Reconnaissance for Radioactive Deposits in the Fairbanks and Livengood Quadrangles, East-Central Alaska, 1949

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

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

ABSTRACT

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

in the area during Quaternary time might well have introduced gravels from nearby areas.

INTRODUCTION

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

1) to examine several lode deposits in the Fairbanks district not previously tested for radioactivity.

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

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

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

MINES, PROSPECTS, AND AREAS EXAMINED FOR RADIOACTIVITY

Fairbanks district

Melba Creek bismuth prospect

A placer concentrate from Fish Creek, a short distance below the mouth of Pearl Creek (fig. 1), obtained prior to the initiation of the search for radioactive ores in

Alaska in 1945 contains 0.01 to 0.1 percent equivalent uranium (Wedow and Matzko, 1947, p. 12). The concentrate consists of a few small nuggets, mostly of native bismuth with traces of flake and wire gold. Native bismuth is also reported (Hill, 1933, p. 71) in concentrates from placers on Pearl Creek, a tributary of Fish Creek, and on the upper part of Gilmore Creek, west of Fish Creek.

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

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

Tolovana mine

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

Cleary Hill mine

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

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

Elliott Highway

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

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

2) The sedimentary rocks of pre-Middle Ordovician age consist of red and green slaty shale, black argillite, chert, quartzite, phyllite, quartzose, sandstone, and limestone. The rocks are metamorphosed, but not to the same extent as the older Birch Creek

schist. At a few localities a slaty cleavage has developed in the shale and the argillite.

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

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

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

Radioactivity

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

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

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

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

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

_/ In scale divisions of 2.0 range

Goodluck Creek

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

1945 (Harder and Reed, 1945, p. 23 and table 1). Reanalysis of this sample in 1946 indicated an equivalent uranium content ranging from 0.031 to 0.048 percent but field studies in 1946 failed to duplicate the concentrate (Wedow and Matzko, 1947, p. 22).

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

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

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

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

CONCLUSIONS

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

Further radioactivity traversing in the watershed of Goodluck Creek in search of the bedrock source of a euxenite-polycrase mineral found in a placer on that creek is also unwarranted because of the widespread cover of vegetal material, muck, and alluvium and the resultant paucity of outcrops. It is also likely that the bedrock source of this mineral may lie outside of the Goodluck watershed, as possible drainage changes in Quaternary time, prior to the establishment of the present drainage system, as suggested by Mertie (1918, p. 260-262), may have brought gravels into the watershed from such nearby areas as the Amy Creek drainage to the west. It is possible, therefore, that the source of the euxenite-polycrase mineral may have been in a now-eroded pegmatitic facies of a small albite granite intrusive on Amy Creek (Mertie, 1918, p. 248, pl. 13).

Thus, the problem of the origin of this highly radioactive mineral is similar to that of the uraniferous ellsworthite and other radioactive minerals found in the placers of the Tofty tin belt of the Manley Hot Springs-Rampart district to the west (Moxham, 1952, p. 9-15).

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