

GEOLOGICAL SURVEY CIRCULAR 349



RECONNAISSANCE FOR
URANIUM-BEARING
CARBONACEOUS MATERIALS
IN SOUTHERN UTAH

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UNITED STATES DEPARTMENT OF THE INTERIOR
Douglas McKay, Secretary

GEOLOGICAL SURVEY
W. E. Wrather, Director

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By Howard D. Zeller

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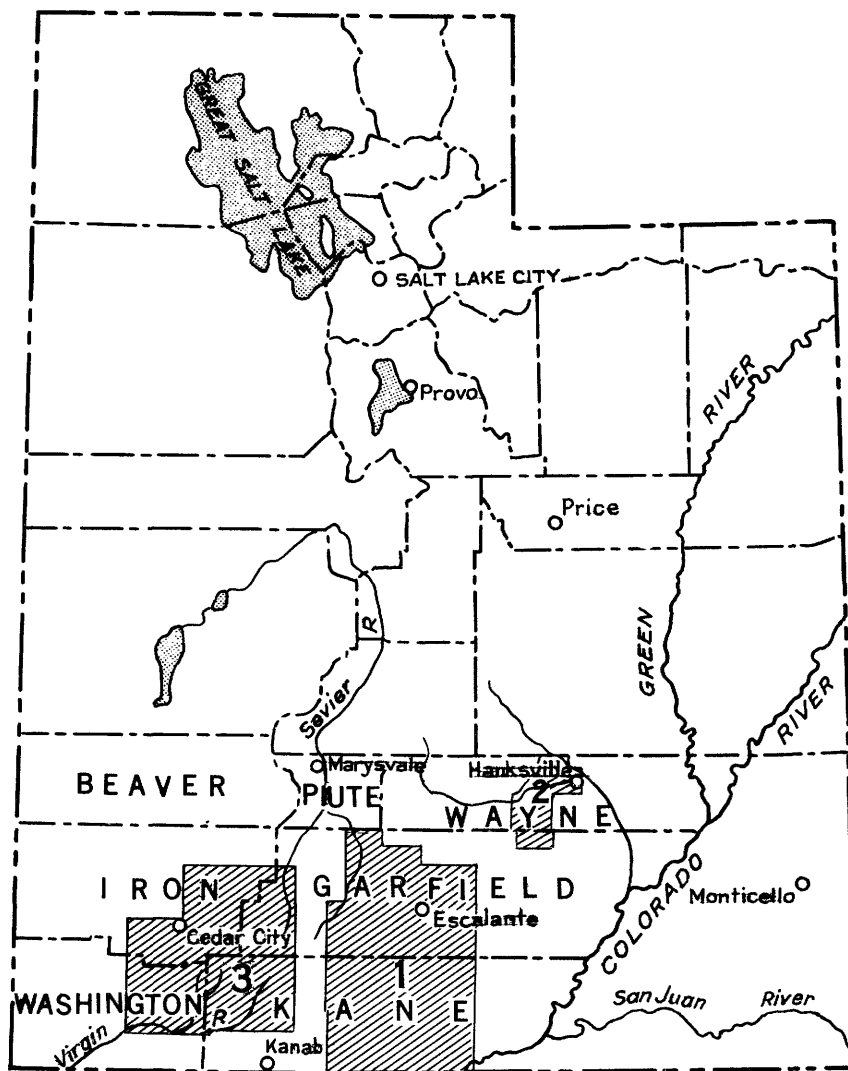


Figure 1.—Index map of Utah showing areas described in this report. Kaiparowits Plateau (1), Henry Mountains (2), and Kolob terrace (3).

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CONTENTS

	Page		Page
Abstract.....	1	Areas examined.....	2
Introduction.....	1	Kaiparowits Plateau.....	2
Purpose and		Henry Mountains.....	2
scope.....	1	Kolob Terrace area.....	5
Acknowledgments.....	2	Literature cited.....	5

ILLUSTRATIONS

	Page
Figure 1. Index map of Utah showing areas described in this report.....	ii
2. Map of the Kaiparowits area showing localities examined for carbonaceous materials.....	3
3. Map of part of the Henry Mountains area showing localities examined for carbonaceous materials.....	4
4. Map of the Kolob Terrace area showing localities examined for carbonaceous materials.....	6

TABLE

Radioactivity measurements and chemical analyses of samples from southern Utah.....	7
-------------------------------------------------------------------------------------	---

ABSTRACT

A reconnaissance investigation for uranium-bearing carbonaceous materials was made in three major areas of southern Utah: Kaiparowits Plateau, Henry Mountains, and Kolob Terrace. No uranium deposits of economic interest were found. A few 1- to 2-foot beds of carbonaceous shale in the Dakota(?) sandstone contain 0.006-0.007 percent uranium. Other carbonaceous sediments that were examined contain 0.002 percent or less uranium.

INTRODUCTION

During the summer of 1953 a reconnaissance investigation was made in parts of southern Utah in search of new deposits of uranium-bearing carbonaceous rocks. Coal and carbonaceous shale of Cretaceous age were systematically sampled in three major areas: Kaiparowits Plateau, Henry Mountains, and Kolob Terrace (fig. 1). Eighty samples were submitted for uranium analyses and radioactivity measurements. They included 53 samples of coal, 10 of carbonaceous shale, 10 of volcanic rock, 2 of sandstone, 4 of water, and 1 of evaporite. The radioactivity measurements and chemical analyses of the samples are given in the table.

The samples are not appreciably radioactive nor do they contain uranium in amounts of economic importance. The only rocks with a uranium content that could be considered above normal for their type of lithology were a few thin beds of carbonaceous shale.

Field radioactivity measurements indicated a higher equivalent uranium content than was determined by the laboratory analyses. This may be due to the contamination from fallout, which was very heavy in southern Utah during the entire period of investigation. Background readings with the field Geiger and scintillation counters were so high at some localities in the Kolob Terrace that the instruments could be used only in mines or freshly dug pits.

Purpose and scope

This reconnaissance was undertaken in an attempt to locate deposits of uranium-bearing carbonaceous materials, especially coal, that might be used as by-product sources of uranium.

The areas in southern Utah were chosen for study because they contain bedrock favorable for concentration of uranium and are overlain in part by volcanic and

tuffaceous beds that might be a source of uranium. Coal having as much as 0.1 percent uranium in the ash content was found during similar reconnaissance in South Dakota, North Dakota, Wyoming, Colorado, New Mexico, Nevada, Idaho, and Montana (Denson and others, written communication, 1952).

Acknowledgments

The writer was assisted in the field by Don M. George. The reconnaissance in western Kane County, Utah, was greatly facilitated by W. B. Cashion. Radioactivity measurements and uranium analyses were made by the Geological Survey laboratories in Denver and Washington. The work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.

AREAS EXAMINED

Kaiparowits Plateau

The Kaiparowits Plateau is located in Garfield and Kane Counties, south-central Utah. Escalante, the principal town in the area, located near the northeastern corner of the Plateau, can be reached from Utah State Highway 54 by way of Tropic. (See fig. 2.) The plateau area covers about 1,500 square miles, much of which is accessible only on foot or horseback. The nearest railhead is Marysville, about 85 miles by road to the northwest of Escalante.

The plateau is composed of Jurassic and Cretaceous rocks that have been preserved from erosion because they lie in a shallow syncline that is capped by resistant sandstone (Gregory and Moore, 1931, p. 134).

Generalized section of Cretaceous rocks in the Kaiparowits Plateau

[Modified from Gregory and Moore (1931, p. 36) and from Gregory (1951, p. 23)]

Tertiary: Wasatch formation.

Unconformity.

Cretaceous:

Kaiparowits formation-----	Bluish-drab fine-grained to medium-coarse-grained arkosic sandstone and sandy shale.
Wahweap sandstone-----	Yellowish-gray massive sandstone with some sandy shale. Forms conspicuous cliffs.
Straight Cliffs sandstone--	Yellowish-gray to brown irregularly bedded medium to massive sandstone. Contains coal beds. Forms conspicuous escarpment.
Tropic formation-----	Bluish-drab argillaceous to sandy shale. Fossiliferous sandstone at base contains <i>Gryphaea newberryi</i> .
Dakota(?) sandstone-----	Yellow to nearly white sandstone, conglomeratic in part. Irregularly bedded. Contains thin beds of coal.

Unconformity.

Jurassic: Morrison formation or Winsor formation.

Carbonaceous rocks that contain more than 0.002 percent uranium were found only at two localities, one on the northwest flank of the East Kaibab monocline (locality 28, fig. 2), and the other near Collet Creek on the northeast edge of the Kaiparowits Plateau (locality 20, fig. 2). The uranium content at these localities is 0.006 to 0.007 percent, and the uranium occurs in beds of carbonaceous shale 1 to 2 feet thick in the Dakota(?) sandstone. The carbonaceous shale at locality 28 is 2 feet thick and lies 15 feet above the unconformity between the Dakota(?) sandstone and the Winsor formation.

Other localities where carbonaceous rocks contain as much as 0.002 percent equivalent uranium were locality 14, in natural coal ash in the Dakota(?) sandstone; locality 24, in carbonaceous shale of the Dakota(?) sandstone; and locality 29, in carbonaceous shale of the Straight Cliffs sandstone. (See fig. 2.)

Samples of carbonaceous material from localities 9, 16, 21, 25, and 27 (fig. 2) contained 0.001 percent equivalent uranium.

A bed of ferruginous sandstone in the Dakota(?) sandstone at locality 11 contains 0.002 percent equivalent uranium and 0.0017 percent uranium. A 2-foot bed of bentonite at locality 31 near Cannonville at the base of the Dakota(?) sandstone contains 0.001 percent equivalent uranium and 0.0007 percent uranium. (See fig. 2.)

Several samples of volcanic flow rocks of Tertiary age collected on the nearby Aquarius Plateau show relatively high contents of equivalent uranium. A porphyritic flow rock at locality 3 at the head of Coyote Creek near Antimony contains 0.0054 percent equivalent uranium and 0.0009 percent uranium. Another sample, from locality 5 on Escalante Mountain, contains 0.006 percent equivalent uranium and 0.001 percent uranium. A third sample, from locality 4 near Cyclone Lake, contains 0.003 percent equivalent uranium but only 0.0005 percent uranium. (See fig. 2.)

A field radiometric survey was made of some beds of limestone in the Wasatch formation along the edge of the Aquarius Plateau (fig. 2), but no radioactivity anomalies were found.

Samples from the other localities examined in the Kaiparowits Plateau area contain less than 0.001 percent equivalent uranium. (See table, p. 7.)

Henry Mountains

The Henry Mountains area is located in Wayne and Garfield Counties, southeastern Utah. Reconnaissance work was restricted to the northern part of the Henry Mountains from the west flank of Mount Ellen northward to the boundary between Emery and Wayne Counties (fig. 1). The town of Hanksville is located near the northeastern corner of the area. Green River, Utah, the nearest railhead, is 60 miles to the northeast on Utah State Highway 24.

The geologic map (fig. 3) was taken from the northern part of a map by Hunt and others (1952).

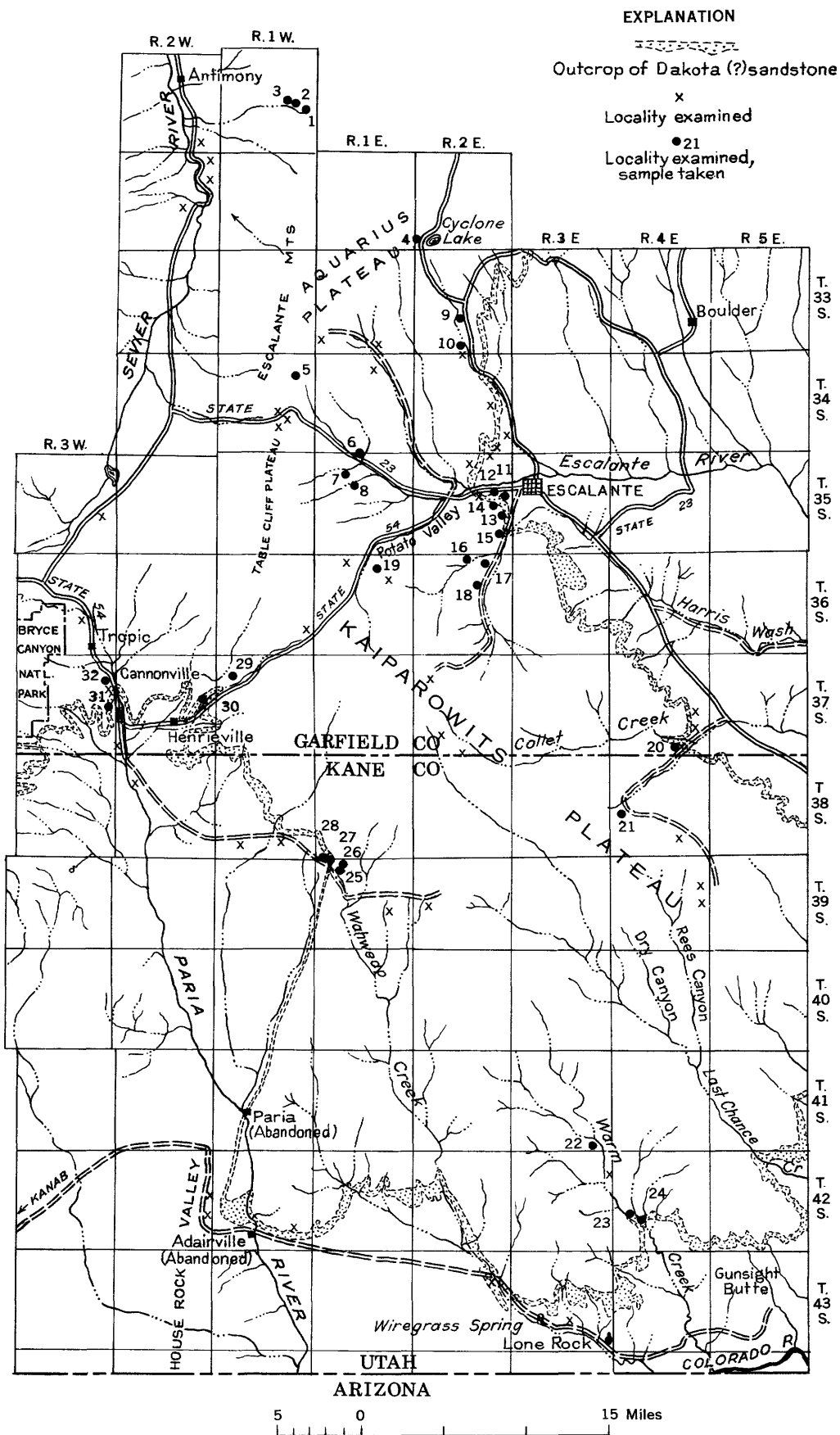


Figure 2.—Map of the Kaiparowits area showing localities examined for carbonaceous materials.

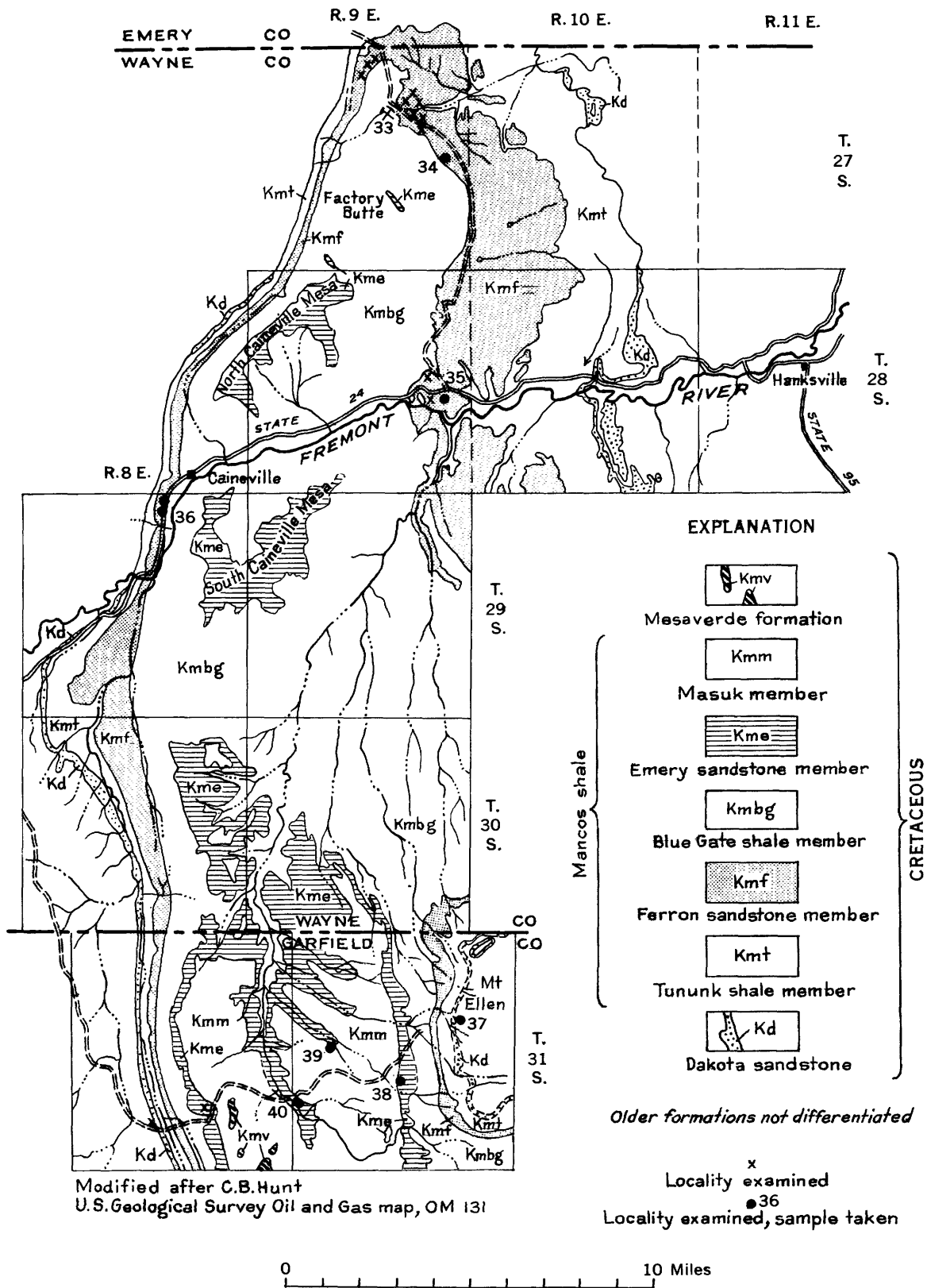


Figure 3—Map of part of the Henry Mountains area showing localities examined for carbonaceous materials.

It shows localities that were examined and sampled during one week of reconnaissance work. Coal beds in the Henry Mountains area occur in the Dakota sandstone, the upper part of the Ferron sandstone member of the Mancos shale, and the upper part of the Emery sandstone member of the Mancos. Additional information on the geology of the area is given by Hunt (1946) and Hunt and others (1954).

The carbonaceous material examined contained less than 0.002 percent equivalent uranium. Carbonaceous clay shale in the Ferron sandstone member at locality 36 (fig. 3) near Caineville indicated an estimated 0.01 percent equivalent-uranium content after careful field Geiger counter readings, but laboratory analyses showed only 0.002 percent equivalent uranium.

A bed of coal 8 inches thick in the Ferron sandstone member at locality 35 contains 0.001 percent equivalent uranium. This bed, like the one at locality 36, indicated a higher equivalent-uranium content in the field than in the laboratory. It is at about the same stratigraphic position as the bed at the Factory Butte coal mine (locality 33, fig. 3). The coal at the mine is 7 feet thick but contains less than 0.001 percent equivalent uranium.

All of the coal beds examined in the Emery sandstone member contain less than 0.001 percent equivalent uranium. (See table, p. 7.) These beds occur only in the deepest part of the Henry Mountains structural basin west of Mount Ellen and Mount Pennell (Hunt and others, 1954).

Kolob Terrace area

The Kolob Terrace area is located in parts of Kane, Washington, Garfield, and Iron Counties in southwestern Utah (fig. 1). Cedar City, near the northwest corner of the area, is the main railhead. Numerous secondary country roads give access to most of the region, but deep, narrow canyons tributary to Virgin River make traversing difficult.

The Kolob Terrace, a bench cut on the south flank of the Markagunt Plateau, extends from Coal Creek Canyon near Cedar City southward and southeastward to the vicinity of Glendale, Utah (fig. 4) lying between the Hurricane fault on the west and the Sevier fault on the east (Gregory, 1950a, p. 5-6). The terrace ranges in altitude from 8,000 to 9,000 feet and consists of rounded hills, swales, and gentle slopes. Recent volcanic cones and lava flows lie on the surface at many places (Gregory, 1950b, p. 134-136).

The main coal beds in this area occur in the Upper Cretaceous Tropic formation (Gregory, 1950b, p. 146). Some layers of carbonaceous rock also occur in the Dakota (?) sandstone and in the Straight Cliffs sandstone of Cretaceous age.

Beroni and others (1953) describe an occurrence of uranium in the lower part of the Dakota sandstone and upper part of the Summerville formation at the Bullock claims in T. 40S., R. 9W., Kane County, Utah. Fragments of carbonized wood and clay that occur in a conglomeratic sandstone were found to contain finely disseminated uranium compounds. This zone, near the Cretaceous-Jurassic contact, was examined at many places during the reconnaissance, but no radioactivity was detected.

The only sample collected in the area that contains more than 0.001 percent uranium is coal ash on the waste dump of the Southern Utah Power Company plant near Cedar City, Utah (locality 60, fig. 4). The ash contains 0.004 percent equivalent uranium and 0.002 percent uranium. The ash came from three nearby mines in the Tropic formation; about 100 tons of coal, averaging about 12 percent ash, are mined in a day. One of these mines (the Webster, locality 55, in Right Hand Canyon) penetrates a 6-foot coal bed. The radioactivity detected in the mine was twice background, but samples collected from the mine contain only 0.001 percent equivalent uranium or less. Samples of coal from the other mines (localities 54 and 57, fig. 4) contain less than 0.001 percent equivalent uranium.

Near New Harmony, Utah, at locality 61 (fig. 4) a 1-foot bed of semianthracite coal in the Tropic formation lies adjacent to an intrusion of andesite (Richardson, 1909, p. 384) and contains 0.004 percent equivalent uranium and 0.0012 percent uranium. The andesite contains 0.003 percent equivalent uranium but only 0.0003 percent uranium.

A 6-inch bed of carbonaceous shale (locality 52, fig. 4) in the Tropic formation near Pryor Peak on Kolob Terrace contains 0.003 percent equivalent uranium but only 0.0003 percent uranium.

Samples of coal at localities 43, 44, 46, 51, 55, 56, and 58 (fig. 4 and table) contain 0.001 percent equivalent uranium.

A rhyolitic lava at the top of the Brian Head formation of Miocene (?) age (Gregory, 1950b, p. 26) was sampled on Markagunt Plateau to determine whether uranium might be present in volcanic rocks on the plateau. The sample contains 0.003 percent equivalent uranium and 0.001 percent uranium.

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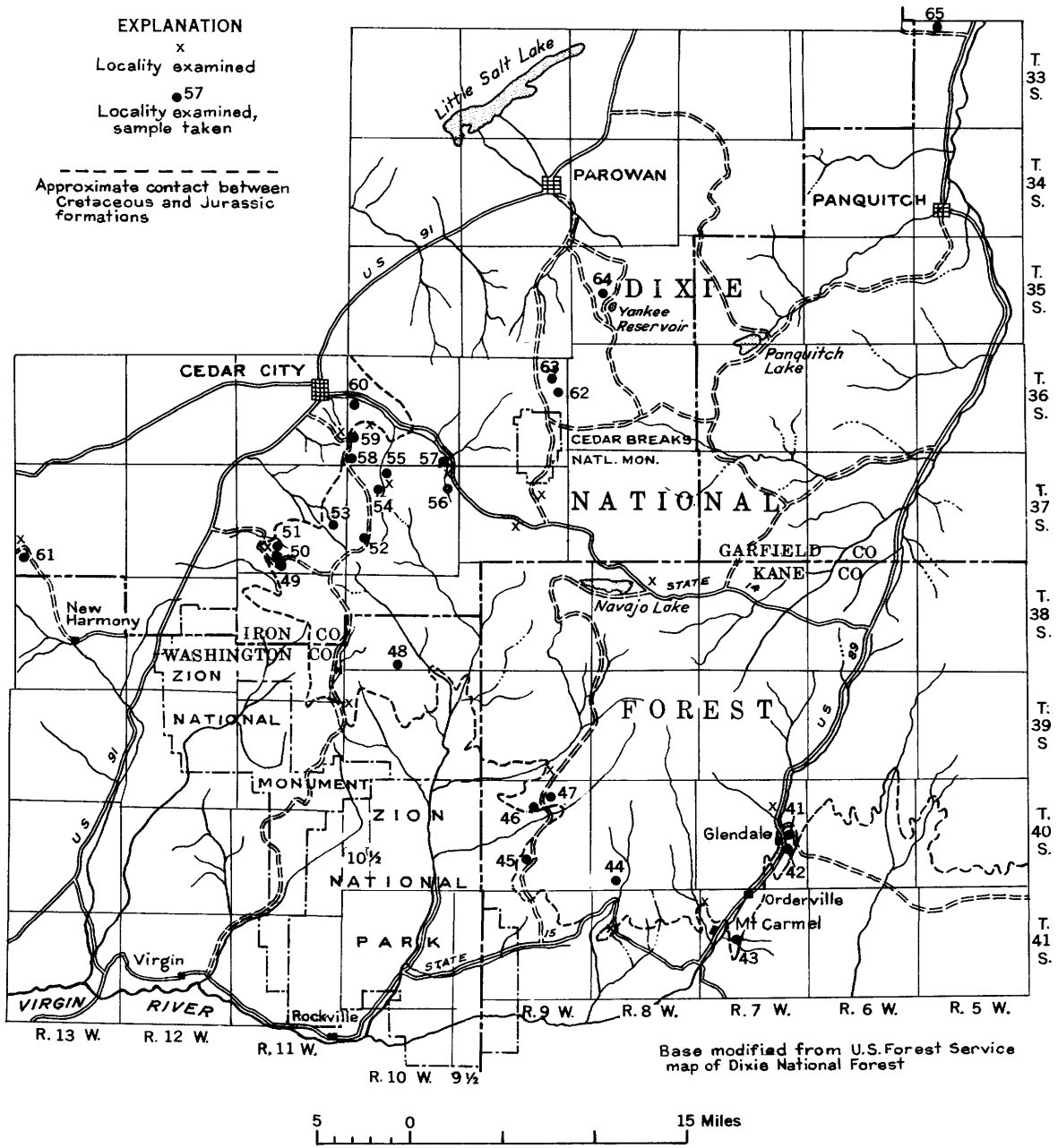


Figure 4.—Map of the Kolob Terrace area showing localities examined for carbonaceous materials.

Radioactivity measurements and chemical analyses, in percent, of samples from southern Utah
 [Laboratory serial no.: D, analysis made in Denver lab. Equivalent uranium: a, less than 0.001 percent. Analyses by S. Furman, W. Mountjoy, E. Campbell, B. A. McCall, and J. Goode.]

Map locality no.	Laboratory serial no.	Section-township-range	County	Equivalent uranium	Uranium	Ash	Material sampled
Kaiperowits Plateau area							
1	D-98328	24-31S-1W	Garfield	0.0008	0.0002		White volcanic tuff interbedded with lava flows of Tertiary age on west slope of Aquarius Plateau.
2	D-98346	23-31S-1W	--do--		<1x10 ⁻⁷		Water sample from spring issuing from volcanic rocks in Coyote Canyon.
3	D-98329	23-31S-1W	--do--	.0054	.0009		Tertiary volcanic flow rock at head of Coyote Canyon.
4	D-95980	31-32S-2E	--do--	.003	.0005		Tertiary volcanic flow rock near Cyclone Lake on Aquarius Plateau.
5	D-95977	11-34S-1W	--do--	.006	.0010		Tertiary volcanic flow rock on Aquarius Plateau.
6	114298	4-35S-1E	--do--	(a)			Upper 3 feet of a 12-foot coal bed in the Straight Cliffs sandstone at an abandoned mine on Birch Creek.
7	114302	8-35S-1E	--do--	(a)			12-foot coal bed at the Frandsen coal mine in the Straight Cliffs sandstone on upper Cherry Creek.
7	114303	8-35S-1E	--do--	(a)			1-foot coal rider bed 3 feet above the coal at the Frandsen coal mine.
8	114301	9-35S-1E	--do--	(a)			Upper 3.2 feet of a 6.4-foot coal bed on Cherry Creek in Straight Cliffs sandstone.
9	114328	27-35S-2E	--do--	.001			2-foot coal bed near base of Tropic formation.
10	114316	34-35S-2E	--do--	(a)			6-inch coal bed near base of Tropic formation.
11	D-95979	13-35S-2E	--do--	.002	.0017		Ferruginous sandstone near base of Dakota(?) sandstone.
12	114311	13-35S-2E	--do--	(a)			1-foot coal bed in the Dakota(?) sandstone 40 feet above contact with Morrison formation.
13	114299	24-35S-2E	--do--	(a)			2-foot coal bed in Dakota(?) sandstone.
14	114300	24-35S-2E	--do--	.002			Natural ash from same horizon as the 2-foot coal bed at locality 13.
15	D-95975	25-35S-2E	--do--	.015			White evaporite in Alvey Wash.
16	114305	3-36S-2E	--do--	.001	.0005	49.9	2-inch coal bed in the Straight Cliffs sandstone in Coal Bed Canyon.
16	114306	3-36S-2E	--do--	(a)			6-inch coal bed 9 feet below bed from which sample 114305 was taken.
16	114307	3-36S-2E	--do--	(a)			2.5-foot coal bed 10.7 feet below bed from which sample 114305 was taken.
17	114308	2-36S-2E	--do--	(a)			11-foot coal bed in the Straight Cliffs sandstone at the abandoned Christensen mine.
18	114304	10-36S-2E	--do--	(a)			Grab sample from 8-foot coal bed in the Straight Cliffs sandstone at an abandoned mine.
19	114320	3-36S-1E	--do--	(a)			Upper 2.7 feet of a 5.4-foot coal bed in Straight Cliffs sandstone in Upper Potato Valley.
19	114321	3-36S-1E	--do--	(a)			Lower 2.7 feet of the 5.4-foot coal bed from which sample 114320 was taken.
20	114322	35-37S-4E	--do--	.005	.007		Upper 1 foot of a 2-foot bed of carbonaceous shale in the Dakota(?) sandstone.
20	114323	35-37S-4E	--do--	.002			3-foot bed of carbonaceous shale at same horizon as sample 114322, but 300 feet west.
21	114312	19-38S-4E	Kane	.001			5-foot bed of weathered coal in the Straight Cliffs sandstone.
21	114326	36-41S-3E	--do--	(a)			2-inch coal rider in the Straight Cliffs sandstone in Middle Warm Creek.
22	114327	36-41S-3E	--do--	(a)			3-foot coal bed 1 foot below rider from which sample 114326 was taken.
23	114325	29-42S-4E	--do--	(a)			8-inch coal bed in the Dakota(?) sandstone in Middle Warm Creek.
24	114324	29-42S-4E	--do--	.002			1-foot bed of carbonaceous shale in the Dakota(?) sandstone.
25	114319	8-39S-1E	--do--	.001			Upper 1 foot of a 10-foot coal bed in the Straight Cliffs sandstone.
26	114318	5-39S-1E	--do--	(a)			6-foot coal bed in the Straight Cliffs sandstone.
27	114317	5-39S-1E	--do--	.001			4-foot bed of carbonaceous shale in the Straight Cliffs sandstone.
28	114313	6-39S-1E	--do--	.003	.002		2-foot bed of carbonaceous shale in the Dakota(?) sandstone about 15 feet above the top of the Winsor formation.
28	114314	6-39S-1E	--do--	.007	.006	83.6	1-foot bed of carbonaceous shale 2 feet below the shale from which sample 114313 was taken.
28	114315	6-39S-1E	--do--	.002			Lower 1 foot of a 2-foot bed of impure coal about 22 feet stratigraphically above the shale from which sample 114313 was taken.

Radioactivity measurements and chemical analyses, in percent, of samples from southern Utah—Continued

Map locality no.	Laboratory serial no.	Section-township-range	County	Equivalent uranium	Uranium	Ash	Material sampled
Kaiparowits Plateau area—Continued							
29	114329	8-37S-1W	Garfield	0.002			8-inch bed of carbonaceous shale in the Straight Cliffs sandstone.
29	114330	8-37S-1W	do	(a)			3-foot bed of carbonaceous shale 40 feet above shale from which sample 114329 was taken.
30	114309	13-37S-2W	do	(a)			4.2-foot coal bed near the contact of Tropic formation and Dakota(?) sandstone.
31	D-95978	13-37S-3W	do	.001	0.0007		Bentonite, 2 feet thick, at base of Dakota(?) sandstone.
32	114310	12-37S-3W	do	(a)			1.7-foot coal bed in Dakota(?) sandstone 2 miles north of Cannonville, Utah.
Henry Mountains area							
33	D-95983	11-27S-9E	Wayne	(a)		9.8	Upper 3.5 feet of the 7-foot Factory Butte coal bed in Ferron sandstone member of the Mancos shale.
33	D-95984	11-27S-9E	do	(a)		14.8	Lower 3.5 feet of the Factory Butte coal bed from which sample D-95983 was taken.
34	D-95985	24-27S-9E	do	0.001		79.0	6-inch layer of natural ash from the Factory Butte coal bed.
35	D-95986	24-28S-9E	do	.001		18.1	8-inch coal bed in Ferron sandstone member of Mancos shale.
36	D-95987	3-29S-8E	do	.002			2-foot bed of carbonaceous shale in Ferron sandstone member.
36	D-95988	3-29S-8E	do	.001		43.5	1-foot coal bed 20 feet stratigraphically below the shale from which sample D-95987 was taken.
37	D-95981	11-31S-9E	Garfield	.001	0.0001		Volcanic laccolithic rock on west flank of Mount Ellen (Henry Mountains).
38	D-95989	21-31S-9E	do	(a)		1.9	2.5-foot coal bed in Emery sandstone member of the Mancos shale.
39	D-95990	17-31S-9E	do	(a)		46.0	Upper 8 feet of a 14-foot coal bed in an operating mine in Emery sandstone member.
40	D-95991	30-31S-9E	do	(a)		36.4	Upper 2 feet of a 7-foot coal bed in Emery sandstone member at an abandoned mine.
Kolob Terrace and vicinity							
41	D-95993	13-40S-7W	Kane	(a)		21.9	Upper 1 foot of a 5-foot coal bed in Tropic formation at an abandoned mine.
42	D-95994	23-40S-7W	do	(a)		4.6	Upper 2 feet of a 5-foot coal bed in Tropic formation.
43	D-96000	21-41S-7W	do	0.001		25.8	5-foot coal bed in a slump block of Tropic formation adjacent to the Sevier fault.
44	D-95996	32-40S-8W	do	.001		8.9	5-foot upper coal bed in Tropic formation.
45	D-95999	28-40S-9W	do	(a)		10.9	3-foot lower coal bed in Tropic formation.
46	D-95997	10-40S-9W	do	.001		32.5	Stringers of coal above lower coal bed in Tropic formation.
47	D-95998	3-40S-9W	do	(a)		8.1	4-foot upper coal bed in Tropic formation.
48	D-98325	32-38S-10W	Washington	.0016	0.0002		Volcanic cinder near an old volcano on Thorley ranch.
49	D-98343	33-37S-11W	Iron		3x10 ⁻⁴		Water from spring issuing from abandoned coal mine near Graff Point.
50	D-98334	33-37S-11W	do	(a)			Upper 2 feet of a 10-foot coal bed in Tropic formation at abandoned mine near Graff Point.
51	D-98340	28-37S-11W	do	.001			Upper 1 foot of a 14-foot coal bed at the abandoned Kleen Coal mine in Tropic formation.
52	D-98336	20-37S-10W	do	.003	.0003		6-inch bed of carbonaceous shale in Tropic formation near Pryor Peak.
53	D-98337	24-37S-11W	do	(a)			Coal dump at Burns Coal Co. mine on Shurtz Creek.
54	D-96005	5-37S-10W	do	(a)		17.0	Coal dump at Fucker mine in Tropic formation in Right Hand Canyon.
55	D-96002	5-37S-10W	do	(a)		21.9	6-foot bed of coal and shale from Webster mine in Tropic formation in Right Hand Canyon.
55	D-96003	5-37S-10W	do	.001		7.4	Grab sample of commercial coal from Webster mine.

56	D-98338	1-37S-10W	do	.001			4-inch bed of coal in Straight Cliffs sandstone in Coal Canyon.
57	D-96001	36-36S-10W	do	(a)	7.7		Grab sample of commercial coal in Tropic formation from mine in Coal Canyon.
58	D-98339	36-36S-11W	do	.001			Upper 1 foot of an 8-foot bed of impure coal at abandoned mine in Tropic formation.
59	D-98335	30-36S-10W	do	(a)	89.7		Coal dump at abandoned and caved mine.
60	D-96004	13-36S-11W	do	.004	.002		Grab sample of ash from coal of three mines in Tropic formation at Southern Utah Power Company plant in Coal Canyon.
61	D-96006	30-37S-13W	do	.001			Impure coal on dump of mine in Tropic formation near igneous intrusion.
61	D-98341	30-37S-13W	do	.004	.0012		1-foot coal bed in abandoned mine in Tropic formation.
61	D-95982	30-37S-13W	do	.003	.0003		Grab sample of igneous intrusive rock (andesite) in contact with coal.
62	D-98344	13-36S-9W	do		3x10 ⁻⁷		Water sample from spring issuing from tuff in Brian Head formation of Miocene(?) age.
62	D-98345	13-36S-9W	do		1x10 ⁻⁷		Water sample from a larger spring higher in the section than that from which sample D-98344 was taken.
63	D-98326	12-36S-9W	do	.0030	.0010		Grab sample of rhyolitic lava on Brian Head in Brian Head formation.
64	D-98327	20-35S-8W	do	.0004	.0003		White volcanic tuff near Yankee Reservoir in Brian Head formation.
65	D-98331	5-35S-5W	do	.0019	.0002		Greenish-white buffaceous sandstone.

