CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
416 W. Congress St., Suite 100
Tucson, Arizona 85701
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

GEOLOGICAL SURVEY CIRCULAR 212

URANIUM-BEARING COAL AND CARBONACEOUS ROCKS IN THE FALL CREEK AREA BONNEVILLE COUNTY, IDAHO

By James D. Vine and George W. Moore

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary

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W. E. Wrather, Director

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CONTENTS

ILLUSTRATIONS

TABLE

ABSTRACT

Uraniferous coal, carbonaceous shale, and carbonaceous limestone occur in the Bear River formation of Early Cretaceous age at the Fall Creek prospect, in the Fall Creek area, Bonneville County, Idaho. The uranium compounds are believed to have been derived from mildly radioactive silicic volcanic rocks of Tertiary age that rest unconformably on all older rocks and once overlay the Bear River formation and its coal. Meteoric water, percolating downward through the silicic volcanic rocks and into the older rocks along joints and faults, is believed to have brought the uranium compounds into contact with the coal and carbonaceous rocks in which the uranium was absorbed.

INTRODUCTION

Uraniferous coal, lignite, and associated carbonaceous rocks were searched for in the summer of 1951 as part of the Geological Survey's program for the investigation of carbonaceous sedimentary rocks, in the western states, that might be potential sources of uranium. This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. The occurrence of small quantities of uranium with lignite had been reported previously from other areas by Slaughter and others (1946), Staatz and others (1951), and Wyant and others (1951). The uraniferous coal at the Fall Creek prospect was found as the result of reconnaissance radiometric examination of coals in Colorado, Wyoming, and Idaho closely associated with volcanic rocks, an association believed to be favorable for the occurrence of uranium in carbonaceous rocks (Denson, Bachman, and Zeller, 1950).

Radiometric examination was made chiefly with a Geiger-Muller counter. A scintillometer was available for a short time and it was used in the radiometric examination of the silicic volcanic rocks because this instrument permits the recognition of lower radioactivity anomalies than does the counter used. All

GENERAL GEOLOGY

Structure

The Caribou Mountains are part of the system of parallel mountains which form an arcuate belt along the Idaho-Wyoming border. The Caribou Range lies at the northern end of the arc where the prominent structural features trend northwest to plunge beneath the lavas of the Snake River Plain. Tight folds and thrust sheets characterize the complex structure of the Caribou Mountains. The Snake River flows along a strike valley with the Caribou Range on the southwest side and the Snake River Range on the northeast side. Also to the southwest lie other ridges belonging to the same system of parallel mountains; eventually they give way to the block faulted type of mountains which characterizes the Great Basin.

Sedimentary rocks

Mesozoic and Paleozoic strata are exposed in the Caribou Range. The following tabular description of the Cretaceous sedimentary rocks exposed in the vicinity of the Fall Creek prospect is taken chiefly from Kirkham (1924, pp. 23-29). The Bear River formation is described from the authors' observations in the field, following the usage of Louis S. Gardner.

Sedimentary strata exposed in the vicinity of the Fall Creek prospect

Age	Series		Formation	Thickness (feet)	Description
Cretaceous	Upper Cretaceous.		Wayan	8,800	Sandstones, grits, conglomerates, shales, limestones, and ash beds of fresh-water and continental origin.
			Bear River	150+	Black shale of brackish and fresh-water origin, quartzite, and thin beds of coal and carbonaceous limestone.
	Lower Cretaceous	Gannett group.	Tygee sandstone	1,020	Sandstone, reddish, yellowish, and gray and carbonaceous shale.
			Draney limestone	175	Limestone, very fine grained, light gray, also 25 feet of dark-colored coarse-grained limestone at the top.
			Bechler shale	225	Red shale, soft, weathers into a red soil.
			Peterson limestone	50	Limestone, massive, fine grained, dark gray; contains calcite seams and dark chert nodules.
			Ephraim conglomerate	360	Conglomerate, massive; sandstone, reddish; shale, reddish; and limestone.
Jurassic	Upper Jurassic		Stump sandstone.		

Kirkham (1924, p. 26) states that the Tygee sandstone unconformably underlies the Wayan formation and makes no mention of the Bear River formation, which Gardner (personal communication) recognizes between the Tygee and the Wayan. It seems probable that Kirkham has included the Bear River formation in the Tygee sandstone.

Igneous rocks

Tertiary volcanic rocks of several types and ages lie unconformably on the steeply tilted Mesozoic and Paleozoic strata. Ross and Forrester (1947) show three classes or groups of volcanic rocks in this area:

Pleistocene and Recent--Snake River basalt (chiefly basaltic flows).

Pliocene(?)--Salt Lake formation and associated strata (rather poorly consolidated sand, silt, and gravel of lacustrine and fluviatile origin, including fan deposits. Minor quantities of rhyolitic flows and welded tuffs and of basalts are included. Some of the sediments are tuffaceous, and fresh water limestone is locally present).

Miocene and Pliocene--Silicic volcanic rocks associated with the Snake River basalt (welded tuffs and flows of rhyolitic appearance).

Small remnants of the silicic volcanic rocks cap many of the hills in the vicinity of the Fall Creek area. Radiometric tests with a scintillometer indicate that these volcanic rocks are mildly radioactive.

FALL CREEK COAL PROSPECT

Introduction

The Fall Creek coal prospect is an adit which extends about 83 ft down the dip of a coal bed in the

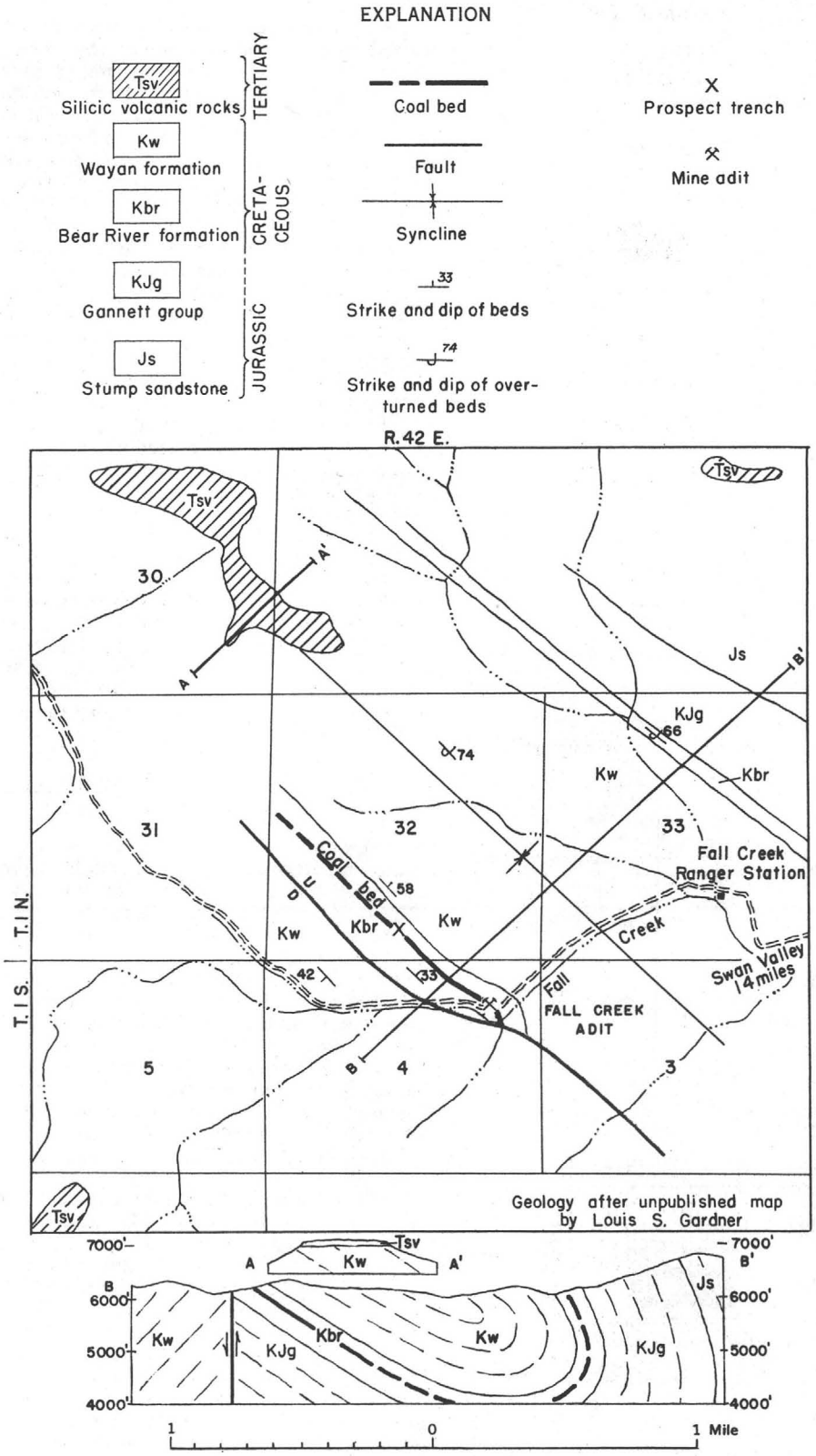


Figure 2.--Geologic sketch map of the Fall Creek area, Bonneville County, Idaho.

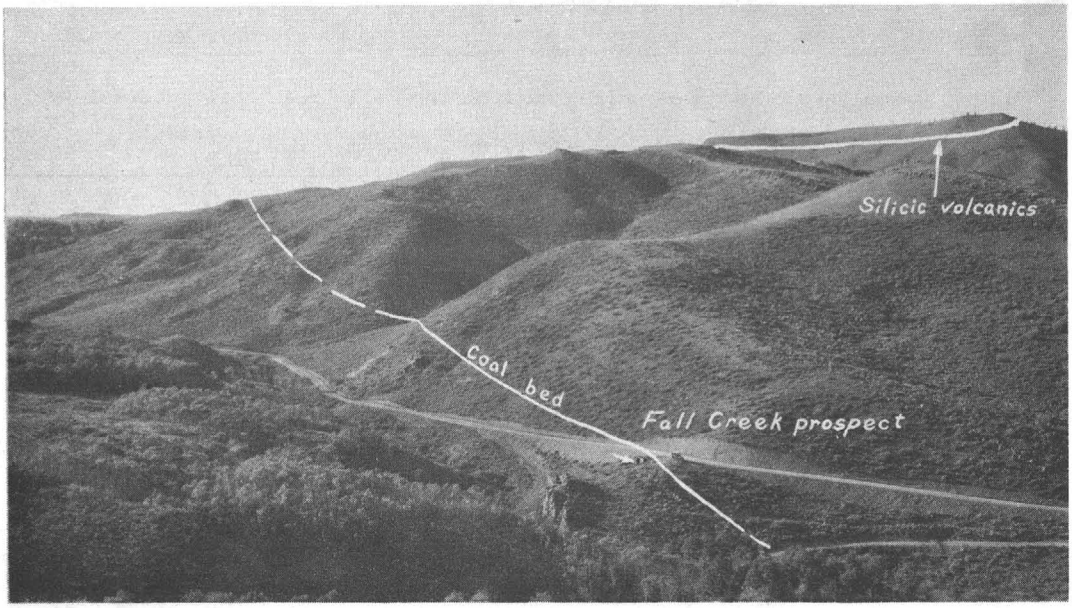


Figure 4 A. --View of Fall Creek coal prospect, showing position of entry and trace of coal bed with relation to road and surrounding hills.

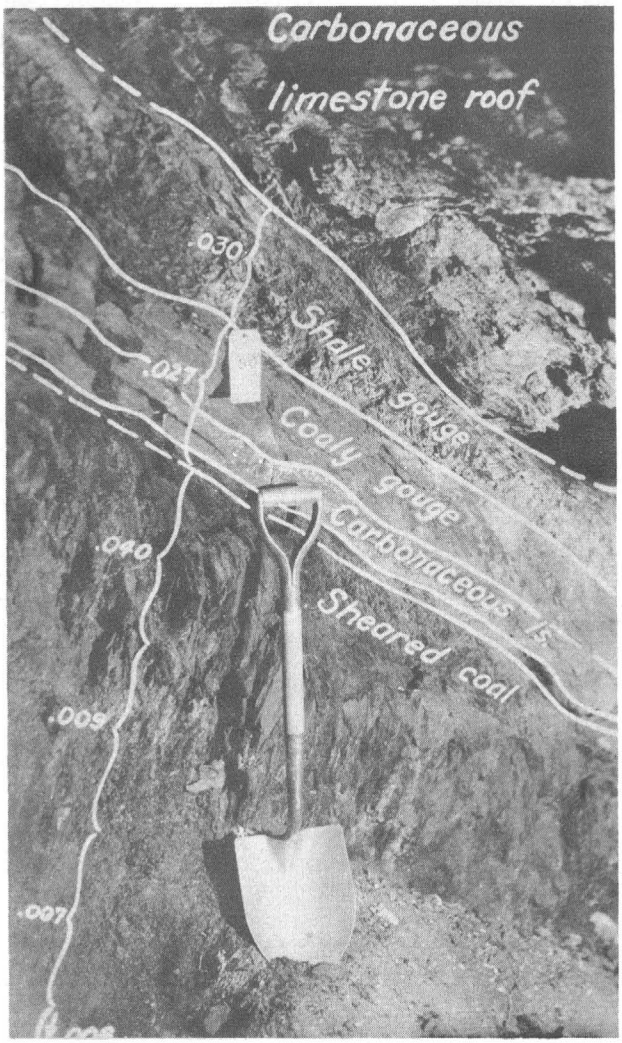


Figure 4 B. --Interior view of Fall Creek coal prospect, taken 50 ft from portal showing stratigraphic sequence of mineralized beds and percent uranium in the sample.

Table 1.--Analyses of samples collected from the Fall Creek coal prospect--Continued

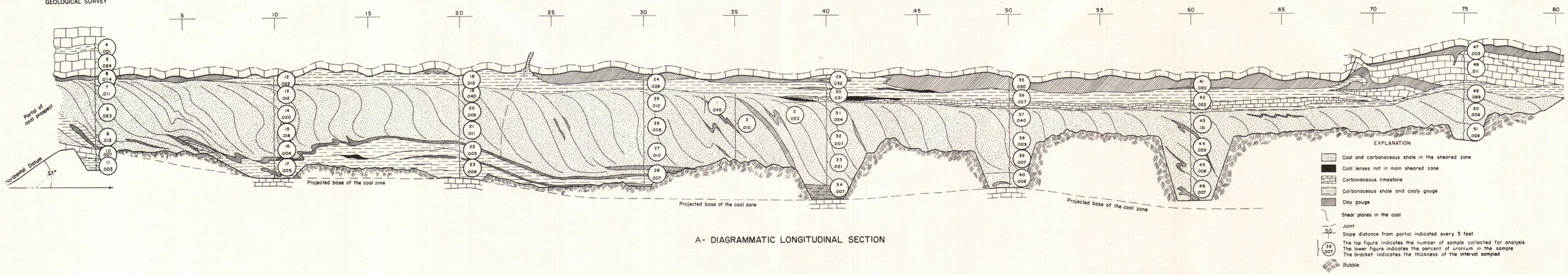
Sample number	Lab. No.	eU (percent)	Ash (percent)	U in Ash (percent)	U in sample (percent)	Sample description
Samples collected from station 40 ft from portal--Continued						
31.	66888	0.021	72.3	0.033	0.024	Top 1 1/3 ft sheared coal.
32.	66889	.006	74.6	.010	.007	Next 1 1/3 ft sheared coal.
33.	66890	.018	71.4	.030	.021	Next 1 1/3 ft sheared coal.
34.	66891	.005	78.2	.009	.007	1 1/3 ft coal, carbonaceous shale, and limestone.
Samples collected from station 50 ft from portal						
35.	66892	0.026	----	----	0.028, .030	1 ft carbonaceous shale and limestone.
36.	66893	.025	----	----	.027	8 in. carbonaceous limestone, shale, and vitreous coal.
37.	66894	.033	60.4	0.066	.040	Top 1¼ ft sheared coal.
38.	66895	.007	66.0	.013	.009	Next 1¼ ft sheared coal.
39.	66896	.005	70.8	.010	.007	Next 1¼ ft sheared coal.
40.	67239	.006	70.8	.008	.006	1 ft coal and clay.
Samples collected from station 60 ft from portal						
41.	67240	0.016	----	----	0.018, .020	8 in. carbonaceous shale.
42.	67241	.018	----	----	.022	15 in. carbonaceous limestone.
43.	67242	.096	43.7	0.30	.131	Top 1¼ ft sheared coal.
44.	67243	.025	66.2	.044	.029	Next 1¼ ft sheared coal.
45.	67244	.006	75.9	.010	.008	Next 1¼ ft sheared coal.
46.	67245	.007	77.4	.009	.007	Bottom 1¼ ft sheared coal.
Samples collected from station 75 ft from portal						
47.	67246	0.003	----	----	0.003	4 in. carbonaceous shale.
48.	67247	.010	----	----	.011	17 in. carbonaceous limestone.
49.	67248	.064	58.4	0.145	.085, .089	Top 1.1 ft sheared coal.
50.	67249	.007	64.9	.009	.006	Next 1.1 ft sheared coal.
51.	67250	.008	72.4	.012	.009	Next 1.1 ft sheared coal.
Sample from dump of abandoned prospect half a mile northwest of portal						
52.	66858	0.066	37.0	0.22	0.08	Coal fragments.

uranium in the coal and 0.222 percent uranium in the ash.

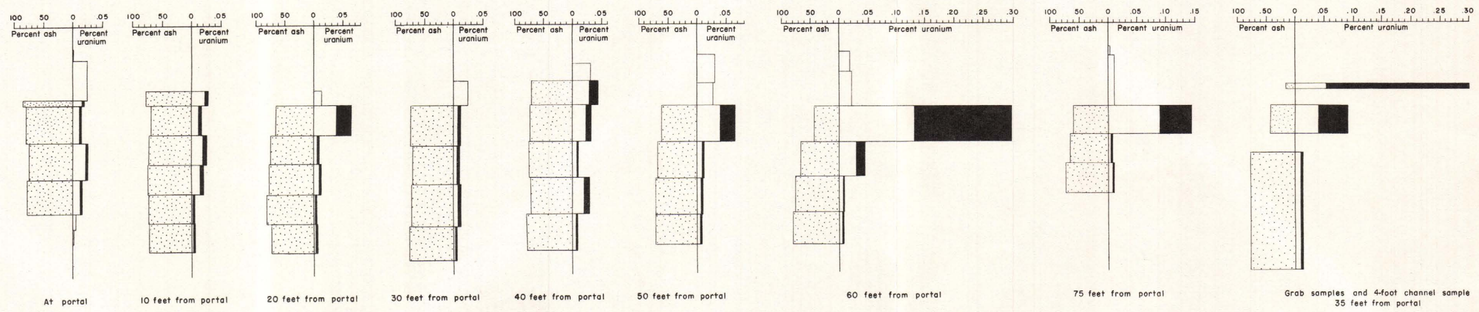
No other exposures of the coal bed were found along its strike. The hills in this area are covered by thick soil and colluvium, and only the most resistant beds crop out (fig. 4A). Fragments of radioactive carbonaceous limestone were found within half a mile northwest of the adit. A trench 3-5 ft deep and 20 ft long was dug adjacent to a caved and abandoned coal prospect about half a mile northwest of the adit in an attempt to uncover an exposure of the coal, but bedrock was not found. Enough small chunks of coal, however, were gathered from the dump of the abandoned coal prospect to fill a quart container. These fragments analyzed 0.08 percent uranium in the sample, 37 percent ash, and 0.22 percent uranium in the ash. This substantiates the belief that the uranium-bearing coal bed extends for at least half a mile along the strike northwest of the main adit.

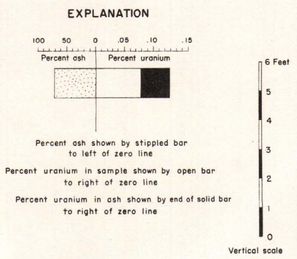
Mineralogy

No uranium minerals have been identified by this field study of the coal, carbonaceous shale, or carbonaceous limestone even though the analyses indicate a comparatively large quantity of uranium. Tolmachev (1943) has shown in his experiments on the adsorption of uranyl nitrate by activated carbon and carbonaceous shales that after the adsorption had taken place the amount of nitrate in the solution remained the same, but the amount of uranyl ion diminished. This suggested to him that the uranyl ion was adsorbed between the graphitic layers of carbonaceous material. A similar mechanism may explain why the uranium-bearing coal in the Fall Creek area contains no megascopically detectable uranium minerals. That is, the uranium may be present in the ionic state, adsorbed by carbonaceous material.



A- DIAGRAMMATIC LONGITUDINAL SECTION





B- PERCENT URANIUM AND ASH SAMPLES

GRAPHS OF RELATIONS AT THE FALL CREEK COAL PROSPECT, BONNEVILLE COUNTY, IDAHO