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# RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN SOUTH-CENTRAL ALASKA, 1947-49

Part 1. Reconnaissance for radioactive deposits in areas adjacent to highways in south-central Alaska during 1947

By R. M. Moxham

Part 2. Radioactive pegmatite minerals in the Willow Creek mining district

By R. M. Moxham and A. E. Nelson

Part 3. Radioactive pegmatite minerals in the Yakataga beach placers

By R. M. Moxham

This report concerns work done on behalf of the U. S. Atomic Energy Commission and is published with the permission of the Commission.

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## PART 1.--RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN AREAS ADJACENT TO HIGHWAYS IN SOUTH-CENTRAL ALASKA DURING 1947

By R. M. Moxham


### ABSTRACT

A radiometric reconnaissance of the areas adjacent to the principal highways and secondary roads of south-central Alaska was carried out during the summer of 1947. The investigation included the examination of nine gold-placer workings, five gold lodes, a gypsum mine, and a copper prospect. Nearly all types of rock cropping out in the highway belt were tested. No significant amounts of radioactive material were found.


### INTRODUCTION

The highway system of south-central Alaska (pl. 1 and fig. 1) offers ready access to a mineralized region of considerable size from which little information on radioactivity had been obtained prior to 1947. The objective of the 1947 field work was to make a radiometric reconnaissance of the area. This entailed testing various rock types for radioactivity, investigating lode and placer-mining operations, and collecting placer concentrates from as many streams as possible to determine whether radioactive minerals were being liberated from bedrock in the various drainage basins by erosion.

Reconnaissance of the areas bordering the principal highways in Alaska was begun in 1946 (Wedow and Matzko, 1947).[1] This report gives the results of a continuation of the previous year's work. The 1947 field party, consisting of Robert M. Moxham, geologist, and Donald R. Olson, camphand, began work in June and terminated in September. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

### GEOGRAPHY

Mountainous areas separated by broad lowlands make up that portion of south-central Alaska with which this report is concerned. The Wrangell Mountains, situated between the Chugach Mountains to the south and the Alaska Range of the interior, are partly volcanic in origin and include some of the highest peaks in Alaska. In the Coast Range, or Chugach Mountains, rugged peaks 4,000 to 7,000 ft high border the coast of the Gulf of Alaska from the Canadian border to Cook Inlet. To the north, the broad lowland of the Copper and Chitina Rivers lies between the Coast Range and the Wrangell Mountains. The northwestern border of the region is marked by the Talkeetna Mountains, an isolated mass separated from the Chugach Mountains by the Matanuska Valley and from the interior by the Copper and Susitna River lowlands. The latter drainage basins include a vast area of glacial moraine and outwash extending from north of the Talkeetna Mountains southeast to the Wrangell Mountains.

As referred to in this report, the southern highway belt comprises the areas bordering the following highways and secondary roads in south-central Alaska: the Edgerton Highway, locally referred to as the Chitina road; the Richardson Highway from Gulkana to Valdez; the Glenn Highway from Anchorage to Glenn Allen; and the secondary roads in the Willow Creek mining region northwest of Palmer. The Nizina and Bremner mining areas were included in the reconnaissance, although they are some distance east of the highway belt described above (fig. 1 and pl. 1).

### MEASUREMENTS OF RADIOACTIVITY

A standard portable survey meter, equipped with a single 6 in. beta tube, was employed in the field. Investigations included spot outcrop tests of the various rock types; panning stream gravel to obtain heavy-mineral concentrates; investigating mines, prospects, and mineralized zones; and testing and collecting mine concentrates. Standard methods were followed in making semiquantitative measurements and spot checks. The procedures have been discussed in detail by Stead (1945) and Wedow and Matzko (1947, pp. 5-7). In the laboratory the rock samples were crushed, and the equivalent uranium (hereafter referred to as eU) content of the unconcentrated material measured on the basis of the beta count. Placer concentrates were treated with bromoform to remove the minerals with a specific gravity greater than 2.9, and the eU content of the heavy-mineral fraction was determined on the basis of the beta count. The localities at which tests were made are shown in plate 1.

### AREAS INVESTIGATED

#### Wrangell Mountains

##### Geology

Only the southeastern part of the Wrangell Mountains was visited in the course of the examinations described in this report. The Nikolai greenstone of Permian and Triassic(?) age is the oldest formation

[1] See references cited.

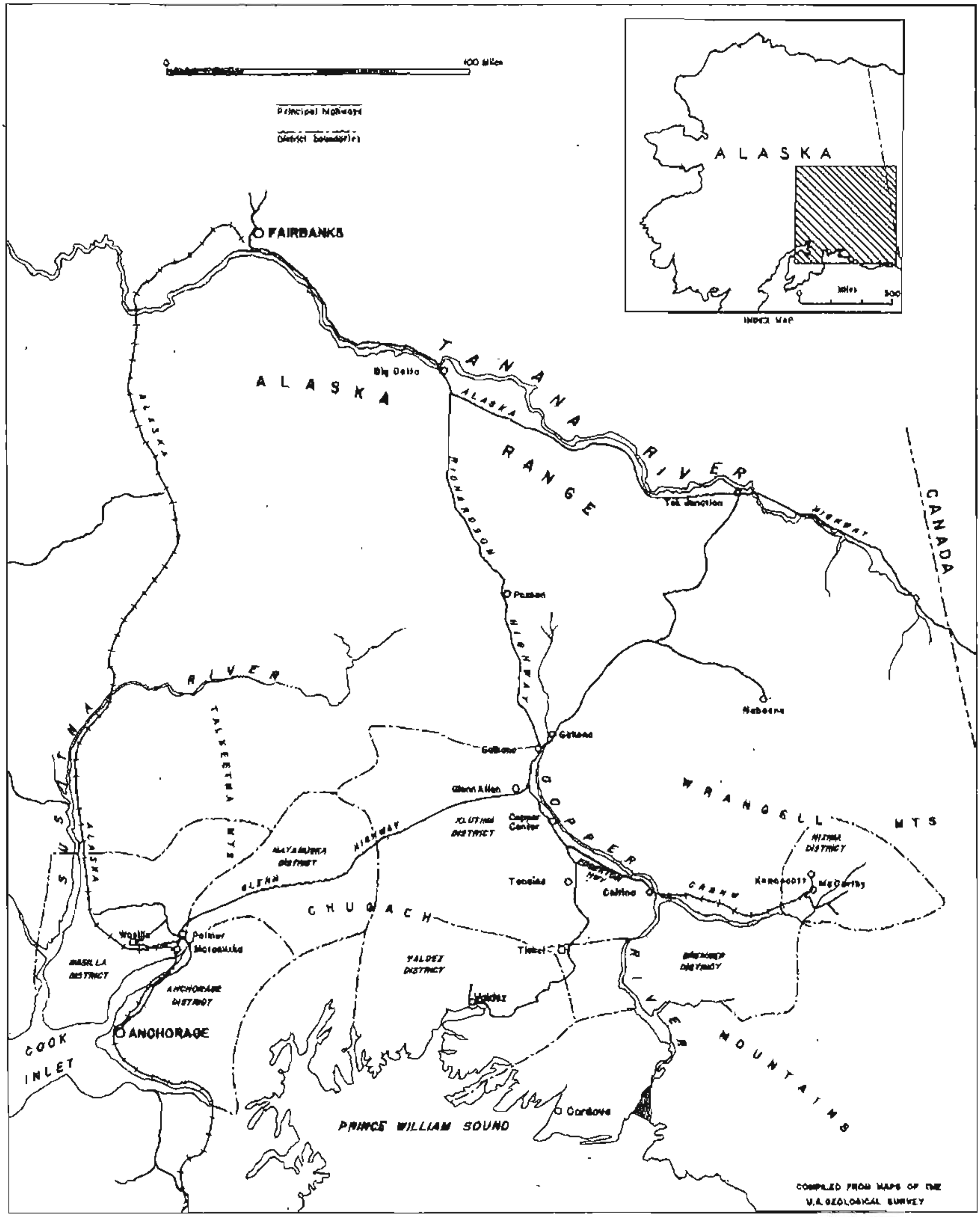


Figure 1. Map showing the principal highways in south-central Alaska.

in this area. The unit consists of approximately 4,000 ft of dark altered lava flows, many of them coarse-textured and amygdaloidal. The greenstone is overlain conformably by the Chitistone limestone of late Triassic age, whose thickness is approximately 3,000 ft. The limestone in the lower part of the formation is gray and massive-bedded; that in the upper part of the formation is increasingly thin-bedded upwards and passes by transition to a black shale with a few intercalated limestone beds. The Chitistone limestone is overlain by the McCarthy shale, of Triassic age, and the McCarthy by the shales and sandstones of the Kennicott formation of Early Cretaceous age. The Permian, Triassic(?) and Cretaceous rocks have been intruded by dikes, sills, and laccoliths of light-colored quartz diorite of post-Jurassic age. In most places these intrusives have had little effect on the country rock, though local silicification of the limestone and shale and recrystallization of the limestone have taken place. A detailed description of the geology of the area is given by Moffit (1938, pp. 42-48).

Nizina district

Mineral deposits and mining. --The Nizina district, in the southeastern part of the Wrangell Mountains, is noted for the production of copper, principally from mines of the Kennecott Copper Corp. It is estimated that more than a billion pounds of the metal were produced in this area from 1911 to 1938. Since 1938 the region has produced only a few tons of native copper. Gold has been produced from placer deposits of Dan and Rex Creeks for many years, but the total value of the gold is relatively small.

Radioactivity studies. --The materials tested and the results of the tests are listed below:

| Sample no. | Location | Type of material | Radioactivity (in percent eU) |
|---|---|---|---|
| 10 | Dan Creek | Shale (Kennicott formation). | 0.002 |
| 11 | Dan Creek tributary. | Panned concentrate | .000 |
| 12 | Rex Creek | Shale (Kennicott formation). | .002 |
| 13 | Young Creek | Panned concentrate | .001 |
| 14 | North of McCarthy | Shale (McCarthy formation). | .000 |
| 15 | North of McCarthy | Greenstone (Nikolai formation). | .002 |
| 16 | Near Kennecott | Granite | .001 |
| 25 | O'Neill mine, Dan Creek. | Sluice-box concentrate | .000 |
| 86 | Chititu Mines, Inc. Rex Creek. | do | .000 |
| Spot checks | (1) | Shale (Kennicott formation). | Insignificant. |

[1]Several localities.

The Kennecott mines could not be examined, as the property has been closed since 1938.

## Chugach Mountains

Geology

The Chugach Mountains consist mainly of dark metamorphosed argillites and graywackes, probably of Mesozoic age. These units are interbedded with altered extrusive rocks in the western part of this range. Carboniferous argillite, conglomerate, quartzite, and lava intruded by quartz diorite crop out in a relatively small area near Tonsina. The geology of the Chugach Mountains has been discussed in detail by Moffit (1935, pp. 16-26) and Capps (1940, pp. 53-64).

Bremner district

Mineral deposits and mining. --A small amount of gold has been produced from lode and placer mines in the vicinity of the Bremner River, southwest of the Nizina district. Most of the metal has been taken from placer deposits on Golconda Creek and adjacent streams and from lode mines in the valley of Golconda Creek. The district has been inactive since about 1941.

Radioactivity studies. --Lack of time limited the work in the Bremner area to the collection of one placer sample from surface gravel in the vicinity of former mining operations on Golconda Creek. The heavy-mineral fraction contained 0.004 percent eU. A small percentage of zircon and sphene is responsible for the slight radioactivity.

Klutina district

Mineral deposits and mining. --The Klutina district includes the area drained by the west tributaries of the Copper River between the Tiekel and Gulkana Rivers. There are many placer and gold-lode prospects in the district, and mining has been carried on sporadically for many years. Fall, Boulder, and Hurtle Creeks, in the vicinity of Tieke, and the headwater tributaries of the little Nelchina River were the principal sources of placer gold. A number of gold-lode prospects are in the vicinity of Tiekel. At the present time, however, mining is confined to one placer operation on Albert Creek, a headwater tributary of the Little Nelchina River.

Radioactivity studies.--The material tested and the results of the tests are listed below:

| Sample no. | Location | Type of material | Radioactivity (in percent eU) |
|---|---|---|---|
| 1 | North of Rock Creek------- | Extrusives (Carboniferous) | 0.001 |
| 2 | Pippin Lake -------------- | Diorite ------------ | .000 |
| 4 | Mount du Relle ----------- | ---------do--------- | .001 |
| 5 | Squirrel Creek ----------- | Panned concentrate - | .000 |
| 6 | Bernard Creek ------------ | Diorite ------------ | .000 |
| 7 | ----------- do ----------- | Panned concentrate-- | .000 |
| 8 | Rock Creek --------------- | -------- do -------- | .000 |
| 9 | Little Tonsina River tributary. | -------- do -------- | .001 |
| 17 | Tiekel River ------------- | -------- do -------- | .003 |
| 18 | Abandoned placer mine, Fall Creek. | -------- do -------- | .003 |
| 19 | Tiekel River tributary --- | -------- do -------- | .002 |
| 20 | Abandoned placer mine, Boulder Creek. | -------- do -------- | .002 |
| 21 | Stuart Creek ------------- | -------- do -------- | .002 |
| 22 | Mile 38, Richardson Highway. | Schist.------------- | .002 |
| 23 | Mile 64, Richardson Highway. | Graywacke ---------- | .000 |
| 32 | Little Tonsina River tributary. | Panned concentrate-- | .001 |
| 33 | Bernard Creek ------------ | -------- do -------- | .000 |
| 34 | Tonsina River ------------ | -------- do -------- | .001 |
| 35 | Tonsina River ------------ | -------- do -------- | .000 |
| 36 | Copper River tributary --- | -------- do -------- | .000 |
| 38 | Tazlina River tributary--- | -------- do -------- | .000 |
| 39 | Little Nelchina River ---- | -------- do -------- | .000 |
| 56 | Crooked Creek tributary--- | -------- do -------- | .000 |
| 57 | Crooked Creek tributary--- | -------- do -------- | .000 |
| 58 | Albert Creek ------------- | -------- do -------- | .000 |
| 59 | Crooked Creek ------------ | -------- do -------- | .000 |
| 87 | McMahon mine, Albert Creek | Sluice concentrate-- | .000 |
| Spot check | Along Richardson Highway. | Graywacke and argillite (Mesozoic). | Insignificant. |
| Spot check | Holland-Townsend prospect, 11 miles south of Tiekel. | Gold lode, dump material. | Do. |

Valdez district

Mineral deposits and mining.--The Valdez district comprises the coastal flank of the Chugach Mountains and the northeastern part of Prince William Sound in the general vicinity of the town of Valdez. Most of the mines in this area have been idle in recent years. Previous production was chiefly gold and copper. Many gold lodes have been prospected in the valley of Mineral Creek, a short distance from Valdez, and in earlier years gold was mined from placer deposits on mineral and Gold Creeks.

Radioactivity studies.--The materials tested and the results of the tests are listed below:

| Sample no. | Location | Type of material | Radioactivity (in percent eU) |
|---|---|---|---|
| 24 | Tonsina River ----------- | Panned concentrate-- | 0.003 |
| 26 | Ptarmigan Drop ---------- | -------- do -------- | .003 |
| 27 | Lowe River tributary ---- | -------- do -------- | .003 |
| 28 | Lowe River -------------- | -------- do -------- | .000 |
| 29 | Mineral Creek ----------- | -------- do -------- | .003 |
| 30 | Abandoned placer mine, Mineral Creek. | -------- do -------- | .005 |
| 31 | Abandoned placer mine, Gold Creek. | -------- do -------- | .003 |
| 50 | Valdez Glacier ---------- | Panned concentrate, outwash. | .002 |
| Spot check | Along Richardson Highway- | Argillite (Mesozoic)- | Insignificant. |
| Spot check | Little Giant mine, Mineral Creek. | Gold-bearing quartz veins. | Do. |

Anchorage district

Mineral deposits and mining. --The Anchorage district includes the areas between Knik Arm and Turnagain Arm at the head of Cook Inlet, extending in an easterly direction to the crest of the Coast Range. Little mining has been done in this district. At the present time one placer-gold operation is working on a northern tributary of the Knik River. The property was not accessible by road at the time of this investigation.

Radioactivity studies. --The material tested and the results of the tests are listed below:

| Sample no. | Location | Type of material | Radioactivity (in percent eU) |
|---|---|---|---|
| 72 | Eklutna Creek--------------- | Panned concentrate-- | 0.000 |
| 73 | Ship Creek ---------------- | -------- do -------- | .001 |
| 76 | Peters Creek --------------- | -------- do -------- | .000 |
| 77 | Eagle River ---------------- | -------- do -------- | .001 |
| 78 | Knik River ----------------- | -------- do -------- | .002 |
| Spot check | Eklutna Creek--------------- | Rhyolite ----------- | Insignificant. |

Talkeetna Mountains

Geology

The Talkeetna Mountains are chiefly granitic rocks of the Talkeetna batholith, but lavas and tuffs, schists, and sedimentary rocks occur as subordinate units in the peripheral area of the intrusive. The oldest rock is the Birch Creek schist of pre-Cambrian age which crops out in the southern part of the mountains. The Birch Creek consists of highly contorted, fissile mica schists and phyllites cut by numerous quartz veins. The structure is highly complex; all traces of the original bedding are obscured by the secondary schistosity. Along the southern boundary of the mountains, a group of volcanic rocks are interbedded with Lower Jurassic sedimentary rocks. The volcanic rocks are largely stratified breccias composed of angular fragments in a chloritic matrix. Several thousand feet of Middle and Upper Jurassic sedimentary rocks crop out in the headwaters of the Little Nelchina River. The principal intrusive rock forming the Talkeetna batholith is a medium- to coarse-grained quartz diorite of Jurassic age. Capps (1940, pp. 65-93) has given a detailed description of the geology of the area.

Wasilla district

Mineral deposits and mining. --The Wasilla district comprises the southwestern part of the Talkeetna Mountains and a part of the lower Susitna River valley. Mining at the present time is confined to the Willow Creek area a short distance north of the town of Palmer. Production from lode mines in this district accounted for a large part of the prewar Alaskan output of gold. In earlier years a small amount of placer gold was taken from streams in this area, particularly from Grubstake Gulch. Several writers have reported pegmatite dikes in the Willow Creek region, but the only one described in the literature (Ray, 1933, p. 184) is an intrusive at the head of Purches Creek, with which copper mineralization is associated.

Subsequent to the 1947 field studies, R. G. Ray, of the Geological Survey, discovered pegmatite float at two localities east of the road in the valley of Fishhook Creek. The rocks are slightly radioactive. During the 1949 field season the pegmatites in the Fishhook Creek area were examined. The results are presented in part 2 of this report.

Radioactivity studies. --The materials tested and the results of the tests are listed below:

| Sample no. | Location | Type of material | Radioactivity (in percent eU) |
|---|---|---|---|
| 64 | Fishhook Creek ----------- | Panned concentrate-- | 0.000 |
| 65 | Independence mine, Fishhook Creek. | Diorite ------------ | .003 |
| 66 | Willow Creek ------------- | Panned concentrate-- | .004 |
| 67 | Willow Creek ------------- | -------- do -------- | .001 |
| 68 | Little Susitna River ----- | -------- do -------- | .000 |
| 69 | Archangel Creek ---------- | -------- do -------- | .001 |
| 70 | Abandoned placer mine, Grubstake Creek. | -------- do -------- | .000 |
| 74 | Grubstake Gulch ---------- | Birch Creek schist-- | .001 |
| 75 | Little Susitna River ----- | Panned concentrate-- | .001 |
| 79 | Fish Creek --------------- | -------- do -------- | .000 |
| 88 | Independence mine -------- | Mill headings------- | .000 |
| 89 | Independence mine -------- | -------- do -------- | .000 |
| Spot check | (1) | Quartz diorite ----- | Insignificant |
| Spot check | (1) | Birch Creek schist-- | Do. |
| Spot check | Independence mine -------- | Gold-bearing quartz veins. | Do. |
| Spot check | Gold Cord mine, Fishhook Creek. | -------- do -------- | Do. |
| Spot check | Fern mine, Archangel Creek | -------- do -------- | Do. |
| Spot check | Holland prospect, Purches Creek. | Copper-bearing pegmatite. | Do. |

[1] Many localities.

## Matanuska Valley

### Geology

The valley of the Matanuska River separates the Talkeetna and Chugach Mountains. The oldest rocks in the valley belong to the Matanuska formation, comprising shale and sandstone and subordinate amounts of conglomerate of Late Cretaceous age. The thickness of the Matanuska formation is approximately 4,000 ft. The beds are strongly folded in the southwestern part of the valley and are progressively less disturbed to the northeast. Overlying the Matanuska formation are shale, sandstone, arkose, coal, and conglomerate of Eocene age which have been tilted and folded. The sedimentary rocks of the Matanuska Valley have been intruded by a large number of small, irregularly shaped dikes of various types, including diorite, trachyte, diabase, gabbro, and basalt, probably of late Tertiary age. A detailed description of the geology of the Matanuska Valley is given by Landes (1927).

### Matanuska district

Mineral deposits and mining. --The Matanuska district includes the valley of the Matanuska River and adjacent areas. It is noted primarily for the Matanuska coal field, one of the two most important coal-producing regions in Alaska. Five miles northeast of Glacier Point in the extreme eastern part of the Matanuska district, a recently discovered deposit of gypsum in being developed.

Radioactivity studies. --The materials tested and the results of the tests are listed below:

| Sample no. | Location | Type of material | Radioactivity (in percent eU) |
|---|---|---|---|
| 40 | Matanuska River tributary -- | Panned concentrate-- | 0.000 |
| 41 | ----------- do ------------ | -------- do -------- | .001 |
| 42 | Caribou Creek-------------- | -------- do -------- | .000 |
| 43 | Hicks Creek --------------- | -------- do -------- | .000 |
| 44 | Matanuska River tributary -- | -------- do -------- | .001 |
| 45 | Matanuska River ----------- | -------- do -------- | .002 |
| 46 | ----------- do ------------ | -------- do -------- | .001 |
| 47 | East of Chickaloon --------- | Basic intrusive----- | .000 |
| 48 | Chickaloon River ----------- | Panned concentrate-- | .000 |
| 49 | Near Hicks Creek ----------- | Shale, (Matanuska formation). | .000 |
| 51 | Matanuska River ------------ | Panned concentrate-- | .000 |
| 52 | Kings River --------------- | -------- do -------- | .001 |
| 53 | 4 miles west of Hicks Creek- | Anthracite coal----- | .000 |
| 54 | Matanuska River tributary -- | Panned concentrate-- | .000 |
| 55 | Granite Creek -------------- | -------- do -------- | .002 |
| 60 | Gravel Creek -------------- | -------- do -------- | .002 |
| 61 | Eska Creek ---------------- | -------- do -------- | .000 |
| Spot check | (1) | Bituminous coal----- | Insignificant. |
| Spot check | Northeast of Glacier Point— | Gypsum----------- | Do. |
| Spot check | (1) | Basic dikes-------- | Do. |

[1]Many localities.

## CONCLUSIONS

None of the rocks examined in the southern highway belt are significantly radioactive, and no further work appears warranted. Radioactive pegmatite float discovered in the Willow Creek area of the Wasilla district subsequent to the work on which this report is based is probably of significance only in suggesting the possibility of larger concentrations of radioactive materials elsewhere in the vastly more extensive area of the Talkeetna batholith.

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# PART 2.--RADIOACTIVE PEGMATITE MINERALS IN THE WILLOW CREEK MINING DISTRICT,

By R. M. Moxham and A. E. Nelson

## ABSTRACT

During the summer of 1948 radioactive pegmatite float was found in the Willow Creek mining district. Laboratory examination showed a small amount of uraninite and thorite to be primarily responsible for the radioactivity. A brief field examination was made by the Geological Survey in 1949. Representative channel samples of 11 pegmatites average 0.004 percent equivalent uranium; the heavy-mineral fractions of the samples average 0.332 percent equivalent uranium. None of the pegmatites are of such dimensions as to be mined profitably. Dikes and veins in the area, although genetically related to the pegmatites, do not contain radioactive minerals.

## INTRODUCTION

The Willow Creek mining district is located in the southern part of the Talkeetna Mountains about 60 miles north of Anchorage and includes the headwater area of Willow Creek and Little Susitna River (fig. 2). During the summer months the district is accessible by road from the Anchorage area and from the Alaska Railroad. There are three small airplane landing strips in the district which are used chiefly during the winter months.

Prior to World War II, gold production from lode mines in the Willow Creek district ranked second in Alaska (Smith, 1942). In 1947, the district was included in a reconnaissance by the U. S. Geological Survey of the southern highway belt (see part 1). All mines that were in operation at that time were examined underground and dump material was checked at many inactive mines. No radioactive material in significant quantities was found.

During the summer of 1948, Richard G. Ray of the Geological Survey found radioactive pegmatite float at two localities in the valley of Fishhook Creek, near the center of the Willow Creek district (figs. 2 and 3). Laboratory tests indicated that the radioactivity was due chiefly to uraninite and thorite. In view of the relatively easy access of the area and the presence of active mining and milling facilities close at hand, it seemed desirable to investigate briefly the pegmatites and other related intrusive bodies. During September 1949, approximately one week was spent in the Fishhook Creek-Archangel Creek area of the Willow Creek district. The field party consisted of R. M. Moxham and A. E. Nelson, geologists, J. C. Whitaker, field assistant, and Henry Bender, camp assistant.

This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

## GEOLOGY

The geology of the Willow Creek district has been described in detail by Capps (1915) and Ray (1933).

The Birch Creek schist of pre-Cambrian age, the oldest formation in the district, comprises highly contorted fissile mica schists and phyllites. The Birch Creek schist was intruded in Mesozoic time by the batholith which forms the core of the Talkeetna Mountains. Quartz diorite is the most abundant constituent, but phases ranging from quartz monzonite to gabbro are found. Along the southern boundary of the intrusive a gneissic phase has been developed.

The igneous mass is cut by pegmatites in many localities. The pegmatites examined in 1949 are tabular bodies, typically irregular and discontinuous, and range from less than 1 in. to about 2 ft in width. None were exposed for more than 150 ft along their strike. The rock-forming minerals exhibit only moderate crystal growth; orthoclase prisms as much as 8 cm in length were seen. Although no evidence of zoning was noted in any of the pegmatites examined, R. G. Ray (1951, unpublished) reports pegmatites containing a medial aplite zone.

Lamprophyre and diabase dikes are common throughout the region and aplite dikes occur somewhat less frequently.

Quartz veins, some of which carry gold in commercial quantities, have been injected along joint planes and shear zones in both the intrusive rocks and the Birch Creek schist.

The various pegmatites, dikes, and veins that have been injected into the schist and quartz monzonite probably represent end phases in the consolidation of the Talkeetna batholith.

## MEASUREMENTS OF RADIOACTIVITY

A portable survey meter with a probe consisting of four 18- by 1-in. brass-walled gamma tubes connected in parallel was used in all radiometric surveys. A 6-in. glass-walled beta tube was utilized for individual examinations. In the laboratory the equivalent uranium determinations were made by beta count. Quantitative analyses for uranium were made in the Geological Survey's, Trace Elements Section, Washington Laboratory.

## RADIOACTIVITY STUDIES

More than twenty pegmatites were found in the Fishhook Creek-Archangel Creek area during the field work in 1949. None, however, were sufficiently radioactive to be detected solely by means of the counter. The radiation emitted by the slightly radioactive accessory minerals disseminated throughout the quartz monzonite masked any possible anomalous radiation from the pegmatite minerals.

The minerals responsible for the radioactivity of the pegmatites are found in greatest concentration in association with biotite plates up to 1 in. in diameter. The development of biotite with the associated concentration of radioactive minerals is relatively uncommon. The

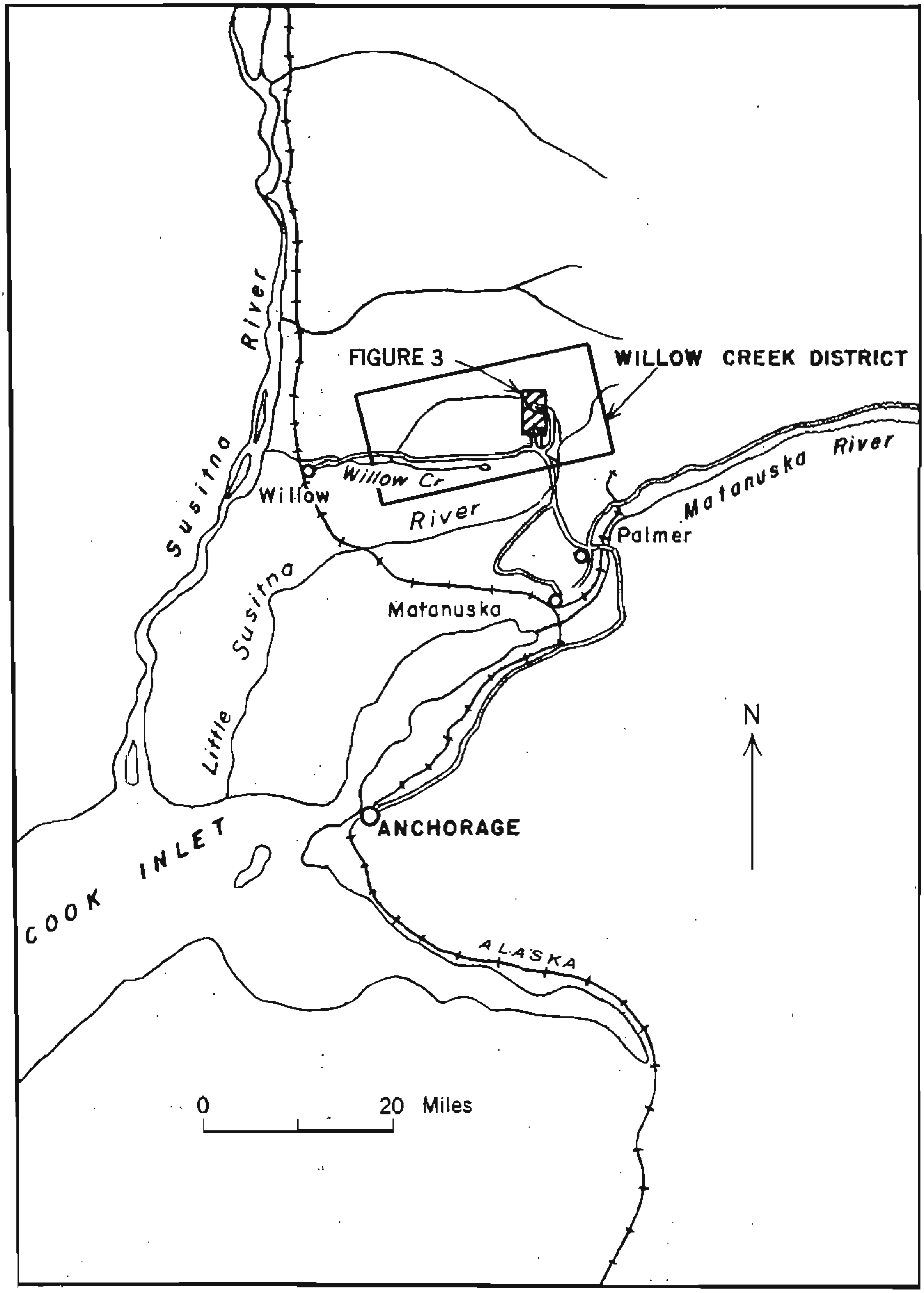


Figure 2. Map of the Anchorage area, south-central Alaska.

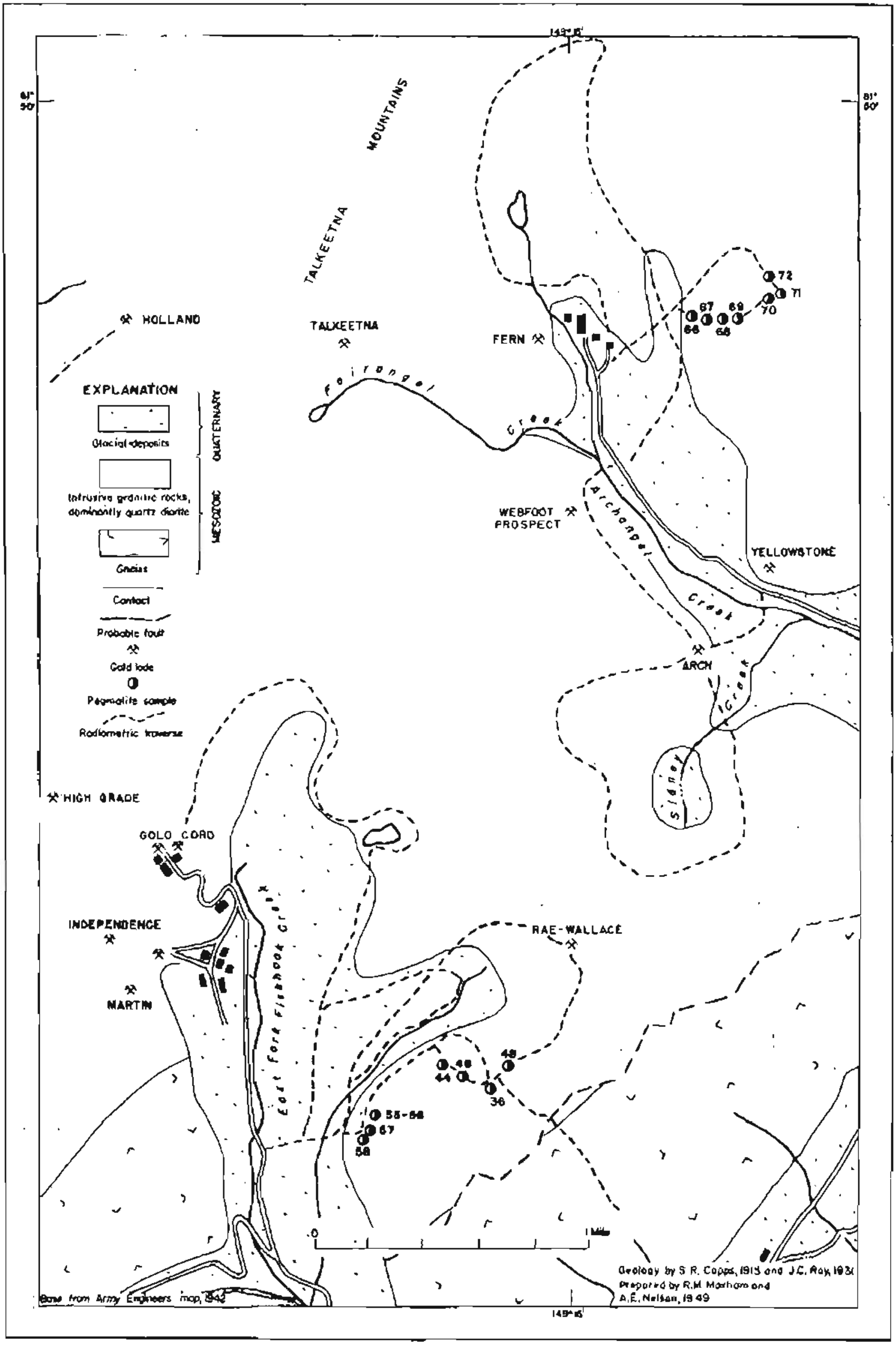


Figure 3. Geologic map of the Fishhook Creek-Archangel area, Willow Creek district, Alaska.

somewhat lower but relatively constant radiation level along the strike and across the apparently barren parts of the veins indicates, however, that the radioactive minerals are sparsely disseminated throughout most of the pegmatite material. Channel samples were taken across eleven pegmatites that are thought to be representative of those found in the Fishhook Creek-Archangel Creek area. The results of the analytical work are given in table 1.

Table 1.--Radiometric analyses of pegmatites from the Fishhook Creek-Archangel Creek area; Willow Creek mining district, south-central Alaska

| Sample no. | | Location (see fig. 3) | Unconcentrated (percent eU) | Heavy fraction (percent eU) [1] | Heavy fraction (percent U) | Concentration ratio |
|---|---|---|---|---|---|---|
| 49AM by 36 | 3801 | Fishhook Creek | 0.005 | 0.535 | --- | 1664:1 |
| 44 | 3809 | ------ do ------ | .004 | .368 | --- | 279:1 |
| 46 | 3811 | ------ do ------ | .007 | 2.93 | --- | 901:1 |
| 48 | 3813 | ------ do ------ | .003 | .070 | 0.041 | 438:1 |
| 55 | 3820 | ------ do ------ | .007 | .146 | --- | 222:1 |
| 56 | 3821 | ------ do ------ | .005 | .202 | --- | 279:1 |
| 57 | 3822 | ------ do ------ | .005 | .178 | .056 | 227:1 |
| 58 | 3823 | ------ do ------ | .005 | .142 | .042 | 430:1 |
| 66 | 3831 | Archangel Creek | .004 | .024 | --- | 236:1 |
| 67 | 3832 | ------ do ------ | .002 | .022 | --- | 161:1 |
| 68 | 3833 | ------ do ------ | .003 | .016 | --- | 207:1 |
| 69 | 3834 | ------ do ------ | .004 | .027 | --- | 299:1 |
| 70 | 3835 | ------ do ------ | .003 | .142 | .017 | 599:1 |
| 71 | 3836 | ------ do ------ | .004 | .120 | .019 | 478:1 |
| 72 | 3837 | ------ do ------ | .003 | .065 | .031 | 369:1 |

[1] eU: equivalent uranium.

Mineralogic study by personnel of the Trace Elements Section, Washington Laboratory indicates that the radioactivity of the pegmatites is attributed to the presence of one or more of the following minerals:

| | |
|---|---|
| Uraninite | $UO_2$ |
| Thorite | $ThSiO_4$ |
| Cyrtolite | $ZrSiO_4$ |
| Allanite | $4(Ca, Fe)O.3(Al,Ce,Fe,Di)_2O_3.6SiO_2.H_2O$ |

Uraninite occurs in small distinct cubes in all samples except 66, 67, 68 and 69; but none contain a significant quantity.

Those samples containing uraninite also contain small amounts of thorite, which occurs in anhedral grains. The mineral is amber to orange, apparently a result of alteration. The varietal name orangeite may be applicable. Sodium fluoride flux tests for uranium were strongly positive and yttrium is shown as a minor constituent by spectrographic analyses.

Allanite was found in nearly all samples. Its radioactivity, which is quite low, probably is due to thorium.

Cyrtolite was found in all samples examined. It occurs in translucent euhedral grains containing numerous opaque inclusions. Weak fluoresence in sodium fluoride flux indicates that a small amount of uranium is present.

Although uraninite and thorite are relatively minor constituents of the heavy-mineral fractions of the pegmatites, their high content of radioactive elements is probably the controlling factor in the radioactivity of the various samples.

Field examinations were made on outcrops of lamprophyre, diabase, and aplite dikes, and several quartz veins, but no radioactivity anomalies were noted. The results of investigations of lode mines in the Willow Creek area are reported in part 1 of this publication.

## CONCLUSIONS

The radioactive pegmatite minerals of the Willow Creek area do not occur in sufficient quantity to be considered as a commercial source of uranium. Dike and vein materials in the region, although genetically related to the pegmatites, are nonradioactive.

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## PART 3. --RADIOACTIVE MINERALS IN THE YAKATAGA BEACH PLACERS

By R. M. Moxham

### ABSTRACT

The radioactivity of nine samples of beach placer deposits in the Yakataga area, southern Alaska, was studied in 1948. The samples were given to the Geological Survey by prospectors operating in the area. The heavy-mineral fractions from the concentrates average 0.044 percent equivalent uranium. Three minerals, all members of the zircon group, contain the radioactive material in the sample; one mineral is uranium-bearing, the other two are thorium-bearing.

Unless the concentration of radioactive minerals in the beach deposits is considerably higher than the present data indicate, the placers at Yakataga beach do not constitute a feasible source of supply of radioactive materials.

### INTRODUCTION

Nine samples of placer material from beach deposits in the Yakataga area (fig. 4) were given to the Geological Survey several years prior to 1948; three were donated by Joe Meloy, a prospector, and six by Seymour Standish and Associates, a Chicago mining organization prospecting the beach placers. Preliminary radiometric examination of the concentrates showed them to be slightly radioactive. In 1948 the samples were studied in the laboratory to determine whether they contain sufficient uranium-bearing minerals to warrant a field investigation of the beach placers or a search for the bedrock source. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

The Yakataga area is on the coast of the Gulf of Alaska about 50 miles east-southeast of Cordova (fig. 4). It is virtually isolated from adjacent areas by glaciers on the east and west and by high mountains to the north. The coast line is unbroken and unprotected from the open sea except for two small reefs which offer little shelter. Transportation to the area is chiefly by air. An airstrip 5,000 ft long is located near the beach between the Duktoth and Yakataga Rivers. Two airlines offer flag-stop service to this field. The only inhabitants of the area are Civil Aeronautics Authority personnel and a few miners living near Cape Yakataga.

### GEOLOGY

About 20,000 ft of sandstone, arkose, graywacke, shale and limestone of probable Eocene age, and conglomerate of Oligocene age underlie most of the area adjacent to the Yakataga beach. Unconsolidated deposits of Quaternary age overlie deformed Tertiary rocks in the valley bottoms and form a coastal plain extending from half a mile to a mile inland (Spieker and others, manuscript report in files of U. S. Geol. Survey).

Between Cape Yakataga and Umbrella Reef, a distance of 18 miles, the beach is steep and not more than 300 ft wide; it is composed of well-packed, coarse sand and local concentrations of gravel. The gold in the beach sand is distributed erratically, the greatest concentrations being near the mouth of the White River. The quantity and size of the gold are reported (Maddren, 1913 p. 135) to diminish both east and west from this locality.

In general the gold and other heavy minerals are not concentrated on bedrock, but are irregularly disseminated vertically through the beach deposits. The gold and at least part of the other heavy minerals in the Yakataga beach placers probably originated in the igneous rocks of the St. Elias Range east of the Yakataga area and were transported to the area mainly by a combination of glacial action and ocean currents.

### MINING

Placer mining has been carried on sporadically in the Yakataga area since the discovery of gold in 1897. In recent years only a few small operations have been reported. In 1946 a company represented by Seymour Standish acquired a tract of beach between Cape Yakataga and the White River. The drilling operation, from which samples 3259 through 3264 were taken, was begun east of Cape Yakataga. According to Standish, the holes were drilled on 2,000-ft centers in two east-west lines, one at the high-tide line, the other a short distance north. The deepest hole reached bedrock at 15 ft. The six drill-hole samples probably represent an area extending some 4,000 ft along the beach. Apparently insufficient gold was found, as the project was abandoned.

### RADIOACTIVITY INVESTIGATIONS

The radioactivity of the beach sands of the Yakataga area was first noted in 1946 when the Meloy samples were examined radiometrically, but a thorough examination of the material had to be postponed until other work had been completed.

Each of the nine samples available for study was processed according to a standard laboratory procedure for the extraction of the heavy minerals (those greater than 3.3). The equivalent uranium content of the heavy residue was determined by beta count. Fluorimetric methods were used to determine the uranium content of the four most radioactive samples. The results of these tests are summarized in table 2. The heavy minerals of the three most radioactive samples were split into size and magnetic fractions to obtain a maximum concentration of radioactive minerals. The various fractions were then tested radiometrically. Data on these fractions are given in table 3. The chemical analyses and X-ray studies were made in the Trace Elements Section, Washington Laboratory.

#### Radioactive minerals

Three radioactive minerals were isolated from the Yakataga samples. One of the samples has been identified definitely as zircon, but optical and X-ray studies of the other two were

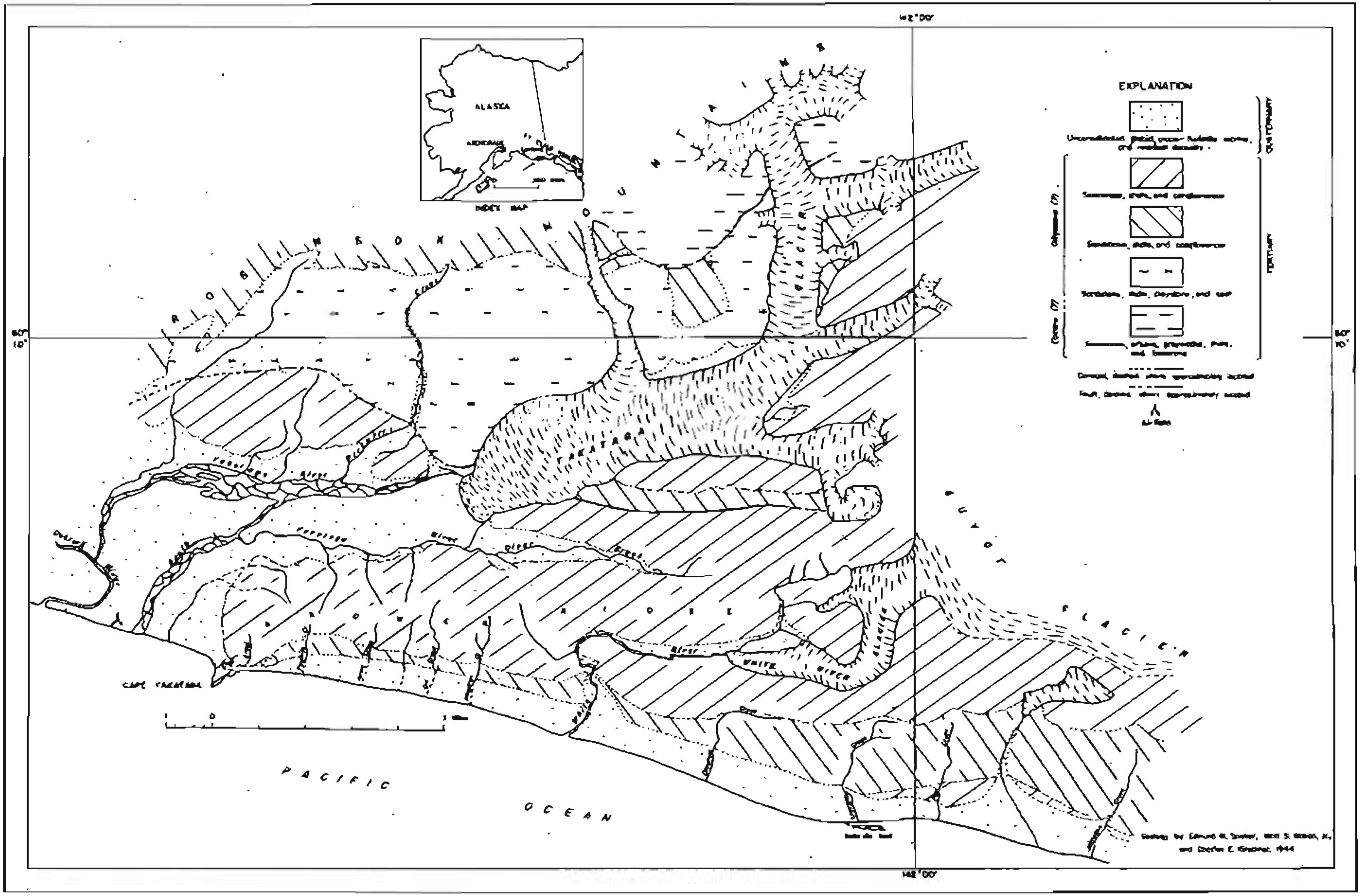


Figure 4. Geologic map of the Yakataga area, Alaska.

Table 2.--Data on beach placer samples from the Yakataga area, southern Alaska

| Sample no. | Type of material | Heavy fraction (percent eU)[a] | Heavy fraction (percent U) | Concentration ratio (total sample: heavy fraction)[b] |
|---|---|---|---|---|
| 1355[c] | Natural beach concentrate | 0.021 | 0.016 | 1.2:1 |
| 1356 | Amalgamation residue---- | .320 | .012 | 1.1:1 |
| 1357 | Common beach sand------ | .000 | --- | 6.7:1 |
| 3259[d] | ---------- do ---------- | .026 | .014 | 1.2:1 |
| 3260 | ---------- do ---------- | .018 | .006 | 1.8:1 |
| 3261 | ---------- do ---------- | .000 | --- | 9.3:1 |
| 3262 | ---------- do ---------- | .003 | --- | 3.8:1 |
| 3263 | ---------- do ---------- | .004 | --- | 26.0:1 |
| 3264 | ---------- do ---------- | .002 | --- | 4.7:1 |
| Average | | .044 | | |

[a]Equivalent uranium.
[b]All samples except 1357 were concentrated to an unknown extent prior to their receipt by the Geological Survey. The concentration ratio given above refers to the heavy minerals in the sample as it was received.
[c]Samples 1355-1357 given by Joe Meloy.
[d]Samples 3259-3264 given by Seymour Standish and Associates.

inconclusive except to show that they belong to the zircon group.

Zircon constitutes 95 percent of the nonmagnetic fractions (fraction F) of the three samples listed in table 3.

Table 3.--Equivalent-uranium (eU) content of concentrates from beach placers in the Yakataga area, southern Alaska, by grain size and magnetic fractions

| Sample | +20-mesh | -20-mesh | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Fractions of decreasing magnetic susceptibility | | | | | | |
| | | A (Strongly magnetic) | B | C | D | E | | F (Nonmagnetic) |
| | | | | | | +70-mesh | -70-mesh | |
| 1355 | | | | | | | | |
| Percent eU | 0.000 | 0.000 | 0.000 | 0.000 | 0.015 | 0.039 | 1.727 | 0.074 |
| Percent of total heavy fraction | 4.4 | 1.4 | 4.8 | 67.7 | 5.8 | 1.4 | 2.3 | 12.1 |
| 1356 | | | | | | | | |
| Percent eU | .000 | .000 | .000 | .000 | .018 | .016 | 3.710 | .098 |
| Percent of total heavy fraction | 2.5 | 14.8 | 7.1 | 25.3 | 8.1 | 3.3 | 1.8 | 17.1 |
| 3259 | | | | | | | | |
| Percent eU | .000 | .000 | .004 | .001 | .085 | .010 | 4.475 | .514 |
| Percent of total heavy fraction | 5.2 | 22.2 | 10.3 | 39.4 | 9.9 | 2.9 | 1.3 | 8.8 |

Radiometric tests indicate that the mineral contains 0.2 percent equivalent uranium. Sodium fluoride fluorescence tests for uranium were negative, although the high zirconium content may have had a quenching effect. It is likely, however, that the radioactive element is thorium.

Two unidentified radioactive minerals are found in the weakly magnetic fraction (fraction E, table 3). One is black and opaque with a metallic luster. It is highly radioactive and bead tests for uranium were strongly positive. The other unidentified mineral is reddish brown, translucent, has a vitreous luster, and is only moderately radioactive. Bead tests for uranium were negative, so the radioactivity is ascribed to thorium.

## CONCLUSIONS

The sedimentary rocks of the Yakataga region are probably not the original source of the radioactive minerals found in the beach placers. The gold and other heavy minerals may have been derived from the igneous rocks of the St. Elias Range to the northeast. After deposition in low concentration in the coastal plain sediments, they were reworked by wave action and deposited in higher concentration in the beach placers.

Unless the concentration is significantly greater than indicated by available information, the beach placers of the Yakataga area do not constitute a feasible source of supply of radioactive materials. This could be determined with certainty only by detailed drilling. The possibility of locating the bedrock source of the material in the glacier-covered region from which it has probably been derived would seem remote.

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