GEOLOGICAL SURVEY CIRCULAR 344

URANIUM IN THE POISON BASIN AREA, CARBON COUNTY WYOMING

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UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

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ABSTRACT

Uranium minerals were found on October 15, 1953, about 6 miles west of Baggs in the Browns Park formation of the Poison Basin area, Carbon County, Wyo. A number of small occurrences are present over an area of several square miles in secs. 4 and 5, T. 12 N., R. 92 W., and secs. 32 and 33, T. 13 N., R. 92 W. Uranophane-bearing sandstones contain as much as 3.21 percent uranium in select samples. The occurrences cannot be evaluated because their dimensions and average grade have not been determined. The presence of uranium, however, is significant because it indicates that uranium deposits may be present in the Browns Park formation and also in the underlying formations unconformably overlapped by the Browns Park.

INTRODUCTION

The Poison Basin area is located 6 miles west of Baggs on the southeast flank of the Washakie Basin in southwestern Carbon County, Wyo. Unusually high radioactivity in the Browns Park formation of Miocene(?) age was discovered by the writers on October 15, 1953, as a result of a reconnaissance with a car-mounted recording scintillation detector. The area was investigated because of the occurrence of uranium in rocks of Miocene(?) age in the Miller Hill area, Carbon County, Wyo., about 35 miles to the northeast (Love, 1953).

Several days after the discovery of uranium, an airborne radioactivity survey was made in the immediate area by the U. S. Atomic Energy Commission,[1] and a few weeks later another airborne radioactivity survey was made of a large area in southern Wyoming, including this area, by the U. S. Geological Survey (Henderson, 1954).

The area was revisited on October 19 and 20, 1953, to collect samples, locate land corners, and map the deposits. Prichard returned to the area on November 14 with aerial photographs to map the geology. On February 7 and 8 Vine examined the localities of

[1] U. S. Atomic Energy Commission airborne anomaly location map of Carbon County, Wyo., posted in AEC offices in Denver, Colo., and Douglas, Wyo., on November 15, 1953.

the radioactivity anomalies recorded by the U. S. Geological Survey airborne radioactivity survey.

The reconnaissance of the Poison Basin area was made on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

GEOGRAPHY

The Poison Basin area is a small topographic basin tributary to the Little Snake River, which drains a large region west of the Continental Divide on both sides of the Colorado-Wyoming boundary and flows across northwestern Colorado to join the Colorado River drainage system.

A small group of low hills locally known as Poison Buttes derive their name from the fact that vegetation in the area is toxic to livestock. Investigation of the vegetation and of the sandstone on which it is growing has indicated that the content of selenium, the principal toxicant, is unusually high (Beath, and others, 1946, p. 13). Because a high percentage of the selenium is in a water-soluble form, suitable precautions should be taken by persons working in the area or processing the samples to prevent the inhalation of selenium-bearing dust. Selenium-bearing dust can be a deadly poison to human beings.

The region is easily accessible by car from Baggs, Wyo., one of several ranching towns in the valley of Little Snake River. To reach the area from Baggs proceed north on State Highway 330 about 1 mile and turn west on a graveled county road. Proceed on the main traveled road about 4.5 miles to a road junction and take the right fork. Proceed another 1.5 miles to pit 1. The occurrences are located in secs. 4 and 5, T. 12 N., R. 92 W., and secs. 32 and 33, T. 13 N., R. 92 W., about 3 miles north of the Colorado border (figs. 1 and 2).

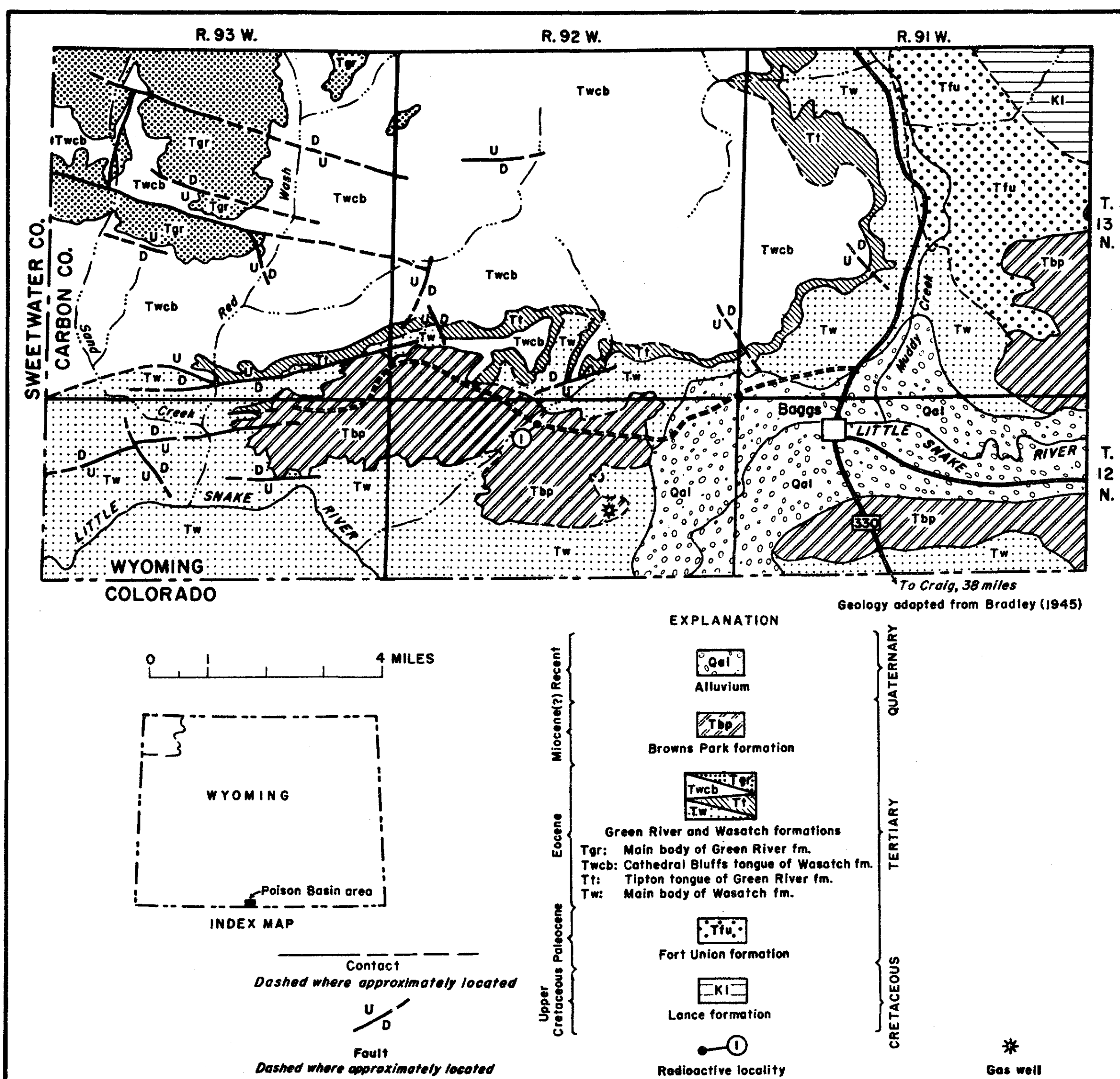

Figure 1.—Geologic map of Poison Basin and adjacent areas, Carbon County, Wyo.

The nearest railroad is the Denver and Salt Lake line at Craig, Colo. about 41 miles south of Baggs. The Union Pacific Railroad is at Creston, Wyo., about 50 miles north of Baggs. The only residents in the area live along the alluvial plain of the Little Snake River to the south. Sheep and cattle ranching are the chief industries, although several oil and gas test wells have been drilled in the vicinity.

GEOLOGY

The Poison Basin area is a topographic basin eroded chiefly from the Browns Park formation of probable Miocene age (fig. 2). The Browns Park was deposited on an erosion surface developed on gently dipping and truncated beds of the Wasatch and Green River formations of Eocene age. These formations comprise the outer rim of the Washakie Basin, a structural depression between the Rock Springs uplift on the west and the Sierra Madre Mountains on the east. Later movement along an east-trending fault zone, which extends across the entire south side of the Washakie Basin, has folded and faulted all of these strata (Bradley, 1945). A second group of faults, which strike north or northwest, is probably younger.

Both lower and upper Tertiary igneous intrusions are found in the Elkhead Mountains of Colorado 15 to 50 miles southeast of Baggs, Wyo. (Gale, 1910). The Hahns Peak mining district, about 45 miles southeast of Poison Basin has produced gold, silver, lead, and copper from vein deposits in rhyolite, latite, and andesite porphyry (Gale, 1906).

STRATIGRAPHY

Although no stratigraphic studies were made during this reconnaissance, the rocks exposed in this area were described by Bradley (1945) and the following descriptions are summarized chiefly from his work.

All the exposed rocks are of Tertiary age and include the Wasatch, Green River, and Browns Park formations.

Wasatch formation

The Wasatch formation of Eocene age is the oldest rock sequence exposed in the vicinity of Poison Basin. It consists of several thousand feet of fluviatile deposits, chiefly sandy gray mudstone containing

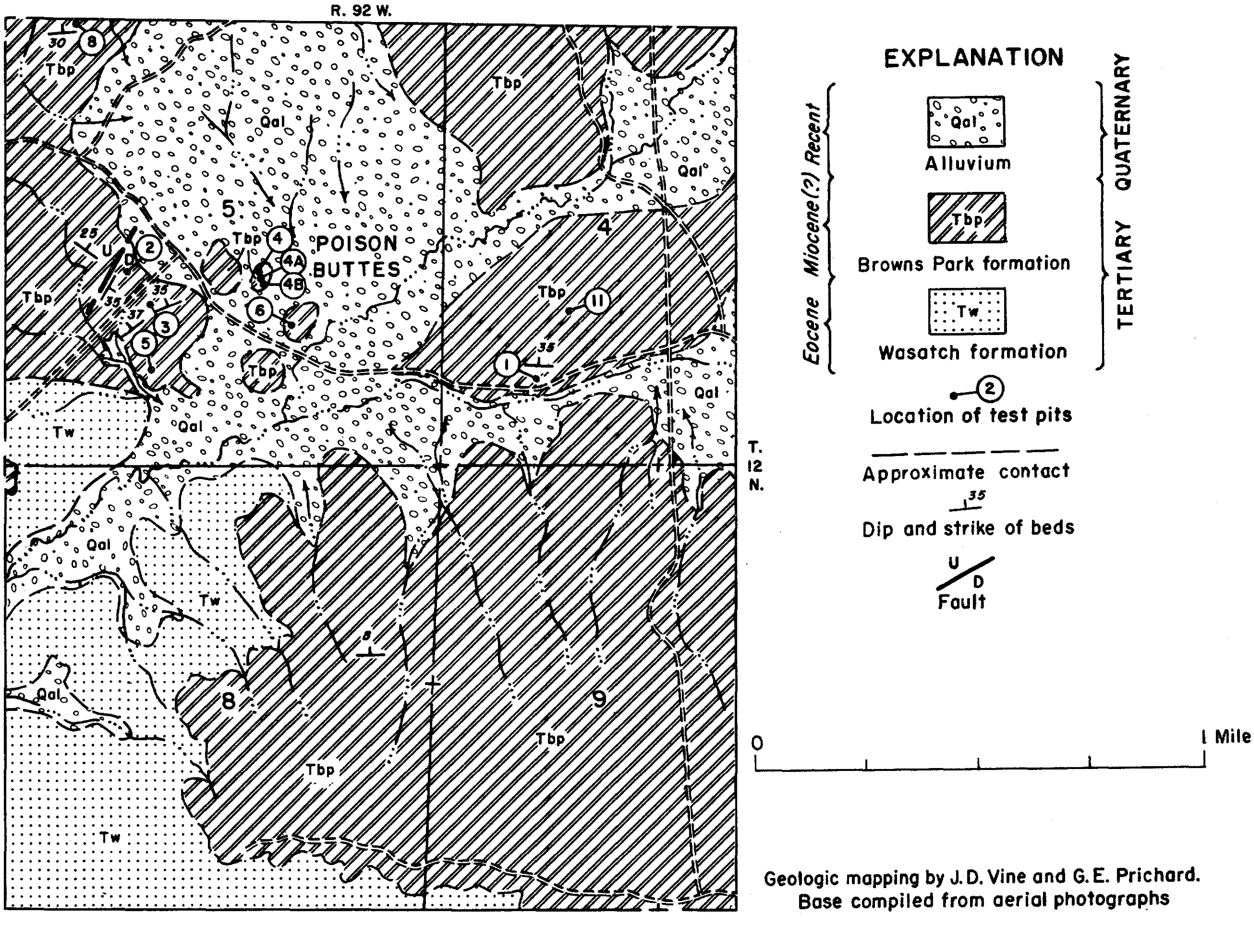

Figure 2. —Sketch map of part of Poison Basin area showing location of test pits.

irregular lenses of sandstone. The main body of the Wasatch is chiefly gray (banded with red), green, and yellow. The upper part of the Wasatch interfingers with the Green River formation and a unit of the Green River known as the Tipton tongue separates the main body of the Wasatch from its upper unit, the Cathedral Bluffs tongue. In the Poison Basin area, the Tipton tongue, although well developed to the north and west, has thinned to a feather edge. The Cathedral Bluffs tongue consists chiefly of gray mudstone, banded with red, and is probably about 1,000 feet thick.

Green River formation

The Green River formation of Eocene age consists of lacustrine, thin-bedded marlstone, oil shale, and carbonaceous shale containing numerous fresh water fossils including fish, gastropods, and ostracods. These strata interfinger with and overlie the Wasatch formation. The Tipton tongue, which is separated from the main body of the Green River by the Cathedral Bluffs tongue of the Wasatch, is the principal unit of the Green River formation exposed in the Poison Basin area. The Tipton tongue consists chiefly of soft, brown, papery, fossiliferous shales about 75 feet thick north of Poison Basin but becomes sandy and carbonaceous, and loses its identity in the area south and west of Poison Basin.

Browns Park formation

The Browns Park formation of probable Miocene age was deposited on an erosion surface of slightly tilted Eocene rocks. Outliers of the Browns Park formation occur along the south flank of the Washakie Basin as well as in areas to the east, south, and west. They were probably once continuous with the Browns Park formation of northwestern Colorado and northeastern Utah where the formation overlies rocks as old as pre-Cambrian at the east end of the Uinta Mountains.

At the base of the Browns Park formation is a conglomerate about 75 feet thick consisting largely of quartzite pebbles and cobbles in a sandy matrix. Above the conglomerate is a thick series of soft, white, highly crossbedded sandstone and tuffaceous sandstone. This material weathers into a loose sand that covers much of the Poison Basin area. Beds of dense quartzite form the top of the formation exposed in this area. Bradley (1936) states that the lower part of the Browns Park formation along the south side of the Washakie Basin consists largely of glassy tuffs, although this lithology was not observed during the reconnaissance of the Poison Basin area. No figures are available on the total thickness of the Browns Park formation and although more than 1,000 feet may be present elsewhere the top has been subjected to erosion in the Poison Basin area and it is estimated that only about 300 feet of strata remain.

Bradley (1936, p. 182-184) discusses the origin of the Browns Park formation and considers that the rounded and frosted sand grains, prominent crossbedding, and wind-faceted cobbles are probable evidence that the material was wind blown. In the Poison Basin area widely divergent strike and dip readings taken on a few isolated exposures of crossbedded sandstones in the Browns Park formation make structural interpretation difficult.

URANIUM OCCURRENCES

Sandstone containing as much as 3 percent uranium occurs in the Browns Park formation in isolated exposures on a group of low hills known as Poison Buttes and in the surrounding area in secs. 4 and 5, T. 12 N., R. 92 W., and secs. 32 and 33, T. 13 N., R. 92 W., 6th principal meridian (fig. 3). Uranophane, $Ca(UO_2)_2Si_2O_7 \cdot 6H_2O$, has been identified by R. S. Jones, W. F. Outerbridge, and A. J. Gude 3d as the principal uranium mineral in three select samples. Schroeckingerite, $NaCa_3(UO_2)(CO_3)_3(SO_4)F \cdot 10H_2O$, has been identified as the principal uranium mineral in one sample. These minerals are known at other nearby localities in Wyoming. Uranophane is the principal uranium mineral in the Miller Hill area, Carbon County, Wyo. (Vine and Prichard, 1953). Schroeckingerite is the principal uranium mineral that occurs along Lost Creek in the Great Divide Basin, Sweetwater County, Wyo. (Sheridan and others, 1952). Samples for analysis were collected from 11 shallow pits dug at several places of high radioactivity on Poison Buttes and adjacent hills. The location of most of these pits are shown on figure 2. All analyses are listed in table 1.

Pit 1. Radioactive loose brown sand lies on the bedrock for several hundred feet along the north side of the main east-trending road. About 18 inches of brown, friable, medium-grained sandstone containing fracture coatings and disseminations of uranophane was exposed in a pit dug at a place of high radioactivity. Sample VW3-91 is an 18-inch channel sample of this sandstone and contains 0.43 percent equivalent uranium and 0.39 percent uranium. Channel samples, VW3-470, VW3-471, and VW3-472, through 6 feet of the radioactive zone contain an average of 0.068 percent equivalent uranium, but only 0.016 percent uranium. The most radioactive part of the rock consists of a dark-brown lens of sandstone about 2 inches thick containing fracture coatings of uranophane. Sample VW3-89 was collected from this lens and contains 0.86 percent equivalent uranium and 0.90 percent uranium. An unidentified black mineral colors a 1- to 2-inch streak through the radioactive zone. A grab sample from this black streak, sample VW3-401, contains 0.5 percent equivalent uranium and 0.69 percent uranium. A second sample from this same zone, VW3-473, contains 1.5 percent equivalent uranium and 1.31 percent uranium.

Directly overlying the sandstone in pit 1 is a bed of medium- to coarse-grained crossbedded sandstone about 8 feet thick that appears to strike east and dips about 35° north.

Pit 2. An 18-inch zone of reddish-brown radioactive sandstone was uncovered at pit 2. No yellow uranium minerals were observed. A 12-inch channel sample from this pit, sample VW3-94, contains 0.024 percent equivalent uranium and 0.004 percent uranium. A grab sample from the most radioactive part of the same pit contains 0.25 percent equivalent uranium and 0.011 percent uranium. The sandstone exposed in the pit appears to dip less than 5° but a nearby outcrop of sandstone at the top of the hill dips about 35° and strikes about N. 30° E.

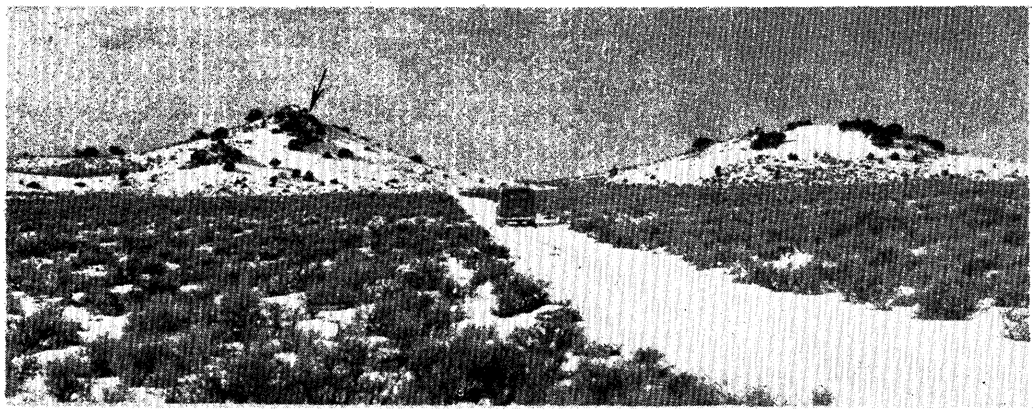

Figure 3.—Close view of Poison Buttes looking southwest. Arrow indicates approximate location of pit 3.

Pit 3 was dug in a highly radioactive zone which appeared to be parallel to the dip of the beds on the side of a hill. Digging uncovered a reddish-brown and greenish-gray, friable sandstone. The greenish tint in part of the sand may be due to disseminated uranium minerals. A 12-inch channel sample from this pit, sample VW3-95, contains 0.7 percent equivalent uranium and 0.69 percent uranium.

Pit 4. Soft, friable, light greenish-gray, massive sandstone at the top of a small hill is highly radioactive about 6 inches below the surface. The greenish tint of the sandstone may be due to disseminated uranium minerals. A 12-inch channel sample from this zone, sample VW3-96, contains 0.1 percent equivalent uranium and 0.018 percent uranium.

Pit 4A was dug in a highly radioactive zone about 25 feet southeast of pit 4 on the same hill. Friable sandstone in the pit contains fracture coatings of yellow uranophane. A sample, VW3-97, of selected yellow-stained sandstone fragments contains 1.5 percent equivalent uranium and 3.21 percent uranium. This sample contains the highest percent uranium of any of the samples collected from the Poison Basin area.

Pit 4B, on the same hill as pits 4 and 4A, was dug about 50 feet southeast of pit 4. This pit uncovered a 2-inch thick lens of radioactive, reddish-brown sandstone, estimated to be about 15 feet stratigraphically lower than the sandstone sampled in pit 4A. A grab sample, VW3-98, collected from this lens contains 0.13 percent equivalent uranium and 0.027 percent uranium.

Pit 5 was dug along a zone of moderately radioactive, light-gray sandstone similar in appearance to that encountered in pit 4. A 12-inch channel sample, VW3-99, from this pit contains 0.037 percent equivalent uranium and 0.021 percent uranium. A grab sample, VW3-474, from the same pit shows a trace of unidentified yellow mineral. It contains 0.39 percent equivalent uranium and 0.26 percent uranium.

Pit 6. A fine-grained sandstone with a pale yellowish tint was uncovered in this pit. The yellowish stain may be due to a uranium mineral disseminated through the matrix of the sandstone. A 6-inch channel sample, VW3-400, from this sandstone contains 0.34 percent equivalent uranium and 0.016 percent uranium.

Pits 7-11 were located and sampled in February 1954, after the area had been prospected by claim holders. Only pits 8 and 11 fall within the area shown on fig. 2.

Pit 7 was dug in a highly radioactive zone 2 feet in diameter. A 12-inch channel sample from this pit, VW3-475, contains 0.052 percent equivalent uranium, and 0.013 percent uranium. The pit is located about 1,200 feet north of the quarter corner between sec. 32, T. 13 N., and sec. 5, T. 12 N., R. 92 W.

Pit 8. A bulldozer trench about 75 feet long and 6 feet deep was dug in essentially barren sandstone except for one small mineralized zone at its southern end. On the east wall of the trench and about 3 feet below the ground surface, a yellow fluorescent mineral occurs in the sandstone. A 12-inch channel sample, VW3-476, of the mineralized zone contains 0.033 percent equivalent uranium, and 0.017 percent uranium. The mineral has been identified as schroeckingerite.

Pit 8A is located about 300 feet north of pit 8. A grab sample, VW3-477, of brown sandstone from the pit contains 0.018 percent equivalent uranium and 0.004 percent uranium.

Pit 9, about 3 feet deep, is located about 650 feet north-northeast of pit 8. Three channel samples, VW3-478, VW3-479, and VW3-480, were collected to represent the 3-foot interval of exposed sandstone. The average percent equivalent uranium content of these samples is about 0.1, but the average uranium content is only 0.087 percent.

Pit 10. A bulldozer trench about 10 feet deep was dug about 450 feet northeast of the northwest corner of sec. 4, T. 12 N., R. 92 W. At the bottom of the bulldozer trench a 3-foot hole was dug and a channel sample collected, VW3-481. This sample,

Table 1.—Analyses of samples collected from the Poison Basin area

Pit no.	Field no.	Lab. no.	Equivalent uranium (percent)	Uranium (percent)	V_2O_5 (percent)	As (ppm)	Se (ppm)	Description
1	VW3-89	D98776	0.86	0.90	< 0.05	250	30	Grab sample. Dark-brown uranophane-bearing sandstone.
1	VW3-91	D98777	.43	.39	< .08	200	20	18 inches. Brown sandstone.
1	VW3-401	D99839	.50	.69	----------	----	-----	Grab sample. Black sandstone.
1	VW3-470	204323	.026	.004	----------	----	-----	24 inches. Top of 6 feet of sandstone.
1	VW3-471	204324	.14	.020	----------	----	-----	24 inches. Next 2 feet sandstone.
1	VW3-472	204325	.039	.025	----------	----	-----	24 inches. Bottom 2 feet sandstone.
1	VW3-473	204325	1.5	1.31	----------	----	-----	Grab sample. Black sandstone.
2	VW3-93	D99831	.25	.011	.08	250	15	Grab sample. Reddish-brown sandstone.
2	VW3-94	D99832	.024	.004	.06	150	12	12 inches. Reddish-brown sandstone.
3	VW3-95	D99833	.70	.69	.16	----	-----	12 inches. Brown and green sandstone.
4	VW3-96	D99834	.10	.018	.13	50	40	12 inches. Greenish-gray sandstone.
4A	VW3-97	D99835	1.5	3.21	.10	100	80	Grab sample. Uranophane-bearing sandstone.
4B	VW3-98	D99836	.13	.027	.11	----	-----	Grab sample. Reddish-brown sandstone.
5	VW3-99	D99837	.037	.021	.08	----	-----	12 inches. Gray sandstone.
5	VW3-474	204327	.39	.26	----------	----	-----	Grab sample. Brown sandstone.
6	VW3-400	D99838	.34	.016	.08	----	-----	6 inches. Yellowish sandstone.
7	VW3-475	204328	.052	.013	----------	----	-----	Grab sample. Brown sandstone.
8	VW3-476	204329	.033	.017	----------	----	-----	12 inches. Schroeckingerite-bearing sandstone.
8A	VW3-477	204330	.018	.004	----------	----	-----	Grab sample. Brown sandstone.
9	VW3-478	204331	.073	.016	----------	----	-----	12 inches. Top foot of 3 feet sandstone.
9	VW3-479	204332	.19	.19	----------	----	-----	12 inches. Next foot sandstone.
9	VW3-480	204333	.051	.056	----------	----	-----	12 inches. Bottom foot sandstone.
10	VW3-481	204334	.008	.004	----------	----	-----	36 inches. Brown sandstone.
11	VW3-482	204335	.073	.019	----------	----	-----	12 inches. Brown sandstone.

representing a 3-foot zone, contains 0.008 percent equivalent uranium, and 0.004 percent uranium.

Pit 11. A limonite-stained sandstone at the top edge of a bulldozer trench about 900 feet northeast of pit 1 is highly radioactive. A 1-foot channel sample, VW3-482, of this sandstone contains 0.073 percent equivalent uranium and 0.019 percent uranium.

All the pits were dug on or near the tops of low hills where the bedrock is fairly well exposed. Radioactivity is relatively high throughout the area, but it is not known whether the uranium minerals follow stratigraphic zones which might be continuous beneath soil cover between the hills. The dominant structural trend throughout the region appears to be east-west but locally the attitude of the rocks is widely divergent from this general trend. Some of this divergence may be due to large-scale crossbedding similar to that along the south side of Washakie Basin which Bradley (1936, p. 182) describes. Erratic dips, however, may also be structural in origin. Some of the zones of radioactive, friable sandstone may be localized along faults or other structural features. Detailed geologic mapping, stratigraphic studies, and extensive trenching will probably be necessary to determine the structure.

The radioactive disintegration products of uranium are not in balance with the uranium contained in most of the samples collected. This is shown by the U:eU ratio, which ranges from 2.1:1 to 1:22.7 for the samples collected. This probably indicates a relative instability of the uranium or its radioactive disintegration products in the present environment.

ORIGIN OF THE URANIUM

The occurrence of uranium in the Poison Basin area is similar to several other areas in Wyoming including the Pumpkin Buttes (Troyer and others, 1953), Red Desert (Sheridan and others, 1952, and Masursky and Pipiringos, 1953), Miller Hill (Love, 1953), and Gas Hills (unpublished rept., Love, 1953) areas. They all contain surface deposits of secondary (yellow) uranium minerals in Tertiary strata remote from igneous activity but within or below Tertiary tuffaceous sandstones. In each instance the origin of the uranium is in doubt but most geologists favor an epigenetic origin, that is, they believe uranium was deposited at the present site by ground-water solutions passing through the rock long after the rock itself was deposited. The nature and origin of the ground-water solutions is a point of controversy. Some believe that the solutions were hydrothermal and ascended from a hidden source deep within the earth. According to this hypothesis various minerals in solution are deposited in a sequence depending on their solubility as the temperature and pressure of the solution decrease toward the earth's surface. Others believe that descending meteoric waters percolating through Tertiary tuffaceous sandstones that contain disseminated uranium have redistributed and concentrated uranium at certain favorable places. The locus of concentration may be determined by a combination of several factors including (1) chemical reactions with the rocks and (2) rate and direction of flow of the solutions as determined by structural features and permeability of the rocks.

Much more study will be required before a definite statement is warranted regarding the origin of the uranium in the Poison Basin area. However, before accepting any hypothesis it would be well to consider the following: (1) The Poison Basin area is at least 15 miles from known igneous activity and 45 miles from the Hahns Peak mining district, though situated adjacent to an east-trending fault zone which could have provided access to ground waters of relatively deep origin. (2) Uranium occurs within a sequence of rocks characterized by material of volcanic origin. (3) No features unequivocally characteristic of hydrothermal deposits were observed. (4) The similarities between the Poison Basin area and several other widely scattered occurrences in Wyoming suggest a large uraniferous province. A single hidden source adequate to supply hydrothermal solutions over that large an area seems improbable as does also the requisite number of hidden sources if each area is independent. In contrast, there was a tremendous volume of volcanic debris spread over Wyoming and most of the adjacent states during middle and late Tertiary time, more than adequate to supply the uranium contained in these scattered occurrences.

SIGNIFICANCE OF THE POISON BASIN AREA IN THE SEARCH FOR URANIUM

The occurrence of uranium minerals in the Browns Park formation of the Poison Basin area is the second reported occurrence in this formation, the first being in the Browns Park formation of Miocene(?) age in the Miller Hill area, about 35 miles to the northeast of Poison Basin (Love, 1953). There is some doubt, however, regarding the correlation of the rocks in the two areas, and it is possible that the uranium in the Miller Hill occurrences may be in a slightly younger formation. Nevertheless, the occurrance of uranium minerals in the Browns Park formation indicates that the large area covered by this formation in northwestern Colorado and adjacent parts of Wyoming and Utah can now be considered as favorable for prospecting. Similarly, although no uranium is yet known in the strata directly underlying the Browns Park in the Poison Basin area, it seems possible that uranium may have been leached from tuffaceous sandstone and redeposited at favorable places in the older rocks. A map by Bradley (1936, pl. 34) shows what he believes to be the restored surface on which the Browns Park formation was deposited and this map should provide a useful guide to prospecting in areas only recently stripped of the Browns Park as well as in areas where the formation is present.

The occurrence of uranium in the Poison Basin area coincides remarkably with an area known to be high in selenium content (Beath, and others, 1946, p. 13). The association of the two elements is probably not due to chemical combination in a specific mineral but probably is best explained by a common origin. Selenium indicator plants have been useful guides to uranium prospecting in many areas and although the two elements do not always occur together, the association may be sufficiently common to continue prospecting for uranium in other areas of known high selenium content.

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