lower adit has been described in Bureau of Mines Report of

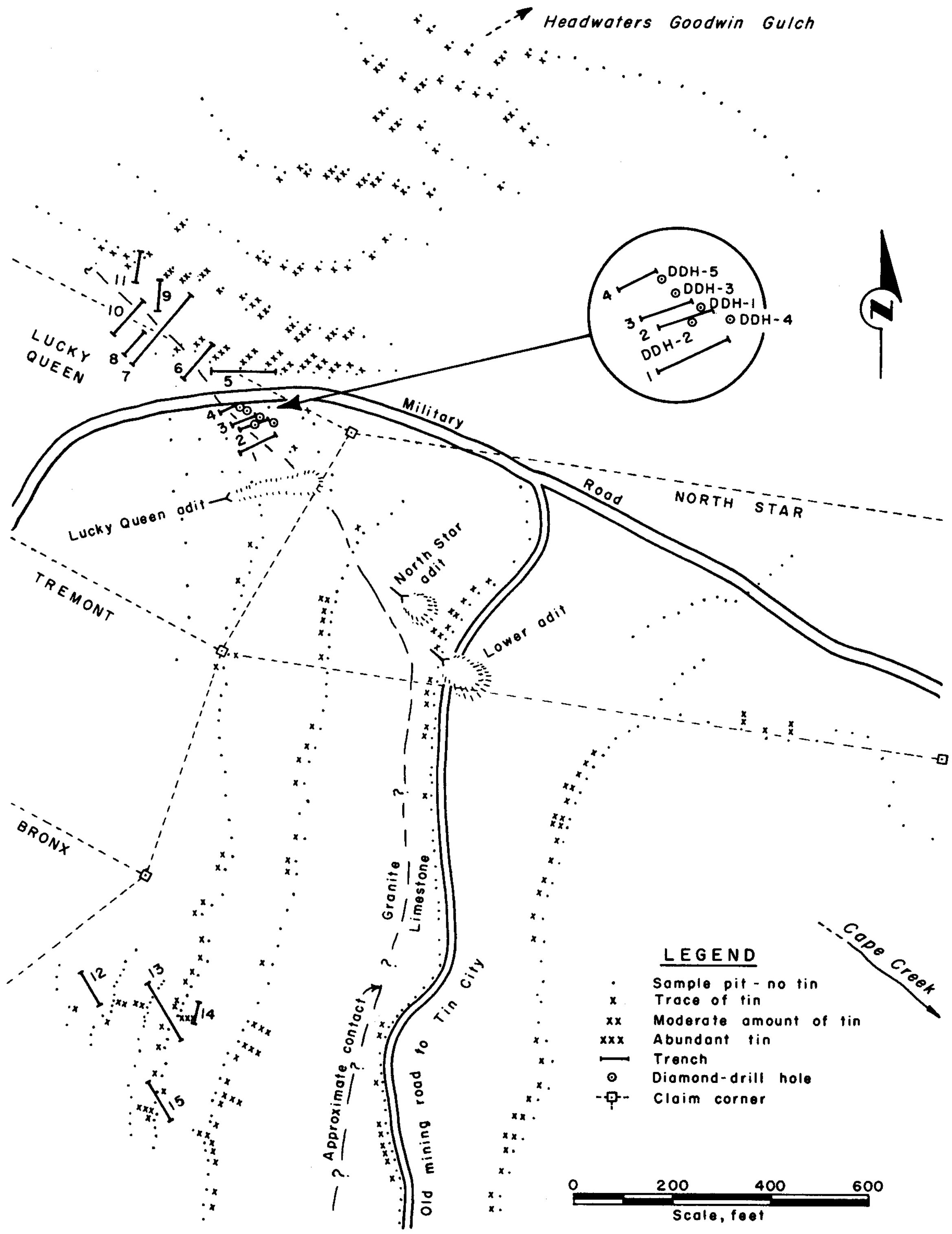


FIGURE 7. - Bartels Mine Area, Cape Mountain.

Investigations 3978 (18). During the present investigation work was limited to a few trenches to indicate the nature of the occurrences and the approximate grade.

Granite-Limestone Contact Deposit

Tin occurs as cassiterite along the granite-limestone contact north of the Lucky Queen adit (fig. 7). The contact is an irregular zone of mixed granite offshoots and limestone blocks. Most of the cassiterite occurs as spectacularly high-grade discontinuous lenticular pods within the limestones near the contact. Obviously, the value of this deposit depends on the size and number of high-grade pods present; however, the intensive sampling necessary to determine the value was beyond the scope of this project. Clay alteration is common in the adjacent granite, but only minor amounts of cassiterite were found in the granite or on the actual contacts. Descriptions and analyses of the material in the high-grade veins are in table 7. Trenches 1 through 11 were excavated in the same area and sampled to determine the grade of the intervening material. Results are in table 8. Records of five short diamond-drill holes drilled during a previous investigation also are in tables 9 and 10. The drill holes locations shown are approximate only because hole collars and nearby reference marks had been excavated for road fill.

TABLE 7. - Discontinuous cassiterite-bearing lenticular pods in limestone near the granite contact, Bartels mine area

| Sample width, feet | Engineer's field description[1] | Tin, percent |
|---|---|---|
| 0.8 | Quartz, muscovite, cassiterite, some limestone | 14.57 |
| 1.0 | Quartz, sericite, some limestone and cassiterite | 4.14 |
| 1.0 | Quartz, muscovite, brown cassiterite, and limestone | 14.44 |
| 1.0 | Limestone, some quartz and cassiterite | 1.99 |
| 1.0 | Tremolite, muscovite, and limestone | .05 |
| .5 | Limestone, quartz, and sericite | .05 |
| .5 | Quartz, sericite and some quartz porphyry | .12 |
| 1.0 | Limestone, quartz, sericite, and some cassiterite | 1.12 |
| 1.0 | Limestone, muscovite, quartz, and some cassiterite | 1.47 |
| 1.0 | Limestone, sericite, quartz, with some cassiterite | 3.58 |
| 1.0 | Quartz, sericite, and cassiterite | 32.93 |
| 1.0 | Gray limestone, calcite, quartz, sericite and some cassiterite | 3.28 |
| 5.5 | Granite, limestone, actinolite, quartz, and cassiterite | 5.12 |
| 1.0 | Gray limestone with some cassiterite | 3.73 |
| 2.8 | Gray limestone | .24 |
| 1.8 | Limestone and quartz | .12 |
| 2.0 | Quartz, sericite, granite, and cassiterite | 14.86 |
| 2.0 | Granite, tremolite, quartz, sericite, and abundant cream-colored cassiterite | 25.02 |

[1] Rutledge, F. A. Unpublished report by former Bureau of Mines mining engineer containing descriptions and analyses, 1960. Available on request from Area VIII Mineral Resource Office, Bureau of Mines, Juneau, Alaska.

TABLE 8. - Trench samples, granite-limestone contact zone

| Footage From | Footage To | Engineer's field description | Tin, percent |
|---|---|---|---|
| | | **Trench 1, measured from southwest end** | |
| 0 | 5 | Dark gray to sooty black limestone | ([1]) |
| 5 | 10 | Yellow clay, quartz grains, and granite fragments | 0.06 |
| 10 | 15 | | .03 |
| 15 | 38 | Gray limestone with few calcite veinlets. Partly altered to fine-grained marble. | ([1]) |
| 38 | 41 | Yellow clay, quartz grains, and granite fragments | .06 |
| 41 | 58 | | ([1]) |
| 58 | 59 | Dominantly granite | .09 |
| 59 | 63 | Dark gray limestone | |
| | | **Trench 2, measured from southwest end** | |
| 0 | 12 | Gray limestone with few calcite veinlets | ([1]) |
| 12 | 16 | Dark gray limestone with some altered granite and clay along bedding and fractures. | 0.01 |
| 16 | 20 | | .09 |
| 20 | 25 | | .03 |
| 25 | 28 | Yellow clay, quartz grains, cassiterite, and limestone fragments. | .11 |
| 28 | 40.5 | Broken dark gray limestone with few calcite veinlets | ([1]) |
| 40.5 | 46.5 | Iron-stained limestone, calcite, yellow to red clay, a little quartz. | .11 |
| 46.5 | 56.5 | Light gray limestone with many calcite veinlets | ([1]) |
| | | **Trench 3, measured from southwest end** | |
| 0 | 1.5 | Overburden | ([1]) |
| 1.5 | 5 | Broken dark gray limestone and red brown clay, quartz grains. | 0.06 |
| 5 | 10 | Metalimestone with calcite veinlets and about one-fourth brown clay. | .07 |
| 10 | 15 | | .01 |
| 15 | 20 | | .01 |
| 20 | 25 | Dark brownish green clay with fragments of granite and limestone. | .01 |
| 25 | 30 | | .01 |
| 30 | 35 | Dark brownish green clay grading into dark gray limestone with 3 inches of granite at 33 feet. | .12 |
| 35 | 53 | Dark gray metalimestone with many calcite veinlets | ([1]) |
| | | **Trench 4, measured from southwest end** | |
| 0 | 3 | Dark gray metalimestone | ([1]) |
| 3 | 7 | Quartz, calcite, and cassiterite in limestone | 2.29 |
| 7 | 20 | Dark gray metalimestone with calcite veinlets | ([1]) |
| 20 | 29 | Clay, chlorite, and granite in an elliptical pod | .05 |
| | | **Trench 5, measured from west end** | |
| 0 | 49 | Gray much broken limestone with calcite veinlets | ([1]) |
| 49 | 49.4 | White igneous dike (Alaskite?) | ([1]) |
| 49.4 | 80 | Contorted dark to light gray limestone with calcite veinlets (strikes S 55° E, dip 45° SW at 70'). | ([1]) |
| 80 | 84 | Limestone with much calcite and chlorite (?) and some quartz vein material. | 0.01 |
| 84 | 141 | Limestone similar to 49.4 to 80 | ([1]) |

[1]No analyses.

TABLE 8. - Trench samples, granite-limestone contact zone--Continued

| Footage From | Footage To | Engineer's field description | Tin, percent |
|---|---|---|---|
| | | Trench 6, measured from south end | |
| 0 | 7 | Overburden | (1) |
| 7 | 20 | Granite altered to white, yellow, and brick red clay and quartz grains. | (1) |
| 20 | 22 | Gray-green unaltered granitic dike--apparent strike N to S, dip not evident. | (1) |
| 22 | 29 | Granite altered to reddish yellow clay and quartz grains. | (1) |
| 29 | 35 | Gray less completely altered granite | (1) |
| 35 | 39 | do | 0.09 |
| 39 | 44 | Dark gray silicified limestone | .01 |
| 44 | 54 | Dark gray marble with few calcite veinlets | .01 |
| 54 | 62 | | |
| 62 | 92 | Overburden | (1) |
| | | Trench 7, measured from southwest end | |
| 0 | 55 | Overburden | (1) |
| 55 | 60 | Mixed blocky metalimestone and granite with feldspars altered to clay but much quartz. | 0.18 |
| 60 | 65 | | .12 |
| 65 | 70 | | 1.02 |
| 70 | 75 | | .21 |
| 75 | 80 | | .22 |
| 80 | 85 | Granite-limestone contact intergrades | .02 |
| 85 | 90 | Broken metalimestone with siliceous veinlets and some iron stain. Much mud in cracks--possibly a residual concentration of tin in this material. | .01 |
| 90 | 95 | | .02 |
| 95 | 100 | | .05 |
| 100 | 105 | | .04 |
| 105 | 110 | | .07 |
| 110 | 115 | | .03 |
| 115 | 120 | | .01 |
| 120 | 125 | | .01 |
| 125 | 135 | Similar less altered metalimestone | .01 |
| 135 | 145 | | .06 |
| 145 | 155 | | .11 |
| 155 | 165 | | .06 |
| 165 | 195 | Slightly altered metalimestone with calcite veinlets | (1) |
| | | Trench 8, measured from southwest end | |
| 0 | 12 | Overburden, dominantly limestone debris and clay | (1) |
| 12 | 17 | Red iron-stained clay, some white clay, and altered fragments of limestone. | 0.02 |
| 17 | 22 | | .01 |
| 22 | 27 | White clay, grains of quartz, some fragments of limestone and some red clay. | .02 |
| 27 | 32 | | .01 |
| 32 | 37 | Granite with most of feldspars altered to clay | .33 |
| 37 | 40 | | .04 |
| 40 | 69 | Overburden | (1) |
| | | Trench 9, measured from south end | |
| -9 | +2 | Overburden | (1) |
| 2 | 7 | Siliceous limestone and sandy clay--poorly exposed | 0.05 |
| 7 | 12 | | .02 |

[1] No analyses.

TABLE 8. - Trench samples, granite-limestone contact zone--Continued

| Footage From | Footage To | Engineer's field description | Tin, percent |
|---|---|---|---|
| | | Trench 9, measured from south end--Continued | |
| 12 | 17 | Siliceous limestone with quartz veins and granitic dikes up to about 6 inches normal width. | 0.23 |
| 17 | 22 | | .17 |
| 22 | 32 | Broken siliceous metalimestone with tiny quartz veinlets. | .04 |
| 32 | 42 | | .01 |
| 42 | 50 | Less altered metalimestone | (1) |
| 50 | 63 | Overburden | (1) |
| | | Trench 10, measured from southwest end | |
| 0 | 5 | Overburden | (1) |
| 5 | 10 | Granite with quartz grains intact, feldspars altered to clay dominantly yellow with some red-brown, brown, and white. | 0.01 |
| 10 | 15 | | .01 |
| 15 | 46 | Buried in mud and water | (1) |
| 46 | 56 | Similar granite except clay yellow to white | .01 |
| 56 | 60 | | .01 |
| 60 | 68 | Silicified limestone and dark brown clay | .01 |
| 68 | 73 | White clay and quartz grains; some red stain | .04 |
| 73 | 78 | Siliceous limestone with quartz veins | .01 |
| 78 | 90 | | .01 |
| 90 | 106 | Overburden | (1) |
| | | Trench 11, measured from south end | |
| 0 | 3 | Overburden | (1) |
| 3 | 57 | Blue-gray schistose metalimestone with few small calcite veinlets. Apparent bedding and schistosity strikes N 25° W, dips 10° W. | (1) |
| 57 | 66 | Overburden | (1) |

[1] No analyses.

TABLE 9. - Diamond-drill holes, granite-limestone contact, Bartels mine area[1]

| Hole | Bearing | Angle, degrees | Feet From | Feet To | Core recovery, percent | Description | Tin, percent |
|---|---|---|---|---|---|---|---|
| DD 1 | S 25° W | -45 | 0.0 | 47.0 | 76 | Limestone | (2) |
| DD 1 | S 25° W | -45 | 47.0 | 58.5 | 90 | Granite | (2) |
| DD 2 | S 25° W | -45 | 0.0 | 42.5 | 72 | Limestone | (2) |
| DD 2 | S 25° W | -45 | 42.5 | 52.0 | 86 | Granite | (2) |
| DD 3 | S 58° W | -45 | 0.0 | 40.2 | 81 | Limestone | (2) |
| DD 3 | S 58° W | -45 | 40.2 | 41.0 | 95 | Granite | (2) |
| DD 4 | S 25° W | -45 | 0.0 | 20.0 | 62 | Limestone | (2) |
| DD 4 | S 25° W | -45 | 20.0 | 21.0 | 90 | Limestone, mica, cassiterite | 9.13 |
| DD 4 | S 25° W | -45 | 21.0 | 60.0 | 92 | Limestone | (2) |
| DD 4 | S 25° W | -45 | 60.0 | 68.6 | 95 | Granite | (2) |
| DD 5 | S 63° W | -45 | 0.0 | 35.0 | 81 | Limestone | (2) |
| DD 5 | S 63° W | -45 | 35.0 | 40.0 | 100 | Granite | (2) |

[1] Data from field notes of F. A. Rutledge, former Bureau of Mines mining engineer.

[2] No analyses.

TABLE 10. - Spectrographic analyses, granite-limestone contact, diamond-drill hole 4, Bartels mine area

Letters indicate estimates from qualitative analyses:

| | | | |
|---|---|---|---|
| A | more than 10 percent | E | 0.01 to 0.1 percent |
| B | 5 to 10 percent | F | 0.001 to 0.01 percent |
| C | 1 to 5 percent | G | less than 0.001 percent |
| D | 0.1 to 1 percent | - | not detected[1] |

| Sample[2] | DD4-1 | DD4-2 | Sample[2] | DD4-1 | DD4-2 |
|---|---|---|---|---|---|
| Aluminum.......... | C | A | Manganese.......... | E | E |
| Beryllium.......... | - | F | Molybdenum......... | - | E |
| Boron............. | E | D | Nickel............. | E | E |
| Calcium........... | A | C | Silicon............ | C | A |
| Chromium.......... | E | E | Silver............. | G | G |
| Copper............ | F | F | Strontium.......... | E | - |
| Iron.............. | D | C | Tin................ | E | E |
| Lead.............. | E | E | Titanium........... | E | E |
| Magnesium......... | B | C | | | |

[1]Additional elements sought but not detected: As, Au, Ba, Bi, Cd, Co, Ga, Ge, Hf, Hg, In, Ir, Li, Mb, Os, P, Pd, Pt, Re, Rh, Ru, Sb, Ta, Te, Tl, V, W, Zn, Zr, Sc, and Y.

[2]DD4-1, diamond-drill hole 4, 54.6 - 59.6, limestone.
DD4-2, diamond-drill hole 4, 59.6 - 64.5, granite.
See table 9 and figure 7.

## Tin Veins in Granite

Trenches 13 through 15 (fig. 7) expose a zone of clay alteration and quartz-cassiterite veins within the granite mass. It is not evident whether the clay alteration is a surface weathering effect or extends to depth. Sample descriptions are in table 11. The tin apparently occurs along fractures as cassiterite, in veinlets associated with quartz and also in the granite adjacent to the fractures. Some fluorite was noted in the excavated material but none was recognized in the samples.

## Summary of Lode-Sampling Results, Bartels Mine Area

Sampling in the Bartels mine area revealed lode-tin deposits of adequate size and grade to have produced the Cape Creek and Goodwin Gulch placers. The resemblance between the large "nuggets" characteristic of the Goodwin Gulch tin-placer deposit and the cassiterite-bearing lenticular pods in limestone near granite contacts (table 7) is particularly striking. There is, however, no way to know how much material was eroded and concentrated to form the tin-placer deposits.

The relative scarcity of tin minerals in the Boulder Creek drainage and the fact that they are found only at the extreme head of the valley indicates that the western margins of the lode-tin zone extend only a slight distance into the Boulder Creek drainage basin. The eastern and southern margins of the lode-tin outcroppings coincide with the granite-limestone contact. The mineralizing solutions rising along fracture zones in granite apparently were unable to penetrate the limestones. Therefore, the mineralized granite and contact zone in the Bartels mine area could extend eastward and southward under the limestones without producing any surface evidence.

TABLE 11. - Trench samples, mineralized zone within granite, Bartels mine area

| Footage From | Footage To | Engineer's field description | Tin, percent |
|---|---|---|---|
| | | Trench 12, measured from southeast end | |
| 0 | 10 | Overburden | ([1]) |
| 10 | 15 | Iron-stained gray granite | ([1]) |
| 15 | 20 | Clay, quartz grains, and granite fragments, gray to dull red-brown. | 0.18 |
| 20 | 24 | | .50 |
| 24 | 34 | Gray granite fragments and yellow-brown clay | .02 |
| 34 | 44 | | .01 |
| 44 | 52 | Clay | .01 |
| 52 | 57 | White to dull red-brown clay | .02 |
| 57 | 67 | Broken gray granite with some iron-stained clay | .01 |
| 67 | 77 | | .01 |
| 77 | 82 | Overburden | ([1]) |
| | | Trench 13, measured from southeast end | |
| 0 | 31 | Coarse-grained gray granite, poorly exposed | ([1]) |
| 31 | 54 | Similar granite with some iron stain | ([1]) |
| 54 | 59 | Gray clay and granite fragments | 0.04 |
| 59 | 63 | Yellow, brown, and white clay with a few rounded iron-stained fragments of gray granite. | .06 |
| 63 | 68 | Yellow to brick red clay with some vein quartz | .14 |
| 68 | 72 | Light gray clay and granite fragments | .01 |
| 72 | 98 | Gray granite | ([1]) |
| 98 | 101 | Granite fragments with some clay | 1.34 |
| 101 | 106 | Yellow, brick red, and gray clay with some vein quartz | .38 |
| 106 | 111 | Yellow and gray clay with rounded granite boulders to 12-inch diameter. | .05 |
| 111 | 115 | Yellow clay with some vein quartz and granite fragments | .04 |
| 115 | 120 | Gray and yellow clay | .08 |
| 120 | 125 | Light yellow clay with much granite and granite fragments | .03 |
| 125 | 130 | Gray granite | ([1]) |
| | | Trench 15, measured from southeast end[2] | |
| 0 | 20 | Overburden | ([1]) |
| 20 | 25 | Broken iron-stained gray granite. Quartz-cassiterite in overburden; source may be up hill. | 0.01 |
| 25 | 30 | | .02 |
| 30 | 35 | | .03 |
| 35 | 40 | | .06 |
| 40 | 53 | Gray granite; less stain | ([1]) |
| 53 | 84 | Overburden | ([1]) |

[1] No analyses.

[2] Trench 14, no bedrock, no samples.

## Miscellaneous Lode Prospects

### Mineralized Dike, First Chance Creek Valley

Tin minerals in First Chance Creek apparently are derived from a group of acidic dikes that cross the valley (fig. 6). Three prominent dike outcroppings are shown but float indicates that others are present. The dikes are not uniformly mineralized and the tin minerals are sparsely but widely scattered in the detrital cover. Trench FC-1 (fig. 6) exposes a dike outcrop of about 100 feet in width that appeared to be one of the principal sources of tin. Descriptions and analyses of samples from this trench are in table 12. Note that tin and clay minerals are more abundant near the contacts on both sides suggesting that the tin was introduced by mineralizing solutions that followed these contacts. Occasional cassiterite crystals up to one-half inch in longest dimension were found in the detrital cover downslope from trench FC-1 and in the placer gravels of First Chance Creek. Apparently none were included in the lode samples.

TABLE 12. - Trench FC-1, right limit First Chance Creek

| Footage From | Footage To | Engineer's field description | Tin, percent |
|---|---|---|---|
| 0 | 40 | Light gray marble | ([1]) |
| 40 | 47 | Clay, quartz grains, white to light-gray granite fragments. Clay iron-stained cream, yellow to brownish red. | 0.03 |
| 47 | 52 | Cream to light yellow clay with much quartz and granite fragments. | .05 |
| 52 | 58 | | .01 |
| 58 | 65 | Granite with yellow-red clay and quartz grains | .01 |
| 65 | 72 | | .01 |
| 72 | 77 | Cream to yellow clay with light gray granite fragments and quartz grains. | .01 |
| 77 | 82 | Light gray granite with some clay | .01 |
| 82 | 125 | Gray granite, strike east-west, dip (?), with some clay | .01 |
| 125 | 135 | | .10 |
| 135 | 145 | | .06 |
| 145 | 152 | Granite and marble rubble with mud and water | ([1]) |
| 152 | 154 | White sandy clay | .01 |
| 154 | 156 | White to light gray marble | ([1]) |
| 156 | 175 | Overburden | ([1]) |

[1] No analyses.

### Mineralized Granodiorite Outcrop, Cape Creek Valley

Tin associated with a small granodiorite intrusive was discovered on the left limit of Cape Creek and exposed in trench CC-1 (fig. 6). Intensive clay alteration affected both the granodiorite and the adjacent limestone. The tin appeared to occur as cassiterite principally in segregations at the limestone-granodiorite contact. Sample descriptions are in table 13.

TABLE 13. - Trench CC-1, Cape Creek

| Footage From | Footage To | Engineer's field description[1] | Tin, percent |
|---|---|---|---|
| Measured from northwest end | | | |
| 0 | 25 | Blocky gray limestone | ([2]) |
| 25 | 35 | Mixed clay and limestone rubble | ([2]) |
| 35 | 55 | Clay and granitic fragments | 0.01 |
| | | Green segregations in clay | .69 |
| | | Granitic fragments in clay | .01 |
| 55 | 145 | Blocky gray limestone | ([2]) |

[1] Orientation of granodiorite body not determined.
[2] No analyses.

## Limestone-Shale Contact, Goodwin Gulch

An iron-stained limestone-shale contact is prominently exposed on the north bank of Goodwin Gulch about 2,000 feet upstream from the mouth (fig. 5). A typical specimen from this contact consisted essentially of quartz with minor amounts of pyrite, limonite, and clay as well as very small amounts of calcite and chlorite. Several stages of silicification were apparent. Typical frostbroken material from the outcropping and detrital material directly overlying the outcropping were panned; no tin minerals were recognized.

## North Fork, Goodwin Gulch

Traces of tin were found in the detrital cover near the extreme head of the north fork of Goodwin Gulch (fig. 6) directly downhill from a group of prospect pits. The amount of tin found was considered to be too small to warrant additional work.

## Canoe Prospect

A shallow shaft and a series of pits near the southwest corner of the Canoe lode claim (fig. 3) explores one or more pegmatitic sills in limestone. Panning downslope from the openings (fig. 6) revealed scant traces of tin. No additional work was done.

## Percy Prospect

A caved adit near the center of the Percy claim (fig. 3) explores a zone of metamorphism at the contact between the granitic core of Cape Mountain and the surrounding metalimestones. Specimens from this zone contained some beryllium (see sections on beryllium and petrography) associated with tourmaline, but a series of detrital-cover samples taken directly downslope from the prospect openings (fig. 6) revealed no cassiterite. No additional work was done.

## Headwaters, Boulder Creek

A roughly circular limestone mass is centered about 2,000 feet southwest of the Bartels mine on the divide between Boulder Creek and First Chance Creek (fig. 5). Numerous pits, shafts, and adits explore the contact between the limestone and the underlying granite. Placer sampling on First Chance Creek and detrital-cover sampling in Boulder Creek valley (fig. 6) revealed only scattered traces of tin derived from this area. Work during this investigation, therefore, was limited to the collection of typical specimens from the contact zone (see section on petrography).

### Dieter Prospect

A tunnel on Dieter No. 2 lode claim (fig. 3) at an altitude of about 1,700 feet extends 418 feet S 72° W (data from patent survey). Previous investigators report finding a single tin-bearing boulder of vein quartz on this dump (16, p. 99). Detrital-cover sampling revealed no tin on the banks of Boulder Creek below this prospect; additional sampling below the tunnel revealed no tin. A sample of the tunnel dump weighing about 50 pounds was panned; some quartz vein material was seen but no tin minerals were recognized.

### Northwest Ridge, Cape Mountain

The presence of 0.1 pound of tin per cubic yard in Village No. 1 Creek and in "A" Creek (fig. 2 and table 6) suggests that tin outcroppings occur on the ridge that extends northwestward from the peak of Cape Mountain towards Wales. Reports by local residents that cassiterite crystals are occasionally found in or near the village of Wales tend to substantiate this theory. However, the amount of tin in the streams draining this area was considered to be too small to justify additional investigations.

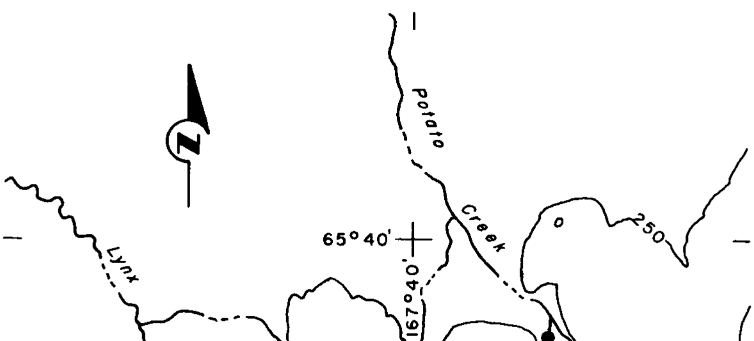


FIGURE 8. - Potato Creek-Lynx Creek Area.

### The Potato Creek-Lynx Creek Area

Potato Creek (fig. 2) is the only stream not draining Cape Mountain that contains more than traces of tin (table 6). The deposit of placer tin in Potato Creek extends up gulch "J" rather than into the headwater tributaries (fig. 8). This suggests that the lode source is on the ridge between gulch "J" and Lynx Creek (fig. 8). The ridge is about 10 miles N 60° E of the tin-bearing zone at Cape Mountain and about 2 miles west of the previously known lode-tin deposits at Potato Mountain (fig. 1). The bedrock in the Potato Creek-Lynx Creek area is similar to the bedrock in the Potato Mountain area where clusters of tin-bearing veinlets occur adjacent to faults in shaly metasediments. The relatively low grade of the placer deposits of Potato Creek and Lynx Creek did not appear to justify additional work in this area.

## Associated Minerals and Metals

### Beryllium

During this investigation no samples were taken specifically for beryllium, but stream concentrates, detrital-cover concentrates, and typical outcrop specimens were checked with a laboratory berylometer. Results were negative with one exception; this was a beryllium-bearing specimen (B 809-3, fig. 9) from the granite-limestone contact zone on the Percy prospect. Examination revealed the following:[5]

> The specimens contain many small (less than 1/8-inch) prisms of white beryl. They check by both optics and X-ray diffraction. The refractive index is rather low so the alkali content probably is also low.

Chemical and spectroscopic checks of a number of generally similar specimens yielded other beryllium-bearing specimens that are described in the section on petrography and are shown on figure 9.

This limited investigation did not reveal any large beryllium deposits but did not eliminate the possibility that large deposits may be present. The minimum amount of beryllium detectable with the instrument used was 100 to 200 parts per million, which is well below the minable limit. However, such an instrument is not sensitive enough for reconnaissance sampling; 50 to 100 parts per million or even less beryllium in stream sediments or detritus may indicate the presence of valuable beryllium lodes (26). Also, all stream sediment and detrital-cover samples were panned concentrates. The relatively light beryllium minerals may have been discarded.

### Radioactive Minerals

Samples and specimens submitted for petrographic analyses were checked for radioactivity as a matter of routine; composite samples that included all the detrital-cover concentrates also were checked. Results were negative. A field Geiger counter indicated a minor increase in radioactivity when carried across the contact from metasediments to massive granitic rocks. A larger increase in radioactivity was noted when the instrument was taken into underground openings in granite. However, radioactivity could not be detected in specimens small enough to be carried in the hands. Evidently the increase in radioactivity was due to the mass effect of a minor radioactive component

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[5] Griffitts, Wallace R. Personal communication by geologist, Branch of Exploration Research, Geological Survey, Denver, Colo., 1965. Available on request from Area VIII Mineral Research Office, Bureau of Mines, Juneau, Alaska.

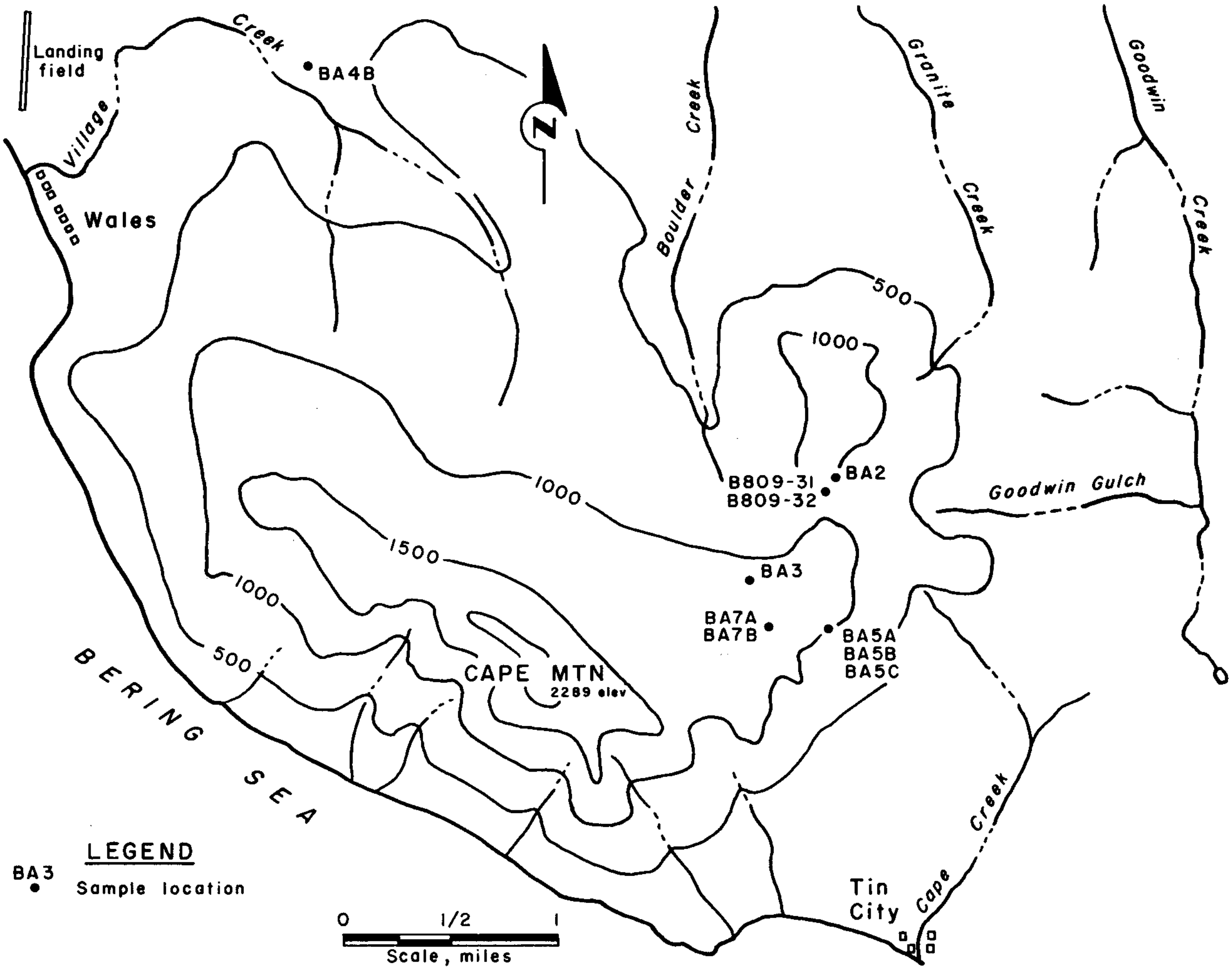


FIGURE 9. - Beryllium Specimens, Cape Mountain.

of the granite. The isolation and identification of minor elements that have no evident relationship to the tin deposits was beyond the scope of this project.

## Gold

Gold is very scarce in the Cape Mountain area. According to a conversation with Glen Adams, a churn driller, a minor amount of gold is reported to have been found in one of a large number of churn-drill holes drilled on Goodwin Creek by private interests about 1935. However, during the extensive churn-drill sampling programs on Cape Creek and Boulder Creek in 1952 and 1953 (24) no gold was found. During the present investigation only a barely perceptible trace of gold was found in one pan taken in a gulch that drains the southwest slopes of Cape Mountain (fig. 2 and table 6). The heavy mineral concentrates from creeks draining the area between Cape Mountain and Potato Mountain (figs. 1 and 2) contained no gold; however, a more intensive investigation of this area probably would have revealed occasional traces of gold as reported by early prospectors.

## Magnetite

Magnetite was found in all detrital-cover samples on the north side (left limit) of Cape Creek from 2,400 to 2,800 feet upstream from the mouth of East Fork (fig. 6). This was the only place in the area where magnetite was a notable part of the heavy mineral concentrates. The source of the magnetite was not investigated but undoubtedly is within 200 feet of the upper line of sample pits. The magnetic concentrates are described in the section of this report entitled petrography.

## Fluorite

Fluorite occurs in granite as veinlets associated with cassiterite and is also a common constituent of contact metamorphic rocks. A specimen of a veinlet in granite found above the North Star adit contained goethite, quartz, fluorite, and cassiterite. Occasional similar specimens were found overlying the tin-bearing granite south of this adit. Samples that contain fluorite are described in the section on petrography.

# PETROGRAPHY

by

Walter L. Gnagy[6]

Petrographic studies were made on specimens of the placer gravels, the detrital cover, and the rocks associated with the lode-tin deposits of the Cape Mountain area. The placer specimens, the detrital-cover specimens, and the various lode specimens have been grouped in separate tables for convenience and clarity. The field descriptions of the specimens are in the footnotes of the various tables.

TABLE 14. - Principal minerals in some placer concentrates[1]

| Sample No.[2] ... | B815-A | B815-B | B815-C | B815-D | B815-E | B822-FI | B822-J | B822-KL | B822-MN | B822-O |
|---|---|---|---|---|---|---|---|---|---|---|
| Minerals: | | | | | | | | | | |
| Albite...... | A | A | A | A | A | S | F | - | S | S |
| Apatite..... | - | - | T | T | T | - | - | - | - | - |
| Biotite..... | F | F | M | T | - | A | A | A | S | S |
| Cassiterite | M | - | - | - | - | M | - | - | T | - |
| Chlorite.... | M | F | F | F | - | A | A | A | A | A |
| Diopside ... | - | - | T? | F? | F? | - | - | - | - | - |
| Epidote..... | - | - | T | - | T | - | - | - | - | - |
| Garnet...... | - | - | - | S | - | - | - | - | - | - |
| Gold........ | T? | - | - | - | - | - | - | - | - | - |
| Ilmenite.... | M | - | - | - | - | - | - | - | - | - |
| Potassium-feldspar... | A | A | A | A | A | - | - | - | - | - |
| Limonite.... | T | - | F | T | - | S | F | F | F | F |
| Muscovite... | F | F | - | T | - | S | A | S | S | S |
| Pyrite...... | - | - | - | - | - | - | - | - | T | - |
| Quartz...... | A | A | A | A | A | S | S | A | A | A |
| Scheelite f | T | T | T | T | T | - | - | - | - | - |
| Tourmaline.. | - | - | - | - | - | T | - | - | - | - |
| Zircon f | T | T | T | T | T | - | - | - | - | - |

[1] P - Predominant — More than 50 percent
A - Abundant — 10 - 50 percent
S - Subordinate — 2 - 10 percent
M - Minor — 0.5 - 2 percent
F - Few — 0.1 - 0.5 percent
T - Trace — Less than 0.1 percent
f - Fluorescent

[2] B815-A, "A" Creek (see fig. 2).
B815-B, "B" Creek (see fig. 2).
B815-C, "C" Creek (see fig. 2).
B815-D, "D" Creek (see fig. 2).
B815-E, Paulina Creek (see fig. 2).
B822-FI, Potato Creek (see figs. 2 and 8).
B822-J, Lynx Creek (see figs. 2 and 8).
B822-KL, Manna Creek (see fig. 2).
B822-MN, Prince of Wales Creek (see fig. 2).
B822-O, Village No. 2 Creek (see fig. 2).

[6] Petrographer, Area VIII Mineral Resource Office, Bureau of Mines, Juneau, Alaska.

TABLE 15. - Principal minerals in detrital cover panned concentrates[1]

| Sample No.[2] | B625-1 | B625-2 | B626-1 | B627-1 | B627-2 | B706-1 | B810-5 |
|---|---|---|---|---|---|---|---|
| Minerals: | | | | | | | |
| Albite | - | - | - | S | - | - | S |
| Biotite | - | - | - | T | - | T | - |
| Calcite | T | S | P | S | P | M | F |
| Cassiterite | - | M | F | M | - | - | A |
| Diopside | - | - | - | - | - | M | - |
| Dolomite | T | P | A | A | A | M | P |
| Epidote | - | T | - | - | - | T | - |
| Goethite-limonite | F | S | S | M | S | M | M |
| Hornblende | - | T | - | - | - | - | - |
| Potassium-feldspar | - | - | - | A | - | - | - |
| Magnetite | P | - | - | - | - | - | - |
| Olivine | - | - | - | - | - | M | - |
| Quartz | T | M | S | A | M | P | S |
| Rutile | - | - | - | - | T | - | - |
| Scheelite f | - | T | T | T | T | T | F |
| Sphene | - | - | T | - | - | - | - |
| Tourmaline | - | T | - | S | - | T | A |
| Zircon | - | - | - | - | - | T | - |

[1] P - Predominant — More than 50 percent
A - Abundant — 10 - 50 percent
S - Subordinate — 2 - 10 percent
M - Minor — 0.5 - 2 percent
F - Few — 0.1 - 0.5 percent
T - Trace — Less than 0.1 percent
f - Fluorescent

[2] B625-1, left limit Cape Creek below trench CC-1, magnetic fraction.
B625-2, left limit Cape Creek below trench CC-1, nonmagnetic fraction.
B626-1, left limit Cape Creek near headwaters.
B627-1, headwaters of Cape Creek.
B627-2, right limit of Cape Creek.
B706-1, First Chance Creek.
B810-5, extreme head of south fork of Goodwin Gulch.

TABLE 16. - Principal minerals and rocks in typical specimens from the lode-tin zone, Cape Mountain[1]

| Sample No.[2] | B704-3 | B704-4 | B704-5 | B802-1 | B802-2 | B809-2 | B810-1 | B810-3 | 829-14 |
|---|---|---|---|---|---|---|---|---|---|
| Rocks: | | | | | | | | | |
| Altered granite | - | - | - | - | - | - | - | - | C |
| Granite-pegmatite | - | - | - | - | - | C | - | - | - |
| Granodiorite | - | C | - | - | - | - | C | - | - |
| Quartz vein | - | - | C | - | - | - | C | C | - |
| Quartzite | C? | - | C | - | - | - | - | - | - |
| Tourmaline vein | - | - | - | C | C | - | - | - | - |
| Minerals: | | | | | | | | | |
| Albite | - | P | - | - | - | - | A | - | - |
| Albite-oligoclase | - | - | - | - | - | - | - | - | A |
| Biotite | - | - | - | - | - | - | - | - | S |
| Calcite | - | - | S | - | S | - | - | A | - |
| Cassiterite | - | - | T | P | P | - | - | A | T |
| Chlorite | - | - | M | - | - | - | - | - | - |
| Dolomite | - | - | - | - | - | M | - | - | - |
| Goethite-limonite | M | - | - | - | - | - | T | - | T |
| Graphite | S | - | - | - | - | - | - | - | - |
| Potassium-feldspar | - | - | - | - | - | - | A | - | A |
| Mica, biotite | - | - | - | - | - | S | - | - | - |
| Mica, muscovite | - | - | - | S | M | - | S | - | T |
| Mica, unidentified | - | - | - | - | - | - | - | S | - |
| Microcline | - | - | - | - | - | P | - | - | - |
| Oligoclase | - | - | - | - | - | - | - | S | - |
| Quartz | P | A | P | M | T | A | A | A | P |
| Scheelite f | - | - | - | - | - | T | - | - | - |
| Tourmaline | - | - | - | A | A | - | - | A | T |
| Vanadium oxide[3] | X | - | - | - | - | - | - | - | - |
| Zircon (altered) | - | - | - | - | - | - | - | - | T |

[1]C - Rock classification
P - Predominant More than 50 percent
A - Abundant 10 - 50 percent
S - Subordinate 2 - 10 percent
M - Minor 0.5 - 2 percent
F - Few 0.1 - 0.5 percent
T - Trace Less than 0.1 percent
f - Fluorescent
X - Detected in sample.

[2]Field description of samples:
B704-3, graphitic metasedimentary rock adjacent to igneous intrusive, trench CC-1, Cape Creek (fig. 6).
B704-4, igneous intrusive, trench CC-1, Cape Creek (fig. 6).
B704-5, complex vein in limestone near trench CC-1, Cape Creek (fig. 6).
B802-1, vein outcrop, trench 4, Bartels mine area (fig. 7).
B802-2, vein outcrop, trench 3, Bartels mine area (fig. 7).
B809-2, coarse-grained granite, Bronx claim (fig. 7).
B810-1, 1-inch-wide quartz vein in granite, Tremont claim (fig. 7). Panning indicates that some cassiterite was derived from this vein but none was seen in specimen.
B810-3, quartz vein in limestone block east of Bronx claim (fig. 7).
829-14, mineralized granite, trench 13, Bartels mine area (fig. 7).

[3]Sample B704-3 was rechecked for radioactivity because of the presence of a vanadium mineral and graphite. Results were negative.

TABLE 17. - Principal minerals and rocks, granite-limestone contact zone, Cape Mountain[1]

| Sample No.[2] .. | B803-71 | B803-72 | B803-73 | B803-74 | B803-75 | B803-76 | B803-77 | B809-33 |
|---|---|---|---|---|---|---|---|---|
| Rocks: | | | | | | | | |
| Dolomite.... | C | - | - | - | - | - | - | - |
| Granodiorite | - | C | - | - | - | - | - | - |
| Limestone... | - | - | - | - | - | - | - | C |
| Skarn....... | - | - | - | C | C | - | - | - |
| Tourmaline vein....... | - | - | C | - | - | - | C | - |
| Quartz vein. | - | - | - | - | - | C | - | - |
| Minerals: | | | | | | | | |
| Albite...... | - | P | - | - | - | - | - | - |
| Calcite..... | - | - | - | - | - | A | - | P |
| Diopside.... | - | - | - | P | P | - | - | - |
| Dolomite.... | P | - | - | - | - | - | - | - |
| Goethite-limonite... | - | - | A | - | A | A | A | - |
| Potassium-feldspar... | - | A | - | - | - | - | - | - |
| Lepidolite.. | - | - | - | - | - | - | - | M |
| Mica, biotite.... | - | T | - | - | - | - | - | - |
| Quartz...... | - | A | S | T | - | P | A | - |
| Scheelite f | - | - | - | T | T | - | T | F |
| Tourmaline.. | - | - | P | A | - | M | P | - |
| Tremolite-actinolite. | - | - | - | - | A | - | - | - |

[1]C - rock classification

| | |
|---|---|
| P - Predominant | More than 50 percent |
| A - Abundant | 10 - 50 percent |
| S - Subordinate | 2 - 10 percent |
| M - Minor | 0.5 - 2 percent |
| F - Few | 0.1 - 0.5 percent |
| T - Trace | Less than 0.1 percent |
| f - Fluorescent | |

[2]B803-71, B803-72, B803-73, B803-74, B803-75, B803-76, B803-77: This is a suite of seven typical specimens from the contact zone of a metalimestone block entirely surrounded by granite on the Boulder Creek-First Chance Creek divide (fig. 5).

B809-33, typical specimen from the contact zone, Percy lode (figs. 3 and 5).

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TABLE 18. - Principal minerals and rocks, beryllium-bearing specimens, Cape Mountain[1]

| Sample No.[2] [3] | BA2 | BA3 | BA4B | BA5A | BA5B | BA5C | BA7A | BA7B | B809-31 | B809-32 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rocks: | | | | | | | | | | |
| Cassiterite vein | - | - | - | - | - | - | - | C | - | - |
| Greisenized limestone | - | - | - | - | - | - | C | - | - | - |
| Skarn | - | C | C | C | C | - | - | - | - | - |
| Tourmaline schist | C | - | - | - | - | - | - | - | - | - |
| Tourmaline soda syenite | - | - | - | - | - | - | - | - | C | - |
| Tourmaline vein | - | - | - | - | - | - | - | - | - | C |
| Vein quartz | - | - | - | - | - | C | - | - | - | - |
| Chemical: | | | | | | | | | | |
| Be (Morin) | T | X | T | T | T | X | T | T | ([4]) | ([4]) |
| Minerals: | | | | | | | | | | |
| Actinolite | - | S | - | - | - | - | - | - | - | - |
| Albite | T | - | - | - | - | - | - | - | P | S |
| Beryl | - | - | - | - | - | - | - | - | S | A |
| Biotite | - | - | - | - | - | S | - | - | - | - |
| Calcite | - | S | A | S | S | - | A | - | - | A |
| Cassiterite | - | - | - | - | - | - | - | P | - | - |
| Chlorite | A | - | - | M | - | S | M | F | M | - |
| Diopside | - | P | A | P | A | - | - | - | - | - |
| Epidote | - | T | S | - | A | T | - | - | - | - |
| Fluorite | - | A | A | A | S | - | M | - | - | - |
| Potassium-feldspar | T | - | - | - | - | - | - | - | - | T |
| Lepidolite | - | - | - | - | - | - | A | S | - | - |
| Limonite | - | - | - | - | - | - | T | A | - | - |
| Mica, unidentified | - | - | - | - | - | - | - | - | M | - |
| Quartz | P | - | A | - | F | P | A | T | - | - |
| Scapolite | - | A | - | F | P | - | - | - | - | - |
| Scheelite f | - | T | F | F | F | T | M | - | T | - |
| Sphene | - | - | - | - | - | T | - | - | - | - |
| Tourmaline | A | - | T | - | - | S | - | S | A | P |
| Vesuvianite | - | - | T | - | - | - | - | - | - | - |

[1] P - Predominant — More than 50 percent
A - Abundant — 10 - 50 percent
S - Subordinate — 2 - 10 percent
M - Minor — 0.5 - 2 percent
F - Few — 0.1 - 0.5 percent
T - Trace — Less than 0.1 percent
X - Detected in sample
f - Fluorescent
R - Radioactive
C - Rock classification
Numerals - percent

[2] Sample locations shown on figure 9:
BA2, float specimen from trench 30 feet east of Percy adit.
BA3, float specimen from trench at head of Boulder Creek; most trench material is granite; surrounding float is limestone.
BA4B, float specimen, altered limestone; granite-limestone contact, Village Creek.
BA5A, BA5B, BA5C } Specimens from adit dump; limestone bedrock at portal; dump mostly granite with some pegmatitic granite and altered metalimestones.
BA7A, BA7B } Specimens from shaft dump; shaft was sunk in metalimestone about 25 feet south of granite-limestone contact; no granite on dump.
B809-31, B809-32 } Specimens from adit dump, Percy adit; see section on beryllium.

[3] Specimens BA2 through BA7B collected by R. V. Berryhill, former Bureau of Mines mine examination and exploration engineer, during a reconnaissance examination made in 1961.

[4] Not tested.

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