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DEPARTMENT OF THE INTERIOR
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This report is preliminary and has not been edited or reviewed for conformity with Geological Survey standards.

Introduction

A large part of western Alaska has been included in a uranium-thorium metallogenic province (Clark and others, 1974; Miller and Bunker, 1976; Miller, 1976) chiefly because of the occurrence of uraniferous plutonic rocks with local concentrations of uranium minerals. Recently, however, anomalous amounts of uranium and thorium have been found by the Geological Survey in volcanic and volcaniclastic rocks near the headwaters of the West Fork of the Buckland River in the central Candle quadrangle (fig. 1). This occurrence is apparently in a different geologic environment than previously noted uranium occurrences in western Alaska. An increase in radioactivity was noted in this general area and three airborne gamma-ray survey traverses, done as part of an ERDA-sponsored reconnaissance survey of western Alaska, cross the area (figs. 1, 2) and confirm the existence of a radioactivity anomaly (U.S. Energy Research and Development Administration, 1975, report GJO-1653).

Geology

The West Fork area has been mapped geologically by Patton (1967) and the following description is taken from his report. The oldest rocks in the immediate area are volcanic rocks including flows and volcaniclastic rocks of andesitic and trachyandesitic composition and labled KJv on fig. 2. Most of unit KJv is believed to be earliest Cretaceous (Neocomian) in age based on fossil correlations and a K-Ar age measurement of 120±3 m.y. (Patton, 1967). This unit is overlain and

in part gradational with a unit of volcanic graywacke and conglomerate of Cretaceous age (Kvg) which in turn is overlain by calcareous graywacke and mudstone units (Kcv, Kcg). Basalt flows of late Tertiary and Quaternary age cap some of the ridges in the immediate area and cover large low-lying areas to the west and north. Plutonic rocks ranging in composition from nepheline syenite to quartz monzonite intrude the andesitic volcanic rocks to the west in the Granite Mountain area (Patton, 1967); these intrusive rocks are thought to be Early Cretaceous in age (Patton, 1967; Miller, 1970).

A major north- to northeast-trending fault separates much of the andesitic volcanic rock unit (KJv) from the younger sedimentary rocks (Kcv, Kcg) to the east. Open folds trending northeast to east lie to the northwest of this fault.

Description of anomalous area

A reconnaissance survey by helicopter in the headwaters of West Fork revealed anomalous radioactivity over an area of several square miles. Inclement weather limited on-the-ground inspection to only a few places. The most radioactive rock, however, appeared generally to be a coarse trachyandesite volcanic breccia commonly characterized by a reddish color, large (1.5 cm) feldspar phenocrysts, and large (up to 2.5 cm) red amygdules of analcite. A green, Na-rich clinopyroxene is commonly observed in thin section. Radioactivity readings of 400-750 cps (counts per second; total count) were recorded on outcrops and rubble crops of this breccia. Very thin veinlets of

cryptocrystalline material can be seen cutting the breccia fragments in some places; in a few cases purple fluorite occurs in the veinlets.

Samples of breccia with high radioactivity were analyzed (nos. 1, 2, fig. 1, table 1) and showed 15.9 and 32.1 ppm uranium and 88 and 124.7 ppm thorium respectively, which is well above the 1-3 ppm uranium and 5-20 ppm thorium (Smith, 1963) considered normal for rocks of this composition. A sample of andesite from volcanic conglomerate (no. 3, table 1) yielded 10.6 ppm uranium and 30.6 ppm thorium.

Three traverses of the ERDA airborne survey, Flight lines 64, 65, and 66, cross the general West Fork area (figs. 1, 2). Profiles of absolute corrected data values for uranium and thorium (counting units are in counts per two seconds) are shown in figure 2. The profiles are annotated with the known geology as taken from Patton (1967) and modified slightly in Miller (1970). All three profiles show an abrupt increase in data values over rocks immediately west of the north-northeast trending fault. The radioactivity anomaly is between stations 1545 and 1629 on flight line 64, between stations 2013 and 2058 on flight line 65, and between stations 2922 and 2949 on flight line 66. The width of these anomalous radioactivity zones ranges from 5 to 11 km on the three traverses. The rocks with the increased radioactivity are mapped (Patton, 1967) as andesitic volcanic rocks (KJv) and volcanic graywacke and conglomerate (Kvg) (fig. 1). However, Patton (1967; personal communication, 1977) states that the conglomerate and graywacke of unit Kvg are tuffaceous and grade into volcanic breccias and conglomerates of unit KJv near their mutual

contact in the West Fork area. This gradational contact zone therefore exhibits anomalous radioactivity. An inspection of magnetic profiles for the three traverses (not shown in this report) shows the magnetic profile over the sedimentary rocks east of the fault to be smooth and flat with very little variation. Immediately west of the fault, the profiles show moderately large amplitude magnetic anomalies regardless of whether the mapped rock type is unit KJv or Kvg indicating either that these rocks have similar magnetic properties or that more magnetic basement rocks lie close to the surface in this area. Magnetic anomalies are of lower amplitude over volcanic rocks of unit KJv further west in the area north and south of Granite Mountain.

The rocks immediately west of the major fault therefore appear to consist chiefly of andesitic volcanic breccias and conglomerates, commonly very coarse-grained (clasts up to 60 cm in diameter) and containing volcanic and granitic rock detritus. Volcanic breccia appears to have a higher radioactivity than conglomerate based on on-the-ground measurements. These rocks as a whole show increased radioactivity and moderately large magnetic anomalies. Along Flight line 65 (fig. 2), for example, the radioactivity over andesitic volcanic breccia in the West Fork area approaches that shown over the Peace River stock and the Granite Mountain pluton to the west, both of which are composed of uraniferous rocks (Miller and Bunker, 1975; Miller and Elliott, 1969).

Summary

Above average amounts of uranium and thorium occur in volcaniclastic rocks near the headwaters of the West Fork of the Buckland

River. This uranium-thorium content is reflected in the increased radioactivity over an area that may be as large as 21 km long by 5 to 11 km wide and is bounded on the east by a major fault. The uranium and thorium values of analyzed samples, while anomalous, are far below what would be considered economic. However, the large area of increased radioactivity, the local abundance of hematite and presence of purple fluorite which is characteristic of anomalous uranium occurrences elsewhere in the province (Miller, 1977), and the possible structural control all combine to suggest the West Fork area is worth exploration for possible epigenetic uranium deposits.

Furthermore, most if not all of the previously known uranium occurrences and/or deposits in western Alaska are closely associated with plutonic rocks. No plutonic rocks are known to occur in the headwaters of the West Fork and the presence of anomalous amounts of uranium in the volcanic rocks of the area indicates that uranium enrichment in the western Alaskan uranium province may not be confined to plutonic rocks.

References cited

Clark, A. L., Berg, H. C., Cobb, E. H., Eberlein, G. D., MacKevett, E. M., Jr., and Miller, T. P., 1974, Metal provinces of Alaska: U.S. Geol. Survey Misc. Inv. Ser. Map I-834.

Miller, T. P., 1970, Petrology of the plutonic rocks of west-central Alaska: U.S. Geol. Survey open-file rept., 132 p.

Miller, T. P., 1976, Hardrock uranium potential of Alaska: U.S. Geol. Survey open-file rept. 76-246, 7 p.

Miller, T. P., 1977, Characteristics of the western Alaska uranium province: Geol. Assoc. of Canada, Ann. Mtg., Program with Abstracts, v. 2, p. 36.

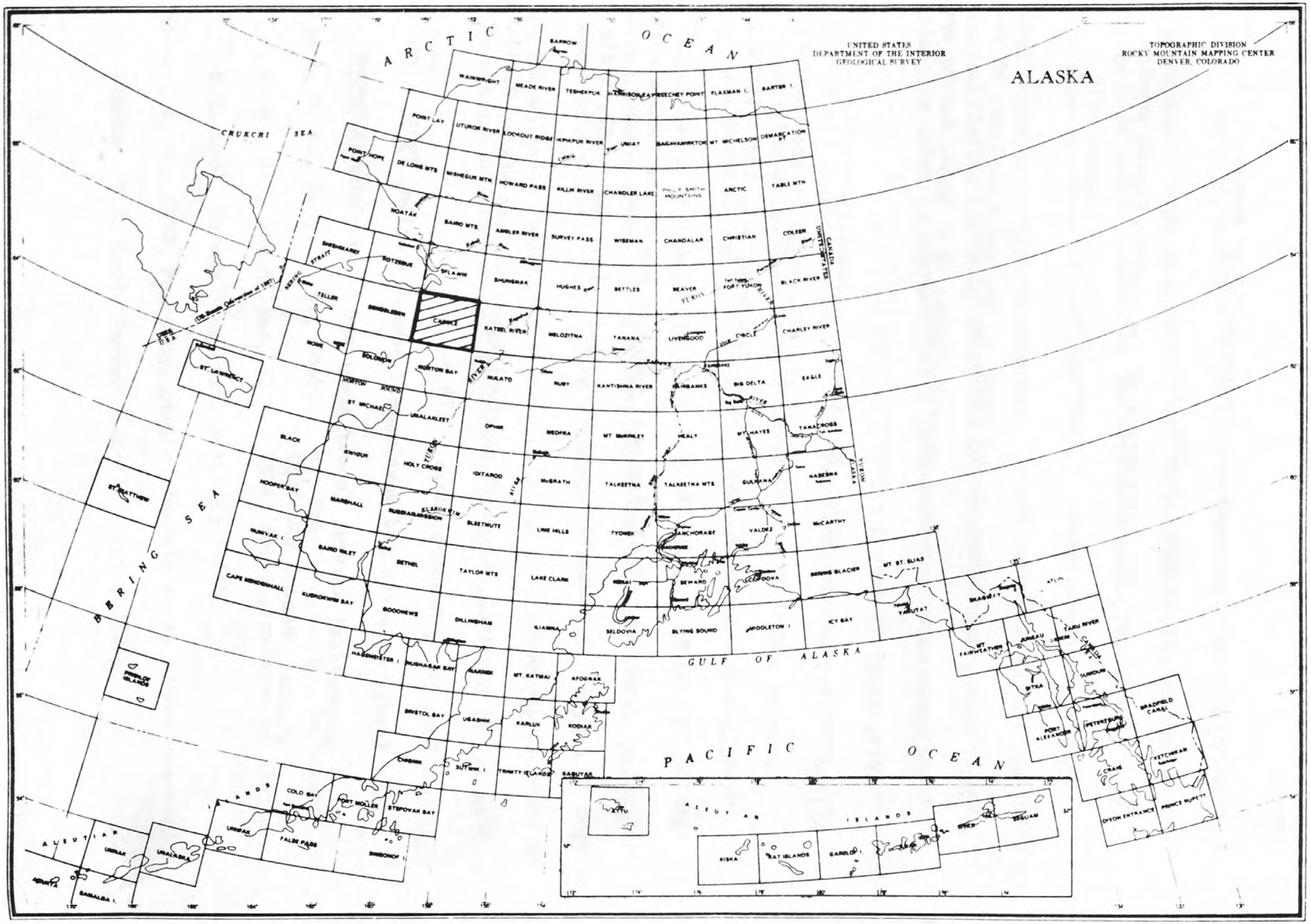
Miller, T. P., and Bunker, C. M., 1975, U, Th, and K analyses of selected plutonic rocks from west-central Alaska: U.S. Geol. Survey open-file rept. 75-216, 5 p.

Miller, T. P., and Bunker, C. M., 1976, A reconnaissance study of the uranium and thorium content of plutonic rocks in the southeastern Seward Peninsula, Alaska: Jour. Research, U.S. Geol. Survey, v. 4, n. 3, p. 367-377.

Patton, W. W., Jr., 1967, Regional geologic map of the Candle quadrangle, Alaska: U.S. Geol. Survey Misc. Geol. Inv. Map I-492, scale 1:250,000.

Smith, F. G., 1963, Physical geochemistry: Addison-WEsley Publishing Co., Inc., Reading, Mass., 624 p.

U.S. Energy Research and Development Administration, 1975, Airborne geophysical survey, Copper River and Seward-Selawik areas, Alaska: Report GJO-1653.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MT. ST. ELIAS
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KUSKOKWIM BAY
GOODNEWS
DILLINGHAM
ILIAMNA
SELDOVIA
BLYING SOUND
MIDDLETON I.
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YAKUTAT
SKAGWAY
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MT. FAIRWEATHER
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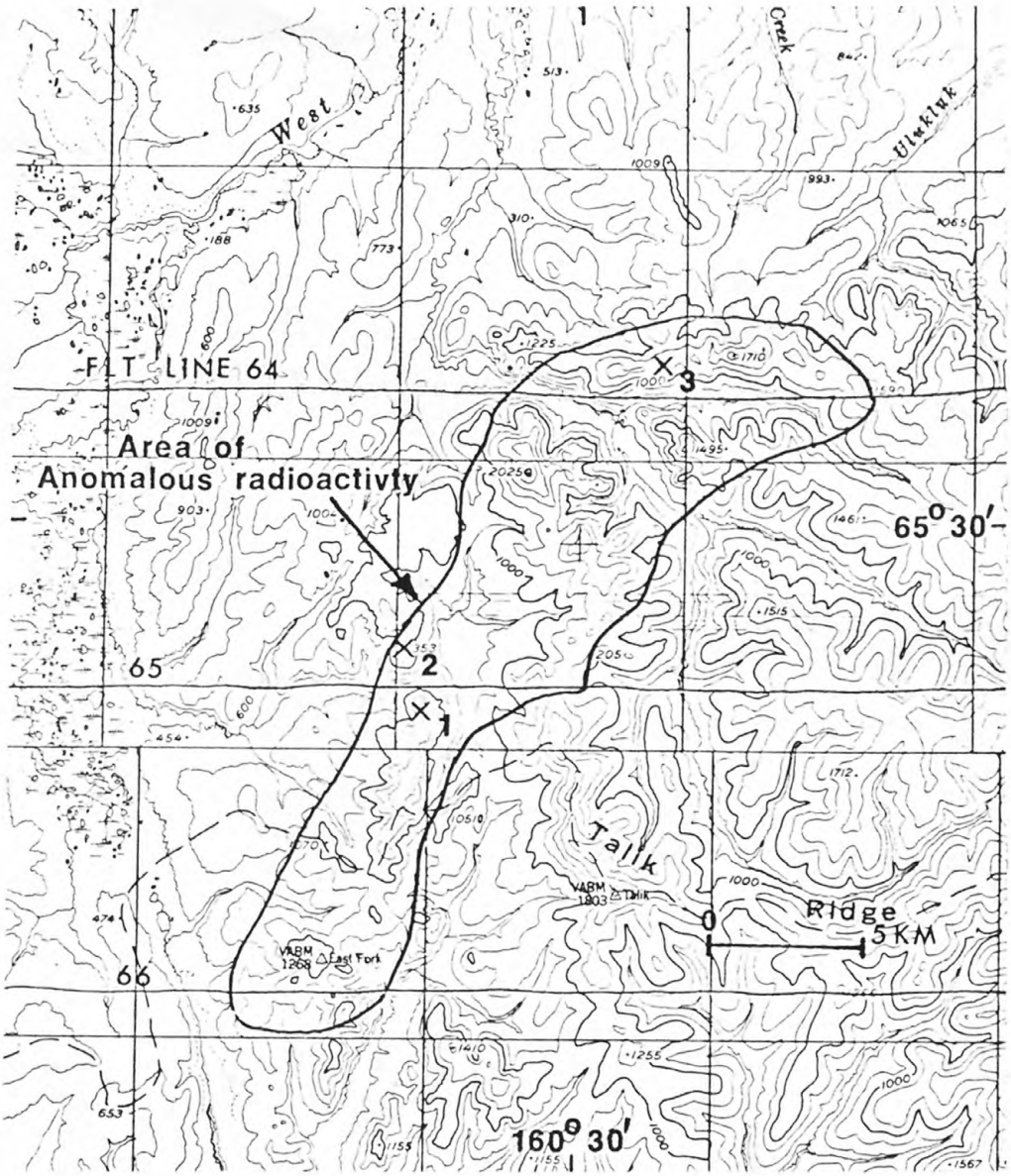

Figure 1. Index map of West Fork area showing flight line traverses, location of analyzed samples (x_1, number refers to table 1), and area of anomalous radioactivity.

Table 1. Uranium and thorium content of selected grab samples from the West Fork area. [1/]

Map no.	Field no.	U (ppm)	CV[2/]	Th (ppm)	CV	Remarks
1	76AMm85	15.38	2	124.66	2	Reddish volcanic breccia, analcite amygdules
2	76AMm83	32.08	1	87.90	4	Reddish volcanic breccia, analcite amygdules
3	76AMm48	10.62	2	30.56	5	Andesite clast from conglomerate

1/ Analysis by delayed neutron determination. Analysts: H. T. Millard, Jr., A. J. Bartel, R. J. Knight, C. M. Ellis, R. L. Nelms, C. A. Ramsey.

2/ CV = coefficient of variation = one standard deviation, based on counting statistics, expressed as percentage of concentration.

1 plate

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