THE GEOLOGICAL SURVEY OF WYOMING
HORACE D. THOMAS, State Geologist

REPORT OF INVESTIGATIONS NO. 5

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

By
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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 350 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.

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 silstones, 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

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Location T., R., Meridian</th>
<th>Source of Sample</th>
<th>Flow</th>
<th>Lithology of Aquifer</th>
<th>Uranium (ppb) 1/</th>
<th>Z 2/</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>232000</td>
<td>SW sec. 7 6N-4W</td>
<td>Irrigation ditch</td>
<td>Variable</td>
<td>Alluvium</td>
<td>2</td>
<td></td>
<td>7.2</td>
</tr>
<tr>
<td>232091</td>
<td>SW sec. 7 6N-4W</td>
<td>Spring</td>
<td>3/4 gallon 1/</td>
<td>Sandy shale</td>
<td>150</td>
<td></td>
<td>8.0</td>
</tr>
<tr>
<td>232092</td>
<td>SW sec. 7 6N-4W</td>
<td>Spring</td>
<td>Would fill a 3/4&quot; pipe</td>
<td>Sandy shale</td>
<td>45</td>
<td></td>
<td>8.1</td>
</tr>
<tr>
<td>232093</td>
<td>SW sec. 7 6N-4W</td>
<td>Spring</td>
<td>Would fill a 3/4&quot; pipe</td>
<td>Sandy shale</td>
<td>45</td>
<td></td>
<td>7.7</td>
</tr>
<tr>
<td>232094</td>
<td>SW sec. 14 6N-3W</td>
<td>Stream</td>
<td>Intermittent</td>
<td>Alluvium</td>
<td>7</td>
<td></td>
<td>8.1</td>
</tr>
</tbody>
</table>

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 uraniumiferous 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 Mission Creek area, Fremont County, Wyoming, showing location of uranium-bearing water samples.
No significant radioactivity could be detected at the surface in the
general area. The background count was 0.011 MR/HR/ 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 inter-
mittent 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 arkose 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. 30 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>
<thead>
<tr>
<th>Serial No.</th>
<th>Location T., R.</th>
<th>Source of Sample</th>
<th>Flow</th>
<th>Lithology of Aquifer</th>
<th>Formation Containing Aquifer</th>
<th>Uranium (µg/l)</th>
<th>pH</th>
<th>Collection Date and Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>12050</td>
<td>SWSE sec. 25</td>
<td>Peace Spring</td>
<td>Would fill a 1&quot; pipe</td>
<td>Sandstone</td>
<td>Wind River</td>
<td>34</td>
<td>7.5</td>
<td>April, 1955</td>
</tr>
<tr>
<td>230198</td>
<td>SE sec. 34</td>
<td>Muskrat Creek</td>
<td>Intermittent</td>
<td>Alluvium</td>
<td>98</td>
<td>7.7</td>
<td>June, 1955</td>
<td></td>
</tr>
<tr>
<td>230199</td>
<td>SW sec. 4</td>
<td>Muskrat Creek</td>
<td>Intermittent</td>
<td>Alluvium</td>
<td>57</td>
<td>7.5</td>
<td>June, 1955</td>
<td></td>
</tr>
<tr>
<td>230101</td>
<td>SE NW sec. 15</td>
<td>Well</td>
<td>Wind River</td>
<td>1</td>
<td>8.5</td>
<td>June, 1955</td>
<td>Depth 90 feet; water at 10 feet</td>
<td></td>
</tr>
<tr>
<td>230102</td>
<td>NE sec. 27</td>
<td>Well</td>
<td>Unknown but strong</td>
<td>Sandstone</td>
<td>Wind River</td>
<td>5</td>
<td>7.2</td>
<td>June, 1955</td>
</tr>
<tr>
<td>230103</td>
<td>NW sec. 28</td>
<td>Spring</td>
<td>Unknown but poor Sandstone</td>
<td>Wind River</td>
<td>3</td>
<td>7.5</td>
<td>June, 1955</td>
<td></td>
</tr>
<tr>
<td>230104</td>
<td>SW SW sec. 26</td>
<td>Well</td>
<td>Unknown but poor</td>
<td>Alluvium (?)</td>
<td>20</td>
<td>7.6</td>
<td>June, 1955</td>
<td>Depth 8 feet</td>
</tr>
<tr>
<td>230105</td>
<td>NW sec. 5</td>
<td>Spring</td>
<td>2 gpm Alluvium (?)</td>
<td>120</td>
<td>7.8</td>
<td>June, 1955</td>
<td></td>
<td></td>
</tr>
<tr>
<td>230106</td>
<td>SW sec. 1</td>
<td>Grieve Well</td>
<td>20 gpm</td>
<td>Wind River</td>
<td>5</td>
<td>7.7</td>
<td>June, 1955</td>
<td>Depth 100 feet</td>
</tr>
<tr>
<td>230107</td>
<td>SE NW sec. 23</td>
<td>Well</td>
<td>2</td>
<td>7.8</td>
<td>June, 1955</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>230108</td>
<td>SE sec. 15</td>
<td>Well</td>
<td>50 gpm</td>
<td>Wind River</td>
<td>4</td>
<td>7.9</td>
<td>June, 1955</td>
<td>Depth 60 feet</td>
</tr>
<tr>
<td>230109</td>
<td>SE sec. 15</td>
<td>Well</td>
<td>172 gpm</td>
<td>Wind River</td>
<td>1</td>
<td>7.6</td>
<td>June, 1955</td>
<td>Depth 120 feet</td>
</tr>
<tr>
<td>230110</td>
<td>SW NW sec. 9</td>
<td>Well</td>
<td>40 gpm</td>
<td>Wind River</td>
<td>5</td>
<td>7.9</td>
<td>June, 1955</td>
<td>Depth 270 feet</td>
</tr>
<tr>
<td>230111</td>
<td>SE SW SW sec. 12</td>
<td>Well</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>12</td>
<td>8.2</td>
<td>June, 1955</td>
<td>Depth unknown; water at 40 feet</td>
</tr>
<tr>
<td>230112</td>
<td>NW sec. 21</td>
<td>Meadow Creek</td>
<td>Intermittent</td>
<td>Alluvium</td>
<td>100</td>
<td>7.4</td>
<td>June, 1955</td>
<td></td>
</tr>
<tr>
<td>230113</td>
<td>SE NW sec. 34</td>
<td>Well</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>340</td>
<td>7.8</td>
<td>June, 1955</td>
<td>Depth 64 feet; water at 48 feet</td>
</tr>
<tr>
<td>230114</td>
<td>NW SW sec. 16</td>
<td>Well</td>
<td>Unknown</td>
<td>1</td>
<td>7.9</td>
<td>June, 1955</td>
<td></td>
<td></td>
</tr>
<tr>
<td>230115</td>
<td>SW NW sec. 30</td>
<td>Well</td>
<td>Unknown but strong</td>
<td>1</td>
<td>8.2</td>
<td>June, 1955</td>
<td></td>
<td></td>
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</tbody>
</table>
TABLE II (Continued)
WATER-SAMPLE DATA OF LOWER MUSKRAT CREEK AREA, FREMONT COUNTY, WYOMING

<table>
<thead>
<tr>
<th>Serial No.</th>
<th>Location T., R.</th>
<th>Source of Sample</th>
<th>Flow</th>
<th>Lithology of Aquifer</th>
<th>Formation Containing Aquifer</th>
<th>Uranium (ppb)</th>
<th>pH</th>
<th>Collection Date and Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>232054</td>
<td>Sec. 3 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>2</td>
<td>7.8</td>
<td>July, 1955; Depth 109 feet; water at 70 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232055</td>
<td>Sec. 35 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>170</td>
<td>7.3</td>
<td>July, 1955; Depth 28 feet; water at 13 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232056</td>
<td>Sec. 36 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>24</td>
<td>7.4</td>
<td>July, 1955; Depth 109 feet; water at 82 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232057</td>
<td>Sec. 37 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>1</td>
<td>7.5</td>
<td>July, 1955; Depth 109 feet; water at 28 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232058</td>
<td>Sec. 33 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>4</td>
<td>7.4</td>
<td>July, 1955; Depth 109 feet; water at 28 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232059</td>
<td>Sec. 36 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>8</td>
<td>7.4</td>
<td>July, 1955; Depth 109 feet; water at 82 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232060</td>
<td>Sec. 36 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>1</td>
<td>7.1</td>
<td>July, 1955; Depth 49 feet; water at 40 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232062</td>
<td>Sec. 3 36N-93W</td>
<td>Conant Creek</td>
<td>Alluvium</td>
<td>48</td>
<td>7.2</td>
<td>July, 1955; One foot to water in dry creek bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232063</td>
<td>Sec. 36 36N-93W</td>
<td>Seismic shot hole</td>
<td>Wind River</td>
<td>1</td>
<td>7.4</td>
<td>July, 1955; Depth 68 feet; water at 60 feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232064</td>
<td>Sec. 1 36N-93W</td>
<td>Creek bed</td>
<td>Alluvium</td>
<td>27</td>
<td>7.3</td>
<td>July, 1955; Three feet to water in dry creek bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232065</td>
<td>Sec. 33 36N-93W</td>
<td>Muskrat Creek</td>
<td>Alluvium</td>
<td>92</td>
<td>7.4</td>
<td>July, 1955; One foot to water in dry creek bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>232066</td>
<td>Sec. 33 36N-93W</td>
<td>Muskrat Creek</td>
<td>Alluvium</td>
<td>49</td>
<td>7.4</td>
<td>July, 1955; Three feet to water in dry creek bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>236421</td>
<td>SW sec. 9 36N-93W</td>
<td>Muskrat Creek</td>
<td>Alluvium</td>
<td>19</td>
<td>7.0</td>
<td>October, 1955; Two feet to water in dry creek bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>236422</td>
<td>NW sec. 10 36N-93W</td>
<td>Muskrat Creek</td>
<td>Alluvium</td>
<td>63</td>
<td>7.5</td>
<td>October, 1955; Two feet to water in dry creek bed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>236433</td>
<td>SW sec. 22 36N-93W</td>
<td>Muskrat Creek</td>
<td>Alluvium</td>
<td>49</td>
<td>7.6</td>
<td>October, 1955; Two feet to water in dry creek bed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 permea-
able 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
everation 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 down-
stream 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 uraniumiferous 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 could be detected by ground reconnaissance but more thorough examinations or drilling might indicate the presence of uranium minerals in rocks of the area.

REFERENCES


