RESULTS OF RECONNAISSANCE FOR URANIFEROUS COAL, LIGNITE, AND CARBONACEOUS SHALE IN WESTERN MONTANA

Trace Elements Memorandum Report 446

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WASHINGTON 25, D. C.

September 22, 1952

AEC - 210/3

Dr. Phillip L. Merritt, Assistant Director
Division of Raw Materials
U. S. Atomic Energy Commission
P. O. Box 30, Ansonia Station
New York 23, New York

Dear Phil:

Transmitted herewith for your information and distribution are six copies of Trace Elements Memorandum Report 446, "Results of reconnaissance for uraniferous coal, lignite, and carbonaceous shale in western Montana," by William J. Hail, Jr. and James R. Gill, September 1952.

No potential commercial deposits of uraniferous lignite and carbonaceous shale were found during 1951 in Montana and Idaho. Further work by the Survey on Cretaceous and Tertiary coal and carbonaceous shale in Montana is believed unwarranted. A few localities in Idaho will be examined in the course of work in nearby areas.

We plan to publish this report as a Geological Survey Circular. We are asking Mr. Hosted whether the Commission has any objections to this plan.

Sincerely yours,

Arthur P. Butler Jr.
for W. H. Bradley
Chief Geologist

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Geology - Mineralogy

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Series A

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

RESULTS OF RECONNAISSANCE FOR URANIFEROUS COAL, LIGNITE, AND CARBONACEOUS SHALE IN WESTERN MONTANA *

By

William J. Hail, Jr. and James R. Gill

September 1952

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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 William J. Hail, Jr. and James R. Gill

ABSTRACT

A reconnaissance search for uraniferous lignite and carbonaceous shale was made in western Montana and adjacent parts of Idaho during the summer of 1951. Particular emphasis in the examination was placed on coal and carbonaceous shale associated with volcanic rocks, as volcanic rocks in many areas appear to have released uranium to circulating ground water from which it was concentrated in carbonaceous material. Twenty-two areas in Montana and one area in Idaho were examined. The coal in five of these areas is of Cretaceous age. The coal and carbonaceous shale in the remaining 18 areas occur in Tertiary "lake-bed" deposits of Oligocene and younger age. Both the Cretaceous and Tertiary coal and carbonaceous shale are associated with contemporaneous or younger volcanic rocks and pyroclastic sequences.

A sample of carbonaceous shale from the Prickly Pear Valley northeast of Helena, Montana, contained 0.013 percent uranium. A sample of carbonaceous shale from the Flint Creek Valley southwest of Drummond, Montana, contained 0.006 percent uranium. All other samples of both Cretaceous and Tertiary coal and carbonaceous shale were essentially non-radioactive.

No further work is planned on the Cretaceous and Tertiary coal and carbonaceous shale in western Montana. A few localities in Idaho will be visited in the course of other work.

INTRODUCTION

A reconnaissance search for uraniferous lignite and carbonaceous shale in western Montana (See accompanying index map.) was made during the summer of 1951 as part of the Geological Survey program of reconnaissance for uranium deposits in the Rocky Mountain region. The work is sponsored by the Division of Raw Materials of the Atomic Energy Commission.

Uraniferous lignite and coal in South Dakota were studied by Denson, Bachman, and Zeller (1950), who showed that the uranium in Cretaceous and Tertiary coal seemed to have been derived by leaching from the slightly radioactive White River formation that unconformably overlies the coal-bearing formations. Both Cretaceous and Tertiary coal-bearing formations in western Montana contain volcanic rocks or tuffs or are associated with them and this association was used as a primary guide for reconnaissance prospecting.

CRETACEOUS COAL

Upper Cretaceous coals in the Livingston-Trail Creek and Electric coal fields and the Ryegate district were examined and tested for radioactivity. The tuffaceous and volcanic rocks of the Livingston formation of Paleocene (?) age, which overlies the coals in the Livingston-Trail Creek and Electric fields, and interbedded tuffs in the Judith River formation in the Ryegate district, might have served as potential source beds for uranium. No appreciable radioactivity was detected, however, in the field examination of the coals. The bulk of the volcanic material in the Livingston formation is basic in composition rather than acidic. Radioactive elements seem to occur more commonly in acidic volcanic rocks.

The petrologic type of the tuffs in the Judith River formation was not determined. Cretaceous coals at other localities also were sampled, but the samples did not contain significant amounts of uranium.

DESCRIPTION OF DISTRICTS EXAMINED

Livingston-Trail Creek Coal Field, Park, Gallatin, and Sweetgrass Counties, Montana

The Livingston-Trail Creek Coal Field covers an area of approximately 300 square miles (Calvert, 1912, p. 29) and lies in the southern part of Montana 36 miles north of Yellowstone National Park. Rocks of Archean to Paleocene age are exposed in the area, and all are deformed by faulting and folding. The upper Cretaceous coal-bearing strata in the area are over 750 feet thick and are overlain by over 5,000 feet of tuffaceous and agglomeratic sediments of the Livingston formation.

The Livingston-Trail Creek Coal Field has been subjected to pronounced folding and faulting which closely parallels the mountain uplift to the south. The coal beds are exposed along the limbs of sharply folded anticlines and synclines, and at many places are vertical or overturned.

Four beds ranging from 1 to 6 feet in thickness have been prospected or mined in the area. The coal is of bituminous rank and has been used in the past for coking. At present, all of the mines are abandoned and most cannot be entered.

Over 20 localities were examined radiometrically with a Geiger counter, and coal samples for chemical analysis were collected at 12 localities in Tps. 1 to 4 S., and Rs. 6 to 8 E., Park and Gallatin Counties. No abnormal radioactivity was detected in the coals in the field, nor did any sample contain more than 0.002 percent uranium in the ash upon chemical analysis.

No further work in the Livingston-Trail Creek coal field is planned.

Table 1. Samples collected in the Livingston-Trail Creek coal field

Lab. No.	Field No.	Percent eU[1]	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
62081	MM-37	a[2]	--	--	34.9	34, 1 S., 6 E., 1.1' coal bed
62052	MM-8	a	--	--	36.4	21, 2 S., 7 E., 2.0' coal bed
62053	MM-9	a	--	--	39.7	21, 2 S., 7 E., 2.8' coal bed
62054	MM-10	a	--	--	56.9	21, 2 S., 7 E., 1.3' coal bed
62055	MM-11	a	--	--	21.3	27, 2 S., 7 E., upper 2.6' of 8' coal bed
62056	MM-12	a	--	--	20.0	27, 2 S., 7 E., middle 2.6' of 8' coal bed
62057	MM-13	a	--	--	12.0	27, 2 S., 7 E., lower 2.6' of 8' coal bed
62074	MM-30	a	--	--	17.5	26, 2 S., 7 E., 5.0' bed of 20.0' coal zone
62075	MM-31	a	--	--	8.82	26, 2 S., 7 E., 7.0' bed of 20.0' coal zone
62076	MM-32	a	--	--	11.6	26, 2 S., 7 E., 3.0' bed of 20.0' coal zone
62077	MM-33	a	--	--	17.6	26, 2 S., 7 E., 5.0' bed of 20.0' coal zone
62071	MM-27	a	--	--	14.4	33, 2 S., 7 E., 2.5' coal bed
62072	MM-28	a	--	--	15.1	33, 2 S., 7 E., upper 2' of 4.0' bed
62073	MM-29	0.001	--	0.001	22.7	33, 2 S., 7 E., lower 2.0' of 4.0' bed
62045	MM-1	a	--	--	40.8	NW 1/4 26, 2 S., 8 E., 3.0' coal bed
62046	MM-2	a	--	--	37.8	NW 1/4 26, 2 S., 8 E., 3.2' coal bed
62070	MM-26	a	--	--	17.4	N 1/2 31, 2 S., 8 E., 4.0' coal bed
62059	MM-15	a	--	--	34.3	27, 3 S., 8 E., 1.9' coal bed
62060	MM-16	.001	--	--	33.0	27, 3 S., 8 E., 2.2' coal bed
62061	MM-17	a	--	--	26.4	27, 3 S., 8 E., 2.6' coal bed
62062	MM-18	a	--	--	35.8	27, 3 S., 8 E., 6.0' coal bed
62063	MM-19	a	--	--	30.9	27, 3 S., 8 E., 4.6' coal bed
62064	MM-20	.001	--	.001	38.6	27, 3 S., 8 E., 4.0' coal bed
62065	MM-21	.001	--	.002	17.9	NW 1/4 28, 3 S., 8 E., 3.0' coal bed
62066	MM-22	.001	--	--	53.5	NW 1/4 28, 3 S., 8 E., 3.0' coal bed
62067	MM-23	a	--	--	16.6	NW 1/4 28, 3 S., 8 E., upper 2.0' of 4.0' coal bed
62068	MM-24	a	--	--	17.0	NW 1/4 28, 3 S., 8 E., lower 2.0' of 4.0' coal bed
62069	MM-25	a	--	--	20.7	NW 1/2 4, 4 S., 8 E., 1.5' coal bed

[1] eU = equivalent uranium

[2] "a" in this and subsequent tables indicates an equivalent uranium content or uranium content of less than 0.001 percent.

Electric Coal Field, Park County, Montana

The Electric Coal Field is in the southwestern corner of Park County, Montana, just north of Yellowstone National Park. The coals in this field are of probable Upper Cretaceous age (Calvert, 1912, p. 55) and may be direct correlatives of those exposed in the Livingston-Trail Creek Coal Field about 40 miles to the north. The general stratigraphy of the area is essentially the same as that of the Livingston-Trail Creek area.

Three to four coals ranging from 6 inches to 4 feet or more in thickness are present in the Electric

Coal Field. All mining has ceased in this area, and good exposures of the coal are difficult to find. Six localities were examined radiometrically, and at four of these, samples were collected for chemical analysis. None of the coals examined contained significant amounts of uranium. No further work in the area is planned.

Table 2. Samples collected in the Electric Coal field.

Lab. No.	Field No.	Percent eU	Percent U	U in ash	Ash	Location (Section, Township, Range) and description
62080	MM-36	a	--	--	11.6	NE 1/4 8, 9 S., 7 E., 2.2' coal bed
62078	MM-34	a	--	--	13.5	36, 9 S., 7 E., upper 3.0' of 6.0' coal bed
62079	MM-35	a	--	--	21.5	36, 9 S., 7 E., lower 3.0' of 6.0' coal bed
62047	MM-3(	a	--	--	14.3	6, 9 S., 8 E., upper 2.5' of 5' coal bed
62048	MM-4	a	--	--	8.57	6, 9 S., 8 E., lower 2.5' of 5' coal bed
62049	MM-5	a	--	--	29.3	6, 9 S., 8 E., 0.8' coal bed
62050	MM-6	a	--	--	75.4	6, 9 S., 8 E., 1.5' coaly shale

Ryegate District, Golden Valley, Wheatland, Yellowstone, and Stillwater Counties, Montana

Lignite and carbonaceous shale interbedded with volcanic ash and tuffaceous sandstone is present in the Judith River formation of Upper Cretaceous age in Golden Valley and adjacent counties (Ellis et al., 1924). The best exposures occur at locality 1, about 10 miles north of Ryegate, where 12 beds of lignite and carbonaceous shale ranging in thickness from 0.5 to 5 feet, and interbedded with thin tuffaceous sandstone and siltstone, occur in a stratigraphic interval of about 48 feet. The stratigraphically highest lignite bed, 1.7 feet thick, directly underlies a 4-foot bed of silty volcanic ash. The lignites and associated carbonaceous shales were sampled as was the 4-foot bed of volcanic ash. The ash contained 0.001 percent equivalent uranium but the lignite and carbonaceous shale were not radioactive.

The eight lignite samples from the four other localities visited contained less than 0.001 percent equivalent uranium.

It is believed that the tuffaceous beds interbedded with the lignites and carbonaceous shales in the Judith River formation are too thin to be effective source beds for uranium. It seems unlikely that potential uranium-bearing coal or carbonaceous shale occurs in the Judith River formation in the

Ryegate District.

Table 3. Samples collected in the Ryegate District

Lab. No.	Field No.	Percent eU	U	U in ash	Ash	Location (Section, Township, Range) and description
66731	MM-139	0.001	--	--	82.5	18, 6 N., 18 E., 1.1' coal bed
66719	MM-127	.001	--	--	67.9	NE 1/4 6, 6 N., 20 E., 1' lignitic shale
66720	MM-128	a	--	--	26.0	SW cor. of 6, 6 N., 20 E., 1.5' lignite
66721	MM-129	a	--	--	36.5	SW cor. of 6, 6 N., 20 E., 2.5' lignite
66726	MM-134	..001	--	--	--	21, 8 N., 20 E., 4.0' volcanic ash
66727	MM-135	a	--	--	18.0	21, 8 N., 20 E., 1.7" lignite
66728	MM-136	a	--	--	40.0	21, 8 N., 20 E., 3.6' lignite
66729	MM-137	a	--	--	48.5	21, 8 N., 20 E., 1.4' lignite
66730	MM-138	a	--	--	27.9	21, 8 N., 20 E., 5.2' lignite
66722	MM-130	.002	--	--	--	31-32, 8 N., 20 E., 1.8' bed volcanic ash
66723	MM-131	a	--	--	28.9	31-32, 8 N., 20 E., 1.7' lignite
66724	MM-132	a	--	--	27.9	31-32, 8 N., 20 E., 2.8' lignite
66725	MM-133	.001	--	--	62.5	31-32, 8 N., 20 E., 1.1' lignite

Silver Bow Valley District, Silver Bow and Deer Lodge Counties, Montana

At two localities near Anaconda, thin impure Cretaceous coals are exposed. At locality 11, Sec. 10, T. 4 N., R. 11 W., half a mile south of Anaconda, 2 feet of coaly shale is exposed and contains 0.002 percent equivalent uranium. At locality 12, sec. 33, T. 5 N., R. 11 W., about 1 1/2 miles west of Anaconda, a total of 4 feet 4 inches of impure coal is exposed. Two channel samples of two beds were submitted for chemical determinations. Both samples had an equivalent uranium value of 0.002 percent and contained less than 0.001 percent uranium in the ash. In view of the low uranium content and the impure nature of these small deposits, additional work in this area is not recommended.

Table 4. Samples collected from the Silver Bow Valley district

Lab. No.	Field No.	Percent eU	U	U in ash	Ash	Location (Section, Township, Range) and description
63967	MM-90	.002	--	--	--	33, 5 N., 11 W., 2.9' coaly shale
63968	MM-91	.002	--	--	45.6	33, 5 N., 11 W., 1.5' coaly shale
63966	MM-89	.002	--	--	86.6	10, 4 N., 11 W., 2.0" coaly shale

Upper Ruby River District, Madison and Beaverhead Counties, Montana

Coal of Upper Cretaceous age is exposed along the course of the upper part of the Ruby River in the valley between the Snow Crest Mountains on the west, and the Gravelly Range on the east.

The coal beds are interbedded with brown and gray shale and siltstone. Several old prospect pits, and one mine, the Basin Creek Mine, (sec. 28, T. 11 S., R. 3 W.) are present in the area. Most of the coal beds are less than 1 foot thick, although the coal bed in the Basin Creek Mine is 2 1/2 feet thick.

Tertiary and Cretaceous volcanic rocks in the vicinity of these prospects and the mine may at one time have been a potential source for uranium. However, the coal beds are separated from the volcanic rocks by several hundred feet of impervious sediments, and the geologic conditions for mineralization by downward percolation of ground water are not favorable. Five samples were collected for analysis. Only one showed any radioactivity, and this sample of bed 1 foot thick contained only 0.002 percent equivalent uranium.

Table 5. Samples collected from the Upper Ruby River district

Lab. No.	Field No.	Percent eU	Percent U	U in ash	Ash	Location (Section, Township, Range) and description
63271	MM-44	a	--	--	17.5	20, 10 S., 3 W., 1.0' coal bed
63272	MM-45	0.002	--	--	74.3	N 1/2 28, 10 S., 3 W., 1.0' coal bed
63274	MM-47	a	--	--	5.35	NE 1/4 28, 11 S., 3 W., 1.3' coal bed
63275	MM-48	a	--	--	12.6	NE 1/4 28, 11 S., 3 W., 1.2' coal bed
63273	MM-46	a	--	--	14.1	NE 1/4 29, 11 S., 3 W., 0.8' coal bed
63276	MM-49	.002	--	--	93.8	SE 1/4 28, 11 S., 1 E., 6.0' volcanic ash

TERTIARY LIGNITE AND CARBONACEOUS SHALE

Basin-like depressions that separate the various mountain ranges in western Montana and adjacent parts Idaho are filled with poorly to well-indurated light-gray, tan, and buff clays, shales, siltstones, and volcanic ash. The deposits range in age from Oligocene to Miocene and perhaps Pliocene. The deposits are commonly known as "lake beds" and are so called in this report although little evidence of truly lacustrine conditions of deposition was noted. Numerous poorly consolidated tuffaceous sands and gravels are common.

A few 6-inch to 30-inch lenticular beds of lignite are exposed at several places along the margins of the basins.

Remnants of volcanic rocks in the form of flows and ash beds occur throughout the Tertiary basins of southwestern Montana but in general are poorly exposed. Tertiary volcanic ash, rhyolite, and basalt flows are common in the mountain ranges that bound the basins and are generally better exposed than their counterparts in the adjacent basins.

Pleistocene and Recent gravel mantles all of the basin deposits, and good natural exposures are rare. The lignites are thin and lenticular and are exposed at few places. All of the Tertiary lake beds examined are deformed by gentle folding and normal faulting. The locations of the areas investigated are shown on the accompanying index map.

DESCRIPTION OF DISTRICTS EXAMINED

Lombard Coal Field, Broadwater County, Montana

A brief reconnaissance was made in Tps. 4 and 5 N., Rs. 2 and 3 E., Broadwater County, Montana, at the approximate site of the Lombard coal field as shown by Combo, et al. (1950). Coal was not found; questioning of the local residents disclosed that coal had never been mined in the area, but that a 1,000-foot tunnel was made along a bed of black shale in an attempt to locate coal. As far as is known, no coal was found. It is likely that this black shale is beneath the Lombard overthrust and may be of Cretaceous age.

Smith River Valley District, Meagher County, Montana

No significant deposits of lignite or carbonaceous shale were found in the poorly exposed Tertiary beds near White Sulphur Springs in the Smith River Valley district, and no further work is planned.

Analyses of samples of volcanic ash collected in the District are shown in table 6.

Table 6. Samples collected in the Smith River Valley district

Lab. No.	Field No.	Percent eU	U	U in ash	Ash	Location (Section, Township, Range) and description
66701	MM-109	0.003	--	--	93.0	8-9, 6 N., 7 E., grab sample volcanic ash
66702	MM-110	.002	--	--	91.1	9, 7 N., 7 E., grab sample volcanic ash
66700	MM-108	.002	--	--	91.1	12-13, 9 N., 5 E., grab sample volcanic ash
66698	MM-106	.002	--	--	--	W 1/2 14, 10 N., 5 E., grab sample volcanic ash
66699	MM-107	.002	--	--	92.5	SW 1/4 26, 11 N., 4 E., grab sample volcanic ash

Townsend Valley District, Broadwater County, Montana

Only one small deposit of lignite was found in the Tertiary lake beds in the Townsend Valley (locality 2, index map). The lignite is in sec. 17, T. 5 N., R. 3 E. and is overlain by several hundred feet of Oligocene tuffaceous shales, clays, and sandstones which are exposed south of Sixmile Creek in T. 5 N., R. 3 E. The lignite consists of two beds having a total thickness of about 5 feet, interbedded with about 7 feet of dark-brown carbonaceous shale. Two samples of the lignite and two samples of tuffaceous shale or argillaceous ash contained less than 0.001 percent uranium.

Further work in this district does not appear warranted.

Table 7. Samples collected in the Townsend Valley district

Lab. No.	Field No.	Percent eU	U	U in ash	Ash	Location (Section, Township, Range) and description
66756	MM-164	0.001	--	--	38.2	17, 5 N., 8 E., 3.0' lignite
66757	MM-165	a	--	--	45.8	17, 5 N., 8 E., 2.1' lignite
66755	MM-163	.003	--	--	--	17, 5 N., 8 E., 2' volcanic ash
66758	MM-166	a	--	--	27.7	17, 5 N., 8 E., grab sample of lignite
66753	MM-161	a	--	--	--	12, 5 N., 2 E., grab sample Pardee Unit 2
66754	MM-162	.002	--	--	--	12, 5 N., 2 E., grab sample Pardee Unit 3

Gallatin Valley District, Gallatin County, Montana

The Tertiary lake deposits that floor the Gallatin Valley district are well exposed along the east side of the Madison River south of Logan, Montana. The deposits in this vicinity are composed of tan to buff tuffaceous shales, siltstones, sandstone, and gravel. Volcanic ash beds are present in places. A sample of a volcanic ash from locality 3, sec. 9, T. 1 N., R. 2 E. (index map) contained 0.002 percent

equivalent uranium and 0.001 percent uranium. In general, the Tertiary lake beds are poorly exposed and at most places are covered with a heavy mantle of gravel. No lignite or carbonaceous shale beds were found. No further work in this district is planned.

Table 8. Samples collected in the Gallatin Valley district

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
62082	MM-38	0.002	0.001	--	--	9, 1 N., 2 E., 0.9' volcanic ash
62083	MM-39	.002	--	--	--	9, 1 N., 2 E., 0.9' tuffaceous sandstone

Prickly Pear Valley District, Lewis and Clark County, Montana

The Prickly Pear Valley district includes parts of the drainage basins of Sevenmile Creek, Tenmile Creek, and Prickly Pear Creek, adjacent to the Missouri River. Exposures of the Tertiary lake beds in this district are restricted to the broad flat or rolling interstream areas and are poor. It was possible to obtain samples at only two of the localities visited. A sample of weathered lignite, obtained from a mine dump on the west side of Silver Creek (locality 4, index map), contained less then 0.001 percent uranium.

West of Houser Lake, beds of Oligocene age are exposed in a series of low rolling hills (Lorenz et al., 1951, p. 16). In this area the beds are predominantly light tan to buff tuffaceous shales and siltstones. A few thin bentonitic ash beds are also present. The adjacent areas are under cultivation, and exposures are poor. At locality 5 (index map) in the NW 1/4 Sec. 28, T. 11 N., R. 2 W., bentonitic ash and one 6-inch bed of carbonaceous shale is exposed. A sample of the carbonaceous shale contained 0.014 percent equivalent uranium and 0.013 percent uranium. The overlying bentonitic ash contained 0.003 percent equivalent uranium. The devitrification of this ash, accompanied by leaching, may account for the high uranium content of the underlying carbonaceous shale. The uranium content of 0.013 percent is the highest determined for any sample of lignite or carbonaceous shale obtained in this reconnaissance examination. Additional examination of the immediate vicinity was hampered by the extent of cover. Additional work may be done in this area if more sensitive instruments can be made available.

Reconnaissance throughout the remainder of this district did not detect other abnormally radioactive

lignite or carbonaceous shale beds.

Table 9. Samples collected in the Prickly Pear Valley district

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
66750	MM-158	.003	--	--	--	NW 1/4 28, 11 N., 2 W., 2' volcanic ash
66751	MM-159	.014	0.013	--	--	NW 1/4 28, 11 N., 2 W., 6" carbonaceous shale
66752	MM-160	.001	--	--	32.2	SW 1/4 8, 11 N., 4 W., grab sample of coal

Avon Valley District, Powell County, Montana

The Tertiary lake beds in the Avon Valley district are poorly exposed and no evidence of appreciable deposits of lignite or carbonaceous shale was found. A carbonaceous shale zone 5 1/2 feet thick was examined and sampled at locality 6 (index map), sec. 21, T. 11 N., R. 8 W., but it did not contain significant quantities of uranium. Further exploration of the Tertiary lake beds of this district failed to discover other deposits and additional work does not seem warranted.

Table 10. Samples collected in the Avon Valley district

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
63949	MM-72	0.002	--	--	--	21, 11 N., 8 W., upper 2.8' carbonaceous shale
63950	MM-73	.001	--	--	--	21, 11 N., 8 W., lower 2.8' carbonaceous shale

Blackfoot Valley district, Powell, Granite, and Missoula Counties, Montana

Reconnaissance of the poorly exposed Tertiary lake beds in the Blackfoot Valley district near Helmville, Montana did not reveal significant deposits of lignite or carbonaceous shale. Abnormal radioactivity was not detected in any of the Tertiary beds examined in this district, and further exploration of these beds does not seem warrented.

Flint Creek Valley District, Granite and Powell Counties, Montana

The Tertiary lake beds are poorly exposed in the Flint Creek Valley district and are covered at most places by a thick mantle of stream gravels. At locality 7 (index map), NW 1/4 sec. 35, T. 11 N., R. 13 W., about 40 feet of lignitic and carbonaceous shales is exposed. Radiometric examination of the outcrop with a Geiger counter did not detect significant radioactivity, but one sample of carbonaceous shale contained 0.006 percent uranium. Uranium was absent in all other samples. The sample containing 0.006 percent uranium represents a four-foot channel sample of the uppermost carbonaceous shale.

It is possible that other uraniferous beds may be in the area, but the poor condition of outcrop made their presence difficult to ascertain. Additional investigation of this immediate vicinity with more sensitive instruments might prove to be of value, but until such equipment is available further work is not planned. Numerous other localities were visited in the area, but no significant radioactivity was detected.

Locality 8 (index map), in the NW 1/4 sec. 18, T. 9 N., R. 12 W., is a coal prospect in steeply dipping Cretaceous beds. Examination and sampling of the thin impure coal at this locality failed to reveal any radioactivity.

Table 11. Samples collected in the Flint Creek Valley District

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
63951	MM-74	0.004	0.006	--	--	NW 1/4 35, 11 N., 13 W., 4' carbonaceous shale
63952	MM-75	a	--	--	29.9	NW 1/4 35, 11 N., 13 W., 1.5' lignite
63953	MM-76	a	--	--	32.8	NW 1/4 35, 11 N., 13 W., 2.5' lignite
63954	MM-77	a	--	--	26.0	NW 1/4 35, 11 N., 13 W., 1.8' lignite
63955	MM-78	a	--	--	28.9	NW 1/4 35, 11 N., 13 W., 0.3' lignite
63956	MM-79	a	--	--	35.9	NW 1/4 35, 11 N., 13 W., 2.5' lignite
63957	MM-80	a	--	--	50.6	NW 1/4 35, 11 N., 13 W., 3.0' lignite
63958	MM-81	a	--	--	88.6	NW 1/4 35, 11 N., 13 W., 4.0' coal ash
63959	MM-82	a	--	--	57.2	NW 1/4 18, 9 N., 12 W., 1' coal

Deer Lodge Valley district, Deer Lodge and Powell Counties, Montana

Reconnaissance in the Deer Lodge Valley district did not find any appreciable deposits of radioactive lignite or carbonaceous shale. At locality 9 (index map), in sec. 24, T. 9 N., R. 11 W., two beds of

carbonaceous shale, each about 1 foot thick, are overlain by an undetermined thickness of light-gray tuffaceous shale and volcanic ash. Samples of carbonaceous shale contained less than 0.001 percent uranium. Further exploration of Tertiary lake beds in this district is not planned.

Table 12. Samples collected from the Deer Lodge Valley District

Lab. No.	Field No.	Percent eU	U	U in ash	Ash	Location (Section, Township, Range) and description
63946	MM-69	0.002	a	--	--	18, 6 N., 10 W., 2.0' volcanic ash
63947	MM-70	.001	--	--	--	24, 9 N., 11 W., 1' carbonaceous shale
63948	MM-71	.002	--	--	--	24, 9 N., 11 W., 1.2' carbonaceous shale
63945	MM-88	a	--	--	--	24, 9 N., 11 W., 2.0' volcanic ash

Missoula Valley District, Missoula County, Montana

Extensive reconnaissance was made of the Tertiary lake beds in the Missoula Valley district. Exposures of coal-bearing sediments are very poor in this district, and a majority of samples had to be collected from abandoned mine dumps. Samples were collected at six localities and 15 other localities were examined but not sampled. Significant radioactivity was not detected at any of the localities examined.

Most of the samples came from the immediate vicinity of Missoula near the Hell Gate Mine, locality 15 (index map) where small scale mining activity was carried on prior to 1940 (Pardee, 1913, pp. 240-241). In this area, four coal beds from 1 to 6 feet thick and overlain by volcanic ash have been reported; three of these four beds were sampled. None of the samples submitted contained more than 0.001 percent uranium and no further consideration of these particular deposits seems warranted.

Table 13. Samples collected from the Missoula Valley District

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
66737	MM-145	a	--	--	15.5	E 1/2 4, 14 N., 19 W., grab sample lignite
66738	MM-146	0.002	--	--	67.7	E 1/2 4, 14 N., 19 W., upper 2.0' of 4.0' lignite
66739	MM-147	.002	--	--	70.3	E 1/2 4, 14 N., 19 W., lower 2.0' of 4.0' lignite
66740	MM-148	.003	--	--	--	E 1/2 4, 14 N., 19 W., 3.0' volcanic ash
66741	MM-149	.001	--	--	26.2	SE 1/4 33, 14 N., 19 W., grab sample lignite
66742	MM-150	a	--	--	11.2	SE 1/4 33, 14 N., 19 W., grab sample lignite
66743	MM-151	a	--	--	24.0	C. 33, 14 N., 19 W., grab sample lignite
66744	MM-152	a	--	--	39.0	C. 33, 14 N., 19 W., grab sample lignite
66734	MM-144	a	--	--	--	NW 1/4 26, 14 N., 22 W., grab sample lignite
66745	MM-153	.001	--	--	38.6	SW 1/4 4, 15 N., 22 W., grab sample lignite
66694	MM-102	a	--	--	28.0	21, 16 N., 23 W., grab sample lignite

Bitterroot Valley district, Ravalli County, Montana

Lignite and carbonaceous shale were found at only one place in the poorly exposed Tertiary lake beds in the Bitterroot Valley district south of Hamilton, Montana. At locality 10, in the NW 1/4, SE 1/4 Sec. 34, T. 4 N., R. 21 W., near Darby, more than 20 feet of lignite and carbonaceous shale is exposed (Pardee, 1913, p. 242). Channel samples were taken of six of the most lignitic beds in the sequence, and the entire section was examined radiometrically. None of the beds indicated significant radioactivity in the field, and of the six samples analyzed only one contained as much as 0.002 percent uranium in the ash. The remaining five samples contained less than 0.001 percent uranium. Additional exploration of this area is not planned.

Table 14. Samples collected from the Bitterroot Valley District

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
66688	MM-96	a	--	--	27.4	NW 1/4, NE 1/4 34, 4 N., 21 W., 2.0' carbonaceous shale
66689	MM-97	a	--	--	18.3	NW 1/4, NE 1/4 34, 4 N., 21 W., 0.7' lignite
66690	MM-98	a	--	--	21.6	NW 1/4, NE 1/4 34, 4 N., 21 W., 0.5' lignite
66691	MM-99	a	--	--	26.1	NW 1/4, NE 1/4 34, 4 N., 21 W., 1.1' lignitic shale
66692	MM-100	a	a	0.002	23.5	NW 1/4, NE 1/4 34, 4 N., 21 W., 1.9' lignite
66693	MM-101	0.002	--	--	56.2	NW 1/4, NE 1/4 34, 4 N., 21 W., 0.1' lignite

Big Hole Valley district, Beaverhead County, Montana

Reconnaissance of the Big Hole Valley district in the vicinity of Wisdom, Jackson, and Fishtrap, Montana did not find lignite or carbonaceous shale. Although exposures of significant thickness of Tertiary lake beds are poor or non-existent, except along the margins of the valley, it is doubtful whether carbonaceous beds of appreciable thickness are present. Additional exploration of the Tertiary lake beds in this area is not planned.

Silver Bow Valley district, Silver Bow and Deer Lodge Counties, Montana

The Silver Bow Valley district includes the towns of Anaconda and Butte and the adjacent county to the south of Anaconda. The lake beds are poorly defined in this district, and the occurrence of Tertiary lignitic deposits is unknown.

Jefferson Valley district, Silver Bow and Madison Counties, Montana

Reconnaissance of the Jefferson Valley district south of Whitehall, Montana did not discover any significant deposits of lignite or carbonaceous shale in the Tertiary lake beds. Exposures in the valley are poor, and the expenditure of additional time needed for a detailed examination of the area does not seem warranted.

Beaverhead Valley district, Beaverhead and Madison Counties, Montana

No deposits of lignite or carbonaceous shale were found in the reconnaissance of the Beaverhead Valley district in the immediate vicinity of Dillon, Montana. The Tertiary lake beds, which are restricted to the valley proper, are poorly exposed and it is unlikely that they contain uraniferous lignite. No further work is planned.

Madison Valley district, Madison County, Montana

Tertiary lake beds are poorly exposed in the Madison Valley District, and appreciable deposits of lignite or carbonaceous shales are not evident. Additional examination of the Tertiary lake beds in the district is not planned.

Centennial Valley district, Beaverhead County, Montana

The Tertiary beds in the vicinity of Lima and Dell, Montana are quite unlike those of other districts. These beds are composed of red poorly consolidated conglomerate, sandstone, siltstone, shale with some interbedded basalt, and rhyolite. Lignite and carbonaceous shales were not found. A more extensive examination of this district for uranium-bearing carbonaceous materials does not seem warranted.

Medicine Lodge Creek Valley district, Beaverhead County, Montana

In this general district at least three beds of lignite are interbedded with light-gray to brown, shales, siltstones, and thin sandstones. The lignite beds range from 2 to 5 feet in thickness, and at many places contain numerous thin partings of carbonaceous shale which contribute to the high ash content to the lignite. These beds are part of the best exposures of coal-bearing Tertiary lake deposits examined in southwestern Montana. Small-scale mining has been intermittently active in this district for more than 30 years. Operations were discontinued during the winter of 1949-1950 because of the local labor conditions and a poor market for high-ash lignite.

Seven localities were examined and 12 samples taken. Two of the mines can still be entered and sampling of moderately fresh coal was possible. Of the 12 samples submitted for analysis, 4 contained 0.003 percent equivalent uranium, 1 contained 0.002 percent equivalent uranium, and 1 contained 0.001 percent equivalent uranium. The remaining samples contained less than 0.001 percent equivalent uranium.

Further work in the area is not planned.

Table 15. Samples collected from the Medicine Lodge Creek district

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
63294	MM-67	a	--	--	44.7	C 6, 10 S., 12 W., grab sample lignite
63277	MM-50	0.003	--	--	64.2	SW 1/4 18, 11 S., 11 W., 1.5' lignitic shale
63278	MM-51	.003	--	--	--	SW 1/4 18, 11 S., 11 W., 1.5' carbonaceous shale
63279	MM-52	.003	--	--	71.5	SW 1/4 18, 11 S., 11 W., 1.5' lignitic shale
63284	MM-57	.003	--	--	79.7	SW 1/4 30, 11 S., 11 W., 3.0' lignitic shale
63285	MM-58	.002	--	--	73.5	SW 1/4 30, 11 S., 11 W., 1.6' lignitic shale
63282	MM-55	a	--	--	19.1	SE 1/4 2, 11 S., 12 W., grab sample lignite
63282	MM-56	a	--	--	15.4	C 14, 11 S., 12 W., grag sample lignite
63286	MM-59	.001	a	0.001	24.5	SW 1/4 35, 11 S., 12 W., upper 2.5' of 5.0' lignite
63287	MM-60	a	--	--	28.3	SW 1/4 35, 11 S., 12 W., lower 2.5' of 5.0' lignite
63280	MM-53	a	--	--	19.6	S 1/2 35, 11 S., 12 W., upper 2.8' of 4.9' lignite
63281	MM-54	a	--	--	21.0	S 1/2 35, 11 S., 12 W., lower 2.1' of 4.9' lignite

Lemhi Valley district, Lemhi County, Idaho

Tertiary beds are extensively exposed along the Salmon River in the vicinity of the town of Salmon. Exposures of these beds are poor except along the river where they form cliffs 200 to 300 feet high. The lake beds consist of tan to buff, shale, siltstone, and sandstone, with thin beds of carbonaceous shale. Lignite in this area seems to be restricted to the western part of the valley.

In Pollard Canyon, 1 1/2 miles west of Salmon, a 6-foot bed of impure lignite is mined from time to time (locality 13, SW 1/4 sec. 2, T. 21 N., R. 21 E.). The lignite was examined radiometrically, and two channel samples of the fresh lignite were taken. These samples contained less than 0.001 percent equivalent uranium. Further investigations do not seem warranted.

At locality 14, sec. 15, T. 23 N., R. 20 E., 18 miles northwest of Salmon, more than 200 feet of coal-bearing strata are exposed along the east bank of Moose Creek. These coal-bearing beds are restricted to a small, high intermountain basin that is estimated to cover 600 acres and is bounded by granitic rocks on all sides. Fifteen to twenty thin beds of lignite are interbedded with soft tan shales and unconsolidated arkosic sands. The lignite is predominantly woody, weathers rapidly, and is probably younger than the lignites in the Tertiary beds near Salmon.

No radioactivity was detected in any coal bed. Two channel samples of a 5-foot bed, the uppermost

in the exposed section, contained less than 0.001 percent equivalent uranium.

Examination of the Lemhi Valley district has not revealed any uraniferous lignite of potential commercial grade. Additional investigation of this area does not seem worthwhile, except to the south in the vicinity of Challis, Idaho where reconnaissance was not made in 1951 because of lack of time. Reconnaissance examinations will be made of these rocks when feasible.

Table 16. Samples collected from the Lemhi Valley district

Lab. No.	Field No.	Percent eU	Percent U	Percent U in ash	Percent Ash	Location (Section, Township, Range) and description
63960	MM-83	a	--	--	43.6	SW 1/4 2, 21 N., 21 E., upper 3' of 6' lignite
63961	MM-84	0.001	a	0.001	42.6	SW 1/4 2, 21 N., 21 E., lower 3' of 6' lignite
63962	MM-85	a	--	--	16.2	15, 23 N., 20 E., upper 2.5' of 5' lignite
63963	MM-86	a	--	--	12.1	15, 23 N., 20 E., lower 2.5' of 5' lignite

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