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RADIOACTIVITY OF SOME COAL AND SHALE OF PENNSYLVANIAN AGE IN OHIO

By
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This report is preliminary and has not been edited or reviewed for conformity with U. S. Geological Survey standards and nomenclature.

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ABSTRACT

Channel samples of the commercially important coal beds and associated rocks in the Pottsville, Allegheny, and Monongahela series of the Pennsylvanian system were collected in eastern Ohio. Equivalent uranium content of 0.001 percent or more was determined in the laboratory for five samples. The uranium content of the coal is less than the equivalent uranium content indicated by radioactivity measurements. None of the samples collected contain recoverable quantities of uranium in the ash.

INTRODUCTION

The coal-bearing rocks of Ohio are in the eastern part of the state and cover about 12,000 square miles, or about one-fourth of the state(fig. 1). This area, part of the Appalachian Plateau, has a relief measured in a few hundred feet, except in the northern part which is a glacial till plain of low relief. The rocks forming the plateau are essentially flat, dipping gently eastward at about 35 feet per mile, except where the eastward dip is interrupted by one of a few minor folds.

Ohio produces about 35 million tons of bituminous coal a year and ranks fifth among the coal producing states. Approximately one-half of the production comes from underground mines and the other half comes from open pit mines. Of the more than 50 named coal beds in Ohio, only 9 beds that produce commercial quantities of coal were sampled for this study. The rank of the coal is high-volatile bituminous, and the commercial beds are all suitable for industrial use, various types of stokers, and domestic use. The ash content of the commercial beds, averaged both by bed and field, ranges

from 6 to 12 percent. (Keystone Coal Buyers Manual, 1951, pp. 288-290).

The Ohio Geological Survey has published a number of reports on the coal-bearing rocks of Ohio (Bownocker and Dean, 1929, Bownocker, 1947, Condit, 1912, Morningstar, 1922, Smith, Brant, Amos, and Krumin, 1952, Ohio Annual Coal Report and Non-Metallic Mineral Report, 1946, and White and Gambs, 1947). Also available are topographic maps of the U. S. Geological Survey which cover the coal field at a scale of 1:62,500 and most of which were originally published between 1900 and 1910.

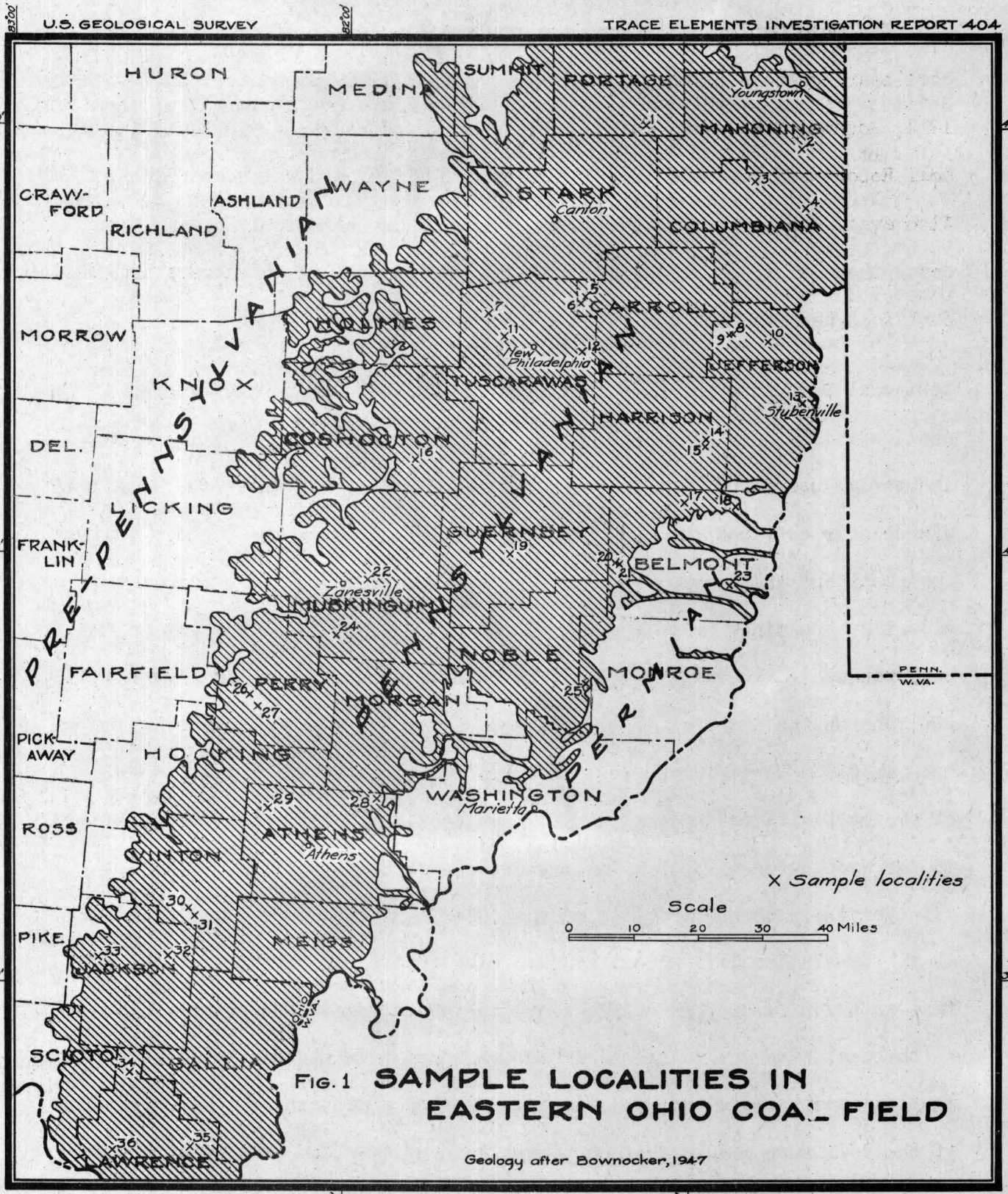

FIG. 1 SAMPLE LOCALITIES IN EASTERN OHIO COAL FIELD

Geology after Bownocker, 1947

SCOPE OF THE INVESTIGATION

The U. S. Geological Survey collected samples and measured the radioactivity of coals and associated rocks in eastern Ohio on behalf of the Division of Raw Materials of the Atomic Energy Commission. Stewart W. Welch and John W. Huddle did preliminary sampling in August 1952, and Stewart W. Welch and John L. Snider did further field work from September 30 to October 11, 1952.

The purpose of this investigation was to search for uranium in important coal beds mined in Ohio that are widely used in industry. Even if the coal contained only very small amounts of uranium, the ash resulting from industrial use might contain recoverable amounts of uranium. The sampling was chiefly confined to large mines producing coal from the highest quality coal beds and the extensively mined beds were sampled at more places than beds that are mined only locally. Because the average ash content of the coal ranges from 6 to 12 percent, the concentration of uranium in the ash would be on the order of 16 to 8 times. A uranium content in the ash of as much as 0.005 percent thus would not be detectable by field measurements of radioactivity of the coal, and all radioactivity measurements were made in the Washington laboratory of the Geological Survey.

Forty-six channel samples of nine different coal beds were collected at thirty-six localities; all samples came from fresh surfaces at the coal face in strip pits or in drift, slope, or shaft mines. The whole thickness of the coal beds excluding shale and bony coal partings was taken as a single sample, except where the coal was in two or more distinct benches. Sections of the coal were measured at each sample locality. Two samples of shale, one of flint clay, and one of cannel coal, also were collected.

STRATIGRAPHY

The coal-bearing rocks in Ohio are in the Pennsylvanian and Permian systems. The Pennsylvanian system is subdivided into four series, which are, in ascending order, the Pottsville, Allegheny, Conemaugh, and Monongahela. The boundaries of the series are at the top or base of certain widespread coal beds. All commercially mined coals in Ohio are in the Pennsylvanian system.

All Permian rocks in Ohio are assigned to the Dunkard series.

Pennsylvanian system

The oldest Pennsylvanian series in Ohio is the Pottsville. It has an average thickness of 255 feet and is composed mostly of sandstone and siltstone and subordinately of clay, coal, and marine limestone (Morningstar, 1922, p. 8). The base of the series is drawn at the unconformable contact with the underlying Maxville limestone member of the Logan formation of Mississippian age and the top is drawn at the base of the Brookville No. 4 coal.

The Allegheny series, which contains more coal, siltstone, shale, and marine limestone than the Pottsville, extends from the base of the Brookville No. 4 coal to the top of the Upper Freeport No. 7 coal and ranges in thickness from 175 to 280 feet (Bownocker and Dean, 1929, Generalized section opposite page 6).

Overlying the Allegheny is the Conemaugh series, which extends from the top of the Upper Freeport No. 7 coal to the base of the Pittsburgh No. 8 coal. The Conemaugh series ranges in thickness from 350 to 475 feet and consists largely of sandstone and siltstone and a few beds of coal and limestone.

The youngest series in the Pennsylvanian is the Monongahela, which

ranges in thickness from 240 to 270 feet and extends from the base of the Pittsburgh No. 8 coal to the top of the Waynesburg No. 11 coal. Limestone and red shale are more common in the Monongahela series than in the older Pennsylvanian rocks. (Bownocker and Dean, 1929, p. 179).

Coal beds

The commercially important coal beds in Ohio are found in the Pennsylvanian system. Coal beds in the Pottsville series are mined at a few places but are not as important as those in the Allegheny and Monongahela. In the Allegheny series the Brookville No. 4, the Lower Kittanning No. 5, the Middle Kittanning No. 6, the Lower Freeport No. 6A, and the Upper Freeport No. 7 are thick and widespread and are commonly mined. The Conemaugh series has only thin and non-persistent coal beds which are not mined extensively. The coal beds in the Monongahela series supply most of the annual coal production in Ohio. The Pittsburgh No. 8 coal is the most important, but the Meigs Creek No. 9 coal also is extensively mined. (Keystone Coal Buyers Manual, 1951, p. 390).

There are two systems of nomenclature used for commercially important coal beds in Ohio. Many miners and operators refer to the coals by numbers, while some use names. This report identifies the coals by both names and numbers. Table 1 lists the names and numbers of the coal beds and the localities at which they were sampled.

Permian system

The Permian system, represented by the Dunkard series in Ohio, is approximately 600 feet thick and consists of sandstone, shale, siltstone, limestone, coal, and underclay. The base of the system is drawn at the top of the Waynesburg coal and the top is the erosional land surface or unconformable contact

Table 1.--Names, numbers, stratigraphic position, and sample localities of coal beds of Pennsylvanian age in Ohio.

System	Series	Coal name	Coal No.	Sample locality
Pennsylvanian	Monongahela	Waynesburg	11	Not sampled
		Uniontown	10	Not sampled
		Meigs Creek	9	17, 20
		Pomeroy	--	Not sampled
		Pittsburgh	8	13,15,18, 21, 23, 25,28,35
	Conemaugh	Anderson	--	Not sampled
	Allegheny	Upper Freeport	7	8,19,24,29
		Lower Freeport	6A	10
		Upper Kittanning	--	Not sampled
		Middle Kittanning	6	4,6,12,14,16,22,26,30A
		Lower Kittanning	5	5,9,11,27,30B
		Clarion	4A	Not sampled
		Brookville	4	1,2,7,32,34,36
	Pottsville	Bedford	--	Not sampled
		Middle Mercer	3A	Not sampled
		Lower Mercer	3	3,31
		Quakertown	2	Not sampled
		Sharon	1	33

Modified after Moore and others, 1944

with glacial deposits. The Permian rocks are distinguished from the Monongahela and older Pennsylvanian rocks by a greater abundance of red shale and limestone. (Bownocker and Dean, 1929, p. 284) In the Dunkard series the coals are thin and non-persistent at most localities and were not sampled.

RADIOACTIVITY OF SAMPLES

The sample localities are shown on figure 1. Table 2 lists the locations, coal bed descriptions, and equivalent uranium content of the samples. Equivalent uranium is the amount of uranium that would be present in the sample if all the radioactivity of the sample were due to uranium in equilibrium with its radioactive disintegration products. The equivalent uranium content of five samples was 0.001 percent or more. The equivalent uranium content of four of these samples was checked twice by radioactivity measurements, and both results are given. The percent ash, percent uranium in ash, and percent uranium in these four samples were determined chemically.

Table 2.--Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio.

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent uranium (percent) [1]
1	Peterson Coal Co. strip mine 1 mile west of Ohio Highway 225 in head of left fork of Willow Creek about 0.7 mile south of U. S. Highway 224. T. 1 N., R. 7 W., Ravena quadrangle, Portage County.	4+		Shale	
			1	Pyrite and impure coal	
			41	Brookville No. 4 coal 1/2" bone coal 17" above base and 5 1/2" impure coal 21" above base not sampled	a [2]
			4+	Coal, dull, bony, base concealed	
2	Delauter Coal Co. strip mine 0.3 mile west of Ohio Highway 165, 0.8 mile north of North Lima on Ohio Highway 164, SW¼ SW¼SW¼ sec. 12, T. 13 N., R. 2 W., Columbiana quadrangle, Mahoning County.	6+		Shale	
			36 1/2	Brookville No. 4 coal	
				8 1/2" cannel coal	a
				2" shale	
				26" coal	a
			1+	Underclay, base concealed	
3	Weikert Coal Co. slope mine on Beaver Creek 1.8 miles north of Ohio Highway 344 at Franklin Square. SW¼NE¼NW¼ sec. 10, T. 15 N., R. 3 W., Lisbon quadrangle, Columbiana County.	1+		Shale	
			1	Pyrite	
			38 3/4	Lower Mercer No. 3 coal	a
			1+	Shale, base concealed	
4	S. and S. Coal Co. strip mine west city limits of East Fairfield on Ohio Highway 517. SW¼SW¼NE¼ sec. 36, T. 12 N., R. 2 W., Columbiana quadrangle, Columbiana County.		7	Shale	
			35 1/4	Middle Kittanning No. 6 coal	a
			1+	Underclay, base concealed	

1/ Radioactivity measurements by Benjamin A. McCall, U. S. Geological Survey, Washington, D. C. All chemical analyses by Mary Joslyn and Alice Padgett, U. S. Geological Survey, Washington, D. C.

2/ a means less than .001 percent equivalent uranium.

Table 2.--Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio-Continued.

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent uranium (percent)
5	James Brothers Coal Co. strip mine 0.2 mile north of Lindentree, SE¼ SW¼SW¼ sec. 28, T. 16 N., R. 7 W., Dover quadrangle, Carroll County.	1+		Shale	
			32 3/4	Lower Kittanning No. 5 coal 1/2" bone 12" above base, 1/2" bone 28" above base not sampled	a
			2 3/4	Bone coal	
			3+	Underclay, base concealed	
6	James Brothers Coal Co. strip mine (abandoned) 0.7 mile southwest of Lindentree, SW¼SE¼SW¼ sec. 33, T. 16 N., R. 7 W., Dover quadrangle, Carroll County.	6+		Shale, fossiliferous-brachiopods and pelecypods, pyrite nodules	.002, .003 3/
			42	Middle Kittanning No. 6 coal 1" bone 23 1/2" above base not sampled	a
			1+	Underclay, base concealed	
7	Mallick Coal Co. strip mine 0.4 mile east of Ohio Highway 93 on road 2.2 miles north of Dundee, SW¼SE¼NW¼ sec. 17, T. 10 N., R. 3 W., Navarre quadrangle, Tuscarawas County.		1/2	Bone coal	
			23 3/4	Brookville No. 4 coal	a
			1+	Underclay, base concealed	
8	Strip mine (abandoned) south side of hill south of Yellow Creek one mile east of Bergholz, NE¼SW¼NW¼ sec. 34, T. 11 N., R. 3 W., Salineville quadrangle, Jefferson County.		7 1/2	Shale	
			43	Upper Freeport No. 7 coal	a
			1+	Underclay, base concealed	

3/ Percent ash 89.2, percent uranium in ash .0005, percent uranium in sample .0004.

Table 2.--Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio--Continued.

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent uranium (percent)
9	Reber Coal Co. strip mine 0.2 mile north of Yellow Creek valley road 0.8 mile east of Bergholz, SE¼NE¼NE¼ sec. 4, T. 12 N., R. 4 W., Salineville quadrangle, Carroll County.	4+		Shale	
			34 1/4	Lower Kittanning No. 5 coal 1 1/2" bone 18 3/4" above base not sampled	a
			1+	Underclay, base concealed	
10	John Ridzun drift mine 8.3 miles east of Bergholz on Yellow Creek valley road. SE¼NW¼NE¼ sec. 3, T. 11 N., R. 3 W., Salineville quadrangle, Jefferson County.	1+		Bone and coal	
			61	Lower Freeport No. 6A coal	a
			1+	Shale, base concealed	
11	Strip mine in head of valley, 1.1 miles north of Ohio Highway 39 on gravel road 3 miles west of Dover. NE¼SW¼NE¼ sec. 22, T. 9 N., R. 3 W., Navarre quadrangle, Tuscarawas County.	20+		Shale	
			43 1/2	Lower Kittanning No. 5 coal 1" shale and bone 3½" above base not sampled	a
			1+	Underclay, base concealed	
12	Midvale Coal Co. core from diamond drill hole 0.3 mile north of Ohio Highway 39 on gravel road, 7.3 miles east of New Philadelphia. SE¼NE¼SE¼ sec. 31, T. 15 N., R. 7 W., Uhrichsville quadrangle, Tuscarawas County.		6	Shale, fossiliferous-brachiopods and pelecypods	.003, .003 4/
			48 1/2	Middle Kittanning No. 6 coal 3/4" bone 28" above base not sampled	a
		1+		Underclay	

4/ Percent ash 88.6, percent uranium in ash .0008, percent uranium in sample .0007.

Table 2.--Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio-Continued.

Loc. No.	Location	Thickness Ft.	In.	Lithology	Equivalent uranium (percent)
13	Huberta Coal Co. strip mine about 0.7 mile south of U. S. Highway 22 on road at west city limits of Steubenville, 2.1 miles west of Ohio River bridge. SW¼SE¼SE¼ sec. 6, T. 6 N., R. 2 W., Steubenville quadrangle, Jefferson County.	7+		Shale	
			1/2	Coal, dull	
			54 1/4	Pittsburgh No. 8 coal 1/2" shale 13½" above base, 1/2" shale 26¼" above base, and 1/4" shale 30½" above base not sampled	a
			1	Shale, pyritic	
14	Youghiogheny & Ohio Coal Co. shaft mine on road 0.3 mile west of Wheeling & Lake Erie R. R. 0.7 mile north of Unionvale. SW¼SW¼SE¼ sec. 24, T. 9 N., R. 4 W., Cadiz quadrangle, Harrison County.		1+	Shale	
			4	Coal	
			1/2	Pyrite	
			90	Middle Kittanning No. 6 coal	a
			1+	Underclay	
15	Cadiz Coal Co. strip mine 2.7 miles east of Cadiz on Cadiz-Smithfield road. T. 9 N., R. 4 W., Cadiz quadrangle, Harrison County.			Top bulldozed for stripping	
			55 1/2	Pittsburgh No. 8 coal 3/4" shale 14½" above base and ¼" shale 29¼" above base not sampled	a
			1+	Underclay, base concealed	
16	Caley & Jennings drift mine 3.7 miles southeast of Coshocton on Ohio Highway 271. T. 5 N., R. 5 W., Conesville quadrangle, Coshocton County.		6+	Shale	
			2	Carbonaceous shale	
			38 1/2	Middle Kittanning No. 6 coal 1" shale 5¼" above base not sampled	a
			1+	Underclay, base concealed	

Table 2.—Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio—Continued.

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent uranium (percent)
17	Lafferty Coal Co. strip mine 0.4 mile south of Ohio Highway 331, 2.6 miles east of Flushing, SW¼NE¼NW¼ sec. 1, T. 9 N., R. 5 W., Flushing quadrangle, Belmont County.		2	Bone coal	
			38 1/2	Meigs Creek No. 9 coal	a
			1+	Shale, base concealed	
18	Bradford Coal Co. truck mine at Crescent. NE¼NW¼SW¼ sec. 25, T. 7N., R. 3 W., St. Clairsville quadrangle, Belmont County.		1	Bone coal	
			70 1/2	Pittsburgh No. 8 coal 1/2" bone 30" above base and 1/2 shale 32½" above base not sampled	.002, .003 5/
			1+	Underclay, base concealed	
19	Rome Coal Co. drift mine 0.7 mile south of U. S. Highway 40 on road 3.3 miles east of Cambridge. T. 2 N., R. 2 W., Cambridge quadrangle, Guernsey County.		2+	Laminated coal and shale	
			73 1/2	Upper Freeport No. 7 coal	
				33½" coal	a
				1/2" bone coal	
				39½" coal with 1" bone coal 4" above base, 1/4" shale 20½" above base not sampled	a
			2 1/2	Impure coal	
20	Wells Coal Co. strip mine southeast side of hill 0.2 mile north of Shannon Run road, 1 mile west of Barnesville, SW¼NW¼NE¼ sec. 27, T. 8 N., R. 6 W., Woodsfield quadrangle, Belmont County.		3	Clay	
			41	Meigs Creek No. 9 coal	a
			3	Coal rash	

5/ Percent ash 10.7, percent uranium in ash .0010, percent uranium in sample .0001.

Table 2.--Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio--Continued.

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent uranium (percent)
21	Wells Coal Co. strip mine west side of valley, 0.2 mile north of Shannon Run Road, 0.8 mile west of Barnesville. Center of NE¼ sec. 27, T. 8 N., R. 6W., Woodsfield quadrangle, Belmont County.	6		Shale	
			46+	Pittsburgh No. 8 coal, base concealed 1/4" pyrite 34¼" above base not sampled	a
22	Slack Coal Co. drift mine 0.5 mile south of U. S. Highway 22-40 on gravel road 3 miles east of Zanesville. T. 1 N., R. 7 W., Philo quadrangle, Muskingum County.	1	11	Bone coal	
			59	Middle Kittanning No. 6 coal	
				33½" coal	a
				1½" shale	
				24 " coal	a
			1+	Underclay, base concealed	
23	Powhattan Coal Co. slope mine 0.2 mile north of Pipe Creek road, 4 miles west of Ohio Highway 7 at Pipe Creek. NE¼NW¼NE¼ sec. 30, T. 4 N., R. 3 W., Clarington quadrangle, Belmont County.		1	Shale	
			11	Flint clay	a
			54	Pittsburgh No. 8 coal	a
			1+	Shale, base concealed	
24	Brun drift mine 1.9 miles west of Ohio Highway 555, on road 1.1 miles north of Cannelville. SW¼NE¼NE¼ sec. 36, T. 15 N., R. 14 W., Zanesville quadrangle, Muskingum County.	3+		Shale	
			45 1/2	Upper Freeport No. 7 coal	a
			2 1/2	Shale	
25	Joe Baker strip mine 1.1 miles west of Ohio Highway 145 on road at Stafford. NW¼SW¼SW¼ sec. 14, T. 6 N., R. 7 W., Macksburg quadrangle, Monroe County.		2+	Shale	
			46	Pittsburgh No. 8 coal 1/4" shale 1 1/4" from base and 2" bone 23" above base not sampled	a
			1+	Underclay	

Table 2.—Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio—Continued.

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent uranium (percent)
26	Floyd Angle strip mine 0.2 mile north of Bremen-Maxahala road 5 miles east of Crossenville. NW¼SW¼SW¼ sec. 24, T. 15 N., R. 16 W., Logan quadrangle, Perry County.		10	Carbonaceous shale	
			29 1/2	Middle Kittanning No. 6 coal	a
				1 1/4" shale 11 1/2" above base not sampled	
		1+		Underclay, base concealed	
27	Dixie Coal Co. strip mine west city limits of Dixie. NE¼NW¼SW¼ sec. 31, T. 15 N., R. 15 W., Logan quadrangle, Perry County.		8	Shale	
			25 1/2	Lower Kittanning No. 5 coal	a
		1+		Underclay, base concealed	
28	Gilchrest Coal Co. drift mine 0.4 mile east of Sharpsburg on U. S. Highway 50 alternate. NE¼SW¼NE¼ sec. 29, T. 7 N., R. 12 W., Chesterhill quadrangle, Athens County.		1	Shale	
			41	Pittsburgh No. 8 coal	a
				1/2" shale 30 1/2" above base and 1/2" shale 38 3/4" above base not sampled	
		1+		Underclay, base concealed	
29	Drift mine 0.8 mile southwest of Kimberly on Kimberly-Carbondale road. T. 12 N., R. 15 W., Athens quadrangle, Athens County.		2	Bone coal	
			43	Upper Freeport No. 7 coal	
				11" coal	a
				3" underclay	
				29" coal	a
		1+		Shale, base concealed	
30A	Hippel Coal Co. strip mine on Ohio Highway 324, 2.5 miles southeast of Dundas. SW¼SW¼NE¼ sec. 14, T. 10 N., R. 17 W., Wilkesville quadrangle, Vinton County.	2+		Shale	
			17	Middle Kittanning No. 6 coal	a
		1+		Underclay, base concealed	

Table 2.--Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio--Continued.

Loc. No.	Location	Thickness Ft.	Thickness In.	Lithology	Equivalent uranium (percent)	
30B	Everett drift mine on Ohio Highway 324, 2.7 miles southeast of Dundas. SW¼SE¼NE¼ sec. 14, T. 10 N., R. 17 W., Wilkesville quadrangle, Vinton County.	4+		Sandstone		
			31	Lower Kittanning No. 5 coal	a	
			1+	Underclay, base concealed		
31	Strip mine (abandoned) on Ohio Highway 160, 1.2 miles west of Oreton. NW¼SW¼NW¼ sec. 24, T. 10 N., R. 17 W., Wilkesville quadrangle, Vinton County.	2	4	Shale		
			54 3/8	Lower Mercer No. 3 coal		
				7 1/2" coal	a	
				5 1/2" shale		
				19 1/2" coal	a	
				2 1/4" shale		
				19 5/8" coal	a	
				1/8" clay 4½" above base not sampled		
			3+	Bone coal		
32	Broken Aro Coal Co. strip mine at the east city limits of Latrobe. SE¼SE¼SE¼ sec. 20, T. 9 N., R. 17 W., Jackson quadrangle, Jackson County.	1	8	Shale		
			7	Impure cannel coal	.001, .001 6/	
			56 1/2	Brookville No. 4 coal		
				18" coal	a	
				2" impure coal		
				6½" underclay		
				30" coal	a	
				1½" shale 1½" above base not sampled		
			2+	Underclay, base concealed		

6/ Percent ash 33.3, percent uranium in ash .0031, percent uranium in sample .0010.

Table 2.--Location, lithology, and radioactivity of samples of coal and associated rocks in Ohio-Continued.

Loc. No.	Location	Thickness Ft.	In.	Lithology	Equivalent uranium (percent)
33	Strip mine (abandoned) 0.4 mile north of Ohio Highway 124 on road 3 miles west of Jackson. NE¼SE¼SW¼ sec. 22, T. 7 N., R. 19 W., Jackson quadrangle, Jackson County.			Top bulldozed for stripping	
			22 1/4	Sharon No. 1 coal	a
			3	Shale	
34	Dave Edward drift mine on Ohio Highway 75, 2.7 miles south of Black Fork. NE¼NW¼SW¼ sec. 23, T. 4 N., R. 18 W., Oak Hill quadrangle, Lawrence County.		22 1/4	Shale	
			45	Brookville No. 4 coal	
				13" coal	a
				6" shale	
				26" coal	a
				1½" shale 6½" above base not sampled	
			2+	Underclay, base concealed	
35	Greasy Ridge Coal Co. strip mine 0.3 mile south of Greasy Ridge. T. 3 N., R. 16 W., Athalia quadrangle, Lawrence County.		19	Shale	
			44	Pittsburgh No. 8 coal	
				4" bone coal	.001
				40" coal	a
			2	Shale	
36	Earl Carmen drift mine 0.6 mile south of Ohio Highway 75 on road 0.5 mile south of Pedro. SW¼SE¼NE¼ sec. 28, T. 2 N., R. 18 W., Ironton quadrangle, Lawrence County.		1 1/2	Shale	
			36 1/2	Brookville No. 4 coal	a
			5	Shale, carbonaceous	

CONCLUSIONS

Only five samples have 0.001 percent or more equivalent uranium. Two of these are of the shale above the Middle Kittanning No. 6 coal, which has 0.003 percent equivalent uranium at localities 6 and 12. A cannel coal above the Brookville No. 4 coal at locality 32 and a bony coal above the Pittsburgh No. 8 coal at locality 35 both have 0.001 percent equivalent uranium. The Pittsburgh No. 8 coal has 0.002-0.003 percent equivalent uranium at locality 18.

The chemical analysis of the sample of the Pittsburgh No. 8 coal from locality 18 shows 0.0001 percent uranium, much less than the equivalent uranium measurement of 0.002-0.003 percent. Three of the other four samples which were chemically analyzed also have a radioactivity greater than the uranium content would explain. Routine equivalent uranium measurements probably are accurate to ± 0.001 percent. Consequently, the difference between such routine measurements and the more accurate chemical analysis probably is at least 0.001 percent, but the discrepancy may be due to error in radioactivity measurement. The discrepancy between the two results also might be explained by a lack of equilibrium in the samples or by the presence of potassium as about 1.5 percent of this element can cause a radioactivity of 0.001 percent equivalent uranium.

There are not enough data to draw any conclusions about relation of high radioactivity to position in the depositional basin, post-depositional structure, or stratigraphy.

Of the 18 important coal beds in Ohio that are mined more or less extensively, 10 were sampled. The most important producing beds were sampled at more places than beds that are mined only locally. The results of sampling indicate that there are no potential sources of uranium in the ash of the coals

that were sampled. It is possible that other mined coal beds, or thin coal beds having a high ash content, because of which they are not extensively mined and were not included in this reconnaissance, contain larger amounts of uranium. The general level of radioactivity indicated by the reconnaissance, however, does not suggest that this is likely.

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