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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON

--PRELIMINARY REPORT--

TRACE ELEMENTS INVESTIGATIONS IN THE SWEEPSTAKES CREEK AREA, KOYUK DISTRICT, SEWARD PENINSULA, ALASKA

Trace Elements Investigations Report No. 25

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PRELIMINARY REPORT ON TRACE ELEMENTS INVESTIGATIONS IN THE SWEEPSTAKES CREEK AREA, KOYUK DISTRICT, SEWARD PENINSULA, ALASKA

by

H. Richard Gault, Robert F. Black and John B. Lyons

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Preliminary report on trace elements investigations
in the Sweepstakes Creek area, Koyuk district, Seward Peninsula, Alaska

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H. Richard Gault, Robert F. Black and John B. Lyons

ABSTRACT

A significant content of radioactive material was recognized in a few placer concentrates from Sweepstakes and Rube Creeks in the Koyuk district of eastern Seward Peninsula, Alaska, when old collections were scanned for radioactivity in the spring of 1945. Subsequent field investigations with a Geiger-Mueller counter were made of the creek gravels and the placer-gold paystreak on the bench ground of Sweepstakes Creek and its tributaries, the syenite stock of Granite Mountain to the north of Sweepstakes Creek, and the creek gravels of Rube and Anzac Creeks which are tributaries of the Peace River east of the syenite stock.

The content of radioactive minerals in the gravels and in the placer-gold paystreak was found to be disappointingly low. Where concentration ratios were between 45 and 169 to 1, the content of concentrates from the creek gravels is only .001 to .016 percent equivalent uranium. The average content of the creek gravels in place is computed as .0001 percent equivalent uranium. The placer-gold paystreak was not accessible in place, but the content was computed as .0003 percent equivalent uranium from the sluice-box concentrates and tailings at Winder's open-cut, the only active placer mine in the area in 1945. The radioactive

minerals are relatively abundant in such gravity concentrates as the sluice-box concentrates, and are particularly abundant in certain size-fractions of these sluice concentrates. Thus the concentrates from the sluice-box, after screening through 20-mesh, showed 0.04 percent equivalent uranium. An even greater concentration of radioactive minerals is obtained in the "blowings," which represent a further cleaning of the sluice-box concentrates, one sample showing 14.20 percent equivalent uranium.

The field investigations indicate that syenite is the only bedrock which has noticeable radioactivity, and stream concentrates that were radioactive were obtained only from creeks containing syenite in the gravels or flowing in areas underlain in part at least by the syenite. Crushed syenite samples from 14 localities show a content of radioactive material ranging from .001 to .013 percent equivalent uranium. The most radioactive unconcentrated material found is a 1-inch pegmatite dike cutting the syenite. The syenite stock is pre-Cretaceous and intrudes andesitic tuffs and flows that form the bedrock over much of the area.

Two radioactive minerals have been recognized from the photographic effects obtained on alpha-ray plates, and are tentatively identified as uranothorite and hydrothorite. Almost all of the radioactive grains are uranothorite and only a few grains of hydrothorite were identified. Chemical analysis of a concentrate collected in 1917 from Sweepstakes Creek shows approximately equal amounts of uranium and thorium, and together they form more than 80 percent by weight of the sample. Chemical analyses of 5 of the samples collected in 1945 indicate a

uranium content of .008 to 2.17 percent. In the sample which has 2.17 percent of uranium, beta counts show 14.20 percent equivalent uranium and the difference is believed to be thorium.

The content of radioactive minerals in the deposits is believed to be too low for them to be significant as sources of uranium, however, there are roughly 14 million cubic yards of gravel on Sweepstakes Creek carrying .0001 percent equivalent uranium, additional yardage of similar content along Rube and Anzac Creeks, and hundreds of millions of tons of syenite averaging about .005 percent equivalent uranium. Deposits along other creeks draining the syenite probably contain similar amounts of equivalent uranium, and more areas of syenite are known to the north of the Sweepstakes Creek area on the Kiwalik River and Buckland River side of the divide separating Norton Bay and Kotzebue Sound.

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INTRODUCTION

A significant content of radioactive minerals was recognized in placer concentrates from Sweepstakes and Rube Creeks in the Kayuk district of eastern Seward Peninsula, Alaska, when collections of the Alaskan Branch of the Geological Survey were scanned for radioactivity in the Spring of 1945 1/. The location of the area is shown on Figure 1. Only two samples from Sweepstakes Creek and one from Rube Creek were available. A sluice-box concentrate from the Circle claim on Sweepstakes Creek showed by chemical analysis more than 80 percent combined uranium and thorium with the two elements in approximately equal amounts.

Between June 28 and September 1945 a Geological Survey field party determined the amount and distribution of the radioactive minerals in the creek gravels of Sweepstakes Creek and its tributaries, in the placer deposits at the two inactive and one active site of gold mining in gravels on the left-limit bench of Sweepstakes Creek, and in the intrusive syenite stock that is north of Sweepstakes Creek and apparently is the bedrock source of these minerals. A few samples were also obtained on Anmac and Rube Creeks, tributaries of the Peace River, on the eastern side of the Syenite stock.

H. R. Gault and R. F. Black, geologists, and D. R. Loftus, camphand, comprised the field party. R. F. Black was relieved from duty on August 10 because of an injury and was subsequently assigned to another

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1/Harder, James O., and Reed, John C., Radioactivity of some Alaskan placer samples: U. S. Geol. Survey, Trace Elements Investigations Report No. 6, unpublished, p. 5 and appendix 1, 1945.

[redacted]

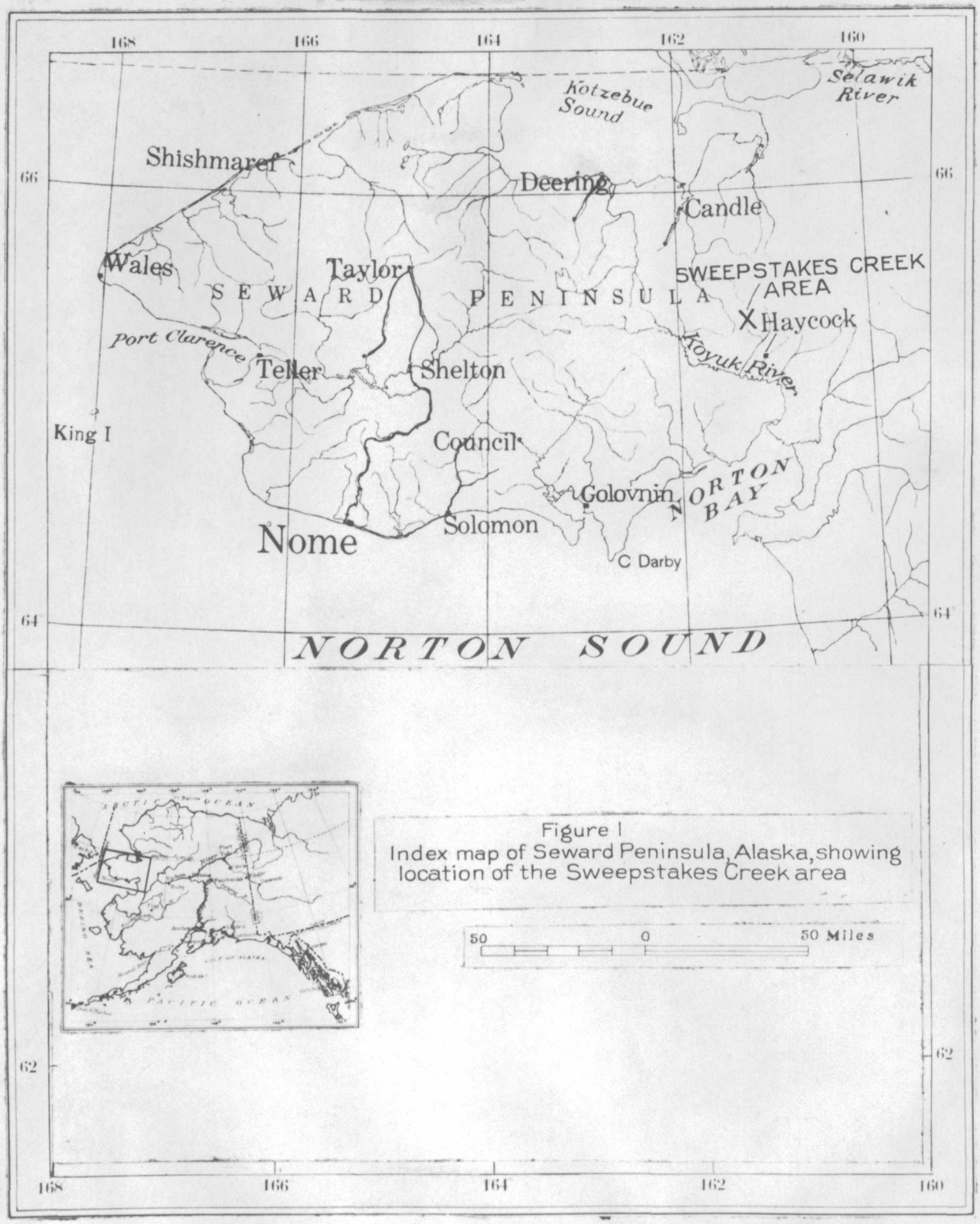

Figure 1
Index map of Seward Peninsula, Alaska, showing location of the Sweepstakes Creek area

project. The preparation of the report and a portion of the laboratory work were done by H. R. Gault. Mineral identifications and the exposures of some alpha-ray plates were made by J. B. Lyons. The work has been done as part of the trace elements program of the Geological Survey.

Acknowledgment is gratefully made to Messrs. John Winder, William Porter, and Carl Rylander of Haycock, and to Arthur Johnson of Fairbanks, for their assistance and friendly cooperation in the field.

LOCATION and GEOGRAPHY

The Sweepstakes Creek area is about 135 miles ENE of Nome. Sweepstakes Creek (see Fig. 2) is a southward-flowing tributary of the Peace River which in turn is a tributary of the Koyuk River. The main creek and some of its upper tributaries head against the Granite Mountain portion of the divide between the Koyuk basin, that drains southward to Norton Sound, and Kiwalik basin, that drains northward to Kotzebue Sound. The headwater forks of Sweepstakes Creek are designated Right Fork and Left Fork as seen when looking upstream. Granite and Spring Creeks are the principal left-limit tributaries and a few minor streams from the north enter below Spring Creek. Bear Gulch is the largest right-limit tributary although several minor ones from the south join lower Sweepstakes Creek. The main creek is 12 miles long and the mouth is about 5 miles north of the village of Haycock. Rube Creek, of which Farmer Creek is a tributary, and Anzac Creek are small tributaries of the Peace River upstream from the mouth of Sweepstakes Creek.

Haycock is the only settlement in the vicinity and consists of a few houses, an Eskimo school, a post office, and a landing field. A small placer gold mine was operating between the landing field and the settlement in 1945. Mail, radio, and plane connections are maintained with Nome, and during the summer months there is also mailboat service from Golovnin and Nome on the Bering Sea.

Tundra covers most of the area except the higher mountains which are covered with talus and frost-heaved blocks. Bedrock exposures are scarce and are principally in bluffs along the streams. Much of Sweepstakes Creek is between 200 and 500 feet above sea level. The heads of the main creek and the tributaries are at altitudes of about 1000 feet, and Granite Mountain to the north is more than 2000 feet above sea level.

From October to June the streams and the upper foot or two of the tundra are frozen while below that depth the muck and underlying gravels are generally permanently frozen. The placer-mining season, except for underground work, is limited to the summer months.

Transportation of supplies and equipment is difficult at any time but particularly in the summer when the surface is thawed. The inhabitants of the region depend principally upon fully tracked vehicles in the summer and winter for hauling fuel and supplies. The natives use dog sleds in the winter.

Temperatures are mild during the day in July and August. Frost can be expected in any month. The precipitation is about 20 inches a year but in the late spring and late summer rain falls on more than half the days. The creeks fluctuate rapidly and high water often adds to the difficulty of travel.

GEOLOGY

The general geology of the Koyuk district has been described by Harrington 2/. Three types of bedrock are distinguished in the vicinity of Sweepstakes Creek: Tertiary and Recent vesicular basaltic lavas, a pre-Cretaceous syenite stock, and still older andesitic tuffs and flows with minor interbedded water-laid sediments. (See Fig. 2) Cretaceous and metamorphosed Paleozoic sedimentary rocks are present farther south around Dime Creek. Over most of the area the bedrock is covered by frost-heaved blocks and finer disintegrated residual material. The valley fill consists of unconsolidated sediments of Quaternary age.

Types of bedrock

The bedrock of Sweepstakes Creek, except near the mouth of Granite Creek, of the lower part of Spring Creek and most of the lower part of Granite Creek, and of all but one of the small right-limit tributaries of lower Sweepstakes Creek is the andesitic tuffs and flows. These rocks are dark gray or green on freshly broken surfaces, but the weathered rock is dark brown and is broken into small angular pieces. Locally the rock is sheared and the small shear fractures are filled by calcite veins. The structure of the tuffs and flows is indistinct and the dip and strike could not be determined. At a few places cleavage is faintly developed. Harrington noted graywacke and conglomerate along Sweepstakes Creek but

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2/Harrington, G. L., The gold and platinum placers of the Kiwalik-Koyuk region: U. S. Geol. Survey Bull. 692, pp. 369-400, 1919.

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stated that these sedimentary beds are not greatly different from the effusive rocks 3/. Similar conglomerate-like rocks were observed in the andesite at several places during the present investigations.

Hills and ridges on the south side of lower Sweepstakes Creek near its junction with the peace River are capped by Tertiary and Recent basaltic lavas. The lowest right-limit tributary of Sweepstakes Creek heads in this basalt.

A large body of syenite, intrusive into the surrounding andesite, forms the bedrock east of the Right Fork of Sweepstakes Creek in the upper portions of Granite and Spring Creeks. Practically all of Granite Mountain above an altitude of 1600 feet is covered with talus and frost-heaved blocks of syenite. A few small masses of syenite beyond the margin of the main mass are probably responsible for large boulders in the creeks and on the tundra. Such boulders are present near the mouth of Granite Creek and at the head of Farmer Creek. The syenite is gray, coarse-grained, and in many places contains large phenocrysts of feldspar. Feldspar, hornblende, and biotite are the essential minerals. Accessory minerals include sphene, zircon, apatite, and probably very small amounts of one of the uranium minerals as indicated by the consistent though slight radioactivity of the crushed samples. Many of the frost-heaved syenite blocks, particularly of the porphyritic facies and the marginal portions, have a well-developed planar structure.

3/Harrington, G. L., op. cit., p. 373.

Placer-gold deposits

The stream and bench gravels in the valleys of Sweepstakes, Rube, Quartz, Bear, and Dime Creeks have been prospected or mined for placer-gold. (See Fig. 2) The mining sites on Quartz and Bear Creeks were not examined and available information is not sufficiently up to date to permit plotting these sites on the map. The sites of the old placer workings on Rube Creek could not be recognized in 1945.

The history of the early development of placer-gold deposits in the Sweepstakes Creek area is given by Harrington 1/. Although placer mining has been carried on since 1910 on Sweepstakes Creek, only a small amount of ground in a limited area has been mined. On Rube Creek little mining has been done since the early days when the area was the scene of a stampede.

Placer-mining operations have been carried on at three places along Sweepstakes Creek in the bench deposits on the left-limit. The valley of Sweepstakes Creek is asymmetric with the creek flowing close to its southwest side, or right-limit, and with a very gentle slope on the left limit. The upper site is on the Right Fork (see Fig. 3) and was worked intermittently by Tom Moon and associates from 1910 to 1914. Another site near the junction of the Right and Left Forks was worked by Arthur Johnson of Haycock and Fairbanks about 20 years ago. The third mining site is opposite the mouth of Bear Gulch on the Circle claim where John Winder's open-cut was the sole active operation in 1945 on Sweepstakes Creek. The old open-cut 2400 feet below Winder's

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1/Harrington, G. L., op. cit. pp. 387-395.

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site was only a prospect and no productive mining was done there. Some gold is said to have been taken out in the past on Spring Creek, about a mile below the hot springs (see Fig. 2), and on Bear Gulch, in the vicinity of the forks.

Creek and bench claims have been staked along the entire length of Sweepstakes Creek and along parts of Granite Creek, Bear Gulch, and Spring Creek. Only the ground along the main creek above Spring Creek is reported to be held now. In order upstream these claims are — the Eagle claim upstream from the mouth of Spring Creek, the Circle claim about opposite Bear Gulch, the Rampart and Fairbanks claims, one unnamed claim between these and the No. 1 claim at Johnson's open-cut, some claims between No. 1 and No. 9 that are reported held by Wallace Porter of Haycock, Moon's workings on claims No. 9 and No. 10, and claims said to have been staked to the head of the Right Fork. The discovery claim was at the junction of the Right and Left Forks just below the site of Johnson's placer. The Eagle, Circle, Rampart, and Fairbanks claims are said to be association claims and, with the unnamed claim above, constitute the holdings of John Winder. According to Mr. Johnson the No. 1 claim is not a full claim.

Much of the information which follows on the depth of the valley fill over bedrock, width of the paystreak, and gold recovery was obtained from John Winder and Arthur Johnson. No records are available of the results of the churn drilling that was done in the creek gravels and bench deposits of the Right Fork in the late 1930's.

The gravel in the creek bed ranges from 6 to 14 feet in depth upstream from Moon's open-cut, 9 to 12 feet between Moon's and Johnson's

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open-cuts, 7 feet between the mouth of Granite Creek and Winder's open-cut, 10 feet at the mouth of Spring Creek, 12 feet on Spring Creek, and 6 feet at the first left-limit tributary below Spring Creek. On Granite Creek, 2000 feet above the mouth, clay is present beneath 2½ feet of gravel, and elsewhere bedrock crops out in the stream.

In bench ground between Moon's and Winder's open-cuts there is 2 to 6 feet of muck and vegetation above 3 to 6 feet of gravel. Thus at Moon's site 2 feet of overburden covers 4 feet of gravel; at Johnson's open-cut 6 feet of overburden overlies 3 to 4 feet of gravel, and at Winder's workings there are 6 feet each of overburden and gravel. About 1200 feet below Winder's site at the rim of the bench the overburden and gravel are 7 feet thick, but 100 feet back from the rim the thickness is 10 to 12 feet, and farther up the slope the unconsolidated material thins and bedrock approaches the surface. The old prospect cut 2400 feet below Winder's workings shows 8 feet of muck overlying 12 feet of gravel. On the third-tier, left-limit bench, 2 miles below Spring Creek, there is 18 feet each of overburden and gravel. A prospect pit on the left limit of lower Sweepstakes Creek, 3/4 mile from the creek and 1/2 mile west of the right limit of the Peace River, also shows 35 feet of combined overburden and gravel. The bench ground along Spring Creek is probably no deeper than along Sweepstakes Creek, at a point 200 feet upstream from the mouth of Snow Gulch (see Fig. 3) the depth to bedrock is 12 feet.

The gravels of Sweepstakes Creek have been mined primarily for gold, although a little platinum has been recovered from Bear Gulch and the upper end of the Circle claim. No platinum has been reported in Sweepstakes Creek above that area. Moon's placer site on claims No. 9 and No. 10 on the Right Fork is reported to have been the richest ground and to have yielded the coarsest gold. The pay is said to have been better on claim No. 10 than on claim No. 11 just above. Some pay gravel is reported on claims No. 6, No. 7, and No. 9 between Moon's and Johnson's placer sites. The paystreak mined at Winder's workings in 1945 yielded an average of $0.25 per square foot. Colors or small particles of gold are reported from prospect pits scattered along Sweepstakes Creek and pay gravel has been found in a few holes. During the Geological Survey investigations in 1945, colors were seen only in the creek gravels on a bar in Sweepstakes Creek. (See Ga 25, Fig. 2.) A few small colors were generally found in pan samples taken from the edges of old cuts.

The width of the paystreak on the left limit of Sweepstakes Creek that could be profitably handled under the general mining costs at the time of operations or with available water pressure, is indicated by the width of the open-cuts. Johnson reports that the paystreak at his site is 150 feet wide and that poorer pay continues upstream for 400 feet, followed by a barren zone for 200 feet, and then by a zone several hundred feet in length in which colors are present. The following data were obtained for the first open-cut on the Circle claim in 1945:

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Area of cut — 1500 square feet
Gold recovered — 9 ounces at $28.50 per ounce or $0.17 per square foot of bedrock
Overburden - Tundra - 6 feet
gravel - 6 feet
Paystreak - gravel - 0.5 foot
bedrock - 1.0 foot
Approximate volume of paystreak handled — 83 cubic yards
Number of sluice boxes — 1 (iron)
Number of riffles — 8½
Dimensions of sluice box — 10 feet x 1 foot x 1.3 feet

RADIOACTIVE MINERAL INVESTIGATIONS

Field Methods

Geiger-Mueller counter: In the field, radioactivity determinations were made with a portable Geiger-Mueller counter. Only a minor amount of time was given to outcrop readings where the counter tube is laid directly against an outcrop or boulder of bedrock, or on the gravels. Most of the work involved panning concentrates from gravels or crushing chips of bedrock for determination of the equivalent uranium content by comparison with a standardized container that had been prepared previously. Gamma counts were made for 5-minute periods in the sequence: background, sample, standard, and background.

Concentrates from gravels: The creek gravels were sampled by panning from 2/3 to 1 1/3 cubic feet of gravel to a concentrate of heavy sand. This concentrate was dried, usually sieved through a 20-mesh screen, and the minus 20-mesh material, approximately 25 cubic inches by volume, was tested by the counter tube in a container of the same size as the standard. At the few sites where placer deposits were accessible, samples were taken from the old tailings of former operations, from tailings at the sluice box of the operating

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mine and from concentrates in the sluice box at the time of a clean-up, from fine concentrates caught in the cracks of old sluice boxes, and from the paystreak where exposed at both old and new placer-mining sites. Some of these samples were further concentrated by careful panning.

Bedrock samples: Crushed samples of the syenite bedrock were generally prepared from a composite of small chips taken from 25 to 30 boulders within an area of several hundred square feet. The samples from Spring Creek (see appendix) represent fragments collected at relatively close intervals on two 1/4-mile traverses along the creek. The chips were crushed to pass an 8-mesh screen.

Laboratory study

Splits of most of the concentrates and of the crushed bedrock were brought back to the laboratory for possible checking of the gamma counts, mineralogical study, and chemical analysis.

Only a few of the concentrates have been re-checked by gamma counts because of the generally low radioactivity of the samples, and the field and laboratory counts are in close agreement. Beta counts were used to determine the radioactivity of some heavy fractions, magnetic subfractions, and samples too small to handle on a gamma counter.

Gravity and magnetic fractions were separated from representative samples of the creek gravels, sluice-box concentrates, and crushed bedrock to aid in the identification of the minerals and to obtain data on the amount of heavy minerals in the concentrates. Three gravity fractions were prepared by the use of bromoform and methylene

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iodide — light fraction, specific gravity less than 2.8; bromoform fraction, specific gravity greater than 2.8 and less than 3.1, and iodide fraction, specific gravity greater than 3.1. The bromoform and iodide fractions were further separated into magnetic and nonmagnetic subfractions.

Alpha-ray photographs were used in recognizing the radioactive minerals. For this purpose the fractions are mounted in bakelite varnish on glass slides, polished, and exposed to a photographic plate coated with an emulsion sensitive only to alpha-rays. As these rays have a short depth of penetration, only those radioactive grains in actual contact with the emulsion produce photographic effects. The slides were prepared on standard glass 1.75 inches by 1 inch and contain an average of about 500 grains. Marked photographic effects were obtained only from slides of the nonmagnetic iodide subfractions. Slides prepared from samples showing less than 0.1 percent equivalent uranium showed only occasional radioactive grains.

RADIOACTIVE MINERAL DEPOSITS

Gravel deposits

The field sampling showed a persistent trace of radioactive minerals in the creek gravels of Sweepstakes Creek and its tributaries and in the bench ground along Sweepstakes Creek. A similar small content was obtained in sampling the creek gravels of Rube and Anzac Creeks, and of Farmer Creek, headwater tributary of Rube Creek. The location, concentration ratio, and content of radioactive minerals in percent of equivalent uranium of the concentrates from these gravels are plotted on figures 2 and 3 and additional data are recorded in the appendix.

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Generally samples with concentration ratios between 45 and 169 to 1 contain only 0.001 to 0.016 percent of equivalent uranium, but the sample from Anzac Creek, with a concentration ratio of 90 to 1, contains 0.033 percent of equivalent uranium. Concentrates from sluice boxes, with concentration ratios around 6000 to 1, or larger, contain 0.02 to 0.095 percent equivalent uranium. The highest content of radioactive minerals expressed in terms of equivalent uranium is obtained in samples of blowings which are those parts of the sluice concentrates that have been further cleaned by panning and then have been removed from the associated gold by gentle blowing. The sample of these blowings from the first clean-up at Winder's placer workings in 1945 has a content of 14.20 percent equivalent uranium but the concentration ratio is computed as 900,000 to 1. The old sample from the Circle claim that yielded such a high content of uranium and thorium during preliminary scanning of the Alaskan Branch collection in 1945 was probably from blowings rather than a sluice-box concentrate.

The natural concentrations in the gravels just above bedrock contain radioactive minerals in amounts comparable to the normal creek gravels. The content of equivalent uranium of panned concentrates corrected for the concentration ratio of normal creek gravels is 0.0001 percent and of natural placers 0.0003 percent.

Bedrock source

The source of the radioactive minerals in the gravels appears to be the syenite mass of Granite Mountain and smaller bodies of syenite in the vicinity. Shortly after field work was begun, the andesite bedrock was found to have no noticeable effect on the Geiger-Mueller counter whereas

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syenite bedrock, syenite boulders, and crushed samples of syenite gave counts noticeably above background readings. Likewise, stream concentrates that show radioactivity were obtained only from those creeks which contain syenite in the gravels or flow in areas underlain at least in part by syenite. The increase in counts on syenite samples is greater than could be attributed to the influence of potassium if all of the potassium was radioactive.

In 14 samples of the crushed syenite the content of radioactive material ranges from 0.001 to 0.013 percent of equivalent uranium. The sample containing 0.013 percent of equivalent uranium when analyzed chemically showed 0.008 percent of uranium and the remainder is presumably thorium if the field gamma count was accurate.

Minerals in the concentrates

The creek gravels, natural placers, sluice-box concentrates, and tailings contain the same minerals although in different proportions, and reflect the mineralogy of the andesite and syenite bedrock from which they were derived. The minerals that have been identified are grouped below according to their source and in their relative order of abundance. As the samples are concentrates, the percentage of heavy minerals is much greater than in the original gravels.

From syenite	From andesite tuffs and flows
Common minerals	
oligoclase	oligoclase
orthoclase	andesine
sodium-rich pyroxene	
augite	augite
dark green hornblende	light green hornblende
sphene	
magnetite	magnetite
melanite	
	pyrite

[redacted]

From syenite		From andesite tuffs and flows
	Minor minerals	
quartz		calcite
biotite		picotite
apatite		ilmenite
uranothorite (?)		platinum
hydrothorite (?)		
	gold (source unknown)	

Radioactive minerals

Two minerals in the concentrates have been recognized as radioactive from the photographic effects obtained on plates sensitive to alpha-rays. These radioactive minerals are tentatively identified as uranothorite (UO_2, ThO_2, SiO_2, etc.) and hydrothorite ($ThSiO_4 . 4H_2O$). Uranothorite constitutes nearly all of the radioactive minerals whereas only a few grains of hydrothorite were recognized. The uranothorite crystals are small black cubes, metamict in structure. Penetration twins on 111 are fairly common. The index of refraction is 2.12 and the specific gravity about 9.2 as determined by Larsen 5/ Hydrothorite is a white fibrous aggregate that is faintly birefringent. Both minerals show a stronger photographic effect on alpha-ray plates than carnotite and samarskite and are therefore probably more radioactive than those minerals.

Chemical determinations of uranium and thorium content

Analyses of the two samples collected in 1917 from the Circle claim on Sweepstakes Creek yielded respectively 42.0 and 3.8 percent of uranium, and 42.03 and 4.7 percent of thorium. Five additional analyses from the 1945 samples were made for uranium only. The difference between the

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5/Larsen, E. S., Correspondence with J. O. Harder, 1945.

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content in percent of equivalent uranium, as determined by gamma counts, and the chemically determined uranium is believed to represent the thorium content.

Sample	Description	Equivalent uranium by gamma or beta count, percent	Chemically determined uranium, percent
45A-Ga24e	Blowings, Circle Claim, 1945	1.20 (beta)	2.17
45A-Ga24dcc	Iodide fraction of sluice-box concentrate, first open-cut, Circle claim, 1945.	.227 (beta)	.16
45A-Ga67	Sweepings, old sluice-box Moon's open-cut, Right Fork.	.095 (beta)	.17
45A-Ga86	Anzac Creek, tributary of Peace River. Concentration ratio 90:1	.033 (gamma, field)	.016
45A-Ga66	Crushed syenite, Granite Mountain	.013 (gamma, field)	.008

Concentration of radioactive minerals in grain-size fractions

The distribution of radioactive minerals was determined in grain-size fractions of a concentrate from the first two riffles of the sluice box at Winder's placer. The sample, Ga86, contained about $20.00 in gold, showed 0.009 percent of equivalent uranium, and represented the concentrate from about 135 square feet of paystreak. The concentrate was fractioned by sieving. Most of the radioactive mineral is in the fraction between minus 6-mesh and plus 100-mesh, and there is a notable concentration between minus 20-mesh and plus 60-mesh.

Sieve opening		Weight in pounds	Percent equivalent uranium
	plus .742 inch	4.37	.000
minus .742,	" .525 inch	3.81	.000
" .525,	" 3 mesh	7.37	.003
" 3 mesh,	" 6 "	7.13	.002
" 6 "	" 10 "	6.25	.011
" 10 "	" 20 "	5.00	.015
" 20 "	" 45 "	5.00	.025
" 45 "	" 60 "	1.50	.030
" 60 "	" 80 "	.62	.015
" 80 "	" 100 "	.28	.012
	minus 100	.81	.007

The weighted average grade of the entire sample is nearly 0.009 percent; of the minus 6-mesh fraction, 0.017 percent; and of the minus 20-mesh, 0.04 percent of equivalent uranium. Another minus 20-mesh sample of the concentrate from 1500 square feet of paystreak or 83 cubic yards also showed 0.04 percent of equivalent uranium.

Gravity and magnetic separations of the concentrates

The percentage, by weight, of mineral fractions obtained by gravity and magnetic separations was determined for the samples shown below. The amount of the light fraction shows the relative effectiveness of concentrating heavy minerals by panning and by sluicing. The bulk of the two heavy fractions is magnetic.

Sample description and concentration ratio (volume)	Percent weight of concentrate Gravity fractions Light	Bromoform	Iodide
Ga24dc. Sluice-box concentrate; minus 20-mesh; Circle claim, 1945. 42,000:1. Repanned.	28.3	9.9 (M)* .9 (N)*	55.1 (M) 5.7 (N)
Ga16. Sluice-box tailings; minus 20-mesh; Circle claim, 1945. 95:1	50.0	12.5 (M) .5 (N)	33.4 (M) 3.6 (N)
Ga67. Sweepings, old sluice-box; minus 20-mesh; Moon's placer mine. Conc. ratio large	7.5 (M) 48.5 (N)	14.5 (M) 7.3 (N)	19.0 (M) 3.2 (N)
Ga75. Sweepings, old sluice-box; minus 20-mesh Johnson's placer mine. Conc. ratio large.	7.5 (M) 16.2 (N)	19.5 (M) 2.1 (N)	47.8 (M) 7.0 (N)
Ga 86. Creek gravel, Anzac Creek; minus 20-mesh. 90:1	1.9 (M) 23.1 (N)	16.4 (M) 1.8 (N)	54.8 (M) 2.0 (N)

*(M) is magnetic subfraction and (N) is nonmagnetic subfraction.

Gravity concentration of radioactive minerals

The radioactive minerals can be concentrated in a nonmagnetic iodide subfraction as might be inferred from the specific gravities and compositions of the minerals. Gravity separation of sample Ga2ldc, a sluice-box concentrate from Winder's placer on the Circle claim, segregated a large percentage of the equivalent uranium in the iodide fraction. Magnetic separation of this iodide fraction yielded a magnetic subfraction of large bulk that contained relatively little of the equivalent uranium. The nonmagnetic subfraction, therefore, contained the remainder of the radioactive material, although the quantity of the subfraction was too small for determination of the percentage of equivalent uranium by beta-ray count. Results of the separation of sample Ga2ldc are as follows:

Fractions	Equivalent uranium in percent
Original concentrate	0.170
Light fraction, 28 percent of original concentrate by weight	0.002
Bromoform fraction, approximately 11 percent of original concentrate by weight	0.002
Magnetic subfraction, 9.9 percent by weight	0.001 minus
Nonmagnetic subfraction, 0.9 percent by weight, too small for count	not determinable
Iodide fraction, about 60.3 percent of original concentrate by weight	0.227 (beta count)
Magnetic subfraction, about 55 percent of original concentrate by weight	0.011
Nonmagnetic subfraction, 5.7 percent by weight of original concentrate, too small for count	not determinable

[redacted]

Reserves of equivalent uranium

Grade: The content in percent of equivalent uranium, the concentration ratio, and other data concerning the samples are given on the maps (Figs. 2 and 3) and in the Appendix.

The average content of the creek gravels in place, computed from the percent of equivalent uranium in the concentrate recovered (not to be confused with a clean, heavy-mineral concentrate) in 50 samples is of the order of 0.0001 percent of equivalent uranium. Excluded in calculating this average were samples from areas where the gravels are andesitic and show essentially no radioactivity: Bear Gulch, the Left Fork of Sweepstakes Creek, two unnamed right-limit tributaries of lower Sweepstakes Creek, and one locality in Sweepstakes Creek below Spring Creek.

Average pounds of concentrate per cubic yard	41.3
Average concentration ratio (volume)	71.7 to 1
Average percent of equivalent uranium in the concentrates	0.006
Average grade in percent of equivalent uranium of gravels in place	0.0001

The average tenor of the paystreak in place is probably 0.0003 percent of equivalent uranium as computed from the amount and tenor of the sluice-box concentrate and tailings from the first open-cut made in 1945 on the Circle claim. At this mine 83 cubic yards of gravel was run through the sluice-box from an open-cut area of 1500 square feet in which the paystreak comprised 1/2 foot of gravel and 1 foot of the underlying bedrock. The equivalent uranium in the concentrate from this 83 cubic yards of paystreak gravel, assuming that a cubic foot of the gravel weighs 115 pounds, was only 0.8 pound. A sample of the tailings from the sluice-box, screened to minus 20-mesh, shows nearly

 [redacted]

[redacted]

0.0002 percent of equivalent uranium. A larger proportion of the radioactive mineral might be recovered in the sluice-box concentrate by more careful sluicing but the amount would still be small and the tenor probably lower for more light minerals would also remain in the boxes. Size fractions of the concentrate vary in content of equivalent uranium and screening affords a means of increasing the tenor of part of the concentrate to as much as 0.041 percent. Panning and "blowing" of the sluice-box concentrate brought the content of one sample to 14.2 percent of equivalent uranium. No information is available on the beneficiation of the sample, collected in 1917, which contained more than 80 percent of uranium and thorium as determined chemically.

The average content of equivalent uranium in 14 samples of the crushed syenite is .005 percent. (See appendix) The smaller percentage of equivalent uranium in the creek gravels is believed to have resulted from dilution of the syenite disintegration products by andesitic material, to the change in bulk volume, and possibly to removal of some of the radioactive material through leaching by surface waters.

Uranium-thorium ratio: Chemical analysis showed 42 percent of uranium and 42.03 percent of thorium in the concentrate collected in 1917 from the Circle claim. The sample of blowings from the 1945 clean-up on the Circle claim yields only 2.17 percent of uranium by chemical analysis, whereas the beta-count showed 14.20 percent of equivalent uranium. The remainder of the equivalent uranium is probably thorium. The radioactive mineral is the same in both samples and no explanation is offered as yet for the difference in the uranium-thorium ratio in the two samples.

[redacted]

[redacted]

Yardage and tonnage: Although the content of radioactive minerals in the deposits is too low for them to be significant as sources of uranium or other radioactive elements, an estimate of the amount of material available has been made. In this estimate the gravels, other than the paystreak, are assumed to have the same general content throughout their vertical and areal extent as was determined by panning the gravels of the creek bed. The limits of the placer-gold paystreak are unknown but are certainly much more restricted than the limits of the present stream and bench deposits.

Area	Thickness of gravel in feet	Cubic yards of gravel
Creek gravels		
Sweepstakes Creek		
From S.E. corner of mapped area (Fig. 3) to Spring Creek	10	1,700,000
Spring Creek to Bear Gulch	9	1,000,000
Bear Gulch to line IX	9	1,200,000
Line IX to line I	7	500,000
S.E. corner of mapped area to Peace River (Fig. 2)		4,400,000
Granite Creek		
Mouth to edge of mapped area	4	270,000
Spring Creek		
Mouth to edge of mapped area	6	1,600,000
Bench ground		
Sweepstakes Creek		
Spring Creek to Circle Claim	7	1,200,000
Circle Claim to line X	4	700,000
Line X to line I	4	600,000
Total		13,170,000

Bedrock

Many hundreds of millions of tons of syenite are available on the basis of the area and relief of the syenite stock of Granite Mountain.

[redacted]

Other deposits in the vicinity

Only Sweepstakes Creek and its major tributaries were examined in detail; but the data from the Rube Creek and Anzac Creek area, and the general geology of the district, suggest that the gravels along other creeks draining areas underlain by syenite and the rock of other syenite stocks north of the Sweepstakes Creek area 6/ may contain similar percentages of equivalent uranium.

6/Harrington, G. L., op. cit., plate X

[redacted]

APPENDIX

Sample data from Sweepstakes Creek area
(for location of samples see figures 2 and 3)

Sample	Size-fraction mesh	Equiv. U in per-cent, field count	Conc. ratio (volume)	Lbs. conc. per cu. yd.	Remarks
			Creek gravels		
Sweepstakes Creek (in order downstream)					
Ga 53	-20	.002	88:1	31.8	hole 4, line 1
54		.003	73:1	65.0	hole 5, line II
55	-20	.005	81:1	34.0	hole 4, line IV
56	-20	.005	85:1	33.6	between lines V & VI
68	-20	.004	64:1	82.0	hole IV, line VII
69	-20	.007	63:1	30.0	hole 3, line VIII
70	-20	.007	60:1	51.2	50 feet below line IX
71	-20	.008	67:1	43.6	right-limit line X
72	-20	.004	60:1	43.0	between lines XII & XIII
51	-20	.003	83:1	31.5	Right Fork, in creek below line XIV
50		.005	47:1	67.6	Right Fork, prospect pit
49		.004	67:1	40.0	Right Fork, gravel bar
52	-20	.000	69:1	39.1	Left Fork, andesite gravels only
48		.002	79:1	39.4	gravel bar
47	-20	.003	67:1	40.0	gravel bar
22	-20	.000	63:1	42.6	gravel bar, mostly andesite fragments.
21	-20	.009	75:1	29.5	gravel bar
Bl 24	-20	.006	80:1	33.4	gravel bar, below Granite Creek
29	-20	.004	94:1	29.6	gravel bar
23	-20	.002	112:1	24.5	gravel bar
10	-20	.007	49:1	56.8	gravel bar below Bear Gulch
9	-20	.003	34:1	75.8	gravel bar
7	-20	.005	56:1	46.0	gravel bar
6	-20	.003	28:1	113.0	gravel bar
5	-20	.005	54:1	49.1	gravel bar
4	-20	.007	45:1	53.7	gravel bar, mouth Spring Creek
32	-20	.008	112:1	26.2	gravel bar
40	-20	.016	135:1	22.8	below Spring Creek (Fig. 3)
33	-20	.012	48:1	64.0	right-limit tributary, syenite gravels.

[redacted]

Sample	Size-fraction mesh	Equiv. U. in per-cent, field count	Conc. ratio (volume)	Lbs. conc. per cu. yd.	Remarks
			Creek gravels (continued)		
Sweepstakes Creek (in order downstream)					
Ca 43	-20	.000	104:1	22.4	right-limit tributary andesite gravels only
Bl 34	-20	.008	161:1	18.2	(Fig. 3)
Bl 35	-20	.005	150:1	19.2	(Fig. 3)
Ca 25	-20	.010	143:1	20.5	gravel bar, few colors
Bl 36	-20	.012	156:1	22.4	(Fig. 2)
Ca 44	-20	.012	124:1	23.6	gravel bar
45		.001	52:1	50.2	andesite bedrock, right-limit tributary
Bl 37	-20	.006	169:1	17.0	(Fig. 2)
Spring Creek (in order upstream)					
Ca 6	-20	.007	56:1		base of cut bank (Fig. 3)
Bl 22	-20	.002	2:1		gravel bar, Snow Gulch
Bl 5	-20	.005	63:1	41.7	gravel bar
Bl 18	-20	.008	67:1	37.9	gravel bar
Bl 20	-20	.006	45:1	54.2	gravel bar
Bear Gulch (in order upstream)					
Bl 11	-20	.001	44:1		gravel bar (Fig. 3)
Bl 30	-20	.001	80:1		right-limit tributary (Fig. 2)
Ca 20	-20	.000	91:1	29.5	bedrock in creek (Fig. 3)
Granite Creek (in order upstream)					
Bl 25	-20	.004	88:1	29.3	gravel bar
Bl 26	-20	.005	81:1	33.4	gravel bar
Bl 27	-20	.003	84:1	31.6	gravel bar
Ca 77		.003	57:1		gravel bar
Peace River					
Ca 45	-20	.005	56:1	54.5	gravel bar
Rube Creek (in order upstream)					
Ca 85	-20	.003	117:1	26.2	gravel bar
Ca 84	-20	.002	90:1	35.3	stream bed
Ca 83	-20	.002	79:1	36.4	stream bed
Farmer Creek					
Ca 82	-20	.007	43:1	77.0	stream bed
Anzac Creek					
Ca 86	-20	.033	90:1	45.2	gravel bar
			Bench Ground		
Sweepstakes Creek (in order downstream)					
Ca 73	-20	.004	36:1	83.3	Right Fork, drill cuttings
Bl 15	-20	.010	133:1	[redacted]	gravel above paystreak, Winder's placer pit.

Sample	Size-fraction mesh	Equiv. U in percent, field count	Conc. ratio (volume)	Lbs. conc. per cu. yd.	Remarks
			Bench Ground (continued)		
Sweepstakes Creek (in order downstream)					
Bl 16	-20	.007	90:1	29.6	gravel above paystreak edge old cut, Circle claim.
Bl 8	-20	.001	40:1	62.3	prospect pit 2400 feet below Winder's pit.
			Placer deposits		
Sweepstakes Creek (in order upstream)					
Ga 13	-20	.005	74:1		paystreak, margin of old cut, Circle claim
Ga 16	-20	.017	95:1	28.0	tailings, Winder's sluice box, Circle claim, 1945.
Ga 24b	-11½ +20	.007	4150:1)		(concentrate from
Ga 24c	-11½ +20	.022	4750:1)	estimated	(first placer cut on
Ga 24d	-20	.041	8300:1)		(Circle Claim, 1945
Ga 24e		14.20*	900,000:1		blowings, Circle claim, 1945 sweepings, old sluice box, Johnson's placer mine.
Ga 75	-20	.013	large		sweepings, old sluice box, Johnson's placer mine.
Ga 76	-20	.013	112:1		edge of paystreak, Johnson's placer mine
Ga 67	-20	.095*	large		sweepings, old sluice box, Moon's placer mine.

*beta count, Washington laboratory

		Crushed syenite samples	
Ga 57		.005	Granite Mountain
Ga 58		.003	" "
Ga 60		.002	" "
Ga 61		.007	" "
Ga 62		.005	" "
Ga 63		.003	" "
Ga 64		.009	" "
Ga 65	less than	.001	divide between Granite and Sweepstakes Creeks.
Ga 66		.013 (lab. count .020)	1-inch pegmatite vein in boulder, vicinity Ga 65
Ga 78 (Bl 42)		.008 (Bl 42 .009)	Granite Creek
Ga 79		.009	" "
Ga 87		.006	head of Farmer Creek
Bl 19		.003	Spring Creek traverse
Bl 21		.003	" " "