Results of Core Drilling for Uranium-Bearing Carbonaceous Shale and Lignite in the Goose Creek District, Cassia County, Idaho

By W. J. Mapel, 1952 and W. J. Hail, Jr. 1952

Trace Elements Investigations Report 438

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Geology and Mineralogy

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Series A

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GEOLOGICAL SURVEY

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W. J. Mapel and W. J. Hail, Jr.

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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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RESULTS OF CORE DRILLING FOR URANIUM-BEARING CARBONACEOUS SHALE AND LIGNITE IN THE GOOSE CREEK DISTRICT, CASSIA COUNTY, IDAHO

By W. J. Mapel and W. J. Hail, Jr.

ABSTRACT

Thirteen core holes, totaling 2,023 feet, were drilled during the fall of 1953 to explore the grade and extent of uranium-bearing beds of carbonaceous shale and lignite in the east-central part of the Goose Creek district, Cassia County, Idaho. The beds tested are interbedded with volcanic ash, bentonite, greenish-gray shale, sandstone, and conglomerate in two fairly well defined zones in the lower part of the Salt Lake formation of lower Pliocene age. Nine holes penetrated carbonaceous shale beds in the Barrett zone, and one hole penetrated carbonaceous shale and lignite beds in zone B, 160 feet stratigraphically below the Barrett zone.

The highest concentration of uranium found by drilling is 0.10 percent in the upper part of a 4-foot bed of carbonaceous shale and lignite in zone B. The grade of carbonaceous shale beds in the Barrett zone ranges from 0.044 percent to less than 0.003 percent uranium.

Inferred reserves in the district are estimated to be 790,000 tons in beds 1 foot or more thick containing an average of 0.014 percent or 120 tons of uranium.

INTRODUCTION

A program of core drilling to explore the underground extent and grade of uranium-bearing carbonaceous shale and lignite beds in the Goose Creek district was carried out in August and September 1953, by the U. S. Geological Survey on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission. Thirteen core holes totaling 2,023 feet were drilled during the investigation.

Location and relations of the area

The Goose Creek district includes about 260 square miles in the northern and central parts of an elongate northward-trending intermontane basin in south-central Idaho and adjacent parts of Utah and Nevada. The area drilled is in the east-central part of the district in Tps. 15 and 16 S., R. 21 E., Cassia County, Idaho. Figure 1 shows the location of the area drilled and its relation to the larger area in Idaho, Utah, and Nevada.

Goose Creek, a large perennial tributary of the Snake River, flows northward across Tps. 15 and 16 S., R. 21 E. in a relatively broad, open valley. Rolling hills and gently sloping flats border Goose Creek in the southern part of T. 16 S., R. 21 E.; the remainder of the drilled area is characterized by steep-sided buttes and narrow canyons. Altitudes within the drilled area range from about 4,750 to 6,350 feet. The

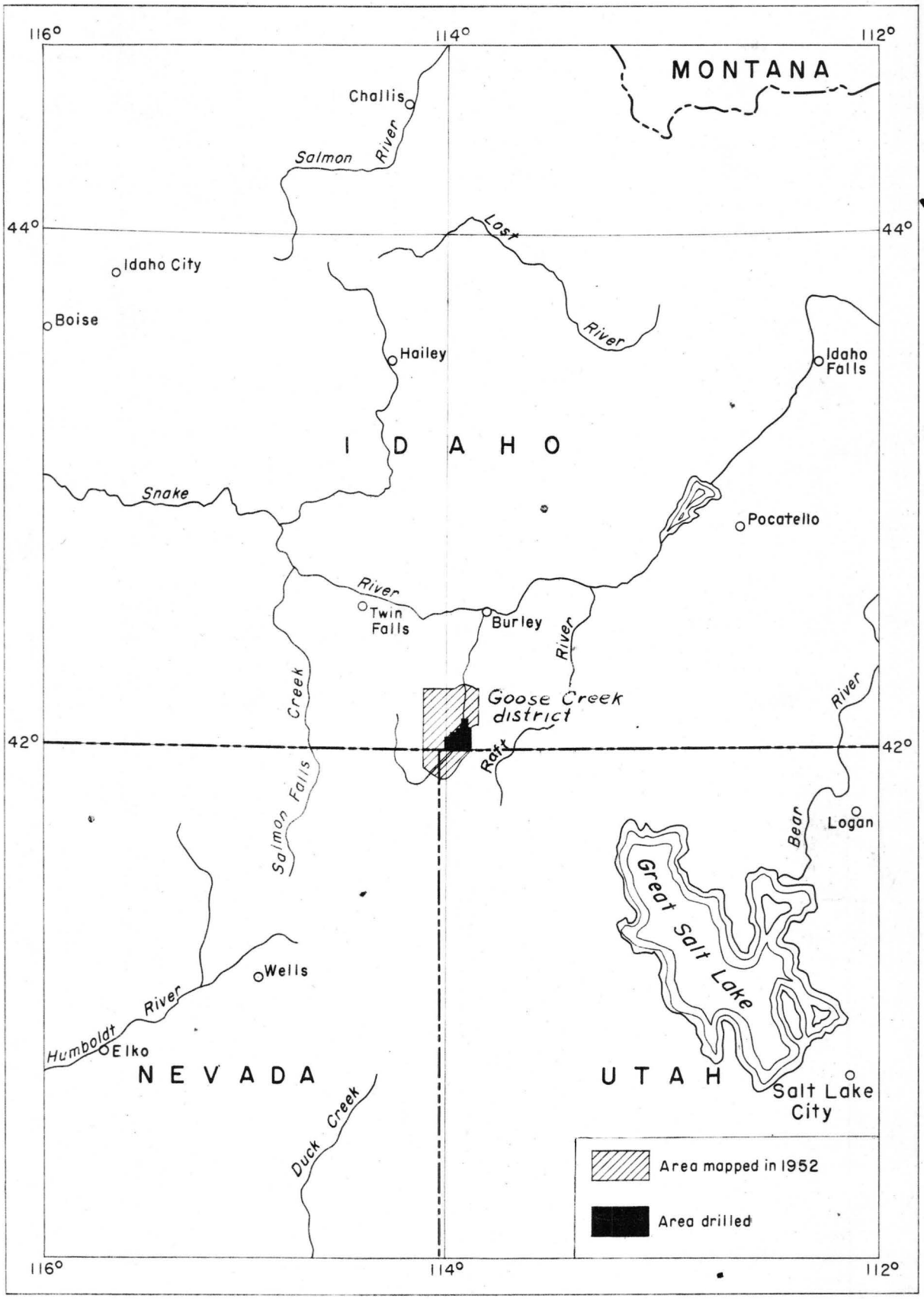

FIGURE 1.– INDEX MAP SHOWING LOCATION OF THE DRILLED AREA

climate is semi-arid and, at many places, the vegetation is sparse. The nearest towns are Oakley (pop. 800), Idaho, and Burley (pop. 5,000), Idaho, 3 and 25 miles north of the district respectively. Access is provided by a graded road that leads from Oakley up the valley of Goose Creek. A branch line of the Union Pacific Railroad, which leads from Burley to Oakley, is the nearest railroad.

Field work and acknowledgments

Core drilling in the Goose Creek district was done from August 15 to September 25, 1953. The writers located the drill holes on the basis of surface mapping and sampling done in the district in 1951 and 1952. (Mapel and Hail, 1953). M. L. Troyer supervised the drilling operations and was responsible for logging and sampling the drill cores.

Chemical and radiometric analyses for uranium were made by the Geological Survey Trace Elements Washington Laboratory. Cores of carbonaceous material from holes 2 and 3A were sampled and described by J. M. Schopf, Geological Survey Coal Geology Laboratory, Columbus, Ohio. Proximate and ultimate analyses of the coal cores from hole 2 were made by the U. S. Bureau of Mines, Central Experiment Station, Pittsburgh, Pa.

Drilling operations

Twelve core holes were drilled in the southeastern part of T. 16 S.,

R. 21 E., and one hole was drilled in the southern part of the township to the north. Figure 2 shows the locations of the holes. Their depths and the carbonaceous zones that were penetrated are listed in table 1.

The drilling was done by Boyles Bros. Drilling Company of Salt Lake City, Utah, under contract no. 14-08-001-720, dated April 10, 1953. The schedule of units prices was as follows:

	NX core	3 1/2 inch solid bit
Surface to 250 feet	$5.90/foot	$5.00/foot
250 to 500 feet	$6.90/foot	$5.00/foot
500 to 750 feet	$7.90/foot	

Reaming NX hole to 3 1/2 inches: $2.50/foot

Cementing: $4.50/foot.

The contract specified a minimum core recovery of 80 percent while drilling coal or carbonaceous shale.

Two truck-mounted hydraulic-feed diamond drills were used by the contractor. The core was cut using a face discharge diamond bit on a 5-foot swivel-tube core barrel. Casing was set to depths ranging from 7 to 65 feet depending on the amount of caving and water loss in the hole. All of the holes were cored to their total depth, except for the top few feet of soil and slope wash. Core recovery of bedrock in most holes was near 100 percent. The cost of the drilling totaled $13,072.66.

Table 1.--Core holes drilled in the Goose Creek district, Cassia County, Idaho

Core hole no.	Location Sec. T. R.	Altitude (feet)	Total depth	Carbonaceous zones penetrated
1	CE 1/2 24-15 S-21E	4,800	358	Barrett zone
2	CSW24-16S-21E	5,175	278	Barrett zone, zone B
3	NENE14-16S-21E	4,865	100	--
3A	CNE14-16S-21E	4,890	108	Barrett zone
4	NENE33-16S-21E	4,995	100	--
5	NWSW26-16S-21E	5,040	92	Barrett zone
6	N 1/2 NW26-16S-21E	5,100	142	Barrett zone
7	C23 - 16 S - 21 E	5,010	133	--
8	N 1/2 NW26-16S-21E	5,110	135	Barrett zone
9	NWSE26-16S-21E	5,165	195	--
11	SENW27-16S-21E	4,920	92	Barrett zone
13	NWSW26-16S-21E	5,050	144	Barrett zone
14	SESW26-16S-21E	5,075	143	Barrett zone

STRATIGRAPHY

The Salt Lake formation of lower Pliocene age forms the surface of most of the area drilled. The formation is a pyroclastic, lacustrine, and fluviatile sequence at least 2,300 feet thick consisting largely of friable white volcanic ash with several cliff-forming beds of welded rhyolitic tuff 10 to 100 feet thick near the middle of the formation, and containing at various horizons lesser amounts of greenish-gray shale, sandstone, pebble and boulder conglomerate, bentonite, and carbonaceous shale and lignite. For convenience in mapping, the formation is divided into two parts at the base of the stratigraphically highest persistent bed of welded tuff. The lower part of the formation, which has a maximum measured thickness of 1,600 feet, contains all of the known anomalously radioactive beds of carbonaceous shale and lignite in the district.

The Salt Lake formation rests unconformably on a large body of rhyolite porphyry of Tertiary (?) age exposed in the southwestern part of T. 16 S., R. 21 E., and is faulted against undifferentiated pre-Tertiary sedimentary rocks exposed in the central and eastern parts of the township to the east. Quaternary alluvium and landslide debris mask the older rocks locally.

STRUCTURE

The structure of the central part of the Goose Creek district is

shown on figure 3 by means of structure contours drawn on the top of the Barrett carbonaceous shale zone. In general, the Salt Lake formation is folded into a shallow northeastward-trending syncline, the axis of which coincides roughly with the valley of Goose Creek. Beds on the west flank of this fold dip 3 to 5 degrees southeastward, and on the east flank about 2 degrees north or northwestward. A low anticlinal ridge in the northern part of T. 16 S., R. 21 E. separates this syncline from a deep northwestward-trending synclinal depression in the township to the north.

Several high-angle normal faults cut the Salt Lake formation. Most of the faults trend northward or northeastward, and some may be traced for several miles. A northward-trending normal fault which borders the area on the east brings Tertiary (?) rhyolite or pre-Tertiary rocks against the upper part of the Salt Lake formation for more than 6 miles. The total displacement along this fault was not determined, but it probably is at least 300 feet and may be much greater. Near Birch Creek, and extending from Birch Creek southward, the upper welded tuff and associated rocks of the Salt Lake formation are preserved at the surface in a complex series of fault wedges bounded by northward- or northeastward-trending normal faults. One of these faults in sec. 25, T. 16 S., R. 21 E. has a displacement of about 900 feet. Other faults having displacements ranging from a few feet to as much as 300 feet cut the Salt Lake formation in the northern and northeastern parts of the drilled area.

CARBONACEOUS BEDS

The carbonaceous beds of the Salt Lake formation are mostly fissile brown shale which locally contains thin seams and streaks of dark brown to black lignite. Lignitic material from holes 2 and 3A were studied by Schopf and Gray (1954) who described it as a highly attrital or non-banded type of coal in which the highly and slightly radioactive portions are indistinguishable in appearance. Most of the beds are high in ash and have little commercial value, although locally some beds have burned along their outcrops and under shallow cover to produce conspicuous masses of bright red clinker. The proximate and ultimate analyses given in table 2 are representative of the higher grade carbonaceous beds in the district.

The carbonaceous beds are interbedded with volcanic ash, greenish-gray shale, sandstone, conglomerate, or bentonite in fairly well defined zones that are persistent for several miles. Individual carbonaceous beds within the zones are lenticular, however, and many of them pinch out or are replaced by non-carbonaceous material within a few tens or hundreds of feet. The carbonaceous beds and lenses range in thickness from a few inches to as much as 10 feet.

Four main carbonaceous zones were recognized in the lower part of the Salt Lake formation. The relative stratigraphic position of these zones is shown by figure 4. The Barrett zone is the thickest, most persistent,

Table 2.--Proximate and ultimate analyses of carbonaceous beds in zone B, drill hole 2, C SW 1/4 sec.24, T. 16 S., R. 21 E., Cassia County, Idaho.

U.S. Bureau of Mines sample no.	Depth in drill hole		Thickness of beds analyzed (feet)	Real specific gravity	Sample condition 1/	Proximate				Ultimate					Heat value
	From (feet)	To (feet)				Moisture	Volatile matter	Fixed carbon	Ash	Sulphur	Hydrogen	Carbon	Nitrogen	Oxygen	
E-28432	243.6	247.7	4.1	1.92	A	33.4	11.8	11.7	43.1	1.0	5.0	16.6	0.3	34.0	--
					B		17.7	17.6	64.7	1.5	2.0	24.9	0.5	6.4	--
E-37197	260.7	269.8	9.1	2.14	A	21.6	8.7	8.1	61.4	1.0	3.4	10.6	0.2	23.2	--
					B		11.2	10.3	78.5	1.3	1.2	13.5	0.3	5.3	--

1/ A, as received; B, moisture free.

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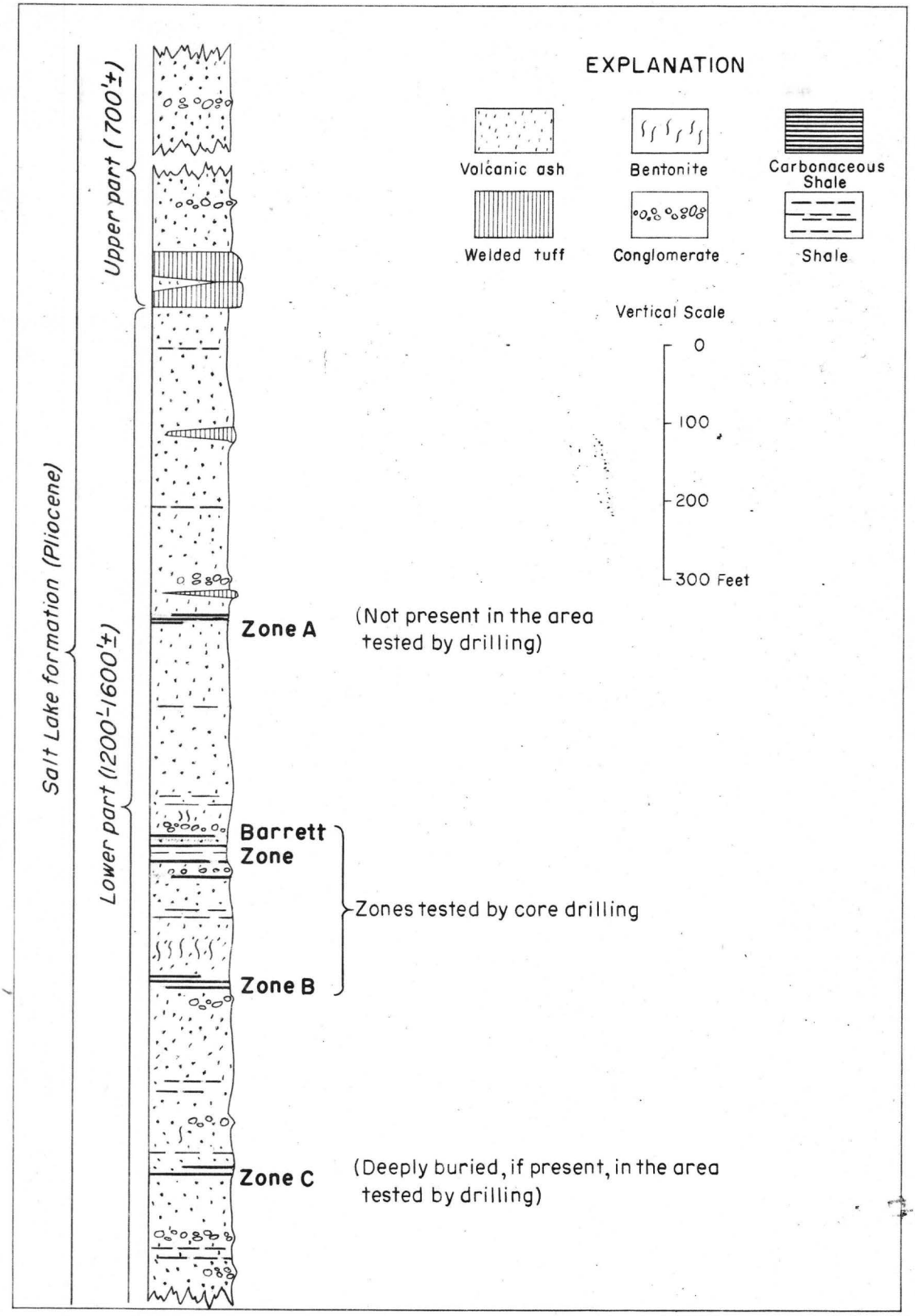

FIGURE 4.—GENERALIZED SECTION SHOWING THE RELATIVE STRATIGRAPHIC POSITION OF CARBONACEOUS SHALE ZONES IN THE SALT LAKE FORMATION, GOOSE CREEK DISTRICT, IDAHO

and in surface exposures contains the most uranium. The Barrett zone crops out in T. 16 S., R. 21 E. along both sides of Goose Creek and in the valleys of Coal Banks, Beaverdam, and Birch Creeks. It is thickest under the Coal Banks-Beaverdam Creeks divide where the zone consists of as many as 10 thin beds of carbonaceous shale and stringers of lignite in a stratigraphic interval of 50 to 80 feet.

Zone B is about 160 feet stratigraphically below the Barrett zone where zone B crops out in the valley of Birch Creek in sec. 25, T. 16 S., R. 21 E. It consists of three thin beds of carbonaceous shale in a stratigraphic interval of about 20 feet. The other two zones, zones A and C, are about 250 feet above the Barrett zone and 230 feet below it, respectively. Neither of these two zones contain much uranium in surface exposures, and neither zone was drilled.

RESULTS OF THE DRILLING

The logs of the drill holes and the thicknesses and uranium content of carbonaceous beds that were penetrated are shown graphically by figure 5, and the analytical data are tabulated in table 3.

Nine of the drill holes penetrated the Barrett carbonaceous shale zone, and 1 hole penetrated zone B, 160 feet below the Barrett zone. Four holes were drilled to the expected location of the Barrett zone, but no carbonaceous shale beds were found. In two of these holes (holes 7 and 9), the Barrett zone probably was removed by erosion beneath local

Table 3.--Tabulation of analytical data

Sample No. Field	Sample No. Lab.	Depth From (feet)	Depth To (feet)	Thickness of interval sampled (feet)	eU (percent)	U (percent)	Ash (percent)	U in ash 1/ (percent)	Description
				Hole 1					
MI-1039	117774	269.5	269.7	0.2	0.003	0.002	-	-	Carb. shale
MI-1040	117775	343.0	344.0	1.0	.001	-	-	-	Do.
				Hole 2					
TE-1	120771	242.0	242.9	0.9	0.004	0.001	95.3	0.001	Sandstone
TE-2	120772	242.9	243.2	0.3	.011 2/	.002	94.6	.001	Do.
TE-3	120773	243.2	243.6	0.4	.053	.050	84.2	.059	Carb. shale, sandy
TE-4	120774	243.6	244.0	0.4	.026	.022	70.1	.031	Carb. shale, lignitic
TE-5	120775	244.0	244.5	0.5	.076 2/	.101 2/	59.7	.176	Do.
TE-6	120776	244.5	244.9	0.4	.057	.055	47.7	.116	Do.
TE-7	120777	244.9	245.4	0.6	.088	.085	67.4	.126	Do.
TE-8	120778	245.4	245.8	0.4	.041 2/	.053 2/	62.1	.082	Do.
TE-9	120779	245.8	246.2	0.4	.018 2/	.033 2/	57.3	.057	Do.
TE-10	120780	246.2	246.7	0.5	.028	.028	63.1	.044	Do.
TE-11	120781	246.7	247.2	0.5	.022 2/	.036 2/	73.3	.050	Do.
TE-12	120782	247.2	247.7	0.5	.020 2/	.035 2/	71.2	.048	Do.
TE-13	120783	247.7	248.3	0.6	.012 2/	.018 2/	51.4	.039	Do.
TE-14	120784	248.3	248.7	0.4	.010 2/	.014 2/	60.1	.025	Do.
TE-15	120785	248.7	249.0	0.3	.022 2/	.005 2/	94.1	.004	Sandstone
TE-16	120786	249.0	249.4	0.4	.019	.016	83.2	.019	Carb. shale
TE-17	120787	249.4	249.7	0.3	.007	.003	92.2	.003	Gray shale
TE-18	120788	249.7	250.4	0.7	.004	.001	91.6	.001	Gray claystone
TE-19	120789	254.0	254.5	0.5	.007 2/	.001	96.4	.001	Carb. shale
TE-20	120790	259.7	260.5	0.7	.005	.005	85.2	.006	Sandstone
TE-21	120791	260.7	261.1	0.4	.021	.022	65.2	.033	Carb. shale, lignitic
TE-22	120792	261.1	261.7	0.6	.014 2/	.019 2/	78.3	.025	Carb. shale

1/ Percent U in ash was calculated.
2/ Average of 2 determinations.

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Table 3.--Tabulation of analytical data--Continued

Sample No. Field	Sample No. Lab.	Depth From (feet)	Depth To (feet)	Thickness of interval sampled (feet)	eU (percent)	U (percent)	Ash (percent)	U in ash 1/ (percent)	Description
				Hole 2 (continued)					
TE-23	120793	261.7	262.3	0.6	0.010	0.013	88.8	0.014	Carb. shale
TE-24	120794	262.3	262.7	0.4	.007	.010	80.5	.012	Do.
TE-25	120795	262.7	263.9	1.2	.004	.002	91.4	.002	Do.
TE-26	120796	264.0	265.0	1.0	.008	.007	78.2	.009	Do.
TE-27	120797	266.6	267.8	1.2	.010	.014	72.8	.019	Do.
TE-28	120798	267.8	268.0	0.2	.007	.006	85.4	.006	Do.
TE-29	120799	268.0	269.4	1.4	.020	.017	57.1	.030	Carb shale, lignitic
TE-30	120800	269.4	269.8	0.4	.006	.009	61.0	.014	Do.
TE-31	120801	270.8	271.4	0.6	.007	.008	91.4	.008	Gray shale
TE-32	120802	273.6	274.5	0.9	.008	.008	94.0	.008	Gray shale, silty
				Hole 3A					
MI-1042	117777	93.0	94.5	1.5	.002	-	-	-	Carb. shale
MI-1041	117776	96.0	96.5	0.5	.002	-	-	-	Do.
				Hole 5					
MI-1006	115802	45.9	46.6	0.7	.011	.011	-	-	Do.
MI-1007	115803	54.0	55.0	1.0	.008	.005	-	-	Do.
MI-1008	115804	55.0	56.4	1.4	.005	.006	-	-	Do.
MI-1009	115805	62.5	63.5	1.0	.006	.004	-	-	Do.
MI-1010	115806	63.5	64.2	0.7	.003	.002	-	-	Do.
MI-1011	115807	67.5	68.2	0.7	.004	.002	-	-	Do.
MI-1012	115808	72.5	72.8	0.3	.004	.002	-	-	Do.
MI-1013	115809	78.9	79.2	0.3	.004	.002	-	-	Do.

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Table 3.--Tabulation of analytical date--Continued

Sample No. Field	Sample No. Lab.	Depth From (feet)	Depth To (feet)	Thickness of interval sampled (feet)	eU (percent)	U (percent)	Ash (percent)	U in ash 1/ (percent)	Description
				Hole 6					
MI-1014	115810	33.5	34.0	0.5	0.002	-	-	-	Claystone, dark gr.
MI-1015	115811	40.5	41.2	0.7	.004	0.004	-	-	Carb. shale
MI-1016	115812	98.0	98.5	0.5	.003	a	-	-	Sandstone, slightly carbonaceous
				Hole 8					
MI-1018	115814	70.3	71.3	1.0	.005	.004	-	-	Carb. shale
MI-1019	115815	71.3	73.1	1.8	.007	.004	-	-	Do.
MI-1020	115816	73.1	74.5	1.4	.007	.007	-	-	Do.
MI-1021	115817	74.8	75.7	0.9	.004	.003	-	-	Do.
MI-1022	115818	76.2	77.0	0.8	.004	.003	-	-	Do.
MI-1023	115819	89.0	89.6	0.6	.009	.009	-	-	Do.
MI-1024	115820	89.6	90.2	0.6	.009	.010	-	-	Do.
MI-1025	115821	91.8	93.0	1.2	.005	.004	-	-	Do.
MI-1026	115822	93.0	94.2	1.2	.003	.001	-	-	Do.
MI-1027	115823	94.5	95.4	0.9	.003	.002	-	-	Do.
MI-1028	115824	95.4	96.1	0.8	.003	.002	-	-	Do.
MI-1029	115825	96.1	96.5	0.4	.008	.009	-	-	Do.
MI-1030	115826	97.2	97.5	0.3	.002	-	-	-	Do.
MI-1031	115827	104.2	105.3	1.1	.002	-	-	-	Do.
MI-1032	115828	106.0	107.0	1.0	.003	.002	-	-	Do.
MI-1033	115829	109.2	109.9	0.7	.003	.002	-	-	Do.
MI-1034	115830	109.9	111.2	1.3	.002	-	-	-	Do.
MI-1035	115831	111.2	112.0	0.8	.005	.004	-	-	Do.
MI-1036	115832	119.0	119.5	0.5	.005	.004	-	-	Do.

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Table 3.--Tabulation of analytical data--Continued

Sample No. Field	Sample No. Lab.	Depth From (feet)	Depth To (feet)	Thickness of interval sampled (feet)	eU (percent)	U (percent)	Ash (percent)	U in ash 1/ (percent)	Description
				Hole 11					
MI-1043	117778	79.0	80.0	1.0	0.001	-	-	-	Carb. shale
MI-1044	117779	82.3	82.8	0.5	.003	0.002	-	-	Do.
MI-1045	117780	85.0	86.0	1.0	.003	.003	-	-	Do.
				Hole 13					
MI-1017	115813	78.4	79.8	1.4	.008	.008	-	-	Do.
				Hole 14					
MI-1037	115833	98.7	99.3	0.6	.003	.001	-	-	Do.
MI-1038	115834	101.2	101.9	0.7	.038	.044	-	-	Do.

1/ Percent U in ash was calculated.
2/ Average of 2 determinations.

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unconformities in the Salt Lake formation. Near hole 4, carbonaceous beds in the Barrett zone may pinch out or grade laterally into volcanic ash. Hole 3 1/ found an unexpected thickness of alluvium which extended

1/ Not shown on the geologic map or by the graphic sections, figure 5.

below the horizon of the Barrett zone; however, hole 3A, drilled later near the site of hole 3, found the Barrett zone in this vicinity.

The richest deposit found by drilling is in zone B, penetrated by hole 2, sec. 24, T. 16 S., R. 21 E. A bed of carbonaceous shale and lignite 5.4 feet thick at the top of zone B contains a maximum of 0.10 percent uranium in the upper part of the bed and an average of 0.044 percent uranium for the bed as a whole. A detailed section of the core from the uranium-bearing zone is shown by figure 6, and proximate and ultimate analyses of the carbonaceous material are given by table 2. The extent of this occurrence is unknown inasmuch as the only other place that zone B has been tested is at a mildly radioactive surface exposure along Birch Creek, a mile to the south.

Carbonaceous beds found in drilling the Barrett zone range in thickness from a few inches to 7 feet, and in uranium content from less than 0.003 percent to 0.044 percent, the last being the grade of an 8-inch bed of carbonaceous shale found in hole 14, sec. 26, T. 16 S., R. 21 E. The upper part of an 8-foot bed of carbonaceous shale in the Barrett zone

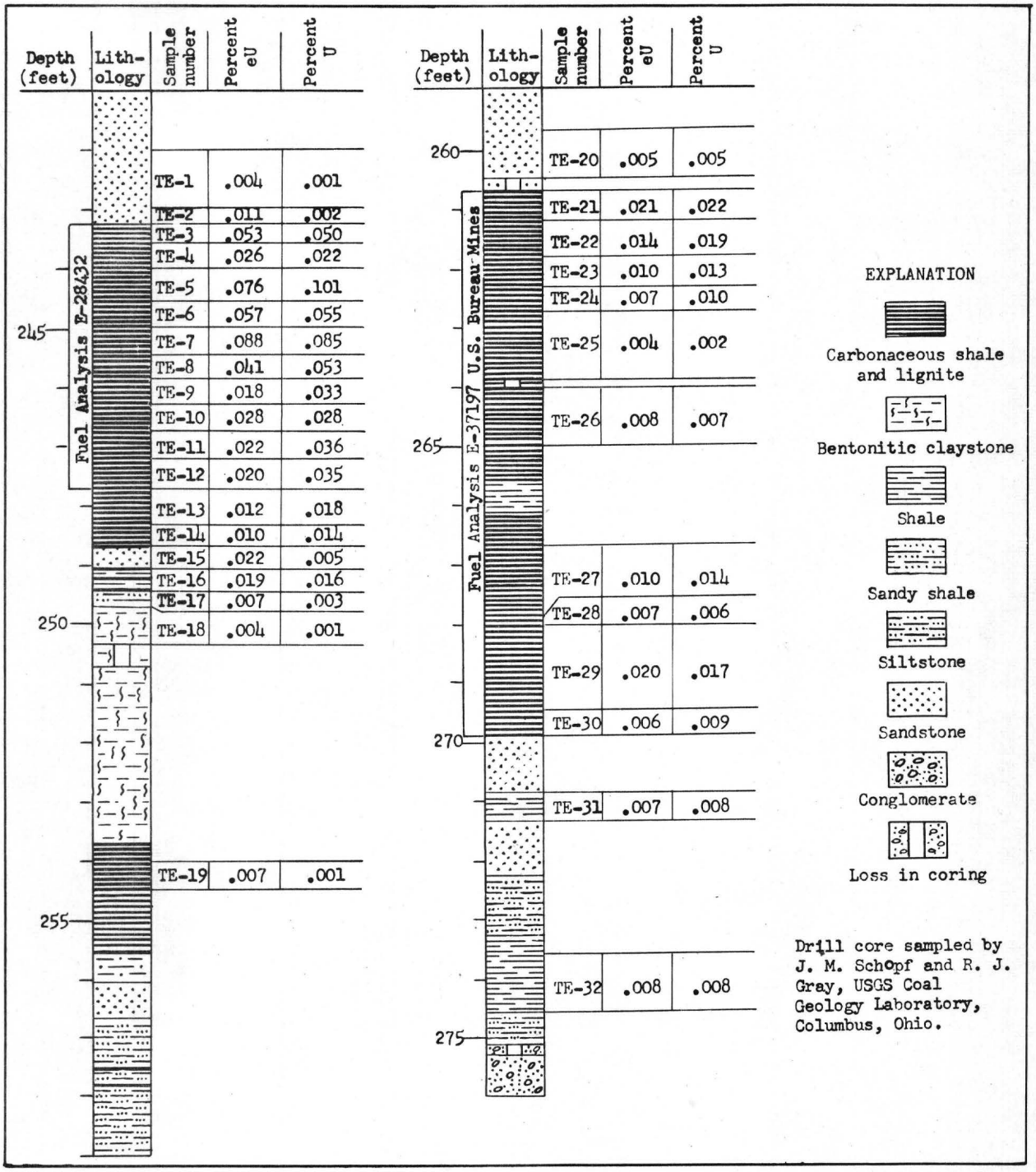

Figure 6.--Detailed section showing the uranium content of carbonaceous shale zone B, drill hole 2, Goose Creek district.

contains as much as 0.12 percent uranium in a surface exposure between holes 5 and 8, but none of the beds in the zone is of comparable thickness and grade where tested by drilling.

The distribution of uranium in the central part of the Goose Creek district is shown on figure 3. Most of the occurrences are on the flanks of the shallow syncline that trends northeastward across T. 16 S., R. 21 E. Within this broad area the uranium content of the carbonaceous beds is highly variable at different places along the same bed, and in different beds in the same zone. No individual uranium-rich bed is known to be persistent in thickness or grade for more than a short distance.

The writers have postulated (1953) that the carbonaceous shales in the Goose Creek district were enriched by ground water which derived uranium from beds of radioactive volcanic ash in the Salt Lake formation. Devitrification of the ash and its alteration to bentonite may have promoted mineralization by making uranium more easily available to the water. Bentonite and bentonitic ash are common at the horizon of the Barrett zone in association with beds of carbonaceous shale and lignite having relatively high uranium contents.

In earlier reports (Hail and Gill, 1953; Mapel and Hail, 1953), it was suggested that the syncline in T. 16 S., R. 21 E. influenced uranium mineralization by channeling the flow of ground water toward the synclinal axis. Consequently, holes 3A, 6, and 11 were drilled near the axis of the syncline in T. 16 S., R. 21 E., and hole 1 was drilled on the axis

of the deeper syncline in the township to the north. Carbonaceous beds found in these holes are not appreciably radioactive. The four holes are too widely spaced to be an adequate test of the synclinal troughs as sites for the occurrence of uranium, but they indicate that the larger synclines are less direct guides to uranium than was formerly supposed.

URANIUM RESERVES

The estimated reserves of uranium in the district, based on drilling and surface sampling, are shown by tables 4 and 5 and the areas for which most of the reserves were calculated are shown by figures 7 and 8. The reserves are listed in two categories: (1) in beds 2 feet thick or more containing 0.005 percent or more uranium, and (2) in beds 1 foot thick or more containing 0.01 percent or more uranium. Reserves in the first category total 12,000,000 tons containing 885 tons of uranium, the average grade being 0.007 percent; and in the second category 820,000 tons containing 120 tons of uranium, the average grade being 0.015 percent. Because of the lenticularity of the radioactive beds and the abrupt lateral changes in their uranium content, the reserves in both categories are regarded as inferred. The total estimated reserve of uranium as presented in this report is about the same as was made before drilling (Mapel and Hail, 1953).

Table 4.--Inferred reserves of uranium, Goose Creek district. In beds 2 feet thick or more containing 0.005 percent uranium or more.

Area for which reserves are calculated 1/	Thickness of bed (weighted average, in feet)	Area (acres)	Grade (weighted average, in percent)	Carbonaceous shale (short tons, rounded) 2/	Uranium (short tons, rounded)
			Barrett zone		
1	2.5	320	0.009	880,000	80
2	6.4	16	.010	110,000	10
3	8.5	185	.007	1,730,000	120
4	2.7	1,420	.007	4,200,000	295
	2.9	1,020	.007	3,250,000	230
	3.0	34	.008	110,000	10
5	3.7	285	.008	1,120,000	90
	3.6	32	.009	130,000	12
6	2.3	85	.008	215,000	17
7	2.5	40	.006	110,000	7
8	2.5	24	.007	65,000	5
Totals(rounded)	3.2	3,460	.007	12,000,000	875

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Table 4.--Inferred reserves of uranium, Goose Creek district. In beds 2 feet thick or more containing 0.005 percent uranium or more.--Continued.

Area for which reserves are calculated 1/	Thickness of bed (weighted average, in feet)	Area (acres)	Grade (weighted average, in percent)	Carbonaceous shale (short tons, rounded) 2/	Uranium (short tons, rounded)
		Zone B			
Core hole 2, sec. 24, T. 16 S., R. 21 E.	6.2	1	0.042	16,500	7
	5.2	1	.015	14,000	2
Totals (rounded)	5.7	2	.030	30,000	9
Grand total (rounded)	3.2	3,460	.007	12,000,000	885

1/ See map, figure 7.

2/ 1,100 short tons of carbonaceous shale per acre-foot used in calculations for the Barrett zone (based on an average apparent specific gravity of 0.83 for 6 outcrop samples); 2,700 short tons of carbonaceous shale per acre-foot used in calculations for zone B (based on an average real specific gravity of 2.0 for 2 drill-core samples).

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Table 5.--Inferred reserves of uranium, Goose Creek district. In beds 1 foot thick or more containing 0.010 percent uranium or more.

Area for which reserves are calculated 1/	Thickness of bed (weighted average, in feet)	Area (acres)	Grade (weighted average, in percent)	Carbonaceous shale (short tons, rounded) 2/	Uranium (short tons, rounded)
			Barrett zone		
9	2.5	115	0.012	320,000	38
10	6.1	18	.010	120,000	12
11	2.3	44	.015	110,000	16
12	2.5	14	.013	40,000	5
13	1.6	3	.013	6,000	1
14	1.7	51	.022	95,000	21
Sec. 5, T. 15 S., R. 21 E.	1.5	14	.024	24,000	6
Sec. 12 and 13, T. 15 S., R. 20 E.	1.0	66	.020	73,000	15
Totals (rounded)	2.2	325	.014	790,000	115

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Table 5.--Inferred reserves of uranium, Goose Creek district. In beds 1 foot thick or more containing 0.010 percent uranium or more.--Continued.

Area for which reserves are calculated 1/	Thickness of bed (weighted average, in feet)	Area (acres)	Grade (weighted average, in percent)	Carbonaceous shale (short tons, rounded) 2/	Uranium (short tons, rounded)
		Zone B			
Drill hole 2, sec. 24, T. 16 S., R. 21 E.	5.4	1	0.044	14,600	6
	4.8	1	.015	13,000	2
Totals (rounded)	5.1	2	.030	28,000	8
Grand total (rounded)	2.2	325	.015	820,000	120

1/ See map, figure 8.

2/ 1,100 short tons of carbonaceous shale per acre-foot used in calculations for the Barrett zone (based on an average apparent specific gravity of 0.83 for 6 outcrop samples); 2,700 short tons of carbonaceous shale per acre-foot used in calculations for zone B (based on an average real specific gravity of 2.0 for 2 drill-core samples).

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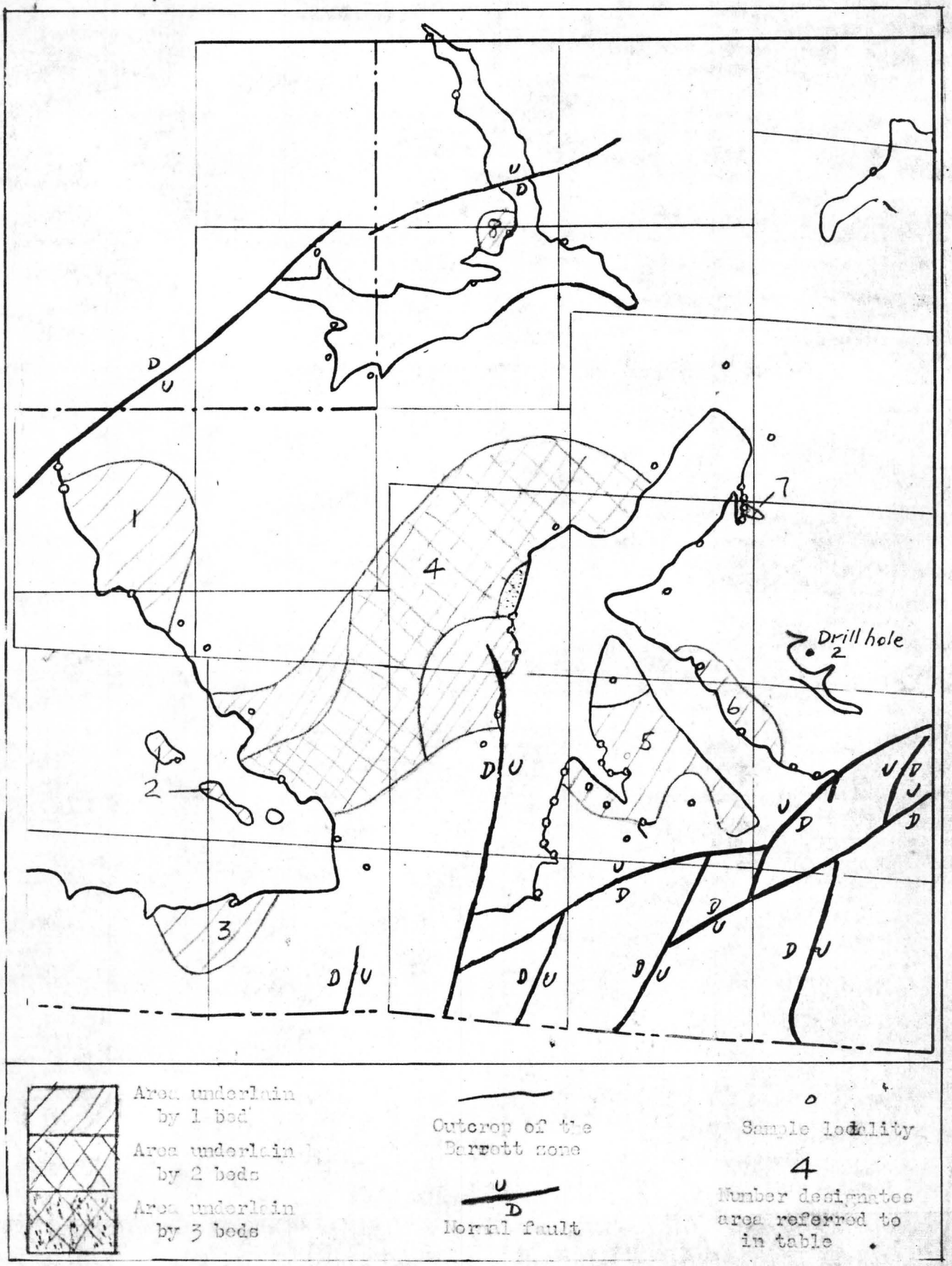

Figure 7.--Map of part of T. 16 S., R. 21 E., Idaho, showing the areas that may be underlain by carbonaceous shale in beds 2 feet thick or more containing 0.005 percent uranium or more.

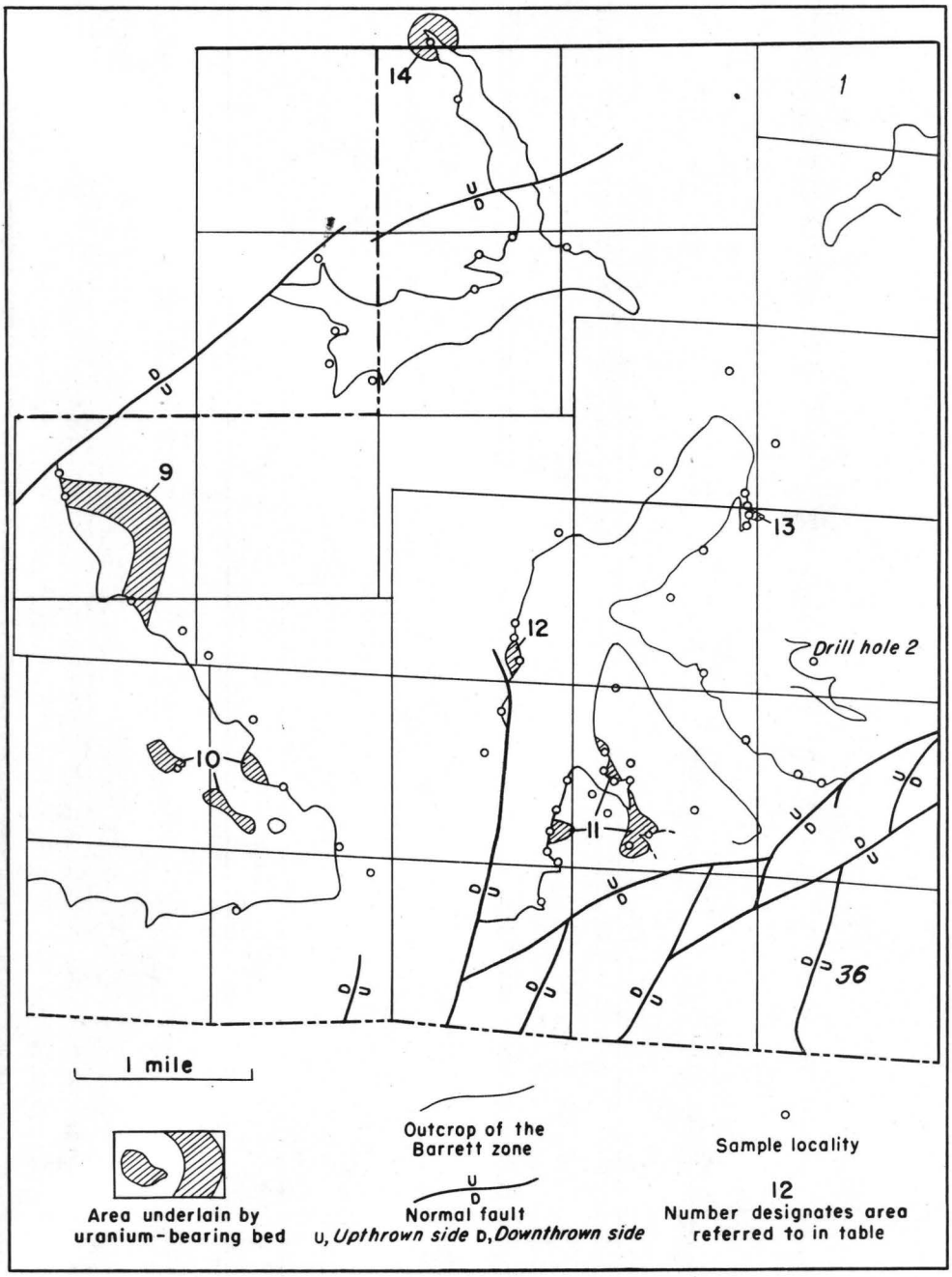

FIGURE 8 – MAP OF PART OF T. 16 S., R. 21 E., IDAHO, SHOWING THE AREAS THAT MAY BE UNDERLAIN BY CARBONACEOUS SHALE IN BEDS 1 FOOT THICK OR MORE CONTAINING 0.010 PERCENT URANIUM OR MORE.

CONCLUSIONS

Carbonaceous shale and lignite beds in the Goose Creek district contain concentrations of uranium which approach ore grade in two zones in the lower part of the Salt Lake formation. The host carbonaceous beds are lenticular, however, and their uranium content varies greatly in short distances, so that individual beds of highly uraniferous shale or lignite probably underlie areas of no more than a few acres. Moreover, the occurrences of relatively high grade shale or lignite do not appear to be numerous. Additional data on the distribution and mode of occurrence of uranium would be obtained from closely spaced drill holes or by sinking shafts or test pits, but in view of the small number of high grade occurrences discovered by surface mapping and exploratory drilling, the area is judged to have doubtful commercial interest, and no further work is planned at this time.

UNPUBLISHED REPORTS

Hail, W. J., Jr., and Gill, J. R., 1953, Radioactive carbonaceous shale and lignite deposits in the Goose Creek district, Cassia County, Idaho: U. S. Geol. Survey Trace Elements Inv. Rept. 272.

Mapel, W. J., and Hail, W. J., Jr., 1953, Uranium-bearing carbonaceous shale and lignite in the Goose Creek district, Cassia County, Idaho, Boxelder County, Utah, and Elko County, Nevada: U. S. Geol. Survey Trace Elements Inv. Rept. 339.

Schopf, J. M., and Gray, R. J., 1954, Microscopic studies of uraniferous coal deposits--a progress report: U. S. Geol. Survey Trace Elements Inv. Rept. 408.