Radiochemical Analyses of Water Samples from Selected Streams, Wells, Springs and Precipitation Collected During Re-Entry Drilling, Project Rulison-7, 1971

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RADIOCHEMICAL ANALYSES OF WATER FROM SELECTED STREAMS, WELLS, SPRES, AND PRECIPITATION COLLECTED DURING REENTRY DRILLING, PROJECT RULISON

(Rulison-7) 1971

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DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Federal Center, Denver, Colorado 80225

RADIOCHEMICAL ANALYSES OF WATER FROM SELECTED
STREAMS, WELLS, SPRINGS, AND PRECIPITATION COLLECTED
DURING REENTRY DRILLING, PROJECT RULISON

By

Paul T. Voegeli, Sr., and Hans C. Claassen
CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Addenda to sample collection procedures</td>
<td>3</td>
</tr>
<tr>
<td>Results</td>
<td>5</td>
</tr>
<tr>
<td>References</td>
<td>10</td>
</tr>
</tbody>
</table>

ILLUSTRATIONS

Figure 1. Locations of the U.S. Geological Survey water-sampling points, Project Rulison .... 2
2. Precipitation sampling station ............ 4

TABLES

Table 1. Radiochemical analyses of water from selected streams in western Colorado .... 6
2. Radiochemical analyses of water from selected springs in western Colorado ......... 7
3. Radiochemical analyses of water from selected wells in western Colorado ........ 8
4. Radiochemical analyses of precipitation from selected points in central and western Colorado .... 9
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INTRODUCTION

The U.S. Geological Survey established a water-sampling network in western Colorado to sample the hydrologic environment prior to and during the reentry drilling and gas-production test phase of Project Rulison. During reentry drilling, samples were obtained between April 28 and July 28, 1970, from selected streams, wells, springs, and precipitation, and were analyzed for tritium, gross alpha, and gross beta activity. The analyses were made in laboratories of the Water Resources Division, U.S. Geological Survey, Denver, Colorado.

A report by Voegeli and Claassen (1971) presents the data from analyses of samples from the network collected prior to reentry drilling, including data obtained both before and after the nuclear detonation.

Water samples will be collected from the sampling points (numbered locations in fig. 1) until gas-production tests are discontinued. Stream and composite precipitation samples will be taken to coincide with each phase of testing, high-volume gas production, low-volume gas production, and shut-in period. Wells and springs will be sampled about every 60 to 90 days. If changes in background are detected at any sampling point, the frequency of sampling will be increased.
FIGURE 1.--Locations of the U.S. Geological Survey water-sampling points, Project Rulison.
Procedures followed in the sampling program are summarized in the report by Voegeli and Claassen (1971). Addenda to the sample collection procedures follow:

**Addenda to Sample Collection Procedures**

The need for collection of rain samples at the precipitation sampling sites prompted the design and construction of samplers which could accumulate moisture for approximately 30 days with only negligible losses to evaporation. The precipitation collectors (fig. 2) were installed the last week in May 1970. The moisture is trapped below the narrow neck in the polyethylene bags, reducing evaporation to a minimum. The collectors have been calibrated against rain gage measurements at two locations: Denver and Grand Junction, and the maximum loss to evaporation was computed to be about 15 percent. This loss occurred at Grand Junction during a period of daily maximum temperatures of between 90°F and 100°F. It is estimated that 15 percent loss is a maximum figure under extreme circumstances and that losses will generally be less than 5 percent for the stations at Denver and Grand Junction, approaching zero percent at the mountain sites.

The samples are transferred from the collectors by cutting the polyethylene bag insert and allowing the water to flow into the appropriate containers, as described previously by Voegeli and Claassen (1971). In addition, the total volume of moisture in the collector is measured to obtain an estimate of the amount of precipitation at the site since the last visit.
Figure 2.—Precipitation sampling station.
RESULTS

The results of the analyses of the stream, well, spring, and precipitation samples collected during reentry drilling at the Rulison site are presented in tables 1 through 4.
Table 1.—Radiochemical analyses of water from selected streams in western Colorado

<table>
<thead>
<tr>
<th>Stream</th>
<th>Sample point number</th>
<th>Location</th>
<th>Latitude N.</th>
<th>Longitude W.</th>
<th>Distance from surface ground zero miles</th>
<th>Date of collection</th>
<th>Tritium (pCi/l)</th>
<th>Gross alpha (GCl/l as 14C natural)</th>
<th>Gross beta (GCl/l as 14C natural)</th>
<th>Solids (mg/l)</th>
<th>Gross alpha (pCi/l as 14C natural)</th>
<th>Gross beta (pCi/l as 14C natural)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roaring Fork River near Aspen</td>
<td>1</td>
<td>39 10</td>
<td>106</td>
<td>48</td>
<td>05 64 103</td>
<td>6-1-70</td>
<td>&lt;960 &lt;300</td>
<td>2.7 0.9 4.5 5.5 30</td>
<td>.1 .4 .3 6 6</td>
<td>.8  .3</td>
<td>.3 3.8</td>
<td>.3 3.8</td>
<td>USGS gaging station.</td>
</tr>
<tr>
<td>Colorado River at New Castle</td>
<td>2</td>
<td>39 34</td>
<td>107</td>
<td>32</td>
<td>26 40 60</td>
<td>6-1-70</td>
<td>&lt;960 &lt;300</td>
<td>3.5 1.2 4.3 5.4 100</td>
<td>5.7 1.9 3.8 4.6</td>
<td>10 3.8</td>
<td>6.6 4.6</td>
<td>7.9 5.7</td>
<td>USGS gaging station.</td>
</tr>
<tr>
<td>Beaver Creek near Rifle</td>
<td>3</td>
<td>39 28</td>
<td>107</td>
<td>49</td>
<td>55 7.6 12</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300</td>
<td>1.1 6 3.5 4.5 210</td>
<td>12 4.0 7.8 9.8</td>
<td>32 1.8</td>
<td>1.8 9.8</td>
<td>1.6 9.9</td>
<td>USGS gaging station.</td>
</tr>
<tr>
<td>Kinshall Creek near Collbran</td>
<td>4</td>
<td>39 17</td>
<td>107</td>
<td>57</td>
<td>13 8.6 14</td>
<td>5-29-70</td>
<td>&lt;960 &lt;300</td>
<td>2.1 7 2.1 2.6 140</td>
<td>9.8 3.3 5.6 6.5</td>
<td>56 4.3</td>
<td>4.3 5.6</td>
<td>4.5 3.1</td>
<td>USGS gaging station.</td>
</tr>
<tr>
<td>Plateau Creek near Cañon</td>
<td>5</td>
<td>39 11</td>
<td>108</td>
<td>16</td>
<td>10 23 37</td>
<td>5-29-70</td>
<td>&lt;960 &lt;300</td>
<td>3.9 1.3 5.3 6.5 320</td>
<td>27 8.9 7.4 9.4</td>
<td>40 1.6</td>
<td>1.6 9.4</td>
<td>2.3 9.5</td>
<td>USGS gaging station.</td>
</tr>
<tr>
<td>Colorado River near Debeque</td>
<td>6</td>
<td>39 20</td>
<td>108</td>
<td>11</td>
<td>35 14 23</td>
<td>5-29-70</td>
<td>&lt;960 &lt;300</td>
<td>4.7 1.6 9.9 13 180</td>
<td>14 5.7 8.0 10</td>
<td>73 5.6</td>
<td>3.8 9.9</td>
<td>6.7 9.9</td>
<td>Downstream 2.7 miles (4.3 kilometers) from USGS gaging station 4-0137.</td>
</tr>
</tbody>
</table>

\* As shown on figure 1.
\*\* Not surveyed.
Table 2.--Radiochemical analyses of water from selected springs in western Colorado

<table>
<thead>
<tr>
<th>Owner or tenant</th>
<th>Sample point number</th>
<th>Location</th>
<th>Latitude N</th>
<th>Longitude W</th>
<th>Distance from surface ground zero miles kilometers</th>
<th>Date of collection</th>
<th>Tritium PC/l</th>
<th>Gross alpha (pCi/l as U natural)</th>
<th>Gross beta (pCi/l as Cs-137)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mrs. Betty Potter</td>
<td>20</td>
<td>NW 39 29 20 107 56 12 5.7 9.2</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300</td>
<td>24 7.8 9.2 9.8</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300 24 7.8 9.2 9.8</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carl Bernklau</td>
<td>21</td>
<td>NW 39 28 09 107 53 45 5.1 8.2</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300</td>
<td>&lt;6.3 &lt;2.1 3.8</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300 24 7.8 9.2 9.8</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Town of Grand Valley</td>
<td>22</td>
<td>SE 39 27 49 108 00 58 5.3 8.5</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300</td>
<td>7.9 2.6 3.1 3.8</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300 24 7.8 9.2 9.8</td>
<td>Town of Grand Valley water supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Otis Murray</td>
<td>23</td>
<td>SE 39 23 23 108 04 28 6.8 11</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300</td>
<td>11 3.6 5.5 6.1</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300 24 7.8 9.2 9.8</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cecil Gardner</td>
<td>24</td>
<td>NW 39 26 16 108 02 40 5.6 9.0</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300</td>
<td>42 14 5.0 5.6</td>
<td>5-30-70</td>
<td>&lt;960 &lt;300 24 7.8 9.2 9.8</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fred Wallace</td>
<td>25</td>
<td>NE 39 21 04 107 56 26 3.8 6.1</td>
<td>5-29-70</td>
<td>&lt;960 &lt;300</td>
<td>&lt;6 &lt;2 2.1 2.7</td>
<td>5-29-70</td>
<td>&lt;960 &lt;300 24 7.8 9.2 9.8</td>
<td>--</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\* As shown on figure 1.
Table 3.--Radiochemical analyses of water from selected wells in western Colorado

<table>
<thead>
<tr>
<th>Owner or tenant</th>
<th>Sample point/number or tendon</th>
<th>Location</th>
<th>Latitude N.</th>
<th>Longitude W.</th>
<th>Distance from surface ground zero miles</th>
<th>Kilometers</th>
<th>Date of collection</th>
<th>Tritium pCi/l</th>
<th>Gross alpha (ug/1 as U natural pCi/l)</th>
<th>Gross beta (pCi/l as Sr-90/ Y-90)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norman Mead</td>
<td>15 6 94 26 NW 39 29 50 107 51 46 7.7 12</td>
<td>5-30-70  &lt;960 &lt;900</td>
<td>&lt;9.1 &lt;3.0 9.3 11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Russell Bingham, Sr.</td>
<td>16 7 94 6 SE 39 27 41 107 55 12 4.1 6.6</td>
<td>5-30-70  &lt;960 &lt;900</td>
<td>9.8 3.3 4.1 4.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albert Gardner</td>
<td>17 7 95 20 NW 39 25 49 108 01 37 4.6 7.4</td>
<td>5-30-70  &lt;960 &lt;900</td>
<td>13 4.3 5.7 6.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sinclair Oil Co.</td>
<td>18 6 96 29 SE 39 29 31 108 07 23 11.1 17.9</td>
<td>5-30-70  &lt;960 &lt;900</td>
<td>27 9.0 23 26</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willard Newell</td>
<td>19 9 94 22 NE 39 15 49 107 52 02 10.6 17.1</td>
<td>5-29-70  &lt;960 &lt;900</td>
<td>13 4.3 14 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[ As shown on figure 1. \]
Table 4.—Radiochemical analyses of precipitation from selected points in central and western Colorado

<table>
<thead>
<tr>
<th>Location</th>
<th>Sample point numbers</th>
<th>Location</th>
<th>Latitude N.</th>
<th>Longitude W.</th>
<th>Distance from surface ground zero miles</th>
<th>Date of collection</th>
<th>Tritium pCi/l</th>
<th>Gross alpha (g/1 as U natural)</th>
<th>Gross alpha (pCi/l as U natural)</th>
<th>Gross beta (pCi/l as Sr-90/37 and Ca-137)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denver, Colorado</td>
<td>7</td>
<td>45, 60N.</td>
<td>29 NW</td>
<td>39 40 30 105 01 40</td>
<td>154 248</td>
<td>6-29-70</td>
<td>1,500 450</td>
<td>0.5</td>
<td>0.2</td>
<td>51 57</td>
<td>(g/l)</td>
</tr>
<tr>
<td>Kenosha Pass, Colorado</td>
<td>8</td>
<td>75, 75W.</td>
<td>27 NE</td>
<td>39 24 50 105 45 19</td>
<td>117 188</td>
<td>6-23-70</td>
<td>1,700 520</td>
<td>0.8</td>
<td>0.3</td>
<td>200 230</td>
<td>(g/l)</td>
</tr>
<tr>
<td>Near Loveland Pass, Colorado</td>
<td>9 (g/l)</td>
<td>39 38 54 105 52 02</td>
<td>113 182</td>
<td>6-23-70</td>
<td>1,800 560</td>
<td>1.0</td>
<td>0.3</td>
<td>62 69</td>
<td>Near Arapahoe Basin ski area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near Vail Pass, Colorado</td>
<td>10 (g/l)</td>
<td>39 32 35 106 13 15</td>
<td>93 150</td>
<td>6-23-70</td>
<td>1,600 490</td>
<td>&lt;0.4</td>
<td>&lt;0.1</td>
<td>110 120</td>
<td>One mile west of summit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Junction, Colorado</td>
<td>11 (g/l)</td>
<td>1N, 1W 31 NW</td>
<td>39 07 11 108 31 28</td>
<td>37 59</td>
<td>6-25-70</td>
<td>1,200 380</td>
<td>0.6</td>
<td>0.2</td>
<td>120 140</td>
<td>At Walker Field.</td>
<td></td>
</tr>
<tr>
<td>Red Mountain Pass, Colorado</td>
<td>12 (g/l)</td>
<td>37 53 37 107 41 56 105 169</td>
<td>6-24-70</td>
<td>1,400 440</td>
<td>0.6</td>
<td>0.2</td>
<td>95 110</td>
<td>0.45 mile south of summit.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wolf Creek Pass, Colorado</td>
<td>13 (g/l)</td>
<td>37 29 00 106 47 50</td>
<td>146 235</td>
<td>6-24-70</td>
<td>1,400 440</td>
<td>0.7</td>
<td>0.2</td>
<td>180 210</td>
<td>On summit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monarch Pass, Colorado</td>
<td>14 (g/l)</td>
<td>38 30 30 106 19 45</td>
<td>108 174</td>
<td>6-24-70</td>
<td>1,800 570</td>
<td>0.9</td>
<td>0.3</td>
<td>200 220</td>
<td>On summit.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1/ As shown on figure 1.
2/ Sample collected and stored.
3/ Not surveyed.
REFERENCES

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