ANOMALOUS URANIUM CONCENTRATIONS IN ARTESIAN SPRINGS AND STREAM SEDIMENTS IN THE MOUNT PRINDLE AREA, ALASKA

by James C. Barker and
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U.S. DEPARTMENT OF THE INTERIOR

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BUREAU OF MINES

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and

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ABSTRACT

A half-mile long series of radioactive artesian springs were found by Bureau of Mines personnel during a mineral resource study of the proposed Beaver Creek National Wild River in the Tanana Uplands. The springs are near the headwaters of Little Champion Creek along the contact of the Mount Prindle granite pluton and the Birch Creek schist. Geochemical analyses of stream sediments in this drainage and that of Champion Creek show anomalously high amounts of uranium. Up to 400 parts per million (ppm) were detected in stream sediments and analyses of spring sediments ranged from 47 to 570 ppm. No visible uranium minerals were identified but the sample results indicate that the area has a potential for uranium enrichment.

INTRODUCTION

In May 1977, the Bureau of Mines made a preliminary mineral reconnaissance of the Beaver Creek-White Mountains area of central Alaska

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1/ Mining engineer, Alaska Field Operation Center, Fairbanks, Alaska.

2/ Formerly geologist, Alaska Field Operation Center.

in conjunction with personnel of the U.S. Geological Survey and the U.S. Bureau of Land Management. The area studied is included in or affected by various proposals under section 17(d)(2) of the Alaska Native Claims Settlement Act and other related legislative and administrative action. It is also part of the Bureau of Land Management White Mountain Planning Unit. A geologic map of the Circle quadrangle which includes this area is being compiled by the U.S. Geological Survey.

The Mount Prindle vicinity (fig. 1) discussed in this paper has been geologically described by Prindle (1910, 1913) (4,5); Mertie (1937); and Holm (1973) (1)3/. Nelson, West and Matzko (1952) (3) report on radioactive mineral investigations in the nearby Nome and Hope Creek areas.

The data in this paper was compiled from the results of a preliminary reconnaissance. Field and analytical work is continuing. A more detailed report will be compiled at a later date.

ACKNOWLEDGMENTS

The sample and geologic maps in this report were adapted from the U.S. Geological Survey Circle B-6 quadrangle map.

The Bureau of Mines was assisted in the preparation of this report by F. Weber, of the U.S. Geological Survey, who provided geologic advice and field assistance; and by C. Murray, of the U.S.

3/ Underlined numbers in parentheses refer to items in the references listed at the end of this report.

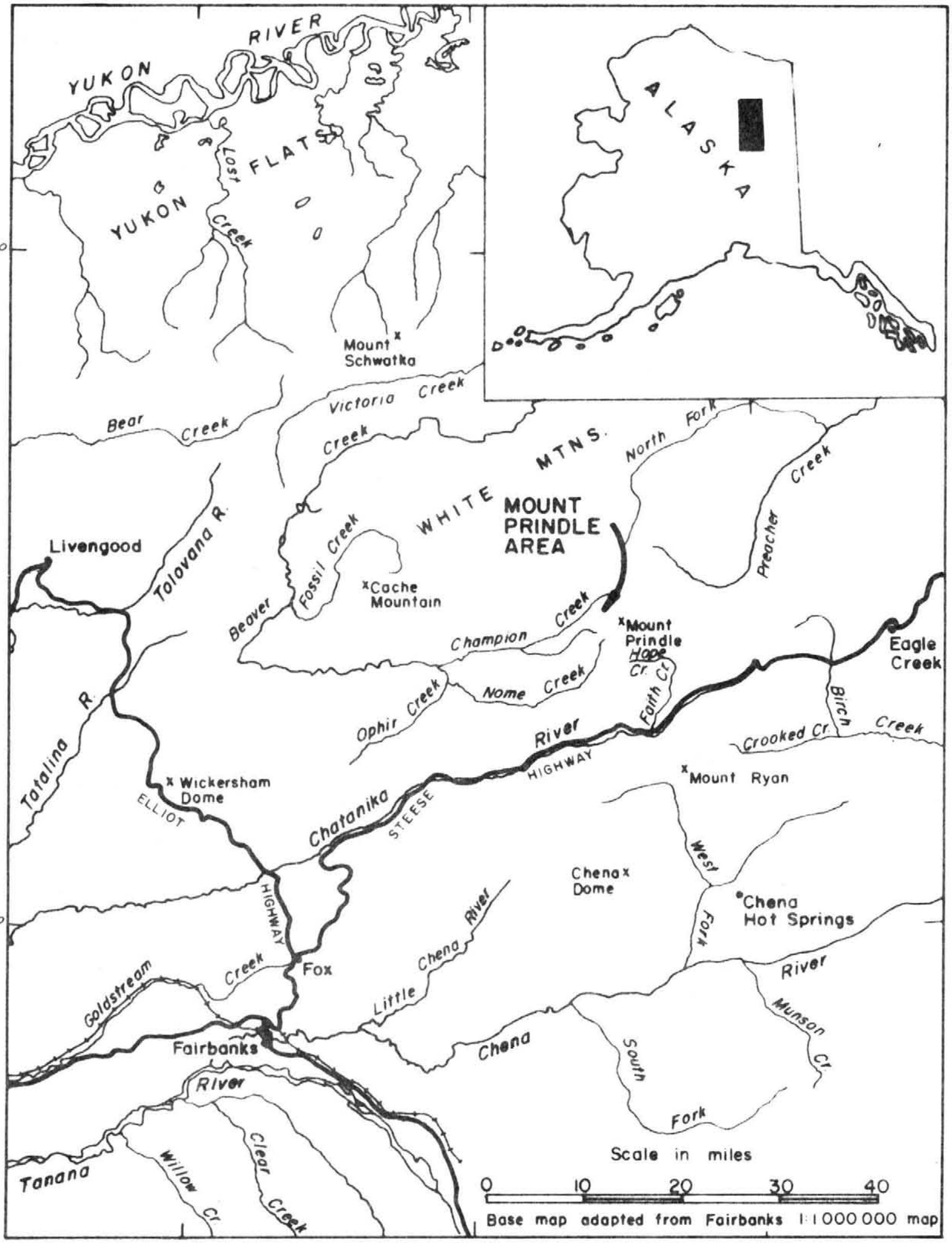


FIGURE 1.- Location map

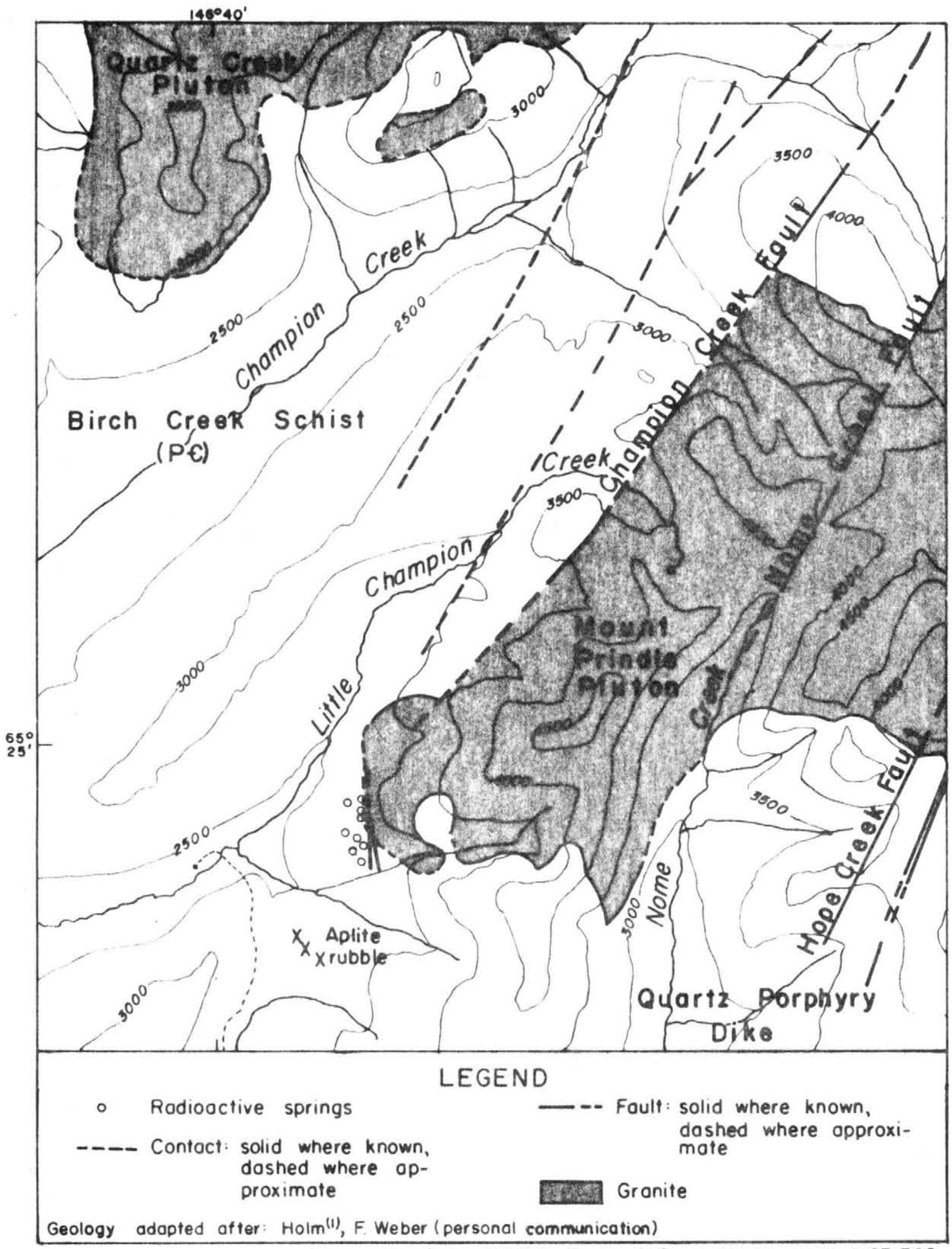
Bureau of Land Management, who aided in the field work and provided the helicopter support. The samples were prepared by the University of Alaska, Mineral Industry Research Laboratory, under a Bureau of Mines grant. Most of the analyses were performed by the Alaska Division of Geological and Geophysical Surveys. The authors wish to thank G. Eakins, who performed this service and provided technical advice.

LOCATION AND ACCESSIBILITY

The report area is in the Circle B-6 quadrangle approximately 50 miles north-northeast of Fairbanks (latitude 65°28'N, longitude 146°35'W; 2500-3000 feet elevation). The area is immediately west of Mount Prindle at the headwaters of Champion and Little Champion Creeks which, in turn, are headwater tributaries of Beaver Creek. Overland access to within five miles of the area is possible during the summer season by four-wheel drive vehicles via five miles of dirt road leaving the Steese Highway at U.S. Creek, milepost 58.

HISTORY AND OWNERSHIP

Nome Creek--another headwater tributary of Beaver Creek--three miles south of the report area, was dredged for placer gold prior to World War II and is currently being mined. Champion and Little Champion Creeks were staked for placer gold in 1976. The report area is on federally-owned land classified under section 17(d)(1) of the Alaska Native Land Claims Settlement Act. It is currently under the management authority of the Bureau of Land Management but is included in an area proposed for withdrawal under H.R. 39.



Topography from U.S.G.S. Circle B-6 quadrangle, scale 1:63,360

FIGURE 2. - Geology

GEOLOGY

The headwaters of Champion and Little Champion lie within the Birch Creek Schist (mapped as Precambrian or early Paleozoic) and are flanked on the southeast by the Mount Prindle Pluton and on the northwest by an unnamed intrusive that will be referred to as the Quartz Creek Pluton (fig. 2).

The Mount Prindle and Quartz Creek intrusives are two of a series of northeast trending acidic plutons of Mesozoic to Cenozoic age in the northcentral portion of the Yukon-Tanana Uplands. The Mount Prindle intrusive is described as a porphyritic, fine to coarse grained, biotite granite with a multi-phase intrusive history yielding K-Ar dates from 56.5±1.7 m.y. to 58.5±1.8 m.y. (6). These dates are similar to dates published for the Cache Mountain (about 25 miles west) and Chena Hot Springs (about 30 miles southeast) quartz monzonites. The pluton is cut by numerous aplite and pegmatite dikes with the latter containing tourmaline crystals up to 15 mm in diameter. A fluorite vein 15 cm wide occurs along the contact of the granite and metamorphic rocks near the headwaters of Hope Creek on the eastern side of the pluton. Several quartz porphyry dikes have been traced through the pluton and into the surrounding Birch Creek Schist (1).

Tin values in the Mount Prindle granite are reported to be higher than those of the tin-bearing granites on the western Seward Peninsula. High boron values throughout the pluton are due to the presence of tourmaline. Values up to 1500 ppm boron have been detected in a biotite granite at the headwaters of Nome Creek (1).

The Quartz Creek Pluton, composed of biotite granite of unknown age and history, lies directly northwest of the Mount Prindle intrusive and is separated from it by two to three miles of metamorphic rocks. Little work has been done in this area but Holm (1) has suggested a similar multi-phase history for this intrusive based on textural differences seen in float at the headwaters of Champion Creek.

During the reconnaissance in May 1977, float rocks of porphyritic felsite and mafic dike material were observed along the contacts of the Quartz Creek granite.

Birch Creek Schist of the Mount Prindle area is composed predominantly of quartzite and micaceous quartzite with lesser amounts of quartz mica schist, phyllitic schist and calcareous schist. Phyllitic schist is reported to occur extensively only in the headwaters of Champion Creek west of the Champion Creek Fault.

Several north-northeast trending faults cut the report area. They appear to be wrench faults formed by subsidiary movement adjacent to the Tintina Fault zone, which is about 20 miles to the north.

WORK PERFORMED BY THE BUREAU OF MINES

Nature and Extent

The Mount Prindle area was investigated in May 1977 as part of a five-day helicopter supported regional reconnaissance of the White Mountains area. This was part of the investigation of the proposed Birch Creek and Beaver Creek National Rivers. One day of traverses were made which roughly followed the contacts of the granitic rocks and metamorphic units on either side of the Champion Creek valley. Additional followup work was conducted on July 25, 1977.

Anomalous radiation was found at the headwaters of Little Champion Creek (NW 1/4, Section 25, Township 7 North, Range 5 East) emanating from artesian seeps along a break in a slope on a wooded and tundra-covered hillside (fig. 3). Surface readings from 600 counts per second (cps) to 3000 cps, measured with a hand-held scintillometer, were observed over the springs. 4/ Background over tundra in the area varied between 175-250 cps. The zone of high counts occurs over a distance of approximately one-half mile where artesian water seeps occur along a north-south lineation and escarpment. The relatively low but well defined escarpment possibly results from recent faulting.

This area is close to, if not actually, the contact between the Mount Prindle Pluton and the Birch Creek Schist. Vuggy, pyritic quartzite and schist mixed with granitic rock were observed in frost boil float. Aplite dike rock was found in a rubble-covered slope immediately southwest of the area of seeps. No igneous or metamorphic rocks, however, registered higher on the scintillometer than background radiation.

The high scintillometer readings which were encountered only over the springs or wet ground are thought to be due to radon gas. Spring sediment samples collected the day of the investigation registered progressively lower scintillometer readings over the following several days. The dissipation of radiation indicates the escape of

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4/ Mt. Sopris, model SC-132, Delta, Colorado.

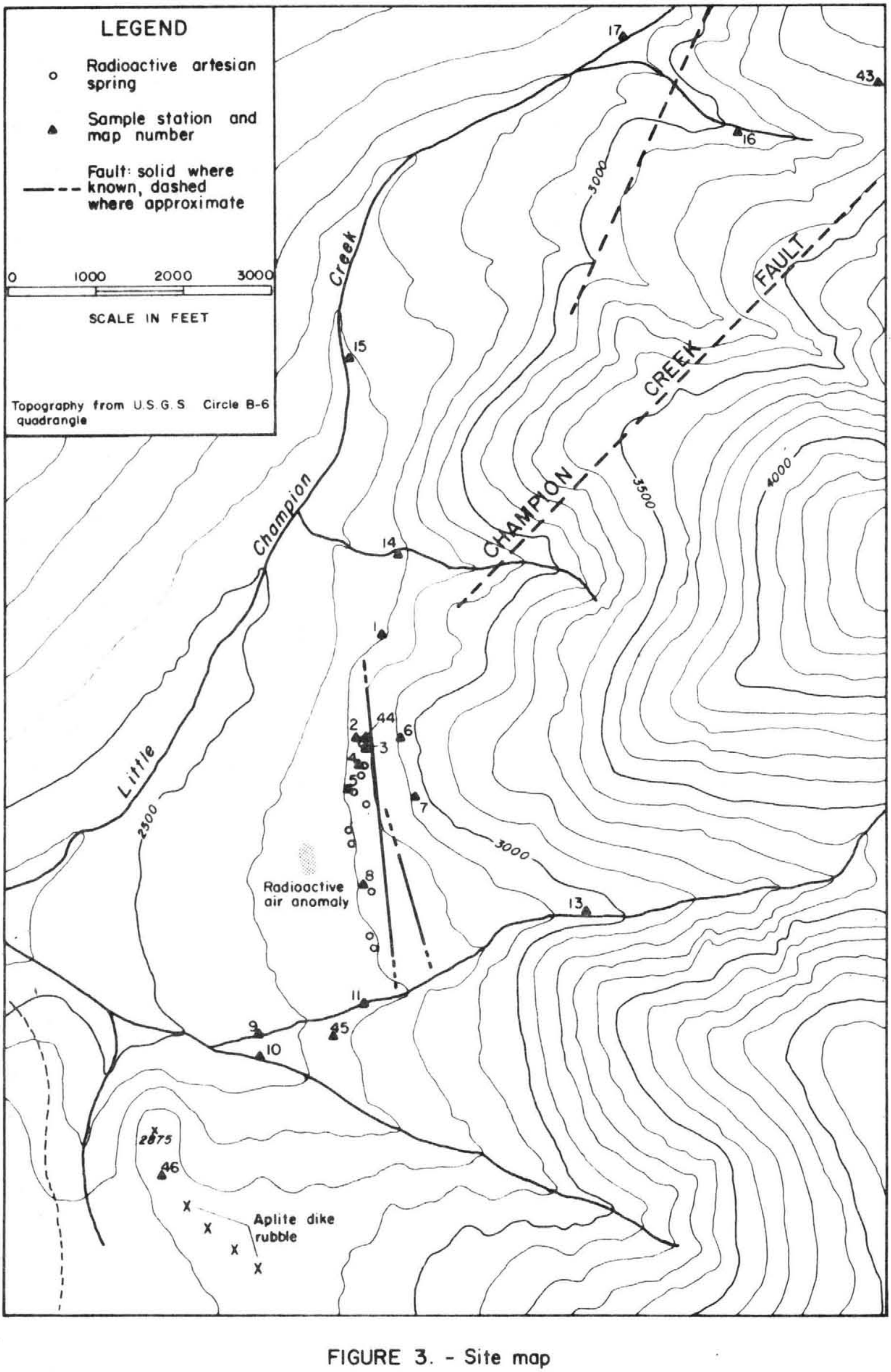

FIGURE 3. - Site map

222 Rn. The aureole of high radiation about the springs appears to be proportional to the flow rate. Springs had a higher count and greater flow rate when measured in May, than when measured in July.

A sharply defined anomaly of five-hundred counts per second was registered with the same instrument from an altitude of 75 to 100 feet over a swampy area downslope and several hundred yards west of the springs, probably due to additional artesian seeps.

Sampling and Analyses

Results of sediment sampling (fig. 4) in the Mount Prindle area are listed in table 1. Samples were selectively taken where possible from the finer portion of sediments within the active channel. Fine material was scarce in some creeks due to frozen stream bottoms and the coarse nature of sediments in streams draining the granitic terrain. In several cases insufficient, fine material was collected to obtain a maximum value. These samples are indicated with an asterisk (*) in table 1. On some streams it was possible to obtain frozen blocks of moss and sediment along the stream bank which contained sufficient sediment for analysis. Many smaller creeks could not be sampled due to snow and ice conditions.

Six samples, as indicated in table 1, were analyzed by a commerical firm. 5/ The remainder were analyzed by the Alaska Division of Geological and Geophysical Surveys' laboratory. The State lab used a nitric acid/hydrofluoric acid extraction of the -80 mesh

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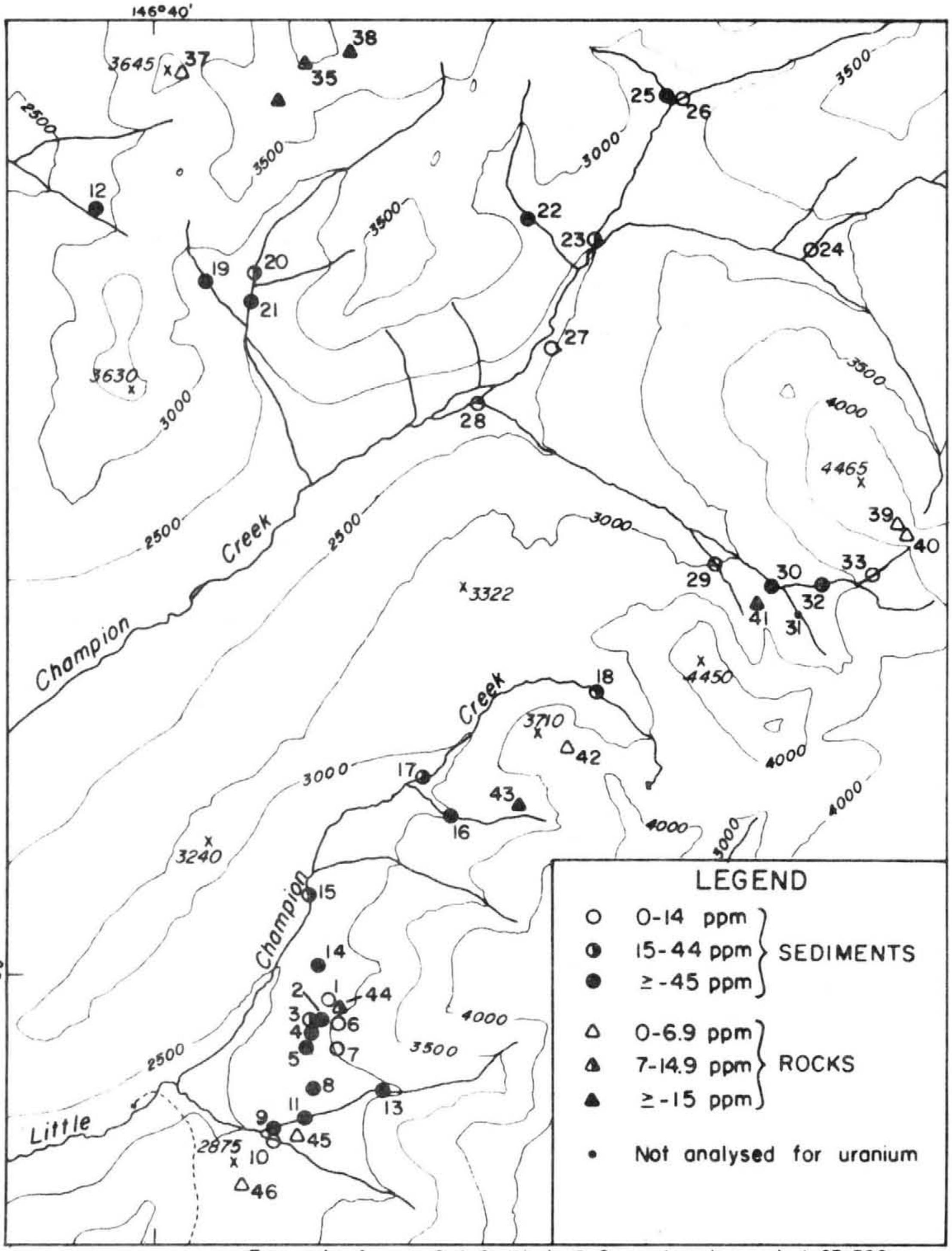
5/ Bondar-Clegg and Company, Ltd., Vancouver, B.C., Canada.



Topography from U. S. G. S. Circle B-6 quadrangle, scale 1: 63,360

FIGURE 4. - Anomaly map (uranium)

TABLE 1.- Uranium and thorium analyses of sediment and soil samples

Map No.	Sample No.	U(ppm)	Th(ppm)	cps 2/	Remarks
1 1/	1273	8	12	225	Soil sample, 1000 feet north of northernmost spring, including fragments of schist, quartzite, granite.
2	1263	390	16.5	1400	Spring sediment. Mostly silt with granite fragments.
3 1/	1264	18	19	2500	Soil sample 10 feet above spring, organic rich with fragments of granite.
4 1/	1272	47	17	3000	Spring sediment. Counter registered only 250 cps on tundra nearby.
5	1270	390	18.5	1250	Spring sediment. Mostly organic with some sand. Taken from about ten inches deep on top of fragmented granite.
6 1/	1268	6	14	200	Soil sample taken at six inch depth, 300 feet upslope from the contact, within granite pluton.
7 1/	1269	4	16	150	Soil sample taken at twelve-inch depth 400 feet above contact, within granite.

1/ Analyzed by Bondar-Clegg and Company, Ltd., Vancouver, B.C., Canada.

2/ Counts per second recorded at the sample station.

TABLE 1.- Uranium and thorium analyses of sediment and soil samples, continued

Map No.	Sample No.	U(ppm)	Th(ppm)	cps 2/	Remarks
8 1/	1276	570	9	850	Spring sediment, in muskeg area, organic-rich silts.
9	1281	220	17.3	150	Granite and quartzite aggregate in creek.
10	1283	4.5	16.3	95	Aggregate at sample station includes one piece of alaskite float, the rest is schist and quartzite containing disseminated pyrite.
11	1279	400	16.3	250	Stream aggregate is granite, quartzite and schist.
12	1301	130	34.3	-	Granite aggregate.
13	1277	310	19	250	Near contact of granite with quartzite.
14	1261	54	19.3	275	Both fine and coarse grained granite aggregate.
15	1259	22	19.5	-	Aggregate includes granite, quartzite and schist.
16	1256	137	18.8	-	Aggregate is predominantly granite with some phyllite.

1/ Analyzed by Bondar-Clegg and Company, Ltd., Vancouver, B.C., Canada.

2/ Counts per second recorded at the sample station.

TABLE 1.- Uranium and thorium analyses of sediment and soil samples, continued

Map No.	Sample No.	U(ppm)	Th(ppm)	cps 1/	Remarks
17	1257	34	18	250	Aggregate includes granite, phyllite, quartzite and schist.
18	1253	19	24	200	Aggregate is predominently granite with some phyllite.
19	1149	181	40	200	All granite aggregate.
20	1148	14*	88*	275	Coarse granite aggregate.
21	1146	61*	-	275	Aggregate is predominently granite with some schist from possible roof pendent to the east.
22	1144	61*	38.5	200	Granite aggregate.
23	1020	30	22.3	-	Aggregate is schist and granite.
24	1017	3.2	14	-	Aggregate is schist and granite.
25	1142	61*	-	200	Very coarse aggregate of granite and schist.
26	1140	14*	25	140	Aggregate is predominantly metamorphics.

*Insufficient sample for total analysis. Actual uranium is greater than or equal to the standard indicated by the value.

1/ Counts per second recorded at the sample station.

TABLE 1.- Uranium and thorium analyses of sediment and soil samples, continued

Map No.	Sample No.	U(ppm)	Th(ppm)	cps 1/	Remarks
27	1024	4.6	12.3	-	Aggregate is granite and metamorphics.
28	1028	6	-	-	Aggregate is granite and metamorphics.
29	1251	-	18.5	200	Sandy moss chipped from frozen stream bank.
30	1199	65	46.5	300	Predominantly granite aggregate.
31	1198	-	30.3	250	Sandy moss chipped from frozen stream bank.
32	1197	44	35	250	Coarse aggregate of granite with some quartzite and phyllite.
33	1196	-	13.5	250	Aggregate is granite with some quartzite.

1/ Counts per second recorded at the sample station.

fraction to determine uranium values by fluorimetry and thorium by colorimetry.

Results of rock sample analyses are listed in table 2. Rock samples were crushed and then analyzed by the State using the same procedure as described above.

SUMMARY OF FINDINGS

Preliminary analyses of samples from this portion of the White Mountains/Beaver Creek area show anomalously high values for uranium in spring and stream sediments. Uranium values from four spring sediment samples range from 47 to 570 ppm. Stream sediment analyses from approximately a 20 square mile area show high uranium values. The anomalies are found in streams draining both the Mount Prindle and the Quartz Creek plutons. Thorium values are found to be consistently low compared to the uranium. The regional extent of the high uranium values is unknown at this time. The results cannot be interpreted to delineate a definable trend but do suggest association of high radioactivity with granite-metamorphic contacts and faulting. However, the presence of aplite and pegmatite dikes also suggest the possibility of uranium-enriched late stage intrusions. The results of the overall project will be reported at a later date.

TABLE 2.- Uranium and thorium analyses of rock samples

Map No.	Sample No.	U(ppm)	Th(ppm)	cps 1/	Remarks
35	1082A	12	27	-	Volcanic, very light gray, weathered tan, quartz phenocrysts and feldspar up to one-half inch diameter.
36	1082B	22	3	-	Iron-stained quartzose country rock.
37	1084	2.7	18.3	-	Banded, baked iron-stained quartzose country rock.
38	1081	24	29	-	Light gray, volcanic dike rock, dark quartz, feldspar, biotite plates in an aphanitic groundmass.
39	1195	5.5	22.8	175	Phyllite with agate and quartz filling.
40	1194	5.6	6.3	200	Brecciated quartzite with minor sulfides in gossan, agate fillings, heavy stain in soil.
41	1200	20	17.3	225	Granite with feldspar phenocrysts up to seven centimeters.
42	1254	6.2	6.5	200	Fine-grained biotite granite, quartz phenocrysts to one centimeter.

1/ Counts per second recorded at the sample station.

TABLE 2.- Uranium and thorium analyses of rock samples, continued

Map No.	Sample No.	U(ppm)	Th(ppm)	cps 1/	Remarks
43	1255	17	14.5	200	Coarse-grained biotite granite.
44	1263	7.4	23.5	1900	Coarse-grained biotite granite found in artesian spring.
45	1280	1	5.5	200	Brecciated and iron-stained schist and quartzite. Appears to be thermally altered.
46	1285	4	7	-	Aplite dike rock occurring in ridge top rubble.

1/ Counts per second recorded at the sample station.

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