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

APR 30 1952

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

Dear Phil:

Transmitted herewith for your information and distribution are six copies of Trace Elements Investigations Report 49, "Reconnaissance for radioactive deposits in the Buckland-Kiwalik district, Candle quadrangle, Seward Peninsula, Alaska", by Walter S. West and John J. Matzko, March 1952.

It is believed that of all the uranothorianite occurrences in the Buckland-Kiwalik district only that in the headwaters of the Peace River has any merit as a lead to a possible high-grade uranium deposit. At this locality uranothorianite and gummite are associated with pyrite, chalcopyrite, hematite, ilmenite, bismuth, bornite, gold, silver, chromite, and thorite in placers near a syenite-andesite contact; the equivalent uranium content of concentrates from these placers is about 10 times that of concentrates from other uranothorianite-bearing placers in the eastern part of the Seward Peninsula. During 1951 a small field appraisal party attempted to locate the bedrock source of the uranothorianite and gummite at the Peace River locality, but was unsuccessful because of permafrost conditions and lack of the heavy trenching equipment necessary to remove the thick frozen tundra cover. A separate short report is being prepared on the results of the 1951 field appraisal. The Survey plans no further work on the radioactive deposits in the Buckland-Kiwalik district beyond the publication of available information in an attempt to stimulate private prospecting.

We plan to publish this report as a Geological Survey circular, and are asking Mr. Hosted, by a copy of this letter, whether the Commission has any objection to such publication.

Sincerely yours,

O.E. McKelvey

for W. H. Bradley
Chief Geologist

JAN 09 2001

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Geology - Mineralogy

This document consists of 27 pages,
plus 1 figure.
Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

RECONNAISSANCE FOR RADIOACTIVE DEPOSITS IN THE BUCKLAND-KIWALIK DISTRICT, CANDLE QUADRANGLE, SEWARD PENINSULA, ALASKA*

By

Walter S. West and John J. Matzko

March 1952

Trace Elements Investigations Report 49

This preliminary report is distributed without editorial and technical review for conformity with official standards and nomenclature. It is not for public inspection or quotation.

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

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By

Walter S. West and John J. Matzko

ABSTRACT

Radioactive minerals are widely distributed in the Buckland-Kiwalik district of the Seward Peninsula, Alaska. Localized concentrations of uranothorianite, the most important uranium mineral found, occur in the headwaters of Peace River, Quartz Creek, and Sweepstakes Creek on the slopes of Granite Mountain; in the Hunter Creek-Connolly Creek area, and on the south slope of Clem Mountain. Although the source of the uranothorianite and the other radioactive minerals has not yet been discovered because of tundra cover and heavy talus deposits, these minerals probably occur as accessories in granitic rocks.

The concentration of uranothorianite in placers at the head of the Peace River is believed to be the only lead to a possible high-grade uranium deposit. At this locality uranothorianite and its alteration product gummite, associated with hematite, limonite, powellite, pyrite, chalcopyrite, bornite, molybdenite, gold, silver and bismuth, occur in the gravels of a restricted drainage basin near a syenite-andesite contact. A low-grade copper sulfide lode was previously reported in granite near the location of these placers. Concentrates from these placers contain from about 0.2 to about 0.8 percent equivalent uranium or about ten times the equivalent uranium content of the average uranothorianite-bearing concentrates from other localities in the eastern Seward Peninsula.

INTRODUCTION

Location of area

The Buckland-Kiwalik district is bounded on the east and west by the Buckland and Kiwalik Rivers respectively, which flow north into the Arctic Ocean and drain the northeastern part of the Seward Peninsula (inset map of Alaska, fig. 1). The area investigated in 1947 includes the divide between these rivers, from Granite Mountain on the south to Clem Mountain on the north, approximately 15 miles from the north shore of the Seward Peninsula (fig. 1).

The area is accessible from Nome, approximately 160 air-line miles to the southwest, by small airplane to two short airstrips, one located in the headwaters of Quartz Creek, and the other on Bear Creek (fig. 1). Haycock, the nearest settlement to the area, is located about 25 miles south of the Bear Creek airstrip. As no roads have yet been built in the area, transportation of supplies to and within the area must be done by tractor and sled or trailer.

The Buckland-Kiwalik divide area is a high elongated partially dissected ridge of marked relief, approximately 50 miles long (north-south), and from 6 to 20 miles wide. Striking topographic features of this divide area are the terraced character of many of the hills and mountains, the steep-sided flat-topped mountains, the conical-shaped hills, and the deeply entrenched valleys. The highest elevation of this watershed is only 2,600 feet, but the abrupt rise from the swampy lowlands of the Buckland and Kiwalik Rivers gives an appearance of great relief.

Purpose and scope of investigation

Radiometric examination in 1944 and 1945 (Harder and Reed, 1945) of a collection of Alaskan placer samples discovered several highly radioactive samples from Sweepstakes and Rube Creeks, south and southeast of Granite Mountain and the headwaters of the Kiwalik and Buckland Rivers (fig. 1). According to Larsen (Harder and Reed, 1945, appendix 1), the radioactivity of two of the Sweepstakes Creek samples is due mainly to a heavy black, opaque, mineral with a cubic habit or form which was thought at the time to be either uraninite or thorianite, or a solid mixture of both.

In 1945 a Geological Survey field party made a reconnaissance investigation (Gault, et al., 1946) of the Sweepstakes Creek area (fig. 1). Although no large deposit nor the source of the black mineral (improperly called uranothorite by Gault) was located, it was found that the mineral has wide distribution in placers derived from the syenite on the south side of Granite Mountain. Traces of hydrothorite also were reported in some of the samples.

In 1946 reconnaissance investigation was extended to the north side of Granite Mountain (Killeen and White, 1950) in the headwaters area of Quartz Creek, a tributary of the Kiwalik River (fig. 1). The black mineral (tentatively called uranothorianite by Killeen and White) was found to be more abundant in placers of this area than in the Sweepstakes Creek area, and, in addition, uranium-bearing thorite(?) was found. Again, however, the bedrock source of the radioactive minerals was not located, although the investigation suggested that the minerals might be disseminated accessory minerals in the syenite underlying the drainage area.

The reconnaissance investigation reported here occupied the entire summer field season of 1947. Its purpose was to extend the 1945-46 investigations to the granitic masses mainly to the north. More than 400 square miles of the Buckland-Kiwalik district was examined by W. S. West and J. J. Matzko, geologists, and A. E. Nessett, J. J. Otoyuk, and J. E. Komak, camp assistants. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

GEOLOGY

Prior to the recent reconnaissance investigations for uranium (see Introduction), the Geological Survey had conducted only two other investigations in the northeastern part of the Seward Peninsula. In 1903 Moffit (1905) mapped the geology of the northeastern part of the Seward Peninsula on an exploration-reconnaissance scale. In 1917 Harrington (1919) visited portions of the area in connection with his investigations of the gold and platinum placers of the eastern part of the Seward Peninsula.

The general distribution of the various rock formations found in the area are shown on figure 1. Because of tundra cover and scarceness of bedrock outcrops, the mapped portion of all rock-formation boundaries is only approximate.

Undivided mafic igneous rocks

The oldest rocks in the Buckland-Kiwalik district are mafic igneous rocks of pre-Cretaceous age consisting mainly of andesitic tuffs and flows but also including some basalt, porphyritic basalt, diabase, and gabbro. Some of these rocks have been altered in varying amounts by weathering, and stresses and heat produced chiefly by later granitic intrusions. Many of the mafic rocks are cut by calcite veins as much as 10 inches in width and scattered quartz veins, but as a whole neither type of vein was found to contain sulfides. Disseminated pyrite and pyritiferous veins, however, occur in andesitic rock in the headwaters of Peace River. Concentrates from stream gravels, in which the recovered minerals were originally derived only from mafic igneous rocks, are not radioactive.

Phyllite

A small outcrop of phyllite near the headwater of the first left tributary to the West Fork of the Buckland River, south of Bear Creek, is probably an outlier of Cretaceous(?) rocks of the same type that crop out more widely 4 miles to the east, beyond the area covered by this report.

Undivided granitic rocks

Granitic rocks including syenite, syenite porphyry, granite, granite porphyry, monzonite, and monzonite porphyry were intruded in the area probably during early Tertiary time. Field evidence indicates that all of these felsic igneous rocks are phases of one batholithic mass and may therefore be regarded as differentiates of a magma which was syenitic at an early stage. Several types of felsic dikes and a few small pegmatite dikes, genetically related to the main bodies of granitic rocks, were injected into the already cooled periphery of this batholith and into the undivided mafic igneous rocks.

Throughout the Buckland-Kiwalik district and especially in the Hunter Creek area (fig. 1), the granitic rocks range from very light to quite dark in appearance and from a very fine even grain, to a coarse porphyritic texture with phenocrysts of feldspar as much as 2 inches long. Most of the granitic rock, however, is light colored. As a whole this mass is not highly mineralized although in localized areas it contains an abundance of disseminated pyrite. Magnetite, galena, fluorite, ilmenite, rutile, and scheelite are also present, but less common. Quartz veins cut the granitic rocks in only small numbers.

In the course of this investigation earlier geologic mapping was corrected insofar as possible, as it was found that the areal distribution of the granitic rocks is much more extensive than that indicated on previously published reconnaissance maps (Moffit, 1905; Harrington, 1919).

As the granitic rocks are the apparent source of the radioactive minerals, this investigation was largely confined to the granitic areas.

Basalt

Extensive remnants of vesicular basalt flows signify that most of the Buckland-Kiwalik district was once covered by lava possibly during Tertiary or early Quaternary time.

Unconsolidated sediments

Quaternary deposits of sands, gravels, cobbles, and boulders occur along all of present stream courses as well as in the form of disintegrated rock and talus blocks which are found on the tops of the mountains, hills, and some of the more gentle slopes.

MINERAL DEPOSITS

Stream and bench gravels in the valleys of Sweepstakes, Rube, Boulder, Rock, Quartz, Bear, Cub, Hunter, Spruce, Fairhaven, Sugar Loaf, Scotch, and Meinzer Creeks have been prospected or mined for placer gold.

During 1947 the only active placer mining in the area was on Bear Creek, where minor amounts of platinum were recovered with the gold. In addition, one man was prospecting on the Right Fork of Hunter Creek.

The only known gold lode in the area is an auriferous quartz vein on a hillside between Split and Polar Creeks, tributaries to Bear Creek. The Beltz prospect on Split Creek is on a copper lode consisting of chalcopyrite with some copper carbonate stain in a quartz vein cutting andesite (Harrington, 1919, p. 399). Smith and Eakin (1911, p. 135) report copper sulfides in a pink granite at the head of Peace River.

RADIOACTIVITY INVESTIGATIONS

Field methods

Traverses with an Eck and Kreb beta-gamma tube attached to a Victoreen counter mounted on a packboard or carried by hand, were made in the Bear Creek and Granite Mountain areas at the start of the season. Results of these traverses were unsatisfactory, however, due to the low sensitivity of the instrument; no well-defined areas having significant radioactivity anomalies could be detected by this method. Consequently, the much slower method of recording individual counts with the counter tube in direct contact with surfaces (freshly broken wherever practical) of bedrock outcrops, talus blocks, disintegrated rock fragments, and stream gravels was employed in spite of the fact that this meant a sacrifice in total coverage and the possibility of not detecting more highly radioactive areas.

As counters available at the time of this investigation were not adequate for a rapid survey of bedrock sources in an area such as the Buckland-Kiwalik district, much of the field work was devoted to the sampling of stream gravels in an attempt to get maximum coverage within this region in the time available. Accordingly, a total of 356 semi-concentrates was collected from stream gravels, not necessarily because of the chance of finding recoverable quantities of uranium minerals in placer deposits, but because of the possibility that the occurrence of radioactive minerals in placers might lead to the discovery of minable lodes which could be studied in detail at a later date. Wherever possible each semi-concentrate was panned from approximately 50 pounds of sand and gravel taken at a depth of from 1 to 3 feet below gravel-bar or stream-bed level in a selected location where natural concentration of heavy minerals would occur. Thus, with the exception of three sluice-box concentrates, all of these samples represent only the surficial stream gravels and sands. Each semi-concentrate was dried and tested with the counter in the field to determine whether or not further sampling should be done on any given stream.

Seventeen slopewash samples were also collected at various localities where highly weathered rock was exposed. Each slopewash semi-concentrate was panned from about 100 pounds of disintegrated rock material.

The location of the creek gravel and slopewash samples are shown on figure 1.

Laboratory methods

The semi-concentrates mentioned above were concentrated further in the laboratory by floating off the light-weight minerals and rock fragments with bromoform (specific gravity 2.8). The equivalent uranium content of the heavier-than-bromoform fractions (hereinafter referred to as the heavy mineral fraction) thus obtained were then determined radiometrically. Selected heavy mineral fractions were then studied to determine the radioactive minerals and their associates. The equivalent uranium determinations were made by members of the Geological Survey's Alaskan Trace Elements Unit; the mineralogic studies were made by personnel of the Trace Elements Section Washington Laboratory.

Radioactive minerals

Uranium and thorium minerals identified in samples from the Buckland-Kiwalik district are uranothorianite, thorite, gummite, orangite, and hydrothorite. Allanite, sphene, and zircon and in some samples hematite, garnet, apatite, augite, and altered hypersthene were found to contain minor amounts of uranium and to contribute to the total radioactivity of the samples in which they are found. More detailed descriptions of the more important radioactive minerals are given below.

Uranothorianite

Uranothorianite is cubical or, in some grains, octahedral in form. Penetration twinning has been noted. The mineral is black with a submetallic luster, an uneven to subconchoidal fracture, and a specific gravity of 9.2. The X-ray diffraction pattern lies between thorianite and uraninite but fits more closely the pattern of thorianite. A spectrographic analysis of uranothorianite from Quartz Creek shows uranium and thorium about equal in amount with no other elements detected. It is possible that this mineral may be uranoan thorianite (Palache, Berman, and Frondel, 1944, p. 621), but until further studies can be made the name uranothorianite (Frondel and Fleischer, 1950, p. 7) will be used. Uranothorianite is the source of most of the radioactivity in the most highly radioactive samples.

Thorite

Thorite is similar to zircon in form and is lustrous gray. It is isotropic with an index of refraction of about 1.86. X-ray information confirmed the identity of this mineral. A spectrographic analysis of thorite from Quartz Creek showed thorium to be the dominant element with approximately

10 percent uranium and silicon and less than 1 percent iron, lead, zirconium, copper, manganese, and yttrium.

Gummite

Gummite forms rounded and flattened fragments having a conchoidal fracture. It is brownish yellow and has a dull greasy luster. The mineral probably represents the final stages of oxidation and hydration of uranothorianite although no actual evidence of this has been found in samples from the area. Elsewhere gummite is known to be an alteration product of uraninite or pitchblende.

Orangite

Orangite is similar to thorite except for its orange-yellow color. It is believed to be an alteration product of thorite.

Hydrothorite

Hydrothorite forms white opaque fibrous aggregates and is strongly radioactive. This mineral is generally considered to be an alteration product of mackintoshite, but the latter mineral has not been identified in any sample from this area.

Allanite

Allanite forms black tabular crystals. The radioactivity of this mineral is due mainly to its thorium content although the presence of uranium was detected by sodium fluoride flux tests.

Sphene

Sphene, which comprises approximately one third of the volume of many samples, is found in brown wedge-shaped fragments with a resinous luster. In many samples the sphene gives a positive fluorimetric test for uranium.

Zircon

Zircon forms square prisms and irregular-shaped fragments. Much of the zircon is colorless but pale yellowish and grayish varieties are abundant in some samples. A large percentage of the zircon contains inclusions, some of which appear to be uranothorianite.

Distribution of radioactive minerals

Laboratory radiometric studies of the heavy mineral fractions of the concentrates from the Buckland-Kiwalik district found that the heavy fractions of 225 of the 356 concentrates taken contain 0.01 or more percent equivalent uranium. Only 67 of these 225 heavy fractions, however, contain 0.025 or more percent equivalent uranium. Mineralogic studies of selected heavy mineral fractions reveal that minerals containing uranium as an impurity or as inclusions of uraniferous material are more numerous and have a more general occurrence than those minerals which contain uranium as a major constituent. Thus the samples collected within or near the limits of the granitic rock areas show a marked variation in their radioactivity depending on the presence or absence of more than just trace amounts of the uranium minerals, particularly uranothorianite.

Data on the 67 heavy mineral fractions containing 0.025 or more percent equivalent uranium are given in table 1. On figure 1 symbols distinguish the locations of the heavy mineral fractions containing 0.025 or more percent equivalent uranium from those containing less. The data strongly suggest that the major radioactive minerals, especially uranothorianite, are concentrated segregations of accessory minerals from differentiate phases of certain types of the granitic rocks. Whether the so-called radioactive accessories are all primary or in part of late stage or later hydrothermal

Table 1.--Data on heavy mineral fractions[1/] of creek placer concentrates containing 0.025 percent or more equivalent uranium from the Buckland-Kiwalik district, Seward Peninsula, Alaska

Sample No.	Location	Concentration ratio	eU[2/] (percent)
	Granite Mountain area		
2448	Anzac Creek, tributary to Peace River	250:1	0.045
2449	do		0.029
2452	Anzac Creek, left limit-sw[3/]		0.031
2463	Peace River, just below head-water branches	500:1	0.025
2464	Peace River, left headwater branch		0.076
2465	do		0.060
2466	Peace River, left tributary to left headwater branch		0.044
2467	Peace River, right limit, left headwater branch-sw		0.061
2468	Peace River, left headwater branch	850:1	0.242
2469	Peace River, right tributary to left headwater branch	1,500:1	0.76
2470	do	750:1	0.73
2471	Peace River, left headwater branch		0.053
2472	do	750:1	0.026

1/ greater than 2.8 specific gravity
2/ equivalent uranium
3/ sw indicates concentrate was obtained from slopewash rather than creek gravels

Table 1.--Data on heavy mineral fractions of creek placer concentrates containing 0.025 percent or more equivalent uranium from the Buckland-Kiwalik district, Seward Peninsula, Alaska--Continued

Sample No.	Location	Concentration ratio	eU (percent)
	Granite Mountain area (continued)		
2482	West Fork, Buckland River, left tributary	700:1	0.048
2483	do		0.030
2518	Cub Creek	475:1	0.026
2523	Cub Creek, left tributary		0.031
2524	Cub Creek, left limit-sw		0.064
2533	Cub Creek, high on slope of Granite Mountain		0.042
2534	do		0.034
2536	do	325:1	0.035
2538	Cub Creek, middle branch		0.032
2539	do	775:1	0.057
2541	do		0.056
2542	do		0.065
2543	do		0.038
2544	Cub Creek, high on slope of Granite Mountain	375:1	0.043
2545	do		0.045
2546	do		0.028
2548	Cub Creek, right tributary, below middle branch		0.027
2549	Cub Creek, right branch	925:1	0.031
2552	do	800:1	0.041
2553	do		0.036

Table 1.--Data on heavy mineral fractions of creek placer concentrates containing 0.025 percent or more equivalent uranium from the Buckland-Kiwalik district, Seward Peninsula, Alaska--Continued

Sample No.	Location	Concentratio ratio	eU (percent)
	Granite Mountain area (continued)		
2560	Cub Creek, right branch	425:1	0.028
2562	Spring Creek, high on slope of Granite Mountain		0.033
2570	Kiwalik River, high on slope of Granite Mountain		0.058
2571	do	200:1	0.096
2572	do	225:1	0.102
2574	Quartz Creek, high on slope of Granite Mountain	275:1	0.065
2575	do		0.028
2576	do	150:1	0.097
2577	do	200:1	0.076
2578	do	250:1	0.063
	Connolly Creek-Hunter Creek area		
2607	Buck Creek, right tributary	800:1	0.025
2631	Connolly Creek, right tributary	1,175:1	0.028
2632	do	800:1	0.040
2633	do	1,050:1	0.066
2634	do	1,675:1	0.040
2639	Linda Creek	275:1	0.040
2644	Muck Creek	300:1	0.125
2645	do	350:1	0.160

Table 1.--Data on heavy mineral fractions of creek placer concentrates containing 0.025 percent or more equivalent uranium from the Buckland-Kiwalik district, Seward Peninsula, Alaska--Continued

Sample No.	Location	Concentratio ratio	eU (percent)
	Connolly Creek-Hunter Creek area (continued)		
2659	Hunter Creek, Right Fork, right tributary	2,875:1	0.027
2677	Hunter Creek, Left Fork, left tributary		0.048
2683	Spruce Creek		0.027
2685	do	325:1	0.033
	Clem Mountain area		
2728	West Clem Creek		0.106
2730	Duck Creek, right tributary	325:1	0.056
2731	do		0.034
2732	do	900:1	0.030
2750	East Clem Creek	1,125:1	0.040
2752	do	2,400:1	0.030
2753	do	800:1	0.045
2755	Buckland River, left tributary	3,425:1	0.037
2756	do	1,900:1	0.027
	Fairhaven Creek area		
2800	Sugar Loaf Creek, left limit-sw	6,875:1	0.050
2801	Sugar Loaf Creek	2,525:1	0.026
2805	do	2,000:1	0.025
2806	do	1,275:1	0.025

Table 1.--Data on heavy mineral fractions of creek placer concentrates containing 0.025 percent or more equivalent uranium from the Buckland-Kiwalik district, Seward Peninsula, Alaska--Continued

Sample No.	Location	Concentration ratio	eU (percent)
	Fairhaven Creek area (continued)		
2815	Fairhaven Creek, left tributary		0.026
2819	Scotch Creek		0.030

origin is still a matter of conjecture, although the presence of various metallic sulfides, fluorite, bismuth, and silver in some of the concentrates indicates that some of the uranium may have been introduced after the emplacement of the granitic rocks. Proof of this through observation of actual sites of mineralization, however, has been hampered by the scarcity of bedrock exposures.

The most important localized placer concentrations of the uranothorianite occur in the following areas: (1) the Granite Mountain intrusive; (2) the belt between Connolly Creek and Hunter Creek; and (3) the area south of Clem Mountain. These areas are described below.

Granite Mountain area

Headwaters of the Peace River.--The most promising locality for the occurrence of high-grade uranium ore in the entire Buckland-Kiwalik district is situated along a headwater branch of Peace River in the Granite Mountain intrusive area (fig. 1). The mineralogy and equivalent uranium content of the heavy mineral fractions of three placer samples from this locality are shown in table 2.

Samples 2470 and 2469 were collected in a small right tributary near the head of the left headwater branch of Peace River; sample 2468 was taken a short distance below the mouth of this right tributary in the left headwater branch (fig. 1). The stream from which samples 2470 and 2469 were taken does not exceed 400 yards in length and flows throughout most of its course over tundra and muck. Sample 2470 was panned in the course of this stream at the first place where gravel appears below the divide. The heavy minerals in this concentrate (table 2), as well as in the other samples, indicates that a highly mineralized zone may occur in syenite at or near a syenite-andesite contact, and the mineralized zone, if present, must of necessity be relatively close to

Table 2.--Mineralogy and equivalent uranium content of three concentrate samples from gravels in the headwaters of the Peace River, Seward Peninsula, Alaska

Sample nos.	2470	2469	2468
Equivalent uranium content (percent)	0.73	0.76	0.242
Minerals	**Estimated volume percent of minerals present**		
Garnet	40	X 1/	50
Hornblende	20	X	1
Augite	10	-	tr
Sphene	13	X	7
Zircon	6	X	4
Thorite	tr 2/	-	-
Wollastonite	tr	-	-
Epidote	-	X	tr
Hypersthene	-	X	-
Apatite	-	-	1
Powellite	-	-	tr
Spinel	-	X	-
Picotite	1	-	tr
Ilmenite	1	-	-
Hematite	1	X	tr
Limonite	-	-	tr
Magnetite	-	-	12
Chromite	tr	-	-
Corundum	-	X	-
Uranothorianite	2	X	tr
Gummite	tr	-	-
Pyrite	3	X	25
Chalcopyrite	1	X	-
Bornite	tr	-	-
Molybdenite	-	-	tr
Gold	tr	X	-
Silver	tr	-	-
Bismuth	tr	-	-

1/ X indicates presence of mineral in sample, amount not determined

2/ tr - trace

the sample location. The presence of gummite, which is somewhat water-soluble, further bears out the belief that the minerals could not have traveled far from their bedrock source. The stream gravels just below sample 2470 were estimated to consist of 60 percent syenite and 40 percent andesite. Although no outcrops are found within this area, the sampling of the placers indicates that the highly mineralized zone is probably confined to an area with a maximum size of about half a square mile. As surface cover does not appear to be deep in this vicinity and the terrain is gently rolling, it is believed that bedrock could be exposed for detailed study by trenching with a bulldozer.

Quartz Creek.--Concentrates ranging from 0.01 to 0.102 percent equivalent uranium were obtained on the northwest slope of Granite Mountain above the headwaters of Quartz Creek and the Kiwalik River (table 1). The occurrence of uranothorianite was traced higher up the mountain slope than had been done in 1946 by Killeen and White (1950). The occurrence of thorite in the Buckland-Kiwalik district appears to be confined largely to this area. No bedrock is exposed in the general vicinity of the sites sampled.

Other localities.--Other localities in the Granite Mountain intrusive area where uranothorianite is present in the placer concentrates collected during the 1947 investigation are as follows:

(1) Anzac Creek, a right tributary to Peace River;

(2) Boulder Creek, a right tributary to Peace River;

(3) Rock Creek, a right tributary to Peace River;

(4) the headwater area of the first left tributary to the West Fork of the Buckland River above Bear Creek;

(5) the area on the left side of Cub Creek a short distance below the junction of the headwater branches;

(6) the northeastern side of Granite Mountain near the head of the middle branch of Cub Creek;

(7) the eastern side of Granite Mountain in the vicinity of the right headwater branch of Cub Creek; and

(8) the south slope of Granite Mountain above the headwaters of Spring Creek.

The last area named produced the only sample (no. 2563) in the Buckland-Kiwalik district which was found to contain hydrothorite. Hydrothorite had been discovered at lower elevation in this same area in 1945 (Gault, et al., 1946).

Connolly Creek-Hunter Creek area

Samples 2644 and 2645, which contain 0.125 percent and 0.16 percent equivalent uranium respectively, were panned in Muck Creek, a left tributary to Hunter Creek, and show the highest radioactivity of any concentrates taken in the belt between Connolly Creek and Hunter Creek. The minerals with a specific gravity greater than 2.8 in these two samples are listed below in order of decreasing abundance.

Garnet
Hornblende
Augite
Sphene
Zircon
Epidote
Apatite
Scheelite
Powellite
Ilmenite
Hematite
Limonite
Magnetite
Uranothorianite
Pyrite

The uranothorianite in the above list contains most of the radioactive elements in the two samples. Uranothorianite was also found in samples 2633 (0.066 percent equivalent uranium) and 2634 (0.040 percent equivalent uranium) in the headwater area of the first right tributary to Connolly Creek above the latter's mouth at Hunter Creek; and both uranothorianite and gummite were identified in sample 2865 (0.033 percent equivalent uranium) in the headwaters of Spruce Creek, a left tributary to the Left Fork of Hunter Creek. No bedrock outcrops were found in the vicinity of any of these samples.

Clem Mountain area

Sample 2728 (0.106 percent equivalent uranium) is the most radioactive sample from the area immediately south of Clem Mountain (fig. 1). It was taken at shallow depths near the head of West Clem Creek, a right tributary to Duck Creek. Other than sphene and zircon, uranothorianite is the only radioactive mineral in this sample. Sample 2730 (0.056 percent equivalent uranium), taken on the second right tributary to Duck Creek above West Clem Creek, and samples 2752 (0.030 percent equivalent uranium), 2753 (0.045 percent equivalent uranium), and 2754 (0.019 percent equivalent uranium) collected in the headwaters of East Clem Creek, a tributary to the Buckland River, were the only other samples in this area in which uranothorianite was identified. A trace of thorite was found also in sample 2752. Because of the depth of snow cover and the arrival of the freeze-up, field work had to be terminated in this area south of Clem Mountain before this phase of the investigation could be completed.

Other areas

The only other known occurrence of uranothorianite in the Buckland-Kiwalik district outside of the general boundaries of the three major areas discussed above is in sample 2788 (0.014 percent equivalent uranium) which was collected in the headwater of Meinzer Creek, a left tributary to Fairhaven Creek. In the same general area a trace of orangite was identified in sample 2801 (0.026 percent equivalent uranium) which was panned in Sugar Loaf Creek, a left tributary to Fairhaven Creek, and thorite was found in sample 2802 (0.023 percent equivalent uranium) from the same stream.

CONCLUSIONS

Although radioactive minerals are widely distributed in the Buckland-Kiwalik district, the more important of these minerals, such as uranothorianite and thorite, occur for the most part in rather well defined placer zones within the granitic rock areas. It is therefore believed that these latter minerals are segregated accessories in differentiate phases of the granitic rocks. However, the presence of various metallic sulfides, fluorite, bismuth, and silver along with the uranothorianite in a number of the concentrates suggests that some of the uranium may have been introduced after the emplacement of the granitic rocks during a period of hydrothermal alteration.

The local concentration of uranothorianite in the placers at the head of Peace River is believed to be the best lead to a possible high-grade uranium lode deposit on the basis of equivalent uranium content and mineral association.

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