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# RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN THE RUBY-POORMAN AND NIXON FORK DISTRICTS, WEST-CENTRAL ALASKA, 1949

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UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

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# RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN THE RUBY-POORMAN AND NIXON FORK DISTRICTS, WEST-CENTRAL ALASKA, 1949

By Max G. White and John M. Stevens

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By Max G. White and John M. Stevens

## CHAPTER A. —RUBY-POORMAN DISTRICT


### ABSTRACT

Reconnaissance for radioactive deposits in the Ruby-Poorman district, Ruby quadrangle, central Alaska during July 1949 showed that two small bodies of granite in the Long area, about 30 miles south of Ruby, contain an average of 0.005 percent equivalent uranium. This radioactivity is due chiefly to a uraniferous thorium silicate, tentatively identified as uranothorite, which is disseminated in the granite. Other minerals, such as sphene, allanite, and zircon, that contain radioactive elements as impurities, however, also contribute to the total radioactivity of the granite. The uranothorite(?) contains about 57 percent thorium and 8 percent uranium.

Search for the bedrock source of a radioactive mineral of the spinel group which occurs in placers on upper Solomon Creek in the Poorman area was unsuccessful. Radiometric traversing indicated no anomalous radiation at a silver-bearing galena deposit on New York Creek in the Ruby area.

Although it is believed that there is little possibility of commercial deposits of uranium in the Ruby-Poorman district, it should be noted that the heavy cover of vegetation and alluvium prevents complete coverage of the district by radiometric surveying.


### INTRODUCTION

The Ruby-Poorman district (fig. 1) lies just south of the Yukon River mainly along the divide between the Innoko and Nowitna Rivers in central Alaska, approximately 230 miles west of Fairbanks. Ruby, Long, and Poorman are the only settlements in the area. Ruby (population 175) is located on the Yukon River and is the point of entry for supplies to the mines in the district. Long is 28 miles south of Ruby and is the center of most of the mining activity in the district. Poorman is about 25 miles south of Long and is located at the headwaters of the Innoko River drainage. Long and Poorman are now virtually abandoned and have a combined population of not more than 8 people. The Alaska Road Commission maintains a single-lane truck road from Ruby to a point near Monument Creek (fig. 1). Formerly, this road extended to Poorman, but maintenance on this stretch of road was abandoned a few years ago and it is now impassable even to tractors.

Study of concentrates in the Geological Survey's Alaskan Geology Branch collections showed the presence of radioactive minerals in placers on the upper part of Solomon Creek near Poorman and near two small granite intrusives in the vicinity of Long. The occurrence of these radioactive minerals, coupled with the facts that tin and bismuth are also known in the placers, and a silver-bearing galena deposit is located about 12 miles south of Ruby indicated that the district might be favorable for the occurrence of uraniferous lodes. The party conducting the reconnaissance consisted of M. G. White and J. M. Stevens, geologists, and Egil Salveson and R. D. Olson, camp assistants. They worked in the area during the month of July 1949. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

### GEOLOGY

The geology of the Ruby-Poorman district is known only on a reconnaissance scale chiefly as a result of investigations by Eakin (1914, pp. 20-27), Mertie and Harrington (1924, pp. 12-74), and Mertie (1936, pp. 130-143). The mantle of residual soil covering most of the upper slopes and tops of all the hills, the depth of alluvium covering all the lower slopes and stream valleys, and the blanket of moss, low brush, and timber growth covering all but the highest hills make any geologic investigation both difficult and time-consuming. Outcrops are rare, talus slides are uncommon, and float rock is found usually only by digging through the moss into the residual soil mantle.

#### Bedrock

The major part of the country rock in the Ruby-Poorman district consists of a complex including schist, phyllite, slate, greenstone, quartzite, chert, and limestone of Paleozoic age and possibly older. Within this complex it has been possible to recognize the following formations: a recrystallized limestone of unknown age; Devonian rocks consisting mainly of limestone; and a group of rocks that include greenstone, tuff, and chert. Granite bodies, cropping out in the headwaters of Flint Creek and on Birch Creek, are tentatively classified as Mesozoic in age. The youngest rocks in the district are believed to be soda-granite dikes of possible Eocene age that occur in the vicinity of Poorman, and below Ruby on the banks of the Yukon River.

#### Alluvium

Altitudes within the district range from less than 400 feet above sea level at Ruby to somewhat more than 1,800 feet on some of the rounded hills south of Ruby. The average altitude is probably between 1,300 and

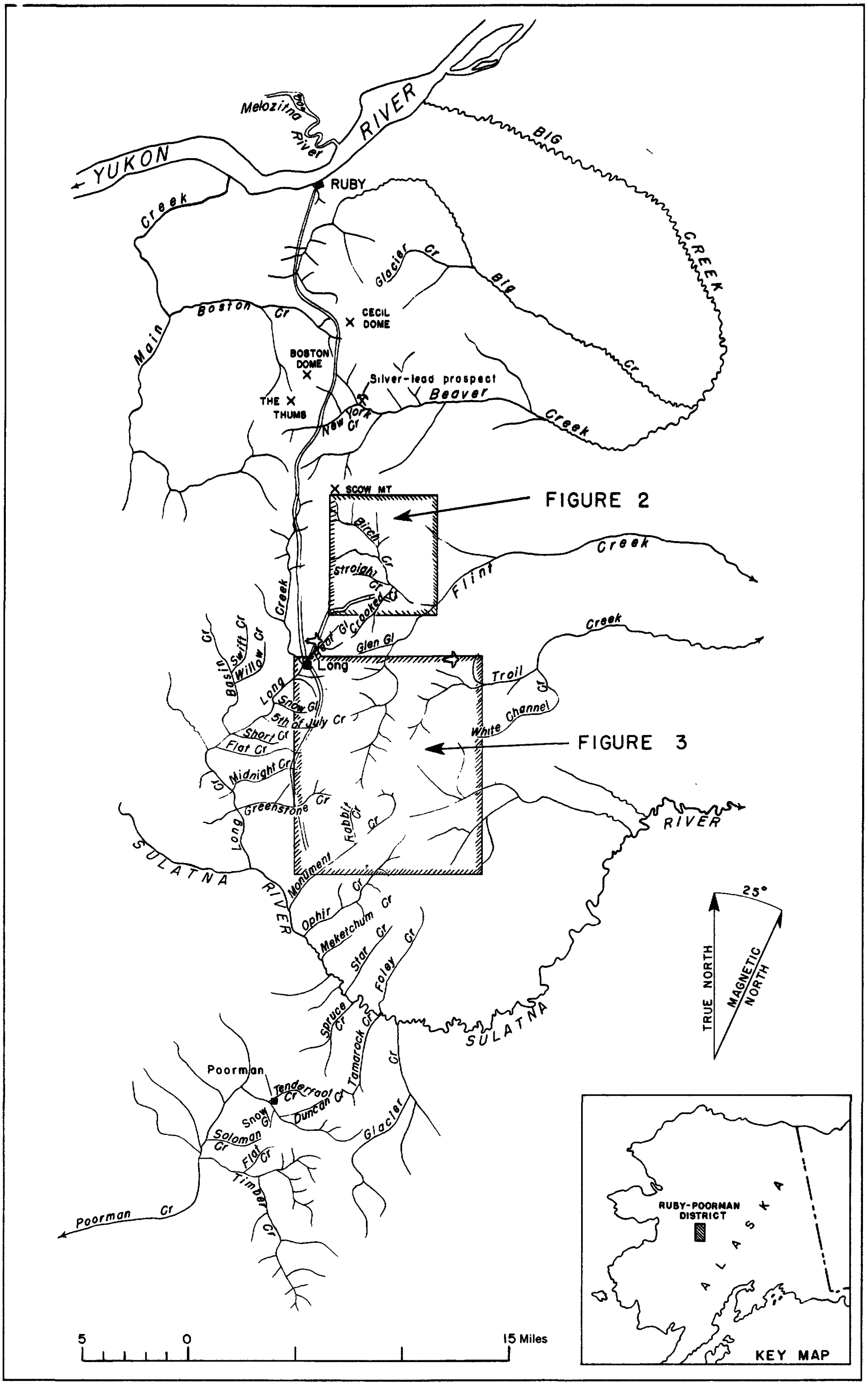


Figure 1.—Sketch map of the Ruby-Poorman district, Alaska, showing location of Birch Creek and upper Flint Creek.

1,400 feet. Alluvial deposits consisting mainly of silt of Pleistocene age with some gravel fill nearly all the stream valleys almost to their heads and in places occur as high as 1,200 feet. Faintly outlined terraces are found at altitudes of 1,000 feet and higher along some of the bedrock slopes and on many of the ridges. It is of some significance that the only rock outcrops seen below that altitude are along stream cuts of Recent age. Essentially all of the bedrock float found was in frost-heave mounds thrown up through the alluvial mantle. Eakin (1916, p. 55) in discussing the origin of these alluvial deposits, which are widespread in this region of Alaska, states:

> **The character of the silts indicates deposition in quiet water; the distribution and form of the gravel terraces point to origin by beach action. As there are other corroborative lines of evidence pointing to the extensive inundation of the low-lying parts of the region, probably during and following the period of maximum glaciation in interior Alaska, the silts are interpreted as the deposits made by the debris-laden glacial waters and the high-lying gravel terraces as largely the product of beach action on the shores of lakes that are now extinct. There are also more extensive high-level gravel deposits that are probably of fluvial origin, representing deltas built out into the margins of the ancient lakes by glacial and other streams.**

According to Maddren (1910, p. 68) there was an interval following the glaciation when downcutting by the present streams was very rapid, leaving some of the preglacial gravel perched on the sides of the valleys as bench gravels. This gravel appears on the west side of middle Flint Creek, and on lower Birch Creek.

## MINERAL DEPOSITS

Placer gold has been the only mineral mined profitably in the Ruby-Poorman district. Tin is abundant in many of the streams of the area, and though attempts have been made to ship some of the cassiterite concentrate to the American market, none of the attempts have been profitable. The lode source of both the tin and gold is easily surmised to be from the hills and ridges adjacent to the placer deposits. However, the residual rock and vegetal material on the ridges and the alluvial mantle in the stream valleys so effectively mask the bedrock in the district as to make any lode prospecting too expensive and speculative an enterprise. A general description of the lode and placer deposits in the district is given in a report prepared by Mertie (1936).

Development work was done for a number of years on a silver-lead prospect on New York Creek at the head of Beaver Creek (fig. 1) in the vicinity of Ruby. Attempts to ship the ore were unprofitable, and the property was abandoned. This deposit (Brown, 1926, pp. 146, 147; Mertie, 1936, pp. 226-227) consists of metalliferous lenticular veins as much as several feet thick which lie parallel to the schistosity of the enclosing micaceous quartz schist. The ore consists chiefly of silver-bearing galena, much cerussite and limonite, minor amounts of rhodochrosite, manganese oxides, calcite, and siderite, and traces of gold, quartz, pyrite, and ruby silver.

Bismuth occurs at two localities: one in the vicinity of Ruby, at the head of Glacier Creek (fig. 1) where a sluice-box concentrate from placer-gold mining contains 29 percent bismuth by chemical analysis; the other on lower Birch Creek in the vicinity of Long, where Mertie (1936, p. 157) reported finding native bismuth in the placer concentrates.

## RADIOACTIVITY INVESTIGATIONS

The vegetal and alluvial mantle blanketing a large part of the Ruby-Poorman district effectively absorbs most of the radiation from radioactive minerals in the underlying rocks. Radiometric testing in the district, therefore, was efficient only at the few localities where bedrock is exposed, in talus, or on the portions of the ridges and upper valley slopes where the vegetation cover was not too thick to test the underlying residuum either directly or with shallow test pits. For example, it is estimated that only about 20 percent of the road between Ruby and Monument Creeks (fig. 1) was satisfactorily tested by traversing with a jeep, because of the thick vegetal and alluvial mantle. Two probes, one containing six 1- by 14-inch copper-walled gamma tubes and the other with four 1- by 18-inch brass-walled gamma tubes, were attached to standard commercial models of portable survey meters for jeep and back-packing traverses.

### Ruby area

Fifteen placer concentrates from the Ruby area were in the Survey's Alaskan concentrate collection before the present investigation. The creeks (fig. 1) from which these samples had been obtained, the number of samples available, and the range in equivalent uranium content of the samples from each creek are given below.

| Creek | Number of concentrates | Range in equivalent uranium content (percent) |
|---|---|---|
| Ruby Creek | 2 | 0.000-0.002 |
| Glacier Creek | 6 | .000- .003 |
| Big Creek | 2 | .000- .001 |
| Cox Pup (headwater tributary of Big Creek) | 5 | .001- .006 |

Because of the low radioactivity exhibited by these concentrates, reconnaissance in the Ruby area was limited to the radiometric traversing along the road and the testing of the silver-bearing galena lode on New York Creek (fig. 1) about 1.5 miles east of the road. The road traversing revealed no significant radioactivity anomalies and no significant amount of radioactive material was found at the galena prospect. The maximum equivalent uranium content of check samples taken at this prospect was 0.003 percent.

## Long area

A total of 47 placer concentrates from the Long area (fig. 1) were available for testing prior to the present investigation. The data on these concentrates are summarized at the bottom of this page. It is apparent from this summary that the only concentrates with radioactivity of significance are from Birch, Flint, Monument, and Greenstone Creeks (fig. 1). These streams drain the small areas of granite on Birch Creek (fig. 2) and on the divide between Flint Creek and Monument and Greenstone Creeks (fig. 3). Consequently most of the reconnaissance in the Long area was directed toward determining whether the granite bodies were the source of the radioactive minerals in the placers, and, if so, whether any zone of concentration of radioactive minerals existed within or near the granites.

### Granite on Birch and Straight Creeks

Data on the samples collected in the vicinity of the granite on Birch and Straight Creeks are given in table 1. The source locations of these samples are shown on figure 2. The six samples of the granite on these creeks (table 1) range from 0.003 to 0.006 percent (average 0.005 percent) in equivalent uranium content. The heavy-mineral fractions (those greater than 2.8 specific gravity) of these samples range from 0.007 to 0.036 percent equivalent uranium, and average 0.027 percent equivalent uranium. Similar heavy-mineral fractions of panned concentrates from placers and disintegrated granite in the vicinity of Birch Creek contain from 0.007 to 0.36 percent equivalent uranium, obviously higher because of the greater degree of concentration. Sample no. 3456, a panned placer concentrate, showed the highest equivalent uranium content (0.36 percent) of any of the samples collected in the vicinity of Birch Creek. The radioactive elements are primarily in zircon and allanite, although the sample contains minor amounts of hematite and traces of sphene and uranothorite(?) (see below) which are also radioactive. Although it is likely that the bulk of the radioactivity in this sample is due chiefly to thorium, all of the minerals mentioned give a positive qualitative sodium-fluoride flux test for uranium. Other minerals in the heavy fractions of the granite and placer concentrates from the vicinity of the granite on Birch Creek are anatase, garnet, ilmenite, and a trace of malachite.

### Granite on upper Flint Creek

Data on the samples collected from the vicinity of the granite body on upper Flint Creek are given in table 2; the source locations of the samples are shown on figure 3. The equivalent uranium content of 12 samples from this granite ranges from 0.003 to 0.008 percent and averages 0.005 percent. The range in equivalent uranium content of the heavy-mineral fractions (those greater than 2.8 specific gravity) of the 12 samples is 0.015 to 0.15 percent; the average is 0.037 percent. This average is higher than that of the granite on Birch Creek because of one heavy fraction, that of sample 3505, which contains 0.15 percent equivalent uranium. If this fraction is not considered in the range and average, the results (range 0.015-0.05 percent equivalent uranium; average 0.026 percent equivalent uranium) are closely comparable to the range and average for the granite on Birch Creek. It is likely that this relatively greater radioactivity in the heavy fraction of sample 3505 is due to the occurrence of fewer nonradioactive minerals in proportion to the radioactive minerals rather than a greater overall content of the radioactive minerals. This is also suggested by the fact that the radioactivity of the unconcentrated granite at this point is the same as the average of the granite (0.005 percent equivalent uranium).

| Creek | Number of concentrates | Range in equivalent uranium content (percent) |
|---|---|---|
| Birch Creek | 13 | 0.000-0.013 |
| Lucky Creek | 1 | .001 |
| Glen Gulch | 1 | .006 |
| Flint Creek | 1 | .43 |
| Trail Creek | 1 | .000 |
| Monument Creek | 1 | .032 |
| Greenstone Creek | 3 | .001- .017 |
| Midnight Creek | 13 | .000- .002 |
| Short Creek | 2 | .000- .001 |
| Fifth of July Creek | 2 | .001 |
| Willow Creek | 1 | .001 |
| Long Creek | 5 | .000- .001 |
| Bear Gulch | 3 | .000- .002 |

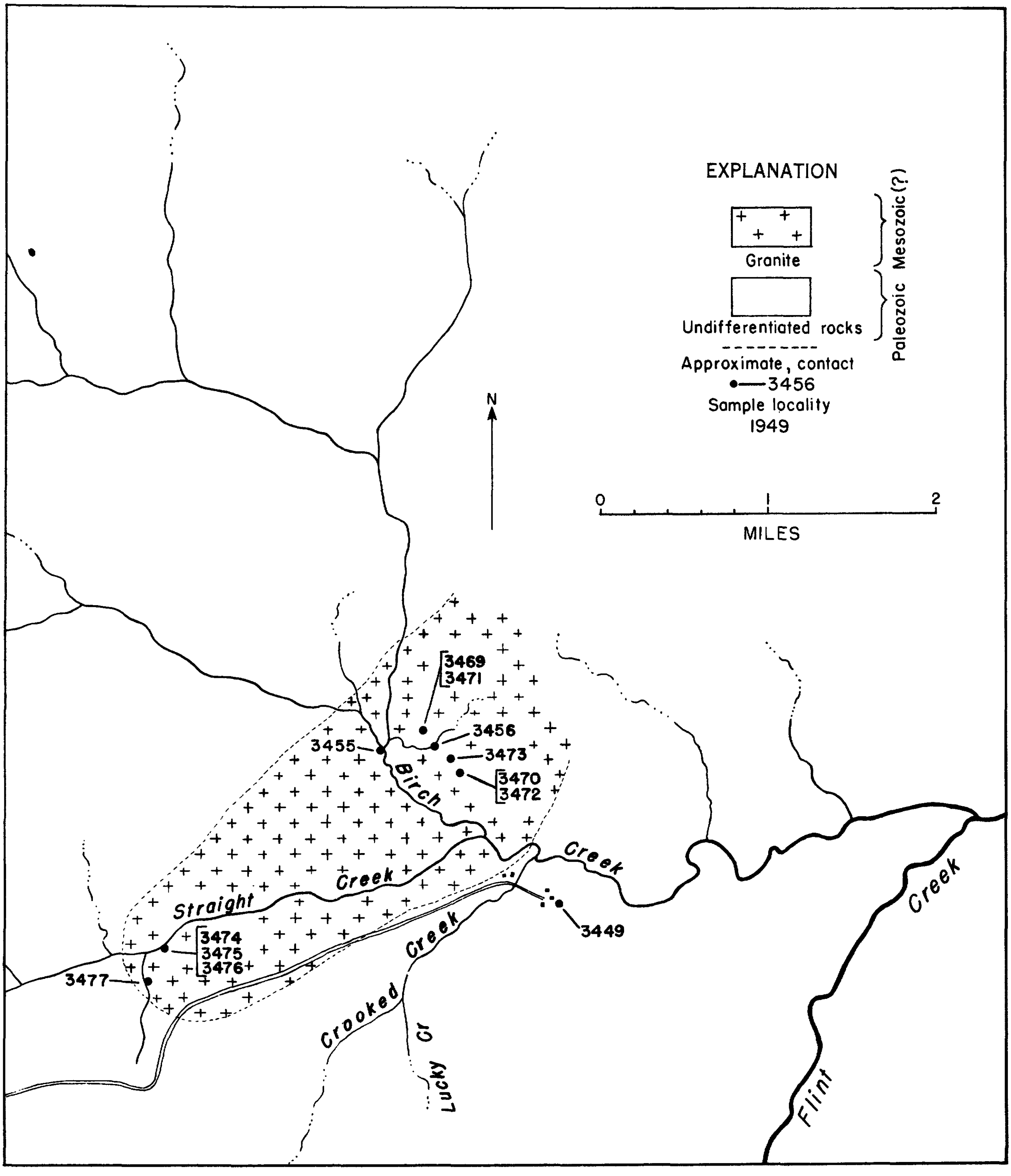


Figure 2.—Geologic sketch map of Birch Creek, Ruby-Poorman district, Alaska.

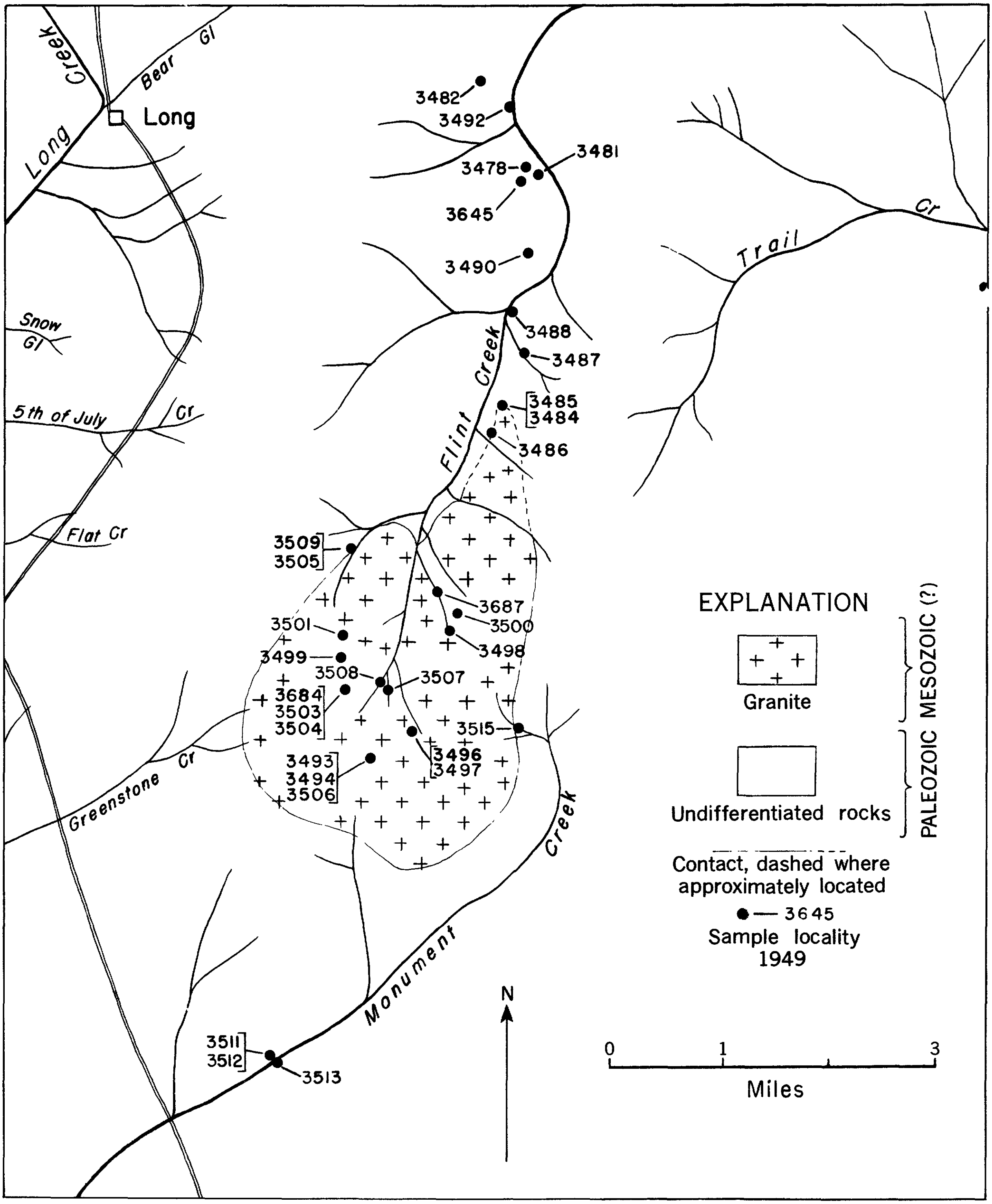


Figure 3.--Geologic sketch map of upper Flint Creek, Ruby-Poorman district, Alaska.

Table 1.—Data on samples from the vicinity of the granite on Birch and Straight Creeks, 1949

| Sample no. | Type of sample: Location[1] | Crushed rock percent eU[2] | Heavy-mineral fraction[3]: Percent eU | Heavy-mineral fraction[3]: Concentration ratio |
|---|---|---|---|---|
| | **Granite** | | | |
| 3471 | Birch Creek------------------------ | 0.006 | 0.036 | 45:1 |
| 3472 | ------do--------------------------- | .006 | .028 | 35:1 |
| 3473 | ------do----(fine-grained granitic dike). | .006 | .06 | 225:1 |
| 3474 | Straight Creek--------------------- | .003 | .009 | 13:1 |
| 3475 | ------do--------------------------- | .006 | .013 | 17:1 |
| 3476 | ------do--------------------------- | .005 | .015 | 30:1 |
| | **Panned concentrates from disintegrated granite** | | | |
| 3469 | Birch Creek------------------------ | --- | 0.30 | 15,300:1 |
| 3470 | ------do--------------------------- | --- | .22 | 11,000:1 |
| | **Placer concentrates** | | | |
| 3449 | Birch Creek------------------------ | --- | 0.007 | ([4]) |
| 3455 | ------do--------------------------- | --- | .024 | 2,300:1 |
| 3456 | ------do--------------------------- | --- | .36 | 2,700:1 |
| 3477 | Straight Creek--------------------- | --- | .15 | 640:1 |

[1]See also figure 2.
[2]eU-equivalent uranium.
[3]That greater than 2.8 specific gravity.
[4]Very high.

In addition to sampling the granite itself, panned concentrates were taken of stream gravels on Flint and Monument Creeks and wash from the disintegrated granites at the head of Flint Creek. The heavy-mineral fractions of these samples show the consistently relatively higher equivalent uranium content that would be expected with the greater degree of concentration (table 2).

The radioactivity of the granite on upper Flint Creek and of the placers and wash derived from the granite is due chiefly to a uraniferous thorium silicate, tentatively identified as uranothorite. The heavy fractions also contain much sphene, allanite, and zircon, which also contribute to the total radioactivity of the samples because they contain radioactive elements as impurities. Magnetite and ilmenite are also found in the heavy-mineral fractions.

The uranothorite(?) is dark green with a vitreous to dull luster. It is isotropic and has an index of refraction near 1.86. Following is a spectrographic analysis on selected grains from sample 3507, the heavy-mineral fraction of which contains 1.53 percent equivalent uranium by radiometric analyses and 8 percent of the uranothorite(?) as estimated by visual inspection.

**Over 10 percent**

thorium
silicon

**0.1-1.0 percent**

bismuth
cobalt
iron
tin

**0.01-0.1 percent**

aluminum
cerium
copper
magnesium
molybdenum
potassium
silver
sodium

Table 2.—Data on samples from the vicinity of the granite on upper Flint and Monument Creeks, 1949

| Sample number | Crushed rock percent eU[1] | Heavy-mineral fraction[2] | |
|---|---|---|---|
| | | Percent eU[1] | Concentration ratio |
| **Flint Creek (locations plotted on figure 3)** | | | |
| **Granite samples** | | | |
| 3484 | 0.005 | 0.015 | 99:1 |
| 3485 | .006 | .019 | 9:1 |
| 3493 | .008 | .025 | 6:1 |
| 3494 | .005 | .024 | 40:1 |
| 3497 | .004 | .026 | 150:1 |
| 3498 | .003 | .024 | 65:1 |
| 3499 | .004 | .043 | 100:1 |
| 3500 | .006 | .021 | 120:1 |
| 3501 | .005 | .050 | 75:1 |
| 3503 | .005 | .030 | 15:1 |
| 3505 | .005 | .15 | 2,850:1 |
| 3684 | .005 | .015 | 20:1 |
| **Panned concentrates from granite wash** | | | |
| 3504 | --- | 0.75 | 5,000:1 |
| 3506 | --- | .31 | 8,200:1 |
| **Panned concentrates from creek gravels** | | | |
| 3478 | --- | 0.11 | 1,250:1 |
| 3481 | --- | .12 | 650:1 |
| 3482 | --- | .224 | 1,450:1 |
| 3486 | --- | .70 | 1,000:1 |
| 3487 | --- | .025 | 2,700:1 |
| 3488 | --- | .26 | 1,100:1 |
| 3490 | --- | .62 | 680:1 |
| 3492 | --- | .02 | 640:1 |
| 3496 | --- | .93 | 1,600:1 |
| 3507 | --- | 1.63 | 3,800:1 |
| 3508 | --- | .46 | 4,200:1 |
| 3509 | --- | .64 | 3,700:1 |
| 3645 | --- | .065 | 1,250:1 |
| 3687 | --- | .20 | 4,500:1 |
| **Monument Creek (locations plotted on figure 3)** | | | |
| **Panned from creek gravels** | | | |
| 3511 | --- | 0.086 | (3) |
| 3512 | --- | .001 | (3) |
| 3513 | --- | .002 | 290:1 |
| 3515 | --- | .14 | 9,000:1 |

[1] eU - equivalent uranium.
[2] That greater than 2.8 specific gravity.
[3] High.

In addition to the above elements the mineral contains 8.2 percent uranium (determined chemically). Phair and Shimamoto (1952, p. 662) show the thorium content as 56.6 percent.

Analytical spectrographic analyses on what is apparently the same mineral from other samples (no. 3496 from Flint Creek, and no. 3477 from Birch Creek) show yttrium(?) as a minor constituent. The samples from Monument Creek (0.032 percent equivalent uranium) and Flint Creek (0.43 percent equivalent uranium) obtained before 1949 contain a green uraniferous thorium-yttrium silicate which was tentatively identified prior to this study as yttrialite. It is likely, however, that this mineral is the uranothorite(?) discussed on page 7.

The uranothorite(?) and the other radioactive minerals are disseminated accessory minerals of the granite, which is typically coarse-grained and porphyritic. No zones of high concentration were found. The uranothorite(?) appears to be less abundant in a minor fine-grained facies of the granite than in the large mass of coarse-grained rock.

## Poorman area

Data on placer concentrates from the Poorman area (fig. 1) available for study prior to 1949 are summarized below:

| Creek | Number of concentrates | Range in equivalent uranium content (percent) |
|---|---|---|
| Poorman Creek | 5 | 0.000-0.006 |
| Solomon Creek | 3 | .002- .056 |
| Flat Creek | 1 | .001 |
| Moose Creek | 1 | .000 |
| Tamarack Creek | 1 | .001 |
| Spruce Creek | 1 | .004 |

From this summary it appears that the only radioactivity of significance in concentrates from the Poorman area is in the samples from Solomon Creek. The most radioactive sample came from the upper part of the creek. However, radiometric traversing in the upper valley of Solomon Creek and along adjacent divides failed to detect any significant radioactivity. Mineralogic study of the placer concentrate from Solomon Creek having the greatest radioactivity (0.056 percent equivalent uranium) showed that the radioactivity there is due to a uraniferous mineral of the spinel group. Qualitative spectrographic analysis of the mineral shows aluminum, chromium, iron, magnesium, titanium, and rare earths as major constituents.

## SUMMARY AND CONCLUSIONS

Two small bodies of granite in the vicinity of Long in the Ruby-Poorman district contain an average of 0.005 percent equivalent uranium. Although the radioactivity is due chiefly to a uraniferous thorium silicate—tentatively identified as uranothorite—radioactive allanite, hematite, sphene, and zircon also contribute to the total radioactivity.

Radiometric tests in the vicinity of a silver-lead lode 12 miles south of Ruby found no anomalous radiation at that locality. Search for the bedrock source of a radioactive spinel previously found in placers on Solomon Creek in the Poorman area was unsuccessful.

It is concluded from this investigation that there is little likelihood of finding uranium deposits of commercial grade in the Ruby-Poorman district. It should be noted, however, that much of the district is heavily covered with vegetation and alluvium, which prevents the satisfactory use of portable survey meters to detect radiation.

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## CHAPTER B. —NIXON FORK DISTRICT

### ABSTRACT

Reconnaissance for radioactive deposits in the Nixon Fork mining district, Medfra quadrangle, central Alaska, in 1949 disclosed the occurrence of allanite in samples containing as much as 0.05 percent equivalent uranium from the dump of the Whalen mine; the presence of radioactive parisite (a rare-earth fluocarbonate) in a highly altered limestone containing about 0.025 percent equivalent uranium near the Whalen shaft, and radioactive idocrase in samples of altered garnet rock with about 0.025 percent equivalent uranium, from the Crystal shaft of the Nixon Fork mine. This radioactivity is due mostly to thorium rather than uranium. Placer concentrates from Ruby and Eagle Creeks contain 0.078 and 0.26 percent equivalent uranium respectively, in which the radioactivity is due chiefly to uraniferous thorianite. The bedrock source of the uraniferous thorianite was not located primarily because much of the area is overlain by a relatively thick mantle of vegetation (mostly moss) which limited the effectiveness of radiometric surveying. The uraniferous thorianite is believed to occur in a restricted zone or zones at or near the contact of limestone with monzonite similar to the gold-copper ores of the district and the deposits of radioactive parisite and garnet rock at the Whelan and Crystal shafts respectively.

### INTRODUCTION

The Nixon Fork mining district (fig. 4) is in a low range of hills of the Kuskokwim Mountains, about 12 miles north of Medfra, a small settlement on the Kuskokwim River 95 miles upstream from McGrath, in central Alaska. Access to the area is by boat or airplane from McGrath to Medfra, and from Medfra to the mines by truck.

The term "Nixon Fork mines" has long been used for both lode and placer mines in the district. Most of the lode-mining property is held by the Nixon Fork Mining Co., whose principal owners are the Mespelt brothers of McGrath. Their property is called the Nixon Fork mine. The only other lode-mining property of any importance is the Whalen mine, adjacent to and south of the Nixon Fork mine property.

Some of the radioactive placer concentrates from the Nixon Fork mining district available in the Geological Survey's Alaskan Geology Branch placer-concentrate file before 1949 (table 3) contain uraniferous thorianite associated with bismuth and copper minerals. This association suggested that the district was favorable for the occurrence of a uranium-bearing lode deposit. Therefore, in 1949, a Geological Survey party conducted a reconnaissance in the district to determine its uranium possibilities. Approximately 3 weeks were required for the investigation, of which $1\frac{1}{2}$ days were spent at a gold-lode prospect on Eagle Creek, about 5 to 7 miles south of the main Nixon Fork mines (fig. 4). The party consisted of M. G. White and J. M. Stevens, geologists, and Egil Salveson and R. D. Olson, camp assistants. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

### GEOLOGY, MINERAL DEPOSITS, AND RADIOACTIVITY INVESTIGATIONS

The low range of hills on which the Nixon Fork mines are located is composed of limestone of Paleozoic age and Upper Cretaceous sandstone, shale, and slate. The rocks are intruded by quartz monzonite that is probably Eocene in age. The lode deposits in the district are an enrichment in limestone along contact metamorphic zones between the limestone and monzonite. Most of the mineral deposits are apparently restricted to the valleys of the tributaries of Hidden Creek and the slopes around the north headwater fork of Ruby Creek (fig. 4). No mineral deposits of any note have been found along the eastern edge of the monzonite.

Placer gold was found on Ruby Creek in the winter of 1917, and shortly thereafter the lode deposits at the head of Crystal Gulch were located. In 1920 a 10-stamp mill was installed at the head of Ruby Creek to process

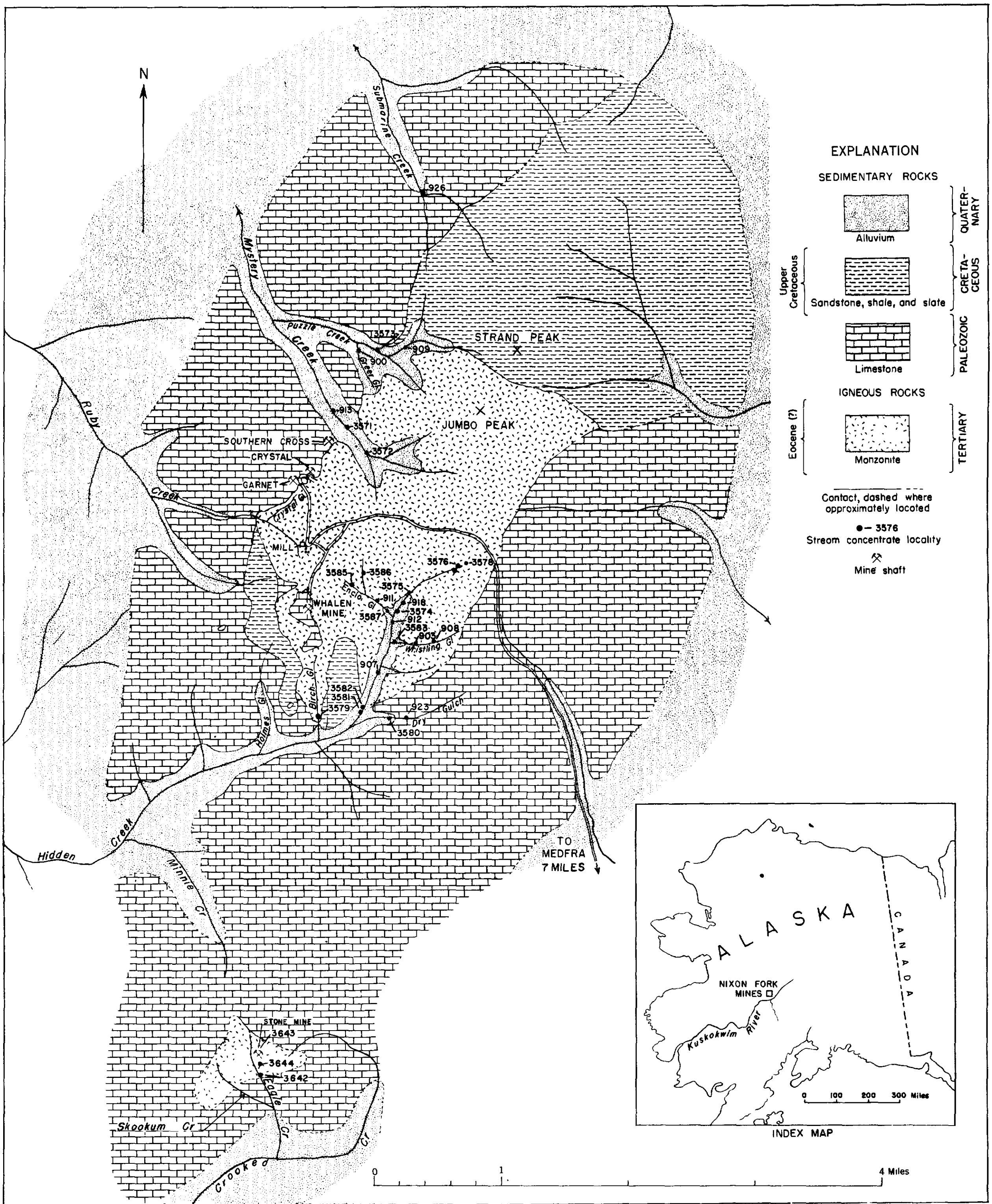


Figure 4.—Geologic sketch map of the vicinity of the Nixon Fork mines.

the highly oxidized copper-gold ores from the various shafts and prospects in the district. Mining and milling has been carried on in the district intermittently since 1920.

More detailed descriptions of the geology, mineral deposits, and mining of the Nixon Fork district are contained in reports by Martin (1922), Brown (1926), and Mertie (1936).

As is the case with much of interior Alaska, the area around the Nixon Fork mines is thickly covered with underbrush of willow, alder, spruce, and birch, and by moss, which averages about 3 feet in thickness. These conditions make the results of radiometric traversing at best inconclusive, except in the localities where recent mining developments have uncovered sufficient bedrock for direct examination.

The mineral deposits on the properties of the Nixon Fork Mining Co. and at the Whalen mine contain both copper and gold, and occur along the contact between the limestone and monzonite. The highly mineralized part of the contact zone is exposed by a large number of shafts and prospect pits, and, hence, was examined in some detail. Much of the remainder of the contact could not be examined because of the moss cover.

## Hidden Creek area

Some of the samples in the Nixon Fork district with the greatest concentration of thorianite come from Encio Gulch, a tributary of Hidden Creek (fig. 4). However, radiometric traverses around the head of Hidden Creek and its headwater tributaries gave negative results. The results are negative, not so much because of the lack of any radioactive materials, which may be perfectly possible, but probably because the valley is covered almost completely by a thick shielding cover of moss and low brush. Concentrates from stream gravels collected during the 1949 investigations are listed in table 4. They are somewhat lower in radioactivity than the pre-1949 samples because the latter were obtained when placer operations were active in the valley. The occurrence of bismuth in the placers is apparently restricted to the valley of Hidden Creek above Dry Gulch, and, because it is thought that all of that portion of the valley of Hidden Creek is underlain by monzonite, it is likely that the bismuth is restricted to the monzonite.

## Whalen mine

The main shaft of the Whalen mine is located at the head of Holmes Gulch very near the contact between the limestone and monzonite. The limestone forms an island surrounded by monzonite (fig. 4). At this shaft boulders of limestone on the waste dump are radioactive and contain a high percentage of allanite. The equivalent uranium content of the boulders is 0.05 percent but fluorometric analysis indicates a uranium content of only 0.004 percent (table 5). It is assumed, therefore, that most of the radioactivity of these rocks is due to thorium. The heavy-mineral concentrate (that greater than 2.8 specific gravity) of the rock consists of 98 percent allanite (the radioactive mineral) and 2 percent zircon, kyanite, and scheelite. These heavy minerals constitute about 25 percent of the rock.

A short distance east of the main shaft is a large depression about 40 feet deep formed as the result of a cave-in on the 40-foot level of the mine. Most of the material of the cave-in was high-grade gold ore and was mined out, leaving a "glory hole." Along the walls of the glory hole is exposed highly weathered metamorphic rock consisting mainly of quartz and recrystallized limestone that has an average content of about 0.025 percent equivalent uranium (table 5). However, chemical analyses show only 0.002 percent uranium in this rock. The radioactive mineral is parisite ( a rare-earth fluocarbonate ) that makes up about 95 percent of the heavy-mineral fraction of the rock.

The main shaft of the Whalen mine is 200 feet deep and is inclined at an 85-degree angle down the contact. This shaft could not be examined because it was filled with ice to within 12 feet of the top.

There are between 150 and 200 small shafts and prospect pits along the contact between the limestone and monzonite in the vicinity of the Whalen mine. Approximately 80 of the prospect pits were cleaned out and tested radiometrically in an effort to discover any additional concentrations of radioactive minerals. A few of the holes tested have a higher-than-normal radioactivity and were sampled for further study (table 5). Radiometric analyses of these samples indicate an equivalent uranium content ranging from 0.001 to 0.006 percent (table 5). The radioactive minerals in these samples are allanite, hematite, zircon, and sphene.

## Ruby Creek area

Samples from Ruby Creek are not plotted on figure 4, but their locations are described in table 6. The most radioactive sample obtained in the Ruby Creek drainage (no. 3570, table 6) contains 0.078 percent equivalent uranium. The sample is a sluice-box concentrate from the Strand placer mine on Ruby Creek at the foot of the headwaters gradient of Crystal Gulch. Most of the lode deposits on the Nixon Fork Mining Co. property are located at the head of this gulch. The percentages of the minerals in the fraction greater than 2.8 specific gravity of this concentrate are given in table 7. Most of the radioactivity in this sample is probably due to the thorianite. The unknown secondary minerals were analysed spectrographically. The yellow mineral contains bismuth, lead, copper, iron, vanadium, and silicon as major constituents,

Table 3.—Data on concentrates collected in the Nixon Fork mining district before 1949

| Samples: File no. | Samples: Field no. | Location and description | Percent equivalent uranium |
|---|---|---|---|
| 10 | 33AMt 68 | Nixon Fork mine; mill concentrates | < 0.001 |
| 11 | 70 | Birch Gulch, 1/4 mile above mouth; placer concentrate | .014 |
| 50 | 73 | Hidden Creek, above Dry Gulch; placer concentrate | .031 |
| 134 | --- | Holmes Gulch(?); probably sluice-box concentrate | .086 |
| 900 | 45AW 59 | Greer Gulch; placer concentrate | .003 |
| 901 | 57 | Holmes Gulch; placer concentrate | .008 |
| 902 | 57A | ------do | .015 |
| 903 | 51 | Whistling Gulch; placer concentrate | .006 |
| 904 | 53 | Nixon Fork mine; mill concentrates | < .001 |
| 905 | 44 | Ruby Creek; placer concentrate | .012 |
| 906 | 56 | Birch Gulch; placer concentrate | .007 |
| 907 | 54 | Hidden Creek, between Whistling and Dry Gulches; placer concentrate. | .013 |
| 908 | 50 | Whistling Gulch; placer concentrate | .006 |
| 909 | 58 | Puzzle Creek; placer concentrate | .002 |
| 910 | 57B | Holmes Gulch; placer concentrate | --- |
| 911 | 47 | Encio Gulch; placer concentrate | .005 |
| 912 | 48 | Hidden Creek, below Encio Gulch; placer concentrate | .012 |
| 913 | 60 | Mystery Creek; placer concentrate | .004 |
| 914 | 45 | Ruby Creek; placer concentrate | .005 |
| 915 | 46 | ------do | .007 |
| 916 | 49 | Hidden Creek, above Encio Gulch; placer concentrate | .010 |
| 917 | 52 | Nixon Fork mine; concentrate from mill tailings | .002 |
| 923 | 55 | Dry Gulch; placer concentrate | .001 |
| 926 | 61 | Submarine Creek; placer concentrate | .002 |

Table 4.—Data on placer concentrates collected from Hidden Creek and its tributaries in 1949

| Samples: File no. | Samples: Field no. | Location | Concentration ratio | Percent equivalent uranium in heavy-mineral fraction[1] |
|---|---|---|---|---|
| 3574 | 49ASv 108 | Hidden Creek, above Encio Gulch | 145:1 | 0.009 |
| 3575 | 109 | Hidden Creek, left limit tributary above Encio Gulch. | 400:1 | .006 |
| 3576 | 110 | Hidden Creek, extreme head, 1,000 feet below road. | 120:1 | .006 |
| 3577 | 111 | ------do | 310:1 | .007 |
| 3578 | 112 | Hidden Creek, prospect hole | 275:1 | .006 |
| 3579 | 113 | Birch Gulch, 1,000 feet above mouth | 360:1 | .012 |
| 3580 | 114 | Dry Gulch, 1,500 feet above mouth | 630:1 | .003 |
| 3581 | 115 | Hidden Creek, 1/2 mile above Birch Gulch. | 150:1 | .005 |
| 3582 | 116 | Hidden Creek, 1/2 mile above Birch Gulch; tailings pile. | 90:1 | .005 |
| 3583 | 117 | Whistling Gulch, near mouth | 190:1 | .007 |
| 3584 | 118 | Holmes Gulch, left headwaters fork | 270:1 | .005 |
| 3584 | 119 | Encio Gulch, left headwaters fork | 60:1 | .004 |
| 3585 | 120 | Encio Gulch, right headwaters fork | 90:1 | .005 |
| 3586 | 121 | Encio Gulch, near mouth | 80:1 | .006 |

[1] That greater than 2.8 specific gravity.

Table 5.—Data on samples collected from the Whalen mine and vicinity

| Samples | | Location and description | Crushed rock | | Heavy-mineral fraction[3] | |
|---|---|---|---|---|---|---|
| File no. | Field no. | | eU[1] (percent) | U[2] (percent) | eU[1] (percent) | Concentration ratio |
| | | Samples collected at Whalen mine | | | | |
| 3619 | 49AWe 127 | Whalen mine tailings dump; limestone with large amount of metamorphic minerals. | 0.05 | 0.004 | 0.081 | 4:1 |
| 3620 | 128 | Same as sample 3619; concentrate from panning crushed rock. | --- | --- | .08 | 4:1 |
| 3621 | 129 | Whalen mine"glory hole", wash from west side rim. | --- | --- | .06 | 900:1 |
| 3622 | 130 | "Glory hole"; rock along contact between highly weathered limestone and highly leached limestone, panned concentrate. | --- | --- | .14 | 850:1 |
| 3623 | 132 | Same as sample 3622; highly weathered limestone. | .03 | .002 | .14 | 35:1 |
| 3624 | 133 | Same as 3623;panned concentrate-- | --- | --- | .14 | 160:1 |
| 3625 | 134 | Same as 3622; weathered limestone. | .02 | .002 | .10 | 400:1 |
| 3626 | 135 | "Glory hole"; combination of the rock types of samples 3623 and 3625. | .03 | .002 | .12 | 30:1 |
| 3627 | 150 | Slope east of Whalen mine shaft; decomposed limestone; panned concentrate. | --- | --- | .019 | 2,400:1 |
| 3628 | 151 | Same as sample 3627; unconcentrated rock. | .005 | .002 | .04 | 640:1 |
| | | Samples collected from some of the prospect holes along the contact between the monzonite and limestone in the vicinity of the Whalen mine | | | | |
| 3629 | 153 | Hole no. 21; limestone----------- | 0.004 | --- | 0.010 | 170:1 |
| 3630 | 154 | Hole no. 24; monzonite----------- | .003 | --- | .010 | 90:1 |
| 3631 | 155 | Hole no. 25; monzonite----------- | .003 | --- | .004 | 40:1 |
| 3632 | 156 | Hole no. 32; limestone----------- | .000 | --- | .001 | 50:1 |
| 3633 | 157 | Hole no. 51; limestone----------- | .002 | --- | .004 | 40:1 |
| 3634 | 158 | Hole no. 52; limestone----------- | .006 | --- | .018 | 20:1 |
| 3635 | 159 | Hole no. 54; monzonite----------- | .002 | --- | .004 | 20:1 |
| 3636 | 160 | Hole no. 56; monzonite----------- | .003 | --- | .008 | 50:1 |
| 3637 | 161 | Hole no. 60; monzonite----------- | .001 | --- | .003 | 25:1 |
| 3638 | 162 | Hole no. 61; limestone----------- | .005 | --- | .019 | 300:1 |
| 3639 | 163 | Hole no. 65; monzonite----------- | .001 | --- | .003 | 30:1 |
| 3640 | 164 | Hole no. 68; limestone----------- | .004 | --- | .006 | 60:1 |
| 3641 | 164 | Hole no. 74; monzonite----------- | .005 | --- | .007 | 25:1 |

[1] eU - equivalent uranium.
[2] U - uranium.
[3] That greater than 2.8 specific gravity.

Table 6.—Data on bedrock samples and concentrates collected in the Ruby Creek area in 1949

| Samples: File no. | Samples: Field no. | Location and description | Crushed rock: eU[1] (percent) | Crushed rock: U[2] (percent) | Heavy-mineral fraction[3]: eU[1] (percent) | Heavy-mineral fraction[3]: Concentration ratio |
|---|---|---|---|---|---|---|
| 3558 | 49ASv 91 | Head of Ruby Creek; placer concentrate above mill and mill tailings dump. | --- | --- | 0.007 | 300:1 |
| 3567 | 100 | Ruby Creek; placer concentrate at foot of headwaters gradient. | --- | --- | .006 | 130:1 |
| 3568 | 101 | Same as sample 3567------------- | --- | --- | .008 | 290:1 |
| 3569 | 102 | Crystal Gulch; concentrate from head of placer workings. | --- | --- | .02 | 650:1 |
| 3570 | 103 | Ruby Creek; sluice-box concentrate from Strand placer workings. | --- | --- | .078 | ([4]) |
| 3593 | 49AWe 89 | Along trail on left limit of Crystal Gulch; monzonite. | 0.004 | --- | .005 | 15:1 |
| 3594 | 91 | Along road from mill to Garnet Shaft; monzonite. | .003 | --- | .006 | 9:1 |
| 3596 | 94 | Bench on right limit of Ruby Creek above Strand placer mine; disintegrated monzonite. | --- | --- | .011 | 690:1 |
| 3597 | 95 | Same as sample 3596; undisintegrated rock. | .003 | --- | .005 | 10:1 |
| 3598 | 97 | At mouth of Crystal Gulch in Strand placer mine; shattered monzonite. | --- | --- | .004 | 650:1 |
| 3599 | 98 | On north side of Strand placer mine; panned concentrate from disintegrated granitic dike in monzonite. | --- | --- | .013 | 2,270:1 |
| 3600 | 99 | Same as sample 3599; quartz veins paralleling granitic dike. | .002 | --- | .010 | 220:1 |
| 3601 | 101 | On south side of Strand placer mine; panned concentrate of disintegrated granitic dike. | --- | --- | .032 | 780:1 |
| 3602 | 102 | Same as sample 3601; undisintegrated rock. | .003 | --- | .016 | 80:1 |
| 3603 | 104 | Strand placer mine; inclusions in monzonite. | .002 | --- | .003 | 5:1 |
| 3604 | 105 | Middle Crystal Gulch; bedrock from contact zone. | .002 | --- | .007 | 70:1 |
| 3607 | 111 | Same as sample 3594; panned concentrate from disintegrated monzonite. | --- | --- | .015 | 1,800:1 |
| 3608 | 112 | Same as sample 3594; panned concentrate of disintegrated granitic dike in monzonite. | --- | --- | .033 | 2,270:1 |
| 3609 | 113 | Same as sample 3594; undisintegrated granitic dike in monzonite. | .008 | 0.004 | .021 | 100:1 |

[1] eU- equivalent uranium.
[2] U- uranium (determined chemically).
[3] That greater than 2.8 specific gravity.
[4] Very high.

Table 7.—Mineralogy and radioactivity of three placer concentrates from the Nixon Fork mining district

| Minerals | Sample no. 3570 | Sample no. 3642 | Sample no. 3850 |
|---|---|---|---|
| Allanite | --- | 3* [1] | 1* |
| Azurite | tr | --- | --- |
| Cassiterite | 3 | --- | --- |
| Common rock-forming minerals | 4 | 2 | --- |
| Fluorite | tr | 1 | tr |
| Garnet | --- | 5 | 4 |
| Gold | a [2] | --- | --- |
| Hematite | a* | tr* | --- |
| Ilmenite | 70 | 85 | 80 |
| Malachite | tr* | --- | --- |
| Magnetite | 13 | tr | 8 |
| Monazite | --- | --- | tr |
| Powellite | --- | --- | tr |
| Pyrite | --- | --- | tr |
| Scheelite | 5 | 3 | 4 |
| Sphene | a* | tr* | --- |
| Thorianite | a* | 1* | 1* |
| Unknown secondary green mineral | tr* | --- | --- |
| Unknown secondary yellow mineral | tr* | --- | --- |
| Uraninite | --- | --- | .1* |
| Zircon | a* | tr | tr |
| Equivalent uranium content (percent) | 0.078 | 0.26 | 0.18 |
| Uranium content (percent) | n.d. | n.d. | .06 |

[1] Estimated volume percent; the asterisk indicates that the mineral is uranium-bearing as determined by a sodium fluoride flux test.
[2] a indicates that these five minerals total 5 percent of the sample.

and calcium, aluminum, arsenic, and antimony as minor constituents. The green mineral contains copper, bismuth, silicon, calcium, iron, and lead as major constituents, and aluminum, vanadium, and phosphorous as minor constituents. The source of the thorianite or the secondary uranium-bearing minerals was not found, though search was extended to all the slopes of Ruby Creek along the contact and in the monzonite, where these slopes were not thickly covered by moss. It is possible that these minerals are derived from a restricted zone at or close to the contact, similar to the parisite-bearing zone in the Whalen mine "glory hole." The radioactivity in all the concentrates and rock samples from the head of Ruby Creek is probably due mainly to the minerals zircon and sphene. Thorianite was not found among them.

## Nixon Fork mine

Almost all the ore that was processed from all the shafts and prospect pits in the vicinity of the Nixon Fork mine was processed at the stamp mill located at the head of Ruby Creek (fig. 4). The tailings from the milling operation, crushed to fine silt size, were dammed up at the rear of the mill with the expectation that by further refinement of the milling processes additional gold could be recovered from these tailings. Radiometric tests of these tailings in the field indicated no appreciable radioactivity. However, in order to determine whether any radioactive minerals had been carried over into the tailings during milling operations, the mill-tailings pile was sampled both across the surface or top (with holes 3 to 4 feet deep) and across the base. As the equivalent uranium content of the heavy-mineral fractions (those greater than 2.8 specific gravity) of these samples ranges only from 0.002 to 0.008 percent (table 8), it is obvious that very little radioactive material occurs in the tailings.

Samples of ore were collected and tested from various ore and concentrate bins in and near the mill. The maximum equivalent uranium content of any of these samples is 0.019 percent. The radioactivity is apparently associated with iron oxides in the ore. Table 8 lists the data on all the samples collected in and near the mill.

Table 8.—Data on ore, mill, and tailings samples from the Nixon Fork mine, 1949

| Samples | | Location and description | Crushed rock eU (percent)[1] | Heavy-mineral fraction[2] | |
|---|---|---|---|---|---|
| File no. | Field no. | | | eU (percent)[1] | Concentration ratio |
| 3542 | 49ASv 75 | Nixon Fork mill; mill tailings | --- | 0.002 | 1,950:1 |
| 3543 | 76 | Small stream along side of Nixon Fork mine; mill tailings. | --- | .004 | 370:1 |
| 3544 | 77 | Nixon Fork mine mill; mill tailings | --- | .003 | 590:1 |
| 3545 | 78 | do | --- | .008 | 3,400:1 |
| 3546 | 79 | do | --- | .005 | 620:1 |
| 3547 | 80 | do | --- | .004 | 120:1 |
| 3548 | 81 | do | --- | .002 | 1,360:1 |
| 3549 | 82 | do | --- | .003 | 1,360:1 |
| 3550 | 83 | do | --- | .002 | 560:1 |
| 3551 | 84 | do | --- | .003 | 750:1 |
| 3552 | 85 | Nixon Fork mine mill; crushed ore, partly concentrated. | --- | .003 | (?) |
| 3553 | 86 | do | --- | .003 | (?) |
| 3554 | 87 | do | --- | .006 | (?) |
| 3555 | 88 | do | --- | .004 | (?) |
| 3556 | 89 | do | --- | .004 | (?) |
| 3557 | 90 | Nixon Fork mine mill; mill tailings | --- | .002 | 1,360:1 |
| 3559 | 92 | do | --- | .002 | 500:1 |
| 3560 | 93 | do | --- | .002 | 2,700:1 |
| 3561 | 94 | do | --- | .004 | 270:1 |
| 3562 | 95 | do | --- | .002 | 450:1 |
| 3563 | 96 | do | --- | .002 | 210:1 |
| 3564 | 97 | do | --- | .002 | 500:1 |
| 3565 | 98 | do | --- | .003 | 900:1 |
| 3566 | 99 | do | --- | .002 | 380:1 |
| 3588 | 49AWe 81 | Nixon Fork mine; gold ore | 0.000 | .001 | 3:1 |
| 3589 | 82 | Nixon Fork mine; oxidized ore | .007 | .007 | 2:1 |
| 3590 | 83 | do | .009 | .012 | 3:1 |
| 3591 | 85 | do | .006 | .008 | 3:1 |
| 3592 | 86 | do | .019 | .019 | 2:1 |
| 3595 | 93 | Nixon Fork mine; partly milled ore from Garnet shaft. | .002 | .006 | (?) |
| 3605 | 107 | Nixon Fork mine; malachite ore from Crystal shaft. | .002 | --- | --- |
| 3606 | 109 | Nixon Fork mine; malachite ore from Garnet shaft. | .006 | --- | --- |

[1] eU-equivalent uranium.
[2] That greater than 2.8 specific gravity.

Table 9.—Data on samples of garnet rock from the vicinity of the Crystal shaft, Nixon Fork mine

| Samples | | Description | Crushed rock | | Heavy-mineral fraction[3] | |
|---|---|---|---|---|---|---|
| File no. | Field no. | | eU[1] (percent) | U[2] (percent) | eU[1] (percent) | Concentration ratio |
| 3610 | 49AWe 115 | Surface wash on contact between limestone and monzonite 50 feet northeast of Crystal shaft; panned concentrate. | --- | --- | 0.014 | 270:1 |
| 3611 | 116 | Random fragments of garnet rock showing high radioactivity. | 0.018 | 0.008 | --- | --- |
| 3612 | 117 | Clean, unweathered garnet rock from shaft. | .000 | --- | --- | --- |
| 3613 | 118 | do | .000 | --- | --- | --- |
| 3614 | 119 | Selected specimen of garnet rock showing strongest radioactivity. | .025 | .008 | --- | --- |
| 3615 | 120 | Garnet rock showing strong radioactivity. | .017 | .006 | .026 | 10:1 |
| 3617 | 122 | Monzonite at contact with garnet rock. | .003 | --- | .006 | 25:1 |
| 3618 | 123 | Same as sample 3617; concentrate obtained by panning crushed rock. | --- | --- | .012 | 60:1 |

[1] eU-equivalent uranium.
[2] U-uranium (determined chemically).

Crystal shaft.—The Crystal shaft (fig. 4) of the Nixon Fork mine is located in a highly metamorphosed zone of rock that probably includes both monzonite and recrystallized limestone. About 50 feet northeast of the shaft a massive garnet rock underlies garnet-bearing, marmorized limestone and contains as much as 0.025 percent equivalent uranium. Study of samples from this locality (table 9) shows that the radioactivity is associated with garnet rock that is somewhat impure and weathered. The fresh, unweathered garnet is nonradioactive. The impurity in the garnet occurs in thin beds or irregular masses and is well coated with hydrous iron oxides. The composition of the garnet rock, exclusive of the hydrous iron oxides, is 65 percent garnet, 20 percent idocrase, 12 percent common rock-forming minerals, 3 percent sphene, and traces of zircon and magnetite. The radioactive minerals are idocrase and sphene. The radioactive material in the garnet appears to be mainly an iron-oxide coating and filling in fractures and fissures in the rock.

No significant radioactivity was detected at any of the numerous other prospect pits and shafts on the property of the Nixon Fork mine.

## Other localities examined

### Mystery, Puzzle, and Submarine Creeks

Three concentrates were collected from gravels in Mystery and Puzzle Creeks to supplement the samples from these creeks previously available in the Alaskan Geology Branch concentrate file (table 3). The radioactivity of the three samples is given below:

| Samples | | Location | Heavy-mineral fraction | |
|---|---|---|---|---|
| File no. | Field no. | | eU (percent) | Concentration ratio |
| 3571 | 49ASv 104 | Mystery Creek---------------------------- | 0.006 | 125:1 |
| 3572 | 105 | Mystery Creek---------------------------- | .018 | 3,025:1 |
| 3573 | 106 | Puzzle Creek----------------------------- | .003 | 130:1 |

Radiometric traverses were made around the heads of these two creeks as well as Submarine Creek, particularly along the ridge of which Strand and Jumbo Peaks are a part (fig. 4). No radioactivity anomalies were found.

### Eagle Creek

Eagle Creek, a tributary of Crooked Creek, is located about 5 to 7 miles south of the Nixon Fork mines (fig. 4). B. A. Stone of Medfra operates a small gold-lode mine on the headwater slopes of the creek near the contact between the limestone country rock and a small monzonite mass. The heavy-mineral fraction (that greater than 2.8 specific gravity) of a sluice-box concentrate (sample no. 3642) from a placer operation on Eagle Creek owned by Stone contains 0.26 percent equivalent uranium. The mineral composition of the Eagle Creek sluice-box concentrate is given in table 7. The radioactivity appears to be due chiefly to uraniferous thorianite, although the allanite, hematite, and sphene are also radioactive. Radiometric traverses along the headwater slopes of Eagle and Skookum Creeks (fig. 4) failed to disclose the bedrock source of the radioactive minerals. A sample (no. 3644) of the monzonite on Eagle Creek contains only 0.003 percent equivalent uranium and a sample (no. 3643) of garnet rock from the lode mine contains less than 0.001 percent equivalent uranium. Again, however, the negative radiometric data obtained in traversing is not conclusive because of the thick vegetation cover over most of the area.

In 1950 a placer concentrate containing 0.18 percent equivalent uranium and 0.06 percent uranium was received from a prospector, who indicated only that it came from western Alaska; information obtained later suggests that it is probably from a placer mine in the Nixon Fork district. The mineralogy of this sample (no. 3850) is compared with two other placer concentrates from the Nixon Fork district in table 5. The marked similarity of this concentrate to that from Eagle Creek (no. 3642) suggests the probability that it also is from Eagle Creek rather than elsewhere in the district. Of note is the occurrence of uraninite as well as the uraniferous thorianite.

## SUMMARY AND CONCLUSIONS

A summary of significant radioactivity data obtained in the Nixon Fork mining district in 1949 is given in table 10. The only radioactive mineral of major importance is uraniferous thorianite, although such minerals as allanite, parisite, idocrase; sphene, zircon, malachite, and two unidentified secondary polymetal minerals are also radioactive. Uraninite has been identified in a concentrate that may have come from a placer mine in the district. The bedrock source of the uraniferous thorianite has not been located, but it is believed to occur, at least in part, in a restricted zone or zones at or near the contact between limestone and monzonite similar to the gold-copper ores of the district, the radioactive parisite zone at the Whelan mine, and the radioactive garnet-rock zone at the Crystal shaft of the Nixon Fork mine.

Search for bedrock sources of the radioactive minerals in the district by radiometric surveying is hampered considerably by the shielding effect of the heavy moss cover so prevalent through much of interior Alaska.

Table 10.—Summary of significant radioactivity date obtained in the Nixon Fork mining district, 1949

| Location and type of material tested | Radioactive minerals | Maximum radioactivity Percent eU | Maximum radioactivity Percent U |
|---|---|---|---|
| **Placers** | | | |
| Hidden Creek and tributaries | Uraniferous thorianite | 0.012 | --- |
| Ruby Creek area: | | | |
| Sluice-box concentrate from Strand placer mine. | Uraniferous thorianite, hematite, zircon, sphene, malachite, and two unidentified secondary minerals. | .078 | --- |
| Mystery Creek and tributaries | Not determined | .018 | --- |
| Eagle Creek: | | | |
| Sluice-box concentrate from Stone placer mine. | Uraniferous thorianite, allanite, and sphene. | .26 | --- |
| Placer concentrate, location unknown but possibly from Eagle Creek (submitted by prospector in 1950). | Uraninite, uraniferous thorianite, and allanite. | .18 | 0.06 |
| **Bedrock** | | | |
| Whalen mine: | | | |
| Metamorphosed limestone on waste dump. | Allanite | 0.05 | 0.004 |
| Altered limestone in "glory hole". | Parisite | .03 | .002 |
| Limestone and monzonite in prospect holes. | Allanite, hematite, zircon, and sphene. | .006 | --- |
| Ruby Creek area: | | | |
| Monzonite | Zircon and sphene | .004 | --- |
| Granitic dike in monzonite | do | .008 | --- |
| Nixon Fork mine: | | | |
| Mill tailings concentrates. | Not determined | .008 | --- |
| Ore samples from ore bins in mill. | Iron oxides | .019 | --- |
| Altered garnet rock from Crystal shaft. | Idocrase, sphene, and iron oxides | .025 | .008 |
| Fresh garnet rock from Crystal shaft. | ---------- | .000 | --- |
| Eagle Creek: | | | |
| Monzonite | Not determined | .003 | --- |
| Garnet rock | do | .001 | --- |

It is suggested that geochemical prospecting techniques, such as the analysis of samples of disintegrated material taken from auger holes through the shielding moss cover may prove more successful in locating the bedrock source of the uranium- and thorium-oxide minerals than surface radiometric traversing. Such sampling might well be supplemented by the radiometric logging of the auger holes with a survey meter such as a portable scaler. Much study on the application of geochemical prospecting techniques in Arctic and sub-Arctic regions is needed, however, before a routine can be developed.

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