UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

MAR 5 1951

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Dr. Phillip L. Merritt, Assistant Manager
Raw Materials Operations
U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

Dear Phil:

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Sincerely yours,

for W. H. Bradley
Chief Geologist

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

RADIOACTIVITY IN THE "OKPILAK" GNEISSIC GRANITE MOUNT MICHELSON AREA, NORTHEASTERN ALASKA

by

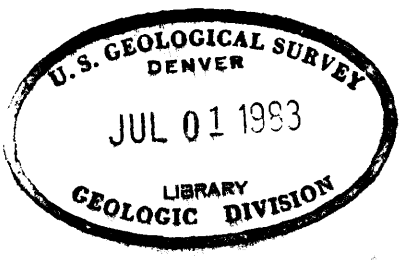
Max G. White

January 1951

Shorter Contributions to Alaskan Trace Elements Studies

for 1948

Trace Elements Investigations Report 57-C



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RADIOACTIVITY IN THE "OKPILAK" GNEISSIC GRANITE MOUNT MICHELSON AREA, NORTHEASTERN ALASKA

By Max G. White

ABSTRACT

Radiometric examination of 13 samples collected in the Mt. Michelson area, northeastern Alaska, in 1948, shows that four samples of gneissic granite contain an average of 0.007 percent equivalent uranium. The heavy-mineral fractions from three of these four samples contain an average 0.052 percent equivalent uranium and 0.03 percent uranium. The heavy-mineral fractions of panned concentrates from gravels of streams draining relatively large areas of granitic rock, contain an average of 0.028 percent equivalent uranium, whereas similar heavy fractions of panned concentrates from streams that drain areas other than those largely underlain by granitic rock contain an average of only 0.005 percent equivalent uranium.

Mineralogic study of all heavy-mineral fractions having more than 0.01 percent equivalent uranium indicates that the radioactive material apparently is confined to biotite, which in one sample contains 1.19 percent uranium. Fluorite, hematite, zircon, sphene, galena, and molybdenite, commonly associated elsewhere with uranium, apparently are disseminated in the granite along with the biotite.

The presence of uranium in the biotite of the granite and, of other minerals associated with uranium elsewhere, suggests that this area should be considered in relation to others in Alaska as a possible locality to search for high-grade uranium deposits.

INTRODUCTION

On the latest geologic map of Alaska, compiled by Smith (1939, pl.1), three areas of intrusive rocks are shown in northeastern Alaska on the north flank of the Brooks Range. These areas are as follows:

1) On the international boundary about 30 miles south of the Arctic Coast.

2) In the vicinity of Mt. Michelson about 80 miles west of the international boundary (figs. 1, 2).

3) In the vicinity of Mt. Chamberlain about 15 miles west of Mt. Michelson (fig. 2).

The presence of granite in areas (1) and (3) listed above is uncertain. Its presence has been confirmed by recent field investigations only in the vicinity of Mt. Michelson, area (2), (Whittington and Sable, 1948, pp. 14-16, and fig. 1). A. G. Maddren, the only Survey geologist to work along the northern part of the international boundary, indicates in his unpublished notes and maps that the rocks in area (1) are tuffs and agglomerates. The area around Mt. Chamberlain (fig. 2), originally mapped by Leffingwell (1919, pl. 2) as granite(?), was found by Whittington and Sable (1948, fig. 1) to consist instead of pre-Cambrian(?) schists of the Neruokpuk formation. In the Mt. Michelson area, however, the work

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TRACE ELEMENTS INVESTIGATIONS
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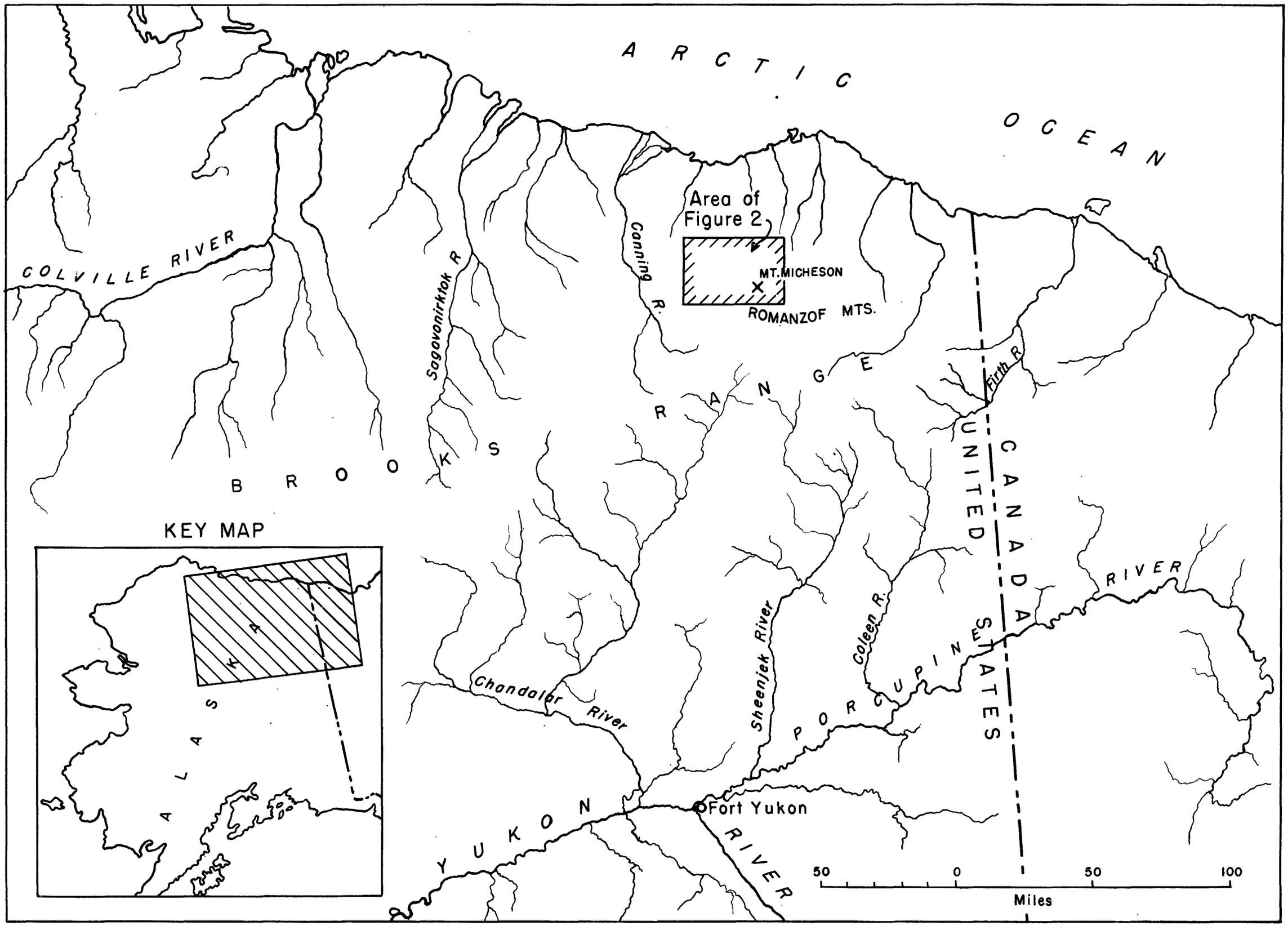
FIGURE 1



MAP OF NORTHEASTERN ALASKA SHOWING LOCATION OF THE MOUNT MICHELSON AREA

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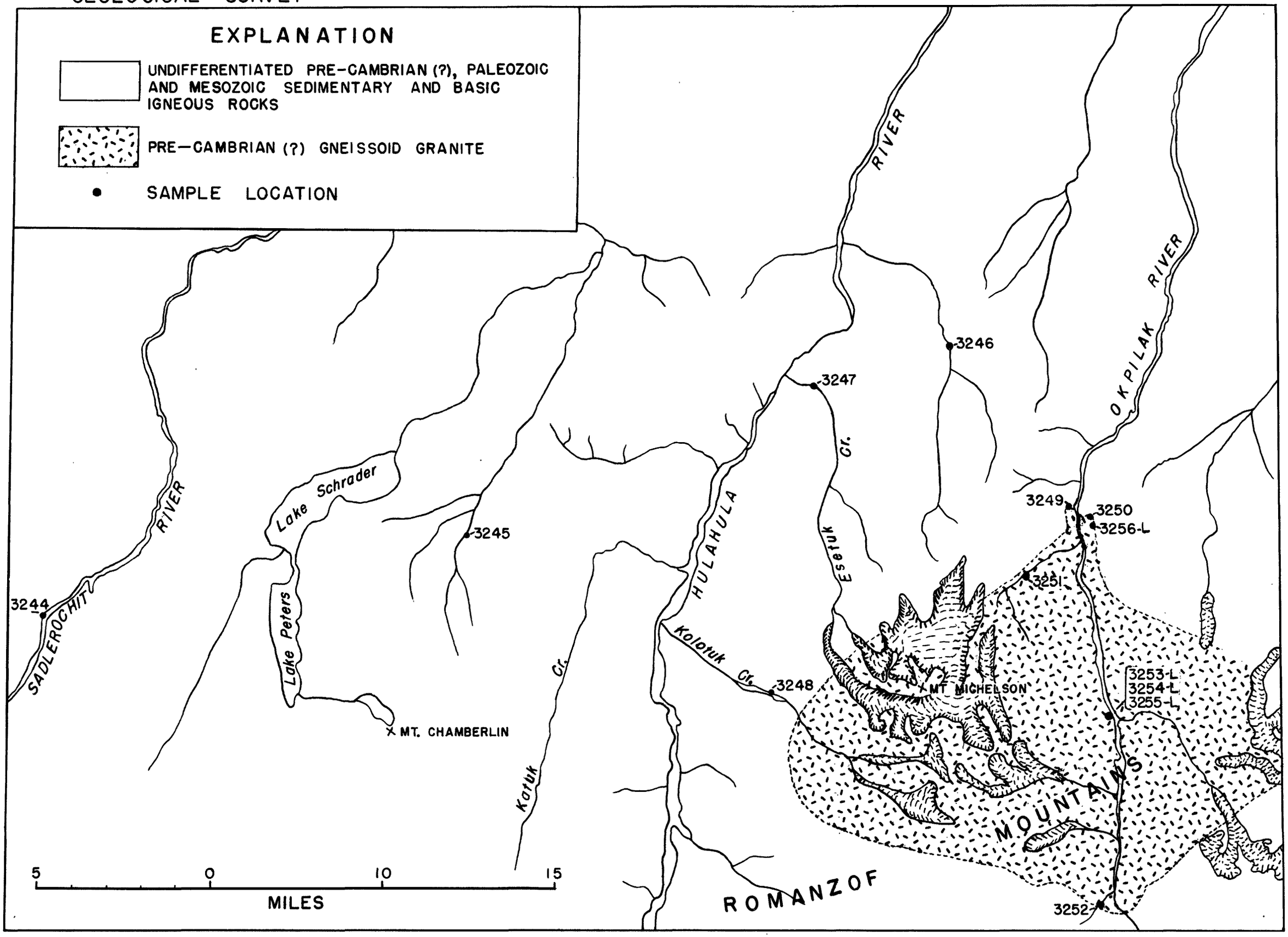
FIGURE 2

EXPLANATION

UNDIFFERENTIATED PRE-CAMBRIAN (?), PALEOZOIC AND MESOZOIC SEDIMENTARY AND BASIC IGNEOUS ROCKS

PRE-CAMBRIAN (?) GNEISSOID GRANITE

SAMPLE LOCATION



Geology and base from maps by USGS Navy Oil Unit

SKETCH MAP OF THE MOUNT MICHELSON AREA, NORTHEASTERN ALASKA

by Whittington and Sable corroborated the area of intrusive rock mapped by Leffingwell (1919, pp. 126-128, and pl. 2). It is thus the only verified area of intrusive rock in northeastern Alaska on the north flank of the Brooks Range.

Following the field season of 1948, Whittingon turned over to the author a collection of 13 samples from the Mt. Michelson area (fig. 2). The purpose of this report is to present the results of the radiometric and mineralogic studies of these samples.

GEOLOGY

The gneissic granite at Mt. Michelson has been named "Okpilak" by Whittington and Sable (1948, p. 14-16), as it occurs in the headwaters of the Okpilak River (fig. 2). The granite commonly is gray and coarse-grained. According to Whittington and Sable (1948, pp. 14-15) the "Okpilak" granite

> "seems to be made up of several different granites. The granite which is apparently most common is gray in color. In general the granites are composed of quartz, white feldspars, and minor amounts of dark minerals. Quartz probably averages 25 percent with feldspars contributing the bulk of the remainder. The feldspars are mostly white in color, but pink feldspar was seen in float. In a number of hand specimens two different white feldspars were tentatively differentiated. Although the dark minerals are generally a minor constituent, in a few cases they were found to comprise a considerable percentage, 30 to 50 percent, of the rock. The dark mineral or minerals have been mostly altered to chlorite. In a few cases biotite was found with a chlorite outline. Feldspar phenocrysts are present in some of the rock.

> Outcrops of granite containing phenocrysts were found near the north edge of the mass. Erratics bearing phenocrysts are common, and many of them have come from other parts of the mass. In general, the phenocrysts are one to one and one-half inches long, but some have been seen up to six inches in length. The phenocrysts are usually fractured, often showing two sets of fractures approximately at right angles.
>
> "Inclusions and segregations were seenonly in outcrops along a creek which flows from the west into the Okpilak River near the north edge of the granite mass. The inclusions are generally angular, but the corners are rounded and the edges minutely scalloped, suggesting absorption of some of the rock by the including magma. Both light and dark colored inclusions were found. They are generally finer-grained than the including rock and are thought to be entirely igneous. One dark colored inclusion contained a light colored inclusion. Another dark inclusion contained feldspar sphenocrysts. Segregations seen apparently consist of small masses of biotite which have been concentrated into layers."

In places the granite grades into the schist and phyllite of the Neruokpuk formation of pre-Cambrian(?) age. A gneissic structure is characteristic of the granite, but is not universally present and varies considerably in degree of development. Where the granite grades into the schist, the gneissic structure becomes more intense and passes into the foliation of the Neruokpuk formation. On the basis of the gneissic structure, the apparent lateral gradation into presumed pre-Cambrian(?) schist, and the unmetamorphosed condition of adjacent Carboniferous limestone, the "Okpilak" granite is tentatively assigned to the pre-Cambrian and correlated with the Pelly gneiss of the Yukon-Tanana region (Mertie, 1937, pp. 201-203).

RADIOACTIVITY AND MINERALOGY

The 13 samples from the Mt. Michelson area consisted of four specimens of the granite bedrock along the Okpilak River, seven panned concentrates from gravels of streams in the immediate vicinity of Mt. Michelson, and two panned concentrates from stream gravels of the Sadlerochit River and one of its tributaries west of Mt. Michelson (fig. 2). The four rock samples were crushed to minus-20 mesh and analyzed radiometrically. They were then fractionated with bromoform (G 2.8). The nine panned concentrates from stream gravel also were sized to minus-20 mesh and fractionated with bromoform. The bromoform-heavy fractions of both the crushed rock samples and panned concentrates were then analyzed for uranium fluorimetrically. Table 1 gives the data on the 13 samples. Mineralogic studies were made of all the heavy-mineral fractions containing more than 0.01 percent equivalent uranium (eU). Table 2 shows the mineral composition of these radioactive heavy-mineral fractions.

The four samples of gneissic granite bedrock contain an average of 0.007 percent equivalent uranium. The heavy-mineral fractions of three of these four samples contain an average of 0.052 percent equivalent uranium and 0.03 percent uranium. Thus by concentrating the heavy minerals of the granite by a ratio of about 30:1 approximately a seven-fold increase in the equivalent uranium content is obtained, of which about 60 percent is uranium.

Table 1. Data on samples from the Mt. Michelson area, northeastern Alaska

Sample No.	Location (see fig. 2)	Crushed bedrock eU (percent)	Heavy-mineral fraction eU (percent)	Heavy-mineral fraction U (percent)[1]	Concentration ratio[2]
Bedrock samples:					
3253-L	Left limit of Okpilak River about midway between north and south edges of intrusive mass.	0.007	0.080	0.033	40:1
3254-L	Same as sample 3253-L.	0.007	0.034	0.010	18:1
3255-L	Same as sample 3253-L.	0.008	0.043	0.046	36:1
3256-L	Right limit of Okpilak River at north edge of intrusive mass.	0.005	0.008	n.d.	10:1
Panned concentrate samples:					
3244	Sadlerochit River about 7 miles southwest of Lake Schrader.	-	0.006	n.d.	2,600:1
3245	Tributary of Sadlerochit River about 3 miles southeast of Lake Schrader.	-	0.004	n.d.	5,100:1

1/ Determined fluorometrically by the Geological Survey Laboratory

2/ Concentration ratio is ratio between original material and heavy-mineral fraction

Table 1. Data on samples from the Mt. Michelson area, northeastern Alaska (continued)

3246	East tributary of Hulahula River about 5 miles upstream from junction with Hulahula River and about 10 miles north of Mt. Michelson.	-	0.002	n.d.	4,400:1
3247	Esetuk Creek about 1 mile upstream from junction with Hulahula River and about 8 miles downstream from granite contact.	-	0.013	n.d.	4,000:1
3248	Kolotuk Creek about 4 miles upstream from junction with Hulahula River and about 1 mile downstream from granite contact.	-	0.030	n.d.	5,300:1
3249	Small tributary on west side of Okpilak River just downstream from north edge of granite.	-	0.030	n.d.	7,500:1
3250	Small tributary on east side of Okpilak River at contact of granite and limestone.	-	0.005	n.d.	10,000:1
3251	West tributary of Okpilak River, about 2 miles upstream from junction with Okpilak River; near north edge of granite.	-	0.040	n.d.	10,000:1
3252	West fork of Okpilak River, about 3/4 mile upstream from junction of forks; near south edge of granite where it is in contact with the Neruokpuk formation.	-	0.007	n.d.	2,500:1

Table 2. Mineralogy [1/] of heavy-mineral fractions containing more than 0.01 percent equivalent uranium, Mt. Michelson area, northeastern Alaska

Minerals are listed in order of decreasing abundance

Sample 3247 (0.013 percent eU)	Sample 3248 (0.030 percent eU)	Sample 3249 (0.030 percent eU)	Sample 3251 (0.040 percent eU)
Biotite	Biotite	Biotite	Biotite
Chlorite	Chlorite	Hematite	Garnet
Muscovite	Muscovite	Pyrite	Muscovite
Epidote	Yttrocerite(?)	Ilmenite	Chlorite
Fluorite)	Fluorite	Zircon	Tourmaline
Zircon)-trace	Magnetite	Zoisite)	Yttrocerite(?)
Hematite)		Magnetite)	Fluorite
		Sphene)-trace	Pyrite
		Brookite)	Zircon)
		Scheelite)	Hematite)-trace
			Galena)

Sample 3253-L (0.080 percent eU) (0.033 percent U)	Sample 3254-L (0.034 percent eU) (0.010 percent U)	Sample 3255-L (0.043 percent eU) (0.046 percent U)
Biotite	Biotite	Fragments of quartz with biotite, muscovite, pyrite, and magnetite
Muscovite	Muscovite	Muscovite
Pyrite (with hematite coating)	Yttrocerite(?)	Biotite
Yttrocerite(?)	Fluorite	Pyrite (with hematite coating)
Fluorite	Chlorite	Magnetite
Garnet)	Magnetite	
Chlorite)-trace		
Magnetite)		
Molybdenite)		

1/ Mineralogical analyses by K. Onoda of the Geological Survey Laboratory

On the basis of the radiometric data on the panned concentrate samples, it appears obvious that the radioactive material comes from the granite, as all samples from gravels of the streams draining large sectors of the granitic area have a relatively large equivalent uranium content (see especially samples 3248, 3249, and 3251, fig. 2 and table 1). The equivalent uranium content decreases considerably in other sectors even where the watershed of the stream contains a small amount of granitic rock.

The radioactivity of all the samples investigated mineralogically appears to be entirely in the biotite. X-ray studies of selected grains of this mineral from sample 3253-L show a mixed pattern with major biotite-phlogopite(?) lines. Spectrographic analysis of the biotite indicates the presence of silicon, calcium, iron, aluminum, magnesium, lanthanum, zirconium, and rare earths. A fluorimetric test shows that the biotite from sample 3253-L contains 1.19 percent uranium. Minerals such as fluorite, hematite, molybdenite, galena, zircon, and sphene (table 2), commonly associated with radioactive materials elsewhere, apparently are disseminated in the gneissic granite along with the biotite, although the fluorite and molybdenite suggest either pegmatitic or hydrothermal conditions.

CONCLUSIONS

Radiometric and mineralogic study of four bedrock samples and nine panned concentrate samples from the Mt. Michelson area of northeastern Alaska shows that uranium is associated with biotite in the pre-Cambrian(?) gneissic granite of the area. Fluorite, hematite, molybdenite, galena, and other minerals, associated with uranium elsewhere, also occur in the granite. These occurrences suggest that this area should be considered in relation to others in Alaska as a possible locality at which to search for high-grade deposits of uranium.

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Whittington, C. L. and Sable, E. G. (1948) Preliminary report on the geology of the Sadlerochit River area (Alaska): U. S. Geol. Survey Geological Investigations, Naval Petroleum Reserve No. 4, Alaska, unpublished.