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GEOLOGICAL SURVEY CIRCULAR 335

RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN EAST-CENTRAL ALASKA, 1949

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UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

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RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN EAST-CENTRAL ALASKA, 1949

By Helmuth Wedow, Jr., M. G. White, and others

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By Helmuth Wedow, Jr., M. G. White, and others

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By Helmuth Wedow, Jr., J. M. Stevens, and G. E. Tolbert

ABSTRACT

In the summer of 1949, several mines and prospects in the Fairbanks and Livengood quadrangles, east-central Alaska, were examined for the possible presence of radioactive materials. Also tested were metamorphic and sedimentary rocks of pre-Cambrian and Paleozoic age crossed by the Elliott Highway, which extends from Fox, near Fairbanks, northwestward about 70 miles to the town of Livengood. Nuggets consisting chiefly of native bismuth and containing as much as 0.1 percent equivalent uranium had been found previously in a placer on Fish Creek several miles downstream from the reported bismuth-bearing lode on Melba Creek, but none of the lodes tested in 1949 exhibited radioactivity in excess of 0.003 percent equivalent uranium. The greatest radioactivity found in the rocks along the Elliott Highway was in an iron-stained pre-Cambrian schist and in a carbonaceous(?) shale of Middle Devonian or Carboniferous age. Respective samples of these rocks contain 0.003 and 0.004 percent equivalent uranium. A possible local bedrock source for the euxenite-polycrase mineral found in a placer concentrate containing about 0.04 percent equivalent uranium was sought in the watershed of Goodluck Creek, near Livengood. The bedrock source of this mineral could not be located and it is believed that the source could be outside of the Goodluck watershed because drainage changes during Quaternary time may well have introduced gravels from nearby areas.

INTRODUCTION

The purpose of this report is to record the results of brief radioactivity reconnaissance investigations made during the summer of 1949 in the Fairbanks and Livengood quadrangles, east-central Alaska (pl. 1). The objectives of these investigations were:

(1) To examine several mineral deposits in the Fairbanks district not previously tested for radioactivity,

(2) to make a radioactivity traverse of the Elliott Highway between Fox and Livengood,

(3) to search for a possible local bedrock source of a radioactive mineral of the euxenite-polycrase series found in a concentrate from a placer on Goodluck Creek in the Livengood district.

The field radioactivity tests were made with portable survey meters adapted to accept probes consisting of six 1- by 14-inch or four 1- by 18-inch gamma tubes connected in parallel and covered with a cylindrical metal housing. The equivalent-uranium determinations given in this report were made by the writers with a laboratory scaler in Washington. This reconnaissance was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

MINES, PROSPECTS, AND AREAS EXAMINED FOR RADIOACTIVITY

Fairbanks district

Melba Creek bismuth prospect

A placer concentrate (obtained prior to the initiation of the search for radioactive ores in Alaska in 1945), from Fish Creek, a short distance below the mouth of Pearl Creek (pl. 1), contains 0.01 to 0.1 percent equivalent uranium (Wedow, Killeen, and others, 1954, p. 7). The concentrate consists of a few small nuggets, mostly of native bismuth, with traces of flake and wire gold. Native bismuth is also reported (Hill, 1933, p. 71) in concentrates from placers on Pearl Creek, a tributary of Fish Creek, and on the upper part of Gilmore Creek, west of Fish Creek.

The only recorded bedrock occurrence of bismuth in the upper part of the watershed of Fish Creek upstream from the location of the concentrate containing the radioactive bismuth, is on the divide between Melba and Monte Cristo Creeks, both tributaries of Fish Creek near its head. Chapin (1914, p. 330, 331) describes the mineral deposit as a bismuth-bearing gold quartz vein cutting a fine-grained biotite granite. He reports that an opening on the vein at the time of his visit in 1912 was inaccessible, but that a surface exposure of the vein showed it to be about 5 inches thick with a vertical dip and an easterly trend. Chapin states further that in specimen material visible gold was imbedded in the native bismuth and bismuth sulfide. At the time of the reconnaissance in July 1949 the workings on the bismuth prospect were completely caved and all that remained of the operation was highly disintegrated rock on the dumps around the old filled shaft and in the ruins of a small mill.

Search of the dumps and the old mill revealed no traces of bismuth-bearing material. The maximum radioactivity observed was in the fine-grained biotite granite which, by field test, was estimated to contain no more than 0.002 percent equivalent uranium. Similar tests showed that the few pieces of iron-stained vein quartz, also found on the dumps, contain less than 0.001 percent equivalent uranium.

Tolovana mine

The Tolovana mine (Hill, 1933, p. 91, 92) lies on the east side of Willow Creek, a headwater tributary of Cleary Creek (pl. 1). It has long been abandoned and the adit is almost closed by ice. However, approximately 900 feet of underground workings along the ore deposit were still accessible in 1949. The deposit consists of stringers or veinlets of quartz enclosing lenses of quartz-biotite schist. Gold and metallic sulfides occur both in the quartz veinlets and in the schist adjacent to the veinlets. A traverse along the accessible workings showed no anomalous radioactivity. Ratemeter readings, using the 18-inch gamma probe previously described, ranged from 3 to 9 scale divisions on the 2.0 range. A sample of highly iron-stained vein material from a point showing the maximum radioactivity contains only 0.003 percent equivalent uranium.

Cleary Hill mine

The Cleary Hill mine (Hill, 1933, p. 93-96) lies on the divide between Chatham and Bedrock Creeks, tributaries of Cleary Creek (pl. 1). In 1949 only small, selected parts of the vein were being mined by two men working on a lease from the company, Cleary Hill Mines, Inc. The workings of the mine are extensive and intricate because the vein is offset by a complex series of faults. The vein ranges from 4 to 24 inches in width and consists of crushed iron-stained quartz with gold and minor amounts of arsenopyrite and stibnite. Yellow-green oxides of arsenic and antimony commonly stain many parts of the vein and enclosing schist country rock.

Radioactivity traverses were made along the main haulage tunnel on the 300-foot level and also on part of the 400-foot level. Higher levels and stopes were not examined because of caving. As in the Tolovana mine, about a mile to the southwest, the rate-meter readings ranged from 3 to 9 scale divisions on the 2.0 range. The maximum readings were obtained in the more heavily iron-stained parts of the vein and in iron-stained zones of fault gouge. Several selected samples of the iron-stained vein and gouge material contain no more than 0.003 percent equivalent uranium.

Elliott Highway

Geology

The Elliott Highway is about 70 miles long and extends from Fox on the Steese Highway to the northern terminus at Livengood (pl. 1). It cuts diagonally across the northeasterly trend of the regional structure. Four major sedimentary and metamorphic rock units form the bedrock along the highway. Brief descriptions of these units, summarized from reports by Mertie (1937) and Capps (1940) follow:

(1) The Birch Creek schist of pre-Cambrian age consists mainly of quartzite, quartz-mica, mica, feldspathic, and chloritic schists and quartzite with minor amounts of calcareous and carbonaceous schists and crystalline limestone. Quartz-mica and quartzite schists are the prevalent types cropping out along the highway. These rocks are highly metamorphosed and practically none of the original sedimentary features of the rocks remain. Quartz veins are abundant throughout the schist.

(2) The sedimentary rocks of pre-Middle Ordovician age consist of red and green slaty shale, black argillite, chert, quartzite, phyllite, quartzose sandstone, and limestone. The rocks are metamorphosed but not to the same extent as the older Birch Creek schist. At a few localities a slaty cleavage has developed in the shale and the argillite.

(3) The Tolovana limestone of Middle Silurian age is exposed along the Elliott Highway only in the bluff along the north side of Globe Creek. It is a light- to dark-gray massive limestone that weathers to buff and white.

(4) Rocks of post-Middle Silurian age include sedimentary rocks of Middle Devonian and Carboniferous age. The predominant rock types are sandstone, quartzite, shale, slate, argillite, and limestone. Some of the shale is carbonaceous.

The distribution of these units along the highway is shown on plate 1. Because much of the highway crosses terrain covered by moss and muck deposits typical of interior Alaska, the chief exposures of bedrock are in road cuts and borrow pits.

Radioactivity

The radioactivity traverse along the Elliott Highway was made with the 18-inch gamma probe mounted on the hood of a jeep. The average speed of the jeep during the traversing was about 15 miles per hour. Background for the probe used was 4-5 scale divisions on the 2.0 range.

The range and average of the rate-meter readings over the four major rock units are given below:

Rock unit	Rate-meter readings (in scale divisions on 2.0 range)	
	Maximum range	Average range
Birch Creek schist	4-11	6-7
Pre-Middle Ordovician sedimentary rocks	4-10	4-6
Tolovana limestone	2- 4	3
Middle Devonian and Carboniferous sedimentary rocks	4- 9	4-6

As a check on the significance of the maximum rate-meter readings along the route of the traverse, selected samples were taken at points of "high" radioactivity. The locations of these sampling points are shown on plate 1. The rock type and radioactivity data of the samples are given in table 1.

Goodluck Creek

Goodluck Creek is a headwater tributary of Livengood Creek in the Livengood gold-placer district (pl. 1). A concentrate from a placer operation on Goodluck Creek showed a content of 0.02 percent equivalent uranium when tested for radioactivity in 1945.[1]

[1]Harder, J. O., and Reed, J. C., 1945, Radioactivity of some Alaskan placer samples: U. S. Geol. Survey Trace Elements Inv. Rept. 6, p. 23 and table 1. (Unpublished.)

Table 1.—Data on samples collected along the Elliott Highway, 1949

[Rate-meter readings in scale divisions of 2.0 range]

Sample no.	Age and rock type	Rate-meter reading	Equivalent uranium (percent)
3842	Pre-Cambrian (Birch Creek schist)—iron-stained schist	9-11	0.003
3843	Pre-Cambrian (Birch Creek schist)—unweathered gray-green schist	8- 9	.003
3844	Pre-Middle Ordovician—red slaty shale	8- 9	.002
3845	Pre-Middle Ordovician—gray shale	9-10	.001
3846	Middle Devonian-Carboniferous—carbonaceous(?) shale	8- 9	.004
3847	Middle Devonian-Carboniferous—brecciated shale and sandstone	7- 8	.001
3848	Middle Devonian-Carboniferous(?)—felsite dike	8- 9	.001

Reanalysis of this sample in 1946 indicated an equivalent uranium content ranging from 0.031 to 0.048 percent but field studies in 1946 (Wedow, Killeen, and others, 1954, p. 11) failed to duplicate the concentrate.

The bedrock of the Goodluck Creek watershed is chiefly chert and silicified limestone of Mississippian age. The chert is dark gray to black and lies mostly on the northeast side of the creek; the silicified limestone is buff to white and lies, for the most part, on the northwest side of the valley. A small body of diorite or greenstone crops out on the southwest side of the creek near its head and, possibly, may be a dike lying between the chert and limestone.

Mineralogic study of the radioactive concentrate in the spring of 1949 determined that the radioactivity of the sample is due to a black pitchy or resinous metamict mineral which on X-ray analysis by Evelyn Cisney of the Geological Survey proved to be one of the euxenite-polycrase series. This series consists of niobates and titanates of yttrium, erbium, cerium, and uranium (Ford, 1932, p. 697, 698). The common mode of occurrence of euxenite-polycrase minerals at known localities throughout the world is in granite pegmatites or in placers probably derived from such rocks (George, 1949, p. 52-55).

The reconnaissance in the Goodluck Creek area in 1949 was an attempt to locate a possible local bedrock source of the euxenite-polycrase mineral. Radioactivity traverses were made on foot throughout the watershed of Goodluck Creek but no rocks showing significant radioactivity were detected. The chert, limestone, and diorite or greenstone were all estimated to contain 0.001 percent equivalent uranium or less. No evidence of the possible occurrence of granitic rock types, particularly pegmatite, was observed in the Goodluck Creek watershed.

Concentrates (taken in 1946 and 1949) from old dumps of the placer operations on Goodluck Creek in the vicinity of the euxenite-bearing concentrate contain only 0.002 percent equivalent uranium. The concentrates are chiefly limonite-hematite with some magnetite and traces of epidote, spinel, chromite, ilmenite, gold, cinnabar, and cassiterite.

CONCLUSIONS

The brief reconnaissance investigations in the Fairbanks and Livengood quadrangles in 1949 failed to reveal any occurrences of radioactive minerals warranting further study. It is likely that the radioactivity associated with bismuth nuggets in placers on Fish Creek in the Fairbanks district may be of some significance but the scarcity of outcrops in the upper part of the watershed of Fish Creek precludes the use of portable survey meters for traversing in search of the lode source.

Further radioactivity traversing in the watershed of Goodluck Creek in search of the bedrock source of the euxenite-polycrase mineral found in a placer on that creek is also unwarranted because of the widespread cover of vegetal material, muck, and alluvium and the resultant paucity of outcrops. It is also likely that the bedrock source of this mineral may lie outside of the Goodluck watershed. Drainage changes in Quaternary time prior to the establishment of the present drainage system, as suggested by Mertie (1918, p. 260-262), may have brought gravels into the watershed from such nearby areas as the Amy Creek drainage to the west. It is possible, therefore, that the source of the euxenite-polycrase mineral may have been in a now-eroded pegmatitic facies of a small albite granite intrusive on Amy Creek (Mertie, 1918, p. 248, pl. 13). Thus, the problem of the origin of this highly radioactive mineral is similar to that of the uraniferous ellsworthite and other radioactive minerals found in the placers of the Tofty tin belt of the Manley Hot Springs-Rampart district to the west (Moxham, 1953).

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CHAPTER B.—MILLER HOUSE-CIRCLE HOT SPRINGS AREA

By M. G. White and G. E. Tolbert

ABSTRACT

Granite of Mesozoic(?) age in the Miller House-Circle Hot Springs area, east-central Alaska, contains 0.005 to 0.007 percent equivalent uranium. The radioactivity is mostly caused by uranium in such primary accessory minerals of the granite as allanite, garnet, scheelite, sphene, and zircon. However, the presence of metallic sulfides, cassiterite, and uraniferous fluorite, malachite, and topaz in the granite or associated placers suggests the possibility of a post-emplacement or late-stage mineralization of the granite, presumably of hydrothermal origin, as a source for at least part of the uranium. Additional reconnaissance in the area to determine the presence or absence of hydrothermal uraniferous deposits of commercial grade appears warranted.

INTRODUCTION

The Miller House-Circle Hot Springs area is located in east-central Alaska about 100 miles east-northeast of Fairbanks (pl. 2). The area lies in the highlands along the south edge of the Yukon Flats. It is easily accessible from Fairbanks via the Steese Highway or by plane to small airfields in the area (pl. 2).

Analysis of 33 placer concentrates (obtained prior to 1949 from mining operations on Porcupine, Bonanza, Miller, Mastodon, Independence, Deadwood, Ketchum, Holdem, Switch, Portage, Half Dollar, and Harrison Creeks in the Miller House-Circle Hot Springs area) showed radioactive material in the range of 0.0X percent equivalent uranium only in concentrates from Ketchum and Portage Creeks. Preliminary mineralogic study of these samples indicated that the radioactive mineral may be monazite, although too little material was available for thorough examination.

In September 1949 a Geological Survey party consisting of Max G. White and Gene E. Tolbert, geologists, and Egil Salveson, camp assistant, conducted a reconnaissance in the Miller House-Circle Hot Springs area in an attempt to locate the source of the radioactive material found in the placers and to obtain more material for mineralogic study. The party was in the area for about one week at the close of the field season after having completed previously assigned projects elsewhere in interior Alaska. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

GEOLOGY

The geology, mineral deposits, and mining activities of the Miller House-Circle Hot Springs area have been described by Prindle (1913) and Mertie (1938). The bedrock of the area includes the pre-Cambrian Birch Creek schist, which is mostly a quartz-mica variety. This schist has been intruded by granitic rocks of Mesozoic(?) age.

Johnson (1910) reports the occurrence of wolframite, cassiterite, arsenopyrite, pyrite, galena, limonite, and tourmaline, in addition to gold, in placer concentrates from Deadwood and Switch Creeks; arsenopyrite in quartz-feldspar veins on Switch Creek; and pyrite, galena, and quartz in mineralized fracture zones on the upper part of Deadwood Creek.

RADIOACTIVITY INVESTIGATIONS

Radiometric traverses in the Miller House-Circle Hot Springs area were made with commercial portable survey meters modified to accept probes of six 1- by 14-inch gamma tubes or four 1- by 18-inch gamma tubes which were interchangeable with the standard 6-inch beta-gamma probes.

As many localities as the limited time permitted were traversed for radioactivity. The courses of these traverses are shown on plate 2. The results of the radiometric traversing indicate that the granite and the wash from disintegrated granite are more radioactive than the adjacent schist and alluvium and were probably the source of the radioactive minerals found in the placer concentrates taken prior to this reconnaissance. Selected samples of the granite on Portage and Deadwood Creeks and at Miller House were taken for radioactivity analysis and mineralogic study. In addition, concentrates were taken from various placer workings, other stream gravels, and areas of granite wash to supplement the data on the granite samples. The equivalent-uranium analyses of these samples were made in 1949-50 by personnel of the Alaskan Trace Elements Unit. Most of the mineralogic determinations were made by Miss Kiyoko Onoda of the Trace Elements Section Washington Laboratory.

Granite

The data on the granite samples obtained in the Miller House-Circle Hot Springs area are summarized in table 2.

Mineralogic study of the heavy-mineral fraction of sample 49AWe177L from Portage Creek shows the presence of minor amounts of allanite, zircon, and apatite, and traces of magnetite and sphene. The allanite, apatite, and sphene are uraniferous. The heavy-mineral fraction of the granite on Deadwood Creek (sample 49AWe199L) contains chlorite, uraniferous fluorite, and magnetite. The minerals of the heavy fraction of the granite near Miller House are as follows:

Minerals	Estimated volume (percent)
Altered rock fragments with hematite and limonite[1]	60
Magnetite	20
Common rock-forming minerals	10
Malachite[1]	5
Zircon[1]	2
Anatase	1
Galena	1
Ilmenite	1
Pyrite	trace
Rutile	trace

[1]Indicates mineral is uranium-bearing.

The mineralogic study indicates that the radioactivity of the granite is apparently due mostly to uranium rather than thorium although this is not conclusive because no quantitative analyses were made. The locality distribution of the uranium-bearing minerals in the granite is shown in table 3.

Placers

The radioactivity of the concentrates from stream gravels and granite wash in the Circle Hot Springs area (pl. 2) is comparable to that of the several samples available prior to 1949; that is, it is in the 0.0X range of percent equivalent uranium. The radioactivity, as in the granite, is more than likely due to uranium, rather than thorium.

The mineralogy of the placer concentrates is similar to that of the heavy-mineral fractions of the granite samples. Many other heavy minerals, though, are also present. Of significance are cassiterite and traces of chalcopyrite and fluorite on Portage Creek, scheelite on Hot Springs and Ketchum Creeks, cassiterite on Ketchum and Deadwood Creeks, and topaz on Ketchum Creek. The locality distribution of the uranium-bearing minerals in the placers is shown by creek in table 3.

The presence of monazite was not verified in any of the samples collected in 1949.

Table 2.—Data on granite samples from the Miller House-Circle Hot Springs area

Sample no.		Location and description	Equivalent uranium (percent)		Concentration ratio
Field	File		Unconcentrated	Fraction >2.8 sp gr	
49AWe168L	3649	Portage Creek; granite from bedrock in placer mine.	0.005	0.020	15:1
177L	3655	Portage Creek; disintegrated granite from bedrock in placer mine.	---	.056	15,400:1
198L	3669	Deadwood Creek, just below mouth of Switch Creek; granite bedrock in placer cut.	.005	.023	400:1
199L	3670	Deadwood Creek; granite bedrock	.006	.041	550:1
200L	3671	do	.006	.035	325:1
203L	3674	Miller House; granite bedrock	.007	.053	150:1
204L	3675	do	.007	.065	325:1

Table 3.—Locality distribution of uranium-bearing minerals in the Miller House-Circle Hot Springs area

Locality and material sampled	Allanite	Apatite	Fluorite	Garnet	Limonite	Malachite	Scheelite	Sphene	Topaz	Zircon
Portage Creek:										
Granite	X	X	---	---	---	---	---	X	---	---
Placer	X	---	---	X	---	---	X	X	---	X
Hot Springs Creek:										
Placer	X	---	---	---	---	---	---	X	---	---
Ketchum Creek:										
Placer	X	---	---	X	---	---	X	X	X	---
Deadwood Creek:										
Granite	---	---	X	---	---	---	---	---	---	---
Placer	---	---	---	---	---	---	X	---	---	---
Miller House:										
Granite	---	---	---	---	X	X	---	---	---	X

CONCLUSIONS

Although many of the uranium-bearing minerals in the granite and placer concentrates of the Miller House-Circle Hot Springs area are probably primary accessory minerals of the granite, the presence of fluorite, topaz, several of the metallic sulfides, cassiterite, and malachite indicates the possibility that hydrothermal alteration of the granite after its emplacement or in the late stages of its emplacement may in part be the source of the uranium. It is possible that concentrations of primary uranium minerals may occur in association with the granitic rocks in the Miller House-Circle Hot Springs area, particularly in the headwaters of Deadwood, Boulder, and Bedrock Creeks (pl. 2) in the vicinity of the granite-schist contact. The possibility, however, that such concentrations may occur within the granite should not be overlooked.

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CHAPTER C.—COPPER CREEK COPPER LODE PROSPECT, EAGLE DISTRICT

By Helmuth Wedow, Jr. and G. E. Tolbert

ABSTRACT

Investigation of radioactivity anomalies at the Copper Creek copper lode prospect, Eagle district, east-central Alaska, during 1949 disclosed that the radioactivity is associated with copper mineralization in highly metamorphosed sedimentary rocks. These rocks are a roof pendant in the "Charley River" batholith of Mesozoic(?) age. The radioactivity is probably due almost entirely to uranium associated with bornite and malachite.

INTRODUCTION

The Copper Creek copper lode prospect is located in the southwestern part of the Eagle district in east-central Alaska, and is about 60 miles west of the town of Eagle, which is near the international boundary. (See fig. 1.) The prospect is on the right bank of Copper Creek about 6 miles above the creek's confluence with the Charley River.

The Copper Creek prospect has never been reported in Geological Survey literature although knowledge of it is widespread among prospectors in interior Alaska. It was staked and partially developed by the Hudson brothers in the early 1900's, but has since changed hands several times. The owner of the claim in 1949, Howard Sparks of Fairbanks, restaked the prospect in 1946 on the possibility that the gold, silver, lead, and tungsten content, in addition to the copper, might warrant further exploration.

The workings at the Copper Creek prospect consist of an adit in a cliff-surface showing of copper ore. The portal is 10 to 15 feet above the level of Copper Creek and the workings extend 114 feet underground. The ore showings occur only in about the first 40 feet of the adit. Lack of understanding of a complex structure apparently caused the earlier prospectors to wander off the trend of the ore-bearing zone with the result that the last 60 feet of the adit are entirely in essentially barren rock.

The examination of the Copper Creek prospect was made as a side trip in connection with other radioactivity studies in a nearby part of the Fortymile district (see chapter E). Transportation to the prospect was by a helicopter furnished by Detachment "B," Tenth Rescue Squadron, U. S. Air Force, based at Ladd Field, Fairbanks. The examination was made on August 17, 1949. The authors were accompanied by George O. Gates of the Geological Survey and Howard Sparks, owner of the prospect. The statement below on the geologic setting of the prospect has been taken mainly from field notes by Gates.

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

GEOLOGY

The bedrock at the Copper Creek lode prospect, previously mapped in reconnaissance as granite of Mesozoic(?) age (Prindle, 1913, pl. 2; Mertie, 1937, pl. 1), consists of highly metamorphosed sedimentary rocks. These rocks are apparently part of a small (several square miles) roof pendant in the "Charley River" batholith and acted as a host for the deposition of the metallic minerals found in the prospect.

Tentative identifications show a lime-silicate rock and an amphibolite as the two main lithologic types at the prospect. The bulk of the metallic minerals is in the lime-silicate rock, mainly along a contact with the amphibolite, with minor amounts of the metallic minerals disseminated through both rock types but in diminishing amounts away from the contact. Chalcopyrite, malachite, and azurite are the chief metallic minerals at the prospect. Minor amounts of galena are present and traces of gold, silver, and tungsten have been reported in assays.

RADIOACTIVITY STUDIES

The radioactivity of the rocks at the Copper Creek prospect was measured with a commercial model of a portable survey meter modified to accept both the standard 6-inch beta-gamma probe and a probe consisting of six 1- by 14-inch copper-walled gamma tubes connected in parallel.

The variation in radioactivity in the adit, as measured with the large gamma probe, is summarized in table 4.

Table 4.—Variation of radioactivity in the adit on the Copper Creek copper lode, Eagle district

Distance (ft) into adit from portal	Radioactivity (divisions on 2.0 scale)	Rock type
0- 2	12	Lime-silicate rock and amphibolite.
2- 18	10	Do.
18- 32	8	Amphibolite.
32- 40	10	Lime-silicate rock.
40- 44	16-18	Lime-silicate rock with iron-stained fracture zones.
44- 48	12	Lime-silicate rock.
48- 54	10	Do.
54-114	8	Do.

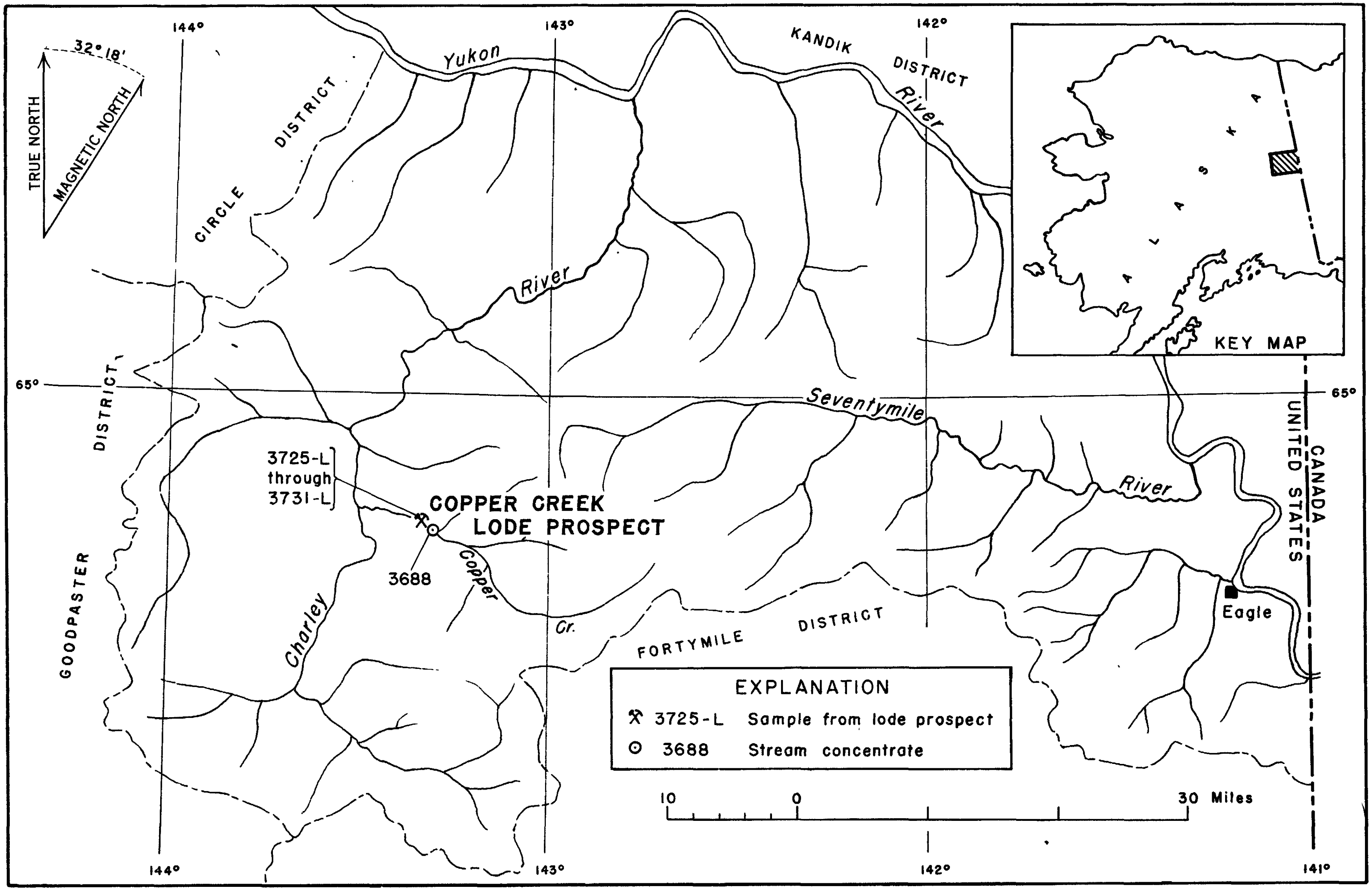

Figure 1.—Sketch map of the Eagle district, Alaska.

Table 5.—Data on selected samples from the Copper Creek copper lode prospect, Eagle district

[Equivalent-uranium analyses by members of the Alaskan Trace Elements Unit]

Sample no.	Equivalent uranium (percent)			Remarks
	Unconcentrated rock	Fraction < 3.3 sp gr	Fraction > 3.3 sp gr	
				Placer
3688	--------------	[1] 0.003	[2] 0.013	Concentrate from about 50 pounds of gravel in Copper Creek about 100 feet upstream from lode prospect.
				"Portal" anomaly
3730-L	0.032	[3] 0.044	[2] 0.003	Grab sample from most radioactive spot on east side of portal.
3731-L	.001	.003	.002	Grab sample from slightly radioactive part of ore zone on east side of portal.
				"40-44" anomaly
3725-L	0.003	0.010	0.002	Grab sample of rock adjacent to most radioactive iron-stained fracture zone.
3726-L	.006	.004	.003	Chip sample of 1-foot layer above most radioactive fracture.
3727-L	.003	[4] .012	.002	Chip sample of 1-foot layer below most radioactive fracture.
3728-L	.004	.006	.003	Grab sample of same fracture zone as sample 3725-L but about 6 feet downdip of fracture.
3729-L	--------------	------------	-----------	Specimen of rock immediately below fracture in sample 3725-L; radioactivity appears to be confined to 0.1 foot of rock immediately adjacent to fracture.

[1]Fraction <2.8 sp gr.
[2]Fraction >2.8 sp gr.
[3]Contains 0.058 percent U as determined by F. S. Grimaldi, Washington Trace Elements Laboratory.
[4]Contains 0.009 percent U as determined by F. S. Grimaldi, Washington Trace Elements Laboratory.

Testing with the 6-inch beta-gamma probe indicated that the radioactivity at the "portal" anomaly is localized around certain mineral groupings in the ore zone. At the "40-44" anomaly the radioactivity appears to be confined to iron-stained surfaces or zones along low-angle fractures or faults in the lime-silicate rock. Data on selected samples from the locations of both anomalies are summarized in table 5.

As seen in table 5, the uranium in the samples from the Copper Creek prospect is concentrated mainly in material of less than about 3.0 specific gravity. This material consists mostly of wollastonite and reddish or yellowish calcite. It also contains minor amounts of galena and bornite, mostly as inclusions in some of the wollastonite grains. The bornite is slightly altered to malachite. The uranium apparently occurs as an impurity in the bornite and malachite.

The radioactivity of the placer concentrate (sample 3688, table 5 and fig. 1) from Copper Creek is probably due mostly to thorium within trace amounts of monazite.

CONCLUSIONS

Minor amounts of radioactive materials are associated with copper ores at the Copper Creek prospect in the Eagle district where a small roof pendant in the "Charley River" batholith appears to be highly mineralized. The radioactive minerals are bornite and malachite, in which uranium apparently occurs as an impurity. Because of the limited time available for the examination of the prospect, reconnaissance of most of the roof-pendant area was not undertaken. It is possible that greater concentrations of uranium may occur in or immediately adjacent to the area of the roof pendant.

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CHAPTER D.—PLACER CONCENTRATES FROM THE FORTYMILE DISTRICT

By M. G. White

ABSTRACT

Studies of 24 placer-concentrate samples from the Fortymile district of east-central Alaska available in the Geological Survey's Alaskan Concentrate File prior to 1949 revealed only two samples containing significant amounts of radioactivity. Both samples are from Atwater Bar on the South Fork of the Fortymile River, a short distance below the confluence of Mosquito and Dennison Forks. The radioactivity is due to traces of uranium-bearing thorianite, which occurs as minute black cubes and fragments. No data are available as to the source of the thorianite.

INTRODUCTION

The purpose of this report is to present the results of laboratory radioactivity and mineralogic studies on the 24 placer-concentrate samples from the Fortymile district, east-central Alaska, available in the Alaskan Concentrate File of the Geological Survey prior to 1949. These samples were collected by several Survey geologists over a period of years from sluice boxes of placer-mining operations in the east-central part of the district. (See fig. 2.) Significant radioactivity was detected in only two samples, both from Atwater Bar on the South Fork of the Fortymile River. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

Until 1949 the only field investigation for radioactivity made in the Fortymile district was a reconnaissance in 1946 along the Alaska Highway at the southwestern edge of the district (Wedow, Killeen, and others, 1954).

GEOLOGY

The geology and mining of the Fortymile district has been discussed by Prindle (1905, 1907, 1909, 1913) and Mertie (1930, 1937, 1938). The bedrock of the district consists chiefly of metamorphic rocks of pre-Cambrian and Paleozoic age. The metamorphic rocks are represented by many different lithologic types and are intruded by large and small masses of granitic rocks of Mesozoic(?) age. Minor amounts of Tertiary volcanic rocks and coal-bearing sedimentary strata are also found in the district.

Atwater Bar is a deposit of bench gravels located on the left limit of the South Fork of the Fortymile River several miles below the confluence of Mosquito and Dennison Forks (see fig. 2). No extensive mining operations have been undertaken at Atwater Bar since it was dredged for several seasons in the mid-1930's. During the 1949 season a small outfit was prospecting in preparation for mining on a small scale.

RADIOACTIVITY AND MINERALOGIC STUDIES

The equivalent-uranium content of the placer-concentrate samples as determined in the laboratory is given in table 6.

Table 6.—Equivalent-uranium content of placer concentrates obtained from the Fortymile district prior to 1949

File no.	Location	Equivalent uranium (percent)	File no.	Location	Equivalent uranium (percent)
256	Ingle Creek----------------------	0.001	277	Atwater Bar----------------------	0.041
2252	-------do------------------------	.004	284	-------do------------------------	.033
176	Chicken Creek, Claim $5\frac{1}{2}$ Below----	.001	79	Gilleland Creek------------------	.003
248	Chicken, prospect pit (?)--------	.004	538	Wade Creek-----------------------	.001
530	Myers Fork, Purdy's claim--------	.005	84	-------do------------------------	<.001
536	Myers Fork-----------------------	.005	537	-------do------------------------	.001
535	-------do------------------------	.004	1	-------do------------------------	<.001
533	Stonehouse Creek-----------------	.001	2250	South Fork, Fortymile River, near mouth of Napoleon Creek.	.004
170	Chicken Creek, Burrett's claim---	<.001			
85	Chicken Creek, Busts' claim------	.001	1149	Franklin Creek-------------------	.001
27	Chicken Creek--------------------	.001	29	Dome Creek-----------------------	.001
534	-------do------------------------	.001	2251	Fortymile River, near mouth of Steel Creek.	.007
532	Lost Chicken Creek---------------	.002			

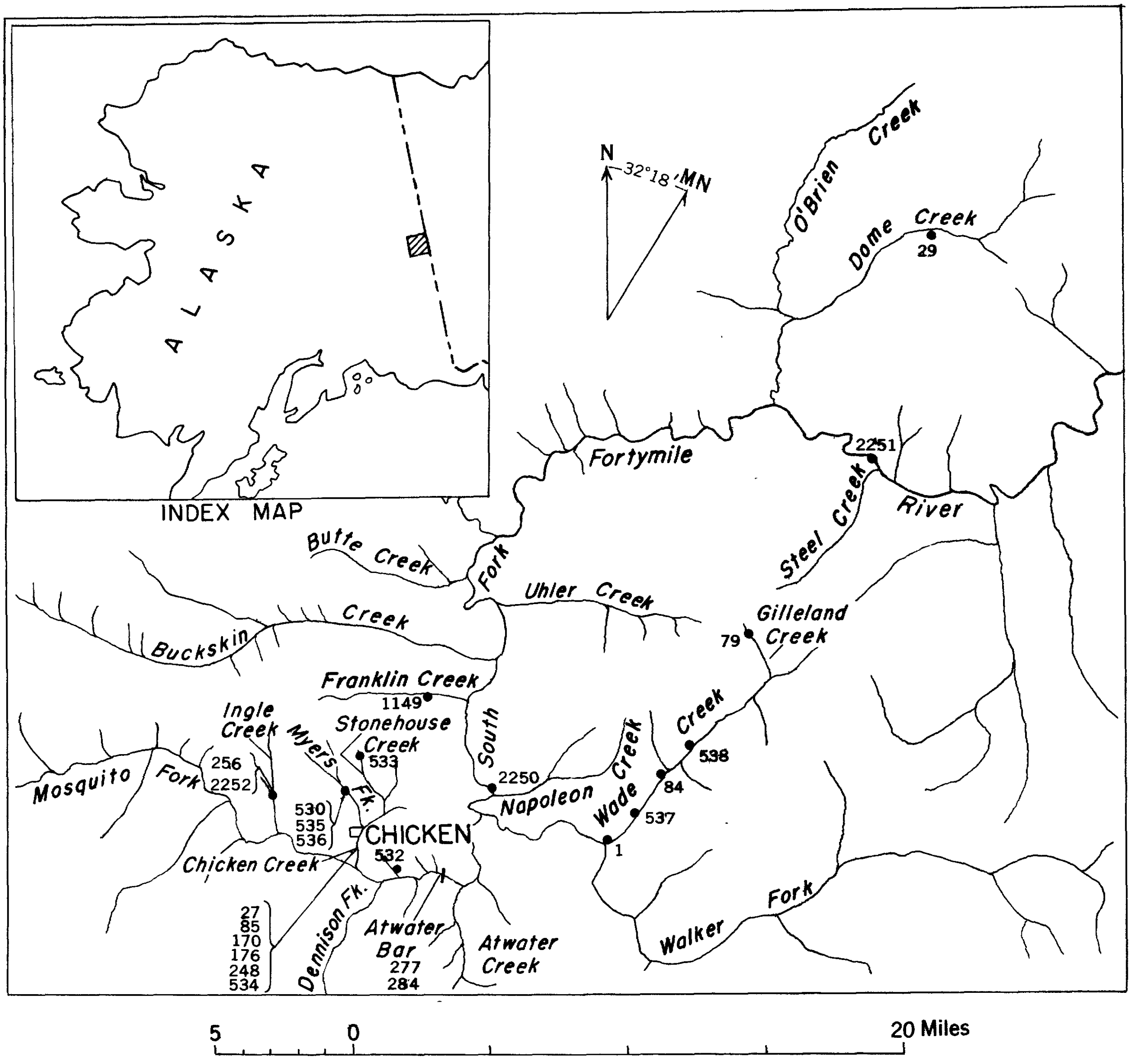

Figure 2. —Sketch map of part of the Fortymile district, Alaska, showing location of placer concentrates obtained from the district prior to 1949.

Only the two samples (nos. 277 and 284) from Atwater Bar show noteworthy amounts of radioactivity. The principal radioactive mineral in these samples, as determined by spectrographic methods, is uranium-bearing thorianite. It occurs in trace amounts as minute black cubes and fragments in the minus 100-mesh size-fraction of the samples. No detailed information is available on the source of the gravels at Atwater Bar; therefore little can be said here as to the significance of thorianite in these gravels. The two samples from Atwater Bar are almost identical in mineral composition. The average composition is as follows:

Mineral	Percent by volume	Mineral	Percent by volume
Ilmenite	25	Tourmaline	2
Spinel	25	Pyrite	2
Garnet	15	Olivine	1
Magnetite	10	Scheelite	trace
Zircon	10	Cassiterite	trace
Sphene	5	Thorianite	trace
Rock-forming (chiefly ferromagnesian silicates) minerals	5	Gold	trace

Mineralogic studies show that the slight amount of radioactivity in the other samples apparently originates from traces of radioelements in zircon and sphene.

CONCLUSIONS

The radioactivity of placer concentrates obtained prior to 1949 from the Fortymile district is due chiefly to zircon and sphene. In two samples from Atwater Bar, however, most of the radioactivity is due to a uranium-bearing thorianite. Because the source of the Atwater Bar gravels is unknown, the significance of this thorianite cannot be evaluated. However, this occurrence may be a clue to possible bedrock sources of uranium in the drainage basin upstream from the location of the placer.

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CHAPTER E.—WILSON CREEK, MY CREEK, BEN CREEK, AND CHICKEN AREAS, FORTYMILE DISTRICT

By Helmuth Wedow, Jr. and G. E. Tolbert

ABSTRACT

A reconnaissance was conducted in the Wilson Creek, My Creek, and Ben Creek areas, Fortymile district, east-central Alaska, in 1949 in an attempt to locate three occurrences of high-grade uranium ores reported by prospectors. The search was unsuccessful. A maximum of 0.005 percent equivalent uranium was found in felsic igneous rocks of the Wilson Creek and Ben Creek areas. The radioactivity of these rocks in the Wilson Creek area is probably due to traces of radioactive elements in the common accessory minerals of the igneous rocks; in the Ben Creek area it is probably due chiefly to thorium in monazite and allanite, which were identified in concentrates from gravels of streams draining areas underlain by the igneous rocks. Radioactivity tests of Tertiary sedimentary rocks in the vicinity of Chicken show that a sulfide-bearing montmorillonite-type clay contains as much as 0.005 percent equivalent uranium and that coked(?) coal and ash from a burned coal bed contain as much as 0.003 percent equivalent uranium. A concentrate submitted by a prospector from a gold-placer deposit at Atwater Bar, a short distance east of Chicken, contains traces of uranothorianite and monazite and has an equivalent uranium content of 0.027 percent.

INTRODUCTION

The purpose of this report is to give the results of reconnaissance in the Fortymile district, east-central Alaska (fig. 3), conducted in 1949 to investigate three possible occurrences of high-grade uranium ores reported by prospectors. These reported occurrences were in the vicinity of Wilson Creek (fig. 4), My Creek (fig. 5), and Ben Creek (fig. 6). Limited additional studies were made in the vicinity of Chicken as time permitted. (See inset, fig. 3.) The work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission by a Geological Survey party consisting of Helmuth Wedow, Jr. and Gene E. Tolbert, geologists, and Fred Freitag, camp hand. The party was in the field from July 22 to August 20, 1949.

At the request of the Atomic Energy Commission, the U. S. Air Force detailed a helicopter and its crew and provided such other air support as was necessary to assist the Survey party in its operations. The assistance of the members of Detachment "B," 10th Rescue Squadron, U. S. Air Force, in developing the details of the air support furnished the Survey party is gratefully acknowledged. Lt. Murl Chamberlin and Sgt. Walter Embree, pilot and mechanic respectively, were the military personnel detailed directly to the Survey project.

The Fortymile district lies in east-central Alaska along the international boundary (see key map, fig. 3). Most of the district is drained by the Fortymile River and its tributaries (fig. 3). The town of Chicken is the only settlement of consequence within the district, although many placer-mining camps are scattered throughout the northeastern part of the district and homesteads are being claimed along the Alaska Highway on the southern edge of the district. Chicken is accessible by air by regularly scheduled flights from Fairbanks and, since September 1949, by ground traffic along the newly constructed southern part of the Taylor (Fortymile) Highway (fig. 3). Other parts of the Fortymile district are relatively inaccessible because the few other small airfields in the district are located mostly at the mining camps.

For the investigation of the Wilson Creek and My Creek areas the helicopter-supported Geological Survey party was based near the airstrip at Chicken and daily flights were made out to the areas under study. For the reconnaissance in the Ben Creek area a temporary advance base was established on Slate Creek at the mouth of Gold Run.

MEASUREMENT OF RADIOACTIVITY

The radioactivity of rocks in the areas of the reported high-grade uranium occurrences in the Fortymile district was measured with high-count traverse probes consisting of six 1- by 14-inch gamma tubes connected in parallel and attached to modified commercial models of portable survey meters. For convenience in carrying for foot traversing, the counters and probes were lashed to packboards and the rate meters were attached to cables and carried by hand in front of the operator. The instrument response (background) in the field over most sedimentary and metamorphic rocks averaged about 900 counts per minute, or a rate-meter reading of about 5 scale divisions on the 2.0 mr/hr[1] range.

In each area investigated selected samples were taken from rocks that exhibited radioactivity above the basic instrument response. The samples were later analyzed for their equivalent-uranium content in the laboratory by the authors.

AREAS INVESTIGATED

Wilson Creek area

In 1948 the Alaska Territorial Department of Mines reported that Mr. Charles Fillyez, former

[1] Milliroentgens per hour.

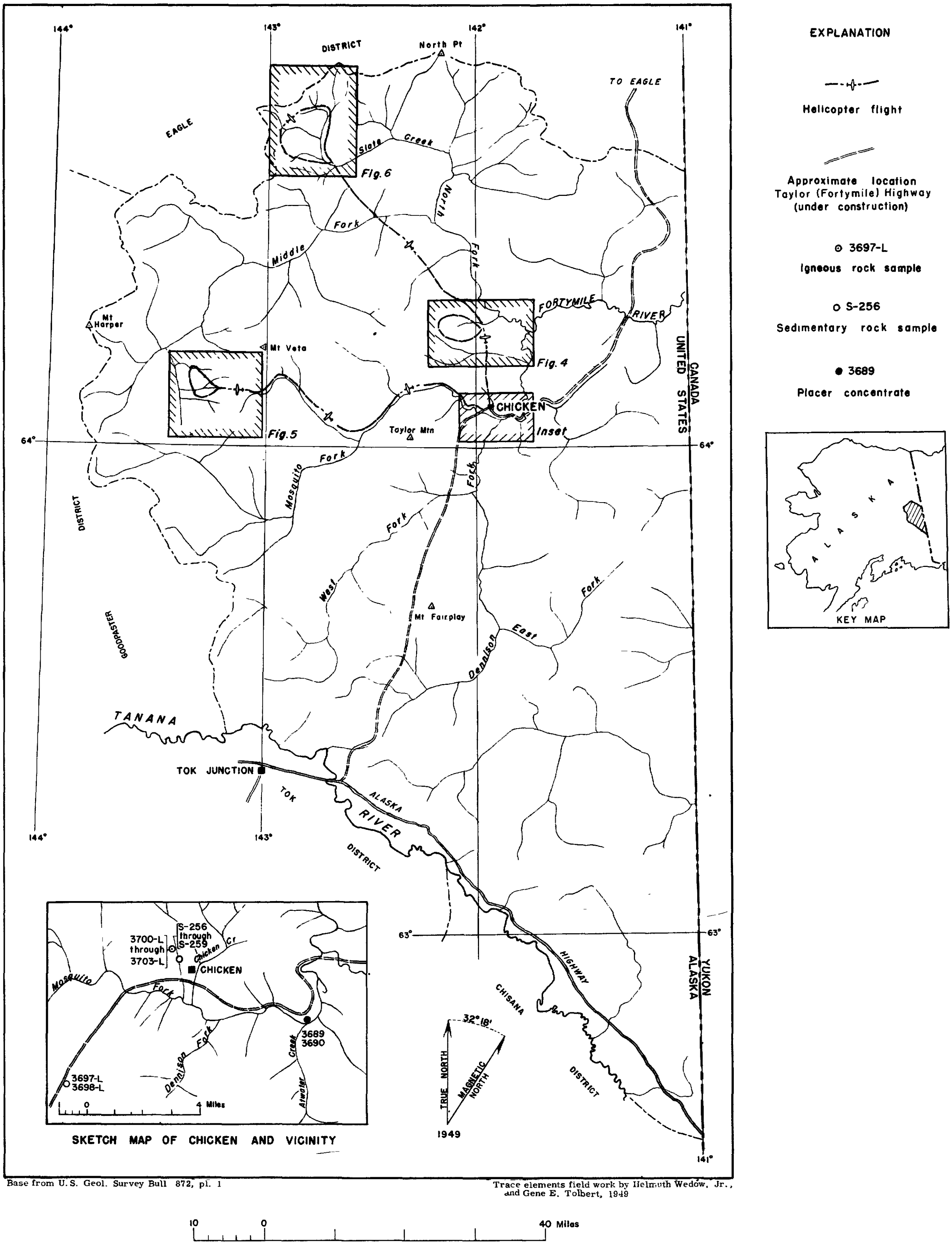

Figure 3.—Sketch map of the Fortymile district, east-central Alaska.

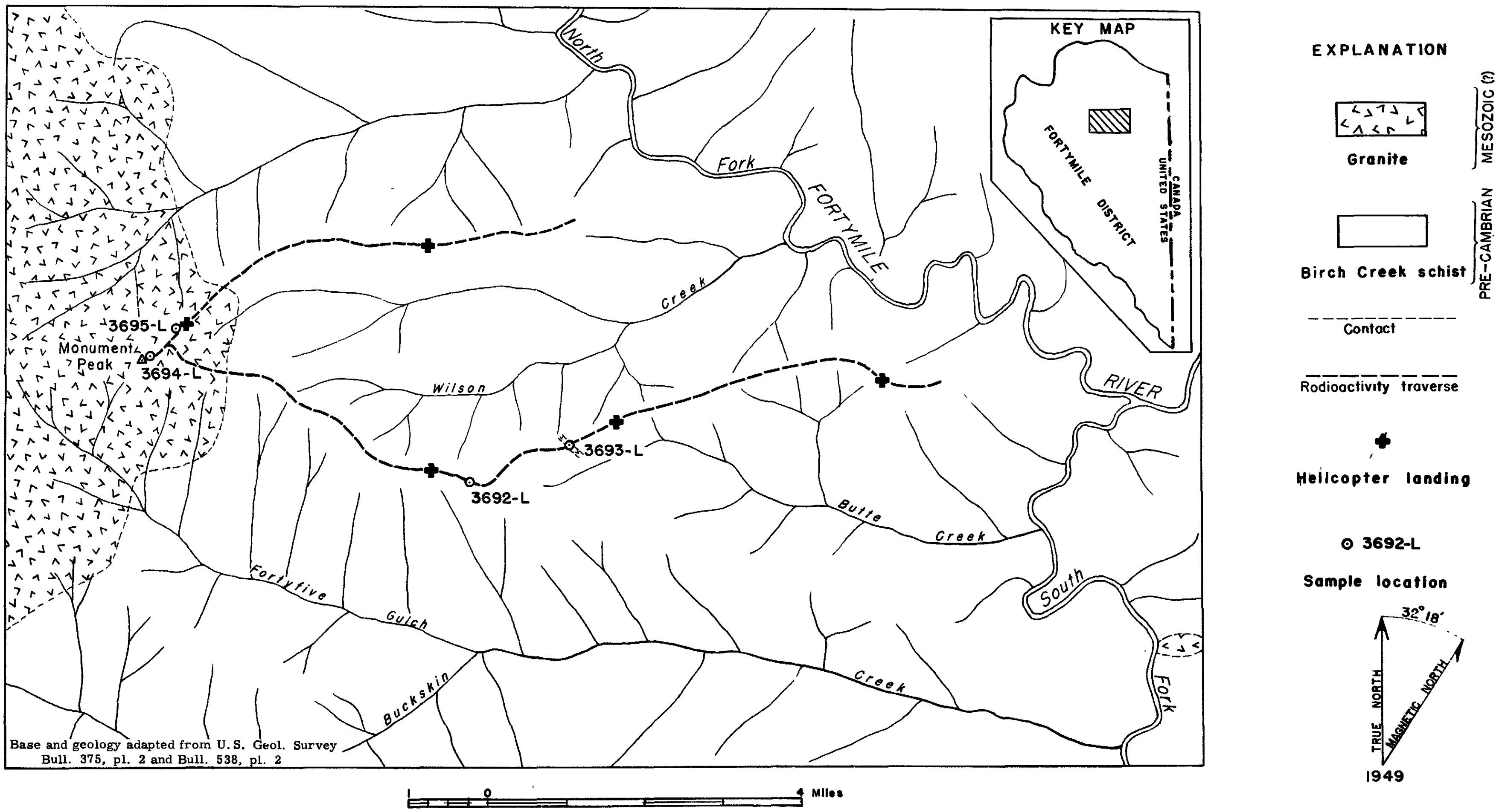

Figure 4. —Geologic sketch map of the Wilson Creek area, Fortymile district, Alaska.

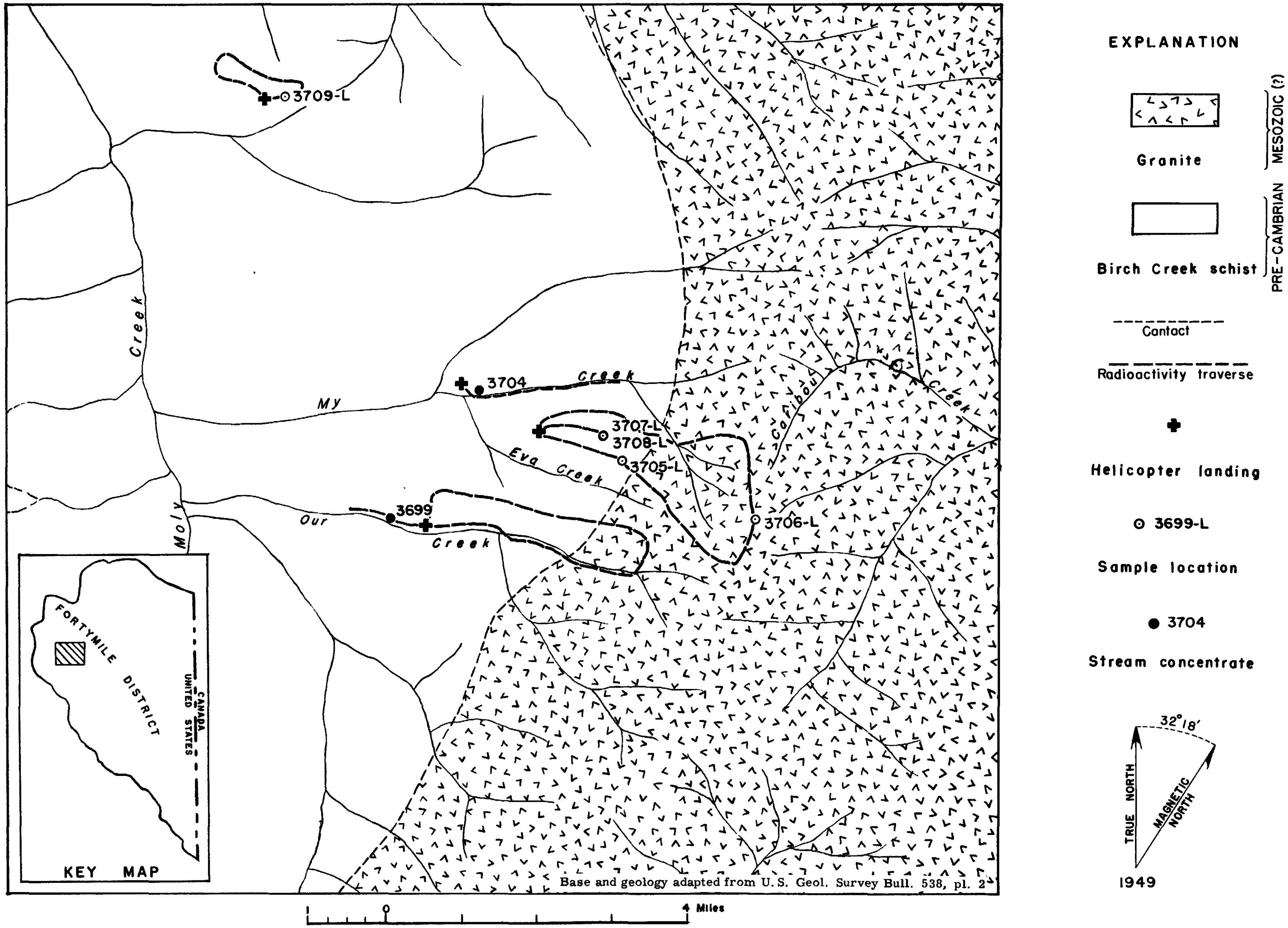

Figure 5.—Geologic sketch map of the My Creek area, Fortymile district, Alaska.

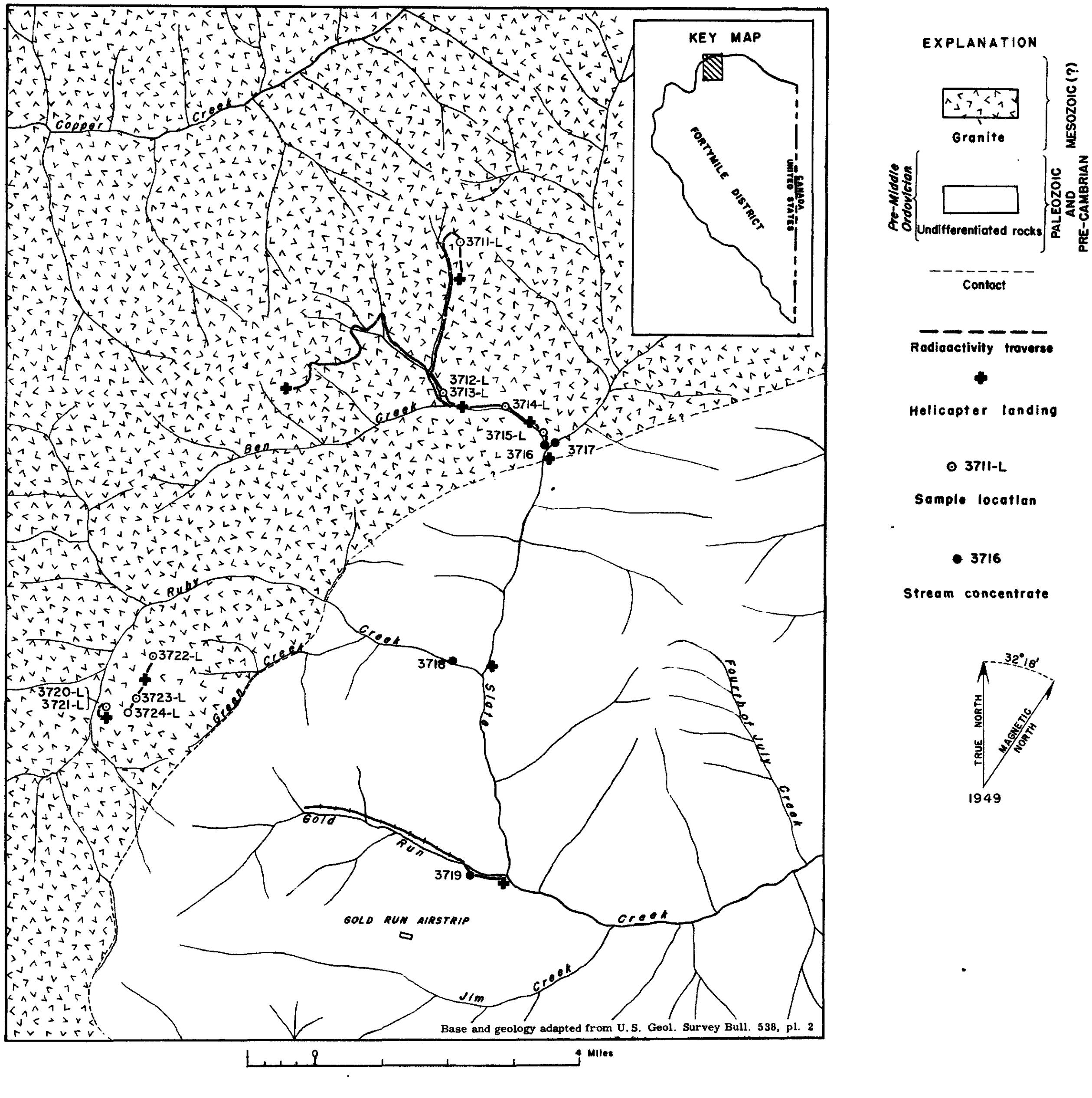

Figure 6. —Geologic sketch map of the Ben Creek area, Fortymile district, Alaska.

Alaskan prospector, had information about a pitchblende occurrence in the Fortymile district. When questioned early in 1949 by W. S. Twenhofel of the Geological Survey, Fillyez indicated that in 1919 he had found a heavy black mineral in a vein on the crest of the ridge west of the confluence of the North and South Forks of the Fortymile River in the vicinity of Wilson Creek (fig. 4). The mineral subsequently was identified as pitchblende by Mr. Seymour a private assayer in Fairbanks, now deceased. Fillyez stated further that an old trail leading westward along the ridge toward Wilson Creek from the confluence of the forks would lead to the vein. Scattered remnants of this trail were located along this ridge in the course of the reconnaissance in 1949.

Geology

The geology of the Wilson Creek area has been mapped by reconnaissance methods by Prindle (1909, pl. 2; 1913, pl. 2) in the course of studies of the Fortymile and Circle quadrangles. The bedrock consists of the pre-Cambrian Birch Creek schist and granitic intrusives of Mesozoic(?) age (fig. 4). In the Wilson Creek area the Birch Creek schist is predominantly a quartz-mica schist, but locally contains such metamorphic rock types as quartzite, coarse-crystalline marble, and micaceous and chloritic schists. Small dikes and sills of intrusive granite, apparently offshoots of the large igneous mass at Monument Peak (fig. 4), and quartz veins of unknown age and origin occur in the area mapped as Birch Creek schist, but their small size prevents their being distinguished separately on the map.

Radioactivity studies

Approximately 17 miles of foot traverses were made along the ridges in the vicinity of Wilson Creek (fig. 4) west of the confluence of the North and South Forks of the Fortymile River in an attempt to locate the reported Fillyez pitchblende occurrence. No significant radioactivity anomaly was detected that might lead to the discovery of the pitchblende.

Most rate-meter readings over the various lithologic types of the Birch Creek schist ranged between 5 and 7 scale divisions (2.0 range) or approximately 0.001 percent or less equivalent uranium. Readings over the granitic rocks in the Wilson Creek area ranged from 13 to 18 scale divisions (2.0 range) and were the highest obtained in the area. The equivalent-uranium content of the granitic rocks ranges from 0.001 to 0.005 percent. This radioactivity is assumed to be due to the presence of traces of radioactive elements in the common accessory minerals of the granite.

A zone of limonitic alteration in brecciated schist (sample 3692-L, fig. 4) contains 0.004 percent equivalent uranium. This slightly anomalous radioactivity is most likely due to traces of uranium in the iron oxides. A search was made for other evidence of mineralization, particularly at or near the granite-schist contact, but none was found.

The data on the samples obtained in the Wilson Creek area are given in table 7; the locations of the samples are plotted on figure 4.

My Creek area

An occurrence of pitchblende in the My Creek area (fig. 5) was reported by Mr. E. D. Manske to the Geological Survey through the Territorial Department of Mines in the latter part of 1948. The original discovery was supposed to have been made by Mr. William Kruhm, former Alaskan prospector, now deceased, in 1904 while he and one other man were prospecting for gold. According to Manske the presence of pitchblende was substantiated by a report on samples submitted by Kruhm to a commercial assay firm in the States.

Geology

Reconnaissance geologic mapping in the My Creek area (fig. 5) was done by Prindle (1913, pl. 2) in the course of his studies in the Circle quadrangle. The bedrock consists of the pre-Cambrian Birch Creek schist and granitic intrusives of Mesozoic(?) age. In general, the geology is very similar to that of the Wilson Creek area, described above.

Some of the quartz veins in the My Creek area are as much as several feet thick and normally are highly fractured and stained with hematite. One quartz vein observed was on the "Ruby silver claim" (sample locality 3707-L, fig. 5) which, in addition to quartz and hematite, contains pods of galena, partly altered to cerussite, and calcite. No pyrargyrite (ruby silver) was identified in later laboratory study of samples taken from this vein. A stibnite prospect has been reported on the divide between My Creek and Our Creek several miles west of the "Ruby silver claim."

Radioactivity studies

About 18 miles of radioactivity traverses were made on foot in the My Creek area (fig. 5) in an attempt to locate anomalous radiation that would lead to the discovery of the pitchblende-bearing vein reported by Manske who accompanied the party for one day in the field. No significant radiation was detected in the course of the traversing, nor did tests of concentrates (samples 3699 and 3704, fig. 5) from gravels on Our and My Creeks show any radioactivity or mineral content that would suggest the occurrence of a high-grade uranium deposit in the watersheds of the streams above the point of the sampling. The hematite-stained quartz veins, one of which also contains lead minerals, showed no radioactivity. The maximum radioactivity (10 scale divisions on the 2.0 range and 0.003 percent equivalent uranium) found in the area was in the coarse-grained granite at the head of Our Creek (sample locality 3706-L, fig. 5). This slight amount of radioactivity is believed to be due to traces of uranium and thorium commonly found in the accessory minerals of felsic igneous rocks. A large area of schist heavily stained with hematite on the north side of the first stream north of My Creek (sample locality 3709-L, fig. 5) was also slightly radioactive. The maximum radioactivity detected at this locality was 9 scale divisions on the 2.0 range. A sample of this altered rock contains 0.002 percent equivalent uranium.

The data on the samples collected in the My Creek area are listed in table 8; the locations of the samples are shown on figure 5.

Table 7.—Data on samples collected in the Wilson Creek area

Sample no.	Description and location	eU[1] (percent)	Rate-meter reading[2]
3692-L	Iron-stained zone in contorted brecciated schist; on divide between Wilson and Buckskin Creeks about 4½ miles east of Monument Peak.	0.004	10
3693-L	Granitic dike in schist; on divide between Wilson and Buckskin Creeks about 5½ miles east of Monument Peak.	.003	13
3694a-L	Granite; at summit of Monument Peak----------------------------------	.005	15
3694b-L	Pegmatitic(?) facies of granite; same location as 3694a-L------------	.001	[3] 15
3695-L	Granite; from spur of Monument Peak about ½ mile northeast of summit--	.005	18

[1]Equivalent uranium as determined in the laboratory.
[2]In scale divisions on 2.0 range.
[3]High reading probably due to adjacent granite.

Table 8.—Data on samples collected in the My Creek area

Sample no.	Description and location	eU[1] (percent)	Rate-meter reading[2]
3699	Heavy-mineral fraction[3] of panned concentrate of 50 pounds of gravel; from dump of old placer-gold prospect pit on Our Creek.	0.002	----------
3704	Heavy-mineral fraction[3] of panned concentrate of 50 pounds of gravel; from dump of old placer-gold prospect pit on My Creek at mouth of Eva Creek.	.001	----------
3705-L	Massive shattered quartz vein with hematite staining along fractures; on ridge between My and Eva Creeks.	< .001	6
3706-L	Coarse-grained granite; on divide at head of My and Our Creeks--------	.003	10
3707-L	Quartz vein containing galena and hematite with some limonite and cerussite, also some calcite in the gangue; "Ruby silver claim" on ridge between My and Eva Creeks.	<.001	6
3708-L	Iron-stained (gossan) rock with a few fragments of galena; same location as 3707-L.	<.001	6
3709-L	Hematite-stained quartz-mica schist with scattered quartz veinlets; on ridge on north side of first stream north of My Creek.	.002	9

[1]Equivalent uranium.
[2]In scale divisions on 2.0 range.
[3]Greater than 2.8 specific gravity.

Ben Creek area

An occurrence of "yellowish uranium ore" on one of the branches of the first south-flowing tributary of Ben Creek (fig. 6) in the northwestern part of the Fortymile district was reported by Mr. William Ott of Fairbanks to the Geological Survey through the Territorial Department of Mines in 1948. A sample collected by Ott in 1918 was reportedly assayed by a laboratory at Seattle, Washington and was reported to have a "high content of uranium." However, no records are available for checking because the laboratory went out of business about 1923-24.

Geology

The geology of the Ben Creek area (fig. 6) was mapped by Prindle (1913, pl. 2) in his studies of the Circle quadrangle. The rocks consist of pre-Middle Ordovician sedimentary rocks, chiefly clastic, intruded by granite of Mesozoic(?) age. An area of porphyritic rhyolite between Green Creek and Ruby Creek shown on figure 6 as part of the granite may be a border phase of the granite. On the other hand, it may well be one of the Tertiary rhyolites described by Mertie (Prindle, 1913, p. 44, 45), although sufficient evidence is not available to substantiate this possibility.

Little is known of the possibilities for mineral deposits in the area. Gold Run in the southern part of the area (fig. 6) was mined for placer gold in the early part of the century. Ott reports, also, that large fragments of vein float containing galena occur in the gravel at the mouth of Fourth of July Creek (fig. 6). A small copper prospect (see Chapter C) is located on Copper Creek about 22 miles northwest of the mouth of Ben Creek.

Radioactivity studies

Between 6 and 7 miles of radioactivity traversing was done in the Ben Creek drainage basin in the vicinity of the "yellowish uranium ore" occurrence reported by Ott. No anomalous radioactivity was found beyond that which normally occurs in most felsic igneous rocks. Rate-meter readings for the most part were constant at about 9 scale divisions on the 2.0 range. These readings increased to 10 and 11 scale divisions toward the contact of the granite with the sedimentary rocks in the part of the traverse to the mouth of Ben Creek. Selected samples (nos. 3711-L to 3714-L, fig. 6) of the granite contain from 0.002 to 0.004 percent equivalent uranium. In addition to the radioactivity traverses on the ground, the area was searched carefully from the air at low altitudes with the helicopter for the highly colored zones indicative of possible mineralization; none were found in the Ben Creek drainage area or in the Slate Creek drainage area above the mouth of Ben Creek. Southwest of the Ben Creek drainage, however, a large orange-colored hill between Green Creek and Ruby Creek was prominent and showed a slightly greater radioactivity than surrounding rocks when tested from the air. The rock in this hill is a porphyritic rhyolite varying in color from yellow through orange and red to purple. Ground traverses over the rhyolite showed rate-meter readings of 14 to 18 scale divisions on the 2.0 range; samples (nos. 3720-L to 3724-L, fig. 6 and table 9) of the rhyolite contain 0.005 percent equivalent uranium. In contrast to the granite and rhyolite, rate-meter readings over the clastic sedimentary rocks on a traverse along the lower part of Gold Run (fig. 6) showed only 4 to 6 scale divisions on the 2.0 range. These readings indicate an equivalent-uranium content of less than 0.001 percent for the rocks along the traverse. The radioactivity data on samples taken in the Ben Creek area are given in table 9. The locations of the samples are plotted on figure 6.

As a check on the possible radioactive minerals in the granitic rocks, concentrates were taken from the stream gravels at the mouth of Ben Creek, on Slate Creek just above the mouth of Ben Creek, at the mouth of Ruby Creek, and on Gold Run (samples 3716 to 3719, fig. 6). The data on the radioactivity of these concentrates are given in table 9. Monazite and allanite are present in the concentrates from Ben, Slate, and Ruby Creeks, therefore the radioactivity is assumed to be due chiefly to thorium. Although the granite samples were not examined specifically for monazite and allanite, the presence of these minerals in the concentrates from gravels of streams with drainage basins entirely within the granite suggests that they probably occur as accessory minerals in the granite. Supporting this hypothesis is the fact that the concentrate from Gold Run, which does not drain any area of granitic rock, is not appreciably radioactive and does not contain either allanite or monazite.

Chicken area

A few radioactivity tests were made in the vicinity of Chicken. (See inset, fig. 3.) In addition, several slightly radioactive samples were donated to the Geological Survey by prospectors. The data on the samples obtained in the vicinity of Chicken are listed in table 10; the locations of the samples are plotted on the inset of figure 3.

The radioactive sluice-box concentrate from the placer-gold operation on Atwater Bar is comparable to similar concentrates from Atwater Bar described by White (see Chapter D). The chief radioactive minerals are uranothorianite and monazite. Although time did not permit a search for the bedrock source of the uranothorianite, the brittle nature of this mineral, and hence its tendency to shatter when transported, suggests that the source is not far distant.

Prindle (1909, p. 24 and pl. 2) describes and maps a small area of Tertiary coal-bearing sedimentary

Table 9.—Data on samples collected in the Ben Creek area

Sample no.	Description and location	eU[1] (percent)	Rate-meter reading[2]
3711-L	Medium- to coarse-grained granite; on divide between Ben Creek and Slate Creek drainage.	0.002	9
3712-L	Coarse-grained (pegmatitic facies?) granite, in large stream boulder; from tributary of Ben Creek about ¼ mile above mouth.	.004	----------
3713-L	Medium- to coarse-grained granite bedrock (weathered); same location as 3712-L.	.002	9
3714-L	Medium- to coarse-grained granite on left limit of Ben Creek about 1 mile above mouth.	.003	10
3715-L	Medium- to coarse-grained granite on left limit of Ben Creek about 100 yards above mouth.	.003	11
3716	Heavy-mineral fraction[3] of panned concentrate from about 100 pounds of stream gravel; on Ben Creek about 250 feet above mouth.	.096	----------
3717	Heavy-mineral fraction[3] of panned concentrate from about 100 pounds of stream gravel; on Slate Creek about 500 feet above mouth.	.068	----------
3718	Heavy-mineral fraction[3] of panned concentrate from about 75 pounds of stream gravel; on Ruby Creek about ½ mile above mouth.	.015	----------
3719	Heavy-mineral fraction[3] of panned concentrate from about 100 pounds of stream gravel; on Gold Run about ½ mile above mouth.	.003	----------
3720-L	Hematite- and limonite-stained porphyritic rhyolite of granite; on west flank of large "orange hill" between Ruby and Green Creeks.	.005	18
3721-L	Orange-colored residuum from rhyolite; same location as 3720-L-------	.005	18
3722-L	Purplish-colored rhyolite; about 1 mile northeast of 3720-L---------	.005	14
3723-L	Iron-stained rhyolite; about ¼ mile northeast of summit of "orange hill."	.005	14
3724-L	Same as 3723-L; at summit of "orange hill" ------------------------	.005	14

[1]Equivalent uranium.
[2]In scale divisions on 2.0 range.
[3]Greater than 2.8 specific gravity.

rocks in the vicinity of Chicken. The samples of montmorillonite-type clay from deeply weathered rock in the valley of the first creek west of Chicken Creek (table 10) most likely were collected from a bed in the Tertiary sequence. The samples contain 0.001-0.005 percent equivalent uranium and consist mostly of clay with some sand-size particles and a minor amount of coarser material. The coarser material is chiefly in the form of rounded pellets. The entire material of the samples, however, is too disintegrated to determine whether the original rock was igneous or sedimentary in origin. A few of the pellets contain small crystals of pyrite partly altered to hematite and limonite. The heavy-mineral fraction greater than 2.8 specific gravity of sample 3701-L contains as much as about 0.06 percent equivalent uranium. It consists of about 99 percent pyrite with traces of hematite, goethite, covellite, chalcopyrite, biotite, and chlorite. The radioactivity is probably due to uranium occurring as an impurity in the iron oxides.

The coked(?) coal and related ash beds containing as much as 0.003 percent equivalent uranium collected near Chicken are also part of the Tertiary sedimentary rocks mapped by Prindle (1909, pl. 2). The proximity of a body of basalt to the coal and the fact that much of the coal now exposed was coked(?) rather than completely burned suggests that the burning and possible coking accompanied the emplacement of the basaltic rocks. The slightly anomalous radioactivity of the coal and ash beds is probably due to the concentration of traces of radioactive elements in the process of coking and burning.

SUMMARY AND CONCLUSIONS

Three occurrences of high-grade uranium ores reported by prospectors in the Fortymile district were not found. The maximum radioactivity detected was in felsic igneous rocks, which contain as much as 0.005 percent equivalent uranium. Concentrates from gravels of creeks draining areas underlain by the felsic igneous rocks contain as much as 0.096 percent equivalent uranium. This radioactivity is assumed to be due chiefly to thorium in allanite and monazite. A summary of the materials tested in the Fortymile district is given in table 11.

Table 10.—Data on samples from Chicken and vicinity, 1949

Sample no.	Description and location	eU[1] (percent)	Rate-meter reading[2]
3689	Sluice-box concentrate from placer-gold operations at Atwater Bar; donated by Lon L. Davis.	0.027	----------
3690	Same as sample 3689----------	.003	----------
3697-L	Coarse-grained granitic rock; in borrow pit along Taylor Highway about 4 miles southwest of Mosquito Fork bridge.	.002	7-8
3698-L	Mafic dike about 6 feet thick cutting granitic rock at locality of sample 3697-L.	.002	7-8
3700-L	Montmorillonite-type clay from artificial exposures on first creek west of Chicken Creek.	.003	----------
3701-L	Same as sample 3700-L----------	.005	----------
3702-L	Same as sample 3700-L; hard pellets in clay—appear to be sulfide bearing.	.004	----------
3703-L	Same as sample 3700-L; mostly clay----------	.001	----------
S-256	Ash bed from burned coal; about ½ mile northwest of Chicken----------	.003	11
S-257	Coked(?) coal; same location as sample S-256----------	.002	10
S-258	Burned clay; same location as sample S-256----------	.001	10
S-259	Coked(?) coal; same location as sample S-256----------	.002	10

[1] Equivalent uranium.
[2] In acale divisions on 2.0 range.

Table 11.—Summary of data on radioactivity of materials tested in the Fortymile district, 1949

Type of material tested and location	Equivalent uranium (percent)	Type of material tested and location	Equivalent uranium (percent)
Granitic rocks:		Hematite- or limonite-stained schist:	
Wilson Creek area----------	0.003-0.005	Wilson Creek area----------	0.004
My Creek area----------	.003	My Creek area----------	.002
Ben Creek area----------	.002- .004	Sulfide-bearing clay:	
Vicinity of Chicken----------	.002	Vicinity of Chicken----------	0.001- .005
Porphyritic rhyolite:		Coked(?) coal and ash beds from burned coal:	
Ben Creek area----------	.005		
Mafic dike:		Vicinity of Chicken----------	.001- .003
Vicinity of Chicken----------	.002	Concentrates from placers:	
Mineralized quartz veins:		My Creek area----------	.001- .002
		Ben Creek area----------	.003- .096
My Creek area----------	.001	Vicinity of Chicken----------	.003- .027

Although the search for high-grade uranium deposits in the Fortymile district in 1949 was unsuccessful, the district cannot be arbitrarily dismissed as having no potential for radioactive minerals. It is significant to note that small amounts of uranium occur in a copper deposit on Copper Creek (see Chapter C) a short distance northwest of the district, and traces of uranothorianite are found in the placers of Atwater Bar near Chicken. In addition, occurrence of fluorite (Wedow and others, 1953, p. 13) and metallic minerals (Mertie, 1937, p. 244, 245), commonly associated elsewhere with uranium, are known in the district. At present, however, too little geologic information is available to suggest specific localities for uranium prospecting.

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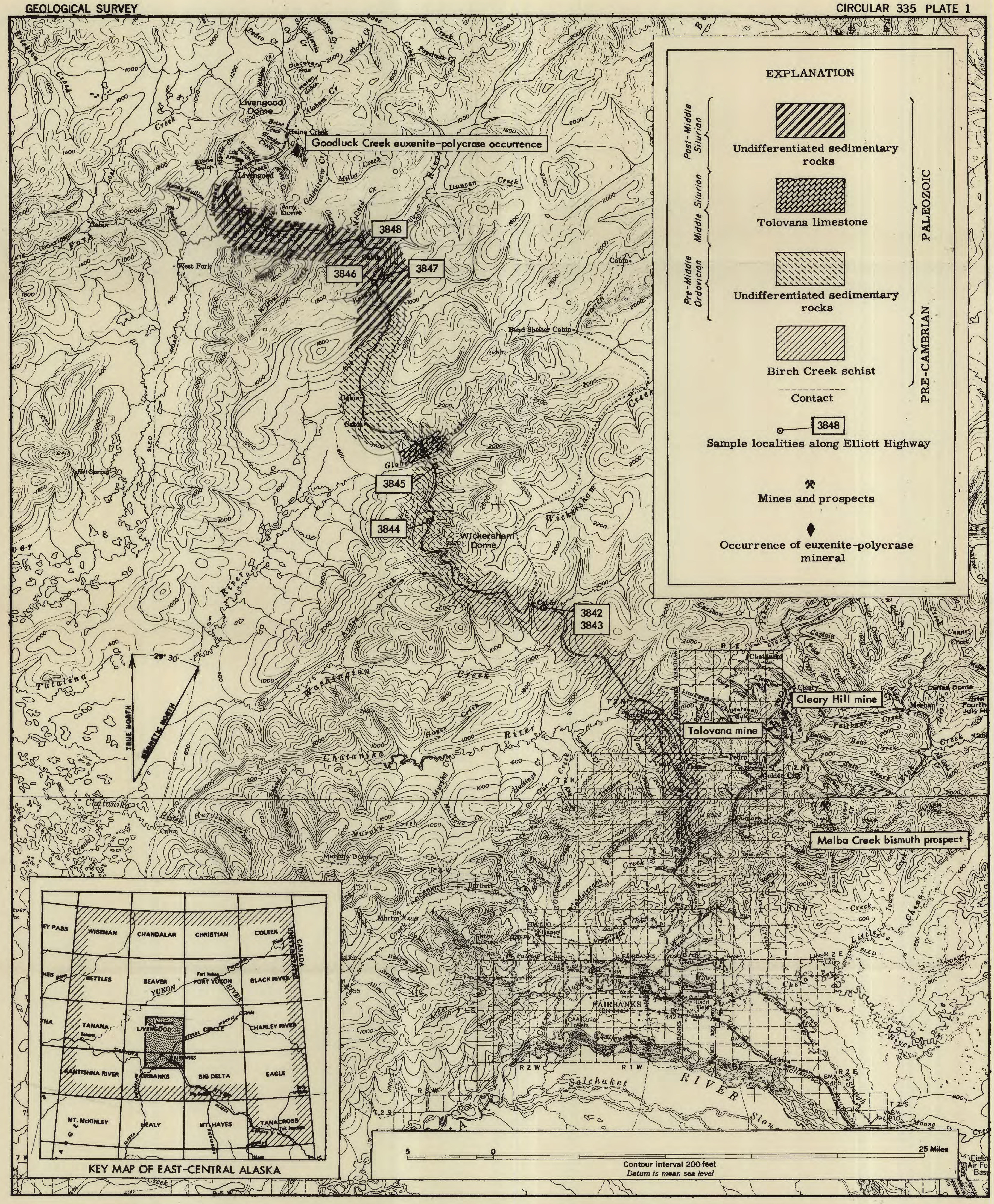
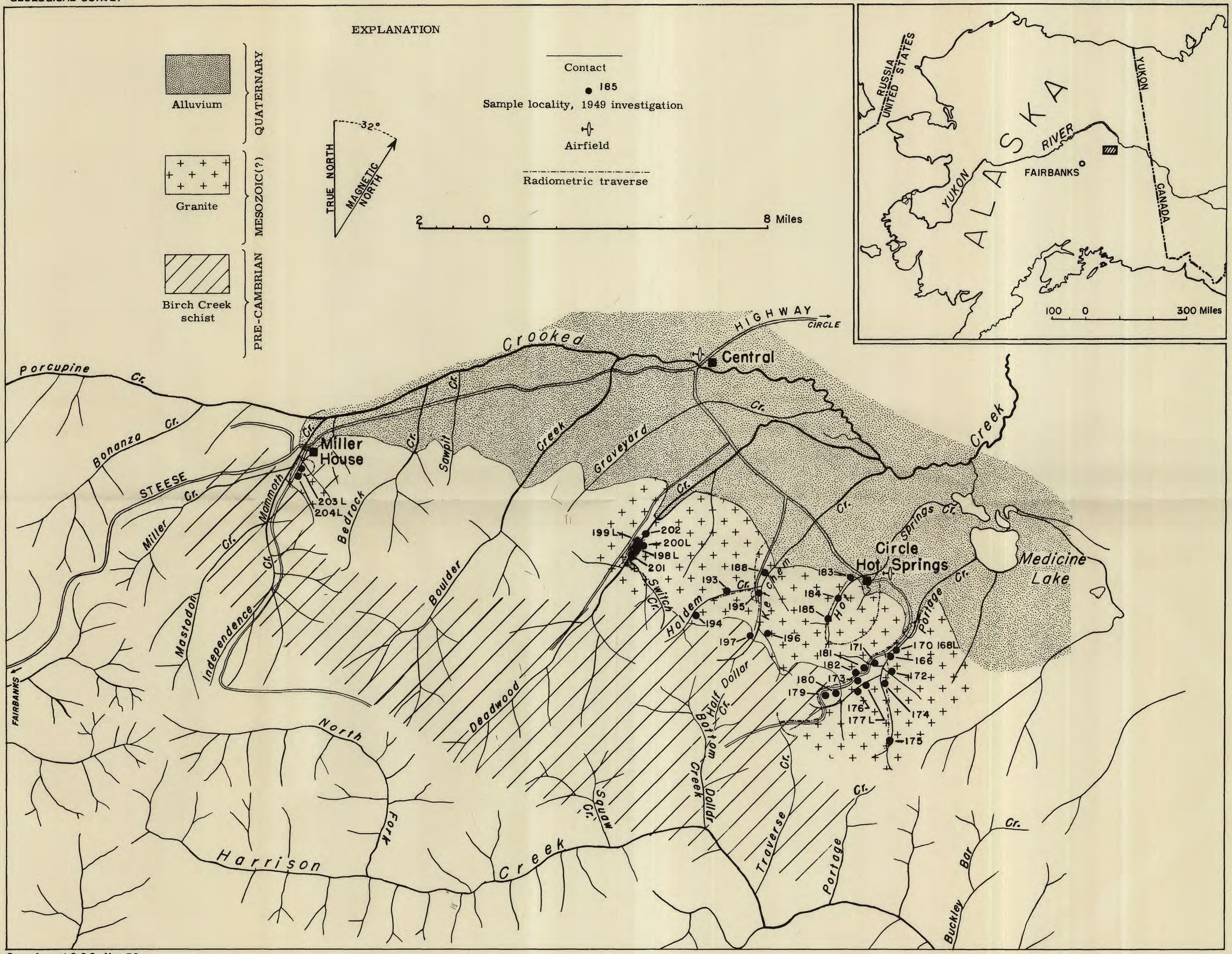


MAP OF PARTS OF FAIRBANKS AND LIVENGOOD QUADRANGLES, EAST-CENTRAL ALASKA



Base from U.S.G.S. Map 38

GEOLOGIC SKETCH MAP OF THE MILLER HOUSE - CIRCLE HOT SPRINGS AREA, EAST-CENTRAL ALASKA