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

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AEC-546/2

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

Dear Phil:

Transmitted herewith for your information and distribution are 6 copies of Trace Elements Investigations Report 191, "Radioactive pegmatite minerals in the Willow Creek mining district, south-central Alaska", by Robert M. Moxham and Arthur E. Nelson, January 1952.

The Survey plans no further work in the Willow Creek mining district in the near future.

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

Sincerely yours,

O.E. McKelvey

for W. H. Bradley
Chief Geologist

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Geology - Mineralogy

This document consists of 11 pages, plus 1 figure.
Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

RADIOACTIVE PEGMATITE MINERALS IN THE WILLOW CREEK MINING DISTRICT, SOUTH-CENTRAL ALASKA_/

By

Robert M. Moxham and Arthur E. Nelson

January 1952

Trace Elements Investigations Report 191

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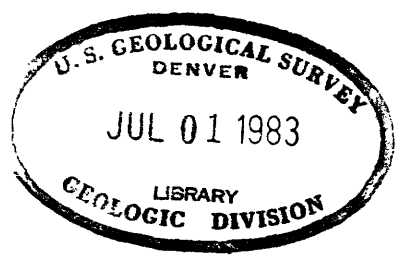

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W. S. Twenhofel, Juneau	1
R. M. Chapman, Fairbanks	1
TEPCO, Washington (Including master)	5
	55

CONTENTS

TABLE

ILLUSTRATIONS

RADIOACTIVE PEGMATITE MINERALS IN THE WILLOW CREEK MINING DISTRICT, SOUTH-CENTRAL ALASKA

By

Robert M. Moxham and Arthur E. Nelson

ABSTRACT

During the summer of 1948 radioactive pegmatite float was found in the Willow Creek mining district. Laboratory examination showed a small amount of uraninite and thorite to be primarily responsible for the radioactivity. A brief field examination was made by the Geological Survey in 1949. Representative channel samples of 11 pegmatites average 0.004 percent equivalent uranium; the heavy-mineral fractions of the samples average 0.332 percent equivalent uranium. None of the pegmatites are of minable dimensions. Dikes and veins in the area, although genetically related to the pegmatites, do not contain radioactive minerals.

INTRODUCTION

The Willow Creek mining district is located in the southern part of the Talkeetna Mountains about 50 miles north of Anchorage and includes the headwater area of Willow Creek and Little Susitna River (fig. 1). During the summer months the district is accessible by road from the Anchorage area and from the Alaska Railroad. There are three small airplane landing strips in the district which are used chiefly during the winter months.

Prior to World War II, gold production from lode mines in the Willow Creek district ranked second in Alaska (Smith, 1942). In 1947, the district was included in a reconnaissance by the U. S. Geological Survey of the Southern Highway Belt (Moxham, 1950), and all of the mines that were in

operation at that time were examined underground and dump material was checked at many inactive mines. No radioactive material in significant quantities was found.

During the summer of 1948 Richard G. Ray of the Geological Survey found radioactive pegmatite float at two localities in the valley of Fishhook Creek, near the center of the Willow Creek district (figs. 1 and 2). Laboratory tests indicated that the radioactivity was due chiefly to uraninite and thorite. In view of the relatively easy access of the area and the presence of active mining and milling facilities close at hand, it seemed desirable to investigate briefly the pegmatites and other related intrusive bodies. During September 1949, approximately one week was spent in the Fishhook Creek-Archangel Creek area of the Willow Creek district. The field party consisted of R. M. Moxham and A. E. Nelson, geologists, J. C. Whitaker, field assistant, and Henry Bender, camp assistant.

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

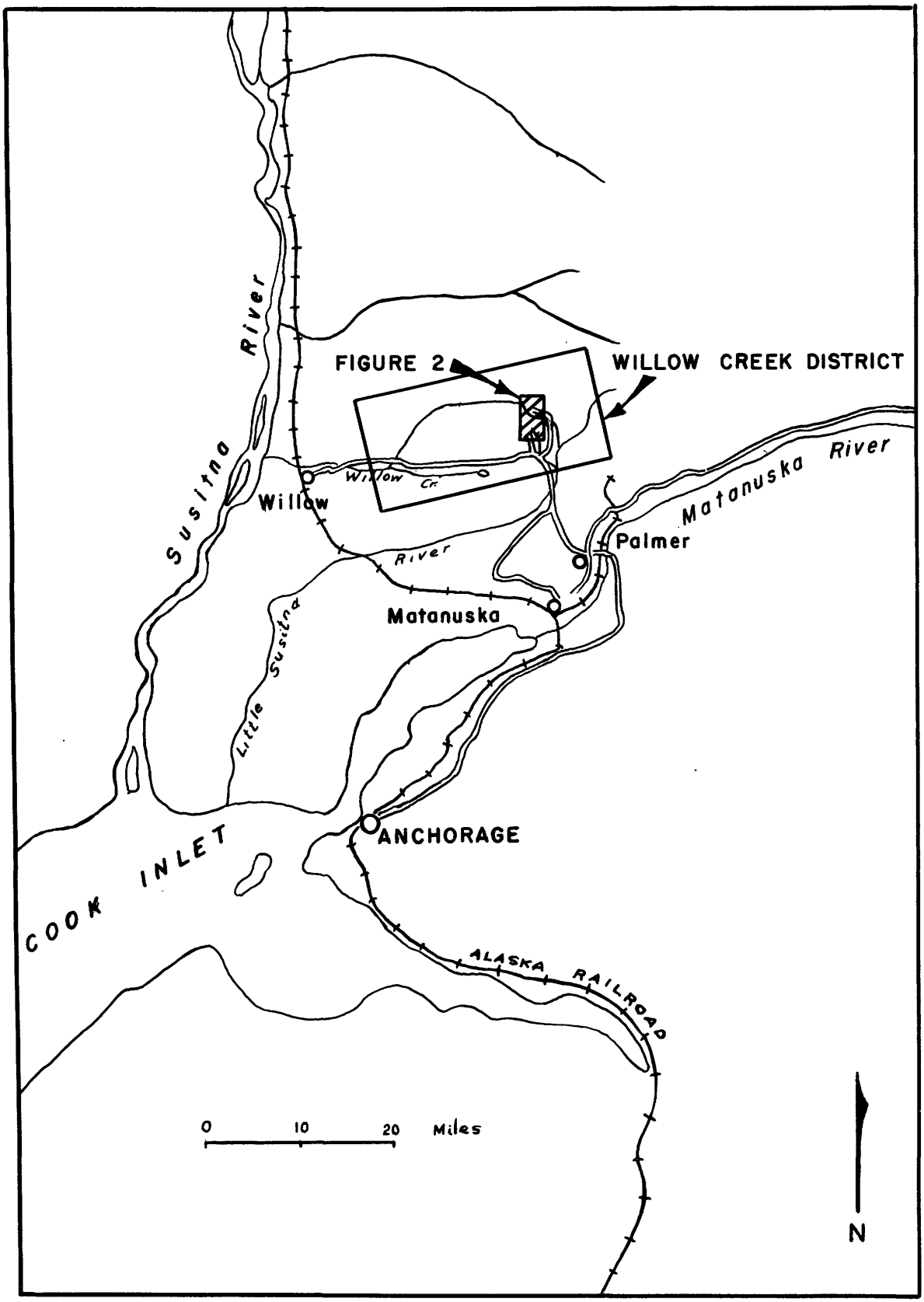
GEOLOGY

The geology of the Willow Creek district has been described in detail by Capps (1915) and Ray (1933).

The pre-Cambrian Birch Creek schist, the oldest formation in the district, comprises highly contorted fissile mica schists and phyllites. The Birch Creek formation was intruded in Mesozoic time by the batholith which forms the core of the Talkeetna Mountains. Quartz diorite is the most abundant constituent, but phases ranging from quartz monzonite to gabbro are found. Along the southern boundary of the intrusive a gneissic phase has been developed.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

TRACE ELEMENTS INVESTIGATIONS
REPORT 191
FIGURE 1



MAP OF THE ANCHORAGE AREA
SOUTH-CENTRAL ALASKA

The igneous mass is cut by pegmatites in many localities. The pegmatites examined in 1949 are tabular bodies, typically irregular and discontinuous, and range from less than an inch to about 2 feet in width. None were exposed for more than 150 feet along their strike. The rock-forming minerals exhibit only moderate crystal growth; orthoclase prisms as much as 8 centimeters in length were seen. Although no evidence of zoning was noted in any of the pegmatites examined, R. G. Ray (in preparation) reports pegmatites containing a medial aplite zone.

Both lamprophyre and diabase dikes are common throughout the region and aplite dikes occur somewhat less frequently.

Quartz veins, some of which carry gold in commercial quantities, have been injected along joint planes and shear zones in both the intrusive rocks and the Birch Creek formation.

The various pegmatites, dikes, and veins that have been injected into the schist and quartz monzonite probably represent end phases in the consolidation of the Talkeetna batholith.

MEASUREMENTS OF RADIOACTIVITY

A modified Beckman portable survey meter with a probe consisting of four 18- x 1-inch brass-walled gamma tubes connected in parallel was used in all radiometric surveys. A 6-inch glass-walled beta tube was utilized for individual examinations. In the laboratory the equivalent uranium determinations were made by beta count. Quantitative analyses for uranium were made in the Geological Survey's Trace Elements Section Washington Laboratory.

RADIOACTIVITY STUDIES

More than twenty pegmatites were found in the Fishhook Creek-Archangel Creek area during the field work in 1949. None, however, were sufficiently radioactive to be detected solely by means of the counter. The radiation

emitted by the slightly radioactive accessory minerals disseminated throughout the quartz monzonite masked any possible anomalous radiation from the pegmatite minerals.

The minerals responsible for the radioactivity of the pegmatites are found in greatest concentration in association with biotite plates up to an inch in diameter . The development of biotite with the associated concentration of radioactive minerals is relatively uncommon. The somewhat lower but relatively constant radiation level along the strike and across the apparently barren parts of the veins indicates, however, that the radioactive minerals are sparsely disseminated throughout most of the pegmatite material. Channel samples were taken across eleven pegmatites that are thought to be representative of those found in the Fishhook Creek-Archangel Creek area. The results of the analytical work are given in table 1.

Mineralogic study by personnel of the Trace Elements Section Washington Laboratory indicates that the radioactivity of the pegmatites is attributed to the presence of one or more of the following minerals:

Uraninite	UO_2
Thorite	$ThSiO_4$
Cyrtolite	$ZrSiO_4$
Allanite	$4(Ca, Fe)0.3\ (Al, Ce, Fe, Di)_2O_3.6SiO_2.H_2O$

Uraninite occurs in small distinct cubes in all samples except 66, 67, 68 and 69, but none contain a significant quantity.

Those samples containing uraninite also contain small amounts of thorite, which occurs in anhedral grains. The mineral is amber to orange, apparently a result of alteration. The varietal name orangeite may be applicable. Sodium fluoride flux tests for uranium were strongly positive and yttrium is shown as a minor constituent by spectrographic analyses.

Table 1.--Analyses of pegmatites from the Fishhook Creek-Archangel Creek area, Willow Creek mining district, south-central Alaska.

Sample No.		Unconcentrated (percent eU)	Heavy fraction (percent eU)	Heavy fraction (percent U)	Concentration ratio	Location (See fig. 2)
49AMx36	3801	0.005	0.535	n.d.	1664:1	Fishhook Creek
44	3809	0.004	0.368	n.d.	279:1	do
46	3811	0.007	2.93	n.d.	901:1	do
48	3813	0.003	0.070	0.041	438:1	do
55	3820	0.007	0.146	n.d.	222:1	do
56	3821	0.005	0.202	n.d.	279:1	do
57	3822	0.005	0.178	0.056	227:1	do
58	3823	0.005	0.142	0.042	430:1	do
66	3831	0.004	0.024	n.d.	236:1	Archangel Creek
67	3832	0.002	0.022	n.d.	161:1	do
68	3833	0.003	0.016	n.d.	207:1	do
69	3834	0.004	0.027	n.d.	299:1	do
70	3835	0.003	0.142	0.017	599:1	do
71	3836	0.004	0.120	0.019	478:1	do
72	3837	0.003	0.065	0.031	369:1	do

eU: equivalent uranium
n.d.: not determined

Allanite was found in nearly all samples. Its radioactivity, which is quite low, probably is due to thorium.

Cyrtolite was found in all samples examined. It occurs in translucent euhedral grains containing numerous opaque inclusions. Weak fluorescence in sodium fluoride flux indicates that a small amount of uranium is present.

Although uraninite and thorite are relatively minor constituents of the heavy-mineral fractions of the pegmatites, their high content of radioactive elements is probably the controlling factor in the radioactivity of the various samples.

Field examinations were made on outcrops of lamprophyre, diabase, and aplite dikes, and several quartz veins, but no radioactivity anomalies were noted. The results of investigations of lode mines in the Willow Creek area have been reported previously (Moxham, 1950).

CONCLUSIONS

The radioactive pegmatite minerals of the Willow Creek area do not occur in sufficient quantity to be considered as a commercial source of uranium. Dike and vein materials in the region, although genetically related to the pegmatites, are nonradioactive.

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