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KENTUCKY COAL

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Kentucky

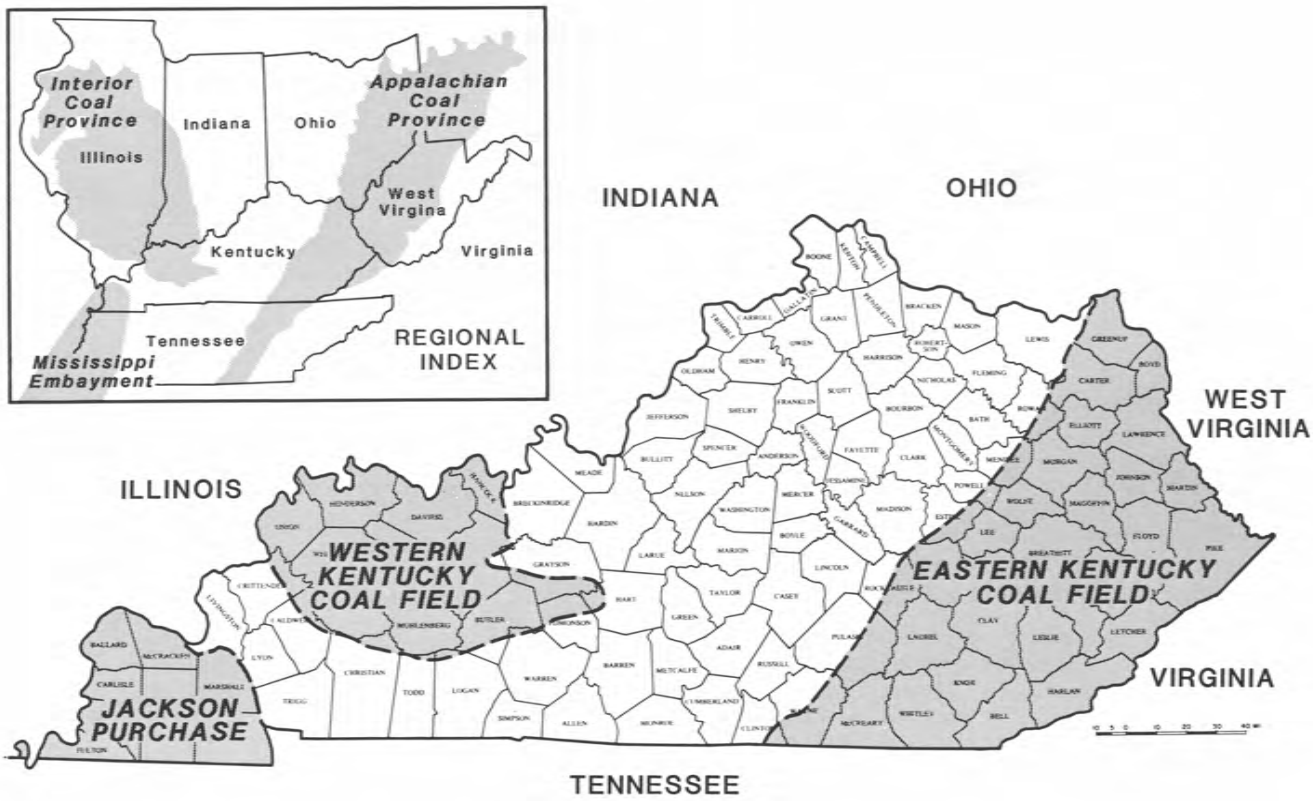

Figure 1. Map of Kentucky showing the Eastern and Western Kentucky Coal Fields.

Coal Resources of Kentucky

Kentucky has led the Nation in coal production since 1973. In 1983 Kentucky produced 151 million tons of bituminous coal from two different coal fields (Fig. 1); the Eastern Kentucky Coal Field contributed 112 million tons and the Western Kentucky Coal Field contributed 39 million tons of this production. A record 157 million tons of coal was produced in Kentucky in 1981.

The Western Kentucky Coal Field, which is in the eastern region of the Interior Coal Province (Illinois Basin), contains coal-bearing rocks of Pennsylvanian age and underlies 6,400 square miles in western Kentucky. This coal field contains up to 4,000 feet of coal-bearing strata and 35 named coal beds. The Eastern Kentucky Coal Field covers 10,500 square miles of Pennsylvanian-age strata in the Appalachian Coal Province. There are more than 80 named coal beds and up to 5,000 feet of coal-bearing strata in this coal field.

Lignite occurs in Cretaceous and Tertiary deposits of the Mississippi Embayment in the Jackson Purchase Region of western Kentucky (*see* Fig. 1). The resource potential of this lignite has not been assessed, but is considered to be limited. No lignite is currently being mined in Kentucky, and field data suggest that the lignite is highly variable in thickness and is of limited extent.

The bituminous coal fields of Kentucky vary considerably in geomorphic and structural setting. The Western Kentucky Coal Field lies in the Interior Low Plateau physiographic province and has low relief and rolling hills; in contrast, the Eastern Kentucky Coal Field is in the Allegheny Plateau physiographic province and the thrust fault of Pine Mountain, and has high relief, steep slopes, and dissected terrain.

Kentucky's coal also varies in occurrence and composition. Thick, widespread, medium- to high-sulfur coal beds are found in the Western Kentucky Coal Field. Numerous beds of lesser importance account for small but locally important portions of the resources of the Western Kentucky Coal Field. The coal resources of the Western Kentucky Coal Field are described in Smith and Brant (1980). The estimated remaining resource for the Western Kentucky Coal field is 38.46 billion tons, as of January 1, 1981.

The Eastern Kentucky Coal Field is nearly double the area of the Western Kentucky Coal Field, and thinner coal beds predominate, although eight widespread, thicker beds with low sulfur contents occur. The coal resources of the Eastern Kentucky Coal Field are described in a series of six publications published in the Energy Resource Series by the Kentucky Geological Survey and the University of Kentucky Institute for Mining and Minerals Research. These publications describe the coal resources in each of the six districts of the eastern coal field: the Princess, Big Sandy, Licking River, Southwestern, Hazard, and Upper Cumberland. The estimated remaining resource for the Eastern Kentucky Coal Field is 57.33 billion tons, as of January 1, 1981.

Coals in the two Kentucky coal fields range in rank from high-volatile C to high-volatile A bituminous. Some Kentucky coals are used for metallurgical coke. More than 90 percent of the western Kentucky coal is used for electric utilities; some amounts are used for domestic use, industrial power stations, and coke. The low-sulfur coal from eastern Kentucky has been used for coking coal and the compliance coal needs of the Ohio Valley and other utility markets, particularly in southeastern states.

Prepared by James C. Cobb, Coal Section Head, and Russell A. Brant, James C. Currens, and Allen D. Williamson, Coal Section, Kentucky Geological Survey, University of Kentucky, Lexington, Ky., January 1985.

Coal Production in Kentucky

Coal production in Kentucky increased steadily between 1971 and 1981, from 119.2 to 157.6 million tons, a 32 percent increase; the exception is 1976, when there was a small decline in production of 1.6 million tons. After the record year in 1981, there were successive declines in production of 6.2 and 19.7 million tons in 1982 and 1983, respectively.

Production of coal by all surface methods exceeded production by underground mining from 1971 to 1978. Since 1979, the production of coal by underground mining has exceeded surface production. Coal production by strip mining has exceeded production by auger stripping every year from 1971 to 1983, except 1978, when auger stripping exceeded strip mining by 1.4 million tons.

Table 1 gives coal production for Kentucky from 1971 to 1983 by type of mining: auger-strip, auger, strip, and underground. Figure 2 shows the trends in coal production for these types of mining for the years 1971 to 1983.

Table 1. Kentucky Coal Production from 1971 to 1983 by Mine Type.

	Auger Strip	*Auger*	*Strip*	*Total Surface*	*Underground*	*Totals*
1971	25,409,640	2,159,911	38,900,244	66,469,795	52,697,787	119,167,582
1972	22,759,943	2,374,795	38,604,647	63,739,385	56,531,862	120,271,247
1973	24,708,632	1,792,141	37,644,808	64,145,581	63,361,739	127,507,320
1974	33,061,159	2,037,712	37,650,251	72,749,122	64,019,427	136,768,549
1975	35,528,558	1,789,873	40,848,528	78,166,959	66,037,552	144,204,511
1976	36,597,627	1,543,372	40,207,448	78,348,447	64,245,115	142,593,562
1977	39,362,821	1,251,576	42,397,383	83,341,780	64,264,215	147,605,995
1978	37,773,162	1,344,689	36,331,876	75,449,727	61,391,736	136,841,461
1979	33,782,898	1,268,374	38,057,513	73,108,785	76,728,306	149,837,091
1980	28,797,204	761,139	41,424,043	70,982,386	79,161,587	150,143,973
1981	31,648,191	655,789	45,456,330	77,760,310	79,799,194	157,559,504
1982	30,232,206	457,959	43,148,987	73,839,152	77,473,291	151,312,443
1983	25,857,034	570,102	38,456,205	64,883,341	66,712,175	131,595,516

Tonnages from Kentucky Department of Mines and Minerals Annual Report.

Compliance Coal Resources in Kentucky

The coal resources of Kentucky have been assessed in terms of their potential sulfur dioxide emissions by Cobb and others (1982) because of the importance of compliance coal for the utility coal market. The assessment of compliance resources is based upon a frequency distribution analysis of nearly 600 whole coal channel samples (partings ⅜ inch and greater excluded) from the Eastern and Western Kentucky Coal Fields.

The potential sulfur dioxide emission in pounds of SO_2 per million Btu for each coal was calculated using the following relationship:

$$\frac{20 \times \text{sulfur (percent)}}{\text{Btu per pound } (10^{-3})}$$

Table 2 gives the means and standard deviations for total sulfur, Btu, and potential SO_2 emissions per 10^6 Btu for 11 eastern and three western Kentucky coal beds. Table 3 shows the percent of eastern and western Kentucky resources meeting selected compliance standards.

At the current EPA compliance coal standards for SO_2 emission of 1.2 lb. SO_2 per 10^6 Btu, about 43 percent of eastern and 3 percent of western Kentucky coals are in compliance with moderate coal cleaning. However, at stricter standards, the percentages of compliance coal resources decrease at a rapid rate. At a standard of 0.6 lb. SO_2 per 10^6 Btu, for example, almost no Kentucky coal is in compliance.

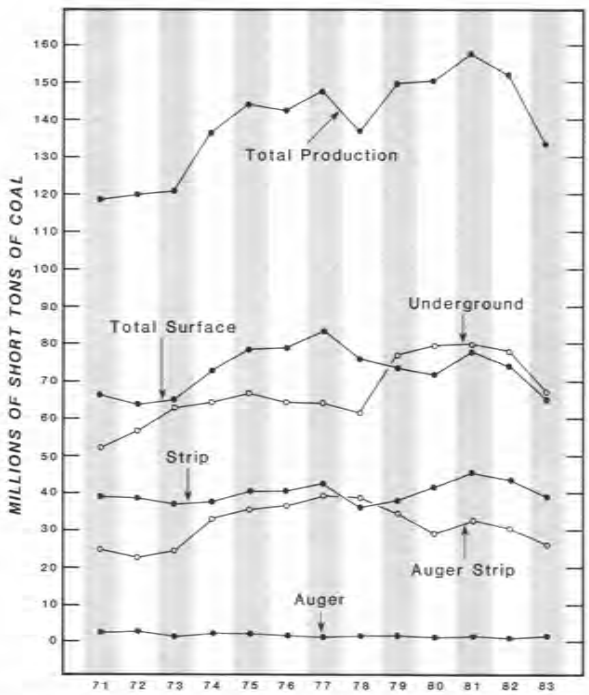

Figure 2. Coal production trends for Kentucky by types of mining.

Table 2. Means and Standard Deviations for Total Sulfur, Btu, and Potential SO_2 Emissions for Selected Kentucky Coal Beds.

Coal Bed	*N*	*Total Sulfur* Mean	S.Dev.	*Btu (daf)* Mean	S.Dev.	*SO_2 10^6 Btu* Mean	S.Dev.
Eastern Kentucky Coal Field							
Richardson	22	1.15	0.83	14349	202	1.80	1.32
Broas	31	1.58	0.88	14459	331	2.17	1.16
Peach Orchard	105	1.33	0.79	14613	364	1.84	1.09
Hazard	35	1.20	0.79	14662	373	1.50	0.70
Fire Clay	89	1.09	0.52	14819	415	1.47	0.76
Amburgy	39	1.82	1.04	14730	550	2.54	1.39
Upper Elkhorn No. 3	83	1.33	1.02	14903	319	1.70	1.19
Upper Elknorn No. 2	31	1.59	1.02	14937	310	2.15	1.38
Upper Elkhorn No. 1	59	1.21	0.72	14896	329	1.67	0.98
Lower Elkhorn	62	1.17	0.82	15035	208	1.58	1.08
Manchester	27	1.75	1.17	14878	427	2.03	1.16
Western Kentucky Coal Field							
Herrin (W.Ky.No.11)	28	3.98	0.51	14484	132	5.49	0.71
Springfield (W.Ky.No.9)	72	4.12	0.65	14414	222	5.77	0.89
Western Kentucky No. 4	24	3.01	1.42	14268	449	4.49	2.19

Western Kentucky Coal Field

The Western Kentucky Coal Field includes all or part of 17 counties in the western part of Kentucky (Fig. 3). It is bounded on the north by the Ohio River and on the east, south, and west by the outcrop of coal-bearing rocks. The Western Kentucky Coal Field is geologically similar to and, in part, stratigraphically similar to the adjacent Indiana and Illinois Coal Fields to the north and west.

The terrain of the Western Kentucky Coal Field is rolling, with gentle slopes and meandering rivers. These rivers are important for barge transportation for coal from this coal field.

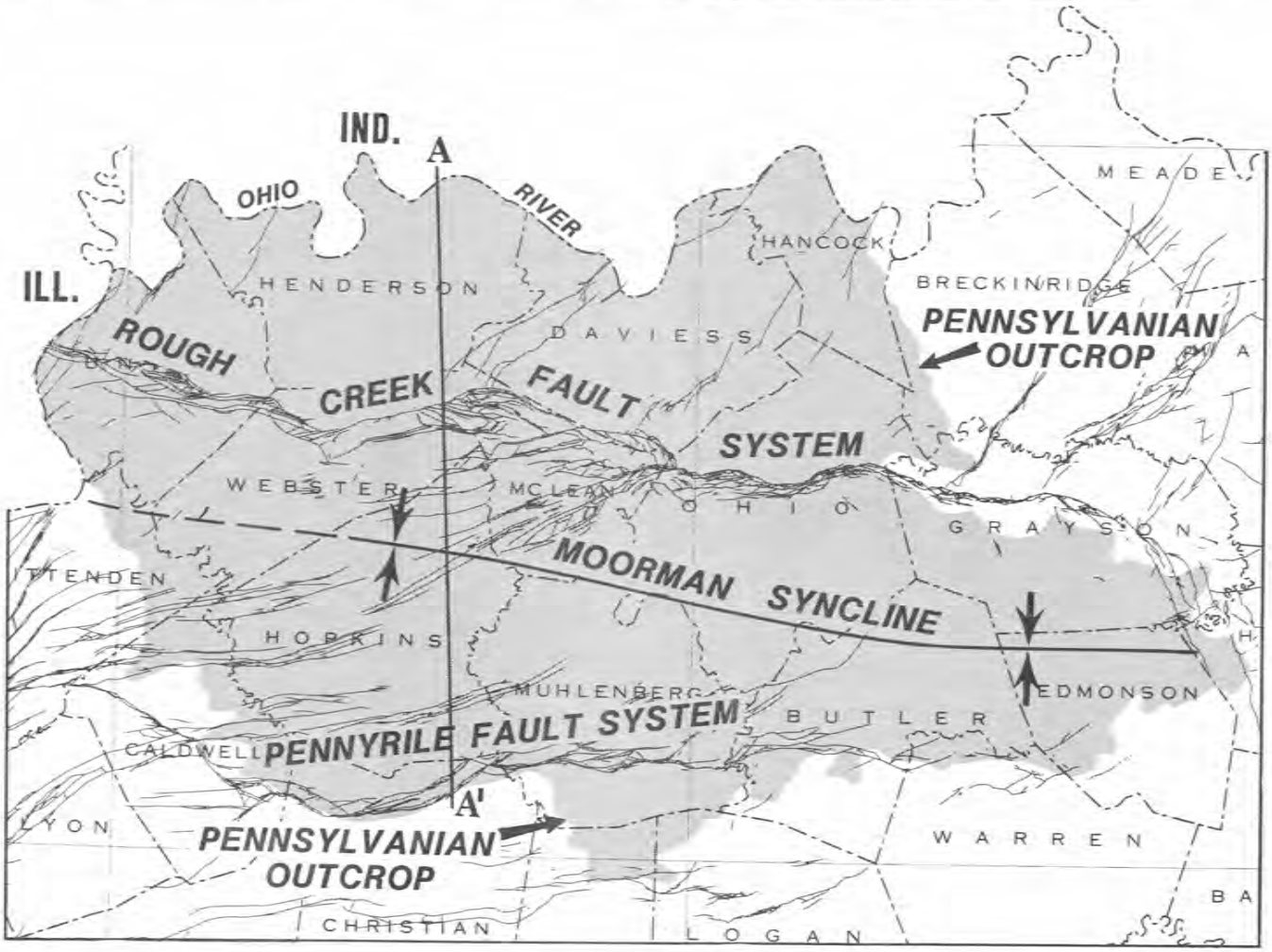

Figure 3. Map of the Western Kentucky Coal Field.

Stratigraphy of the Western Kentucky Coal Field

The coal-bearing rocks of the Western Kentucky Coal Field are Pennsylvanian in age and are divided into, in stratigraphic order, the Caseyville, Tradewater, Carbondale, and Sturgis Formations (Fig. 4). There are approximately 30 named coal beds in the Western Kentucky Coal Field, some of which are shown in Figure 4. Only minor beds are found in the Caseyville Formation. The most persistent and thickest coal beds occur in the upper Tradewater, Carbondale, and lower Sturgis Formations. These coal beds, in stratigraphic order from the lowest, are the Dunbar and Mannington (W. Ky. No. 4) in the Tradewater Formation; the Davis (W. Ky. No. 6), Western Kentucky No. 7, Springfield (W. Ky. No. 9), and Herrin (W. Ky. No. 11), in the Carbondale Formation; and the Western Kentucky No. 12, Baker (W. Ky. No. 13), and Coiltown (W. Ky. No. 14) in the Sturgis Formation.

The rocks of the coal-bearing sequence are sandstone, siltstone, shale, limestone, and coal. Sandstone and siltstone make up about 50 to 80 percent of the section, while shale makes up 20 to 40 percent. Limestone makes up only about 5 percent of the section, but is important for stratigraphic correlation.

The four regionally persistent limestone beds are the Curlew Limestone Member of the Tradewater Formation and the Providence, Madisonville, and Carthage Limestone Members of the Sturgis Formation. The Herrin (W. Ky. No. 11) coal bed contains a distinctive clay-shale parting that occurs extensively across the Illinois Basin. This parting is known as the "blue band" and is often used as a stratigraphic indicator.

The stratigraphy of the Western Kentucky Coal Field has been discussed in Rice and others (1979). The stratigraphic framework of the coal field, including detailed descriptions of cores from test holes, is given in Williams and others (1982).

Table 3. Percent of Eastern and Western Kentucky Resources Meeting Selected Potential Emissions Standards for Compliance Coal.

Selected Potential Emissions Standard (lbs. So_2 per 10^6 Btu)	*Percent Resources Meeting Compliance Standard*	
	Eastern Kentucky	*Western Kentucky*
1.2	43	<2.5
1.1	25	<1.0
1.0	20	<1.0
0.9	7	<1.0
0.8	5	<1.0
0.7	3	<1.0
0.6	<1.0	<1.0

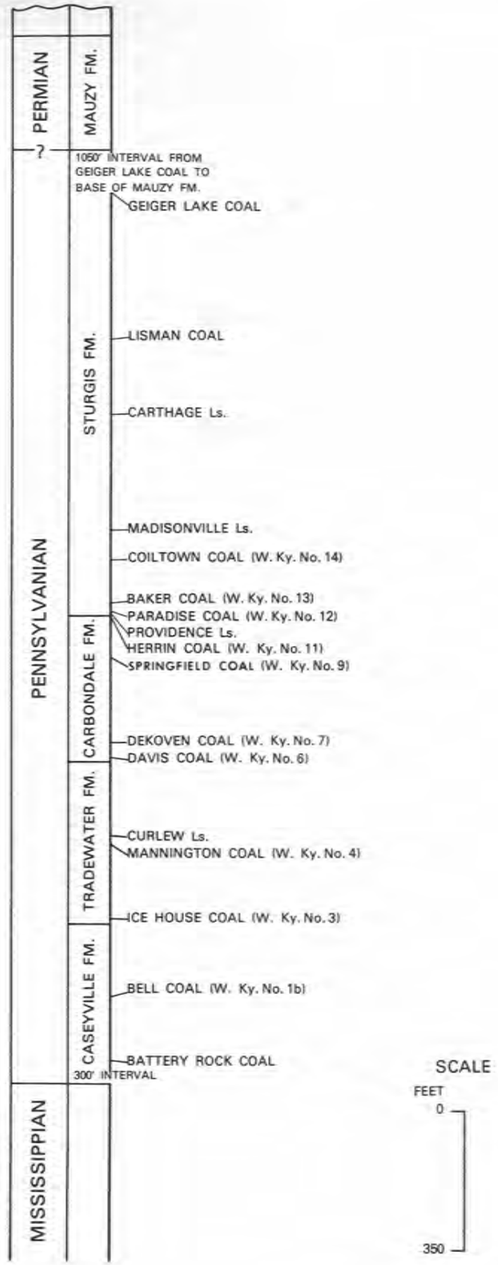

Figure 4. Generalized stratigraphic column for the Western Kentucky Coal Field.

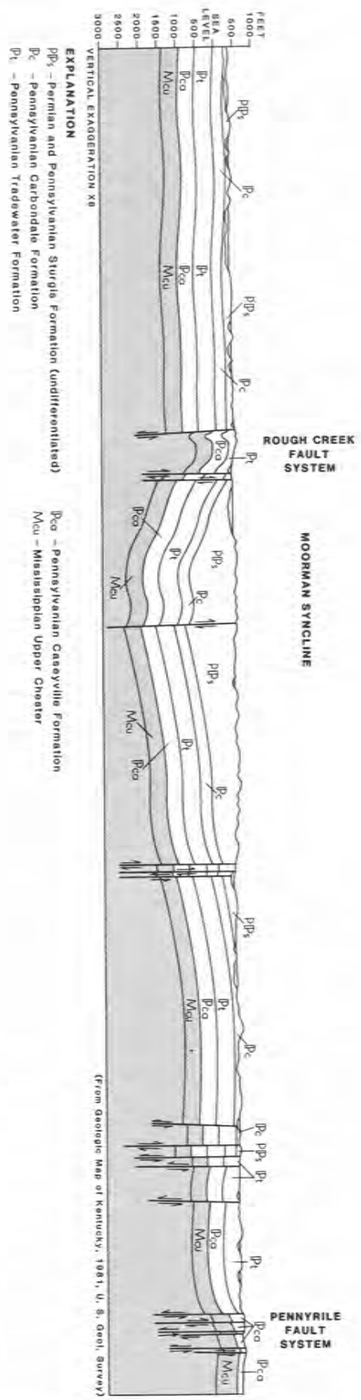

Figure 5. Generalized north-south cross section through the Western Kentucky Coal FIeld.

Structure of the Western Kentucky Coal Field

The Western Kentucky Coal Field occupies the southeastern part of the Eastern Interior Coal Basin (Illinois Basin). The coal-bearing strata generally dip toward the northwest but are interrupted by major fault systems and other important structures (*see* Fig. 3).

The coal-bearing rocks thicken basinward toward the northwest (Fig. 5). These strata attain a thickness of nearly 4,000 feet in the Moorman Syncline, a major regional structure that cuts across the coal field from the northwest to the southeast. It extends about 15 miles into Illinois, where it is called the Eagle Valley Syncline. The rocks on the southern limb of the syncline dip about 100 feet per mile, and on the northern limb the rocks dip at a somewhat steeper rate. The northern limb of the Moorman Syncline is terminated by the Rough Creek Fault System, but the southern limb is interrupted by the Pennyrile Fault System. North of the Rough Creek Fault System, Pennsylvanian strata dip in general conformity with the Illinois Basin structure.

The Rough Creek Fault System strikes east to west nearly parallel to the axis of the Moorman Syncline (*see* Fig. 3). The Rough Creek Fault System, which cuts across the entire coal field, is a continuous fault with associated subsidiary faults. This fault system is composed of mostly high-angle reverse and vertical faults, which have produced horsts and grabens. Where the inclination of this fault has been measured by drilling it is steep (65° or greater), except in the Morganfield Quadrangle in eastern Union County, where the dip of the fault varies from 70° to as low as 25° (Smith and Palmer, 1974, 1981; Nelson and Lumm, 1984). Offset along the Rough Creek Fault System varies from a few hundred feet to more than 1,500 feet.

The Pennyrile Fault System (Schwalb, 1975) is a major fault system that cuts across the southern part of the coal field (*see* Figs. 3 and 5). The Pennyrile Fault System is an east-trending zone of *en echelon* fractures 25 to 40 miles south of and parallel to the Rough Creek Fault System (Nelson and Lumm, 1984). The displacement along this system is down to the north, with an aggregate throw of more than 1,000 feet that decreases eastward (Nelson and Lumm, 1984).

Coal Resources of the Western Kentucky Coal Field

The Western Kentucky Coal Field contained an original estimated coal resource of 40.99 billion tons (Smith and Brant, 1980). There are seven principal coal beds that contain about 94 percent of the resource. Because approximately 2.53 billion tons of coal have been mined or lost because of mining, the remaining resource is estimated at 38.46 billion tons, as of January 1, 1981.

Table 4 presents the original coal resources for the Western Kentucky Coal Field by bed and county, and also shows the coal mined and lost, by county. The coal beds are listed in stratigraphic order. The seven principal beds are the Springfield (W. Ky. No. 9), Herrin (W. Ky. No. 11) and Western Kentucky No. 12 combined, Davis (W. Ky. No. 6), Mannington (W. Ky. No. 4), Western Kentucky No. 13, and Western Kentucky No. 14. Coal resources were estimated for 33 coal beds in 17 counties; however, the following seven counties contain 88 percent of the remaining resources: Hopkins (7.9 billion tons), Henderson 6.8 billion tons), Union (6.4 billion tons), Webster (6.2 billion tons), Muhlenberg (3.7 billion tons), McLean (3.6 billion tons), Ohio (1.6 billion tons), and Daviess (1.3 billion tons). The remaining nine counties range from having 400 million tons of remaining resources to only 270 thousand tons.

Coal Quality in the Western Kentucky Coal Field

The suitability of a coal for various fuel and chemical applications is determined by its physical and chemical properties. Therefore, a variety of tests are performed on coals to characterize their quality. Table 5 lists the minimums, maximums, and means for moisture, volatile matter, fixed carbon, ash, sulfur, and Btu content for several coal beds in the Western Kentucky Coal Field. These data are based upon standard full-face channel samples (partings $\frac{3}{8}$ inch or greater excluded). These analytical results are from U.S. Bureau of Mines and U.S. Geological Survey analyses and are on open file at the Kentucky Geological Survey. These results approximate a mined coal product that has been subjected to a moderate amount of cleaning.

In general, the principal coals of the Western Kentucky Coal Field are high-volatile bituminous C to A in rank. These coals are, for the most part, moderate to high in sulfur, ash, and moisture. Certain of these coals have been used for cooking coal.

Eastern Kentucky Coal Field

The Eastern Kentucky Coal Field includes all or parts of 37 counties. For convenience, the coal field is divided into the Big Sandy, Hazard, Licking River, Princess, Southwestern, and Upper Cumberland Districts (Fig. 6). The Eastern Kentucky Coal Field is geologically similar to and, in part, stratigraphically similar to the adjacent coal fields in Ohio, West Virginia, and Tennessee.

The Eastern Kentucky Coal Field has been one of the Nation's leading coal-producing regions for many decades. Many types of mining are used in this area. Coal is produced underground from shaft, slope, drift, and punch mines. Surface production comes from contour, area, mountaintop removal, and auger mines.

Stratigraphy of the Eastern Kentucky Coal Field

The coal-bearing Pennsylvanian strata of eastern Kentucky attain a maximum thickness of nearly 5,000 feet. These rocks are grouped into four formations, which are, in stratigraphic order from the lowest, the Lee, Breathitt, Conemaugh, and Monongahela. The Lee Formation is characterized by orthoquartzitic sandstone and conglomerate, and attains a maximum thickness of about 2,000 feet. The Breathitt Formation contains the principal producing coal beds of eastern Kentucky. It attains a maximum thickness of about 2,500 feet and consists of siltstones, sandstones, and shales, and minor amounts of marine shales with limestones occurring mostly as nodules but occasionally as discontinuous layers. The Breathitt Formation has up to 45 coal beds and zones, to which more than 150 names have been applied.

The Conemaugh and Monongahela Formations are not differentiated in eastern Kentucky because the distinctive Pittsburgh coal marker bed was not discovered in Kentucky until recently. These formations attain a maximum thickness of about 600 feet and are predominantly siltstone and shale, but some sandstone and limestone, and small amounts of coal occur. The formations are restricted to the Princess District in the northern part of the coal field.

Structure of the Eastern Kentucky Coal Field

The Eastern Kentucky Coal Field is part of the Appalachian Basin. Its coal-bearing rocks form a clastic wedge that thins toward the northwest and dips basinward at approximately 40 feet per mile. Figure 7 is a generalized cross section from the northwest to the southeast across the coal field.

The Pine Mountain Fault is the major structural feature in eastern Kentucky. It is a thrust fault along which there has been 4 to 8 miles of horizontal movement toward the northwest. The part of the coal field south of Pine Mountain is a separate district and has a different stratigraphic nomenclature.

The Irvine-Paint Creek Fault System, which is in general alignment with the Kentucky River Fault System, cuts across the northern part of the Eastern Kentucky Coal Field.

Table 4. Western Kentucky Coal Resources by County and Coal Bed (in Millions of Tons Original Coal).

Coal Bed	BRK	BUT	CAD	CHR	CRI	DAV	EDM	GRA	HAN	TOTAL
Geiger Creek										2.42
W. Ky. No. 16										200.27
W. Ky. No. 15										51.68
W. Ky. No. 14										1281.65
W. Ky. No. 13										3206.07
W. Ky. No. 11 & 12[a]										9620.36
W. Ky. No. 10										173.19
W. Ky. No. 9										10264.60
W. Ky. No. 8						364.62				116.36
W. Ky. No. 7			0.87			0.43				291.01
W. Ky. No. 6[c]		3.58	0.96			425.87				7482.92
Lewisport						202.36				229.77
Elm Lick									9.20	80.91
Mud River		1.01		0.08						37.74
Bancroft		53.44								112.69
Mining City		28.73				9.74				53.44
White Ash						109.51			0.21	28.73
W. Ky. No. 4[d]		244.63	19.11	51.72	4.28	115.48				6585.89
Leadmine Creek									53.83	225.68
Aberdeen		39.69								39.69
W. Ky. No. 1 & 2			24.72		23.74					48.46
Foster & Amos		24.03								24.03
Hawesville						35.90	129.78	90.64	35.97	71.87
Main Nolin		8.53								234.36
Deanfield						66.41			5.93	290.53
Empire				13.57						20.46
Truman Hill										1.31
Breckinridge	0.27									0.27
Unnamed		10.05	21.71	5.35	13.62		29.83	14.40	65.14	202.92
Total	0.27	413.69	67.37	70.72	41.64	1330.32	159.61	105.04	170.28	40989.39
Mined & Lost	0.00	14.53	0.89	7.84	0.00	226.69	1.21	0.37	2.77	2530.83
Remaining Coal	0.27	399.16	67.53	62.88	41.64	1303.63	158.00	104.67	167.51	38458.46

BRK	HND	HOP	MCL	MUH	OHI	UNI	WAR	WEB	TOTAL
						2.42			2.42
				4.57		200.27			200.27
	28.63	4.94		156.43	105.16	8.60		42.17	51.68
	492.29	610.43	64.37	265.73	100.33	675.91		187.95	1281.65
	1110.46	2478.00	331.38	1225.99	385.81	1758.15		730.00	3206.07
			689.80	45.22	5.61	158.62		1972.15	9620.36
	2091.87	1691.07	1097.58	1166.18	575.51	1650.99		1687.72	10264.60
		19.01			96.29			1.06	116.36
		164.56				122.86		2.29	291.01
0.20	1789.52	1330.90	79.14	878.38	107.37	1213.36		942.84	7482.92
					18.21				229.77
				36.74	80.91				80.91
		3.26		109.35					37.74
									112.69
									53.44
									28.73
0.21	1340.00	1741.72	546.81	889.25	68.89	822.20		747.77	6585.89
					56.37				225.68
									39.69
									48.46
									24.03
5.97									71.87
					218.19		5.41		234.36
5.93		6.89							290.53
					1.31				20.46
									1.31
									0.27
6.14		33.50			6.59		2.74		202.92
0.39	6852.78	8814.80	3576.41	4723.84	1824.55	6506.98	8.15	6322.85	40989.39
0.28	834.51	1022.24	23.41	1026.81	254.62	148.91	0.01	76.02	2530.83
0.67	6818.27	7902.56	3553.00	3697.03	1569.93	6358.07	8.14	6246.83	38458.46

[a]W. Ky. No. 11 & 12 or Herrin & Paradise coals.
[b]W. Ky. No. 9 or Springfield coal.
[c]W. Ky. No. 6 or Davis coal.
[d]W. Ky. No. 4 or Mannington coal.

County Abbreviations

BRK = Breckinridge	EDM = Edmonson	MUH = Muhlenberg	
BUT = Butler	GRA = Grayson	OHI = Ohio	
CAD = Caldwell	HAN = Hancock	UNI = Union	
CHR = Christian	HND = Henderson	WAR = Warren	
CRI = Crittenden	HOP = Hopkins	WEB = Webster	
DAV = Daviess	MCL = McLean		

Table 5. Coal Analysis Summary for Seven Major Seams in the Western Kentucky Coal Field.

	Total Moisture	*Volatile Matter*	*Fixed Carbon*	*Ash*	*Sulfur*	*Btu*
Mannington (W. Ky. No. 4)						
Maximum	7.7	39.8	51.0	32.5	3.7	13,000
Minimum	4.9	27.2	35.4	3.2	1.6	8,290
Mean	6.4	36.2	47.5	10.0	2.8	11,850
Number[a]	6					
Davis (W. Ky. No. 6)						
Maximum	11.4	40.7	51.0	14.6	4.4	13,340
Minimum	3.8	35.1	43.0	3.6	1.6	10,550
Mean	6.4	37.2	48.1	8.2	2.9	12,320
Number[a]	24					
Springfield (W. Ky. No. 9)						
Maximum	14.1	38.8	50.6	17.4	5.4	12,930
Minimum	1.4	34.7	36.1	5.0	2.1	9,900
Mean	8.3	36.4	44.9	10.5	3.3	11,742
Number[a]	56					
Herrin (W. Ky. No. 11)						
Maximum	9.6	42.7	48.9	24.1	4.9	12,810
Minimum	3.7	33.5	35.8	6.2	3.1	9,540
Mean	6.4	38.9	45.1	9.7	4.0	12,070
Number[a]	34					
Paradise (W. Ky. No. 12)						
Maximum	13.4	37.9	52.4	18.4	4.5	13,100
Minimum	3.7	32.5	40.0	6.4	1.0	10,660
Mean	8.2	35.1	47.1	9.7	2.0	11,900
Number[a]	20					
Baker (W. Ky. No. 13)						
Maximum	8.0	36.5	48.7	20.6	6.7	12,460
Minimum	5.2	30.7	37.2	10.3	1.5	10,140
Mean	6.3	34.3	44.1	15.3	3.5	10,970
Number[a]	3					
Coiltown (W. Ky. No. 14)						
Maximum	12.1	51.8	53.4	12.6	5.5	13,140
Minimum	4.9	32.2	40.7	6.1	1.4	10,850
Mean	9.0	36.5	46.7	8.7	3.2	11,860
Number[a]	19					

[a]Number of analyses for each mean.

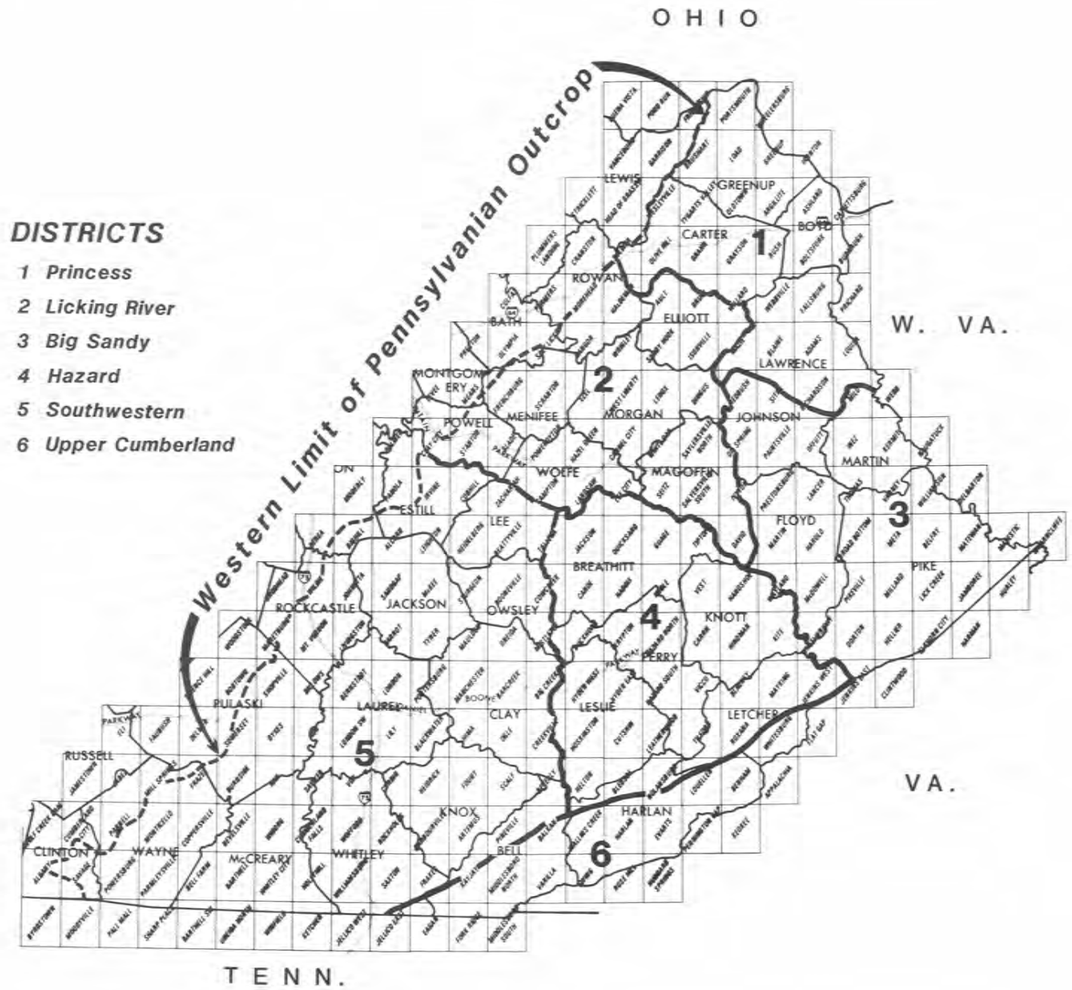

Figure 6. Map of the Eastern Kentucky Coal Field showing the six districts of the coal field.

Coal Resources of the Big Sandy District

The Big Sandy District contains the largest coal resource of the six districts in eastern Kentucky. This district covers approximately 1,613 square miles in the eastern part of the Eastern Kentucky Coal Field. It includes Floyd, Johnson, Martin, and Pike Counties. The estimated original coal resources of this district were 20.30 billion tons, and the remaining resources, as of January 1, 1981, are estimated at 18.03 billion tons. Thirty-three coal beds with thicknesses greater than 14 inches are included in these estimates. Figure 8 gives the names and correlations of principal coal beds in the district and key stratigraphic units.

The coal resources of the Big Sandy District are shown by coal bed and county in Table 6. Table 7 shows the resources of this district estimated for each thickness class.

Five principal coal beds in this district account for 52 percent of the coal. They are the Lower Elkhorn, Upper Elkhorn No. 1, Upper Elkhorn No. 2, Upper Elkhorn No. 3, and Fire Clay.

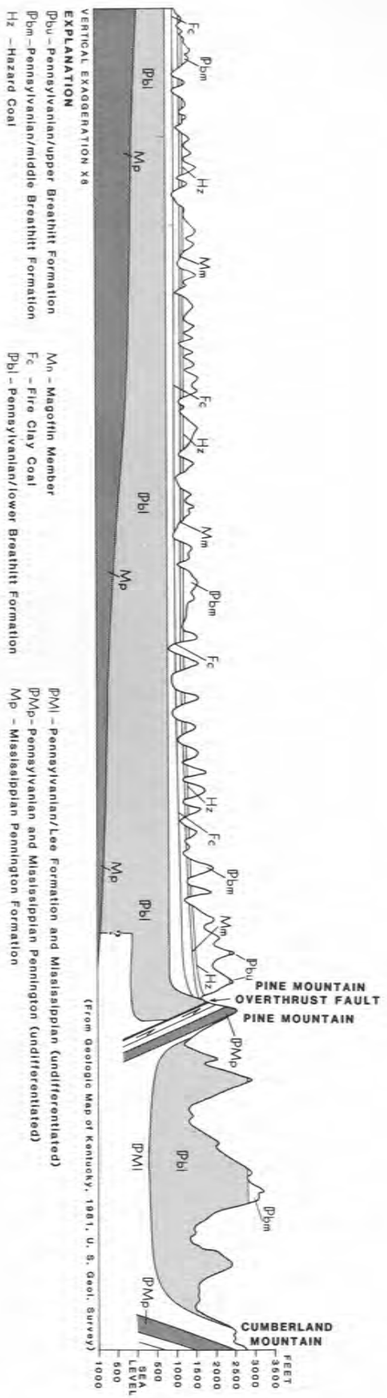

Figure 7. Generalized north-south cross section through the Eastern Kentucky Coal Field.

Figure 8. Principal coal beds and stratigraphic units of the Big Sandy District.

Table 6. Estimated Original and Remaining Resources in the Big Sandy District by County and Coal Bed (in Millions of Short Tons, Arranged Stratigraphically).

Coal	*Floyd*	*Johnson*	*Martin*	*Pike*	*Totals*
Princess No. 7			2.12	1.46	3.58
Princess No. 6			3.52		3.52
Richardson	13.11	20.53	178.61	6.14	218.39
Upper Broas	12.14	16.36	122.04	24.45	174.99
Lower Broas	46.99	22.57	171.92	43.59	285.07
Upper Peach Orchard	40.31	89.09	329.45	54.11	512.95
Lower Peach Orchard	61.99	33.45	245.97	119.18	460.59
Buffalo Creek			77.92	11.24	89.16
Hazard	29.78	19.26	151.98	142.74	343.76
Haddix	67.21	100.56	169.16	14.42	351.35
Taylor	39.68	63.47	304.29	145.95	553.39
Hamlin	51.16	7.50	4.69	67.12	130.47
Fire Clay Rider	96.34	15.76	166.70	181.52	460.32
Fire Clay	331.86	133.11	373.29	466.37	1,304.63
Upper Whitesburg	123.09	83.21	213.91	264.01	684.22
Lower Whitesburg	302.90	233.19	52.77	251.66	840.52
Williamson[a]	368.24	126.16	74.74	618.74	1,187.88
Upper Elkhorn No. 3½	18.46	11.37		345.75	375.58
Upper Elkhorn No. 3	1,119.48	349.96	298.85	1,574.77	3,343.06
Upper Elkhorn No. 2	627.98	78.75		1,102.93	1,809.66
Upper Elkhorn No. 1	670.85	1.85	240.07	864.89	1,777.66
Lower Elkhorn Rider	1.71		9.49	457.50	468.70
Lower Elkhorn	112.04	6.69	126.42	2,161.68	2,406.83
Powelliton		4.20	0.02	27.23	31.45
Clintwood	3.34			625.34	628.68
Eagle	2.62			469.36	471.98
Glamorgan				630.03	630.03
Hagy				367.97	367.97
Splash Dam[b]		2.41		237.38	239.79
Upper Banner				67.30	67.30
Lower Banner				11.13	11.13
Raven				6.77	6.77
Unnamed	26.80		2.04	28.92	57.76
Totals	4,168.08	1,419.44	3,319.97	11,391.65	20,299.14
Mined & Lost[c]	595.01	135.17	187.73	1,350.01	2,267.92
Remaining Resource	3,573.07	1,284.27	3,132.24	10,041.64	18,031.22
Percent Remaining[d]	85%	90%	94%	88%	88%

[a]Williamson or Amburgy coal.
[b]Splash Dam or Mine Fork coal.
[c]The figure given is twice the cumulative production from 1790 through 1980 to account for coal mined and lost in the mining and cleaning process.
[d]Percent remaining of the estimated original coal resource.

Table 7. Estimated Original and Remaining Resources in the Big Sandy District by Thickness and Coal Bed (in Millions of Short Tons, Arranged Stratigraphically.

Coal Bed	*14"-28"*	*28"-42"*	*42"-56"*	*56"+*	*Total*
Princess No. 7	3.58				3.58
Princess No. 6	3.52				3.52
Richardson	9.48	23.28	16.56	169.07	218.39
Upper Broas	35.26	49.56	28.56	61.61	174.99
Lower Broas	77.78	48.04	77.28	81.88	285.07
Upper Peach Orchard	140.88	149.23	107.21	115.63	512.95
Lower Peach Orchard	166.97	142.48	54.04	97.10	460.59
Buffalo Creek	74.59	13.21	0.46		89.16
Hazard	177.98	82.86	61.12	21.80	343.76
Haddix	180.58	142.75	21.84	6.18	351.35
Taylor	349.13	169.92	33.80	0.54	553.39
Hamlin	108.93	16.45	5.09		130.47
Fire Clay Rider	274.68	146.21	37.06	2.37	460.32
Fire Clay	674.98	375.56	134.24	119.85	1,304.63
Upper Whitesburg	614.60	54.96	14.38	0.28	684.22
Lower Whitesburg	651.87	110.94	29.73	47.98	840.52
Williamson[a]	602.85	289.11	205.14	90.78	1,187.88
Upper Elkhorn No. 3½	178.04	158.81	31.47	7.26	375.58
Upper Elkhorn No. 3	1,286.61	1,464.73	454.31	137.41	3,343.06
Upper Elkhorn No. 2	521.53	873.51	353.93	60.69	1,809.66
Upper Elkhorn No. 1	811.89	715.16	227.25	23.36	1,777.66
Lower Elkhorn Rider	341.58	106.78	20.34		468.70
Lower Elkhorn	529.88	515.77	844.06	517.12	2,406.83
Powellton	31.45				31.45
Clintwood	285.70	256.17	67.68	19.13	628.68
Eagle	411.02	49.55	10.16	1.25	471.98
Glamorgan	487.34	125.65	16.15	0.89	630.03
Hagy	255.96	92.10	17.20	2.71	367.97
Splash Dam[b]	133.10	104.09	2.60		239.79
Upper Banner	35.53	25.71	6.06		67.30
Lower Banner	10.42	0.71			11.13
Raven	5.78	0.99			6.77
Unnamed	34.78	16.88	3.02	3.08	57.76
Totals	9,509.26	6,321.17	2,880.74	1,587.97	20,299.14
Percent of Total	47%	31%	14%	8%	100%

[a]Williamson or Amburgy coal.
[b]Splash Dam or Mine Fork coal.

Coal Quality in the Big Sandy District

The quality of coals in this district is generally good. A summary of coal-quality parameters for the coals in this district is given in Table 8. The means of total sulfur content for the five principal coal beds range from 0.8 to 1.4 percent sulfur (as-received); however, the range for any bed may be as large as 0.6 to 5.7 percent sulfur. The means for heating value for these coals range from 13,120 to 13,756 Btu per pound (as-received). The ash content of these coals is generally low; the means range from 6.1 to 10.6 percent (as-received). These coals contain some of the lowest values for volatile matter and moisture in the Eastern Kentucky Coal Field. In certain cases coals of this area approach medium-volatile rank. Volatile matter ranges from 29.4 to 43.1 percent, and means range from 33.4 to 36.7 percent (as-received). The means for moisture range from only 2 to 3.4 percent (as-received). The free-swelling indexes vary from 1.0 to 8.0. Coking coals and coke blending coals are mined extensively in this district.

Table 8. Coal Analysis Summary for Five Major Coal Beds in the Big Sandy District.

	As-Received						
	Moisture	*Volatile Matter*	*Fixed Carbon*	*Ash*	*Total Sulfur*	*Btu*	*F.S.I.*	*Ash-Softening Temp. (°F)*
Upper Elkhorn No. 3								
Maximum	7.4	38.5	62.4	15.2	3.0	14177	7.5	2800
Minimum	1.7	31.6	44.2	0.9	0.6	11833	1	2060
Mean	3.6	35.6	53.4	7.3	1.4	13120		
Number[a]	13							
Lower Elkhorn								
Maximum	2.8	36.9	60.9	16.7	1.7	14196	8	2910
Minimum	1.6	29.4	51.2	5.1	0.4	12894	2.5	2480
Mean	2.0	33.4	55.1	9.6	0.8	13226		
Number[a]	12							
Upper Elkhorn No. 2								
Maximum	3.3	43.1	62.0	19.1	5.7	14485	7.5	2800
Minimum	1.6	32.1	45.5	2.1	0.6	11384	3	2003
Mean	2.4	36.6	53.8	7.2	1.9	13535		
Number[a]	10							
Upper Elkhorn No. 1								
Maximum	3.2	41.3	60.0	9.2	1.2	14544	8	2800
Minimum	1.4	33.3	47.0	3.7	0.6	13075	1.5	2620
Mean	2.5	36.7	54.8	6.1	0.9	13756	5	2723
Number[a]	9							
Fire Clay								
Maximum	6.7	36.9	56.6	13.6	1.3	13912	7.5	2910
Minimum	1.5	31.6	49.5	5.8	0.6	12170	1.5	2800
Mean	2.9	34.8	51.8	10.6	0.9	13059	3.5	2818
Number[a]	9						8	8

[a]Number of analyses for each mean.

Coal Resources of the Hazard District

The Hazard District contains the second largest resources of the six districts in eastern Kentucky. This district covers approximately 1,886 square miles in the central part of the Eastern Kentucky Coal Field. It includes Breathitt, Knott, Leslie, and Perry Counties, and the parts of Letcher and Harlan Counties north of the Pine Mountain Fault. The estimated original coal resources for this district were 19.40 billion tons, and the remaining resources, as of January 1, 1981, are 17.50 billion tons. Twenty-three coal beds with thicknesses greater than 14 inches are included in this estimate. Figure 9 gives the names and correlations of principal coal beds in the district and key stratigraphic units.

The coal resources of the Hazard District by coal bed and county are shown in Table 9. Table 10 shows resources by coal bed and thickness class. Each of the seven principal coal beds contains more than 1.2 billion tons of original resources, and in aggregate the seven beds contain more than 70 percent of the district's total resources. The seven principal beds are the Fire Clay, Ambargy, Upper Elkhorn No. 3, Hazard No. 7, Francis, and Fire Clay Rider.

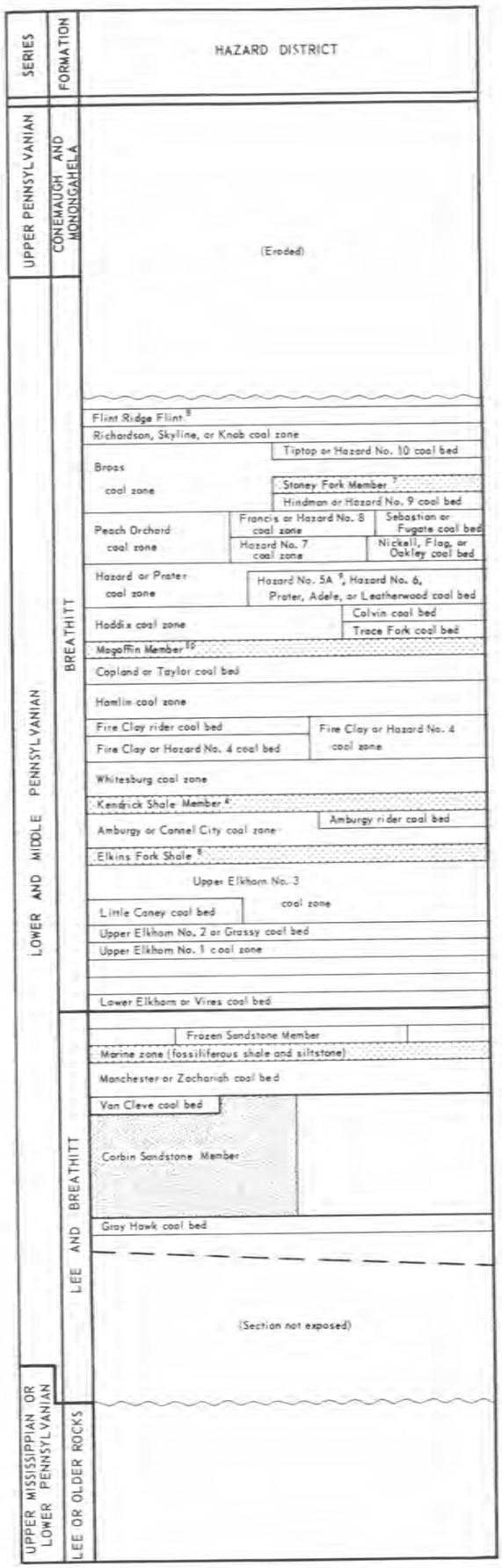

Figure 9. Principal coal beds and stratigraphic units of the Hazard District.

Table 9. Estimated Original and Remaining Resource of the Hazard District (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	*Breathitt*	*Harlan*[a]	*Knott*	*Leslie*	*Letcher*[a]	*Perry*	*Totals*
Skyline	295.67	1.95	38.52	4.12		7.68	347.94
Tiptop	127.04	5.99	6.06	18.49		11.98	169.56
Hindman Rider			2.34			1.06	3.40
Hindman	110.27	81.94	116.85	116.44	3.90	141.87	571.27
Francis Rider				0.80		0.49	1.29
Francis	415.78	63.01	297.48	215.28	12.72	296.53	1300.80
Hazard No. 7	277.58	10.77	331.69	245.06	10.55	478.80	1354.45
Hazard	442.53	178.45	272.83	579.01	115.78	521.74	2110.34
Haddix	350.39		83.85	135.93	40.41	214.30	824.88
Upper Hamlin	70.89	42.20	107.75	307.95	107.71	259.64	896.14
Lower Hamlin	0.80		76.97	27.01		29.77	134.55
Fire Clay Rider	155.06	67.24	167.10	503.27	156.31	212.49	1261.47
Fire Clay	102.99	126.26	752.29	948.07	413.77	720.65	3064.03
Upper Whitesburg	154.62		251.94	123.46	230.32	44.56	804.90
Lower Whitesburg	92.30		175.68	53.94	22.28	103.57	447.77
Amburgy	708.59		459.31	168.48	526.41	365.95	2228.74
Upper Elkhorn No. 3½	25.06		17.84		65.86	0.60	109.36
U. Elkhorn No. 3	406.82	68.14	648.82	99.47	868.26	114.26	2205.77
U. Elkhorn No. 2	239.13		204.98		134.04	18.58	596.73
U. Elkhorn No. 1	4.66		338.14	7.26	263.55	50.29	663.90
Lower Elkhorn	84.57		34.61		133.96		253.14
Van Cleve	45.57						45.57
Unnamed	1.87	0.03		0.61	0.10	1.86	4.47
Totals	4112.19	645.98	4385.05	3554.65	3105.93	3596.67	19400.47
Mined & Lost[b]	177.30	small	192.52	174.24	689.57	671.72	1905.36
Remaining	3934.89	645.97	4192.53	3380.41	2416.36	2924.95	17495.11
Percent Remaining[c]	96%	99+%	96%	95%	78%	81%	90%

[a]A small part of Harlan County and large part of Letcher County lie within the Hazard District. The Pine Mountain Fault divides these counties between the Hazard and Upper Cumberland Districts.
[b]The figure given is twice the cumulative production of coal from 1790 through 1980 to account for coal mined and lost in the mining and cleaning process.
[c]Percent remaining of the estimated original coal resource.

Table 10. Estimated Original Coal Resource by Thickness Class in the Hazard District (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	*14"–28"*	*28"–42"*	*42"–56"*	*56"+*	*Total*
Skyline	43.01	70.18	72.81	161.94	347.94
Tiptop	24.51	51.00	60.22	33.83	169.56
Hindman Rider	0.64	2.76			3.40
Hindman	91.32	134.09	135.54	210.32	571.27
Francis Rider	1.29				1.29
Francis	392.33	380.30	395.65	132.52	1300.80
Hazard No. 7	328.18	417.74	346.27	262.26	1354.45
Hazard	877.87	808.05	292.87	131.55	2110.34
Haddix	555.31	136.22	131.54	1.81	824.88
Upper Hamlin	791.89	100.47	3.28	0.50	896.14
Lower Hamlin	123.61	10.94			134.55
Fire Clay Rider	875.22	283.21	59.26	43.78	1261.47
Fire Clay	718.67	1463.52	775.29	106.55	3064.03
Upper Whitesburg	628.37	124.51	48.31	3.71	804.90
Lower Whitesburg	400.63	47.14			447.77
Amburgy	1618.15	583.61	19.90	7.08	2228.74
Upper Elkhorn No. 3½	109.36				109.36
Upper Elkhorn No. 3	1201.95	608.16	309.58	86.08	2205.77
Upper Elkhorn No. 2	458.73	113.10	24.90		596.73
Upper Elkhorn No. 1	467.14	185.76	10.73	0.27	663.90
Lower Elkhorn	152.47	96.94	3.64	0.09	253.14
Van Cleve	43.64	1.93			45.57
Unnamed	3.37	0.13	0.36	0.61	4.47
Totals	9907.66	5619.76	2690.15	1182.90	19400.47
Percent of Totals	51%	29%	14%	6%	100%

Table 11. Coal Analysis Summary for Five Major Coal Beds in the Hazard District.

				As-Received				
	Moisture	*Volatile Matter*	*Fixed Carbon*	*Ash*	*Total Sulfur*	*Btu*	*F.S.I.*	*Ash-Softening Temp. (°F)*
Fire Clay								
Maximum	3.9	39.4	56.8	19.3	1.3	13880	5.5	2880
Minimum	2.0	32.1	46.6	4.2	0.5	11393	1	2600
Mean	2.8	35.7	52.3	9.2	0.8	13037		
Number[a]	10							
Amburgy								
Maximum	3.3	41.7	54.0	50.0	5.2	13960	6.5	2910
Minimum	1.6	25.3	17.0	5.3	0.6	13998	2	2310
Mean	2.5	36.8	44.2	12.3	2.0	12419		2561
Number[a]	11							
Upper Elkhorn No. 3								
Maximum	4.2	42.0	56.5	21.8	4.0	13980	5.5	N/A
Minimum	1.2	32.4	40.7	2.4	0.8	11510	3.5	N/A
Mean	2.8	36.6	51.5	9.0	1.7	13205	4.5	N/A
Number[a]	12						5	
Hazard No. 5								
Maximum	6.0	37.7	55.4	26.4	4.1	15832	4.5	2880
Minimum	1.9	31.1	40.6	6.0	0.5	10404	1	2130
Mean	3.3	35.1	49.5	11.5	1.7	12826	3	2668
Number[a]	8							
Hazard No. 7								
Maximum	5.3	36.5	54.6	17.9	1.5	13549	3.5	2880
Minimum	2.2	31.7	48.2	7.5	0.6	11587	1	2550
Mean	3.6	34.5	50.9	11.1	1.7	12537	1.5	2773
Number[a]	10							

[a]Number of analyses for each mean.

Coal Quality in the Hazard District

The quality of coals in this district is generally good although variable in places. A summary of coal-quality parameters for the principal coals in this district is given in Table 11. The Fire Clay coal has a mean total sulfur content of 0.8 percent (as-received), a mean heating value of 13,037 Btu per pound (as received), a mean ash content of 9.2 percent (as-received), a mean moisture content of 2.8 percent (as-received), and a mean volatile matter of 35.7 percent (as-received).

Hazard No. 5 and Hazard No. 7 coals average 1.7 percent total sulfur (as-received). Their ash and moisture contents are higher than those for the Fire Clay, with mean values of 11.5 and 11.1 percent ash (as-received), and 3.3 and 3.6 percent moisture (as-received), respectively. The mean heating values for the Hazard No. 5 and the Hazard No. 7 are 12,826 and 12,537 Btu per pound (as-received), respectively.

The Amburgy coal averages 2.0 percent total sulfur (as-received), but low-sulfur Amburgy coal occurs locally. Mean value for ash content is 12.3 percent (as-received); for heating value, 12,419 Btu per pound (as-received); and for moisture, 2.5 percent (as-received). In southern Perry and Letcher Counties, Upper Elkhorn No. 3 coal has a mean sulfur content of 1.7 percent, a mean heating value of 13,205 Btu per pound (as-received), and a mean ash content of 9.0 percent (as-received).

Table 12. Estimated Coal Resources of the Licking River District (in Millions of Short Tons).

Coal Bed	*Elliot*	*Magoffin*	*Menifee*	*Morgan*	*Powell*	*Wolfe*	*Total*
Princess No. 7	7.97						7.97
Princess No. 6	17.66						17.66
Unnamed				0.25			0.25
Laurel	6.09			15.40			21.49
Skyline[a]	19.14	15.91				0.22	35.27
Tiptop		20.35					20.35
Broas	27.01	49.39		33.73		4.58	114.71
Peach Orchard[b]	12.66	424.48		170.29		39.07	646.50
Hazard	113.88	270.29		148.41		53.87	586.45
Haddix		145.97		15.40		46.85	208.22
Taylor		15.67		8.68			24.35
Hamlin		310.24		14.97		2.87	328.08
Fire Clay Rider		26.95				2.71	29.66
Fire Clay	26.57	233.51		88.71		13.52	362.31
Whitesburg	2.44	82.86		10.41		54.64	150.35
Cannel City	31.86	140.09		105.34		78.22	355.51
Little Caney[c]	34.75	191.42		146.50		26.79	399.46
Grassy[d]	6.78	22.17	0.11	88.20		43.45	160.71
Upper Elkhorn No. 1	9.51	0.85					10.36
Lower Elkhorn[e]		2.05		0.02		34.52	36.59
Whitesburg		16.06					16.06
Zachariah					0.21	32.01	32.22
Van Cleve						9.85	9.85
Gray Hawk		0.84	0.24	3.09	0.28	0.34	4.79
Beattyville			10.18		0.27		10.45
Contrary						0.41	0.41
Total Original Coal	316.32	1969.10	10.53	849.40	0.76	443.92	3590.03
Mined & Lost[f]	13.82	47.78	0.83	24.53	0.04	5.67	92.67
Remaining Coal	303.50	1921.32	9.70	824.87	0.72	438.25	3497.37
Percent Coal Remaining	96%	98%	90%	97%	95%	99%	97%

[a]Skyline or Princess No. 5 coal.
[b]Peach Orchard or Princess No. 3 coal.
[c]Little Caney or Upper Elkhorn No. 3 coal.
[d]Grassy or Upper Elkhorn No. 2 coal.
[e]Lower Elkhorn or Vires coal.
[f]As of January 1, 1981. Production from Currens and Smith (1976) and Kentucky Department of Mines and Minerals. Included coal left in pillars and lost in cleaning.

Table 13. Estimated Original Resources by Thickness Class of the Licking River District (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	*14"-28"*	*28"-42"*	*42"-56"*	*56"+*	*Total*
Princess No. 7	2.03	5.94			7.97
Princess No. 6	2.43	11.54	3.13	0.56	17.66
Unnamed	0.25				0.25
Laurel[a]	3.02	2.67	4.65	11.15	21.49
Skyline[b]	19.44	10.98	4.16	0.69	35.27
Tip Top	2.74	17.40	0.21		20.35
Broas	70.68	35.79	7.42	0.82	114.71
Peach Orchard[c]	369.88	224.82	43.50	8.30	646.50
Hazard	329.95	174.57	72.28	9.65	586.45
Haddix	144.17	60.66	3.39		208.22
Taylor	23.38	0.97			24.35
Hamlin	312.15	15.21	0.52	0.20	328.08
Fire Clay Rider	29.66				29.66
Fire Clay	315.01	46.03	1.27		362.31
Whitesburg	128.20	21.60	0.55		150.35
Cannel City	332.71	22.80			355.51
Little Caney	357.46	42.00			399.46
Grassy	150.90	9.81			160.71
Upper Elkhorn No. 1	10.36				10.36
Vires	31.86	4.73			36.59
Wheelersburg	16.06				16.06
Zachariah[d]	24.60	5.62	2.00		32.22
Van Cleve	9.85				9.85
Gray Hawk	4.79				4.79
Beattyville	6.39	4.06			10.45
Contrary	0.41				0.41
Totals	2698.38	717.20	143.08	31.37	3590.03
Percent of Total	75%	20%	4%	1%	100%

[a]Laurel or Princess No. 5b.
[b]Skyline or Princess No. 5.
[c]Peach Orchard or Princess No. 3.
[d]Zachariah or Manchester.

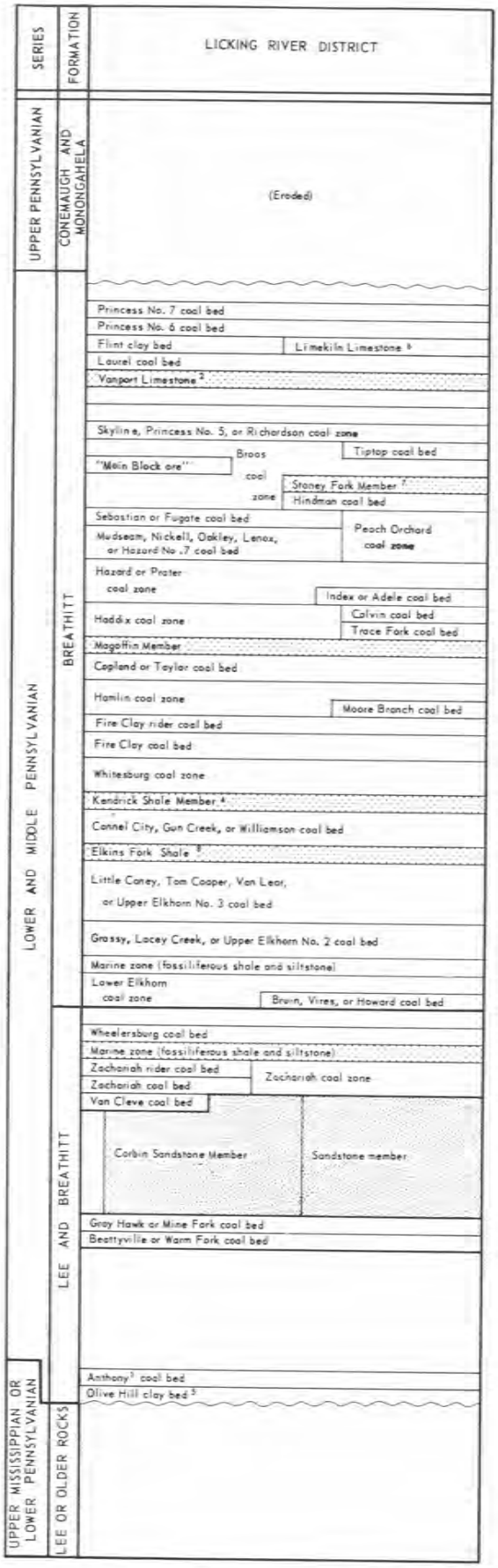

Figure 10. Principal coal beds and stratigraphic units of the Licking River District.

Coal Resources of the Licking River District

The Licking River District occupies 1,400 square miles in the north-central part of the Eastern Kentucky Coal Field. It includes Elliott, Morgan, Magoffin, Wolfe, and parts of Menifee, Powell, Rowan, Montgomery, and Bath Counties. This district contained an estimated 3.59 billion tons of original coal resources, and has an estimated 3.50 billion tons of remaining resources, as of January 1, 1981. Twenty-six coal beds greater than 14 inches in thickness are included in these estimates.

The coal resources of the Licking River District by coal bed and county are shown in Table 12. Table 13 shows these resources by coal bed and thickness class. The principal coal beds are the Peach Orchard, Hazard, Little Caney, Fire Clay, and Cannel City, and they account for 65 percent of the coal resources in the district. Figure 10 gives the names and correlations of principal coal beds in the district and key stratigraphic units.

Coal Quality in the Licking River District

A summary of coal-quality parameters for the principal coals in the district is given in Table 14. The principal producing coal beds of the district have a range of mean total sulfur content of 1.0 to 2.5 percent (as-received). There is a wide range in total sulfur content, however, for most of the coals in this district, with values ranging from 0.5 to 4.0 percent sulfur (as-received). The mean heating values for the principal coal beds range from 12,268 to 13,121 Btu per pound (as-received).

The means for ash and moisture contents are low to moderate for the principal coals in this district, and range from 4.9 to 12.3 percent ash and 3.9 to 5.2 percent moisture (as-received). The means for volatile matter range from 32.3 to 39.6 percent.

Table 14. Coal Analysis Summary for Five Major Coal Beds in the Licking River District.

	As-Received							
	Moisture	*Volatile Matter*	*Fixed Carbon*	*Ash*	*Total Sulfur*	*Btu*	*F.S.I.*	*Ash-Softening Temp. (F)*
Peach Orchard								
Maximum	8.2	44.5	51.0	17.1	4.4	13130	4	2910
Minimum	3.7	34.8	41.5	5.9	0.6	11360	1	2010
Mean	5.2	37.3	47.3	10.2	1.7	12268		
Number[a]	11						9	9
Hazard								
Maximum	6.7	35.4	56.3	12.4	1.4	13190	N/A	N/A
Minimum	3.4	28.9	48.8	8.2	0.8	12270	N/A	N/A
Mean	4.4	32.3	53.5	9.8	1.0	12812	N/A	N/A
Number[a]	5						N/A	N/A
Little Caney								
Maximum	8.4	43.4	57.0	11.0	3.2	13549	9.5	2800
Minimum	3.7	35.3	46.6	0.9	0.5	12010	1	2030
Mean	5.0	39.3	50.8	4.9	2.0	13121		
Number[a]	8							
Fire Clay								
Maximum	5.4	46.1	49.0	16.3	2.9	14260	3	2720
Minimum	2.5	33.1	35.8	5.6	1.6	11160	1	2500
Mean	3.9	39.0	44.9	12.3	2.1	12650		
Number[a]	5							
Cannel City								
Maximum	7.5	42.7	48.9	13.3	3.6	13690	5	2910
Minimum	3.3	38.3	44.0	5.3	0.7	12311	2.5	2030
Mean	4.4	39.6	47.1	9.0	2.5	12785		
Number[a]	4							

[a]Number of analyses for each mean.

Coal Resources of the Princess District

The Princess District occupies about 1,350 square miles in the northern part of eastern Kentucky. It includes Boyd, Carter, Greenup, and Lawrence Counties and a part of Lewis County. This district contained an estimated 3.62 billion tons of original resources and 3.18 billion tons of remaining resources, as of January 1, 1981. Twenty-five coal beds of 14 inches or greater thickness were included in these estimates.

The coal resources of the Princess District by coal bed and county are shown in Table 15. Table 16 shows these resources by coal and thickness classes. The five principal coal beds in this district are the Princess No. 3, Princess No. 5, Princess No. 7, Van Lear, and Princess No. 6. Figure 11 gives the names and correlations of principal coal beds in the district and key stratigraphic units.

Coal Quality in the Princess District

The quality of coals in the Princess District is variable. A summary of coal-quality parameters for the principal coals in the district is given in Table 17. The average total sulfur content of the principal coals ranges from 1.4 to 3.5 percent (as-received). The mean heating values for the five principal coals range from 10,762 to 12,602 Btu per pound (as-received); however, values vary from 8,720 to 13,496 Btu per pound (as-received). The moisture and ash values for these coals are quite variable. The average volatile matter for the principal coals ranges from 34.3 to 39.4 percent.

Table 15. Estimated Coal Resources of the Princess District (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	*Boyd*	*Carter*	*Greenup*	*Lawrence*	*Total*
Brush Creek				2.38	2.38
Princess No. 9				12.60	12.60
Princess No. 8	84.09	25.69		23.85	133.63
Princess No. 7	143.25	88.94	17.09	109.56	358.84
Princess No. 6	83.34	71.35	1.35	68.53	224.57
Princess No. 5B[a]				2.47	2.47
Princess No. 5[b]	58.36	50.74	19.90	287.25	416.25
Princess No. 4[c]	7.28	3.05	1.62	121.53	133.48
Princess No. 3[d]	171.65	153.47	144.82	537.28	1007.22
Hazard				38.97	38.97
Haddix	49.74			93.76	143.50
Taylor				13.59	13.59
Hamlin[e]	2.67	13.09		84.33	100.09
Fire Clay Rider				77.27	77.27
Fire Clay	30.30	32.31	16.61	118.46	197.68
Little Fire Clay				7.17	7.17
Whitesburg		5.95		108.21	114.16
Williamson[f]		2.25	0.07	115.47	117.79
Van Lear[g]		54.27	1.92	191.31	247.50
Grassy				4.99	4.99
Bruin		0.46			0.46
Wheelersburg		0.39		0.39	0.78
Warm Fork			1.49		1.49
Unnamed				5.31	5.31
Total Original Resource	630.68	501.96	204.87	2024.68	3362.19
Coal Mined & Lost[h]	115.74	33.56	6.60	27.58	183.48
Remaining Coal Resource	514.94	468.40	198.27	1997.10	3178.71
Percent Coal Remaining	82%	93%	97%	99%	95%

[a]Princess No. 5b or Laurel coal.
[b]Princess No. 5 or Richardson coal.
[c]Princess No. 4 or Broas coal.
[d]Princess No. 3 or Mudseam and Peach Orchard coals.
[e]Hamlin or Moore Branch coal.
[f]Williamson or Gun Creek and Cannel City coals.
[g]Van Lear or Tom Cooper and Little Caney coals.
[h]As of 1980. Includes coal lost in pillars, incidental loss, and loss in cleaning.

Table 16. Estimated Original Coal Resources by Thickness Class of the Princess District (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	*14"–28"*	*28"–42"*	*42"–56"*	*56"+*	*Total*
Brush Creek	1.44	0.94			2.38
Princess No. 9	7.15	5.45			12.60
Princess No. 8	67.39	66.86			133.63
Princess No. 7	144.01	171.92	29.16	13.75	358.84
Princess No. 6	162.57	56.35	4.42	1.23	224.47
Laurel[a]	2.47				2.47
Princess No. 5[b]	268.18	114.62	19.71	13.71	416.25
Princess No. 4[c]	97.12	33.99	2.13	0.24	113.48
Princess No. 3[d]	869.01	132.66	5.55		1007.22
Hazard	28.13	8.47	2.37		38.97
Haddix	138.88	4.62			143.50
Taylor	13.59				13.59
Hamlin[e]	99.41	0.62			100.09
Fire Clay Rider	76.09	1.18			77.27
Fire Clay	195.95	1.73			197.68
Little Fire Clay	7.17				7.17
Whitesburg	105.69	8.73			114.16
Williamson[f]	117.25	0.54			117.79
Van Lear[g]	247.07	0.43			247.50
Grassy	4.49				4.49
Bruin	0.46				0.46
Wheelersburg	0.78				0.78
Warm Fork	0.83	0.66			1.49
Unnamed	5.31				5.31
Totals	2660.15	609.77	63.34	28.93	3362.19
Percent of Total	79%	18%	2%	1%	100%

[a]Laurel or Princess No. 6 coal.
[b]Princess No. 5 or Richardson coal.
[c]Princess No. 4 or Broas coal.
[d]Princess No. 3 or Mud Seam and Peach Orchard coals.
[e]Hamlin or Moore Branch coal.
[f]Williamson or Cannel City and Gun Creek coals.
[g]Van Lear or Little Caney and Tom Cooper coals.

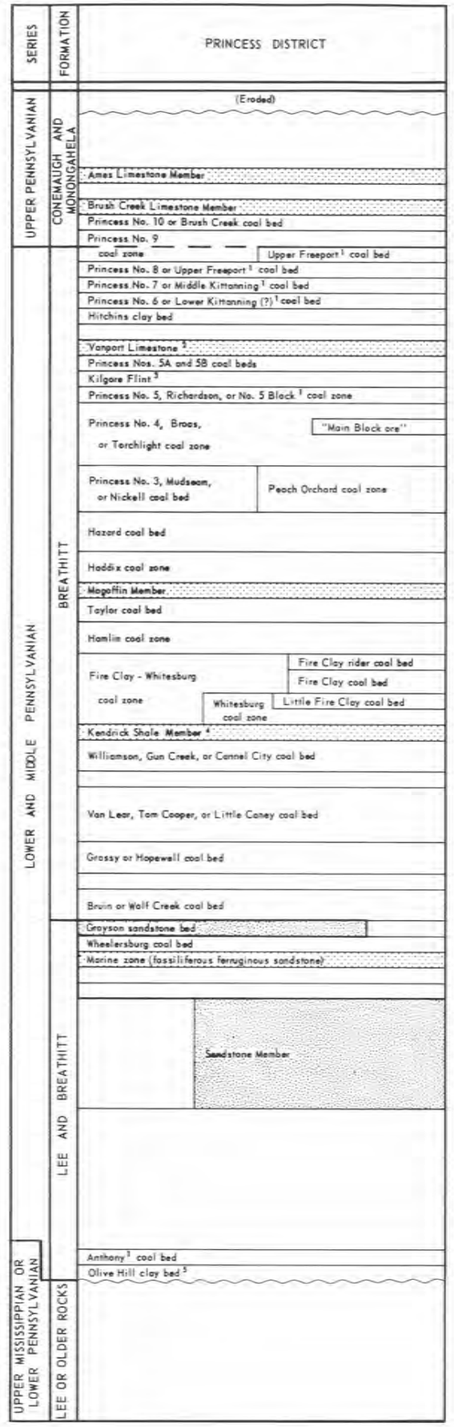

Figure 11. Principal coal beds and stratigraphic units of the Princess District.

Table 17. Coal Analysis Summary for Five Major Coal Beds in the Princess District.

	As-Received						*Ash-Softening Temp. (°F)*
	Moisture	*Volatile Matter*	*Fixed Carbon*	*Ash*	*Total Sulfur*	*Btu*	*F.S.I.*	
Princess No. 3								
Maximum	6.8	41.0	51.7	15.3	2.7	12770	2	2800
Minimum	3.5	32.5	42.1	3.9	1.0	10752	1	2625
Mean	5.4	37.0	47.0	10.7	1.4	11880	9	5
Number[a]	11							
Princess No. 5								
Maximum	6.0	36.8	50.4	24.8	8.5	12478	1.5	2800
Minimum	3.0	34.6	39.1	7.1	0.8	9267	0.5	2620
Mean	4.6	34.3	43.3	17.8	3.0	10762	9	5
Number[a]	11							
Princess No. 7								
Maximum	9.1	37.7	50.0	30.6	7.1	12762	6	2800
Minimum	1.4	30.3	35.0	5.9	0.7	8720	1	2010
Mean	5.5	39.4	44.1	14.3	3.1	11270	9	7
Number[a]	11							
Van Lear								
Maximum	6.6	38.8	55.2	11.0	2.9	13496	3.5	2800
Minimum	4.1	35.8	46.6	3.0	0.7	12010	1	2220
Mean	5.3	37.0	50.9	6.9	1.4	12602	3	3
Number[a]	4							
Princess No. 6								
Maximum	7.7	40.3	49.6	23.7	5.6	12229	3	2620
Minimum	3.9	33.7	37.4	6.1	1.5	9576	2.5	2470
Mean	5.5	37.6	43.5	13.7	3.5	11263	3	2
Number[a]	5							

[a]Number of analyses for each mean.

Coal Resources of the Southwestern District

The Southwestern District is the largest district in the Eastern Kentucky Coal Field, but contains only the fourth largest coal resource, after Big Sandy, Hazard, and Upper Cumberland. This district covers approximately 3,400 square miles in the southwestern part of the Eastern Kentucky Coal Field. It includes Clay, Jackson, Laurel, Lee, McCreary, and Owsley Counties, and parts of Bell, Clinton, Estill, Madison, Pulaski, Rockcastle, Wayne, and Whitley Counties.

This district contained an estimated 7.43 billion tons of original coal resources and an estimated 6.85 billion tons of remaining resources, as of January 1, 1981. Twenty-five coal beds with 14 inches or greater thickness are included in these resource estimates. The five principal coal beds in this district are the Lily, Jellico, Blue Gem, Fire Clay, and Halsey Rough. They contain almost 57 percent of the total coal resources in the district. Table 18 lists resources by county and by bed and Table 19 shows resources by bed and thickness class. Figure 12 gives the names and correlations of principal coal beds in this district and key stratigraphic units.

Table 18. Estimated Coal Resources of the Southwestern District (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	BEL	CLA	CLI	EST	JAC	KNX	LAU	LEE	MAD	MCY	OWS	PUL	ROC	WAY	WHL	TOTAL
Hazard No. 10	0.95	0.07				0.06										1.08
Hazard No. 9	9.16	1.29				1.12										11.71
Hazard No. 8	27.43	14.63				7.47					0.14					50.05
Hazard No. 7	12.55	11.03				0.31					0.52					26.24
Hazard	68.30	74.17				24.09					2.35					205.13
Haddix	55.99	102.69				16.16					38.09				0.48	158.04
Copland	2.62	7.34				6.97					35.72					52.66
Hamlin	53.51	64.95				18.97					0.52				0.62	138.57
Fire Clay Rider	152.18	119.94				98.84					6.44				11.15	388.67
Fire Clay	180.64	148.22				109.84					88.80				24.49	552.17
Whitesburg	88.34	131.53				88.84					8.04				2.37	319.12
Amburgy	28.27	50.61				71.16					91.45				11.25	255.66
Upper Elkhorn No. 3	31.03	137.42				100.19					110.33				2.62	390.38
Jellico	183.99	251.33			0.46	337.26	25.40		24.04		77.92				208.11	1108.72
Blue Gem	159.48	16.25			0.63	383.11	28.37		31.35		12.32				268.13	924.53
Lower Blue Gem						54.70	3.86					2.78			71.39	129.95
Lily Rider		40.60														40.60
Lily	0.33	363.04			16.99	62.84	286.92		66.07		47.68	22.99	50.30		295.27	1186.46
Gray Hawk					82.07						29.41	10.03	63.71		79.58	190.46
Halsey Rough					185.74		53.35				22.05	111.03				461.55
Barren Fork				2.50	43.12		4.26			225.86		6.54				383.44
Beaver Creek			7.21		7.99		2.68		73.44	37.22	0.16	2.78	25.92	27.28		270.15
Stearns No. 2							0.29			42.04						117.27
Stearns No. 1½							1.21			13.75						17.74
Stearns No. 1					38.87		1.70			4.64			4.53			49.80
Total	1034.77	1536.11	7.21	2.50	375.87	1381.93	408.04		363.98	444.97	574.14	153.37	144.46	27.28	975.46	7430.16
Coal Mined & Lost[a]	36.70	78.47	3.34	<.01	16.55	101.96	55.32		12.97	97.31	8.99	31.29	9.12	5.71	122.41	580.18
Remaining Coal	998.07	1457.64	3.87	2.49	359.32	1279.97	352.72		351.01	347.66	565.15	122.08	135.34	21.57	853.05	6849.98
Percentage of Original Coal Remaining	96%	95%	54%	99%	96%	93%	86%		96%	78%	98%	80%	94%	79%	90%	92%

[a]The figure given is two times the cumulative production of coal from 1790 to 1980 to account for coal mined and lost because of mining and cleaning.

County Abbreviations

BEL = Bell	KNX = Knox	OWS = Owsley	
CLA = Clay	LAU = Laurel	PUL = Pulaski	
CLI = Clinton	LEE = Lee	ROC = Rockcastle	
EST = Estill	MAD = Madison	WAY = Wayne	
JAC = Jackson	MCY = McCreary	WHL = Whitley	

Table 19. Estimated Original Coal Resources by Thickness Class of the Southwestern District (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	14"–28"	28"–42"	42"–56"	56"+	Total
Hazard No. 10	0.13	0.88	0.07		1.08
Hazard No. 9	1.18	3.99	4.95	1.59	11.71
Hazard No. 8	11.00	11.70	27.35		50.05
Hazard No. 7	20.41	5.83			21.24
Hazard	98.28	100.55	5.92	0.38	205.13
Haddix	123.86	29.83	3.55	0.80	158.04
Copland	31.13	21.18	0.35		52.66
Hamlin	105.38	30.69	2.19	0.31	138.57
Fire Clay Rider	152.97	179.88	49.56	6.26	388.67
Fire Clay	169.48	199.25	138.87	44.57	552.17
Whitesburg	226.41	91.34	1.37		319.12
Amburgy	223.18	30.70	1.78		255.66
Upper Elkhorn No. 3	336.59	53.25	0.54		390.38
Jellico	701.06	352.61	52.36	2.69	1108.72
Blue Gem	752.00	154.81	17.25	0.47	924.53
Lower Blue Gem	127.42	2.53			129.95
Lily Rider	40.60				40.60
Lily	808.10	376.49	1.87		1186.46
Gray Hawk	190.05	0.41			190.46
Halsey Rough	306.30	148.35	6.90		461.55
Barren Fork	226.00	140.29	17.15		383.44
Beaver Creek	172.79	67.84	29.52		270.15
Stearns No. 2	34.03	45.52	35.62	2.10	117.27
Stearns No. 1½	12.87	0.57	4.30		17.74
Stearns No. 1	18.37	17.58	13.86		49.81
Totals	4889.59	2066.07	415.33	59.17	7430.16
Percent of Total	66%	28%	5%	1%	100%

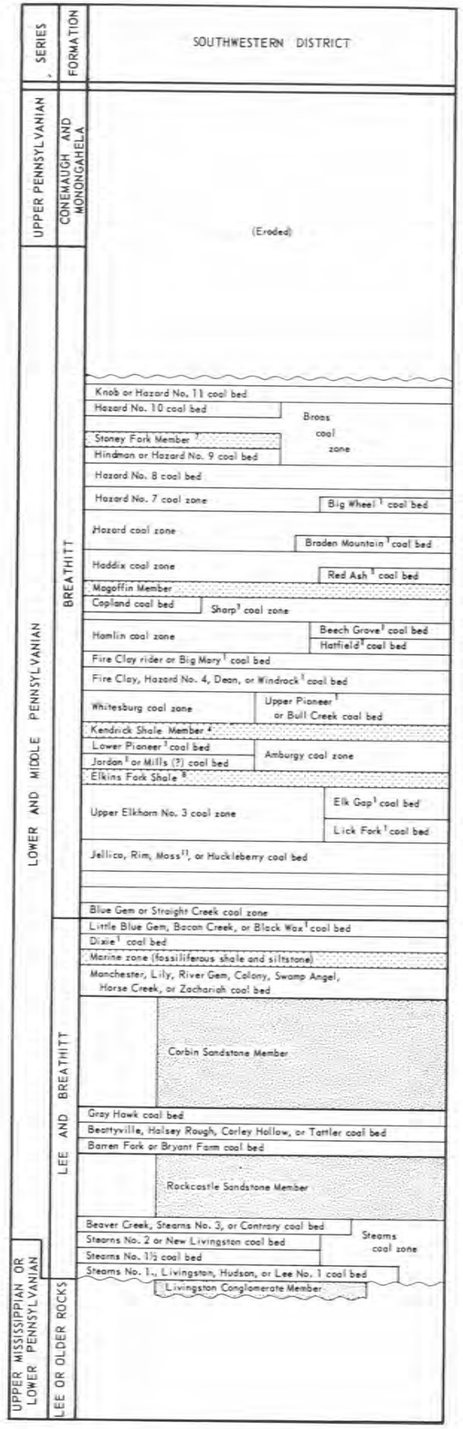

Figure 12. Principal coal beds and stratigraphic units of the Southwestern District.

Coal Quality in the Southwestern District

The quality of coal in the Southwestern District is highly variable. A summary of coal-quality parameters for the principal coals in the district is given in Table 20. The mean sulfur content for the principal coals ranges from about 0.5 to 6.4 percent. The mean total sulfur contents for the principal coal beds in this district range from 1.2 to 2.8 percent (as-received). The mean heating values for these coals range from 12,894 to 13,837 Btu per pound (as-received). The ash and moisture contents average from 5.2 to 9.3 percent and 2.8 to 5.3 percent, respectively (as-received). The mean volatile matter for these principal coals ranges from 36.3 to 37.4 percent (as-received).

Table 20. Coal Analysis Summary for Five Major Coal Beds of the Southwestern District.

	As-Received							Dry			
	Moisture	Volatile Matter	Fixed Carbon	Ash	Total Sulfur	Btu	F.S.I.	Ash	Total Sulfur	Btu	Ash Softening Temp. (°F)
Manchester											
Maximum	5.4	39.5	56.5	19.1	6.4	14139	7				2800
Minimum	1.1	34.6	44.9	1.7	0.5	12043	4.5				2270
Mean	2.8	37.4	52.1	7.7	2.8	13473	11				6
Number[a]	13										
Jellico											
Maximum	4.8	40.0	57.5	11.9	3.7	14216	7				2800
Minimum	3.0	33.6	48.7	2.0	0.7	12223	1				2183
Mean	3.7	37.1	49.2	5.7	1.6	13404	10				
Number[a]	11										
Blue Gem											
Maximum	7.3	40.8	59.9	23.3	4.1	14260	4.5				2610
Minimum	2.3	29.9	44.5	1.5	0.6	10912	1				2030
Mean	3.9	36.9	54.0	5.2	1.5	13837					
Fire Clay											
Maximum	6.4	39.4	55.6	18.3	2.7	14211	5.5				2800
Minimum	1.9	33.8	45.0	3.3	0.6	11267	1				2220
Mean	3.1	36.3	51.3	9.3	1.2	13192	4				2619
Number[a]	10										
Halsey Rough											
Maximum	9.8	38.4	54.4	20.8	3.2	13847	8				2740
Minimum	2.8	29.1	40.3	2.4	0.5	12732	2				1960
Mean	5.3	36.6	50.5	7.6	1.8	12894	4				2193
Number[a]	10										

[a]Number of analyses for each mean.

Coal Resources of the Upper Cumberland District

The Upper Cumberland District is the smallest district in area, but is third in total resources. This district occupies the area south of the Pine Mountain Fault. It includes parts of Bell, Harlan, Letcher, and Whitley Counties.

The Upper Cumberland District contained 9.99 billion tons of original coal resources and 8.32 billion tons of remaining resources, as of January 1, 1981. There are 24 coal beds that attain thickness of at least 14 inches included in these estimates.

The coal resources of the Upper Cumberland District by coal bed and county are shown in Table 21. Table 22 shows these resources by coal bed and thickness classes. The five principal coal beds in this district are the Harlan, Path Fork, Creech, Hance, and Darby. These five coals contain nearly 67 percent of the total original resources. Each of these coal beds accounts for more than 1 billion tons of resources. Figure 13 gives the names and correlations of principal coal beds in this district and key stratigraphic units.

Table 21. Estimated Original and Remaining Coal Resources of Upper Cumberland District, by Coal Bed and County (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	*Bell*	*Harlan*	*Letcher*	*Whitley*	*Totals*
Black Mountain	0.96	0.65			1.61
High Splint	31.35	160.91	1.19		193.45
Morris	0.46	124.15	6.07		130.68
Low Splint	33.43				33.43
Limestone	4.97	111.24	14.22		130.43
Pardee	30.22	149.28	69.08		248.58
Smith		189.74	5.58		195.32
Wallins Creek	107.26	301.16	22.54		430.96
Stray	170.19	51.66			221.85
Creech	263.58	997.88	59.63		1321.09
Verda	6.52	246.31	1.14		253.97
Darby	90.70	827.93	139.48		1058.11
Kellioka	45.12	584.23	57.32		686.67
Harlan	169.61	1396.12	59.02	0.15	1624.90
Path Fork	98.25	1195.34	151.53	0.64	1445.76
Phoebe	97.00	5.46		2.78	105.24
Hance	520.47	702.07		8.41	1230.95
Mason	161.33	118.80			280.13
Splitseam	203.03	51.40			254.43
Clear Fork	41.28				41.28
Naese	73.42	6.31			79.73
Bee Rock	0.59				0.59
Tunnel	5.94	14.50	0.03		20.47
Cumberland Gap	4.25				4.25
Totals	2159.93	7235.14	586.83	11.98	9993.88
Mined & Lost[a]	393.50	1276.44	small	small	1669.94
Remaining Resource	1766.43	5958.70	586.83	11.98	8323.94
Percent Remaining[b]	82%	82%	99+%	99+%	83%

[a]The figure given is twice the cumulative production of coal from 1790 to 1980 to account for coal mined and lost in the mining and cleaning process.
[b]Percent remaining of the estimated coal resource.

Table 22. Estimated Original Coal Resources in the Upper Cumberland District by Thickness and Coal Bed (in Millions of Short Tons, Arranged Stratigraphically).

Coal Bed	*14"–28"*	*28"–42"*	*42"–56"*	*56"+*	*Total*
Black Mountain	1.61				1.61
High Splint	13.06	53.27	55.00	72.12	193.45
Morris	29.77	82.48	17.31	1.12	130.68
Low Splint	26.13	5.48	0.68	1.14	33.43
Limestone	62.33	31.11	24.78	12.21	130.43
Pardee	175.29	56.90	2.70	13.69	248.58
Smith	106.19	67.42	13.44	8.27	195.32
Wallins Creek	170.15	120.87	102.67	37.27	430.96
Stray	94.57	86.30	32.53	8.45	221.85
Creech	472.84	578.20	205.40	64.65	1321.09
Verda	110.25	122.20	21.52		253.97
Darby	266.45	514.69	204.89	72.08	1058.11
Kellioka	213.20	456.26	17.21		686.67
Harlan	401.86	794.23	331.79	97.02	1624.90
Path Fork	682.04	587.58	58.52	117.62	1445.76
Phoebe	101.95	2.83	0.38	0.08	105.24
Hance	773.63	426.13	21.78	9.41	1230.95
Mason	84.52	165.81	29.80		280.13
Splitseam	50.32	165.94	38.17		254.43
Clear Fork	37.42	2.56	1.30		41.28
Naese	73.42		6.31		79.73
Bee Rock	0.59				0.59
Tunnel	1.03	13.45	5.99		20.47
Cumberland Gap			4.25		4.25
Totals	3948.62	4333.71	1196.42	515.13	9993.88
Percent of Total	40%	43%	12%	5%	100%

Coal Quality in the Upper Cumberland District

The Upper Cumberland District provides high-quality coals for steam and coke. A summary of coal-quality parameters for the principal coals in this district is given in Table 23. Analyses of coal samples from the five principal beds show a range of mean values of 13,100 to 13,789 Btu per pound (as-received). The mean total sulfur content for the principal coals ranges from 0.7 to 1.5 percent (as-received). The means for ash and moisture content for these five principal coals range from 5.9 to 9.8 percent ash and 2.3 to 2.9 percent moisture (as-received). This district has the highest free-swelling index in eastern Kentucky, and mean volatile matter ranges from 35.8 to 37.2 percent (as-received). Mean ash-softening temperatures are somewhat higher than generally found in eastern Kentucky and range from 2314 to 2728°F.

Table 23. Coal Analysis Summary for Five Major Coal Beds of the Upper Cumberland District.

	As-Received							
	Moisture	*Volatile Matter*	*Fixed Carbon*	*Ash*	*Total Sulfur*	*Btu*	*F.S.I.*	*Ash-Softening Temp. (°F)*
Harlan								
Maximum	3.5	40.0	56.9	12.3	3.1	14150	6	2800
Minimum	1.7	32.8	51.4	1.7	0.6	12400	3.5	2545
Mean	2.3	36.8	55.0	5.9	1.1	13789	5.5	2653
Number[a]	10						5	
Path Fork								
Maximum	3.2	42.3	56.7	15.1	2.6	14051	7	2910
Minimum	1.5	33.1	49.8	4.4	0.6	12263	2	2080
Mean	2.3	36.0	52.6	9.2	1.4	13340	5	2612
Number[a]	5							
Creech								
Maximum	3.5	39.7	55.3	14.0	3.0	13840	7	2800
Minimum	1.7	32.8	47.7	6.4	0.6	12340	3	2080
Mean	2.6	35.9	51.7	9.8	1.5	13100	5	2606
Number[a]	10						6	5
Hance								
Maximum	4.8	39.6	60.1	17.6	4.5	14411		2676
Minimum	1.9	32.4	47.8	2.4	0.5	12970		2070
Mean	2.9	37.2	53.8	6.0	1.4	13625	5	2314
Number[a]	9					8	1	7
Darby								
Maximum	4.1	38.6	57.0	14.1	0.8	14300	4.5	2790
Minimum	2.0	31.9	50.3	2.9	0.6	12230	4	2660
Mean	2.8	35.8	53.9	7.5	0.7	13466	4	2728
Number[a]	8						4	

[a]Number of analyses for each mean.

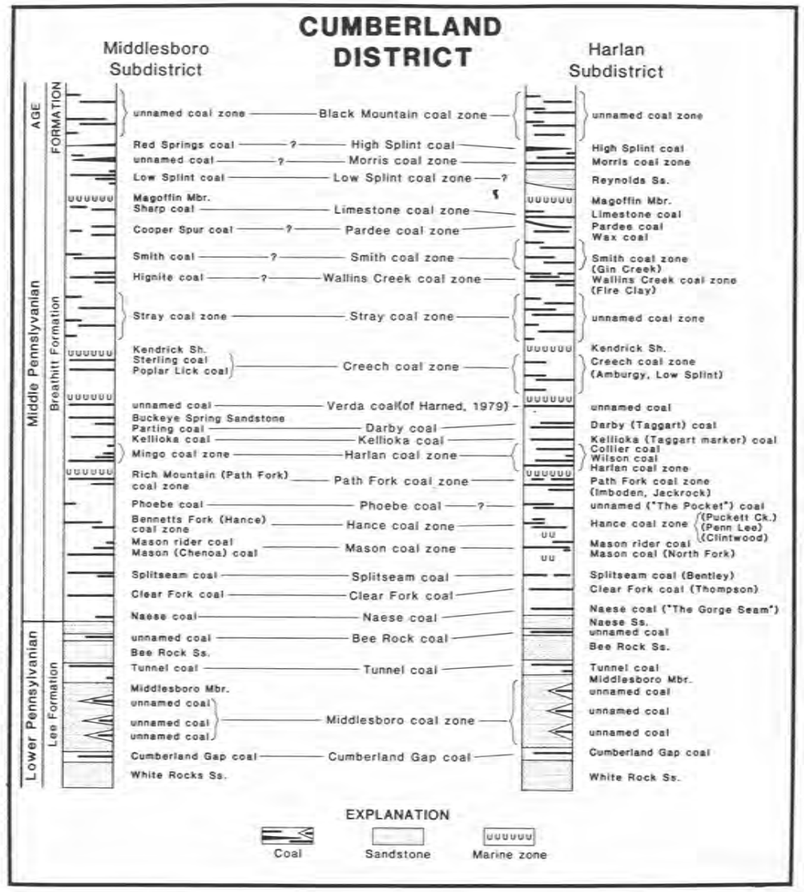

Figure 13. Principal coal beds and stratigraphic units of the Upper Cumberland River District.

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