Reconnaissance for Uranium-Bearing Lignite in the Ekalaka Lignite Field, Carter County, Montana

By J. R. Gill

Trace Elements Investigations Report 452

UNITED STATES DEPARTMENT OF THE INTERIOR
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Geology and Mineralogy

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RECONNAISSANCE FOR URANIUM-BEARING LIGNITE IN THE EKALAKA LIGNITE FIELD CARTER COUNTY, MONTANA*

By

James R. Gill

July 1954

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* This report concerns work done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

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By James R. Gill

ABSTRACT

Uranium-bearing lignite beds 1.5 to 8 feet thick occur in the Fort Union formation of the southern part of the Ekalaka Hills, Carter County, Mont. Data from surface outcrops indicate that an area of about 1,400 acres is underlain by 16,500,000 tons of uranium-bearing lignite containing 700 tons of uranium. The uranium content of the lignite beds ranges from 0.001 to 0.034 percent

Ironstone concretions in the massive coarse-grained sandstones in the upper part of the Fort Union formation contain 0.005 percent uranium in the northern and eastern parts of the area. These sandstones are good potential host rocks for uranium mineralization and are lithologically similar to the massive coarse-grained uranium-bearing sandstones of the Wasatch formation in the Pumpkin Buttes area of the Powder River Basin.

INTRODUCTION

Uranium-bearing lignite was discovered by the writer in the southern part of the Ekalaka Hills (fig. 1) in September 1953. An area of about 120 square miles was mapped in reconnaissance (fig. 2) and 127 samples were collected for uranium determinations.

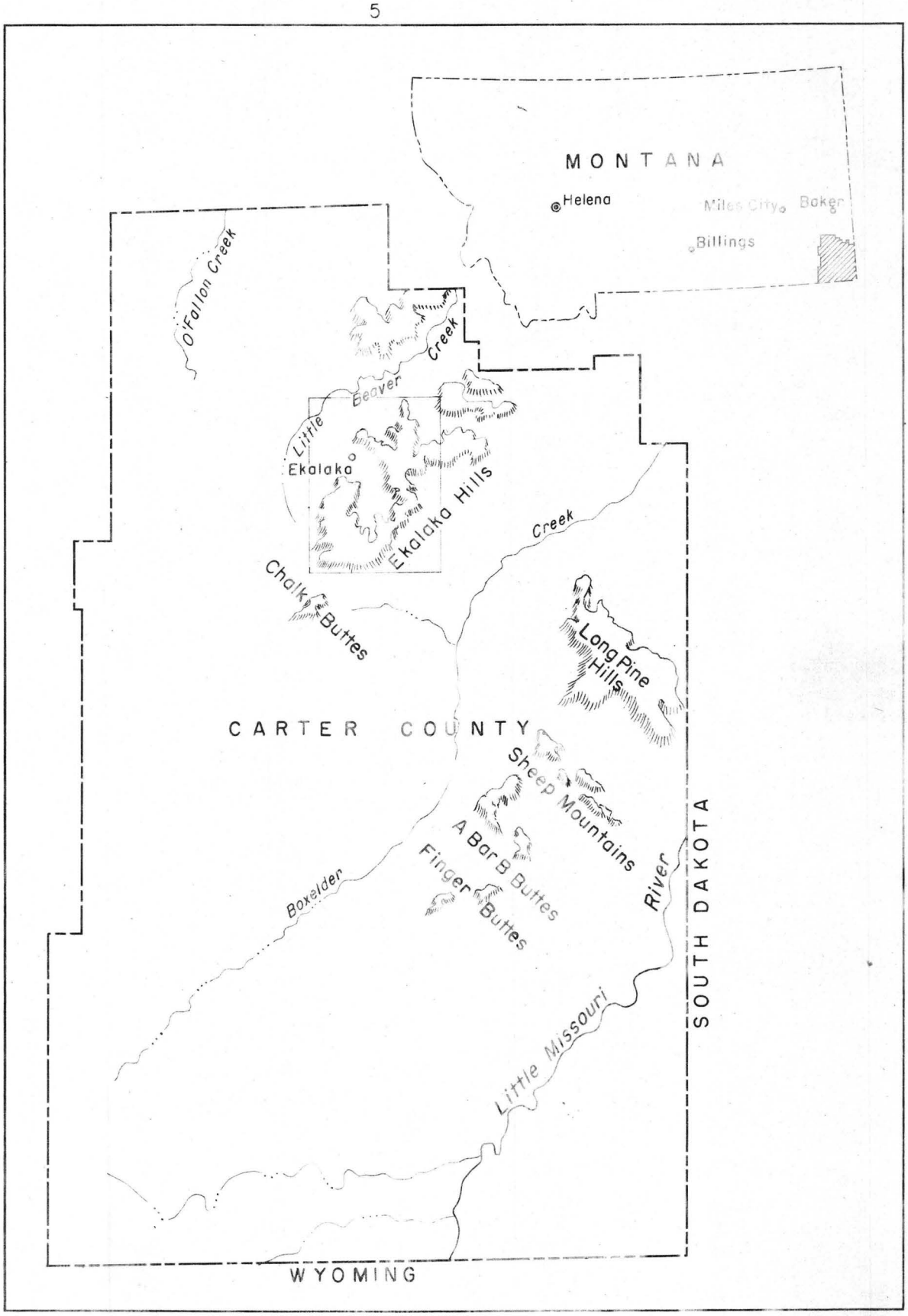
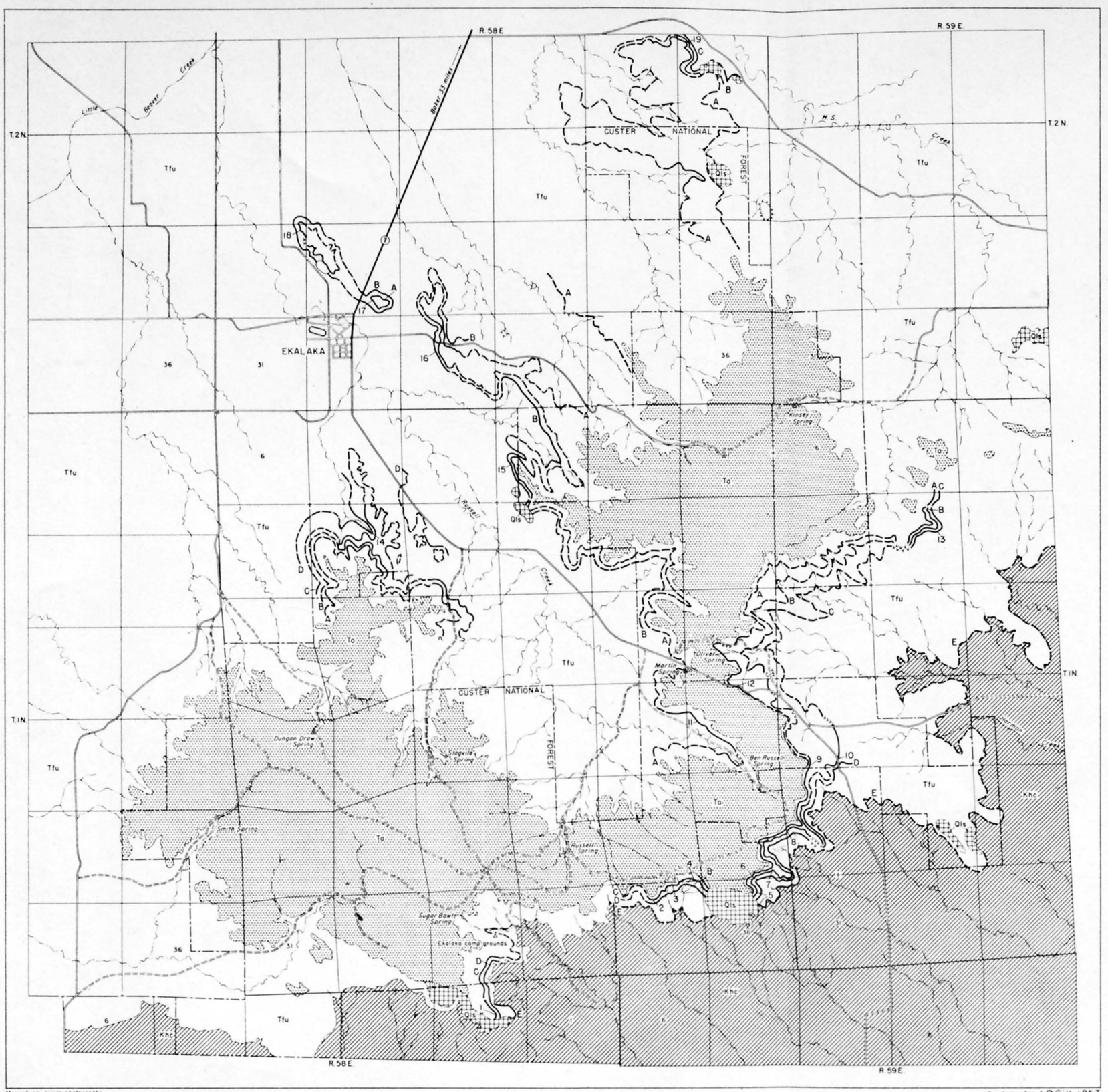


FIGURE 1 —. INDEX MAP OF CARTER COUNTY, MONTANA SHOWING LOCATION OF EKALAKA HILLS AREA



EXPLANATION

Recent	Qls	Landslide material	QUATERNARY
Miocene	To	Arikaree formation	TERTIARY
Upper Cretaceous Paleocene	Tfu	Fort Union formation	TERTIARY
Upper Cretaceous	Khc	Hell Creek formation	CRETACEOUS

Geologic contact
Dashed where approximately located

Lignite outcrop
Dashed where approximately located

Clinker

15 Sample locality

Boundary
CUSTER NATIONAL FOREST

LIGNITE ZONES MAPPED

A — Wilder lignite zone
B — Cleveland lignite zone
C — Upper Elder lignite zone
D — Lower Elder lignite zone
E — Keefer lignite zone

FIGURE 2 — PRELIMINARY GEOLOGIC MAP OF THE EKALAKA HILLS, CARTER COUNTY, MONTANA

Location and accessibility

The Ekalaka lignite field includes approximately 1,100 square miles in northeastern Carter and southern Fallon Counties in southeastern Montana although uranium-bearing lignites are known in only about 120 square miles in Carter County in the southern part of the field. The area studied is largely within Custer National Forest. Ekalaka (population 904), the county seat of Carter County, is the only town in the area. The nearest rail shipping point is at Baker about 36 miles to the north. The area is readily accessible by graded county roads and Forest Service trails, and State Highway 7 which extends southeastward across its central part.

The Ekalaka Hills rising 400 to 500 feet above the surrounding country is the most imposing topographic feature in the area. Vegetation other than grasses is sparse except on the steep slopes and relatively flat tops of the hills where dense growths of western yellow pine abound.

Previous work

The geology and lignite resources of the Ekalaka Hills are described by Bauer (1924) and the ground-water resources by Perry (1935).

Acknowledgments

William Muldowney, Forester, U. S. Forest Service, supplied Forest Service maps and aided in the location of land corners within the National Forest. The work was undertaken on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission as part of a program conducted

in the search for and the appraisal of uranium-bearing carbonaceous rocks in the Rocky Mountain region.

STRATIGRAPHY

The lignite-bearing rocks in the Ekalaka Hills range from late Cretaceous to Paleocene in age and are unconformably overlain by tuffaceous sandstones of Miocene age.

Upper Cretaceous rocks

Hell Creek formation

The oldest rocks exposed in the Ekalaka Hills are assigned to the Hell Creek formation of late Cretaceous age. These rocks consist of gray to buff claystone, with lenses of rusty-brown fine-grained poorly indurated sandstone and a few thin lenticular beds of lignite. Ellipsoidal sandstone concretions ranging from one inch to more than five feet in diameter are common. The formation averages 500 feet in thickness (Bauer, 1924, p. 239) and is conformably overlain by the Fort Union formation. The soft, poorly indurated claystones and sandstones of the Hell Creek erode to form badland topography.

Tertiary rocks

Fort Union formation

The Fort Union formation of Paleocene age consists of light yellow and gray fine- to medium-grained massive sandstone, gray shale,

claystone, and thick lenticular beds of lignite. The formation ranges from 180 to 500 feet or more in thickness and is unconformably overlain by the Arikaree formation.

In the southern part of the area the Fort Union formation is exposed beneath the cliff forming tuffaceous sandstones of the Arikaree formation that form the upper surface of the Ekalaka Hills. In the northern part of the area (T. 2 N., Rs. 58 and 59 E.) the massive, well-indurated sandstones of the upper part of the Fort Union formation form the upper surface of the Ekalaka Hills.

Ironstone concretions in the massive coarse-grained sandstones in the upper part of the Fort Union formation near Ekalaka contain 0.005 percent uranium. These sandstones are good potential host rocks for uranium mineralization and are lithologically similar to the massive coarse-grained uranium-bearing sandstones of the Wasatch formation in the Pumpkin Buttes area of the Powder River Basin (Love, 1952).

Arikaree formation

Unconformably overlying the rocks of the Fort Union formation is the Arikaree formation of Miocene age. The formation is composed of over 230 feet of slightly radioactive light-gray fine-grained tuffaceous sandstones. Samples of the sandstone contain from 0.001 to 0.003 percent uranium. The sandstone is one of the more resistant rock units in the area and causes the Ekalaka Hills to stand more than 500 feet above the surrounding country.

STRUCTURE

The Ekalaka Hills lie along the western margin of a broad shallow syncline between the northwest trending extension of the Black Hills uplift on the southwest and the Cedar Creek anticline on the northeast. The Hell Creek and Fort Union formations are about equally deformed. The overlying rocks of the Arikaree formation lie horizontal on the beveled edges of the underlying formations. In the mapped area the lignite-bearing rocks dip 1° to 3° NE.

LIGNITE

The lignite in the Ekalaka Hills is in the lower part of the Fort Union formation. The beds are best exposed in the southern part of the mapped area in secs. 35 and 36, T. 1 N., R. 58 E., and in secs. 19 and 30, T. 1 N., R. 59 E. (fig. 2). Bauer (1924) mapped three beds of lignite named, from oldest to youngest, the Keefer, Elder, and Wilder. The beds mapped are actually zones of lenticular lignites. In the present study, an additional zone, the Cleveland, was mapped between the Elder and Wilder zones, and the Elder was separated into upper and lower zones (fig. 3). The Cleveland zone is named after the Cleveland Ranch (NW 1/4, sec. 30, T. 1 N., R. 59 E.) in Carter County, Montana, where these beds attain their greatest thickness. The stratigraphic relations of these zones are shown in the following generalized section.

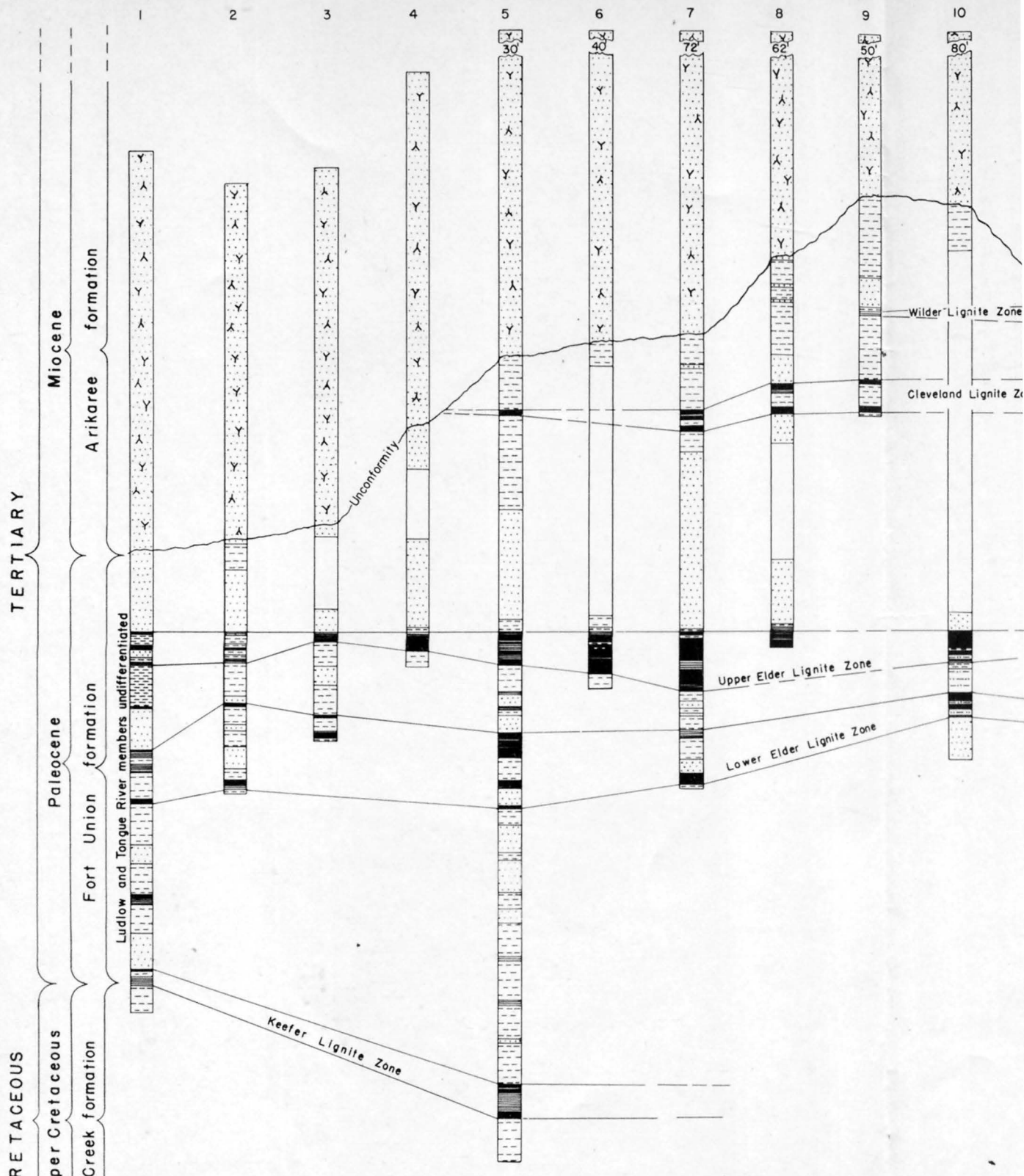


FIGURE 3 – STRATIGRAPHIC SECTIONS SHOWING CORRELATION OF LIGNITE BEDS, EK

	Feet
Wilder zone (1-3 beds)	1 - 35
shale and sandstone	30 - 45
Cleveland zone (1-3 beds)	2 - 30
sandstone and shale	35 - 90
Upper Elder zone (1-4 beds)	1 - 25
shale and sandstone	15 - 35
Lower Elder zone (1-6 beds)	8 - 30
shale and sandstone	70 - 120
Keefer zone (1-3 beds)	5 - 15

Individual beds of lignite are lenticular and are difficult to trace for any great distance. The zones, however, are persistent mappable units even though the beds at many places are represented by carbonaceous shale. Lignite sections were measured at 18 localities, and about 130 samples collected for uranium determinations (table 1, p. 13-18; fig. 4).

The uranium content of the lignite beds ranges from 0.001 to 0.034 percent. The greatest concentration of uranium is in the beds of the Wilder, Cleveland, and Upper Elder lignite zones in the southern part of the area at localities 4 through 12 inclusive (fig. 4) where they are unconformably overlain by the mildly radioactive tuffaceous sandstones of the Arikaree formation. Elsewhere in the area to the north and east, the Arikaree formation unconformably overlies younger rocks of the Fort Union formation and the same lignite beds that are uranium-bearing in the southern part of the area are not radioactive.

In the southern part of the area at localities 11 and 12 the Wilder

Table 1.--Summary of analytical data on surface samples of radioactive lignites in the Ekalaka Hills area, Carter County, Montana 1/

Locality no.	Field no.	Laboratory no.	Equivalent uranium (percent)	Ash (percent)	Uranium in ash 2/ (percent)	Uranium in sample 2/ (percent)	Location and description
1							SW NE Sec. 2, T. 1 S., R. 58 E.
	GM-138	201092	0.003	78.1			1.1' carb. shale
	GM-139	201093	.001				2.9' carb. shale
	GM-140	201094	.001				upper 1.0' of 2.0' lignite
	GM-141	201095	.001				lower 1.0' of 2.0' lignite
2							NE NW Sec. 35, T. 1 N., R. 58 E.
	GM-147	201101	.001				1.1' lignite
	GM-148	201102	.003	65.9	0.003	0.002	1.0' carb. shale
	GM-149	201103	.002				0.4' lignite
3							NW NE Sec. 35, T. 1 N., R. 58 E.
	GM-75	98592	.003	53.8			2.0' lignitic shale
	GM-76	98593	.001	62.7			2.7' lignitic shale
4							SE SE Sec. 26, T. 1 N., R. 58 E.
	GM-66	98583	.007	46.4	.021	.010	upper 1.0' of 6' lignite
	GM-67	98584	.003	45.2	.009	.004	2nd 1.0' of 6' lignite
	GM-68	98585	.004	47.1	.008	.004	3rd 1.0' of 6' lignite
	GM-69	98586	.002	49.4	.004	.002	4th 1.0' of 6' lignite
	GM-70	98587	.005	38.8	.013	.005	5th 1.0' of 6' lignite
	GM-71	98588	.003	38.0	.007	.003	6th 1.0' of 6' lignite
	GM-72	98589	.005			.002	0.9' clay shale
	GM-73	98590	.010	60.0	.010	.006	0.3' lignitic shale
	GM-74	98591	.005			.002	1.5' clay shale

1/ Analyses were made in the U. S. Geological Survey Trace Elements Laboratories, Washington, D. C. and Denver, Colo. by Ivan Barlow, H. Bivens, Maryse Delevaux, S. Furman, Mary Joslyn, Benjamin A. McCall, and Audrey Pietsch.

2/ Most samples containing less than 0.003 percent equivalent uranium were not analyzed chemically. The letter "a" indicates less than 0.001 percent equivalent uranium or less than 0.001 percent uranium.

Table 1.--Summary of analytical data on surface samples of radioactive lignites in the Ekalaka Hills area, Carter County, Montana--Continued

Locality no.	Field no.	Laboratory no.	Equivalent uranium (percent)	Ash (percent)	Uranium in ash (percent)	Uranium in sample (percent)	Location and description
5							NW NE Sec. 36, T. 1 N., R. 58 E.
	GM-5	98543	0.005	94.3	0.003	0.003	1.0' clay shale
	GM-6	98544	.015	60.1	.030	.018	0.3' lignitic shale
	GM-7	98545	.011	74.5	.016	.012	0.5' carb. shale
	GM-8	98546	.007	43.7	.024	.010	upper 0.5' of 2.5' lignite
	GM-9	98547	.004	40.4	.011	.004	2nd 0.5' of 2.5' lignite
	GM-10	98548	.002	46.1	.007	.003	3rd 0.5' of 2.5' lignite
	GM-11	98549	.003	30.9	.013	.004	4th 0.5' of 2.5' lignite
	GM-12	98550	.008	49.7	.017	.008	5th 0.5' of 2.5' lignite
	GM-13	98551	.005	56.0	.010	.006	0.5' lignitic shale
	GM-14	98552	.002				1.0' carb. shale
	GM-15	98553	.003	49.3	.004	.002	0.5' lignite
	GM-16	98554	.002				1.0' carb. shale
	GM-17	98555	a	58.3			1.0' lignitic shale
	GM-18	98556	.001	60.4		.004	1.0' lignitic shale
	GM-19	98557	.004	47.3	.008	.004	1.0' lignite
	GM-20	98558	.004	65.8	.007	.005	1.0' carb. shale
	GM-21	98559	.002	55.3			1.0' lignitic shale
	GM-22	98560	.003	54.8			1.0' lignitic shale
	GM-23	98561	.003	45.3	.007	.003	1.0' lignite
	GM-24	98562	.002	39.0	.006	.002	1.0' lignite
	GM-27	98563	.002	41.4	.006	.002	upper 0.5' of 1.5' lignite
	GM-28	98564	.004	33.5	.014	.005	2nd 0.5' of 1.5' lignite
	GM-29	98565	.005	40.7	.011	.004	3rd 0.5' of 1.5' lignite
6							SW SE, Sec. 25, T. 1 N., R. 58 E.
	GM-77	98594	.004			.001	2.4' clay shale
	GM-78	98595	.008	53.0	.009	.005	0.4' lignitic shale
	GM-79	98596	.005			.001	0.4' clay shale

Table 1.--Summary of analytical data on surface samples of radioactive lignites in the Ekalaka Hills area, Carter County, Montana--Continued

Locality no.	Field no.	Laboratory no.	Equivalent uranium (percent)	Ash (percent)	Uranium in ash (percent)	Uranium in sample (percent)	Location and description
6(cont.)	GM-80	98597	0.003	39.8	0.012	0.005	upper 1.0' of 10' lignite
	GM-81	98598	.001	42.4	.004	.002	2nd 1.0' of 10' lignite
	GM-82	98599	.002	33.6	.008	.003	3rd 1.0' of 10' lignite
	GM-83	98600	.003	33.5	.011	.004	4th 1.0' of 10' lignite
	GM-84	98601	a	32.0			5th 1.0' of 10' lignite
	GM-85	98602	.007	43.0	.017	.007	6th 1.0' of 10' lignite
	GM-86	98603	a	33.6			7th 1.0' of 10' lignite
	GM-87	98604	.002	33.5	.001	a	8th 1.0' of 10' lignite
	GM-88	98605	a	32.0			9th 1.0' of 10' lignite
	GM-89	98606	a	44.9			10th 1.0' of 10' lignite
7							SE SE Sec. 25, T. 1 N., R. 58 E.
	GM-30	95526	.006	27.7	.017	.005	upper 0.5' of 1.5' lignite
	GM-31	95527	.021	24.0	.014	.034	2nd 0.5' of 1.5' lignite
	GM-32	95528	.007	51.9	.015	.008	3rd 0.5' of 1.5' lignite
	GM-33	95529	.004	71.8	.004	.003	1.0' carb. shale
	GM-34	95530	.004	34.3	.012	.004	0.7' lignite
	GM-35	95531	.003	86.9	.002	.002	0.3' carb. shale
	GM-36	95532	.002	35.5	.005	.002	upper 1.0' of 2.0' lignite
	GM-37	95533	.003	38.2	.008	.003	lower 1.0' of 2.0' lignite
	GM-38	95534	.010	91.8	.008	.007	0.8' shale
	GM-39	95535	.011	39.3	.027	.011	0.3' lignite
	GM-40	95536	.005	86.3	.003	.003	1.0' carb. shale
8							CWL Sec. 30, T. 1 N., R. 59 E.
	GM-53	98569	.005	56.2	.012	.007	1.0' carb. shale
	GM-54	98570	.003	41.4	.010	.004	upper 1.0' of 2.0' lignite
	GM-55	98571	.002	39.1	.011	.004	lower 1.0' of 2.0' lignite
	GM-56	98572	.007	48.9	.019	.009	1.0' lignite
	GM-57	98573	.007	81.0	.012	.010	0.4' carb. shale
	GM-58	98574	.011	63.5	.014	.009	0.2' lignite

Table 1.--Summary of analytical data on surface samples of radioactive lignites in the Ekalaka Hills area, Carter County, Montana--Continued

Locality no.	Field no.	Laboratory no.	Equivalent uranium (percent)	Ash (percent)	Uranium in ash (percent)	Uranium in sample (percent)	Location and description
8(cont.)	GM-59	98575	0.008	86.6	0.009	0.008	0.8' carb. shale
	GM-60	98576	.004			.001	1.0' shale
	GM-61	98577	.005	52.2	.008	.004	0.5' of 2.5' lignite
	GM-62	98578	.002	42.6	.007	.003	2nd 1.0' of 2.5' lignite
	GM-63	98579	.007	37.8	.014	.005	lower 1.0' of 2.5' lignite
	GM-64	98580	.003	72.1			0.7' carb. shale
	GM-64A	98581	.008	90.1	.007	.006	0.3' carb. shale
	GM-65	98582	.003	41.6	.001	a	0.3' lignite
9							SE SW Sec. 19, T. 1 N., R. 59 E.
	GM-96	98607	.003	38.2	.009	.003	upper 1.1' of 2.2' lignite
	GM-97	98608	.006	36.6	.020	.007	lower 1.1' of 2.2' lignite
	GM-98	98609	.003				1.0' clay shale
	GM-99	98610	.002	48.5	.005	.002	0,7' lignite
11							NW SW Sec. 24, T. 1 N., R. 58 E.
	GM-50	98566	.004	39.2	.011	.004	upper 1.0' of 5.8' lignite
	GM-51	98567	.004	47.0	.008	.004	2nd 1.0' of 5.8' lignite
	GM-52	98568	.001	30.7	.007	.002	lower 3.8' of 5.8' lignite
12							NW NE Sec. 24, T. 1 N., R. 58 E.
	GM-100	98611	.005	26.6	.020	.005	upper 1.0' of 6.0' lignite
	GM-101	98612	.002	36.0	.006	.002	2nd 1.0' of 6.0' lignite
	GM-102	98613	.001	41.9	.002	.001	3rd 1.0' of 6.0' lignite
	GM-103	98614	.001	14.1	.014	.002	4th 1.0' of 6.0' lignite
	GM-104	98615		17.1			5th 1.0' of 6.0' lignite
	GM-105	98616	.001	16.4	.005	.001	lower 1.0' of 6.0' lignite

Table 1.--Summary of analytical data on surface samples of radioactive lignites in the Ekalaka Hills area, Carter County, Montana--Continued

Locality no.	Field no.	Laboratory no.	Equivalent uranium (percent)	Ash (percent)	Uranium in ash (percent)	Uranium in sample (percent)	Location and description
13							SE NW Sec. 8, T. 1 N., R. 59 E.
	GM-142	201096	0.002				1.8' lignite
	GM-143	201097	.001				0.9' lignite
	GM-144	201098	.001				1.8' carb. shale
	GM-145	201099	.002				1.3' carb. shale
	GM-146	201100	.002				0.4' carb. shale
14							SW NE Sec. 8, T. 1 N., R. 58 E.
	GM-108	201061	.002				2.5' lignite
	GM-109	201062	.001				0.6' lignite
	GM-110	201063	.002				0.7' lignite
	GM-111	201064	.006	86.0	0.003	0.002	0.6' analcite
	GM-112	201065	.004	78.5	.003	.002	0.4' carb. shale
15							NW SW Sec. 3, T. 1 N., R. 58 E.
	GM-134	201087	.004	34.7	.005	.001	3.4' lignite
	GM-135	201088	.002				1.0' carb. shale
	GM-136	201089	.002				upper 1.5' of 3.0' shale
	GM-137	201090	.004	79.4	.001		lower 1.5' of 3.0' shale
16							SE NE Sec. 33, T. 2 N., R. 58 E.
	GM-133	201086	.008	81.0	.005	.005	Ironstone concretion
17							SW SE Sec. 29, T. 2 N., R. 58 E.
	GM-120	201073	.002				2.0' carb. shale
	GM-121	201074	.002				1.9' lignite
	GM-122	201075	.003	53.6	.003	.001	2.6' carb. shale
	GM-123	201076	.004	43.0	.009	.004	0.3' lignite

Table 1.--Summary of analytical data on surface samples of radioactive lignites in the Ekalaka Hills area, Carter County, Montana--Continued

Locality no.	Field no.	Laboratory no.	Equivalent uranium (percent)	Ash (percent)	Uranium in ash (percent)	Uranium in sample (percent)	Location and description
17 (cont.)							
	GM-124	201077	0.002				1.0' lignite
	GM-125	201078	.003	91.2	a		1.0' carb. shale
	GM-126	201079	.003	35.1	0.004	0.001	upper 1.0' of 3.5' lignite
	GM-127	201080	.004	16.6	.013	.002	2nd 1.0' of 3.5' lignite
	GM-128	201081	.003	28.2	.009	.002	lower 1.5' of 3.5' lignite
	GM-129	201082	.003	91.0	a		2.4' carb. shale
	GM-130	201083	.006	44.7	.010	.005	1.5' lignite
	GM-131	201084	.004	93.2	a		1.0' carb. shale
	GM-132	201085	.002				2.3' carb. shale
18							NE NE Sec.30, T.2 N., R.57 E.
	GM-115	201068	.001				0.7' lignite
	GM-116	201069	.002				1.5' lignite
	GM-117	201070	.003	36.0	.003	.001	0.9' lignite
	GM-118	201071	.004	92.1			0.9' carb. shale
	GM-120	201072	.002				1.2' coal ash
19							NW NW Sec.18, T.2 N., R.58 E.
	GM-113	201066	.003	76.1	.001	.001	2.1' carb. shale
	GM-114	201067	.001				1.0' lignite

Total 128

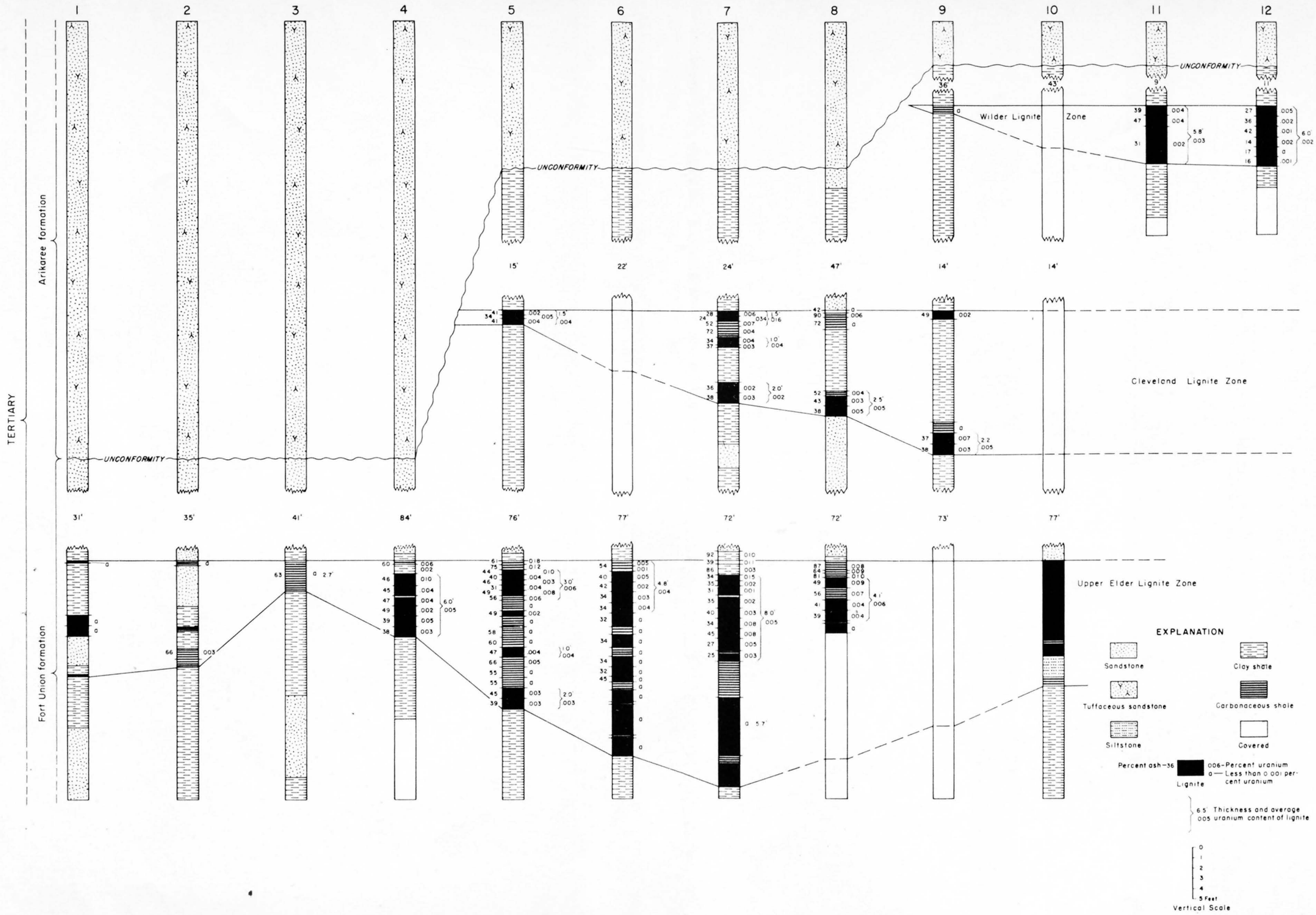


FIGURE 4 —. CHART SHOWING CONCENTRATION AND DISTRIBUTION OF URANIUM IN LIGNITE BEDS, EKALAKA HILLS, CARTER COUNTY, MONTANA.

lignite contains an average of about 0.003 percent throughout its entire thickness of 5.9 feet and the Cleveland lignite zone contains several thin beds ranging from 1.5 to 3.5 feet in thickness that contain an average of 0.006 percent uranium. The Upper Elder lignite zone is highly lenticular ranging from less than one foot to more than 20 feet in thickness. A maximum thickness of 8 feet contains 0.005 percent uranium.

Fresh, unweathered samples suitable for fuel analysis could not be collected from outcrops and there are no mines in the area. The lignites contain 14 to 50 percent ash. The ash determinations were made on weathered samples containing visible impurities of analcite, barite and gypsum. Because these impurities probably were introduced during the weathering of the lignite, it is not unreasonable to assume that unweathered lignite will have a much lower ash content and will have heating values comparable to most lignites.

ORIGIN

Investigations of uranium-bearing lignite deposits in North and South Dakota by Denson, Bachman, and Zeller (1950) suggested that the uranium present in these lignites migrated downward in ground water from the radioactive tuffs in the overlying White River and Arikaree formations of Oligocene and Miocene age. Subsequently, secondary uranium minerals were found in Oligocene rocks in the Slim Buttes area (Gill and Moore, 1954a) and in the Big Badlands of South Dakota (Moore and Levish, 1954).

Some of the conditions that seem to control the concentration of

uranium in the lignite are: stratigraphic proximity of the lignite to the base of the potential source rock, permeability of rocks overlying the lignite, and the adsorptive properties of the lignite. In general, the stratigraphically highest lignite beneath the source rock is the most radioactive, and the greatest concentration of uranium is in the upper parts of beds three feet or more in thickness. Beds less than 3 feet thick may contain uranium through their entire thickness.

The distribution of uranium in the lignite beds is shown on figure 4. The effect of permeability is indicated in the Wilder bed at localities 11 and 12 where the lignite is directly overlain by impervious shale. The uranium content is low despite the fact that the lignite closely underlies the source rocks of the Arikaree formation. At localities 4, 5, 7 and 8 (fig. 3) the Upper Elder lignite zone is overlain by a thick sandstone and though the lignites are 90 to 150 feet stratigraphically below the base of the Arikaree formation the upper parts of the lignite bed are more than twice as uraniferous as the Wilder bed at localities 11 and 12.

Minor variations in the distribution of uranium within the lignite bed can be expected where the lignite is directly overlain by an impervious shale and underlain by a permeable sandstone, as for example, the Cleveland lignite at locality 8. There, a bottom rather than a top preferential distribution suggests that the uranium may have been introduced under hydrostatic head into the base of the lignite from the underlying sandstone.

Where the lignites are separated from the Arikaree formation by the impervious younger rocks of the Fort Union formation, as in the

northern and eastern parts of the area, the beds are not radioactive.

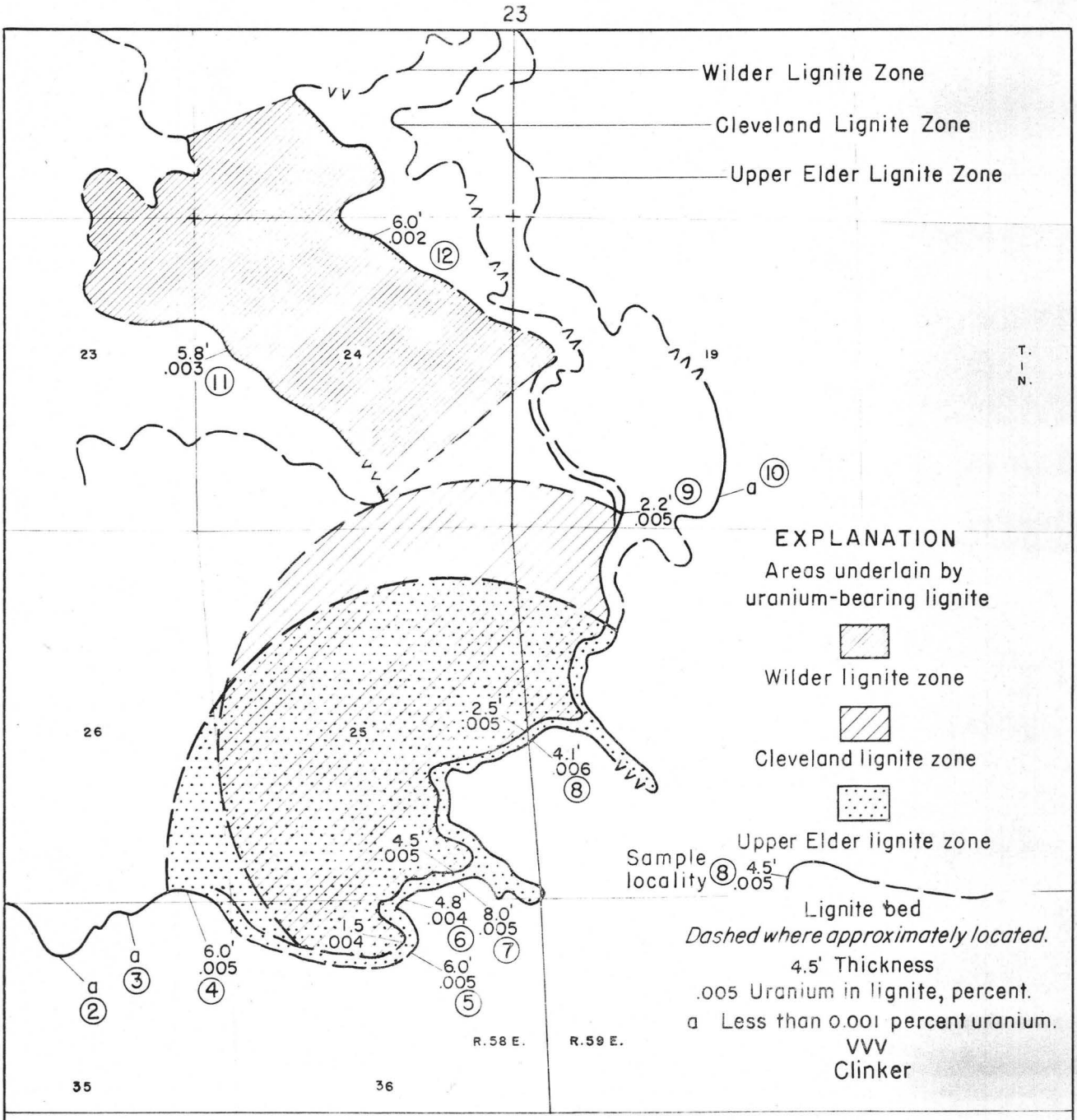
Analyses of spring waters from the Arikaree formation in the Ekalaka Hills indicate that uranium is being leached from this formation and is being transported by ground waters. The uranium content of six representative samples for the area are listed below. Some of the springs shown on the map as being in the uppermost part of the Fort Union actually are in small unmapped alluvial deposits, but the springs derive their water from the Arikaree formation.

Table 2.--Analyses of water samples from springs in the Arikaree formation, Ekalaka Hills, Carter County, Montana

Laboratory number	Field number	Spring	Location (Sec., T., R.)	U content (ppb)
201091	GM-138	Kinsey	6-1N-59E	6
201106	-152	Dugan Draw	19-1N-58E	4
201107	-153	Sugar Bowl	33-1N-58E	7
201108	-154	Stagvile	21-1N-58E	3
201109	-155	Ben Russell	24-1N-58E	3
201110	-156	Martin	13-1N-58E	8

RESERVES

An inferred reserve of approximately 16,500,000 tons of uranium-bearing lignite containing over 700 tons of uranium is present in the southern part of the Ekalaka Hills (fig. 5) in beds of the Wilder, Cleveland, and Upper Elder lignite zones. The radioactive lignite beds have



RESERVES
Inferred

Lignite zone	Average thickness (feet)	Uranium in lignite (percent)	Area (acres)	Lignite[1] (short tons)	Uranium[2] (short tons)
Wilder	5.9	0.003	560	5,782,000	175
Cleveland	2.7	0.006	760	3,591,000	215
Upper Elder	5.8	0.005	700	7,105,000	355
		Total	2,020	16,478,000	745

[1]Based on 1750 tons per acre foot – net result rounded to nearest 1,000 tons.
[2]Rounded to nearest 5 tons.

FIGURE 5 - MAP SHOWING AREA UNDERLAIN BY URANIUM-BEARING LIGNITE, EKALAKA HILLS, CARTER COUNTY, MONTANA.

0 1 Mile

an average ash content of 37 percent; these ash determinations were made on weathered lignite samples. Unweathered lignite probably would have a much lower ash content and could result in a four to five-fold concentration of the contained uranium by burning. The uranium-bearing lignite in the Wilder Zone averages 5.9 feet thick, has a uranium content of 0.003 percent, an ash content of 30 percent, and underlies an area of about 560 acres. The Cleveland lignite averages 2.7 feet in thickness, has an average uranium content of 0.006 percent, an ash content of 43 percent, and underlies an area of about 760 acres. The lignite in the Upper Elder zone averages 5.8 feet in thickness, has a uranium content of 0.005 percent, an ash content of 40 percent, and underlies an area of about 700 acres.

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PLANS

Uranium reserves in lignite in the Ekalaka Hills are relatively small. The lignite probably is comparable in quality to lignite in other areas although this would have to be determined by physical exploration. Until the need for uranium is great enough to make necessary more detailed investigation by Government agencies, or until industry establishes means of utilization and recovery of uranium and other metals from lignites, it does not seem necessary to undertake physical exploration in the Ekalaka Hills. The occurrence of uranium-bearing carbonaceous sandstone containing as much as 3.9 percent and averaging 0.68 percent uranium in a 3.2-foot bed in the Ludlow member of the Fort Union formation underlying the pre-Arikaree unconformity at Reva Gap in Slim Buttes (Gill and Moore, 1954) suggests that similar sandstone favorable for the localization of secondary uranium minerals may be present in the Ekalaka Hills and Long Pine Hills. Reconnaissance traversing with a carborne scintillation counter is planned in these areas during the summer of 1954 to determine if the thick, permeable carbonaceous sandstones underlying the White River and Arikaree formations are favorable host rocks for uranium.

UNPUBLISHED REPORT

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