NO. RA-57

RECLASSIFICATION AUTHORIZATION

In accordance with the authority delegated to me by memorandum from the General Manager, dated December 6, 1948, subject, "Security Procedures and Policies relating to the Domestic Raw Materials Program" and based on criteria for determining classification, as outlined in Appendix A attached thereto, the documents listed below are reclassified as indicated.

	Present Classification	Revised Classification
USGS -"Preliminary Report - Radioactivity of Some Alaskan Placer Samples" T.E.I. No. 6 by J. O. Harder and J. C. Reed, dated February 1945.	SECRET	UNCLASSIFIED

July 18, 1950 — Jesse C. Johnson

Date

Jesse C. Johnson
Manager
Raw Materials Operations

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PRELIMINARY REPORT

ON

RADIOACTIVITY OF SOME ALASKAN PLACER SAMPLES

by

James G. Harder and John C. Reed

(geologic data supplied by the Alaskan Branch)

Trace Elements Investigations -- Report No. 8

February 1945

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APPENDIX

(at end of report)

Appendix 1 Preliminary results of mineralogical studies on Alaskan placer samples.

Preliminary report on radioactivity of some Alaskan placer samples

INTRODUCTION

General statement

More than 600 samples from Alaska, mostly concentrates from placer operations, were tested for radioactivity during January 1945 in the laboratory of the Geological Survey. The samples were collected over a period of nearly 50 years by members of the Alaskan Branch of the Survey during their field work. The samples are from many districts (see figure 1 for boundaries of Alaskan districts). The locations of samples which preliminary work indicates contain more than 0.020% equivalent U. are shown on figures 2 through 15 as well as all other samples for those districts.

Testing procedure and results

Because of the large number of samples, it was decided that a preliminary scanning procedure using field testing equipment should be adopted to select the most promising samples for quantitative laboratory testing. By this method more than 100 samples were chosen from the total of more than 600 and these were tested quantitatively in the laboratory on a counting rate meter to measure radioactivity. Large samples were tested by measuring gamma radiation and small samples were tested by beta measurements.

As the preliminary scanning procedure was not sensitive enough to surely identify samples of moderate activity, quantitative reruns are proceeding on the rejected samples as rapidly as facilities will permit.

The results of all quantitative tests to date are shown in table 1 or in table 2 at the end of the report. The samples are grouped geographically and listed numerically. For convenience the samples have been divided into four groups as follows:

Group A - more than 0.020% equivalent U.
Group B - 0.010-0.020% " "
Group C - less than 0.010% " "
Group D - not yet tested quantitatively.

Group A and group B samples are listed in table 1 and group C samples are listed in table 2. Group D samples are not listed in the tables but the locations of group D samples which accompany group A samples are shown on figures 2 through 15.

Reference to table 2 will show that group C samples are nearly all quite low in radioactivity so they are probably of very little interest at this time except for the negative information they present. In table 2, group B samples are low enough to be of doubtful value. The group A samples are of greatest interest. In considering their possible interest it is pointed out that for many of the concentrates little or no information is available as to the abundance of the concentrate minerals in the placer gravel.

Chemical analyses have been obtained of the 11 samples of group A which showed considerable radioactivity. These results are abstracted below from table 1.

Sample No.	District	Equivalent U Percent	Chem. U Percent	Chem. Th Percent
342	Koyuk	>5.0	42.0	42.03
371	Fairhaven	>5.0	3.8	4.70
289	Kougarok	1.338	0.088	0.93
375	Koyuk	0.443	0.12	0.61
517	Yentna	0.237	0.14	0.044
520	Yentna	0.229	0.090	0.044
527	Yentna	0.190	0.08	0.083
525	Yentna	0.119	0.07	0.03
61	Iditarod	0.092	0.073	0.013
134	McGrath	0.086	0.26	0.026
81	Ophir	0.056	0.020	0.057

Differences between values of U equivalent and percentages of U chemically may be due to thorium but there are other possible explanations such as the equilibrium condition of the material.

Some mineralogical studies on a few of the samples are in progress by Dr. H. S. Larsen at Harvard University. This work is incomplete but preliminary results are shown in Appendix I at the end of the report.

Limitations of report

It should be emphasized that this report is decidedly limited in a number of important respects which are enumerated below.

1. There are placer samples in other Alaskan Branch collections which would not be prepared in time for testing.

2. There are other placer operations in Alaska from which no samples are now available.

3. The scanning procedure adopted to identify the most interesting samples does not insure that there are not some samples of interest in the rejected group. This group is being tested quantitatively as rapidly as possible.

4. It must be remembered in considering the value of any sample that the samples are concentrates and that data indicating the amount of gravel from which they were derived are often not available.

5. Information on the yardage of gravel is not always available.

6. The short time available for the testing of samples and preparation of this report has limited the scope and detail of information that can be presented.

DESCRIPTION OF DISTRICTS

General statement

The following discussion is confined largely to districts from which on the basis of information now available have come samples belonging to group A

as previously defined. The discussion is systematized geographically like the listings in the tables, as follows -- (1) by regions (2) by districts. In the text some districts are further divided into areas. In general the principal discussion unit is the district as commonly used by the Alaskan Branch of the Geological Survey (see fig. 1).

Because most of the samples are concentrates from placer operations, placer deposits are emphasized. However, the placer concentrates reflect in many cases the types of rock bodies, including lode deposits, in an area. Where data on bedrock samples are available and where significant relations between placer samples and bedrock geology appear, such data and relations are pointed out.

The principal sources of information are the notes accompanying the sample collection, the field notebooks of the geologists who collected the samples, publications of the Geological Survey, and the personal knowledge of the districts as supplied by various geologists of the Alaskan Branch.

Seward Peninsula region

York district
(see fig. 2)

Cape Mountain area:

The rocks of the Cape Mountain area include principally granite, limestone, sandstone, slate, and phyllite. Also present are porphyritic variants of the granite, silicic dike rocks, and basic dike rocks. The Cape Mountain area is one of the principal sites of tin mineralization on Seward Peninsula. A number of tin-bearing lodes are known and at one property about 2,000 tons of ore containing 0.53 to 1.13 percent of tin have been blocked out.

Placer cassiterite was mined in the area from 1918 to 1941 but the higher grade tin placers are now largely worked out. The placer mining was restricted to Cape Creek and Goodwin Gulch (see fig. 3).

The tin paystreak on Cape Creek, though discontinuous, had a total length of about 7,000 feet, an average width of 80 feet, and included a body of pay gravel and overburden with an aggregate thickness of 11 feet. The average yield was more than 8 pounds of concentrates per cubic yard of gravel. The concentrates contained 65 percent of tin.

The workable paystreak on Goodwin Gulch had a length of 6,000 feet, an average width of 30 feet, and included a body of pay gravel and overburden 6 feet thick. Some bench ground also was mined. The tenor was nearly the same as on Cape Creek, but the concentrates contained about 70 percent of tin.

Concentrates aggregating 975 tons have been produced and shipped from the Cape Mountain area.

All the creeks in the area have been prospected and lower-grade tin deposits are known on Boulder, Granite, Goodwin, and Village Creeks. The data in the following table are from War Minerals Report 146 of the Bureau of Mines.

Possible placer tin reserves, Cape Mountain area

	Cubic yards of gravel	Pounds of concentrates per cubic yard
Cape Creek	115,000 to 140,000	1 to 3
Goodwin Gulch	2,500 " 3,500	1 to 3
	4,000 " 5,000	2 " 6
Goodwin Creek	35,000 " 50,000	2 " 4
	60,000 " 70,000	1 " 3
Boulder Creek	20,000 " 25,000	2 " 4
Granite Creek	35,000 " 40,000	0.5" 2
	10,000 " 15,000	1 " 3
Village Creek	35,000 " 65,000	2 " 4

The Bureau of Mines has estimated the total placer tin reserves of the Cape Mountain area at about 373,500 cubic yards of gravel containing about 831,780 pounds of concentrates.

Twenty-eight of the samples examined are from the Cape Mountain area (see fig. 3), and ten of the samples are known to belong to group A and 4 to group B. Two group A samples (light fractions of 592 and 593) are from Village Creek and each are concentrates of two pans of stream gravels. Four

group A samples (heavy fractions of 500 and 595; light and heavy fractions of 595; and 594) are each concentrates of two pans of gravels from Boulder Creek. One group A sample (584) is from the mouth of Boulder Creek and is a concentrate of 3 pans of gravel, one from the mouth and 2 from 100 yards upstream. One group A sample (585) one group B sample (583) are from the beach between Boulder and Granite Creeks and each is a concentrate of 2 pans of gravel. Two group B samples (491 and 498) are from Goodwin Gulch; the first is a tin concentrate and the second is a concentrate from a cleaner jig representing 2.7 pounds of concentrates per cubic yards of tailings. One group B sample (578) is from the dump of the middle drift of the North Star mine. One group A sample (497) is of tin concentrates from Cape Creek. One group A sample (575) is a panned concentrate of gravels from Pauline Creek. One group B sample (600) is of concentrates panned from gravels from a trench on Granite Creek.

Minerals reported from Cape Creek are cassiterite, magnetite, ilmenite, hematite, monazite, pyrite, garnet, chloritoid, diopside, apatite, dolomite, actinolite, tourmaline, biotite, and quartz. Sample 497 is known to contain large amounts of cassiterite and magnetite, some pyrite, small amounts of titanite, and rare monazite, vesuvianite, and olivine. Sample 498 contains a large percentage of dolomite, some cassiterite and magnetite, and rare rutile and anatase.

Potato Mountain area:

The Potato Mountain area (see fig. 4) is about 14 miles ENE of Cape Mountain. The bedrocks are principally sandstone, slate, and phyllite. No granite crops out but granite is presumed to underlie the Potato Mountain ridge and to be the source of a few felsitic dikes exposed there. Hybrid basaltic rocks cut all other rocks.

No lode tin deposits of significance have been found in the Potato Mountain area. Placer cassiterite was mined there from 1901 to 1920. The principal site of tin-placer mining in the area has been Buck Creek from which 1,410 tons of concentrates have been produced. The paystreak extended from a point on the West Fork of Buck Creek about 1,000 feet to its mouth, thence down Buck Creek to its mouth, and thence down Grouse Creek for about 4,000 feet, or a total distance of about 20,700 feet. The width of the paystreak ranged up to at least 150 feet and the average depth probably was about 6 feet. In the middle of the paystreak the gravel yielded as much as 50 pounds of concentrates per cubic yard but the general tenor was perhaps 7 pounds per yard.

Iron Creek was mined for a length of 1,900 feet, over a width ranging from 5 to 12 feet, and to a depth of from 4 to 5 feet. About 15 pounds of concentrates per cubic yard were recovered.

Placer cassiterite is known also in the valleys of Potato, Diomede, and Red Fox Creeks, but the tin reserves are small.

The following tabulated data are from War Minerals Report 157 of the Bureau of Mines:

Possible placer tin reserves, Potato Mountain area

	Cubic yards of gravel	Pounds of concentrates per cubic yard
Grouse Creek	30,000 to 40,000	1 to 2
	80,000 " 90,000	2 " 4
Buck Creek	12,000 " 15,000	3 " 5
	37,000 " 45,000	4 " 6
	5,000 " 7,000	1 " 3
Butter Creek including Iron Creek	60,000 " 70,000	2 " 3
	13,000 " 19,000	3 " 6
	12,000 " 16,000	2 " 4
Potato Creek	130,000 " 145,000	2 " 6
Diomede Creek	57,000 " 75,000	2 " 4
Red Fox Creek	43,000 " 60,000	2 " 4

The total tin reserves in the Potato Mountain area are estimated by the Bureau of Mines to be about 625,500 cubic yards containing about 1,778,000 pounds of concentrates.

Of the 18 samples from the Potato Mountain area, 3 belong to the B group. The 3 group B samples (587, 588, and 591) are panned concentrates of gravels from the beach of Lopp Lagoon.

Lost River area:

The country rock of the Lost River area (see fig. 5) consists mainly of Ordovician limestone which has been intruded by two masses of granite and by numerous acidic and basic dikes of several ages. Cassiterite was discovered in this area in 1903 and prospecting has been carried on intermittently since then.

In earlier years small tin-placer operations were carried on at two places in the valley of Cassiterite Creek. Probably between 500 and 1,000 cubic yards of material were sluiced from one of these places. The total production of tin concentrates is reported to have been about 20 tons. All of the valley floor of Cassiterite Creek, from the crossing of the Ida Belle dike downstream to Camp Creek may be placer-tin ground. The volume of gravel is small, boulders are abundant, and floods pass through this valley at times of heavy rains.

Large lode deposits of low-grade tin and tungsten ore are available in and adjacent to the Cassiterite and Ida Belle dikes.

Of the 12 samples from this area which were studied, 7 are from placers on Cassiterite Creek, 4 are from the bench near the mouth of the Lost River, and 1 is from the Lost River lods. Minerals reported from Lost River are cassiterite, wolframite, topaz, dolomite, fluorite, vesuvianite, tourmaline, and scheelite.

Bar Mountain area:

The bedrock of the Bar Mountain area is calcareous schist that has been intruded by a granite stock and alaskite sills. Contact minerals including

cassiterite replace the schist locally. Placer tin was discovered in Eldorado Creek (see fig. 2) in 1901 and lode deposits were staked in 1903. No placer mining has been done and no tin minerals are known to have been shipped from the area.

The Geological Survey has estimated placer-tin reserves on Tuttle Creek to be 630,000 cubic yards of gravel containing 4 tons of tin and on Eldorado Creek to be 14,400 yards containing 1 ton of tin. Lode reserves blocked out are estimated to be 500 tons of ore containing 13 tons of tin. Other placer and lode deposits are small and low-grade.

Work done so far on the 12 concentrates from the Ear Mountain area has revealed that 11 belong to the A group (610-620). Samples 614-617 are from Tuttle Creek; sample 619 is from Eldorado Creek; samples 611-613 are from Quarts Creek; and samples 610 and 620 are from Crosby Creek. In four of these 11 samples (614,616,619, and 620) it is the heavy fraction that falls into group A. Mineral determinations for samples 610-614, 616, 619, and 620 include the following minerals: monazite, xenotime, zircon, cassiterite, scheelite, topaz, hypersthene, danburite, feldspar, quartz, scapolite, biotite, tremolite, apatite, fluorite, tourmaline, axinite, vesuvianite, epidote, olivine, brookite, garnet, magnetite, and diopside.

Koyuk district

The country rocks of the Koyuk district include meta-andesite, basaltic lava, schist and limestone of Paleozoic and Mesozoic age cut by granitic rocks. The Koyuk district (see fig. 6) has been a significant producer of gold and also has yielded some platinum. The production has come from relatively high-grade material. Reserves are estimated to be small.

Sweepstakes Creek area:

The bedrocks of the drainage area of Sweepstakes Creek include meta-andesite, schist, granite, syenite, and basaltic lavas.

In 1917 claims were located along the upper 5 miles of the creek and its upper fork but the creek has been a small producer. Near the head of the creek the gravel is about 4 feet deep and is overlain by 2 feet of muck. Farther downstream the gravel is as much as 9 feet deep and a few inches of weathered bedrock were mined with the gravel.

The two samples from Sweepstakes Creek belong to the A group (342 and 375) and are from the Circle claim opposite Bear Gulch. In sample 342 have been identified magnetite, chrome spinel, platinum, zircon, garnet, and olivine. Sample 342 may be a concentrate of sample 375. In the latter the same minerals have been identified as well as ilmenite, hematite, and gold.

Rube Creek area:

The bedrocks of the Rube Creek area are andesitic tuff and basalt. The creek has yielded only a small quantity of precious metals. Heavy minerals known from the creek include black garnet, hematite, olivine, zircon, chrome spinel, and gold. Platinum has been reported.

One sample of group A (315) is from Rube Creek and is of concentrates known to contain magnetite, gold, chrome spinel, feldspar, hematite, olivine, garnet, and zircon.

Fairhaven district

The Fairhaven district is underlain by interstratified Paleozoic schists and limestones that are intruded by Mesozoic granitic masses. Basaltic and andesitic lavas also are known. Tertiary coal-bearing sediments are present along the Kuguk River. Some of the placer deposits have been mined for gold and the reserves are estimated to be large.

Candle Creek area:

The bedrock of the Candle Creek area is chiefly schist intruded by a small body of granitic rock near the head of the creek. Candle Creek (see fig. 7) has been a large producer for years and dredges have worked on it for 25 years. Most of the productive ground is along the lower 9 miles of the creek and several tributaries to it from the west. The gravel ranges from 5 to 25 feet thick and extends up to as much as 1,000 feet from the creek. The placer gold reserves are probably fairly large.

Heavy minerals reported in sluice boxes from the Candle Creek area include gold, arsenopyrite, pyrite, galena, chalcopyrite, magnetite, ilmenite, rutile, zircon, garnet, cerusite, and hematite. Two of the six samples from Candle Creek (22 and 371) are known to belong to the A group. Sample 371 is of concentrates and free gold from cleanups and may possibly be a further concentration of sample 271. The samples contain magnetite, ilmenite, gold, zircon, garnet, rutile, and hematite. Both samples are from claim 19 above the discovery claim and near the mouth of Patterson Creek.

Kougarok district

The bedrocks in the Kougarok district are gneiss, schist, and limestone of Paleozoic age. The bedrocks are overlain by gravel and sand of Quaternary and possible of Tertiary age.

Little recent information is available on placer mining in the Kougarok district. The more important, earlier placer operations were on the Kougarok River (see fig. 8). The district has been an important producer of gold, and since 1930 production has been increasing. In 1940, four dredges operated in the district on the Kougarok River, American Creek, and Iron Creek. Other producing areas, where methods other than dredging are used, are along Dick and Macklin Creeks and the tributaries of the Nexapaga River. The deposits

near the Noxapaga River were discovered recently. The placer gold reserves of the Kougarok district are estimated to be large.

One (289) of the 6 samples from the Kougarok district is known to belong to group A. The sample is from Harris Creek and represents heavy minerals from a gold concentrate. The bedrocks of the drainage basin of Harris Creek are schist and limestone. Sample 289 contains magnetite, rutile, pyrite, garnet, gold, ilmenite, hematite, sircon, quarts, and rock fragments.

Cook Inlet region

Yentna district

The oldest sedimentary rocks in the Yentna district comprise a complex sequence of Mesozoic graywacke, slate, and quartzite that contain quarts veins and veinlets. These sedimentary rocks are cut by diorite, granite, and associated rocks that are exposed 10 miles west of the placer areas. Tertiary conglomerates and coal-bearing rocks occupy much of the lower ground and lie unconformably on the older sedimentary rocks. Dikes cut the Tertiary rocks near the placers. Glacial till is spread over the lowlands and alluvium fills the stream valleys.

The Cache Creek and Peters Creek areas are the two principal placer areas (see fig. 9). Other deposits are along the Kahiltna River and at the head of Long Creek. Small deposits are known on Falls and Twin Creeks. The Yentna district has yielded a large amount of gold; both dredging and hydraulicking have been done. Gold reserves are estimated to be moderate.

The gold is thought to have come originally from the quarts veins and veinlets in the oldest rocks. Placers were formed in the Tertiary rocks which later were warped. Subsequently other placer deposits were formed, in part by reconcentration of the older Tertiary deposits. During glaciation much of the Tertiary deposits and the placer deposits were planed away and the gold incorporated in glacial deposits in the lowlands. Present streams are working such gold-bearing material to form new placer deposits.

The gravels range in thickness from a few to more than 50 feet and paystreaks are as much as 100 feet wide but average probably less than 100 feet. Some paystreaks are several miles long but the average length probably is less than a mile. Most of the creeks have been staked along their entire lengths.

Little is known of the distribution, number, and characteristics of paystreaks in the reworked glacial material. Despite the complex history of the deposits, the gold is coarse and apparently has not been transported far.

The placer mines are in areas in which either Mesozoic or Tertiray rocks are exposed and most camps are in Tertiary bedrock areas. In the Cache Creek area mines are on Cache, Dollar, Falls, Thunder, Nugget, and Gold Creeks and in the Peters Creek area on Peters, Bird, Willow, and Poorman Creeks.

Of the 22 samples from the Yentna district, 11 are known to belong to group A and one to group B. Four group A and one group B samples are from the Peters Creek area, two group A samples are from the Cache Creek area, and four from the Kahiltna River below Peters Creek.

Sample 520 is a concentrate of platinum-bearing black sand from bench and creek gravels from the upper part of Poorman Creek. The black sand concentrates which were further concentrated to yield sample 520 showed but little radioactivity. The group B sample (519) is also a concentrate of bench and creek gravels from the upper part of Poorman Creek.

Sample 522 contains platinum and is from Willow Creek and its tributaries.

Samples 474 and 518 are concentrates from Peters Creek about 5 miles below Cottonwood Creek. In this vicinity dredge ground is as much as 1,200 feet wide and the gravel is 4 to 7 feet thick.

Sample 473 is heavy sand from sluice boxes from upper Cache Creek just above the mouth of Gold Creek.

Sample 523 is a concentrate from gravels in a creek placer from the right limit of Nugget Creek.

Sample 525 is of dredge concentrates from Cache Creek above the mouth of Windy Creek. The paystreak there averaged 180 feet wide and 4½ feet deep. Its length is said to have been 6 miles.

Sample 517 is a black-sand concentrate containing gold and platinum. The original sample weighed 4.9 ounces and was from about ¼ cubic yard. The sample is from Shalon Bar on Kahiltna River about 8 miles by river below Peters Creek. The average width of the paystreak was about 650 feet and the gold was largely in the upper few feet of gravel. The gravel is from 6 to 9 feet thick and contains 1 to 3 pounds of black sand per cubic yard. Bench gravel also is workable in this vicinity.

Samples 480, 481, and 527 are from Round Bend Bar about 16 miles up the Kahiltna River from the Yentna River. Sample 527, which contains platinum and gold, is from a 10-foot shaft about 100 yards from the river. The sample represents about 1.5 cubic yards of the 10 yards taken from the shaft.

Sample 481 is of repanned concentrates of earlier work which had been thrown out. There is said to have been 3 pounds of black sand per cubic yard. The sample contains platinum and represents 1/3 to 1/4 of the original platinum content. Sample 480 is a concentrate from a sandbar after high water had altered the position of the paystreak. The sample represents 1 cubic yard.

Kuskokwim region

McGrath district

The country rocks of the Nixon Fork area in the McGrath district are early Paleozoic limestone and Cretaceous sandstone and shale. These rocks are intruded by monzonitic rocks probably of Tertiary age. The intrusive

rocks were the source of the solutions that produced the gold lodes in the area from which in turn the gold placers have been derived.

Gold-placer deposits in the Nixon Fork area (see fig. 12) were discovered on Hidden Creek in 1917 and other placer and lode deposits were found soon after. The placers on Hidden Creek have been the most productive. The paystreak on Hidden Creek is about 1 mile long, 100 feet wide at the lower end, and 40 feet wide at the upper end. The average depth to bedrock is about 11 feet. The gold is in the lower gravel and on granitic bedrock. By 1933 only a little ground was left to be mined, but farther downstream, lower-grade deposits lie under 45 feet of overburden.

Of the six samples from the McGrath district, two (50 and 134) have been determined to belong to group A and two (11 and 483) to group B. Sample 50 is of concentrates from the paystreak on Hidden Creek. Sample 134 was donated to the Geological Survey and its exact source in the Nixon Fork placers is not known. Sample 11 is of concentrates from small placer operations on Birch Gulch, tirbutary of Hidden Creek, where the paystreak is 50 feet wide and is covered by 11 feet of muck and gravel. Sample 483 is of scheelite concentrates from Alder Gulch in the Ninuele Mountains.

Yukon region

Iditarod district

The principal bedrocks of the Iditarod district are Cretaceous sandstone, argillite, and slate. These rocks are intruded by bodies of monzonite that locally have recrystallized the sediments. Mineralization in the district was associated with the intrusions. One prominent monzonite body is at the head of Flat Creek and another is in the vicinity of Otter Creek.

The placer deposits are worked for gold and were derived directly from erosion of mineralized sedimentary and igneous rocks. The placers are of two

types -- the normal type and a residual type in which the gold is concentrated in weathered rock in situ. The Iditarod district has produced about 8 percent of the placer gold from Alaska and dredges have been operated there for years. Some tailings have been profitably worked a second time. Reserves are estimated to be large.

The larger placers are around Flat. Four to five miles of claims have been staked on Flat Creek, those to the south on residual deposits and those to the north on stream deposits. The gravel is 10 to 25 feet thick and in places weathered bedrock has been mined with the gravel. Second tier and first tier claims have been staked on Otter Creek on the south and north sides respectively.

Of the nine samples from the Iditarod district, two are known to belong to group A. One of these (57) is a concentrate from claims at the upper end of Flat Creek. It is from a placer of the residual type on monzonite. The overburden is 20 feet deep at the upper end of the claims and 1,000 feet downstream is 4 to 12 feet deep. The gold is distributed uniformly through the overburden. The sample consists principally of angular zircon (about 90 percent) with minor amounts of ilmenite, cinnabar, epidote, and pyroxene.

The other sample (61) of the A group is a concentrate from the head of Happy Creek. The paystreak on Happy Creek is about 100 feet wide at the lower end and widens within a mile upstream, where the ground is richer, to as much as 500 feet. The paystreak continues another 1,500 feet to the head of the gulch. Similarly the depth of the overburden increases from 12 feet at the lower end to 18 feet farther up. The increased thickness in part is due to tailings. Two to three feet of gravel are sluiced and as much as 7 feet of bedrock, which is sandstone and sandy argillite.

Ruby-Long-Poorman area:

The bedrocks in the vicinity of Ruby, Long, and Poorman consist largely of schistose Paleozoic rocks and deformed greenstone lavas and tuffs probably of late Paleozoic age. Some Cretaceous sedimentary rocks and small areas of Tertiary basaltic lavas are present but seem to be unrelated to the presence or absence of placer deposits. The Paleozoic rocks are intruded by granitic rocks, probably of Mesozoic age, and these rocks are believed to have caused the mineralization in the area.

The Ruby-Long-Poorman area (see fig. 11) has yielded important amounts of placer gold. About 2½ tons of cassiterite concentrates have been shipped from the area. The gold-placer deposits in general are deeply buried, discontinuous bodies of gravel on bedrock. They are covered by silt and are in broad open valleys less than 500 feet above sea level. Many of the deposits do not follow the present courses of the streams but lie to one side on so-called benches. Most of the creeks in the area have been worked for gold. The total quantity of gravel is large but paystreaks are spotty and difficult to locate under the silt cover.

Mining operations on Poorman Creek show that in general about 5 feet of gravel on bedrock is overlain by 20 to 75 feet of frozen muck. The gold is on or in the upper part of the bedrock. The paystreak is said to be as much as 300 feet wide.

The paystreak on Soloman Creek is within 200 feet of the creek and extends discontinuously from the head to the mouth. Shafts reveal that 8 to 60 feet of gravel is covered by 10 to 60 feet of frozen muck. Most of the gold is in the upper 2 feet of bedrock and is in narrow lenses in a paystreak 15 to 80 feet wide.

The basins of Long and Flint Creeks in the vicinity of Long have been worked for gold for many years. The principal paystreak is that on Long Creek. It is formed at its upper end by the junction of paystreaks from Bear Gulch and upper Long Creek. The paystreak continues downstream for at least 3½ miles. All the paystreak is on or in the bedrock which is covered by 20 to 80 feet of gravel and muck. The paystreak has been worked to widths of as much as 100 feet, but is is neither continuous nor of uniform grade.

Greenstone Creek has been dredged for 2 miles along its lower course. The paystreak followed the general course of the creek and was from 60 to 100 feet wide. At the lower end of the dredged area, the overburden was 25 feet thick, but at the upper end it was only 5 to 8 feet thick.

Heavy minerals in the Ruby-Long-Poorman area include gold, cassiterite, scheelite, galena, cinnabar, stibnite, and bismuth.

Of a total of 37 samples from the area, one is known to belong to the A and one to the B group. The A-group sample (81) is of concentrates from the lower 2 miles of Soloman Creek. The B-group sample (130) is from the clean-up sluice of the Greenstone Creek dredge.

Hot Springs district

The bedrocks in the Tofty area in the Hot Springs district are largely slate, quartzite, and schist that are intruded by monzonite and similar rocks. Several small zones of gold and tin mineralization are known in the area (see fig. 15). Much of the ground in the Tofty area has been worked but several thousands of tons of tin concentrates have been estimated to be in the tailings and in low-grade gravel.

On Tofty Gulch a considerable open cut has been made in a bench on the hillside about 1,000 feet from Sullivan Creek. The deposit consisted of 4 to 6 feet of gravel covered by several feet of yellow silt and black muck. Placer deposits on Sullivan Creek are 30 to 80 feet below the surface.

All 8 samples from the Hot Springs district are from the Tofty area and one of these (292) is known to belong to group A. Sample 292 is of tin concentrates collected by reworking tailings piles in Tofty Gulch.

Aeschynite has been reported from Deep Creek, Sullivan Creek, and Gache Creek. Xenotime has been reported from Sullivan Creek and monazite from Deep, Sullivan, and Karshner Creeks.

Tolovana district

The bedrocks of the Tolovana district include Paleozoic limestone, chert, silicified limestone, graywacke, sandstone, shale, argillite and phyllite, and basic igneous rocks. Some of the basic igneous rocks are extrusive and some are intrusive. Near Livengood small bodies of basic rock are altered to serpentine. Small bodies of acidic and intermediate intrusive rocks, in part of Mesozoic age but probably representing several stages of intrusion, occur near Livengood and in surrounding areas. The mineralization is believed to be genetically related to the acidic rocks.

Gold placers of commercial value have been found principally along Livengood Creek and on the ridge between Livengood Creek and Tolovana River (see fig. 14). Both bench and stream placers have been worked but the bench placers have had higher values. In recent years dredges have been operated along Livengood Creek. The gold production from the district has been considerable and moderate reserves are estimated.

The paystreak on Livengood Creek is about 4 miles long in bench gravel of an old stream channel. The paystreak averages about 125 feet wide. The average depth to bedrock is 80 feet and the gravel is 14 feet thick. Most of the gold is in the lower three feet of gravel and in the top 1½ feet of the bedrock. Heavy minerals reported are magnetite, ilmenite, limonite, hematite, pyrite, barite, chrome spinel, and chromite.

The bedrocks of Goodluck Creek, a headward tributary of Livengood Creek, are limestone, chert, and greenstone. The paystreak is on bedrock and is as much as 35 feet wide. Abundant chromite is present in the concentrates. Other heavy minerals are cinnabar, gold, zircon, serpentine, and a little magnetite. Little mining has been done on Goodluck Creek.

Of the 24 samples from the Tolovana district, 23 are from the Livengood area and one (4) of these has been determined to belong to group A. It is from a 45-foot shaft on Goodluck Creek.

Fortymile district

The bedrocks of the Fortymile district include pre-Cambrian schist and limestone and meta-igneous rocks intruded by granitic rocks. Emanations from the granitic rocks are believed to have caused the mineralization in the district. Tertiary basic igneous rocks in the area are in part intrusive. Tertiary sandstone, shale, and conglomerate crop out locally.

The principal gold-placer areas are around Chicken Creek, Walker Fork, Wade Creek, Franklin Creek, the Fortymile River, and Dome Creek (see fig. 18). Small placer mines have been operated along some of the smaller tributaries. The district has been a steady producer of gold for half a century and production has been considerable. New paystreaks may still be found although no new ones have been found for many years. Reserves are estimated to be large.

The paystreak along Walker Fork is at least 5 miles long and 50 to 600 feet wide. The gravel is 4 to 10 feet thick. The tenor varies from place to place and the gold is in the lower 2 feet of gravel and, in places, in the upper 1½ feet of bedrock, which includes quartzite, schist, gneiss, pegmatite, and granitic rock. About ten miles of claims have been staked along Wade Creek. The paystreak is intermittent and is 50 to 800 feet wide. The gravel is as much as 12 feet thick and the gold in places is in the upper 1½ feet of bedrock. The bedrocks are schist, limestone, granitic and basic rocks, and quartz veins.

The Chicken area covers about 20 square miles and claims have been staked along at least 5 miles of creeks. The paystreak along Chicken Creek downstream from the mouth of Myers Fork is 100 to 200 feet wide and the gravel is 5 to 15 feet thick. The bedrocks are sandstone, shale, conglomerate, basic rock, granitic rocks, and rhyolite and dacite flows.

Of the 26 samples from the Fortymile district, two (277 and 284) are known to belong to the A group. Samples 277 and 284 are reported to come from Atwater Bar at the mough of Atwater Creek. Minerals reported in these samples are magnetite, ilmenite, hematite, garnet, pyrite, gold, and transparent yellow mineral with high indices and birefringence.

Table 1

Radioactivity values and U content by chemical analysis (if available) of Alaskan placer samples in groups A and B .

Location	Sample No. and (group)	Percent U equivalent	Percent U (Chem.)
SEWARD PENINSULA REGION			
York district	497 (A)	0.030	
" "	500 (A)[1]	0.133	
" "	575 (A)	0.960	
" "	584 (A)	0.180	
" "	585 (A)	0.106	
" "	592 (A)[1]	0.280	
" "	593 (A)	0.057	
" "	593 (A)[2]	0.440	
" "	594 (A)[1]	0.180	
" "	595 (A)[1]	0.160	
" "	596 (A)[1]	0.415	
" "	596 (A)[2]	0.040	
" "	610 (A)	0.142	
" "	611 (A)	0.215	
" "	612 (A)	0.146	
" "	613 (A)	0.175*	
" "	614 (A)[1]	0.370*	
" "	614 (A)[3]	0.302*	
" "	615 (A)	0.021	
" "	616 (A)[1]	0.310*	
" "	616 (A)[3]	0.132*	
" "	617 (A)	0.026	
" "	618 (A)	0.200*	
" "	619 (A)	0.211*	
" "	619 (A)[1]	0.520*	
" "	619 (A)[3]	0.153*	
" "	620 (A)[1]	1.000*	
" "	491 (B)	0.019	
" "	492 (B)	0.012	
" "	578 (B)	0.011	
" "	583 (B)	0.018	
" "	587 (B)	0.019	
" "	588 (B)	0.013	
" "	591 (B)	0.010	
" "	592 (B)	0.012	
" "	600 (B)	0.010	
Shaktolik district	304a (B)	0.011	
Koyuk district	342 (A)	>5.0	42.0
" "	375 (A)	0.443	0.12
Fairhaven district	371 (A)	>5.0	3.8
" "	22 (A)	0.049	
Kougarok district	289 (A)	1.335	0.088
" "	315 (A)	0.026	

Table 1, cont.

Location	Sample No. and (group)	Percent U equivalent	Percent U (Chem.)
COOK INLET REGION			
Yentna district	473 (A)	0.024	
" "	474 (A)	0.064	
" "	480 (A)	0.036	
" "	481 (A)	0.023	
" "	517 (A)	0.237	0.14
" "	518 (A)	0.029	
" "	520 (A)	0.229	0.090
" "	522 (A)	0.035	
" "	523 (A)	0.030	
" "	525 (A)	0.119	0.07
" "	527 (A)	0.190	0.08
" "	519 (B)	0.019	
KUSKOKWIM REGION			
McGrath district	50 (A)	0.031	
" "	134 (A)	0.085	0.26
" "	11 (B)	0.014	
" "	483 (B)	0.015	
YUKON REGION			
Iditarod district	87 (A)	0.060	
" "	61 (A)	0.092	0.073
Ruby district	130 (B)	0.017	
Ophir district	81 (A)	0.056	0.020
Hot Springs district	292 (A)	0.029	
Tolovana district	4 (A)	0.020	
Fortymile district	277 (A)	0.035	
" "	284 (A)	0.030	

*Samples too small for accurate determination
1/ Heavy fraction of sample
2/ Light weight fraction of sample
3/ Intermediate weight fraction of sample

Table 2

Radioactivity values in uranium equivalent, of Alaskan placer samples in group C. (less than 0.010% U equiv.)

Location	Sample No.	Percent U equivalent
SEWARD PENINSULA REGION		
York district	212	0.003
" "	221	0.0
" "	222	0.0
" "	266	<0.001
" "	270	0.0
" "	281	<0.001
" "	294	<0.001
" "	343	0.001
" "	387	0.003
" "	397	0.002
" "	488	0.002
" "	489	0.009
" "	490	0.002
" "	493	<0.001
" "	494	0.001
" "	499	0.0
" "	500[1]	0.004
" "	501	<0.001
" "	502	0.0
" "	503	0.004
" "	504	<0.001
" "	505	<0.001
" "	506	0.003
" "	576	0.004
" "	577	0.008
" "	579	0.005
" "	580	0.0
" "	581	0.0
" "	582	<0.001
" "	586	0.001
" "	589	0.008
" "	590	0.005
" "	593[2]	0.006
" "	594[1]	0.0*
" "	595	0.006
" "	597	0.003
" "	598[3]	0.004
" "	599[3]	0.007
" "	600	0.008
" "	603	0.003
" "	604	0.0
" "	605	0.008
" "	606	0.004
" "	607	0.003
" "	608	0.002

Table 2. cont.

Location	Sample No.	Percent U equivalent
York district	609	0.004
" "	616[4]	0.009
" "	619[1]	0.005*
" "	620[4]	0.0
" "	621	0.007
" "	622	0.005
" "	623	0.008
Shaktolik district	304a	0.001
Koyuk district	253	0.001
" "	265	<0.001
" "	285	0.002
" "	295	0.001
" "	297	0.001
" "	303	0.009
" "	307	0.0
" "	310	0.002
" "	444	<0.001
Fairhaven district	18	<0.001
" " "	117	0.001
" "	120	0.003
" "	208	0.003
" "	271	0.006
" "	299	0.001
" "	377	0.003
Kougarok district	122	0.001
" "	313	0.002
" "	400	<0.001
Buckland district	262	0.003
" "	276	0.0
" "	282	0.002
Council district	105	0.006
" "	278	<0.001
" "	287	<0.001
" "	385	0.003
" "	511	0.006
Kaspenberg district	123	<0.001
" "	288	0.003
Nome district	91	<0.001
" "	94	0.002
" "	112	<0.001
" "	114	0.0
" "	118	0.001
" "	119	<0.001
" "	121	0.001
" "	127	0.001
" "	193	<0.001
" "	201	0.001
" "	203	0.009

Table 2, cont.

Location	Sample No.	Percent U equivalent
Nome district	206	0.001
" "	213	0.001
" "	237	0.0
" "	238	0.001
" "	247	0.001
" "	263	0.0
" "	264	0.001
" "	279	0.002
" "	280	0.008
" "	311	0.0
" "	332	0.0
" "	344	0.0
" "	345	0.001
" "	384	0.0
" "	386	0.002
" "	388	0.0
" "	401	0.0*
" "	446	0.006*
" "	472	0.001
" "	649	0.0
COOK INLET REGION		
Yentna district	254	0.005
" "	258	0.0
" "	260	0.001
" "	475	0.001
" "	476	0.002
" "	478	0.005
" "	479	0.001
" "	521	0.001
" "	524	0.001
" "	526	0.003
YUKON REGION		
Iditarod district	70	0.0
Ruby district	19	0.0
" "	48	0.001
" "	62	0.002
" "	92	0.002
" "	111	0.0
" "	116	0.003
" "	138	0.001
Ophir district	52	0.001
" "	80	0.0
" "	90	0.002
" "	110	0.006
Hot Springs district	239	0.004
" " "	305	0.005
" " "	314	0.006
Tolovana district	2	0.0
" "	6	0.008
" "	40	0.002
" "	75	0.001

Table 2, cont.

Location	Sample No.	Percent U equivalent
Tolovana district	161	0.001
" "	183	0.002
" "	210	0.005
" "	217	0.002
" "	326	0.002
Fortymile district	166	0.0
Circle district	45	0.003
" "	285	0.002
Eagle district	432	0.0
" "	452	0.002
" "	507	<0.001
" "	508	<0.001
" "	513	0.0
" "	565	0.009
" "	632	0.002

* Samples too small for accurate determination
1/Light weight fraction
2/Light colored fraction
3/Heavy fraction
4/Intermediate weight fraction

APPENDIX I
(mineralogical data)

Preliminary mineralogical studies of concentrates from eight Alaskan placer samples have been made by Professor E. S. Larsen of Harvard University. The samples fall into two general groups, (1) those in which the radioactivity is due mainly to monazite and, (2) those in which the radioactivity is due mainly to a heavy, black, opaque mineral which occurs as black cubes. (Larsen has suggested it may be uraninite, or thorianite, or a solid mixture of the two).

Preliminary results of the study which is continuing are summarized for each sample:

371

Eighty percent of the activity is contained in the weakly magnetic part which is 5½ percent of the sample. Uraninite (?) makes up 92 percent of this portion, zircon about 5 percent, and sphene 1 percent.

375

Of the plus 200 mesh portion which is 88 percent of the sample, a weakly magnetic separate makes up 6 percent and contains most of the activity. Composition of the weakly magnetic separate is as follows:

uraninite (?)	10	percent
zircon	2	"
sphene	29	"
pyroxene	46	"
garnet	4	"
feldspar and quartz	9	"

The minus 200 mesh portion makes up 12 percent of the sample and is considerably less radioactive.

342

This sample may be a further concentrate of 375. All of the sample falls into the weakly magnetic class. It contains 90 percent uraninite (?)

and 8 percent magnetite.

289

A weakly magnetic fraction makes up 39 percent of the sample, has 60 percent of the activity, contains 98 percent monazite, 2 percent opaque minerals with traces of uraninite sphene, tourmaline, pyroxene, feldspar, and riebeckite. A less magnetic fraction makes up 2 percent of the sample, contains 85 percent monazite, 5 percent opaque minerals and 10 percent quartz and feldspar.

517

A sized fraction, plus 1 mm., makes up 8 percent of the sample and has very little activity.

A non-magnetic, minus 200 mesh fraction makes up 3.8 percent of the sample, has about 20 percent of the activity, contains 4 percent monazite, 90 percent zircon, 3 percent opaque minerals.

A weakly magnetic, minus 200 mesh fraction makes up 1.3 percent of the sample, has most of the activity, contains 46 percent monazite, 7 percent zircon, 26 percent opaque minerals, some cassiterite, sphene, tourmaline, pyroxene, apatite, quartz, feldspar, and sphene, traces of uraninite and spinel. A weakly magnetic, minus 115, plus 200 mesh fraction constitutes 1.3 percent of the sample, has a minor amount of activity and contains 22 percent monazite, 9 percent zircon, 26 percent opaque minerals, 34 percent pyroxene, some cassiterite, sphene, tourmaline, and traces of uraninite and spinel. A weakly magnetic, minus 48, plus 115 mesh fraction makes up only 0.7 percent of the sample, has a small part of the activity, contains 6 percent monazite.

520

Most of the radioactivity is in a weakly magnetic fraction which constitutes 4½ percent of the sample. This fraction contains 53 percent monazite, 3 percent zircon, 12 percent opaque minerals, 30 percent cassiterite.

525

A weakly magnetic, plus 48 mesh fraction is 1.2 percent of the sample, has 50 percent of the activity, contains monazite and uraninite (no percentage given), some garnet, some platinum (or amalgam?), and some opaque minerals.

A weakly magnetic, minus 48 mesh fraction is 0.9 percent of the sample, has 50 percent of the activity and contains 28 percent monazite, 23 percent uraninite (?), 18 percent opaque minerals, 3 percent zircon, 4 percent cassiterite, some apatite, quartz, feldspar, hornblende and fine aggregates.

A slightly less magnetic, minus 48 mesh fraction makes up 1.8 percent of the sample. It has about ½ of the activity, contains 1 percent monazite, 24 percent zircon, 20 percent opaque minerals, 1 percent uraninite, 50 percent cassiterite, 1 percent clear octahedrons (?), some apatitie, quartz, feldspar, hornblende.

527

The strongly magnetic parts are practically inactive.

A non-magnetic fraction makes up 15.6 percent of the sample, has 14 percent of the radioactivity and contains a trace of monazite, 95 percent zircon, 1 percent opaque minerals, some cassiterite, quartz, feldspar and fine aggregates.

A weakly magnetic fraction makes up 0.6 percent of the sample, has 24

percent of the activity and contains 10 percent monazite, 45 percent zircon, 5 percent opaque minerals, 5 percent apatite, 25 percent fine aggregates.

A slightly more magnetic fraction makes up 3.7 percent of the sample, has 60 percent of the active material, contains 90 percent monazite, 2 percent zircon, 1 percent opaque minerals.

Conclusions

Monazite and uraninite (?) are the principal radioactive constituents in the samples although results indicate that zircon may also contribute to the radioactivity.

The weakly magnetic fractions of the samples are the most radioactive, the non-magnetic fractions are low in activity, the strongly magnetic fractions are lowest. Both monazite and uraninite (?) concentrate in the weakly magnetic portions.

No relation between size of particles and radioactivity can be established from the work done this far.