GEOLOGICAL SURVEY CIRCULAR 338

SUMMARY OF INVESTIGATIONS OF URANIUM DEPOSITS IN THE PUMPKIN BUTTES AREA, JOHNSON AND CAMPBELL COUNTIES WYOMING

This report concerns work done on behalf of the U. S. Atomic Energy Commission and is published with the permission of the Commission.

UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

GEOLOGICAL SURVEY CIRCULAR 338

SUMMARY OF INVESTIGATIONS OF URANIUM DEPOSITS IN THE PUMPKIN BUTTES AREA, JOHNSON AND CAMPBELL COUNTIES, WYOMING

By Max L. Troyer, Edward J. McKay, Paul E. Soister,
and Stewart R. Wallace

This report concerns work done on behalf of the U. S. Atomic Energy Commission and is published with the permission of the Commission.

Washington, D. C., 1954

Free on application to the Geological Survey, Washington 25, D. C.

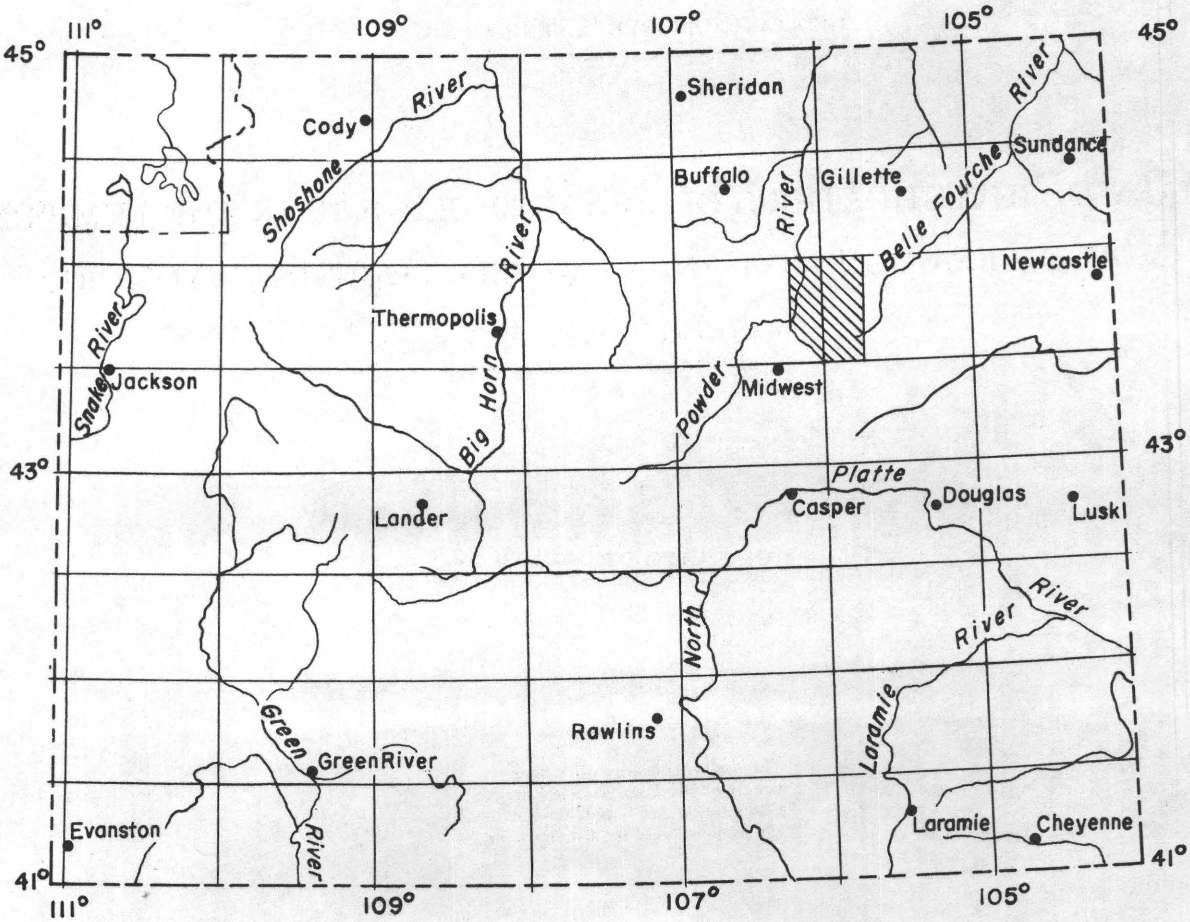


Figure 1. —Index map of Wyoming, showing location of the Pumpkin Buttes area.

SUMMARY OF INVESTIGATIONS OF URANIUM DEPOSITS IN THE PUMPKIN BUTTES AREA, JOHNSON AND CAMPBELL COUNTIES, WYOMING

By Max L. Troyer, Edward J. McKay, Paul E. Soister, and Stewart R. Wallace

CONTENTS

ILLUSTRATIONS

TABLE

ABSTRACT

Uranium minerals were discovered in the Pumpkin Buttes area, Campbell and Johnson Counties, Wyo., by the U. S. Geological Survey in October 1951. From June to November 1952, an area of about 750 square miles was examined for uranium deposits, and 211 localities having abnormally high radioactivity were found; uranium minerals are visible at 121 of these localities.

All known uranium mineralization in the area is restricted to sandstones of the Wasatch formation, except sparsely disseminated uranium in the sandstone of the White River formation, which caps the Pumpkin Buttes, and several localities on the Great Pine Ridge southwest of the Pumpkin Buttes where iron-saturated sandstone and clinker in the Fort Union formation have above-normal radioactivity. The uranium occurrences in the Wasatch formation are in a red sandstone zone 450 to 900 feet above the base of the formation and are of two types: small concretionary masses of uranium, iron, manganese and vanadium minerals in sandstone, and irregular zones in which uranium minerals are disseminated in sandstone. The second type is usually larger but of lower grade than the first.

Most of the localities at which uranium occurs are in a north-trending belt about 60 miles long and 18 miles in maximum width.

INTRODUCTION

Location, culture, and accessibility

Uranium was discovered in the Pumpkin Buttes area by the U. S. Geological Survey in October 1951, and a brief reconnaissance study was made in mid-November of that year (Love, 1952). In June 1952, investigations were resumed to search for additional concentrations of uranium, to study distribution, habit, and occurrence of such concentrations, and to use the information thus obtained as a guide in outlining areas favorable for the occurrence of uranium deposits. The results of the work are presented in this report.

In the vicinity of Pumpkin Buttes all rocks known to contain uranium in other than trace amounts, excepting a few thin carbonaceous shales and coals, are sandstones of the Wasatch formation. These sandstones were mapped by reconnaissance methods in an area of about 100 square miles. About 70 of these 100 square miles are shown on plate 1. The rest of the mapped area is west of the area shown on plate 1 where topographic sheets are lacking. Areas east of the mapped sandstones thought to be favorable for the occurrence of uranium are also shown on plate 1.

Six stratigraphic sections totaling a thickness of 7,000 feet were measured and more than 200 localities were examined where anomalous radioactivity was detected and reported by U. S. Geological Survey and Atomic Energy Commission planes equipped with scintillation-type counters. The localities where uranium minerals were seen or above-normal radioactivity was detected on the ground are shown on plate 2 and described in table 1.

Physical exploration in the area by the Geological Survey consisted of test holes drilled with a jeep-mounted auger and excavation by bulldozer.

This work is a part of the program of exploration for radioactive minerals being conducted by the U. S. Geological Survey on the behalf of the Division of Raw Materials, U. S. Atomic Energy Commission.

The Pumpkin Buttes area (fig. 1) includes about 750 square miles in southwestern Campbell County and southeastern Johnson County, Wyo., in the west-central part of the Powder River Basin. The southern part of the area is crossed by State Highway 387, and the eastern edge is accessible by a graveled road locally known as the Savageton route. One graded dirt road leads into the area from near the northeast corner and ends at the Jack Christensen ranch southwest of the North Butte. Most of the area is accessible by ranch roads and trails that are in fair condition during the summer months.

Gillette, the county seat of Campbell County, with a population of about 2,000, is the largest town serving the region, and is about 30 miles northeast of the northeast corner of the Pumpkin Buttes area. Kaycee, Sussex, Edgerton, and Midwest are small towns 15 to 20 miles west and southwest of the buttes. Access to the area from these towns is by private roads.

Physical features

The Pumpkin Buttes are close to the divide between the Powder River and the Belle Fourche River drainage systems. The buttes rise about 1,000 feet above the surrounding country and are a prominent landmark visible for as much as 80 miles. The land north and east of the buttes is grass-covered and gently rolling; relief between divides and adjacent drainage basins is commonly less than 200 feet. The land southwest and west of the buttes is dissected by many deeply incised valleys, and in a few places badlands have developed.

Two-thirds of the region, including the northern and northwestern parts, are drained by the Powder River and its ephemeral tributaries, the Dry Fork, Cottonwood Creek, Willow Creek, and Pumpkin Creek (pl. 2). The area south of State Highway 387 is drained by Antelope Creek, which is a part of the Cheyenne River drainage system. The eastern edge of the area is in the Belle Fourche River drainage basin. Vegetation is mainly grass and sagebrush; small conifers are found on the upper slopes of the buttes and some cottonwood trees grow along the major valley bottoms west of the buttes.

Acknowledgments

Much of the information used in this report was gathered from the U. S. Geological Survey and the Atomic Energy Commission airplanes equipped with scintillation detectors. Spectrographic, chemical, and radioactivity analyses were made in the Geological Survey's laboratory. Arthur J. Gude, 3d, made X-ray analyses of some of the uranium minerals. Paleobotanical and vertebrate specimens collected in the area were identified by R. W. Brown and Margaret J. Hough, respectively. J. D. Love measured many of the stratigraphic sections. D. F. Davidson, R. Hay, T. Scott, W. C. Culbertson, and E. D. Patterson assisted with the work at various times during the field season. Ranchers living in the area and corporation personnel working in the vicinity cooperated in many ways.

GEOLOGIC SETTING

The Powder River Basin is a large topographic and structural basin that covers most of the northeast quarter of Wyoming and extends northward into Montana. The basin is bordered on the east by the Black Hills, on the southeast by the Hartville uplift, on the south and southwest by Casper Mountain and the Powder River lineament, and on the west by the Bighorn Mountains.

The structural axis of the basin is near the western side, and all but the southwest part of the Pumpkin Buttes area lies east of the axis (pl. 2). In the immediate vicinity of the buttes, the Wasatch formation dips generally west and northwest. Except for local diagenetic and depositional features, the beds are nearly horizontal; dips range from less than 30 feet a mile east of the buttes to more than 100 feet a mile in the area west of the buttes.

Figure 2 is a generalized structure contour map of the Pumpkin Buttes area compiled from limited data. The buttes are on the west flank of a broad north-northwest plunging anticline, the east flank of which is described by Wegeman, Howell, and Dobbin (1928). A slight syncline and anticline are in the northeastern part of the area.

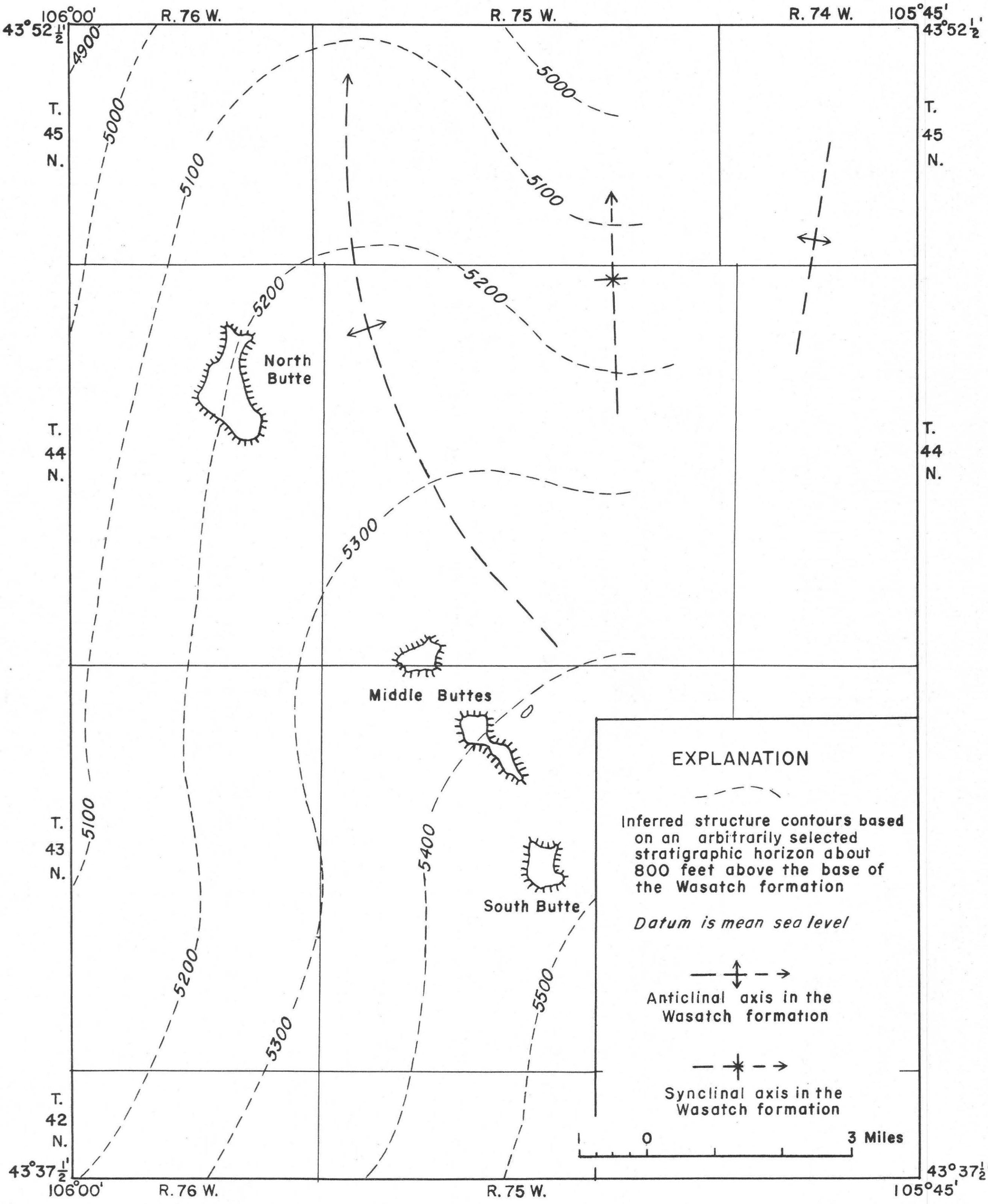


Figure 2. —Sketch map of structure contours of the Wasatch formation, east-central part of the Pumpkin Buttes area, Wyoming.

Table 1.—Localities of known uranium mineralization or anomalous high radioactivity, Pumpkin Buttes area, Wyoming

Locality no.	Location[1]	Field sample no.	Equivalent uranium (percent)	Uranium (percent)	V_2O_5 (percent)	Mn (percent)	Other (percent)	Type of sample[2]	Kind of locality[3]	Discoverer[4]	Remarks
1	15-45-75	TW-65	3.7	3.85	0.80	1.19		S	M	G	
2	22-45-75	TW-64	.24	.21	.26	.248	10.83 CO_2	S	M	G	
3	22-45-75	TW-63	9.1	14.62	3.32	.50		S	M	G	
4	29-45-75	TW-7	14.2	17.08	.38	1.17		S	M	U	
5	28-45-75	TW-21	10.0	8.43	1.51	7.4		S	M	G	
6	27-45-75	TW-5	3.2	3.98	1.96	7.56		S	M	G	
7	33-45-75	TW-6	6.7	7.7	2.69	.63		S	M	U	
8	34-45-75								M	G	
9	36-45-76	LW-86	5.7	6.34	.47	1.1		S	M	G	
		LW-87	4.2	4.72	1.75	5.7		S			
10	35-45-76	LW-82	1.9	2.97	1.21	.63		S	M	G	
		LW-83	2.1	2.30	.55	5.8		S			
		LW-84	2.3	2.43	.92	5.3		S			
		LW-85	5.2	5.62	.64	2.5		S			
11	1-44-76	LW-121	20.0	23.6	.18	.36		S	M	G	
12	12-44-75	TW-3	.44	.55	1.54	.07		S	M	U	
		TW-4	.004	.003	.32	.10	7.28 CO_2	S			Host sandstone.
13	9-43-75	LW-100	8.5	12.85	1.79	3.6		S			
		LW-104	6.5	9.46	1.24	.19		S	M	G	
		LW-105	.06	.079	.1	.12		S			Host sandstone.
14	15-43-76	LW-56	1.7	1.77	1.31			S			
		LW-57	.006	.004	.05			C	M	G	Host sandstone.
15	22-43-76	LW-51	.036	.025	.07			C	R	G	Near deposit.
16	22-43-76	LW-54	5.5	5.42	2.44			S			
		LW-55	.018	.013	.04			C			Host sandstone.
		LW-59	.003	.002	.06			S			Do.
		LW-60	.009	.010	.04			S	M	U	Do.
		LW-61	.26	.19	.86			S			Manganiferous part of deposit.
		LW-62	4.6	4.57	1.72			S			
		TW-41	.007	.004	.06	.147		C			Highly contaminated auger-hole sample.
		TW-42	.45	.48	.35	.945	6.75 CO_2	C			
		TW-46	.13	.12	.19	.468	7.19 CO_2	C			Do.
17	22-43-76	LW-52	1.2	1.38	.96			S	M	U	
		LW-53	.006	.004	.07			C	M	U	Host sandstone.
18	22-43-76	LW-63	.079	.10	.06			S			Upper 4 ft of coal below sandstone.
		LW-64	.037	.008	.10			C	M	G	Basal 5 ft of sandstone.
19	22-43-76	LW-48	.027	.024	.06			S			Top 5 ft of coal below sandstone.
		LW-49	.004	.001	.06			S			Host sandstone.

19	22-43-76	LW-50	7.4	7.27	1.63	----------	----------	S	M	G	
20	19-43-75	LW-120	5.8	6.59	2.09	6.00	----------	S	M	G	
		TW-38	.34	.34	1.02	6.70	4.15 CO_2	S	----------	----------	
21	30-43-75	LW-110	3.8	4.02	.46	17.88	----------	S	M	G	
22	25-43-75	LW-66	.98	1.78	.67	----------	----------	S	----------	----------	
		LW-67	.021	.020	.04	----------	----------	S	M	G	Host sandstone.
		LW-68	.008	.007	.08	----------	----------	S	----------	----------	Upper 0.25 ft of siltstone under sandstone.
		LW-69	.31	.53	.53	----------	----------	S	----------	----------	Base of sandstone.
23	36-43-76	LW-107	.10	.026	.08	1.09	----------	C	M	G	Host sandstone and uranium deposit.
		LW-108	.023	.003	.05	1.11	----------	C	----------	----------	Host sandstone.
		LW-109	.031	.025	.07	.76	----------	C	----------	----------	
24	31-43-76	----------	----------	----------	----------	----------	----------	----------	M	G	
25	35-43-76	TW-10	.62	.63	.61	4.0	2.69 CO_2	S	M	G	
26	4-42-76	LW-88	7.6	9.7	.68	1.2	----------	S	M	G	
27	4-42-76	----------	----------	----------	----------	----------	----------	----------	M	G	
28	4-42-76	TW-40	.042	.030	.08	.60	8.72 CO_2	C	M	G	Host sandstone and uranium deposit.
29	4-42-76	LW-112	1.1	.085	.15	.17	----------	S	----------	----------	
		LW-113	.21	.005	.05	2.29	----------	S	M	G	Manganiferous host sandstone.
30	2-42-76	TW-9	1.1	1.27	1.57	.41	----------	S	----------	----------	
		TW-39	.98	.99	1.15	2.42	----------	S	M	G	
31	22-43-76	AEC-171	6.9	6.79	----------	----------	7.4 CaO	----------	----------	----------	
		----------	----------	7.69	2.94	----------	.22 SO_4	S	M	G	
		AEC-172	2.5	2.5	1.29	----------	10.2 CaO	S	----------	----------	
		----------	----------	3.09	----------	----------	.33 SO_4	----------	----------	----------	50 lbs of average grade from bull-dozed deposit.
		LW-44	4.2	3.92	1.97	----------	----------	S	----------	----------	
		LW-45	.54	.54	.35	----------	----------	C	----------	----------	Basal 1 ft of host sandstone.
		LW-46	.20	.15	.14	----------	----------	C	----------	----------	Basal 3 ft of host sandstone.
		LW-47	.009	.007	.10	----------	----------	C	----------	----------	Host sandstone.
32	5-45-75	----------	----------	----------	----------	----------	----------	----------	R	A	
33	8-45-75	LW-122	.89	1.42	.31	6.20	----------	S	M	G	
34	11-45-75	----------	----------	----------	----------	----------	----------	----------	R	G	
35	11-45-75	----------	----------	----------	----------	----------	----------	----------	M	U	
36	11-45-75	----------	----------	----------	----------	----------	----------	----------	R	U	
37	11-45-75	TW-106	1.7	2.27	1.00	.237	----------	C	M	G	Auger-hole sample.
		TW-107	.061	.03	.04	.028	----------	C	----------	----------	Do.
38	11-45-75	TW-110	.024	.003	.05	.037	----------	C	M	U	
39	15-45-75	----------	----------	----------	----------	----------	----------	----------	M	G	
40	18-45-75	----------	----------	----------	----------	----------	----------	----------	R	U	
41	22-45-75	TW-111	.10	.052	.08	.189	----------	C	M	U	Auger-hole sample.
42	30-45-75	TW-113	.10	.006	.18	.064	----------	S	R	U	
43	33-45-75	TW-114	1.0	.92	.50	12.85	----------	S	M	A	Manganese concretion.

See footnotes at the end of the table.

Table 1.—Localities of known uranium mineralization or anomalous high radioactivity, Pumpkin Buttes area, Wyoming—Cont.

Locality no.	Location[1]	Field sample no.	Equivalent uranium (percent)	Uranium (percent)	V_2O_5 (percent)	Mn (percent)	Other (percent)	Type of sample[2]	Kind of locality[3]	Discoverer[4]	Remarks
44	34-45-75	-------	-------	-------	-------	-------	-------	-------	R	U	
45	31-45-75	-------	-------	-------	-------	-------	-------	-------	M	U	
46	36-45-76	-------	-------	-------	-------	-------	-------	-------	M	A	
47	36-45-76	-------	-------	-------	-------	-------	-------	-------	M	A	
48	36-45-76	TW-76	0.11	0.078	0.35	0.13	-------	S	M	A	
49	30-46-76	TW-78	1.2	1.84	1.53	.98	-------	S	-------	-------	
		TW-79	.13	.084	.13	.05	-------	S	M	-------	
		TW-80	.72	.95	.75	1.36	-------	S	-------	-------	
		TW-81	.20	.032	.58	.27	-------	S	-------	-------	
50	5-45-76	-------	-------	-------	-------	-------	-------	-------	R	U	
51	5-45-76	TW-66	.54	.90	.93	.13	-------	S	M	U	
		TW-67	.063	.064	.25	.10	-------	S	-------	-------	
		TW-68	.008	.008	.07	.11	-------	C	-------	-------	5-ft sample.
		TW-124	.27	.47	1.24	.027	-------	S	-------	-------	
		TW-164	.91	.95	-------	-------	-------	-------	-------	-------	
		TW-165	.71	1.26	-------	-------	-------	-------	-------	-------	
52	9-45-76	TW-70	.013	.013	.05	.13	-------	C	-------	-------	10-ft sample.
		TW-89	.068	.027	.14	.15	-------	C	M	G	
		TW-90	.22	.19	.11	.37	-------	S	-------	-------	
53	16-45-76	-------	-------	-------	-------	-------	-------	-------	R	U	
54	16-45-76	-------	-------	-------	-------	-------	-------	-------	M	U	
55	15-45-76	TW-28	3.0	3.10	.78	7.14	-------	S	M	G	
56	21-45-76	TW-71	1.3	2.42	2.59	.28	-------	S	M	U	
		TW-72	.036	.013	.16	.14	-------	C	-------	-------	6-ft sample.
57	22-45-76	TW-35	.023	.014	.19	.258	-------	S	M	G	
58	22-45-76	TW-34	.21	.17	.29	7.05	-------	S	M	G	
59	22-45-76	TW-112	.06	.023	.08	.277	-------	C	M	U	
60	27-45-76	-------	-------	-------	-------	-------	-------	-------	R	G	
61	26-45-76	TW-27	.018	.006	.06	.028	-------	C	R	A	
62	26-45-76	TW-87	.14	.13	.26	.16	-------	S	M	A	
		TW-88	.18	.17	.46	.07	-------	S	-------	-------	
63	23-45-76	-------	-------	-------	-------	-------	-------	-------	M	A	
64	24-45-76	-------	-------	-------	-------	-------	-------	-------	M	A	
65	33-45-76	-------	-------	-------	-------	-------	-------	-------	R	G	
66	35-45-76	-------	-------	-------	-------	-------	-------	-------	M	U	
67	35-45-76	TW-8	6.0	9.35	1.54	.02	-------	S	M	U	
68	4-44-76	-------	-------	-------	-------	-------	-------	-------	M	G	
69	1-44-77	-------	-------	-------	-------	-------	-------	-------	R	G	
70	10-44-76	LW-123	9.2	11.6	.37	7.60	-------	S	M	G	
71	3-44-75	TW-82	2.4	2.84	.42	2.25	-------	S	M	A	
72	3-44-75	TW-83	.84	1.03	.64	1.25	-------	S	M	A	
73	3-44-75	TW-85	.067	.038	.17	.14	-------	S	M	A	
74	10-44-75	TW-84	2.7	2.94	.92	6.40	9.07 CO_2	S	M	G	

75	10-44-75	TW-86	.19	.085	.22	.32		C	M	A	
76	12-44-75								R	U	
77	18-44-76	TW-33	.39	.28	.38	.173		S	M	G	
78	18-44-76								R	G	
79	18-44-76								M	G	
80	18-44-76								R	G	
81	24-44-76	LW-18	.005	.004				S			Coal below sandstone.
		LW-19	14.0	15.14				S	M	U	
		LW-20	.022	.026				S			Green siltstone near deposit.
82	20-44-75								R	U	
83	22-44-75								M	G	
84	28-44-75								R	U	
85	28-44-75	TW-2	.029	.18	.47	.54		C	M	U	
		TW-73	2.4	2.61	1.48	3.60		S			
86	28-44-75								M	G	
87	32-44-76								R	U	
88	4-43-75	LW-26	.021	.015	.05			S	R	G	Coal below sandstone.
89	3-43-75								R	U	
90	12-44-78	AEC-25399	.153	.153	.20			S	M	A	
91	28-43-75								R	U	
92	28-43-75								M	U	
93	28-43-75	AEC-25302	.527	.876	.62			S	M	G	
94	29-43-75								R	U	
95	30-43-76								M	G	
96	30-43-76								M	G	
97	3-42-75								R	U	
98	23-42-75								R	U	
99	21-42-75	TW-74	.034	.006	.03	.04		C	M	U	
		AEC-1079	.136	.123	.10			S			
100	1-44-76								R	A	
101	1-44-76								R	A	
102	20-45-75								M	A	
103	8-45-76	TW-69	.048	.045	.24	.17		C	M	G	Coal near siltstone.
		AEC-173	.31	.54							
				.633	1.05		2.2 CaO				
104	21-45-76								M	G	
105	17+20-46-74								R	A	
106	17-45-74	TW-102	3.4	4.60	2.28	.305		S	M	A	
107	13-44-77								M	G	
108	13-44-77	TW-36	.073	.016	.09	.378		S	M	G	
109	24-44-77								R	G	
110	28-47-74	TW-77	.020	.007	.67	.09			M	A	
111	9+10-43-77	AEC-25396	.323	.519	.69			S	M	U	
112	20-43-77	TW-13	.091	.064	.98	.83		S	R	U	Ironstone.
		TW-75	.10	.073	.26	.92		S			
113	20-43-77	TW-12	.044	.031	.22	.60		S	R	U	Ironstone.
114	20-43-77								R	U	Do.
115	16-43-77	TW-11	.29	.49	.51	.07		S	M	U	
116	8-43-77								R	U	Ironstone.

See footnotes at the end of the table.

Table 1.—Localities of known uranium mineralization or anomalous high radioactivity, Pumpkin Buttes area, Wyoming—Cont.

Locality no.	Location[1]	Field sample no.	Equivalent uranium (percent)	Uranium (percent)	V_2O_5 (percent)	Mn (percent)	Other (percent)	Type of sample[2]	Kind of locality[3]	Discoverer[4]	Remarks
117	5-42-76	LW-90	0.052	0.081	0.17	0.03	-----	S	R	G	Carbonaceous shale below sandstone.
118	12-42-78	LW-16	.001	.003	-----	-----	-----	S	-----	-----	Coal near siltstone.
		LW-17	.10	.062	-----	-----	-----	S	M	U	Red baked siltstone.
		LW-71	.12	.10	.08	-----	-----	S	-----	-----	Brown baked siltstone.
119	36-43-76	LW-114	.014	.008	.42	20.48	-----	S	M	G	Manganese concretion.
		LW-115	4.8	5.33	.66	2.05	-----	S	-----	-----	
		LW-116	.025	.018	.07	.17	-----	C	-----	-----	1-ft samples near base of sandstone.
		LW-117	.012	.003	.05	1.18	-----	C	-----	-----	1-ft sample of manganiferous sandstone.
		LW-118	14.0	22.4	.87	.35	-----	-----	S	-----	
		LW-119	.088	.084	.05	.08	-----	C	-----	-----	3.2-ft sample of light-brown sandstone near deposit. Manganese nodule.
		TW-43	.033	.020	.35	17.9	-----	S	-----	-----	
120	36-43-76	-----	-----	-----	-----	-----	-----	-----	M	G	
121	25-43-76	LW-70	.033	.012	.53	-----	-----	C	M	G	Green sandstone at base of uranium-bearing sandstone.
122	33-44-76	LW-29	.003	.002	.06	-----	-----	S	R	G	Samples taken at intervals along a hard sandstone concretion about 140 ft long.
		LW-30	.019	.003	.17	-----	-----	S	-----	-----	
		LW-31	.036	.009	.18	-----	-----	S	-----	-----	
		LW-32	.014	.003	.05	-----	-----	S	-----	-----	
		LW-33	.092	.008	.07	-----	-----	S	-----	-----	
		LW-34	.027	.003	.20	-----	-----	S	-----	-----	
		LW-35	.032	.010	.06	-----	-----	S	-----	-----	
		LW-36	.007	.006	.07	-----	-----	S	-----	-----	
123	33-44-76	LW-28	.020	.022	.13	-----	-----	S	R	G	Samples taken at intervals along a hard sandstone concretion about 220 ft long.
		LW-37	.015	.004	.08	-----	-----	S	-----	-----	
		LW-38	.10	.053	.24	-----	-----	S	-----	-----	
		LW-39	.031	.026	.12	-----	-----	S	-----	-----	
		LW-40	.029	.004	.12	-----	-----	S	-----	-----	

123	33-44-76	LW-41	.023	.002	.07	—	—	S	—	—	
		LW-42	.015	.004	.19	—	—	S	—	—	
124	14-43-76	LW-43	.007	.002	.12	—	—	C	R	U	
125	6-43-75	LW-65	.013	.006	.06	—	—	C	R	U	
126	3-44-75	—	—	—	—	—	—	—	R	U	
127	30-42-75	TW-104	8.5	11.24	1.99	.031	—	S	M	U	
128	35-42-77	TW-103	.017	.003	.04	.543	—	S	R	U	
129	23-41-77	TW-105	.029	.018	.08	.038	37.3 Fe_2O_3	S	M	U	Ironstone.
130	7-44-75	TW-125	.44	.07	.14	.553		S	M	A	
		AEC-1066	.306	.026	.05	—	—	S	—	—	
131	1-42-76	—	—	—	—	—	—	—	R	A	
132	29-43-75	—	—	—	—	—	—	—	M	A	
133	23-43-76	LW-106	.036	.009	.1	.02	—	S	R	U	Soil sample.
134	34-43-76	—	—	—	—	—	—	—	M	A	
135	34-43-76	—	—	—	—	—	—	—	M	A	
136	34-43-76	—	—	—	—	—	—	—	M	A	
137	27-43-76	—	—	—	—	—	—	—	M	A	
138	14-43-76	—	—	—	—	—	—	—	M	A	
139	4-42-76	AEC-25313	.068	.043	.03	—	32.8 $CaCO_3$	—	M	A	
140	20-42-76	AEC-25316 and 25317	.332	.51	.32	—	—	S	M	—	
141	28-42-76	AEC-25314	.017	.02	.05	—	—	S	R	A	Base of sandstone.
142	15-42-76	—	—	—	—	—	—	—	M	A	
143	4-42-75	—	—	—	—	—	—	—	R	A	
144	34-43-75	—	—	—	—	—	—	—	R	A	
145	34-43-75	—	—	—	—	—	—	—	R	A	
146	34-43-75	—	—	—	—	—	—	—	R	A	
147	33-44-76	AEC-1067	1.207	1.632	1.67	—	—	S	M	A	
		TW-121	.23	.40	.76	.169	—	S	—	—	
148	28-44-76	AEC-1073	.051	.034	.12	—	—	—	R	A	
149	34-43-75	—	—	—	—	—	—	—	R	A	
150	36-43-76	LW-99	.64	.66	2.71	6.5	5.93 CO_2	C	M	G	
151	4-42-76	LW-89	.12	.15	.1	1.4	—	S	M	G	
152	36-45-76	—	—	—	—	—	—	—	M	U	
153	34-45-76	—	—	—	—	—	—	—	M	G	
154	6-43-74	—	—	—	—	—	—	—	R	U	
155	25-41-77	—	—	—	—	—	—	—	R	U	Ironstone.
156	8-43-77	—	—	—	—	—	—	—	R	U	Do.
157	5-43-77	TW-99	.12	.08	.18	.335	43.88 Fe_2O_3	S	M	U	Do.
158	12-42-76	LW-91	.058	.063	.21	.11	—	C	M	G	2-ft sample.
		LW-92	.27	.43	.72	.13	—	C	—	—	
		LW-93	.16	.16	.75	.03	—	C	—	—	5-ft sample.
		LW-94	.10	.16	.10	.06	—	C	—	—	Basal 2 ft of sandstone.
		LW-95	1.3	.73	.75	.13	—	C	—	—	2-ft samples across deposit.
		LW-96	2.8	1.68	.1	.05	—	S	—	—	
159	12-42-76	—	—	—	—	—	—	—	M	G	
160	13-43-76	—	—	—	—	—	—	—	M	G	
161	8-43-76	—	—	—	—	—	—	—	R	U	
162	14-41-77	—	—	—	—	—	—	—	R	U	Ironstone.

See footnotes at the end of the table.

Table 1.—Localities of known uranium mineralization or anomalous high radioactivity, Pumpkin Buttes area, Wyoming—Cont.

Locality no.	Location[1]	Field sample no.	Equivalent uranium (percent)	Uranium (percent)	V_2O_5 (percent)	Mn (percent)	Other (percent)	Type of sample[2]	Kind of locality[3]	Discoverer[4]	Remarks
163	23-41-75								R	U	
164	5-43-77	TW-100	0.057	0.028	0.05	0.785	34.00 Fe_2O_3	S	R	G	Ironstone.
165	5-43-75	TW-101	.008	.000	.04	.134		S	R	G	
166	4-43-75	TW-119	.22	.010	.05	.628		C	M	U	Host sandstone.
		LW-25	.051	.004	.04			S			
167	11-45-75								M	U	
168	11-45-75	TW-108	.009	.001	.03	.029		C	M	G	Auger-hole sample.
		TW-109	.74	.84	.35	.445		S			
169	6-43-74	AEC-1085	.06	.068	.10				M	A	
170	6-43-74								R	A	
171	12-42-75	AEC-(?)	.017	.03					R	A	
172	12-42-75								R	A	
173	3-43-75								M	G	
174	16-45-74	AEC-25380	.43	.45	.37			S	M	A	
175	16-45-74	AEC-25384	.15	.111	.13			S	M	A	
176	16-42-75	AEC-1080	.01	Tr.	.03				M	A	
			1.05	1.01	.47			S			
177	29-42-75	AEC-1065	.05	.008	.03				M	A	
178	29-42-75	AEC-1068	1.37	1.95	1.42			S	M	A	
			3.21	4.87	2.39			S			
179	28-44-76								R	G	
180	23-44-76								R	G	
181	21-42-75								R	A	
182	14-44-77								R	G	
183	14-44-77								R	G	
184	14-44-77								R	G	
185	23-42-77								R	A	
186	8-43-77								R	A	
187	35-42-77								R	A	
188	25-45-76								R	A	
189	5-41-76	AEC-25401	.026	.009	Tr.			S	R	A	
190	12-42-75	AEC-25402	.02	.10	Tr.			S	R	A	
191	8-41-75	AEC-25400	.009	Tr.	.06			S	R	A	
192	11-44-75								M	A	
193	8-43-77								R	A	
194	1-44-76								M	A	
195	10-44-75								R	A	
196	10-44-75								R	A	
197	2-44-75								R	G	
198	12-44-77								R	G	
199	9-43-77								R	A	
200	32-43-75								R	U	

201	32-43-75	------	------	------	------	------	------	------	R	U	
202	29-43-75	------	------	------	------	------	------	------	R	U	
203	25-43-75	------	------	------	------	------	------	------	R	A	
204	29-41-75	------	------	------	------	------	------	------	M	G	
205	28-43-75	------	------	------	------	------	------	------	R	G	
206	28-43-75	------	------	------	------	------	------	------	R	G	
207	28-43-75	------	------	------	------	------	------	------	R	G	
208	16-43-77	------	------	------	------	------	------	------	R	A	
209	3-43-77	------	------	------	------	------	------	------	R	A	
210	17-43-77	------	------	------	------	------	------	------	R	A	
211	8-43-77	------	------	------	------	------	------	------	R	A	

[1]See plate 2. Numbers indicate section, township, and range.
[2]Type of sample: C-channeled; S-selected.
[3]R-Locality of high radioactivity but no uranium minerals observed; M-Locality of known uranium mineralization.
[4]Locality discovered by: A-Atomic Energy Commission airplane; U-Geological Survey airplane; G-Geological Survey ground party.

STRATIGRAPHY

General statement

Most of the area described in this report is underlain by the Wasatch formation of Eocene age. A thin band of Fort Union formation of Paleocene age crops out along the Great Pine Ridge escarpment in the southwestern corner of the area, and the White River formation of Oligocene age caps the Pumpkin Buttes.

Fort Union formation

The Fort Union formation is a sequence almost 3,000 feet thick, made up of gray, fine-grained sandstone, bluish-gray claystone, and coal beds. In the southwest part of the area and for some distance to the northwest and southeast, beds of coarse-grained, crossbedded sandstone in the upper part of the formation are expressed topographically by Great Pine Ridge. Some of the sandstone is ferruginous. The upper limit of the formation was arbitrarily placed by Wegeman, Howell, and Dobbin (1928) at the top of their coal bed H (see fig. 3); but G. Horn of the Geological Survey (personal communication, 1953) working in the vicinity of the Sussex oil field found that coal bed H occurs progressively lower in the section northwest of the Sussex oil field. R. K. Hose of the Geological Survey (personal communication, 1953) placed the Fort Union-Wasatch boundary at the base of the stratigraphically lowest red siltstone in the Crazy Woman Creek area northwest of the Pumpkin Buttes area and that practice was followed in the Pumpkin Buttes area. The upper 550 feet of the Fort Union formation measured in NE$\frac{1}{4}$ sec. 3, T. 42 N., R. 78 W. is illustrated in the composite stratigraphic section (fig. 3).

Wasatch formation

The Wasatch formation in the Pumpkin Buttes area consists of variegated claystone, relatively continuous thin beds of coal, carbonaceous shale, and thin-bedded sandstone and lenticular, crossbedded, medium- to coarse-grained sandstone (fig. 3). Vertebrate fossils collected during the summer of 1952 established an early Eocene age for the major part of the Wasatch formation in the west-central Powder River Basin. No middle or upper Eocene rocks are recognized.

The Wasatch formation in the Pumpkin Buttes area is about 1,500 feet thick (fig. 3). The lower 500 feet of the Wasatch formation were measured near Great Pine Ridge (SW$\frac{1}{4}$ sec. 35, T. 43 N., R. 78 W.) and the upper 1,000 feet were measured on North Pumpkin Butte (secs. 2 and 10, T. 44 N., R. 76 W.). The two parts of the composite section were connected by carbonaceous shale beds traced a distance of about 12 miles.

The Wasatch formation is composed of approximately 3 parts of shale, claystone, and siltstone to 1 part of sandstone. In overall aspect the Wasatch is lithologically a mudstone sequence interbedded with sandstone lenses. Reconnaissance by Davidson (1953) indicates in a preliminary way that fine-grained material is more abundant northwest of the Pumpkin Buttes area and coarse-grained material is more abundant southeast of the area.

Essentially all known uranium occurrences in the Pumpkin Buttes area are included in a predominantly red sandstone zone (fig. 1). The zone is about 450 feet thick in the line of the measured section, but at other places it is more than 500 feet thick. The sandstone in this zone typically is massive and crossbedded, medium- to coarse-grained, feldspathic, and friable to moderately well cemented; a few beds are tuffaceous. Lime-cemented concretions form "cannon balls," irregular masses, and elongate bodies 10 to several hundred feet long and 1 to 6 feet in diameter. The long axes of most of the observed irregular masses and the elongate bodies are oriented in a northerly direction.

Thin conglomerate beds within the sandstone are common. The pieces in the conglomerate are clay fragments as much as 2 inches in diameter. Fragments of plant material, either coalified or replaced by fine-grained silica, are locally abundant. Some of the coalified material has been replaced by iron sulfide.

Much of the sandstone in the uranium-bearing zone is colored various shades of red and brown by iron oxides, but the staining is not uniform, either stratigraphically or laterally, and gray and buff colored sandstone is common. Most of the sandstone units range from 30 to 60 feet in thickness, but in places some are more than 100 feet thick. The sandstones transgress the section, interfinger with finer clastic material, and are lenticular. They are thought to be flood-plain and channel deposits. In some places the sandstone fills channels cut in underlying beds of shale, mudstone, and siltstone, but in many places the sandstones grade laterally into finer grained sediments. Individual beds of sandstones range in extent from a few hundred yards to several miles. Not all of them are in the same stratigraphic position, but may be correlatable in zones. Very few individual beds can be traced for any distance. Except for color, sandstones in the upper 650 feet of the Wasatch appear to be similar to those in the uranium-bearing zone.

White River formation

A basal remnant of the White River formation caps all the Pumpkin Buttes and is 30 to 75 feet thick. The formation, as represented here, is composed of very coarse-grained to conglomeratic sandstone made resistant by siliceous cement. Remnants of white and pink tuff and bentonitic claystone, a few feet thick, overlie the caprock in a few places. Vertebrate fossils collected by Love (1952) established the early Oligocene age of these strata.

The White River formation overlies the Wasatch formation with an erosional unconformity marked by local channel filling. The pre-Oligocene surface was nearly horizontal in a northwest-southeast direction and, in the vicinity of Pumpkin Buttes, was cut on the underlying west and northwest low-dipping beds of the Wasatch formation.

URANIUM DEPOSITS

Almost all known concentrations of uranium occur in the sandstones of the uranium-bearing red sandstone zone 450 to 900 feet above the base of the Wasatch formation (fig. 3). The uranium occurrences are of two principal types: (1) Concretionary, or small irregularly shaped concretionary masses of uranium, iron, vanadium, and

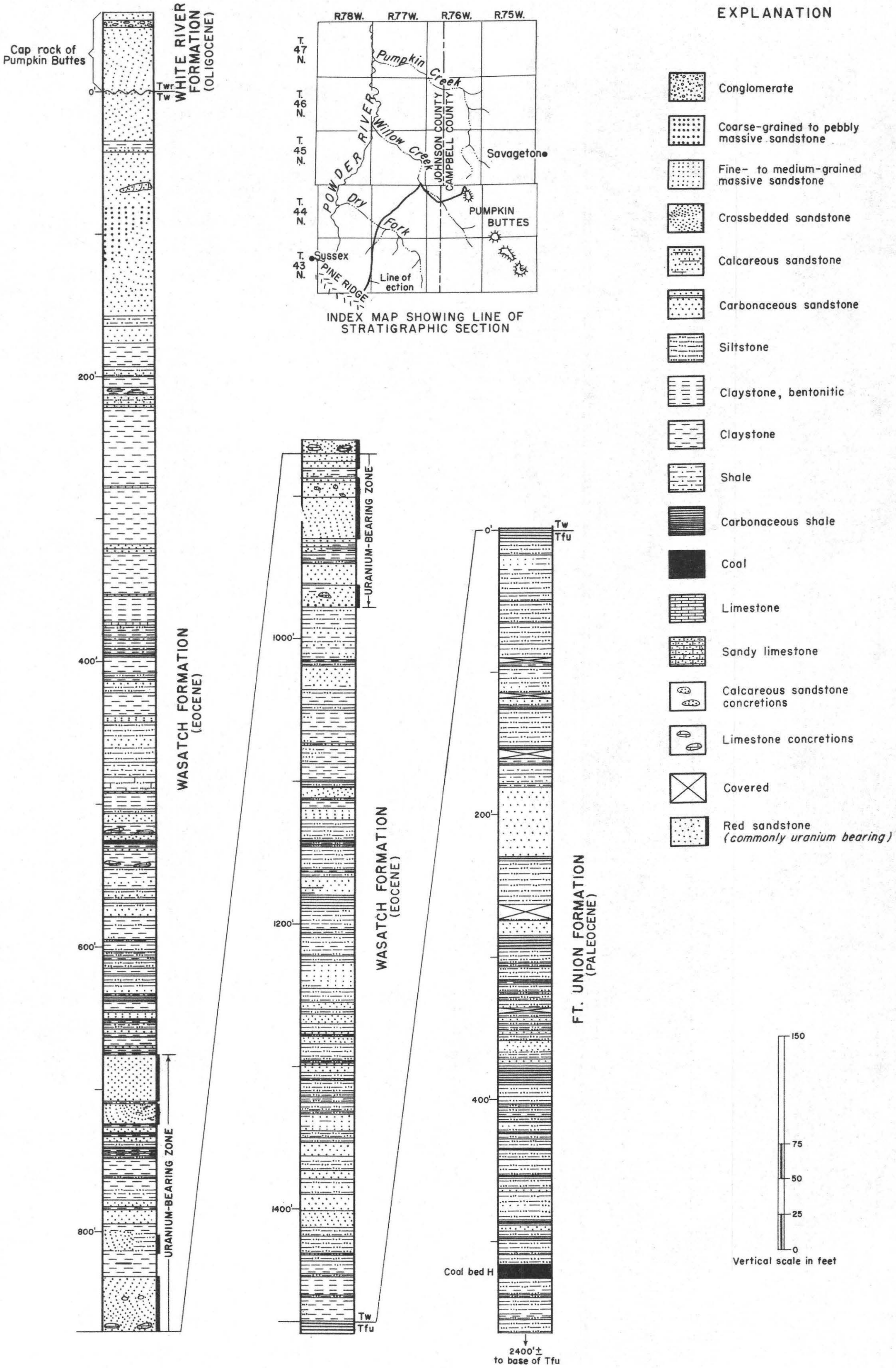
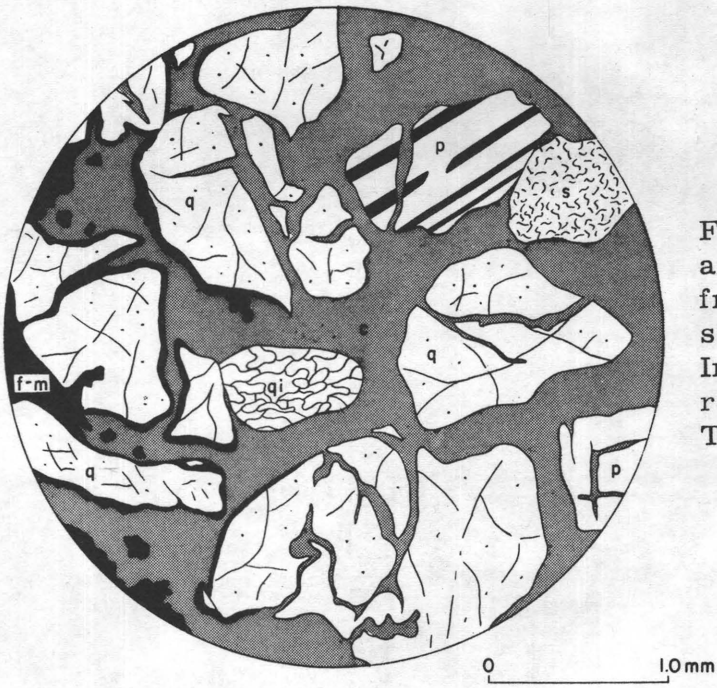
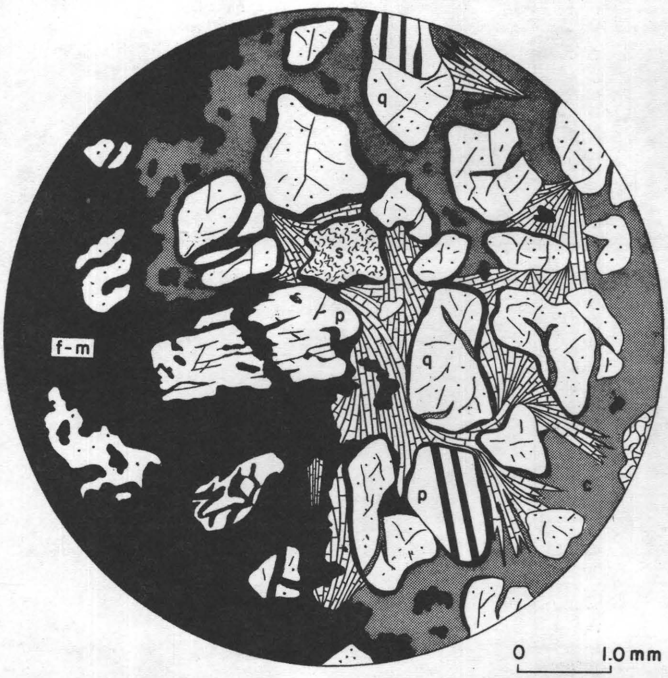


Figure 3.—Composite stratigraphic section of rocks, showing zone of principal uranium occurrence in the Pumpkin Buttes area, Wyoming.



A

Fractured grains of quartz (q) and plagioclase (p) and rock fragments, quartzite (qi) and shale (s) in calcite cement (c). Iron and manganese oxides (f-m) replace calcite in left part of field. Thin section TW-143.



B

Similar to A., but iron and manganese oxides completely replace calcite cement and attack the allogenic mineral grains at left edge of field. At center and right, sheaflike aggregates of bladed uranophane (u) replace the calcite, but not the iron-manganese oxides or the quartz or feldspar. Composite of thin section TW-140 and two sections of TW-141, showing gradational changes in mineralization.

Figure 4.—Sketches of thin sections from concretionary deposits, showing progressive stages of mineralization. Specimens from sec. 36, T. 43 N., R. 76 W.

manganese minerals in sandstone. The uranium content of many of these concretions is very high. (2) Disseminated, or in irregular zones in which uranium minerals are disseminated in sandstone with little or no visible iron and manganese. Known deposits of this type are generally much larger but of much lower grade than the concretionary type.

Uranium minerals were found at 121 of the 211 localities shown on plate 2; above-normal radioactivity was detected either by airborne or ground equipment at the remaining 90 localities, but visible uranium minerals were not found. Ninety-six of the 121 occurrences are of the concretionary type, and 6 are of the disseminated type. Because of poor exposures the remaining 19 occurrences cannot be classified.

The largest individual concretionary deposit found is about 10 feet in its longest dimension. The concretions tend to occur in groups. In some places half a dozen or so small concretions may be found in an area of a few tens of square feet. The density of distribution of the concretions at most places cannot be determined because of lack of exposures. Additional physical exploration is necessary to obtain data from which the frequency of occurrences of concretions in such areas can be predicted. Deposits of the disseminated type were discovered late in the field season of 1952 and little is known about them. The largest deposit is within an area of 100 by 800 feet and within a zone ranging in thickness from a few inches to 10 feet. Not all of the rock in this area is mineralized.

MINERALOGY

The information to be presented now is based largely on the study of 10 thin sections cut from specimens collected at locality 119, sec. 36, T. 43 N., R. 76 W., a concretionary deposit.

The sandstone at the deposit is a medium- to coarse-grained friable sandstone that contains three types of concretions: those in which the sand grains are cemented and partly replaced by calcite, those in which the sand grains are cemented and partly replaced by both calcite and iron and manganese oxides, and those in which the sand grains are cemented and partly replaced by iron and manganese oxides.

The second type contains more uranium than the other types, which commonly contain little or no uranium. Many of the uranium-bearing concretions exhibit a crude concentric banding of alternating but discontinuous zones of black, brown, and yellow mineralization and barren or only slightly mineralized sandstone. The three types seem to represent successive stages in the mineralization of the sandstone, and all gradations exist among the three types. A description of the unmineralized sandstone and of the successive changes produced by the development of the various types of concretions follows:

Subangular to subrounded quartz grains are the dominant constituent (40-60 percent) of the nonconcretionary sandstone. Plagioclase (andesine and oligoclase) and microcline constitute about 5 to 10 percent of the rock. Most of the feldspar is remarkably fresh and clear, but a few grains in every section are badly altered to sericite or allophane or both. Accessory detrital minerals include epidote, biotite, muscovite, garnet, tourmaline, chlorite, sphene, and zircon.

The rock is poorly sorted and much of the space among mineral grains is taken up with fine fragments of shale, which constitute an estimated 15 to 20 percent of the rock. Calcite cement fills the interstices.

The sandstone of the concretions is well sorted and cleaner, having relatively few shale fragments. This suggests that the development of concretions may be correlated with greater permeability. The quartz and feldspar grains in the calcite concretions (first type) are commonly ruptured, and the cracks and breaks healed with calcite which both fills the fractures and replaces the quartz and feldspar (fig. 4a). Some of the plagioclase has been replaced along cleavage cracks. The cause of the fractures is unknown, but few sand grains in specimens that were not taken from concretions show this feature.

The uranium-bearing concretions (second type) are similar to the calcite concretions except that calcite has been partly replaced by iron and manganese oxides, and at a later stage by uranophane and minor amounts of a carnotite-tyuyamunite(?) mineral. Replacement of calcite by iron and manganese oxides begins along the grain boundaries. This stage is illustrated in the left part of figure 4a. As replacement proceeds, the selvages of iron and manganese oxides surrounding the grains thicken, and irregular spots or islands of these minerals develop in the interstitial calcite. Finally the calcite cement is completely replaced, and the quartz and feldspar grains are attacked. This stage is shown in the left part of figure 4b, and results in the type of concretion which contains little uranium.

Uranophane does not develop in the absence of the iron and manganese oxides, but in the sections studied, it does not replace either the iron and manganese oxides or the relict mineral grains; apparently some calcite must be present as a site for replacement. If some calcite cement remains, then uranophane may develop. This stage is shown in the central and right parts of figure 4b. Bladed aggregates of uranophane wrap around the larger grains of quartz and feldspar, but do not replace them; small grains of quartz and islands of iron-manganese oxides are completely enclosed by the uranophane without disturbing the orientation of the individual uranophane crystals (fig. 4b). The uranophane fibers extend into the calcite, but end abruptly against the quartz grains or against the iron-manganese oxide selvage which surrounds some of the grains.

The significance of the association of uranium and the iron and manganese oxides is unknown. In a few places the opaque material exhibits rectangular outlines suggesting that some of it may be pseudomorphic after pyrite. This feature is shown at the border of the black mineralization near the top of figure 4b.

Thin sections of specimens from other concretionary deposits, from disseminated deposits, and from areas in which there are no known deposits are not yet available for study. X-ray analyses indicate that the dominant uranium mineral in the unclassified type of deposits at locality 3 and at a locality in sec. 9, R. 73 W., T. 37 N., about 25 miles south of the Pumpkin Buttes area, is metatyuyamunite. Richard Kellagher (personal communication) has reported manganosite (MnO) from locality 92, sec. 28, T. 43 N., R. 75 W. M. E. Thompson (Weeks, 1952) has

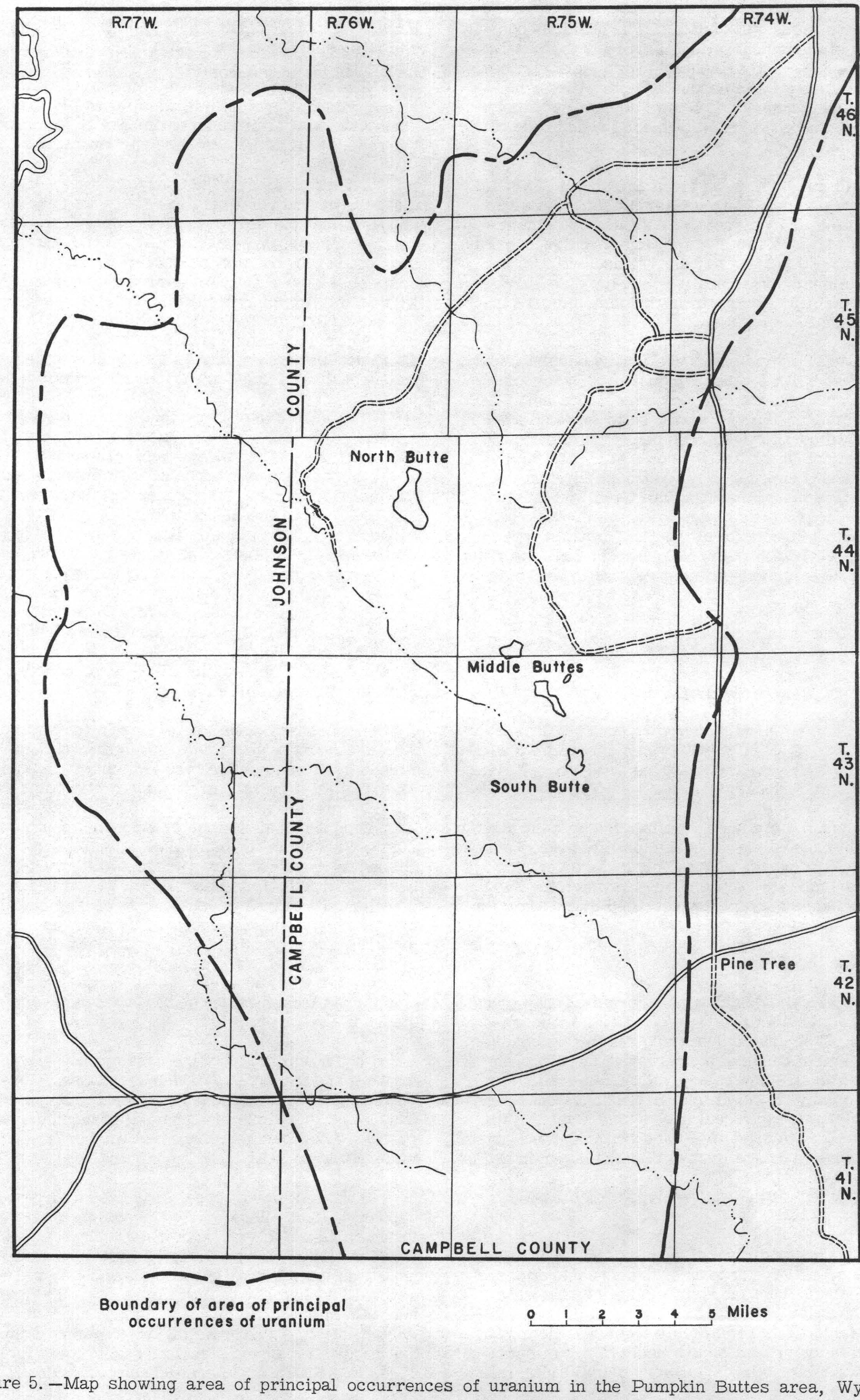


Figure 5.—Map showing area of principal occurrences of uranium in the Pumpkin Buttes area, Wyoming.

identified liebigite ($Ca_2U(CO_3)_4 \cdot 10H_2O$) from locality 29, sec. 4, T. 42 N., R. 76 W. The mineral occurs as a yellow-green efflorescence at a small water seep in sandstone exposed in a steeply cut bank.

The mineralized concretions at locality 31 contain the usual iron-manganese oxides in association with both orange and yellow uranium minerals. The orange mineral has been identified by X-ray as carnotite; the yellow material is a mixture of carnotite and an unidentified mineral.

LIMITS OF KNOWN PRINCIPAL URANIUM MINERALIZATION

The area containing the principal known occurrences of uranium in the Pumpkin Buttes area is shown on figure 5. North and northwest of this area the sandstones of the uranium-bearing zone have not been recognized and may have either been removed by erosion or grade laterally into claystone, shale, and siltstone. The attitude of the beds and surface elevations indicate that east of R. 73 W. and west of R. 77 W. the rocks exposed are stratigraphically below the uranium-bearing sandstone zone of the Wasatch formation. Anomalous radioactivity detected in siltstones, ironstones, and in one or two locally coarse-grained sandstones west of the favorable area is not associated with visible uranium mineralization.

The southern limit of the area favorable for uranium deposits is still open to question. The area extending about 6 miles south of State Highway 387 has been examined on the ground by reconnaissance methods and by Geological Survey and Atomic Energy Commission airborne scintillation detectors. Only one radioactivity anomaly was found. In November 1952, an Atomic Energy Commission plane discovered radioactivity anomalies at 3 localities 16 to 25 miles south of the area of this report. These three points were examined on the ground in February 1953 and a concretionary deposit was found at one locality. No uranium minerals are visible at the other two localities, but both show above-average radioactivity over 200 to 300 square yards. Since these three discoveries, other deposits have been found in the same vicinity by independent geologists.

GUIDES TO PROSPECTING

Three features which the writers feel will be helpful in the search for new deposits in the Pumpkin Buttes area are:

1. All uranium deposits of ore grade (0.1 percent or more uranium) are in sandstones of the red sandstone zone 450 to 900 feet above the base of the Wasatch formation. Most of the known deposits are in iron-stained sandstone or in gray- to buff-colored sandstone that is closely associated, either laterally or vertically, with iron-stained sandstone. The red sandstones and the soil derived from them photograph darker than the unstained sandstone, and it appears that the darker areas representing red sandstones shown on the aerial photographs are generally favorable for uranium mineralization. Many of the concretionary deposits were discovered by noting the color contrast between dark colored iron and manganese oxides and the host sandstone.

2. Most of the concretionary deposits occur in clusters. If one concretion is found, a thorough search should be made in the immediate vicinity for additional concentrations of uranium minerals.

3. Water samples from shallow wells and springs in the vicinity of known deposits contain as much as 50 times the amount of uranium present in water from wells in areas where no uranium deposits are known. Only a few analyses are available, but systematic sampling of water from wells and springs may prove helpful in finding new deposits.

LITERATURE CITED

Love, J. D., 1952, Preliminary report on uranium deposits in the Pumpkin Buttes area, Powder River Basin, Wyoming: U. S. Geol. Survey Circ. 176.

Wegeman, C. H., Howell, R. W., and Dobbin, C. E., 1928, The Pumpkin Buttes coal field, Wyoming: U. S. Geol. Survey Bull. 806.

UNPUBLISHED REPORTS

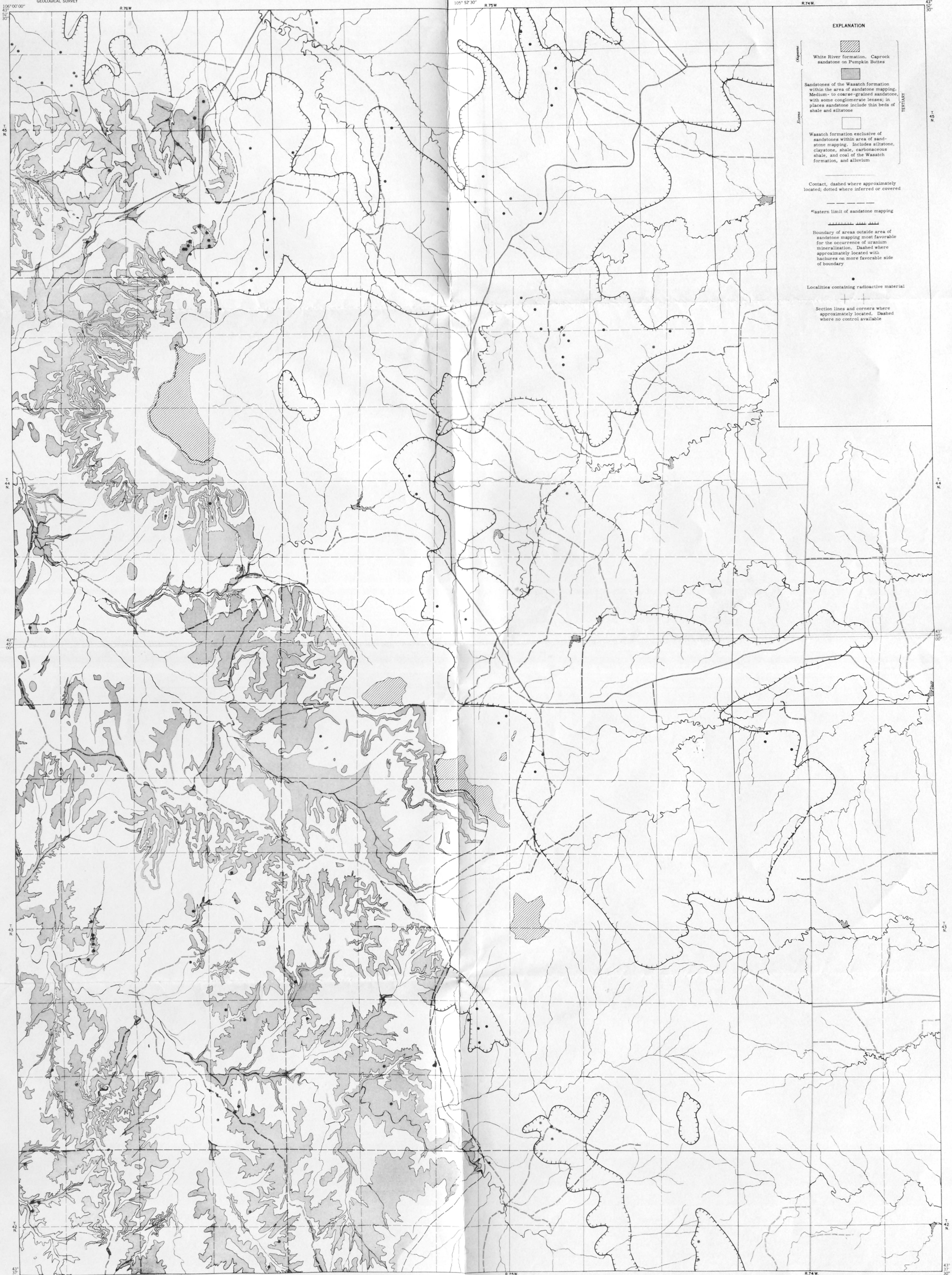
Davidson, D. F., 1953, Distribution of coarse- and fine-grained rocks in the Wasatch formation and their relationship to uranium deposits, Powder River Basin, Wyoming: U. S. Geol. Survey Trace Elements Memo Rept. 676.

Weeks, A. D., 1952, Summary report on mineralogic studies of the Colorado Plateau through April 30, 1952: U. S. Geol. Survey Trace Elements Memo. Rept. 431.

INT.-DUP. SEC., WASH., D.C. 69427

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CIRCULAR 306 PLATE 1



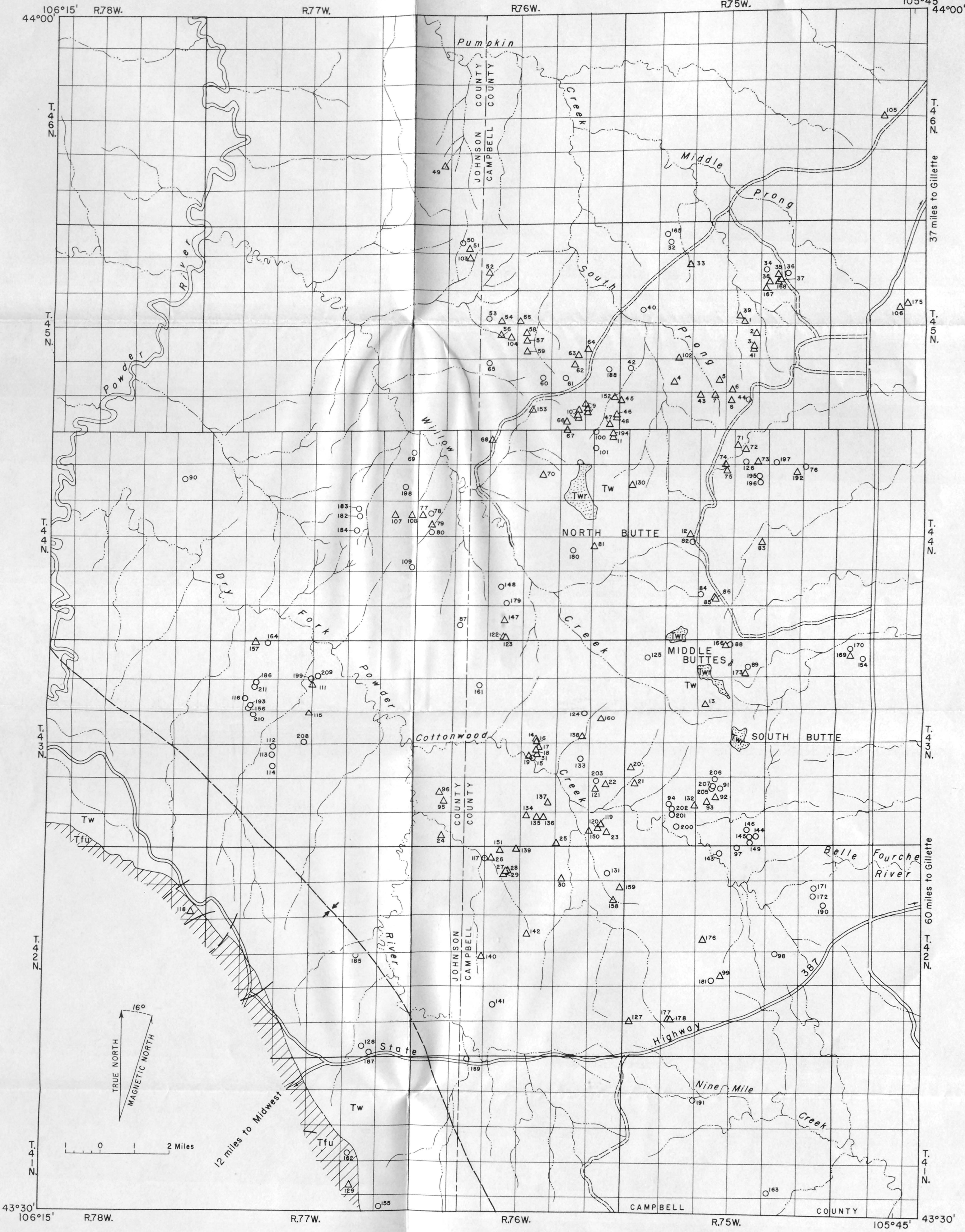
Base from U.S. Geological Survey preliminary 7½' quadrangle maps.

Geology by M. L. Troyer, E. J. McKay, S. R. Wallace, and P. E. Soister

GEOLOGIC MAP OF THE EAST-CENTRAL PART OF THE PUMPKIN BUTTES AREA, CAMPBELL COUNTY, WYOMING

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CIRCULAR 338 PLATE 2



Geology by M. L. Troyer, E. J. McKay, S. R. Wallace, and P. E. Soister

EXPLANATION

Oligocene	Twr	White River formation
Eocene	Tw	Wasatch formation
Paleocene	Tfu	Fort Union formation

TERTIARY

Geologic contact
Dashed where approximately located

Fault
Dashed where inferred

Synclinal axis of Powder River Basin
Approximately located

△[16] Localities showing visible uranium minerals

○[15] Localities showing anomalous radioactivity but no visible uranium minerals

129 Locality number (See table 1)

GEOLOGIC MAP SHOWING LOCALITIES OF URANIUM MINERALIZATION IN PUMPKIN BUTTES AREA, WYOMING