THE GEOLOGICAL SURVEY OF WYOMING

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REPORT OF INVESTIGATIONS NO. 5

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

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MARCH, 1956

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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.

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

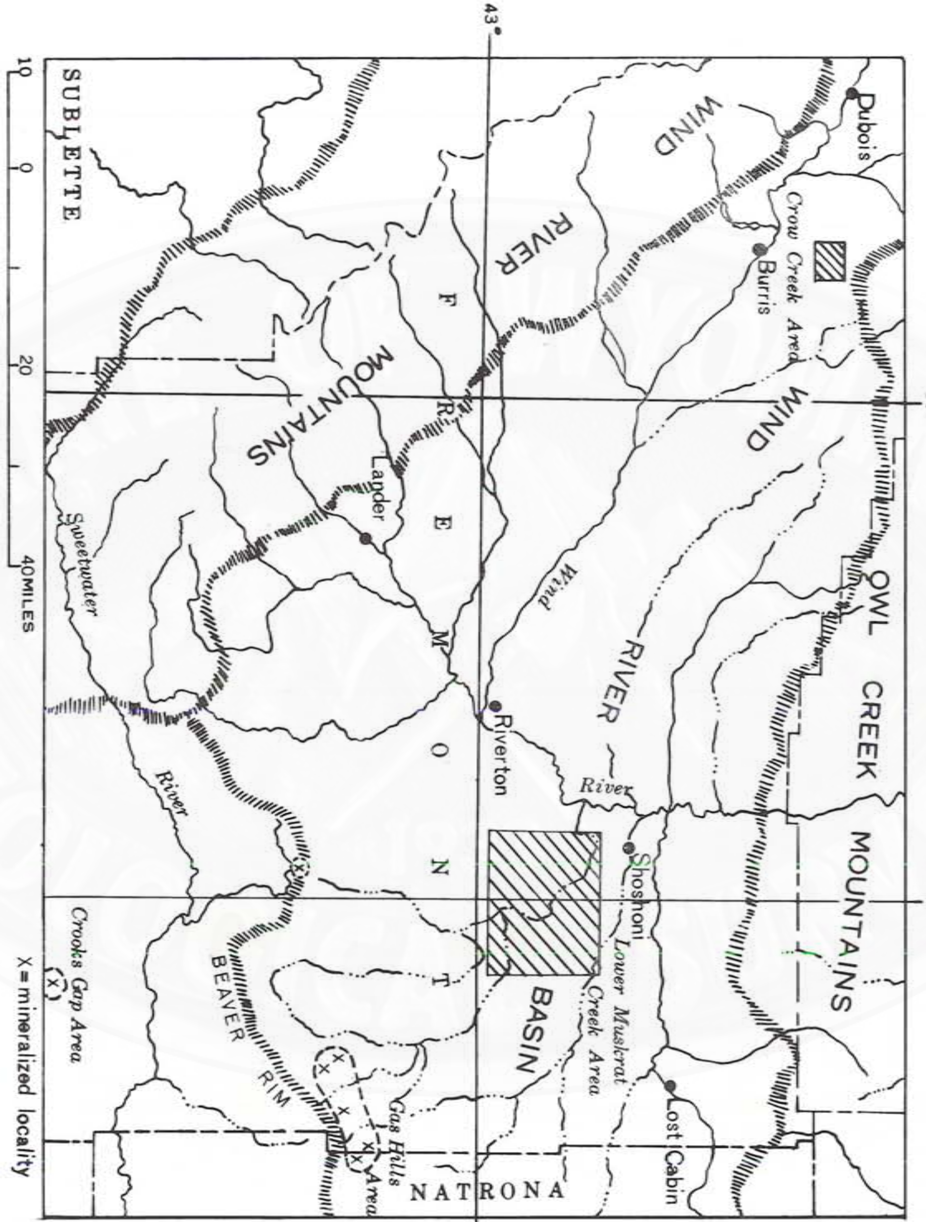


Figure 1—Index map showing areal relationship of uraniferous water localities to areas of known uranium mineralization.

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

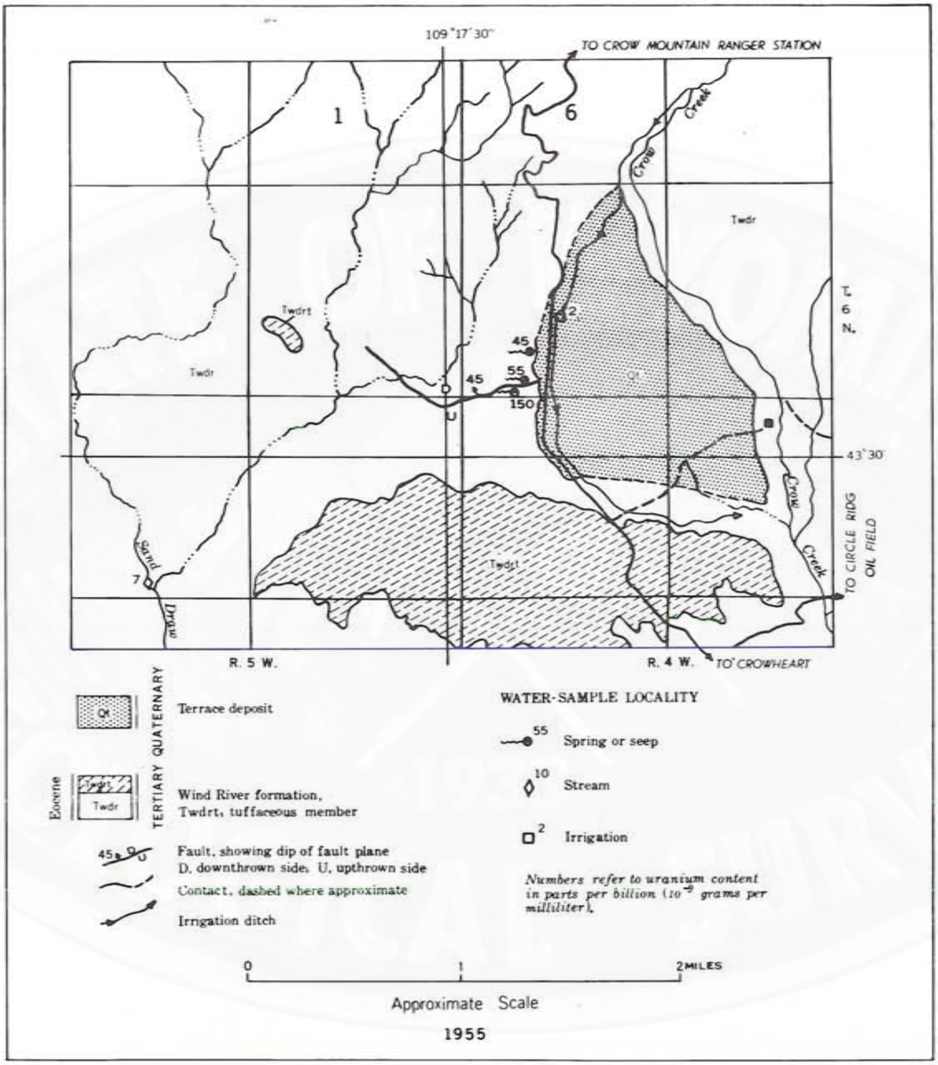


Figure 2—Map of part of the Crow Creek area, Fremont County, Wyoming, showing location of uraniferous water samples.

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.

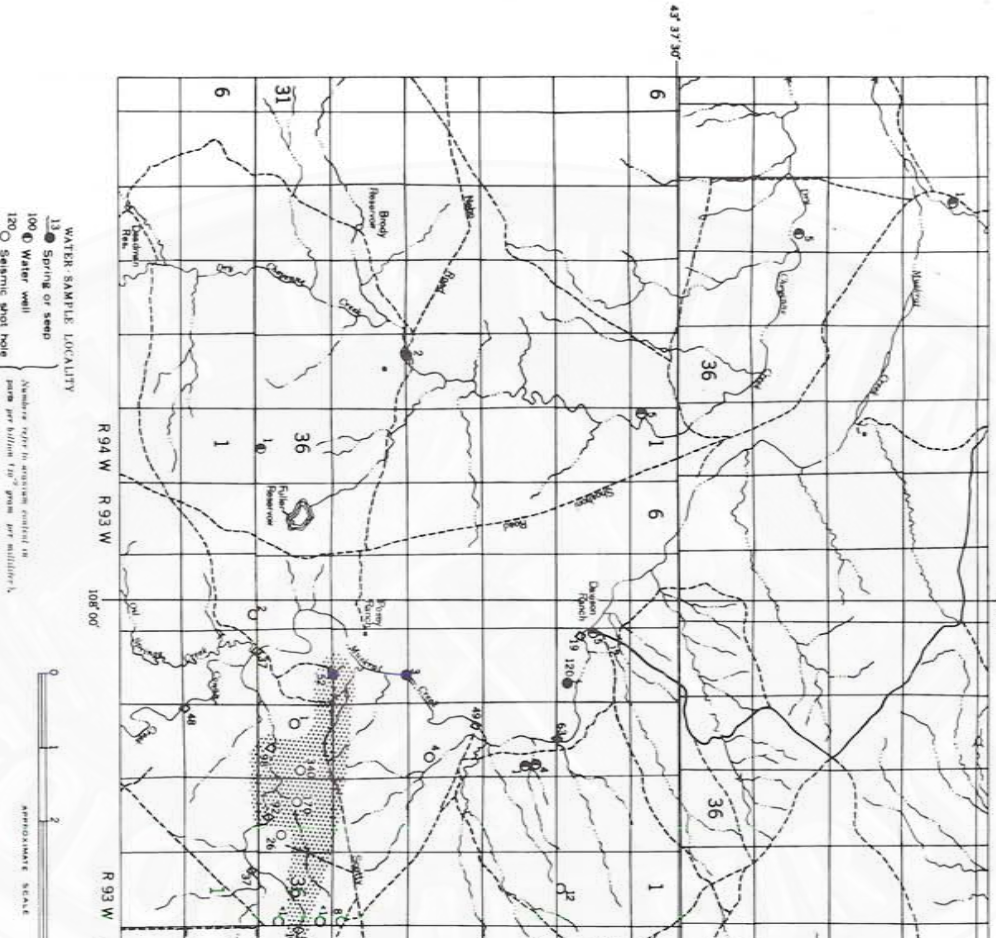


Figure 3—Map of lower Muskrat Creek area, Fremont County, Wyoming, showing location of uraniferous water samples.

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

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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 35N-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 | SENW 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 | SESESW 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 | SWSE 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-93W | Seismic shot hole | | | Wind River | 2 | 7.8 | July, 1955 Depth 100 feet; water at 70 feet |
| 232055 | Sec. 35 36N-93W | Seismic shot hole | | | Wind River | 170 | 7.3 | July, 1955 Depth 58 feet; water at 15 feet |
| 232056 | Sec. 35 36N-93W | Seismic shot hole | | | Wind River | 26 | 7.4 | July, 1955 Depth 100 feet; water at 88 feet |
| 232057 | Sec. 34 36N-93W | Seismic shot hole | | | Wind River | 1 | 7.3 | July, 1955 Depth 100 feet; water at 87 feet |
| 232058 | Sec. 32 36N-93W | Seismic shot hole | | | Wind River | 4 | 7.4 | July, 1955 Depth 100 feet; water at 12 feet |
| 232059 | Sec. 25 36N-93W | Seismic shot hole | | | Wind River | 8 | 7.4 | July, 1955 Depth 45 feet; water at 33 feet |
| 232060 | Sec. 36 36N-93W | Seismic shot hole | | | Wind River | 1 | 7.1 | July, 1955 Depth 49 feet; water at 46 feet |
| 232062 | Sec. 3 35N-93W | Conant Creek | | Alluvium | | 48 | 7.2 | July, 1955 One foot to water in dry creek bed |
| 232063 | Sec. 36 36N-93W | Seismic shot hole | | | Wind River | 1 | 7.4 | July, 1955 Depth 68 feet; water at 6 feet |
| 232064 | Sec. 1 35N-93W | Creek bed | | Alluvium | | 37 | 7.3 | July, 1955 Three feet to water in dry creek bed |
| 232065 | Sec. 35 36N-93W | Muskrat Creek | | Alluvium | | 92 | 7.4 | July, 1955 One foot to water in dry creek bed |
| 232066 | Sec. 33 36N-92W | Muskrat Creek | | Alluvium | | 40 | 7.4 | July, 1955 Three feet to water in dry creek bed |
| 236421 | SW sec. 9 36N-93W | Muskrat Creek | | Alluvium | | 19 | 7.6 | October, 1955 Two feet to water in dry creek bed |
| 236422 | SE sec. 10 36N-93W | Muskrat Creek | | Alluvium | | 63 | 7.5 | October, 1955 Two feet to water in dry creek bed |
| 236423 | NW sec. 22 36N-93W | 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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