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URANIUM-BEARING WATER IN THE CROW CREEK AND MUSKRAT CREEK AREAS, FREMONT COUNTY, WYOMING

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ABSTRACT

Thirty-eight water samples from various sources were collected from localities within Fremont County, Wyoming. High uranium content of many of the samples suggests possible uranium minerals in two areas. Water samples from the Crow Creek area, in the northwestern part of the Wind River Basin, contain as much as 150 parts per billion uranium, and water from the lower Muskrat Creek area, in the central part of the Wind River Basin, contains as much as 340 parts per billion uranium. The uranium content of these samples is comparable to and in many instances exceeds the uranium content of water samples taken from known mineralized localities in the Gas Hills and Crooks Gap areas, some 20 miles and 45 miles farther southeast.

INTRODUCTION

In the course of oil and gas investigations and general geologic reconnaissance in the Wind River Basin of central Wyoming, the writer collected water samples and made preliminary field tests of radioactivity in two areas where no uranium minerals had previously been reported. Some of the water samples contained more than normal amounts of uranium.

Results of previous studies by Denson, Zeller, and Stephens (1955) suggest that the uranium content of water can be a useful guide in prospecting for new areas containing uranium minerals. Most ground water contains less than 2 parts per billion uranium. However, water issuing from springs in areas of known uranium mineralization contains as much as 300 or more parts per billion uranium (Denson et al., 1955). The uranium content of water sampled from mineralized localities within the Gas Hills (Zeller et al., 1955) and Crooks Gap (Stephens and Bergin, 1955) areas (Fig. 1) averages 98 and 124 parts per billion, respectively.

The Crow Creek area (Fig. 1) from which five samples were collected, is a part of the Wind River Indian Reservation and lies about 10 miles north of Burris, Wyoming. Samples from this area were collected in June, 1955, largely from springs, and the locations were plotted on enlarged aerial photographs at an approximate scale of 1:12,000.

The lower Muskrat Creek area (Fig. 1) comprises about 175 square miles in the central part of the Wind River Basin, directly east of the Wind River Indian Reservation. Locations for the 30 samples taken from this area in June and July, 1955, were plotted on topographic maps at a scale of 1:24,000. The water was collected from several types of sources, including water wells, springs, seismic shot holes, and intermittent streams.

*U. S. Geological Survey, Laramie, Wyoming. Publication authorized by the Director, U. S. Geological Survey.

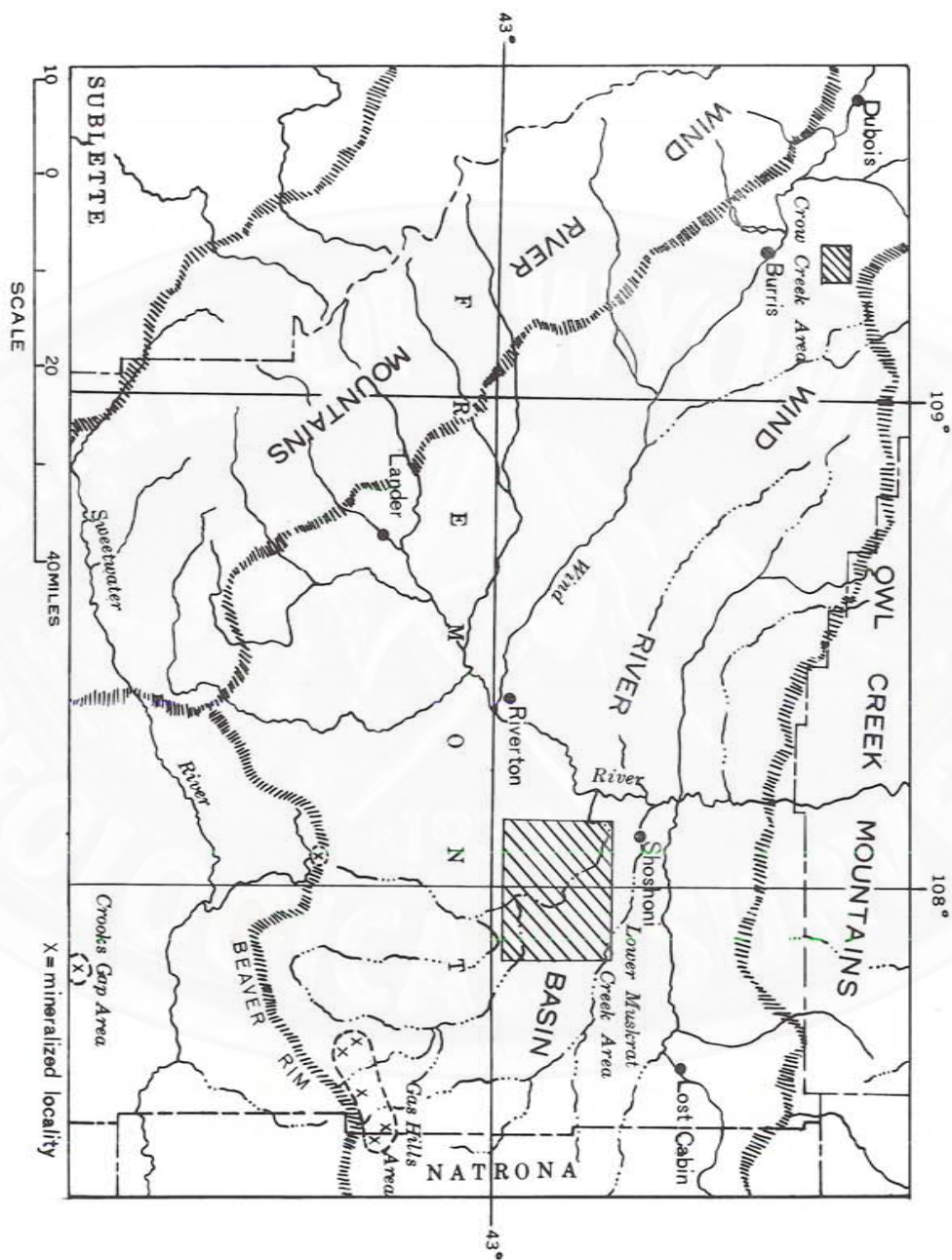


Figure 1—Index map showing areal relationship of uraniumiferous water localities to areas of known uranium mineralization.

Pint polyethylene bottles were used in sampling the water at each locality. Seismic shot holes were sampled by lowering a bail consisting of a weighted perforated pipe into the hole and later transferring the water into a bottle. Hydrologic and geologic notations were made for each sample when data were available. The acidity and uranium content of the samples were determined in the U. S. Geological Survey laboratories by the following chemists: J. McClure, J. Schuch, and Roberta Smith.

The only published geologic map available for the Crow Creek area is by Love (1939). Geologic investigations are currently being conducted in the area by the U. S. Geological Survey as a part of the Department of the Interior program for the development of the Missouri River Basin, with the initial objective of evaluating fuel resources. No detailed geologic map is available for the lower Muskrat Creek area, but it lies directly south of an area mapped by Tourtelot (1953), directly east of an area mapped by Thompson and White (1954), and north of another area mapped by Thompson and White (1952). There is topographic coverage on the entire lower Muskrat Creek area at a scale of 1:24,000.

CROW CREEK AREA

Several uranium-bearing water samples were obtained from the Crow Creek area in the extreme northwestern part of the Wind River Basin, Wyoming. The samples, one of which contained 150 parts per billion uranium, represent the first suggestion of the possible presence of uranium minerals in this region. As shown on the generalized geologic map (Fig. 2), the uraniferous water came from springs, two of which issue from a fault plane. The third spring, carrying 45 parts per billion uranium, is in the scar of a recent landslide. Detailed information on each sample is given in Table I.

The area shown on the map is completely covered by the Wind River formation of early Eocene age and by Quaternary deposits. The Wind River formation in this part of the Wind River Basin consists of highly variegated red, gray-white, and purple siltstones, claystones, and coarse-grained sandstones. A few boulder conglomerate lenses composed largely of Paleozoic rock types are interspersed throughout the section. A northward-dipping normal fault of unknown displacement transects the area in an east-west direction. On the south side of the fault a tuffaceous member of the Wind River formation caps a high butte. This unit was formerly mapped by Love (1939) as part of the Aycross formation of middle Eocene age and may include the basal part of that formation. All Eocene strata in the area dip gently to the southwest.

A Quaternary terrace deposit about five feet thick caps a bench cut by Crow Creek. The deposit is made up mostly of gravel composed of cobble-sized andesite and basalt fragments derived from upper Eocene and Oligocene volcanic conglomerates in the Absaroka Mountains to the north.

The springs are fed in part by irrigation water from a ditch which is cut into the terrace deposit. Testimony from local ranchers indicates

TABLE I
WATER-SAMPLE DATA OF CROW CREEK AREA
FREMONT COUNTY, WYOMING

Serial No.	Location T., R. Wind River Meridian	Source of Sample	Flow	Lithology of Aquifer	Uranium (ppb) 2/	pH
230200	SW sec. 7 6N-4W	Irrigation ditch	Variable	Alluvium	2	7.2
230201	SW sec. 7 6N-4W	Spring	½ gpm 1/	Sandy shale	150	8.0
230202	SW sec. 7 6N-4W	Spring	Would fill a ½" pipe	Sandy shale	55	8.1
230203	SW sec. 7 6N-4W	Spring	Would fill a ¾" pipe	Sandy shale	45	7.7
230204	SW sec. 14 6N-5W	Stream	Intermittent	Alluvium	7	8.1

1/ gallons per minute.

2/ parts per billion.

that the springs are perennial, although their flow is reduced during nonirrigation periods. The irrigation water, which is derived from Crow Creek, was sampled in order to determine whether it was contributing the uranium in the spring water. The irrigation water contains only 2 parts per billion uranium; therefore it can be dismissed as a possible source. Inasmuch as the irrigation water does contribute to the flow of the springs, the original concentration of uranium in the spring water has probably been somewhat diluted by the addition of the irrigation water.

Another hypothesis to explain the source of the uranium in the spring water is that the irrigation water percolating through the volcanic cobbles of the terrace deposit may have dissolved the uranium from the volcanic rocks and carried it in solution to the adjacent springs. The following lines of evidence cast some doubt on this possibility:

1. A water sample collected late in the irrigating season in 1954 contained 22 parts per billion uranium. This sample was taken from the same spring which early in June, 1955, (before the irrigating season) contained 55 parts per billion uranium. These data suggest dilution by continued irrigation.
2. The most highly uraniferous water sample (150 parts per billion uranium) was collected about 80 feet below the elevation of the irrigation ditch and 40 to 50 feet below the elevations of the samples which contained 45 and 55 parts per billion uranium. Because the lowest spring is farthest away from the irrigation ditch, it receives less water from the ditch than the two nearer ones. This relation also suggests dilution of the spring waters by the downward movement of irrigation waters.

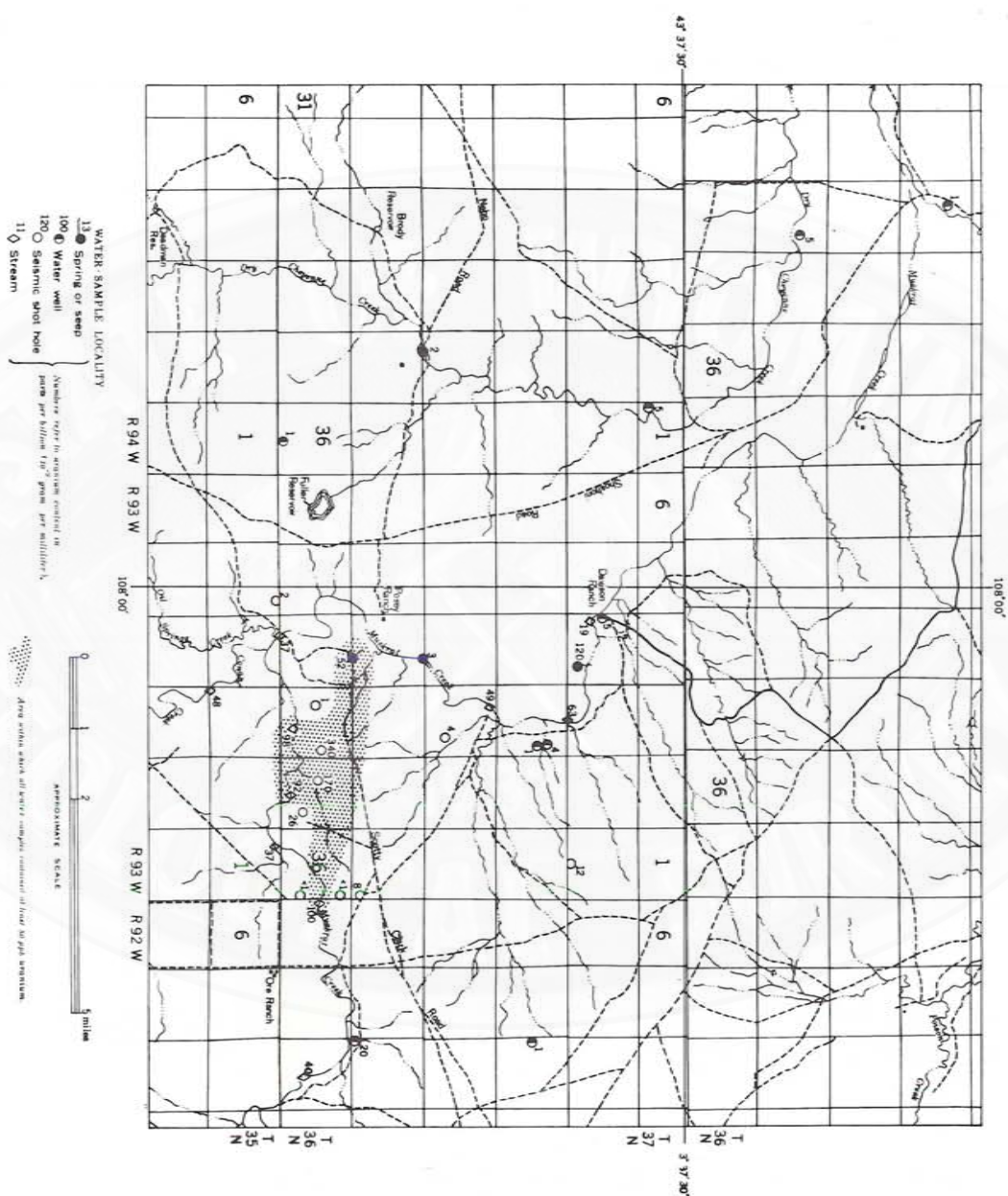


Figure 3—Map of lower Muskrat Creek area, Fremont County, Wyoming, showing location of uraniumiferous water samples.

No significant radioactivity could be detected at the surface in the general area. The background count was 0.011 MR/HR^{1/} and the highest reading was 0.022 MR/HR which was obtained on a carbonaceous shale bed exposed about 10 feet above the northernmost spring.

The writer believes that the uranium is taken into solution at depth by ground water and brought to the surface hydrostatically along the fault plane. Subsurface investigation by drilling may not be warranted, but it is probably the most economical method for further exploration.

LOWER MUSKRAT CREEK AREA

The lower Muskrat Creek area is located about 15 miles southeast of Shoshoni, Wyoming, and about 23 miles northwest of the Gas Hills area—the closest area of known uranium mineralization (Fig. 1). A total of 33 water samples was collected during 1955 from Quaternary alluvium and from the Wind River formation of early Eocene age. The samples came from water wells, springs, seismic shot holes, and intermittent streams. Chemical analysis showed that one sample contained 340 parts per billion uranium. Ten other samples had a uranium content ranging from 40 to 170 parts per billion. Ground water normally contains about 2 parts per billion uranium. Figure 3 shows the location and source of each sample, as well as the parts per billion uranium in each.

The area has very little relief and is drained by Muskrat Creek and its tributaries. This drainage system shows a surface flow only during periods of thawing or excessive rainfall. Essentially flat-lying strata of the Wind River formation of early Eocene age cover the entire region. Deposits of Quaternary alluvium are present along the dry washes and stream bottoms. The Wind River formation consists largely of drab gray-green siltstones and claystones interbedded with thick lenses of buff medium- to coarse-grained arkosic sandstone. Very few exposures of red variegated beds can be observed in the area.

The water samples containing the most uranium were collected from an east-west belt along Muskrat Creek (Fig. 3). The greatest concentrations were found in seismic shot holes in sections 34 and 35, T. 36 N., R 93 W. Water containing 340 parts per billion uranium was from a shot hole 54 feet deep; water was encountered at a depth of 48 feet. Approximately half a mile eastward water containing 170 parts per billion uranium was sampled from a shot hole 58 feet deep; water was found at a depth of 15 feet. The surface elevation at each hole is about equal. It is possible that the uranium in the latter hole may have been diluted by a much greater column of water.

Many samples of water were collected from the surficially dry stream beds of Muskrat Creek and Conant Creek by digging holes 2 to 3 feet deep. Five samples, four of which were taken south of the map area, were collected from Conant Creek over a stream distance of about 6 miles from its junction with Muskrat Creek. These samples ranged

1/ Milliroentgens per hour.

TABLE II
WATER-SAMPLE DATA OF LOWER MUSKRAT CREEK AREA, FREMONT COUNTY, WYOMING

Serial No.	Location T., R.	Source of Sample	Flow	Lithology of Aquifer	Formation Containing Aquifer	Uranium (ppb)	pH	Collection Date and Remarks
142250	SWSE sec. 28 36N-93W	Posey Spring	Would fill a 1" pipe	Sandstone	Wind River	54	7.5	April, 1955
230198	SE sec. 34 36N-93W	Muskrat Creek	Intermittent	Alluvium		98	7.7	June, 1955
230199	NW sec. 4 35N-93W	Muskrat Creek	Intermittent	Alluvium		37	7.5	June, 1955
230161	SESW sec. 15 37N-94W	Well			Wind River	1	8.5	June, 1955 Depth 400 feet; water at 86 feet
230162	NE sec. 27 37N-94W	Well	Unknown but strong		Wind River	5	7.2	June, 1955 Depth 110 feet
230163	NWNE sec. 28 36N-93W	Spring	Unknown but poor	Sandstone	Wind River	3	7.5	June, 1955
230164	SWSW sec. 28 36N-92W	Davison Well	Unknown but poor	Alluvium (?)		20	7.6	June, 1955 Depth 8 feet
230165	SE sec. 9 36N-93W	Spring	2 gpm	Alluvium (?)		120	7.8	June, 1955
230166	SW sec. 1 36N-94W	Grieve Well	20 gpm		Wind River	5	7.7	June, 1955 Depth 140 feet
230167	SESW sec. 23 36N-94W	Spring	Unknown	Alluvium (?)		2	7.3	June, 1955
230168	NE sec. 15 36N-93W	Well	50 gpm		Wind River	4	7.9	June, 1955 Depth 60 feet
230169	NE sec. 15 36N-93W	Well	172 gpm		Wind River	1	7.6	June, 1955 Depth 120 feet
230170	SWNW sec. 9 36N-93W	Davison Well	40 gpm		Wind River	5	7.9	June, 1955 Depth 270 feet
230171	SESW sec. 12 36N-93W	Seismic shot hole			Wind River	12	8.2	June, 1955 Depth unknown; water at 46 feet
230172	NW sec. 31 36N-92W	Muskrat Creek	Intermittent	Alluvium		100	7.4	June, 1955
230173	SENE sec. 34 36N-93W	Seismic shot hole			Wind River	340	7.3	June, 1955 Depth 54 feet; water at 48 feet
230174	NWSW sec. 16 36N-92W	Well	Unknown			1	7.9	June, 1955
230175	SWSW sec. 36 36N-94W	Well	Unknown but strong			1	8.2	June, 1955

TABLE II (Continued)

WATER-SAMPLE DATA OF LOWER MUSKRAT CREEK AREA, FREMONT COUNTY, WYOMING

Serial No.	Location T., R.	Source of Sample	Flow	Lithology of Aquifer	Formation Containing Aquifer	Uranium (ppb)	pH	Collection Date and Remarks
232054	Sec. 5 35N-43W	Seismic shot hole			Wind River	2	7.8	July, 1955 Depth 100 feet; water at 70 feet
232055	Sec. 35 36N-43W	Seismic shot hole			Wind River	170	7.3	July, 1955 Depth 58 feet; water at 15 feet
232056	Sec. 35 36N-43W	Seismic shot hole			Wind River	26	7.4	July, 1955 Depth 100 feet; water at 88 feet
232057	Sec. 34 36N-43W	Seismic shot hole			Wind River	1	7.3	July, 1955 Depth 100 feet; water at 87 feet
232058	Sec. 32 36N-43W	Seismic shot hole			Wind River	4	7.4	July, 1955 Depth 100 feet; water at 12 feet
232059	Sec. 25 36N-43W	Seismic shot hole			Wind River	8	7.4	July, 1955 Depth 45 feet; water at 33 feet
232060	Sec. 36 36N-43W	Seismic shot hole			Wind River	1	7.1	July, 1955 Depth 49 feet; water at 40 feet
232062	Sec. 3 35N-43W	Conant Creek		Alluvium		48	7.2	July, 1955 One foot to water in dry creek bed
232063	Sec. 36 36N-43W	Seismic shot hole			Wind River	1	7.4	July, 1955 Depth 68 feet; water at 6 feet
232064	Sec. 1 35N-43W	Creek bed		Alluvium		37	7.3	July, 1955 Three feet to water in dry creek bed
232065	Sec. 35 36N-43W	Muskrat Creek		Alluvium		92	7.4	July, 1955 One foot to water in dry creek bed
232066	Sec. 33 36N-42W	Muskrat Creek		Alluvium		40	7.4	July, 1955 Three feet to water in dry creek bed
236421	SW sec. 9 36N-43W	Muskrat Creek		Alluvium		19	7.6	October, 1955 Two feet to water in dry creek bed
236422	SE sec. 10 36N-43W	Muskrat Creek		Alluvium		63	7.5	October, 1955 Two feet to water in dry creek bed
236423	NW sec. 22 36N-43W	Muskrat Creek		Alluvium		49	7.6	October, 1955 Two feet to water in dry creek bed

from 23 to 48 parts per billion uranium. Six samples, ranging from 37 to 100 parts per billion uranium, were taken from Muskrat Creek in and upstream from the east-west belt of greatest uranium concentration (Fig. 3). Three additional samples, ranging from 12 to 58 parts per billion uranium, were taken from upstream on Muskrat Creek over a distance of about 4 miles from the eastern edge of the area shown in Figure 3.

According to Zeller (personal communication) a sample taken from Muskrat Creek at the Love Ranch in SW NE NW sec. 34, T. 35 N., R. 91 W., contained 18 parts per billion uranium and another sample taken farther upstream in SE SE SE sec. 16, T. 33 N., R. 91 W., contained 49 parts per billion uranium (Zeller et al., 1955). The latter locality lies within 5 stream miles of a mineralized area in the Gas Hills district which is drained by tributaries of Muskrat Creek.

These consistently high uranium analyses of Muskrat Creek waters represent a spread of sampling upstream from the area of greatest concentration of uranium to the vicinity of well-known mineralized localities in the Gas Hills area. There is no suggestion of progressive dilution with increasing distance away from the probable source area as might be expected. There is instead, a significant increase in uranium content of the stream about 23 miles downstream from the Gas Hills area. At least part of the uranium is probably being transported in solution from the Gas Hills uranium district into the lower Muskrat Creek area. During periods of flow much of the uranium is carried in the waters of Muskrat Creek to its confluence with the Wind River. In dry periods, however, the creek water sinks into the alluvium-filled creek bed, and the downstream movement of the water is essentially stopped. Evaporation of these intermittent flows would tend to further enrich the water. These enriched waters undoubtedly seep into permeable sandstone aquifers through which the creek has cut its downstream course. Some of these sandstone beds may act as favorable host rocks for the concentration of uranium. The age of the present Muskrat Creek drainage system is unknown, but if the proposed processes of evaporation and enrichment have been operating since its inception, then the amount of uranium concentration in favorable host rocks may be significant.

Three water samples taken from the stream bed alluvium downstream from the area of greatest concentration (Fig. 3) suggest to the writer that a large part of the uranium in Muskrat Creek waters is being carried farther downstream. These samples were collected over a stream distance of about 5 miles from the main concentration and range in uranium content from 19 to 63 parts per billion.

The only significant sample of uraniferous spring water located outside the east-west belt of uranium concentration was collected in section 9, T. 36 N., R. 93 W. This sample contained 120 parts per billion uranium. Pertinent data for all samples collected during this study are given in Table II.

The maximum uranium content of these samples is comparable to, and in many instances in excess of, the uranium content found in water samples taken from mineralized localities in the Gas Hills and Crooks

Gap districts. No surface radioactivity in excess of background count could be detected by ground reconnaissance but more thorough examinations or drilling might indicate the presence of uranium minerals in rocks of the area.

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