STATE OF ARKANSAS

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Norman F. Williams, State Geologist

INFORMATION CIRCULAR 28

CHEMICAL ANALYSES OF LIGNITE FROM THE WILCOX AND CLAIBORNE GROUPS (EOCENE) SOUTHERN AND EASTERN ARKANSAS

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by

Ricky T. Hildebrand, U. S. Geological Survey

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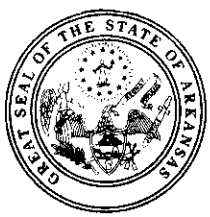

Little Rock, Arkansas
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ENGLISH-METRIC CONVERSION

English unit			Metric unit
Short ton	=	0.907	Metric ton
Mile	=	1.609	Kilometers
Square mile	=	2.589	Square kilometers
Foot	=	.305	Meter
Btu/lb	=	.556	Kcal/kg

Introduction

Potentially economic lignite deposits in strata of Eocene age underlie approximately 6,125 square miles of eastern and southern Arkansas (Haley, 1960). Lignite resources are estimated at 13.5 billion short tons in beds more than 2.5 feet thick to a depth of 200 feet (Clardy, pers. comm., 1981).

Significant to any complete lignite resource appraisal is an estimate of the chemical composition of the lignite. Four reasons for obtaining comprehensive and precise chemical analyses of lignite are as follows: (1) to help determine the most suitable use of the lignite, (2) to assess possible by-product recovery, (3) to help interpret the geological and geochemical history of the lignite-bearing rocks, and (4) to help assess the environmental implications of lignite mining and utilization (Hatch and Swanson, 1977).

During the period between July 1975 and April 1979, 53 samples of lignite (50 core samples and three samples from surface exposures) were collected from 15 counties in southern and eastern Arkansas (figure 1) for chemical analysis during an exploratory investigation conducted by the Arkansas Geological Commission. Sample localities and brief descriptions are given in table 1. Location maps (by county) and drill logs for the holes sampled are included in Clardy (1978) and Holbrook (1980).

Geologic setting

The Arkansas lignite samples were collected from the Wilcox (31 samples) and Claiborne (22 samples) Groups of Eocene age. The areal distribution and stratigraphic relationships of these strata are shown in figures 1 and 2, respectively. General descriptions of the lignite-bearing strata follow. Detailed descriptions of the geology of the areas discussed in this report are included in Harris (1894), Anderson (1942), Murray (1947), and Stearns (1957).

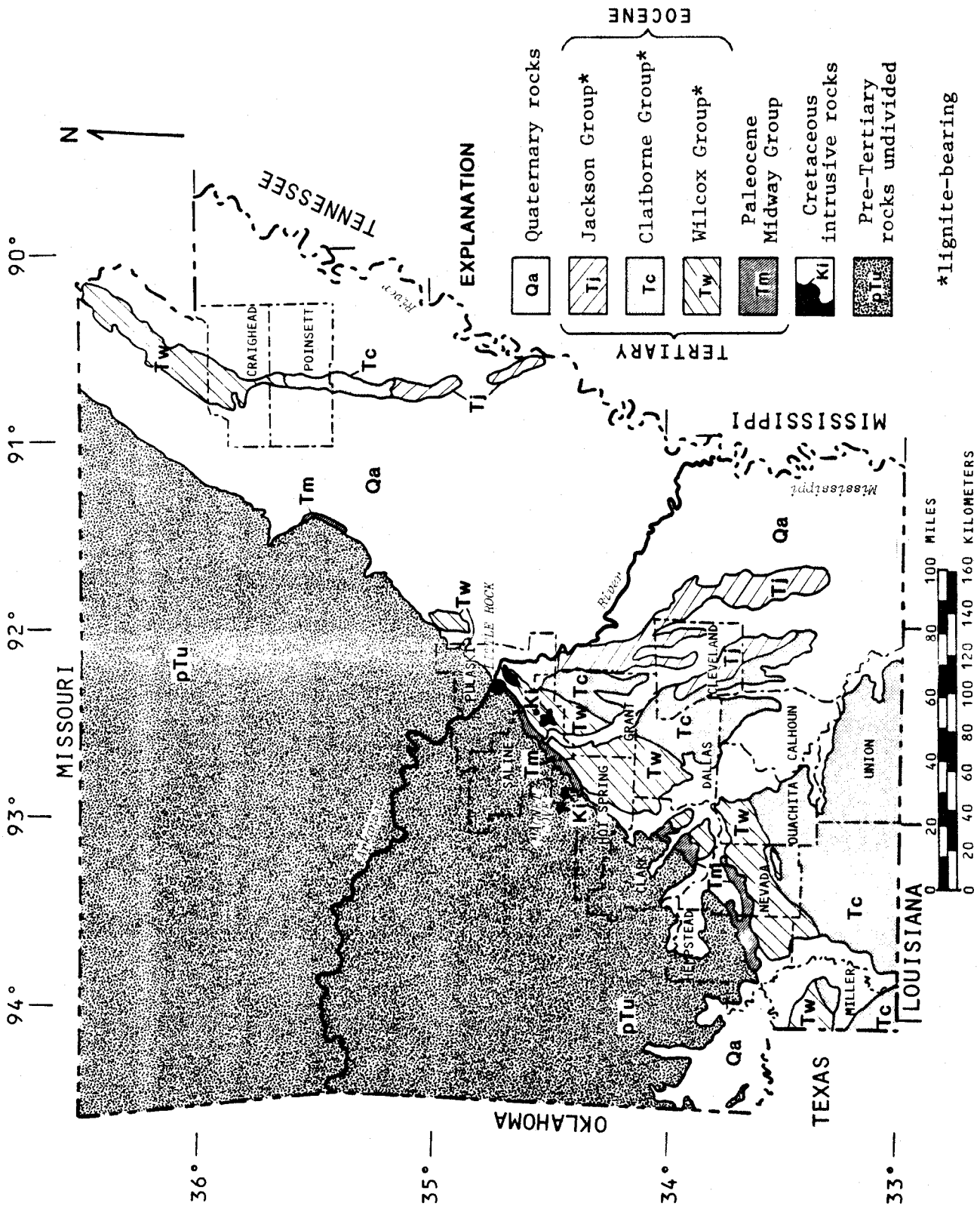

Figure 1.--Geologic map of Arkansas, showing counties from which samples were collected (modified from AAPG Highway Map Committee, 1966).

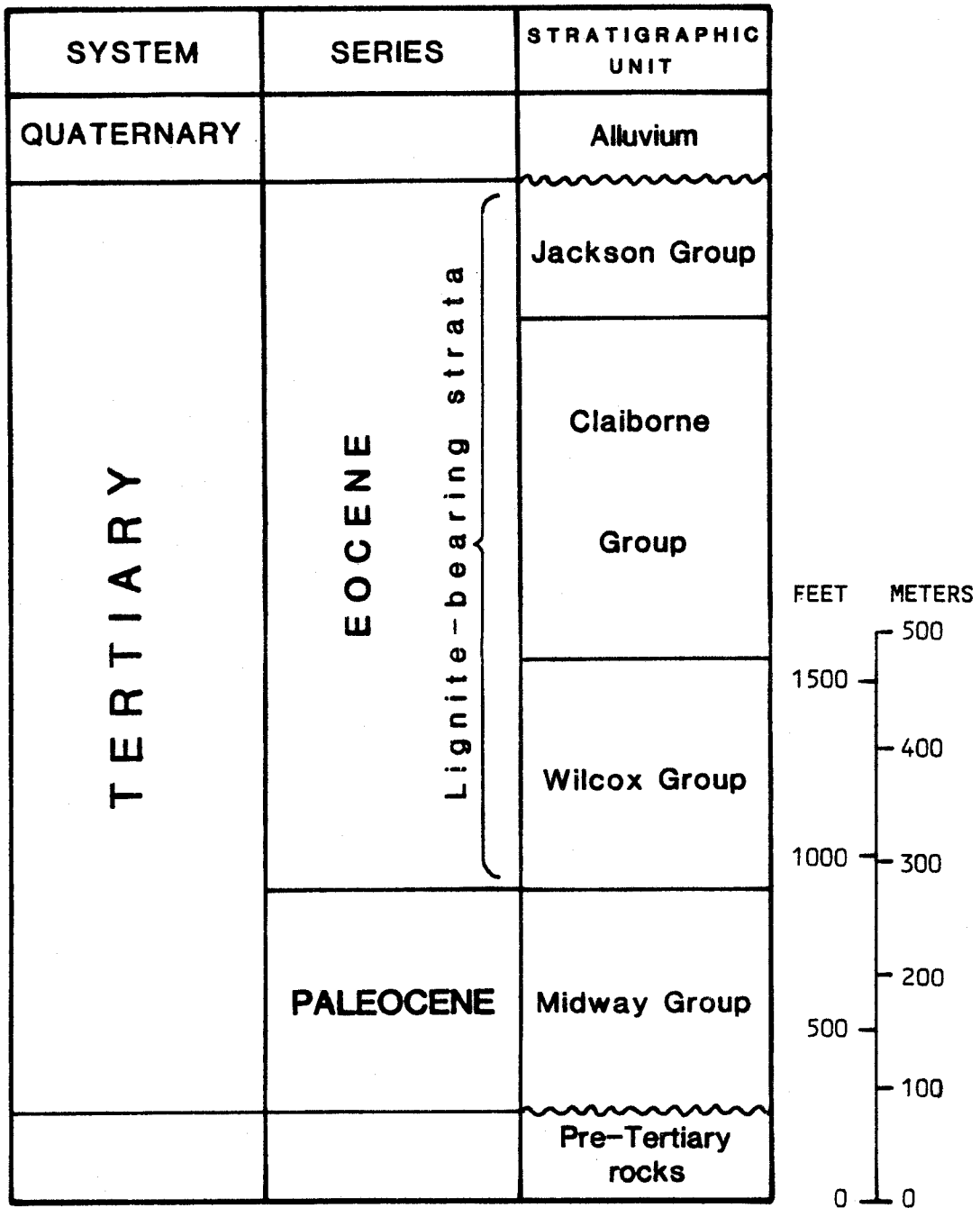

Figure 2.--Generalized stratigraphic column of the Eocene and associated strata, southern and eastern Arkansas (modified from Murray, 1947, and Haley, 1960).

The Wilcox Group consists of interbedded sand, silty sand, silt, clay, and lignite. The unit averages about 650 feet in thickness (Haley, 1960), and attains a maximum thickness of 850 feet in the northeastern part of the state (Holbrook, 1980). Lenticular beds of lignite up to 10 feet thick are present throughout the Wilcox Group (Clardy, pers. comm., 1981).

The Claiborne Group overlies the Wilcox Group and has a similar lithology, consisting of interbedded sand, clay, silt, and lignite. This unit ranges in thickness from 500 feet to 1,200 feet (Haley, 1960; Clardy, 1978). The lignite beds in the Claiborne are lenticular, generally of limited areal extent, and thin, with a maximum reported thickness of 7.0 feet (Clardy, 1978). Lignite in the Claiborne does not appear to be restricted to a particular stratigraphic horizon; several exploratory drill holes encountered beds more than 3.0 feet at depths of 150 feet or less (Clardy, 1978; Holbrook, 1980).

Explanation of data and summary tables

Proximate and ultimate analyses, and heat-of-combustion, air-dried-loss, forms-of-sulfur, and ash-fusion-temperature determinations for the 53 lignite samples from Arkansas are given in tables 2a-2b. These analyses were provided by the Coal Analysis Section, Department of Energy (formerly U.S. Bureau of Mines), Pittsburgh, Pa. Analyses for ash content, contents of 35 major and minor oxides and trace elements in the laboratory ash (tables 3a-3b), and analyses for nine trace elements in whole lignite (table 4a-4b) for the 53 samples were provided by the U.S. Geological Survey in Denver, Colo. Tables 5a-5b contain the data listed in tables 3a-3b converted to a whole-lignite

basis and include the whole-lignite analyses listed in tables 4a-4b. Twenty additional elements not listed in tables 3, 4, and 5, were looked for but not found in amounts greater than their lower limit of detection (table 6).

Unweighted statistical summaries of the analytical data in tables 2a-2b, 3a-3b, and 4a-4b for lignite from the Wilcox and Claiborne Groups are given in tables 7a-7b, 8a-8b, and 9a-9b, respectively. For comparison, statistical summaries of the analytical data in tables 2, 3, and 4 for lignite from the Wilcox and Claiborne Groups combined are presented in tables 10, 11, and 12. Data summaries for P_2O_5 contents in ash are not included in tables 8a, 8b, and 11 because P_2O_5 was detected in an insufficient number of samples to calculate meaningful statistics. For the same reason, data summaries for Ag, Cd, Ce, Ge, La, Nd, and P are not included in tables 9a, 9b, and 12, and Mo is not included in table 9b.

To be consistent with the precision of the semiquantitative emission spectrographic technique, arithmetic and geometric means of elements determined by this method are reported as the midpoint of the enclosing six-step brackets. (See headnotes of tables 3a and 3b, or Swanson and Huffman, 1976, p. 6, for an explanation of six-step brackets.)

Most of the analytical procedures used by the U.S. Geological Survey are described in Swanson and Huffman (1976). Arsenic contents of the samples included in this report were determined by two different analytical methods: samples D176391-D176398 were analyzed spectrophotometrically (lower detection limit 1.0 ppm); the remaining 45 samples were analyzed for arsenic by instrumental neutron activation analysis (lower detection limit 0.1 ppm).

Antimony, selenium, and thorium contents of samples D176391-D176398 were determined by the Rhodamine-B spectrophotometric method (lower detection limit 0.1 ppm), x-ray fluorescence analysis (lower detection limit 0.1 ppm), and delayed neutron activation analysis (lower detection limit 3.0 ppm), respectively. The remaining 45 samples were analyzed for antimony, selenium, and thorium by instrumental neutron activation analysis (lower detection limit 0.1 ppm).

Cobalt and chromium contents of samples D176391-D176398 were determined in ash by semiquantitative emission spectrography (lower detection limits 10 ppm and 2 ppm, respectively) and converted to a whole-lignite basis (table 4a). The remaining 45 samples were analyzed for cobalt and chromium by instrumental neutron activation analysis (lower detection limit 0.1 ppm). The typical sequence of preparation and analysis of samples by the U.S. Geological Survey is presented in figure 3.

Explanation of statistical terms used in summary tables

In this report the geometric mean (GM) is used as the estimate of the most probable concentration (mode). The GM is calculated by taking the logarithm of each analytical value, summing the logarithms, dividing the sum by the total number of values, and obtaining the antilogarithm of the result. The measure of scatter about the mode used here is the geometric deviation (GD), which is the antilog of the standard deviation of the logarithms of the analytical values. These statistics are used because the quantities of trace elements in natural materials commonly exhibit positively skewed frequency distributions; such distributions are normalized by statistically analyzing and summarizing trace-element data on a logarithmic basis.

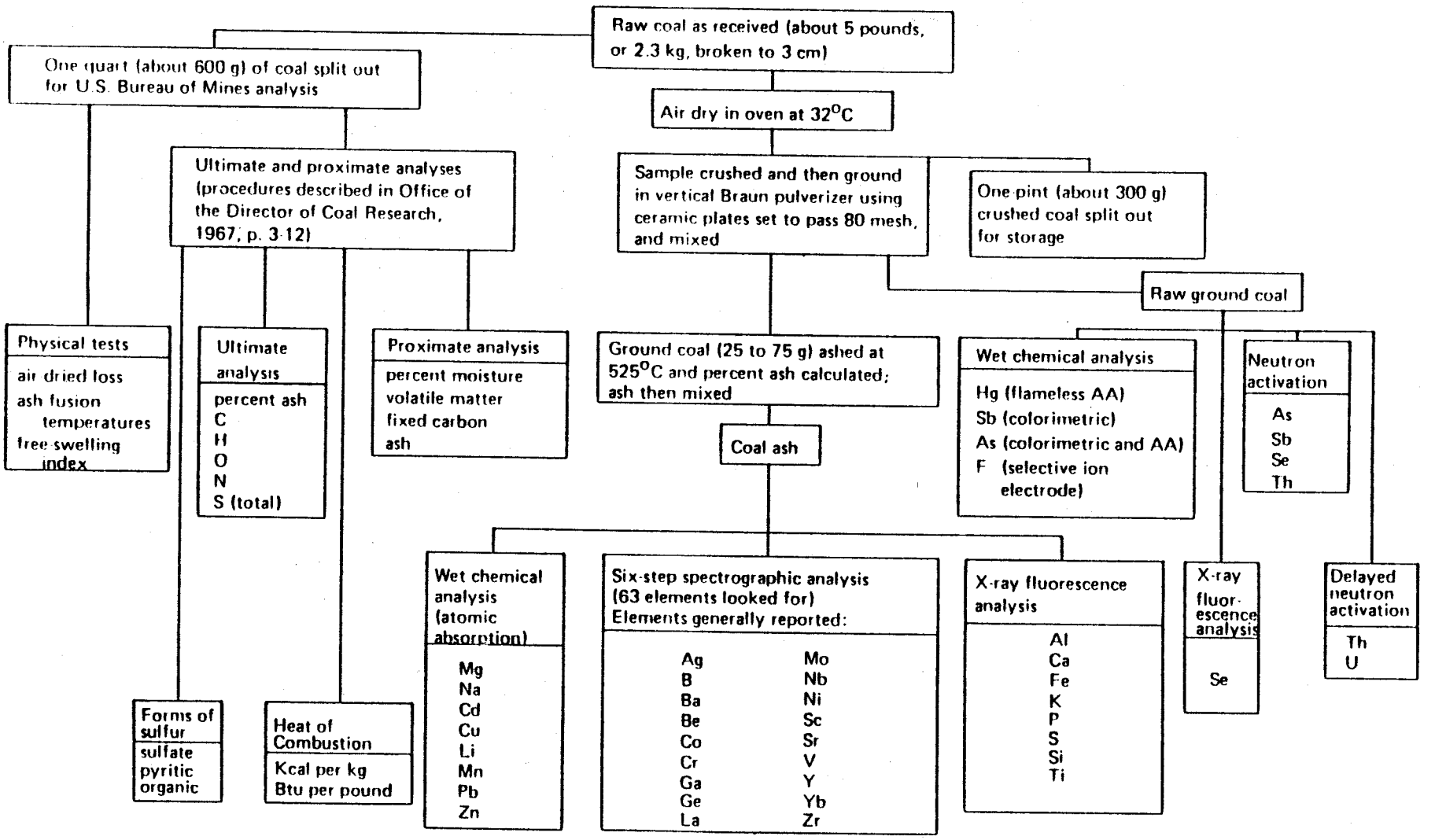

Figure 3.--Flow chart showing sequence of sample preparation and chemical analysis (modified from Swanson and Huffman, 1976).

If the frequency distributions are lognormal, the GM is the best estimate of the mode, and the estimated range of the central two-thirds of the observed distribution has a lower limit equal to GM/GD and an upper limit equal to GM x GD. The estimated range of the central 95 percent of the observed distribution has a lower limit equal to $GM/(GD)^2$ and an upper limit equal to GM x $(GD)^2$ (Connor and others, 1976).

Although the GM is, in general, an adequate estimate of the most common analytical value, it is, neverthless, a biased estimate of the arithmetic mean. The estimates of the arithmetic means listed in the summary tables are Sichel's t statistic (Miesch, 1967).

A common problem in statistical summaries of trace-element data arises when the element content of one or more samples is below the limit of analytical detection. This results in a "censored" distribution. Procedures developed by Cohen (1959) are used to compute biased estimates of the GM, GD, and arithmetic mean when the data are censored.

Discussion

The heats of combustion (moist, mineral-matter free basis) and apparent ranks for the 53 lignite samples from Arkansas were calculated using the data in tables 2a-2b and the formulae in ASTM designation D-388-77 (American Society for Testing and Materials, 1978). The results are summarized below by geologic group.

For 31 lignite samples from the Wilcox Group, heats of combustion range from 4,300 Btu/lb (2,390 kcal/kg) to 8,300 Btu/lb (4,620 kcal/kg). Heats of combustion for 22 lignite samples from the Claiborne Group range from 5,160 Btu/lb (2,870 kcal/kg) to 7,900 Btu/lb (4,390 kcal/kg). The apparent rank for all samples from the Eocene of Arkansas is lignite.

Statistical comparisons, using the "t" and "f" tests (95-percent confidence level) (Miller and Kahn, 1962), of the sample means and variances of the Department of Energy data for the 53 Arkansas lignite samples with 27 lignite samples from the Wilcox Group, central and eastern Texas (Hildebrand and others, 1979), show that the Arkansas samples collectively have significantly higher ash deformation and ash fluid temperatures; significantly higher contents of moisture, ash, hydrogen, and oxygen; significantly lower contents of volatile matter, fixed carbon, carbon, nitrogen, total sulfur, and organic sulfur; and significantly lower heat content. Ash softening temperatures and contents of sulfate and pyritic sulfur are not significantly different.

Statistical comparisons of the sample means and variances of ash and contents of nine major and minor oxides in the ash for the 53 Akansas lignite samples with 39 lignite samples from the Wilcox Group, central and eastern Texas (Hildebrand and others, 1979), show that the Arkansas samples collectively have significantly higher ash content and content of SiO_2 in ash; and significantly lower contents of CaO, MgO, Na_2O, and SO_3 in ash. Contents of Al_2O_3, K_2O, Fe_2O_3, and TiO_2 in ash are not significantly different.

Statistical comparisons of the sample means and variances of 35 elements (whole-lignite basis) for the 53 Arkansas lignite samples with 39 lignite samples from the Wilcox Group, central and eastern Texas (Hildebrand and others, 1979), show that the Arkansas samples collectively have significantly higher contents of Si, Al, K, Fe, Ti, As, Ba, Co, Cr, Cu, F, Ga, Hg, Li, Ni, Pb, Sb, Sc, Sr, Th, U, V, Y, Yb, Zn, and Zr; and significantly lower contents of Ca, B, Mn, and Se. Contents of Mg, Na, Be, Mo, and Nb are not significantly different.

Statistical comparisons of the sample means and variances between 31 lignite samples from the Wilcox Group and 22 lignite samples from the Claiborne Group, southern and eastern Arkansas, show the Wilcox Group samples have significantly higher contents of fixed carbon; significantly higher Na_2O and K_2O contents in ash; significantly higher contents of B, Be, Co, Cu, Ga, Ni, Sb, Sc, and Se; and significantly lower contents of sulfate sulfur. All other values are not significantly different.

Differences in the oxide composition of lignite ash and the element contents of lignite result from differences in the total and relative amounts of the various minerals in the lignite, and the total and relative amounts of organically bound elements. The chemical form and distribution of a given element are dependent on the geologic history of the lignite bed. A partial listing of the geologic factors that influence element distributions includes chemical composition of original plants; amounts and compositions of various detrital, diagenetic, and epigenetic minerals; temperatures and pressures during burial; and extent of weathering.

The trace-element content of the lignite samples from Arkansas, particularly sample D176394, may have been influenced by the contribution of various transition metals in detritus or water-soluble compounds originating from alkaline igneous intrusive source rocks of Cretaceous age in the southeastern part of the Ouachita Mountains uplift. Sample D176394 contains unusually high concentrations of praseodymium and samarium (15 ppm for each element, whole-lignite basis)--rare-earth elements not normally detected in coal--as well as Ag, Ce, Ge, Nd, Y, and Yb. This sample was collected approximately 10 miles southeast of the Cretaceous alkalic igneous Magnet Cove

Complex (Erickson and Blade, 1963). There is a strong possibility that the unusual mineralogy of the rocks at Magnet Cove and similar igneous intrusive bodies have contributed significantly to the trace-element content of lignite samples from Pulaski, Saline, Grant, and Hot Spring Counties. Other geologic factors affecting the trace-element content of lignite from Arkansas have not been evaluated.

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APPENDIX
Tables 1 - 12

Table 1.--U.S. Geological Survey sample numbers, locations, field or drill hole numbers, and sample thickness or depth interval represented for 53 lignite samples from the Eocene of southern and eastern Arkansas

[D176396-D176398 are channel samples from surface exposures; all others represent core samples]

USGS sample number	Location				Field or drill hole number	Sample thickness or depth interval represented (feet)
	Section	Township	Range	County		
			Wilcox Group			
D186852	28	13 N.	4 E.	Craighead	62	78.5- 80.0
D186854	21	14 N.	3 E.	---do----	68	181.0-183.0
D186855	21	14 N.	3 E.	---do----	68	202.0-204.0
D176391	2	1 S.	12 W	Pulaski	2-AR	29.0- 33.0
D176396	10	2 S.	13 W.	Saline	12-AR	1.5
D176397	34	1 S.	14 W.	---do----	13-AR	3.0
D176398	8	3 S.	14 W.	---do----	14-AR	5.9+
D176392	26	3 S.	15 W.	Grant	4-AR	40.0- 44.0
D176394	36	4 S.	17 W.	Hot Spring	5-AR	58.0- 60.5
D211822	10	8 S.	15 W.	Dallas	543	20.2- 29.9
D211823	36	9 S.	17 W.	---do----	587	97.0- 98.6
D176393	27	8 S.	18 W.	Clark	8-AR	19.0- 23.0
D176395	20	9 S.	18 W.	---do----	9-AR	20.5- 25.5
D197025	25	9 S.	19 W.	---do----	286	26.5- 34.6
D197023	29	9 S.	18 W.	---do----	276	63.0- 66.5
D197022	25	9 S.	19 W.	---do----	275	58.0- 61.3
D197024	36	9 S.	19 W.	---do----	285	34.3- 37.0
D199369	13	10 S.	19 W.	---do----	297	50.8- 55.3
D199370	13	10 S.	19 W.	---do----	298	18.5- 20.3
D199371	13	10 S.	19 W.	---do----	298	20.3- 22.3
D197021	6	10 S.	19 W.	---do----	269	24.4- 27.4
D197020	1	10 S.	20 W.	---do----	266	32.0- 34.5
D205165	17	13 S.	22 W.	Nevada	317	58.0- 62.9
D205166	11	13 S.	23 W.	---do----	320	35.0- 38.3
D205163	33	13 S.	23 W.	Hempstead	304	34.2- 36.7
D205164	29	13 S.	23 W.	---do----	305	20.0- 23.8
D197015	32	13 S.	24 W.	---do----	245	37.8- 40.3
D197016	32	13 S.	24 W.	---do----	245	71.3- 73.1
D197017	32	13 S.	24 W.	---do----	245	79.3- 81.4
D197018	25	13 S.	25 W.	---do----	249	22.0- 26.0
D197019	3	14 S.	25 W.	---do----	252	77.4- 81.2

Table 1.--U.S. Geological Survey sample numbers, locations, field or drill hole numbers, and sample thickness or depth intervals represented for 53 lignite samples from the Eocene of southern and eastern Arkansas--continued

USGS sample number	Location				Field or drill hole number	Sample thickness or depth interval represented (feet)
	Section	Township	Range	County		
			Claiborne Group			
D186853	9	11 N.	4 E.	Poinsett	27	64.5- 66.8
D186850	18	11 N.	4 E.	---do----	24	80.0- 88.5
D186848	18	11 N.	4 E.	---do----	3	70.0- 82.0
D186849	18	11 N.	4 E.	---do----	31	140.0-148.0
D186851	31	11 N.	4 E.	---do----	35	73.0- 81.2
D211820	3	5 S.	14 W.	Grant	608	18.8- 21.2
D205170	31	10 S.	12 W.	Dallas	398	44.1- 47.8
D205173	36	10 S.	13 W.	---do----	489	10.5- 12.9
D205169	6	10 S.	11 W.	Cleveland	390	38.0- 40.0
D211821	3	9 S.	13 W.	---do----	527	16.5- 19.0
D205172	20	12 S.	13 W.	Calhoun	473	24.0- 28.2
D205171	6	13 S.	13 W.	---do----	431	43.0- 49.7
D211819	15	13 S.	13 W.	---do----	453	140.0-142.0
D211816	19	13 S.	13 W.	---do----	433	87.7- 93.6
D211818	3	14 S.	13 W.	---do----	441	94.2- 99.8
D211817	4	14 S.	13 W.	---do----	440	51.0- 53.7
D211815	4	14 S.	14 W.	---do----	410	30.0- 31.6
D205167	32	13 S.	18 W.	Ouachita	342	50.0- 52.6
D205168	32	14 S.	19 W.	---do----	361	59.6- 62.2
D197012	26	17 S.	18 W.	Union	187	76.8- 80.0
D197013	36	17 S.	18 W.	---do----	188	28.0- 31.0
D197014	22	19 S.	27 W.	Miller	226a	101.2-107.7

Table 2a.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 31 lignite samples from the Wilcox Group, southern and eastern Arkansas *

[All analyses except kcal/kg, Btu/lb, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; third, moisture and ash free. Kcal/kg = 0.556 x (Btu/lb); °F = (°C x 1.8) + 32. L means less than the value shown; B, not determined]

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D186852	41.6	17.8	13.6	27.0	6.3	20.4	0.3	45.5	0.5	1,890	3,400
	--	30.5	23.3	46.2	2.9	34.9	.5	14.6	.9	3,230	5,820
	--	56.7	43.3	---	5.3	65.0	1.0	27.1	1.6	6,020	10,830
D186854	36.3	20.0	13.3	30.4	5.9	22.9	.4	40.1	.3	2,170	3,910
	--	31.4	20.9	47.7	2.9	35.9	.6	12.3	.5	3,410	6,140
	--	60.1	39.9	---	5.6	68.8	1.2	23.5	.9	6,520	11,740
D186855	40.1	20.1	19.3	20.5	6.5	27.5	.4	44.1	1.0	2,550	4,590
	--	33.6	32.2	34.2	3.4	45.9	.7	14.1	1.7	4,260	7,660
	--	51.0	49.0	---	5.2	69.8	1.0	21.5	2.5	6,470	11,650
D176391	35.5	25.8	14.1	24.6	6.4	26.6	.4	41.5	.5	2,560	4,600
	--	40.0	21.9	38.1	3.8	41.2	.6	15.4	.8	3,960	7,130
	--	64.7	35.3	---	6.2	66.7	1.0	24.9	1.3	6,400	11,530
D176396	55.0	21.4	15.6	8.0	8.0	24.9	.4	58.1	.6	2,240	4,030
	--	47.6	34.7	17.8	4.2	55.3	.9	20.5	1.3	4,980	8,960
	--	57.8	42.2	---	5.1	67.3	1.1	24.9	1.6	6,050	10,890
D176397	43.6	18.1	14.2	24.1	6.7	21.6	.3	46.8	.5	2,010	3,610
	--	32.1	25.2	42.7	3.3	38.3	.5	14.3	.9	3,560	6,400
	--	56.0	44.0	---	5.7	66.9	.9	24.9	1.5	6,210	11,180
D176398	57.0	22.9	12.0	8.1	8.2	23.2	.4	59.9	.2	2,180	3,920
	--	53.3	27.9	18.8	4.3	54.0	.9	21.5	.5	5,060	9,120
	--	65.6	34.4	---	5.3	66.5	1.1	26.5	.6	6,240	11,230
D176392	39.7	19.8	12.4	28.1	6.2	21.8	.4	43.1	.4	2,030	3,660
	--	32.8	20.6	46.6	3.0	36.2	.7	13.0	.7	3,370	6,070
	--	61.5	38.5	---	5.6	67.7	1.2	24.3	1.2	6,310	11,370
D176393	42.0	28.8	25.4	3.8	7.6	38.4	0.5	48.7	1.0	3,630	6,530
	--	49.7	43.8	6.6	5.1	66.2	.9	19.6	1.7	6,250	11,260
	--	53.1	46.9	---	5.4	70.8	.9	21.0	1.8	6,690	12,050
D211822	37.2	22.6	10.6	29.6	B	B	B	B	.5	2,290	4,120
	--	36.0	16.9	47.1	B	B	B	B	.8	3,650	6,560
	--	68.1	31.9	---	B	B	B	B	1.5	6,900	12,420
D211823	39.0	23.7	16.0	21.3	7.1	28.1	.5	42.2	.7	2,770	4,980
	--	38.9	26.2	34.9	4.5	46.1	.8	12.3	1.1	4,540	8,170
	--	59.7	40.3	---	7.0	70.8	1.3	19.0	1.8	6,970	12,550

*Proximate and ultimate analysis performed by the Department of Energy, and adjusted by U.S. Geological Survey computer to total 100%.

Table 2a.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Air-dried loss	Forms of sulfur			Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic	Initial deformation	Softening	Fluid
DI86852	B	0.03	0.14	0.38	1,415	1,445	1,470
	---	.05	.24	.65			
	---	.10	.45	1.21			
DI86854	B	.01	.04	.20	1,320	1,350	1,515
	---	.02	.06	.31			
	---	.03	.12	.60			
DI86855	B	.09	.45	.46	1,230	1,260	1,290
	---	.15	.75	.77			
	---	.23	1.14	1.17			
DI76391	B	B	B	B	1,600+	1,600+	1,600+
	---	B	B	B			
	---	B	B	B			
DI76396	B	B	B	B	1,600+	1,600+	1,600+
	---	B	B	B			
	---	B	B	B			
DI76397	B	B	B	B	1,600+	1,600+	1,600+
	---	B	B	B			
	---	B	B	B			
DI76398	B	B	B	B	1,600+	1,600+	1,600+
	---	B	B	B			
	---	B	B	B			
DI76392	B	B	B	B	1,600+	1,600+	1,600+
	---	B	B	B			
	---	B	B	B			
DI76393	B	B	B	B	1,145	1,170	1,200
	---	B	B	B			
	---	B	B	B			
DI11822	32.6	.01	.11	.38	1,475	1,540+	1,540+
	---	.02	.18	.61			
	---	.03	.33	1.14			
DI11823	32.0	.01	.66	.02	1,315	1,375	1,420
	---	.02	1.08	.03			
	---	.03	1.66	.05			

Table 2a.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D176394	39.1	25.7	16.1	19.1	7.0	29.4	.3	43.5	.7	2,920	5,260
	--	42.2	26.4	31.4	4.4	48.3	.5	14.4	1.1	4,800	8,640
	--	61.5	38.5	--	6.4	70.3	.7	20.9	1.7	6,990	12,580
D176395	40.8	28.6	23.3	7.3	7.2	37.2	.5	47.5	.3	3,480	6,260
	--	48.3	39.4	12.3	4.5	62.8	.8	19.0	.5	5,870	10,570
	--	55.1	44.9	---	5.1	71.7	1.0	21.6	.6	6,700	12,060
D197025	35.2	28.8	25.9	10.1	6.8	39.6	.6	42.4	.6	3,820	6,870
	--	44.4	40.0	15.6	4.5	61.1	.9	17.1	.9	5,890	10,610
	--	52.7	47.3	---	5.3	72.4	1.1	20.3	1.1	6,980	12,560
D197023	38.6	24.2	20.6	16.6	6.6	32.3	.6	43.4	.4	3,130	5,640
	--	39.4	33.6	27.0	3.8	52.6	1.0	14.8	.7	5,100	9,180
	--	54.0	46.0	--	5.2	72.1	1.3	20.3	.9	6,990	12,580
D197022	38.3	22.3	20.1	19.3	6.5	31.0	.6	42.5	.2	2,940	5,300
	--	36.1	32.6	31.3	3.6	50.2	1.0	13.7	.3	4,770	8,590
	--	52.6	47.4	--	5.3	73.1	1.4	19.9	.5	6,940	12,500
D197024	41.7	26.3	23.4	8.6	7.3	35.6	.7	47.3	.6	3,470	6,250
	--	45.1	40.1	14.8	4.6	61.1	1.2	17.6	1.0	5,950	10,710
	--	52.9	47.1	---	5.4	71.6	1.4	20.6	1.2	6,980	12,570
D199369	42.4	24.1	22.9	10.6	7.1	33.4	.6	47.7	.7	3,200	5,760
	--	41.8	39.8	18.4	4.1	58.0	1.0	17.4	1.2	5,550	10,000
	--	51.3	48.7	--	5.1	71.1	1.3	21.3	1.5	6,810	12,250
D199370	46.2	24.1	22.1	7.6	7.5	33.3	.6	50.5	.5	3,170	5,700
	--	44.8	41.1	14.1	4.4	61.9	1.1	17.5	.9	5,890	10,600
	--	52.2	47.8	--	5.1	72.1	1.3	20.4	1.1	6,860	12,340
D199371	35.4	20.6	15.7	28.3	5.9	26.4	.5	38.6	.3	2,520	4,540
	--	31.9	24.3	43.8	3.0	40.9	.8	11.0	.5	3,910	7,030
	--	56.7	43.3	---	5.4	72.7	1.4	19.7	.8	6,950	12,510
D197021	40.7	26.8	22.9	9.6	7.3	35.5	.7	46.5	.5	3,450	6,210
	--	45.2	38.6	16.2	4.7	59.9	1.2	17.4	.8	5,810	10,460
	--	53.9	46.1	---	5.6	71.4	1.4	20.8	1.0	6,940	12,480
D197020	40.1	21.7	24.4	13.8	7.2	33.9	.6	44.2	.4	3,290	5,920
	--	36.2	40.7	23.0	4.6	56.6	1.0	14.3	.7	5,490	9,870
	--	47.1	52.9	--	6.0	73.5	1.3	18.6	.9	7,130	12,830
D205165	33.0	25.0	23.4	18.6	5.8	34.1	.6	40.4	.5	3,300	5,930
	--	37.3	34.9	27.8	3.2	50.9	.9	16.5	.7	4,920	8,860
	--	51.7	48.3	---	4.4	70.5	1.2	22.9	1.0	6,810	12,260

Table 2a.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Air-dried loss	Forms of sulfur			Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic	Initial deformation	Softening	Fluid
D176394	B	B	B	B	1,600+	1,600+	1,600+
	--	B	B	B			
	---	B	B	B			
D176395	B	B	B	B	1,140	1,165	1,195
	--	B	B	B			
	---	B	B	B			
D197025	9.0	.01	.09	.45	1,140	1,155	1,170
	--	.02	.14	.69			
	---	.02	.16	.82			
D197023	29.0	.01L	.17	.26	1,470	1,525	1,600+
	--	.01L	.28	.42			
	---	.01L	.38	.58			
D197022	25.0	.01	.01	.17	1,400	1,425	1,455
	--	.02	.02	.28			
	--	.02	.02	.40			
D197024	28.0	.01L	.09	.49	1,170	1,180	1,200
	--	.01L	.15	.84			
	--	.01L	.18	.99			
D199369	32.8	.01	.32	.37	1,330	1,360	1,525
	--	.02	.56	.64			
	--	.02	.68	.79			
D199370	33.2	.01	.10	.37	1,125	1,155	1,180
	--	.02	.19	.69			
	---	.02	.22	.80			
D199371	29.3	.02	.02	.32	1,415	1,445	1,560
	--	.03	.03	.50			
	--	.06	.06	.88			
D197021	35.0	.02	.02	.45	1,105	1,120	1,140
	--	.03	.03	.76			
	--	.04	.04	.91			
D197020	23.0	.01L	.03	.39	1,200	1,220	1,245
	--	.01L	.05	.65			
	--	.01L	.07	.85			
D205165	10.3	.01	.05	.43	1,230	1,260	1,320
	--	.01	.07	.64			
	--	.02	.10	.89			

Table 2a.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D205166	37.3	20.3	19.7	22.7	5.7	27.5	0.5	42.9	0.6	2,600	4,680
	--	32.4	31.4	36.2	2.5	43.9	.8	15.5	1.0	4,140	7,460
	--	50.7	49.2	---	3.9	68.7	1.2	24.4	1.5	6,500	11,690
D205163	40.1	24.8	23.4	11.7	7.0	35.8	.7	44.6	.4	3,400	6,120
	--	41.4	39.1	19.5	4.2	59.8	1.2	15.0	.7	5,680	10,220
	--	51.5	48.5	---	5.3	74.3	1.5	18.6	.8	7,060	12,710
D205164	29.6	30.1	28.5	11.8	6.2	42.1	.9	38.4	.6	4,010	7,220
	--	42.8	40.5	16.8	4.1	59.8	1.3	17.2	.9	5,700	10,250
	--	51.4	48.6	---	5.0	71.8	1.5	20.6	1.0	6,840	12,320
D197015	38.4	21.5	19.5	20.6	6.4	28.5	.5	43.6	.4	2,780	5,000
	--	34.9	31.7	33.4	3.5	46.3	.8	15.4	.6	4,500	8,110
	--	52.4	47.6	---	5.2	69.5	1.2	23.1	1.0	6,770	12,180
D197016	41.3	24.3	19.9	14.5	7.1	31.6	.5	45.8	.4	3,100	5,570
	--	41.4	33.9	24.7	4.3	53.8	.9	15.5	.7	5,270	9,490
	--	55.0	45.0	---	5.7	71.5	1.1	20.6	.9	7,000	12,610
D197017	32.0	21.0	16.7	30.3	5.7	27.7	.5	35.4	.4	2,600	4,680
	--	30.9	24.6	44.6	3.2	40.7	.7	10.2	.6	3,820	6,880
	--	55.7	44.3	---	5.7	73.5	1.3	18.4	1.1	6,900	12,410
D197018	36.6	29.0	26.5	7.9	7.0	40.3	.8	43.5	.5	3,860	6,950
	--	45.7	41.8	12.5	4.6	63.6	1.3	17.3	.8	6,090	10,960
	--	52.3	47.7	---	5.3	72.6	1.4	19.8	.9	6,950	12,520
D197019	36.0	26.9	22.5	14.6	6.7	36.3	.7	41.4	.4	3,460	6,230
	--	42.0	35.2	22.8	4.2	56.7	1.1	14.7	.6	5,410	9,730
	--	54.5	45.5	---	5.5	73.5	1.4	19.0	.8	7,000	12,610

Table 2a.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Air-dried loss	Forms of sulfur			Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic	Initial deformation	Softening	Fluid
D205166	20.3	0.02	0.18	0.44	1,505	1,560	1,600+
	--	.03	.29	.70			
	--	.05	.45	1.10			
D205163	18.6	.01	.03	.32	1,120	1,150	1,260
	--	.02	.05	.53			
	--	.02	.06	.66			
D205164	7.8	.01	.07	.50	1,165	1,195	1,260
	--	.01	.10	.71			
	--	.02	.12	.85			
D197015	26.0	.01L	.06	.34	1,205	1,290	1,500
	--	.01L	.10	.55			
	--	.01L	.15	.83			
D197016	32.0	.01L	.08	.36	1,200	1,230	1,300
	--	.01L	.14	.61			
	--	.01L	.18	.81			
D197017	23.0	.02	.12	.28	1,405	1,470	1,600+
	--	.03	.18	.41			
	--	.05	.32	.74			
D197018	24.0	.01	.03	.43	1,260	1,290	1,345
	--	.02	.05	.68			
	--	.02	.05	.77			
D197019	24.0	.01	.02	.34	1,205	1,230	1,340
	--	.02	.03	.53			
	--	.02	.04	.69			

Table 2b.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 22 lignite samples from the Claiborne Group, southern and eastern Arkansas*

[All analyses except kcal/kg, Btu/lb, and ash-fusion temperatures in percent. For each sample number, the analyses are reported three ways: first, as received; second, moisture free; third, moisture and ash free. Kcal/kg = 0.556 x (Btu/lb); °F = (°C x 1.8) + 32. L means less than the value shown; B, not determined]

	Proximate analysis				Ultimate analysis					Heat of combustion	
Sample number	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D186853	44.2	25.9	18.0	11.9	7.4	29.5	0.4	47.8	3.0	2,870	5,160
	--	46.4	32.3	21.3	4.5	52.9	.7	15.3	5.4	5,140	9,250
	--	59.0	41.0	--	5.7	67.2	.9	19.4	6.8	6,530	11,750
D186850	43.7	21.8	15.6	18.9	7.0	24.9	.5	48.2	.5	2,370	4,260
	--	38.7	27.7	33.6	3.8	44.2	.9	16.6	.9	4,200	7,570
	--	58.3	41.7	--	5.7	66.6	1.3	25.0	1.3	6,330	11,390
D186848	41.8	26.2	14.4	17.6	7.1	29.0	.4	45.6	.3	2,810	5,060
	--	45.0	24.7	30.2	4.2	49.8	.7	14.5	.5	4,830	8,690
	--	64.5	35.5	--	6.0	71.4	1.0	20.8	.7	6,920	12,460
D186849	34.7	26.2	13.3	25.8	6.5	27.3	.4	39.7	.3	2,680	4,830
	--	40.1	20.4	39.5	4.0	41.8	.6	13.6	.5	4,110	7,400
	--	66.3	33.7	--	6.7	69.1	1.0	22.4	.8	6,790	12,230
D186851	36.8	21.7	13.3	28.2	5.8	23.1	.6	41.9	.4	2,080	3,740
	--	34.3	21.0	44.6	2.7	36.6	.9	14.5	.6	3,290	5,920
	--	62.0	38.0	--	4.9	66.0	1.7	26.3	1.1	5,940	10,690
D211820	46.9	19.0	16.8	17.3	7.2	24.2	.4	49.5	1.3	2,320	4,170
	--	35.8	31.6	32.6	3.7	45.6	.8	14.7	2.4	4,360	7,850
	--	53.1	46.9	---	5.6	67.6	1.1	21.8	3.6	6,470	11,650
D205170	37.7	29.2	15.0	18.1	7.1	31.0	.5	42.8	.4	3,210	5,790
	--	46.9	24.1	29.1	4.7	49.8	.8	14.9	.6	5,160	9,290
	--	66.1	33.9	---	6.6	70.1	1.1	21.0	.9	7,270	13,090
D205173	38.3	23.3	16.3	22.1	6.6	28.0	.6	42.1	.7	2,750	4,950
	--	37.8	26.4	35.8	3.8	45.4	1.0	13.1	1.1	4,450	8,010
	--	58.8	41.2	---	5.9	70.7	1.5	20.3	1.8	6,940	12,490
D205169	31.5	29.8	2 .6	18.1	6.4	36.0	.8	38.2	.5	3,470	6,250
	--	43.5	30.1	26.4	4.2	52.6	1.2	14.9	.7	5,070	9,130
	--	59.1	40.9	---	5.8	71.4	1.6	20.2	1.0	6,890	12,410
D211821	45.8	27.2	20.1	6.9	8.1	34.5	.6	49.5	.4	3,380	6,080
	--	50.2	37.1	12.7	5.6	63.7	1.1	16.2	.7	6,230	11,210
	--	57.5	42.5	--	6.4	72.9	1.3	18.6	.8	7,140	12,850
D205172	41.6	25.7	18.2	14.5	7.0	31.1	.6	46.1	.7	3,070	5,520
	--	44.0	31.2	24.8	4.1	53.3	1.0	15.6	1.2	5,250	9,450
	--	58.5	41.5	--	5.4	70.8	1.4	20.8	1.6	6,990	12,570

*Proximate and ultimate analysis performed by the Department of Energy, and adjusted by U.S. Geological Survey computer to total 100%.

Table 2b.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	Air-dried loss	Forms of sulfur			Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic	Initial deformation	Softening	Fluid
D186853	B	0.50	1.44	1.06	1,090	1,115	1,145
	--	.90	2.58	1.90			
	--	1.14	3.28	2.41			
D186850	B	.01L	.08	.47	1,295	1,320	1,390
	--	.01L	.14	.83			
	---	.01L	.21	1.26			
D186848	B	.01	.02	.30	1,320	1,350	1,410
	--	.02	.03	.52			
	---	.02	.05	.74			
D186849	B	.01	.01	.32	1,295	1,320	1,390
	--	.02	.02	.49			
	---	.03	.03	.81			
D186851	B	.01	.01	.37	1,445	1,470	1,500
	--	.02	.02	.59			
	---	.03	.03	1.06			
D211820	42.9	.01	.31	.97	1,450	1,510	1,600+
	--	.02	.58	1.83			
	--	.03	.87	2.71			
D205170	19.0	.01	.02	.41	1,230	1,260	1,370
	--	.02	.03	.66			
	--	.02	.05	.93			
D205173	19.3	.02	.07	.58	1,220	1,250	1,405
	--	.03	.11	.94			
	--	.05	.18	1.46			
D205169	9.7	.01L	.13	.40	1,220	1,275	1,310
	--	.01L	.19	.58			
	--	.01L	.26	.79			
D211821	40.6	.01L	.05	.32	1,120	1,190	1,230
	--	.01L	.09	.59			
	--	.01L	.11	.68			
D205172	19.9	.02	.20	.52	1,230	1,260	1,375
	--	.03	.34	.89			
	---	.05	.46	1.18			

Table 2b.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	Proximate analysis				Ultimate analysis					Heat of combustion	
	Moisture	Volatile matter	Fixed carbon	Ash	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Kcal/kg	Btu/lb
D205171	43.2	27.9	19.1	9.8	7.5	33.4	0.6	47.7	0.9	3,280	5,900
	--	49.1	33.6	17.3	4.8	58.8	1.1	16.4	1.6	5,770	10,390
	--	59.4	40.6	--	5.7	71.1	1.3	19.8	1.9	6,980	12,560
D211819	33.2	23.3	14.2	29.3	6.0	27.4	.4	36.5	.4	2,680	4,820
	--	34.9	21.3	43.9	3.5	41.0	.6	10.5	.6	4,010	7,220
	--	62.1	37.9	--	6.2	73.1	1.1	18.6	1.1	7,150	12,860
D211816	40.3	26.1	17.6	16.0	7.1	32.1	.5	43.8	.4	3,110	5,600
	--	43.7	29.5	26.8	4.4	53.8	.8	13.4	.7	5,210	9,370
	--	59.7	40.3	--	6.0	73.5	1.1	18.3	.9	7,110	12,800
D211818	35.9	31.1	17.7	15.3	7.2	36.3	.5	40.2	.4	3,650	6,570
	--	48.5	27.6	23.9	5.0	56.6	.8	12.9	.6	5,690	10,240
	--	63.7	36.3	--	6.6	74.4	1.0	17.0	.8	7,470	13,450
D211817	44.5	28.8	17.3	9.4	8.1	33.7	.5	48.0	.3	3,400	6,130
	--	51.9	31.2	16.9	5.7	60.7	.9	15.2	.5	6,130	11,040
	--	62.5	37.5	--	6.8	73.1	1.1	18.3	.7	7,380	13,290
D211815	27.1	23.0	10.2	39.7	5.4	24.6	.4	29.5	.4	2,420	4,360
	--	31.6	14.0	54.5	3.3	33.7	.5	7.4	.5	3,320	5,980
	--	69.3	30.7	--	7.2	74.1	1.2	16.3	1.2	7,300	13,140
D205167	39.9	28.1	20.1	11.9	7.2	35.0	.6	45.0	.3	3,410	6,130
	--	46.8	33.4	19.8	4.6	58.2	1.0	15.9	.5	5,670	10,200
	--	58.3	41.7	--	5.7	72.6	1.2	19.8	.6	7,070	12,720
D205168	41.0	29.0	23.0	7.0	7.5	37.3	.8	47.1	.3	3,640	6,550
	--	49.2	39.0	11.9	5.0	63.2	1.4	18.1	.5	6,170	11,110
	--	55.8	44.2	--	5.7	71.7	1.5	20.5	.6	7,000	12,600
D197012	31.8	22.6	13.0	32.6	5.8	26.4	.4	33.5	1.3	2,600	4,680
	--	33.1	19.1	47.8	3.3	38.7	.6	7.7	1.9	3,810	6,860
	--	63.5	36.5	--	6.4	74.2	1.1	14.7	3.7	7,300	13,150
D197013	38.5	25.8	15.2	20.5	6.9	28.6	.5	43.1	.4	2,860	5,150
	--	42.0	24.7	33.3	4.3	46.5	.8	14.4	.7	4,650	8,380
	--	62.9	37.1	--	6.4	69.8	1.2	21.7	1.0	6,980	12,570
D197014	31.8	20.5	15.9	31.8	5.5	25.2	.5	35.5	1.4	2,410	4,340
	--	30.1	23.3	46.6	2.9	37.0	.7	10.6	2.1	3,530	6,360
	--	56.3	43.7	--	5.4	69.2	1.4	19.9	3.8	6,620	11,910

Table 2b.--Proximate and ultimate analyses, and heat-of-combustion, forms-of-sulfur, and ash-fusion-temperature determinations for 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	Air-dried loss	Forms of sulfur			Ash fusion temperature, °C		
		Sulfate	Pyritic	Organic	Initial deformation	Softening	Fluid
D205171	16.0	0.01	0.19	0.65	1,230	1,255	1,275
	--	.02	.33	1.14			
	--	.02	.40	1.38			
D211819	25.8	.01	.06	.33	1,370	1,430	1,495
	--	.01	.09	.49			
	--	.03	.16	.88			
D211816	28.4	.01	.05	.37	1,200	1,260	1,320
	--	.02	.08	.62			
	--	.02	.11	.85			
D211818	26.7	.01L	.04	.32	1,315	1,380	1,430
	--	.01L	.06	.50			
	--	.01L	.08	.66			
D211817	39.3	.01	.04	.30	1,095	1,155	1,200
	--	.02	.07	.54			
	--	.02	.09	.65			
D211815	21.7	.01	.11	.24	1,470	1,530	1,600+
	--	.01	.15	.33			
	--	.03	.33	.72			
D205167	20.1	.01	.01	.29	1,230	1,260	1,290
	--	.02	.02	.48			
	--	.02	.02	.60			
D205168	24.2	.01	.01	.27	1,165	1,195	1,250
	--	.02	.02	.46			
	--	.02	.02	.52			
D197012	23.0	.01L	.71	.54	1,600+	1,600+	1,600+
	--	.01L	1.01	.79			
	--	.01L	1.99	1.52			
D197013	32.0	.10	.02	.33	1,490	1,600+	1,600+
	--	.16	.03	.54			
	--	.24	.05	.80			
D197014	19.0	.11	.74	.56	1,415	1,445	1,580
	--	.16	1.09	.82			
	--	.30	2.03	1.54			

Table 3a.--Major- and minor-oxide and trace-element composition of the laboratory ash of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas

[Lignite ashed at 525°C. L means less than the value shown; N, not detected; B, not determined. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 0.56, 0.83, 1.2, etc., but are reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc.; precision of the spectrographic data is plus-or-minus one bracket at 68-percent or plus-or-minus two brackets at 95-percent confidence level]

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D186852	45.5	66	18	4.6	1.04	0.10	0.72	4.0	0.87	1.0L	D186852
D186854	45.5	72	13	4.4	.97	.29	1.2	2.2	1.6	1.0L	D186854
D186855	33.9	66	7.8	5.5	1.07	.40	.92	6.3	.87	1.0L	D186855
D176391	34.7	49	32	2.2	.50	.11	.33	3.4	2.2	1.0L	D176391
D176396	23.5	56	29	.53	.37	.10L	.36	6.8	1.9	1.0L	D176396
D176397	41.3	54	24	3.2	1.05	.18	1.3	4.1	.91	1.0L	D176397
D176398	18.4	66	19	.48	.12	.10L	.21	4.6	2.5	1.0L	D176398
D176392	45.0	74	13	1.1	.48	.09	.64	2.8	1.4	1.0L	D176392
D176394	5.2	20	17	19	1.86	.34	.28	3.8	.99	1.0L	D176394
D211822	46.8	56	25	3.4	1.19	.20	.38	2.4	2.2	.090	D211822
D211823	45.9	49	23	4.8	1.04	.22	.76	6.9	1.2	.040	D211823
D176393	30.2	70	11	.31	.12	.14	.36	1.5	4.2	1.0L	D176393
D176395	11.3	41	11	17	4.06	.34	1.0	6.9	.91	1.0L	D176395
D197025	16.4	45	16	13	1.83	.45	.80	3.6	1.0	.060	D197025
D197023	24.5	73	5.9	7.2	.98	.43	.80	2.6	.70	.040L	D197023
D197022	27.9	80	9.2	5.1	1.01	.23	.90	2.6	1.0	.040L	D197022
D197024	13.8	34	17	15	1.87	.56	.40	3.5	1.0	.070L	D197024
D199369	17.2	47	24	4.1	1.10	.24	.80	6.9	1.2	.060L	D199369
D199370	13.1	51	11	11	2.55	.39	.70	7.6	1.0	.080L	D199370
D199371	41.4	81	11	2.8	.78	.19	.60	1.2	1.2	.020L	D199371
D197021	14.6	40	16	12	3.18	1.03	.50	5.8	.60	.070L	D197021
D197020	20.8	53	20	7.2	2.30	.68	.50	2.1	1.2	.050	D197020
D205165	26.4	62	16	3.5	1.10	.26	.70	9.7	1.6	.040L	D205165
D205166	37.2	58	25	2.5	1.33	.22	1.3	4.2	1.4	.030L	D205166
D205163	18.3	60	11	7.1	1.34	.24	.50	10	1.5	.050L	D205163
D205164	15.9	47	16	9.5	1.99	.20	1.0	9.2	1.6	.060L	D205164
D197015	30.7	70	12	3.4	1.28	.26	1.3	4.5	.80	.10	D197015
D197016	23.9	57	16	7.5	1.78	.32	1.4	3.9	.90	.040L	D197016
D197017	42.7	79	10	3.5	.86	.21	.90	1.2	1.2	.050	D197017
D197018	11.5	41	19	11	3.70	1.27	.40	4.4	.90	.090L	D197018
D197019	21.0	48	19	9.4	1.83	.55	.50	2.1	1.2	.050L	D197019

Table 3a.--Major- and minor-oxide and trace-element composition of the laboratory ash of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	SO3 (percent)	Ag-S (ppm)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Ce-S (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	Sample number
D186852	4.1	N	100	2,000	7	2.0	500L	104	20	30	D186852
D186854	2.4	N	150	700	7	1.0L	500L	87	30	N	D186854
D186855	7.6	N	300	700	15	1.0L	N	154	15	50	D186855
D176391	3.1	N	200	700	50	1.0	700	104	70	30	D176391
D176396	1.6	N	200	300	3	9.0	N	159	70	N	D176396
D176397	3.7	N	300	700	15	2.0	500L	206	70	30	D176397
D176398	2.1	N	50L	1,000	3	9.5	500L	126	30	N	D176398
D176392	1.2	N	150	500	7	1.0L	500L	29	30	N	D176392
D176394	22	3	2,000	1,000	70	14.0	700	387	B	700	D176394
D211822	B	1L	100	300	3L	5.0	500L	141	70	N	D211822
D211823	B	N	150	300	3L	2.0	N	54	30	N	D211823
D176393	.62	N	150	300	7	2.0	700	96	50	20L	D176393
D176395	11	N	2,000	2,000	15	1.0L	N	118	30	30	D176395
D197025	11	N	2,000	700	7	1.0L	N	166	50	N	D197025
D197023	6.0	N	1,500	700	10	1.0L	N	41	15	N	D197023
D197022	3,8	N	1,500	1,000	10	1.0L	N	51	30	N	D197022
D197024	14	N	2,000	700	15	1.0L	N	255	70	30	D197024
D199369	7.8	N	700	1,000	7	1.0L	N	317	70	20	D199369
D199370	14	N	1,500	1,000	7	1.0	N	224	50	20L	D199370
D199371	2.2	N	300	500	5	1.0L	N	118	30	N	D199371
D197021	13	N	3,000	300	30	1.0L	N	154	70	50	D197021
D197020	7.3	N	1,500	1,500	15	1.0L	N	107	50	20L	D197020
D205165	4.0	N	500	1,000	7	1.0L	N	131	30	N	D205165
D205166	1.8	N	300	700	7	1.5	N	167	50	N	D205166
D205163	7.3	N	700	1,000	15	1.0L	N	179	30	30	D205163
D205164	8.8	N	700	1,500	7	1.0L	N	233	30	20L	D205164
D197015	6.3	N	300	1,500	15	1.0L	N	101	30	30	D197015
D197016	7.0	N	700	1,500	20	1.0L	N	186	50	30	D197016
D197017	3.3	N	500	700	15	1.0L	N	93	50	N	D197017
D197018	13	N	2,000	1,500	15	3.0	N	128	70	30	D197018
D197019	6.0	N	1,000	1,500	5	1.0L	N	142	50	N	D197019

Table 3a.--Major- and minor-oxide and trace-element composition of the laboratory ash of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	Sample number
D186852	N	57	115	15	30	N	20	40	15	500	D186852
D186854	100L	45	130	N	30	N	15	30	20	500	D186854
D186855	100L	38	190	15	30	N	70	35	20	500	D186855
D176391	300	159	575	30	200	200	150	50	15	700	D176391
D176396	100L	39	50	15	50	N	70	80	30	150	D176396
D176397	200	131	260	20	100	150	50	40	30	700	D176397
D176398	200	34	40	7	50	150	100	160	30	1,500	D176398
D176392	100	90	135	7	50	150	30	25	15	200	D176392
D176394	300	29	1,330	70	30	700	500	90	70	700	D176394
D211822	100L	121	306	7L	30	150L	30	95	30	500	D211822
D211823	100L	69	468	N	20L	N	30	65	15	700	D211823
D176393	300	42	75	7	70	300	50	50	30	200	D176393
D176395	100L	42	890	10	30	N	150	50	30	1,500	D176395
D197025	100L	71	750	10	20	N	70	45	50	2,000	D197025
D197023	N	25	185	N	20	B	30	25L	15	1,500	D197023
D197022	N	38	430	N	20	B	30	25L	20	1,500	D197022
D197024	N	77	560	15	20	B	70	45	30	3,000	D197024
D199369	N	67	145	15	20L	B	150	40	50	1,000	D199369
D199370	N	46	390	10	20L	B	200	50	30	2,000	D199370
D199371	N	49	94	N	20L	B	20	35	15	500	D199371
D197021	N	58	960	15	30	B	100	45	30	1,500	D197021
D197020	N	75	750	7	30	B	70	45	30	1,500	D197020
D205165	100L	48	482	10	20	N	70	108	30	700	D205165
D205166	100L	136	188	7	20L	N	200	84	30	500	D205166
D205163	100L	39	549	7	30	N	50	62	50	1,000	D205163
D205164	100L	44	881	15	30	N	300	83	50	1,000	D205164
D197015	N	47	400	7	20	B	30	60	30	1,000	D197015
D197016	N	69	295	7	20	B	50	60	50	2,000	D197016
D197017	N	45	130	7	20	B	70	30	30	1,000	D197017
D197018	100L	57	870	7	20L	N	100	135	30	1,500	D197018
D197019	100L	97	650	7	20	N	15	30	20	2,000	D197019

Table 3a.--Major- and minor-oxide and trace-element composition of the laboratory ash of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
DI86852	150	70	7	230	150
DI86854	150	70	7	64	150
DI86855	150	70	7	115	200
DI76391	150	150	10	580	700
DI76396	300	50	7	111	300
DI76397	150	70	7	98	300
DI76398	150	150	10	79	300
DI76392	150	70	7	50	300
DI76394	500	700	70	500	150
D211822	300	50	7	95	200
D211823	150	30	3	51	150
DI76393	150	150	15	124	500
DI76395	150	70	7	264	150
DI97025	200	70	7	170	150
DI97023	70	30	3	19	200
DI97022	100	50	7	13	300
DI97024	200	70	7	28	150
DI99369	300	50	5	51	150
DI99370	150	70	7	46	150
DI99371	100	30	3	27	300
DI97021	150	150	10	71	150
DI97020	150	100	7	37	200
D205165	150	70	7	42	200
D205166	200	50	5	168	150
D205163	150	100	10	35	300
D205164	300	100	10	73	200
DI97015	150	70	5	75	200
DI97016	200	100	7	43	150
DI97017	150	70	7	56	200
DI97018	200	100	7	70	150
DI97019	150	30	3	33	150

Table 3b.--Major- and minor-oxide and trace-element composition of the laboratory ash of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas

[Lignite ashed at 525°C. L means less than the value shown; N, not detected; B, not determined. S after element title indicates determinations by semiquantitative emission spectrography. The spectrographic results are to be identified with geometric brackets whose boundaries are part of the ascending series 0.12, 0.18, 0.26, 0.38, 0.56, 0.83, 1.2, etc., but are reported as midpoints of the brackets, 0.1, 0.15, 0.2, 0.3, 0.5, 0.7, 1.0, etc.; precision of the spectrographic data is plus-or-minus one bracket at 68-percent or plus-or-minus two brackets at 95-percent confidence level]

Sample number	Ash (percent)	SiO2 (percent)	Al2O3 (percent)	CaO (percent)	MgO (percent)	Na2O (percent)	K2O (percent)	Fe2O3 (percent)	TiO2 (percent)	P2O5 (percent)	Sample number
D186853	21.5	32	11	10	1.44	0.13	0.69	27	1.3	1.0L	D186853
D186850	33.0	53	22	8.3	1.51	.13	.82	4.8	1.0	1.0L	D186850
D186848	28.2	66	14	11	1.44	.16	.75	3.1	1.3	1.0L	D186848
D186849	39.2	69	15	5.8	1.20	.11	.58	2.5	1.4	1.0L	D186849
D186851	43.0	62	21	6.1	1.22	.13	.90	3.3	1.2	1.0L	D186851
D211820	31.6	64	18	.60	.68	.26	1.4	5.4	.77	.060	D211820
D205170	30.9	56	23	8.3	1.82	.18	.34	4.2	1.4	.030	D205170
D205173	35.4	66	14	4.5	1.66	.16	.12	1.9	.90	.030L	D205173
D205169	26.1	45	18	9.8	1.64	.20	.46	6.2	1.1	.040L	D205169
D211821	12.3	30	17	20	4.53	1.09	.24	3.0	.97	.080	D211821
D205172	25.8	54	18	8.8	1.58	.24	.66	4.7	1.0	.080	D205172
D205171	18.6	36	19	15	2.16	.26	.12	6.2	1.1	.050L	D205171
D211819	41.3	71	13	2.9	.93	.16	1.1	3.7	1.2	.050	D211819
D211816	21.3	56	14	7.3	1.31	.24	.35	4.6	2.0	.090	D211816
D211818	25.4	62	8.3	9.7	1.68	.31	.29	2.7	1.7	.040	D211818
D211817	16.0	49	9.8	13	1.99	.20	.22	5.6	2.0	.060L	D211817
D211815	52.9	75	12	1.8	.56	.12	.61	2.2	1.5	.040	D211815
D205167	18.8	64	11	5.9	.71	.09	.24	10	1.8	.050L	D205167
D205168	11.3	45	17	9.2	1.16	.11	.24	14	1.8	.44	D205168
D197012	44.3	88	4.2	3.0	.65	.09	.20	3.7	.60	.020	D197012
D197013	31.9	63	15	2.7	.67	.10	.40	.60	1.2	.030L	D197013
D197014	44.6	73	8.5	2.6	.62	.10	.50	4.1	.70	.040	D197014

Table 3b.--Major- and minor-oxide and trace-element composition of the laboratory ash of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	SO3 (percent)	Ag-S (ppm)	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Ce-S (ppm)	Cu (ppm)	Ga-S (ppm)	Ge-S (ppm)	Sample number
D186853	15	2	150	300	10	1.0L	500	79	20	N	D186853
D186850	5.7	N	150	700	7	2.0	500L	104	30	20L	D186850
D186848	4.5	N	200	700	5	1.0L	500L	55	20	N	D186848
D186849	2.7	N	150	300	7	1.0L	500L	62	20	N	D186849
D186851	3.1	N	150	700	N	1.0L	500L	51	30	N	D186851
D211820	B	N	150	500	15	3.0	500	44	30	30	D211820
D205170	2.2	N	300	300	N	1.0L	N	59	70	20L	D205170
D205173	3.0	N	300	1,500	3	1.0L	N	62	30	N	D205173
D205169	1.6	N	500	5,000	3	1.0L	N	34	70	20L	D205169
D211821	B	N	1,000	500	5	3.0	N	57	70	30	D211821
D205172	6.0	N	500	5,000	3	2.0	N	46	30	N	D205172
D205171	7.8	N	700	1,000	5	2.0	N	89	30	20L	D205171
D211819	B	N	100	700	3	2.0	500L	59	20	N	D211819
D211816	B	N	200	700	3L	2.0	500L	120	30	20	D211816
D211818	B	N	200	1,000	5	3.0	500L	62	15	N	D211818
D211817	B	N	200	1,500	3L	2.0	N	108	30	N	D211817
D211815	B	N	70	500	3	2.0	N	49	20	N	D211815
D205167	5.8	N	500	1,000	7	2.6	N	62	30	N	D205167
D205168	7.8	N	500	2,000	7	1.0L	N	100	70	20	D205168
D197012	6.0	N	150	500	5	1.0	N	45	20	70	D197012
D197013	4.3	N	70	1,500	15	2.0	500L	77	50	20L	D197013
D197014	5.3	N	150	500	N	1.0L	N	26	20	N	D197014

Table 3b.--Major- and minor-oxide and trace-element composition of the laboratory ash of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	Pb (ppm)	Sc-S (ppm)	Sr-S (ppm)	Sample number
D186853	150	47	115	7	70	N	70	35	20	200	D186853
D186850	100L	74	230	N	30	150L	30	60	30	500	D186850
D186848	100L	48	535	7	50	150L	20	55	20	700	D186848
D186849	100L	64	110	7	50	150L	15	40	20	150	D186849
D186851	N	68	210	N	30	N	15	30	15	300	D186851
D211820	200	24	87	7L	20	300	100	70	15	150	D211820
D205170	N	62	730	7	30	B	15	43	30	700	D205170
D205173	N	55	307	7	30	B	30	37	15	300	D205173
D205169	100L	63	590	7	50	N	30	57	30	1,500	D205169
D211821	100L	86	1,020	7	30	N	30	85	15	1,000	D211821
D205172	100L	35	318	7	30	N	50	65	30	700	D205172
D205171	100L	65	1,330	15	20	N	50	109	30	1,000	D205171
D211819	100L	23	430	7L	20	150L	20	75	15	700	D211819
D211816	100L	20	990	7L	30	N	30	71	20	1,000	D211816
D211818	100L	18	452	7L	30	N	30	65	20	1,000	D211818
D211817	100L	54	400	7L	30	N	30	70	30	700	D211817
D211815	100L	38	192	N	20	N	20	61	15	300	D211815
D205167	100L	53	970	7	30	N	20	29	30	700	D205167
D205168	100L	102	1,190	7	30	N	30	56	30	1,500	D205168
D197012	100L	10	180	N	N	N	30	30	10L	300	D197012
D197013	100	51	145	7	70	N	200	50	15	700	D197013
D197014	N	88	170	N	20	B	10	55	10L	500	D197014

Table 3b.--Major- and minor-oxide and trace-element composition of the laboratory ash of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Zn (ppm)	Zr-S (ppm)
DI86853	100	70	7	255	200
DI86850	300	70	7	135	150
DI86848	150	70	7	53	300
DI86849	150	70	7	34	300
DI86851	150	30	3	40	150
D211820	150	200	20	373	300
D205170	150	30	3	30	200
D205173	150	30	3	20	150
D205169	150	30	3	30	200
D211821	150	70	5	24	300
D205172	150	50	5	49	300
D205171	200	70	7	96	200
D211819	150	50	5	44	300
D211816	300	50	5	20L	300
D211818	150	70	7	20L	300
D211817	150	30	3	36	300
D211815	150	30	3	26	300
D205167	100	70	7	51	300
D205168	150	70	7	161	200
DI97012	70	30	5	402	150
DI97013	100	70	7	111	300
DI97014	70	20	3	32	300

Table 4a.--Content of nine trace elements in 31 lignite samples from the Wilcox Group, southern and eastern Arkansas

[Analyses on air-dried (32°C) lignite. L, less than the value shown. For samples D176391 - D176398, analysis for Co and Cr is on ash (525°C) by semiquantitative emission spectrometry converted to whole-coal basis]

Sample number	As (ppm)	Co (ppm)	Cr (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D186852	8.0	2.7	39	230	0.39	0.2	2.3	9.2	3.6	D186852
D186854	3.2	.1L	39	120	.23	1.7	4.5	8.5	3.5	D186854
D186855	26	.1L	24	85	.20	1.6	4.7	4.6	3.7	D186855
D176391	12	20	10	135	1.00	1.2	16	28	4.3	D176391
D176396	15	7.0	30	115	.40	1.5	5.0	19	4.9	D176396
D176397	5.0	10	30	250	.42	5.2	14	18	7.2	D176397
D176398	5.0	5.0	15	90	.63	.7	7.4	12	2.6	D176398
D176392	3.0	7.0	30	90	.08	.9	1.8	9.8	2.9	D176392
D176394	5.0	7.0	7.0	25	.06	1.5	4.5	3.0L	1.8	D176394
D211822	7.2	5.1	73	220	.73	2.5	9.0	19	7.2	D211822
D211823	3.4	3.0	37	150	.45	.7	3.2	6.7	2.5	D211823
D176393	4.0	5.0	50	75	.28	1.2	4.1	24	4.0	D176393
D176395	2.0	7.0	7.0	35	.09	.8	5.2	3.0L	.7	D176395
D197025	3.9	4.4	14	40	.19	.9	5.7	2.6	1.0	D197025
D197023	2.6	3.6	12	30	.17	.6	5.0	1.7	.5	D197023
D197022	1.5	6.6	18	55	.14	.7	3.9	2.5	.8	D197022
D197024	5.6	5.4	12	20	.16	1.5	5.7	2.8	1.4	D197024
D199369	3.3	7.2	21	55	.17	1.2	8.7	4.2	2.2	D199369
D199370	2.9	11	11	35	.24	.8	5.9	2.4	1.7	D199370
D199371	2.3	4.3	32	100	.21	1.5	8.1	5.5	3.0	D199371
D197021	3.4	9.7	7.8	30	.22	1.0	4.3	2.2	3.4	D197021
D197020	2.4	7.6	16	50	.45	.8	6.5	5.3	1.9	D197020
D205165	3.0	6.3	27	70	.34	1.2	9.0	4.4	2.3	D205165
D205166	14	20	43	180	.26	2.0	7.2	6.6	4.4	D205166
D205163	2.8	2.9	15	30	.20	.9	7.6	3.3	1.7	D205163
D205164	4.2	20	16	55	.19	1.2	9.1	3.9	2.2	D205164
D197015	4.5	5.7	24	85	.15	1.3	5.2	3.7	1.6	D197015
D197016	4.5	5.0	23	80	.21	1.9	6.9	3.4	1.6	D197016
D197017	8.9	8.8	33	100	.25	2.5	7.3	5.4	2.7	D197017
D197018	1.3	13	.1L	30	.24	.7	2.9	1.9	1.0	D197018
D197019	2.4	2.9	16	45	.40	.8	6.7	4.9	1.8	D197019

Table 4b.--Content of nine trace elements in 22 lignite samples from the Claiborne Group, southern and eastern Arkansas

[Analyses on air-dried (32°C) lignite. L, less than the value shown]

Sample number	As (ppm)	Co (ppm)	Cr (ppm)	F (ppm)	Hg (ppm)	Sb (ppm)	Se (ppm)	Th (ppm)	U (ppm)	Sample number
D186853	15	7.3	16	45	0.51	0.1L	3.8	6.1	2.1	D186853
D186850	4.2	6.7	46	130	.23	.7	1.6	9.1	4.4	D186850
D186848	2.4	4.8	25	50	.25	.6	.1L	9.2	3.7	D186848
D186849	2.3	3.1	37	110	.38	.9	2.7	11	2.5	D186849
D186851	2.0	2.9	40	210	.20	.5	.1L	5.6	2.2	D186851
D211820	6.6	7.1	23	180	.20	.7	2.0	8.3	4.8	D211820
D205170	3.4	1.8	21	160	.14	.8	2.9	6.2	2.8	D205170
D205173	4.0	2.3	18	120	.18	.9	2.8	6.0	3.6	D205173
D205169	1.9	2.4	16	100	.11	.8	2.2	6.7	2.8	D205169
D211821	3.3	2.6	6.0	20	.08	.5	3.1	4.9	2.1	D211821
D205172	5.2	2.3	11	70	.24	.5	2.0	7.8	2.8	D205172
D205171	7.9	2.7	11	50	.52	.8	2.5	6.5	2.7	D205171
D211819	3.0	8.3	36	160	.80	1.0	6.0	9.5	3.6	D211819
D211816	2.7	3.5	25	90	.75	1.1	5.4	7.4	2.9	D211816
D211818	2.5	5.1	16	45	.98	.8	5.8	4.9	1.9	D211818
D211817	2.5	3.5	12	20L	1.00	.7	5.5	5.0	2.1	D211817
D211815	3.8	9.3	75	130	.28	.9	4.9	11	3.6	D211815
D205167	1.5	2.3	12	20	.33	.6	2.4	3.1	1.2	D205167
D205168	1.0	2.4	9.2	20	.18	.3	1.9	2.5	1.0	D205168
D197012	8.5	10	16	25	.55	1.4	4.1	4.1	1.6	D197012
D197013	5.2	7.6	16	60	.54	1.9	5.8	16	5.1	D197013
D197014	4.4	2.4	29	50	.16	.4	1.1	3.3	1.4	D197014

Table 5a.--Major-, minor-, and trace-element composition of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas

[As, Co, Cr, F, Hg, Sb, Se, Th, and U values (unless otherwise noted) are from direct determinations on air-dried (32°C) lignite; all other values calculated from analyses of ash. S means analysis by semiquantitative emission spectroscopy. L, less than the value shown; N, not detected, B, not determined. For samples D176391 - D176398, analysis for Co and Cr is by semiquantitative emission spectroscopy on ash]

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	Ag-S (ppm)	As (ppm)	Sample number
D186852	14	4.3	1.5	0.28	0.034	0.27	1.3	0.24	N	8.0	D186852
D186854	15	3.1	1.4	.27	.098	.45	.70	.44	N	3.2	D186854
D186855	10	1.4	1.3	.22	.10	.26	1.5	.18	N	26	D186855
D176391	7.9	6.0	.55	.10	.028	.095	.83	.45	N	12	D176391
D176396	6.1	3.6	.089	.052	.017L	.070	1.1	.27	N	15	D176396
D176397	10	5.3	.94	.26	.055	.44	1.2	.23	N	5.0	D176397
D176398	5.6	1.8	.063	.013	.014L	.032	.59	.28	N	5.0	D176398
D176392	16	3.1	.35	.13	.030	.24	.89	.38	N	3.0	D176392
D176394	.47	.46	.71	.058	.013	.012	.14	.031	.15	5.0	D176394
D211822	12	6.1	1.1	.34	.069	.15	.79	.61	.5L	7.2	D211822
D211823	11	5.5	1.6	.29	.075	.29	2.2	.33	N	3.4	D211823
D176393	9.9	1.8	.067	.022	.031	.091	.32	.75	N	4.0	D176393
D176395	2.2	.64	1.4	.28	.028	.095	.55	.062	N	2.0	D176395
D197025	3.4	1.4	1.5	.18	.055	.11	.41	.098	N	3.9	D197025
D197023	8.4	.76	1.3	.14	.078	.16	.45	.10	N	2.6	D197023
D197022	10	1.4	1.0	.17	.048	.21	.51	.17	N	1.5	D197022
D197024	2.2	1.2	1.5	.16	.057	.046	.34	.083	N	5.6	D197024
D199369	3.8	2.2	.50	.11	.031	.11	.83	.12	N	3.3	D199369
D199370	3.1	.76	1.0	.20	.038	.076	.70	.078	N	2.9	D199370
D199371	16	2.4	.83	.19	.058	.21	.35	.30	N	2.3	D199371
D197021	2.7	1.2	1.3	.28	.11	.061	.59	.052	N	3.4	D197021
D197020	5.1	2.2	1.1	.29	.10	.087	.31	.15	N	2.4	D197020
D205165	7.6	2.2	.66	.17	.050	.15	1.8	.25	N	3.0	D205165
D205166	10	4.9	.66	.30	.060	.40	1.1	.31	N	14	D205166
D205163	5.1	1.1	.93	.15	.033	.076	1.3	.16	N	2.8	D205163
D205164	3.5	1.3	1.1	.19	.024	.13	1.0	.15	N	4.2	D205164
D197015	10	1.9	.75	.24	.059	.33	.97	.15	N	4.5	D197015
D197016	6.4	2.0	1.3	.26	.057	.28	.65	.13	N	4.5	D197016
D197017	16	2.3	1.1	.22	.066	.32	.36	.31	N	8.9	D197017
D197018	2.2	1.2	.90	.26	.11	.038	.35	.062	N	1.3	D197018
D197019	4.7	2.1	1.4	.23	.086	.087	.31	.15	N	2.4	D197019

Table 5a.--Major-, minor-, and trace-element composition of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Ce-S (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Sample number
DI86852	50	1,000	3	0.91	200L	2.7	39	47	230	10	DI86852
DI86854	70	300	3	.46L	200L	.1L	39	40	120	15	DI86854
DI86855	100	200	5	.34L	N	.1L	24	52	85	5	DI86855
DI76391	70	200	15	.35	200	20	10	36	135	20	DI76391
DI76396	50	70	.7	2.1	N	7.0	30	37	115	15	DI76396
DI76397	150	300	7	.83	200L	10	30	85	250	30	DI76397
DI76398	10L	200	.5	1.7	100L	5.0	15	23	90	5	DI76398
DI76392	70	200	3	.45L	200L	7.0	30	13	90	15	DI76392
DI76394	100	50	3	.73	30	7.0	7.0	20	25	8	DI76394
D211822	50	150	1.5L	2.3	200L	5.1	73	66	220	30	D211822
D211823	70	150	1.5L	.92	N	3.0	37	25	150	15	D211823
DI76393	50	100	2	.60	200	5.0	50	29	75	15	DI76393
DI76395	200	200	1.5	.11L	N	7.0	7.0	13	35	3	DI76395
DI97025	300	100	1	.16L	N	4.4	14	27	40	7	DI97025
DI97023	300	150	2	.25L	N	3.6	12	10	30	3	DI97023
DI97022	500	300	3	.28L	N	6.6	18	14	55	10	DI97022
DI97024	300	100	2	.14L	N	5.4	12	35	20	10	DI97024
DI99369	100	150	1	.17L	N	7.2	21	55	55	10	DI99369
DI99370	200	150	1	.13	N	11	11	29	35	7	DI99370
DI99371	150	200	2	.41L	N	4.3	32	49	100	15	DI99371
DI97021	500	50	5	.15L	N	9.7	7.8	22	30	10	DI97021
DI97020	300	300	3	.21L	N	7.6	16	22	50	10	DI97020
D205165	150	300	2	.26L	N	6.3	27	35	70	7	D205165
D205166	100	200	2	.56	N	20	43	62	180	20	D205166
D205163	150	200	3	.18L	N	2.9	15	33	30	5	D205163
D205164	100	200	1	.16L	N	20	16	37	55	5	D205164
DI97015	100	500	5	.31L	N	5.7	24	31	85	10	DI97015
DI97016	150	300	5	.24L	N	5.0	23	44	80	10	DI97016
DI97017	200	300	7	.43L	N	8.8	33	40	100	20	DI97017
DI97018	200	150	1.5	.35	N	13	.1L	15	30	7	DI97018
DI97019	200	300	1	.21L	N	2.9	16	30	45	10	DI97019

Table 5a.--Major-, minor-, and trace-element composition of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Ge-S (ppm)	Hg (ppm)	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	P (ppm)	Sample number
D186852	15	0.39	N	26	52	7	15	N	10	2,000L	D186852
D186854	N	.23	50L	20	59	N	15	N	7	2,000L	D186854
D186855	15	.20	30L	13	64	5	10	N	20	1,500L	D186855
D176391	10	1.0	100	55	200	10	70	70	50	1,500L	D176391
D176396	N	.40	20L	9.2	12	3	10	N	15	1,000L	D176396
D176397	15	.42	100	54	110	10	50	70	20	1,800L	D176397
D176398	N	.63	30	6.3	7.4	1.5	10	30	20	800L	D176398
D176392	N	.08	50	41	61	3	20	70	15	2,000L	D176392
D176394	30	.06	15	1.5	69	3	1.5	30	20	230L	D176394
D211822	N	.73	50L	57	140	3L	15	70L	15	180	D211822
D211823	N	.45	50L	32	210	N	10L	N	15	80	D211823
D176393	7L	.28	100	13	23	2	20	100	15	1,300L	D176393
D176395	3	.09	10L	4.7	100	1	3	N	15	490L	D176395
D197025	N	.19	15L	12	120	1.5	3	N	10	43	D197025
D197023	N	.17	N	6.1	45	N	5	B	7	43L	D197023
D197022	N	.14	N	11	120	N	5	B	10	49L	D197022
D197024	5	.16	N	11	77	2	3	B	10	42L	D197024
D199369	3	.17	N	12	25	2	3L	B	20	45L	D199369
D199370	3L	.24	N	6.0	51	1.5	3L	B	30	46L	D199370
D199371	N	.21	N	20	39	N	10L	B	10	36L	D199371
D197021	7	.22	N	8.5	140	2	5	B	15	45L	D197021
D197020	5L	.45	N	16	160	1.5	7	B	15	45	D197020
D205165	N	.34	30L	13	130	3	5	N	20	46L	D205165
D205166	N	.26	30L	51	70	2	7L	N	70	49L	D205166
D205163	5	.20	20L	7.1	100	1.5	5	N	10	40L	D205163
D205164	3L	.19	15L	7.0	140	2	5	N	50	42L	D205164
D197015	10	.15	N	14	120	2	7	B	10	130	D197015
D197016	7	.21	N	16	71	1.5	5	B	10	42L	D197016
D197017	N	.25	N	19	56	3	10	B	30	93	D197017
D197018	3	.24	10L	6.6	100	.7	2L	N	10	45L	D197018
D197019	N	.40	20L	20	140	1.5	5	N	3	46L	D197019

Table 5a.--Major-, minor-, and trace-element composition of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Sample number
D186852	18	0.2	7	2.3	200	9.2	3.6	70	30	3	D186852
D186854	14	1.7	10	4.5	200	8.5	3.5	70	30	3	D186854
D186855	12	1.6	7	4.7	150	4.6	3.7	50	20	2	D186855
D176391	17	1.2	5	16	200	28	4.3	50	50	3	D176391
D176396	19	1.5	7	5.0	30	19	4.9	70	10	1.5	D176396
D176397	17	5.2	15	14	300	18	7.2	70	30	3	D176397
D176398	29	.7	5	7.4	300	12	2.6	30	30	2	D176398
D176392	11	.9	7	1.8	100	9.8	2.9	70	30	3	D176392
D176394	4.7	1.5	3	4.5	30	3.0L	1.8	20	30	3	D176394
D211822	44	2.5	15	9.0	200	19	7.2	150	20	3	D211822
D211823	30	.7	7	3.2	300	6.7	2.5	70	15	1.5	D211823
D176393	15	1.2	10	4.1	70	24	4.0	50	50	5	D176393
D176395	5.7	.8	3	5.2	150	3.0L	.7	15	7	.7	D176395
D197025	7.4	.9	7	5.7	300	2.6	1.0	30	10	1	D197025
D197023	6.1L	.6	3	5.0	300	1.7	.5	15	7	.7	D197023
D197022	7.0L	.7	5	3.9	500	2.5	.8	30	15	2	D197022
D197024	6.2	1.5	5	5.7	500	2.8	1.4	30	10	1	D197024
D199369	6.9	1.2	10	8.7	150	4.2	2.2	50	10	1	D199369
D199370	6.6	.8	5	5.9	300	2.4	1.7	20	10	1	D199370
D199371	14	1.5	7	8.1	200	5.5	3.0	50	15	1.5	D199371
D197021	6.6	1.0	5	4.3	200	2.2	3.4	20	20	1.5	D197021
D197020	9.4	.8	7	6.5	300	5.3	1.9	30	20	1.5	D197020
D205165	29	1.2	7	9.0	200	4.4	2.3	50	20	2	D205165
D205166	31	2.0	10	7.2	200	6.6	4.4	70	20	2	D205166
D205163	11	.9	10	7.6	200	3.3	1.7	30	20	2	D205163
D205164	13	1.2	7	9.1	150	3.9	2.2	50	15	1.5	D205164
D197015	18	1.3	10	5.2	300	3.7	1.6	50	20	1.5	D197015
D197016	14	1.9	10	6.9	500	3.4	1.6	50	20	1.5	D197016
D197017	13	2.5	15	7.3	500	5.4	2.7	70	30	3	D197017
D197018	16	.7	3	2.9	150	1.9	1.0	20	10	.7	D197018
D197019	6.3	.8	5	6.7	500	4.9	1.8	30	7	.7	D197019

Table 5a.--Major-, minor-, and trace-element composition of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas--continued

Sample number	Zn (ppm)	Zr-S (ppm)
D186852	100	70
D186854	29	70
D186855	39	70
D176391	200	200
D176396	26	70
D176397	40	150
D176398	15	50
D176392	23	150
D176394	26	7
D211822	44	100
D211823	23	70
D176393	37	150
D176395	30	15
D197025	28	20
D197023	4.7	50
D197022	3.6	100
D197024	3.9	20
D199369	8.8	20
D199370	6.0	20
D199371	11	150
D197021	10	20
D197020	7.7	50
D205165	11	50
D205166	62	50
D205163	6.4	50
D205164	12	30
D197015	23	70
D197016	10	30
D197017	24	100
D197018	8.1	15
D197019	6.9	30

Table 5b.--Major-, minor-, and trace-element composition of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas

[As, Co, Cr, F, Hg, Sb, Se, Th, and U values are from direct determinations on air-dried (32°C) lignite; all other values calculated from analyses of ash. S means analysis by semiquantitative emission spectroscopy. L, less than the value shown; N, not detected, B, not determined]

Sample number	Si (percent)	Al (percent)	Ca (percent)	Mg (percent)	Na (percent)	K (percent)	Fe (percent)	Ti (percent)	Ag-S (ppm)	As (ppm)	Sample number
D186853	3.2	1.3	1.5	0.19	0.021	0.12	4.1	0.17	0.5	15	D186853
D186850	8.2	3.8	2.0	.30	.032	.23	1.1	.20	N	4.2	D186850
D186848	8.7	2.1	2.2	.24	.033	.18	.61	.22	N	2.4	D186848
D186849	13	3.1	1.6	.28	.032	.19	.69	.33	N	2.3	D186849
D186851	12	4.8	1.9	.32	.041	.32	.99	.31	N	2.0	D186851
D211820	9.5	3.1	.14	.13	.061	.38	1.2	.15	N	6.6	D211820
D205170	8.1	3.8	1.8	.34	.040	.088	.91	.26	N	3.4	D205170
D205173	11	2.6	1.1	.35	.042	.035	.47	.19	N	4.0	D205173
D205169	5.5	2.5	1.8	.26	.039	.10	1.1	.17	N	1.9	D205169
D211821	1.7	1.1	1.7	.34	.099	.025	.26	.071	N	3.3	D211821
D205172	6.5	2.5	1.6	.24	.046	.14	.85	.15	N	5.2	D205172
D205171	3.1	1.9	2.0	.24	.035	.019	.81	.12	N	7.9	D205171
D211819	14	2.9	.87	.23	.049	.37	1.1	.28	N	3.0	D211819
D211816	5.5	1.5	1.1	.17	.038	.062	.68	.26	N	2.7	D211816
D211818	7.4	1.1	1.8	.26	.058	.061	.48	.25	N	2.5	D211818
D211817	3.7	.83	1.5	.19	.024	.029	.62	.19	N	2.5	D211817
D211815	19	3.4	.69	.18	.047	.27	.80	.46	N	3.8	D211815
D205167	5.6	1.1	.79	.081	.013	.038	1.3	.20	N	1.5	D205167
D205168	2.4	1.0	.74	.079	.009	.023	1.1	.12	N	1.0	D205168
D197012	18	.98	.95	.17	.030	.074	1.1	.16	N	8.5	D197012
D197013	9.4	2.5	.61	.13	.024	.11	.13	.23	N	5.2	D197013
D197014	15	2.0	.83	.17	.033	.19	1.3	.19	N	4.4	D197014

Table 5b.--Major-, minor-, and trace-element composition of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	B-S (ppm)	Ba-S (ppm)	Be-S (ppm)	Cd (ppm)	Ce-S (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	F (ppm)	Ga-S (ppm)	Sample number
D186853	30	70	2	0.22L	100	7.3	16	17	45	5	D186853
D186850	50	200	2	.66	150L	6.7	46	34	130	10	D186850
D186848	70	200	1.5	.28L	150L	4.8	25	16	50	7	D186848
D186849	70	100	3	.39L	200L	3.1	37	24	110	7	D186849
D186851	70	300	N	.43L	200L	2.9	40	22	210	15	D186851
D211820	50	150	5	.95	150	7.1	23	14	180	10	D211820
D205170	100	100	N	.31L	N	1.8	21	18	160	20	D205170
D205173	100	500	1	.35L	N	2.3	18	22	120	10	D205173
D205169	150	1,500	.7	.26L	N	2.4	16	8.9	100	20	D205169
D211821	150	70	.7	.37	N	2.6	6.0	7.0	20	10	D211821
D205172	150	1,500	.7	.52	N	2.3	11	12	70	7	D205172
D205171	150	200	1	.37	N	2.7	11	17	50	5	D205171
D211819	50	300	1.5	.83	200L	8.3	36	24	160	10	D211819
D211816	50	150	.7L	.43	100L	3.5	25	26	90	7	D211816
D211818	50	200	1.5	.76	150L	5.1	16	16	45	3	D211818
D211817	30	200	.5L	.32	N	3.5	12	17	20L	5	D211817
D211815	30	300	1.5	1.1	N	9.3	75	26	130	10	D211815
D205167	100	200	1.5	.49	N	2.3	12	12	20	7	D205167
D205168	70	200	.7	.11L	N	2.4	9.2	11	20	7	D205168
D197012	70	200	2	.44	N	10	16	20	25	10	D197012
D197013	20	500	5	.64	150L	7.6	16	25	60	15	D197013
D197014	70	200	N	.45L	N	2.4	29	12	50	10	D197014

Table 5b.--Major-, minor-, and trace-element composition of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	Ge-S (ppm)	Hg (ppm)	La-S (ppm)	Li (ppm)	Mn (ppm)	Mo-S (ppm)	Nb-S (ppm)	Nd-S (ppm)	Ni-S (ppm)	P (ppm)	Sample number
D186853	N	0.51	30	10	25	1.5	15	N	15	940L	D186853
D186850	7L	.23	30L	24	76	N	10	50L	10	1,400L	D186850
D186848	N	.25	30L	14	150	2	15	50L	7	1,200L	D186848
D186849	N	.38	50L	25	43	3	20	70L	7	1,700L	D186849
D186851	N	.20	N	29	90	N	15	N	7	1,900L	D186851
D211820	10	.20	70	7.6	27	2L	7	100	30	83	D211820
D205170	7L	.14	N	19	230	2	10	B	5	41	D205170
D205173	N	.18	N	19	110	2	10	B	10	46L	D205173
D205169	5L	.11	100L	16	150	2	15	N	7	46L	D205169
D211821	3	.08	100L	11	130	1	3	N	3	43	D211821
D205172	N	.24	20L	9.0	82	2	7	N	15	90	D205172
D205171	3L	.52	20L	12	250	3	3	N	10	41L	D205171
D211819	N	.80	50L	9.5	180	3L	10	70L	10	90	D211819
D211816	5	.75	20L	4.3	210	1.5L	7	N	7	84	D211816
D211818	N	.98	20L	4.6	110	1.5L	7	N	7	44	D211818
D211817	N	1.0	15L	8.6	64	1L	5	N	5	42L	D211817
D211815	N	.28	50L	20	100	N	10	N	10	92	D211815
D205167	N	.33	20L	10	180	1.5	7	N	3	41L	D205167
D205168	2	.18	10L	12	130	.7	3	N	3	220	D205168
D197012	30	.55	50L	4.4	80	N	N	N	15	39	D197012
D197013	7L	.54	30	16	46	2	20	N	70	42L	D197013
D197014	N	.16	N	39	76	N	10	B	5	78	D197014

Table 5b.--Major-, minor-, and trace-element composition of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	Pb (ppm)	Sb (ppm)	Sc-S (ppm)	Se (ppm)	Sr-S (ppm)	Th (ppm)	U (ppm)	V-S (ppm)	Y-S (ppm)	Yb-S (ppm)	Sample number
D186853	7.5	0.1L	5	3.8	50	6.1	2.1	20	15	1.5	D186853
D186850	20	.7	10	1.6	150	9.1	4.4	100	20	2	D186850
D186848	16	.6	7	.1L	200	9.2	3.7	50	20	2	D186848
D186849	16	.9	7	2.7	70	11	2.5	70	30	3	D186849
D186851	13	.5	7	.1L	150	5.6	2.2	70	15	1.5	D186851
D211820	22	.7	5	2.0	50	8.3	4.8	50	70	7	D211820
D205170	13	.8	10	2.9	200	6.2	2.8	50	10	1	D205170
D205173	13	.9	5	2.8	100	6.0	3.6	50	10	1	D205173
D205169	15	.8	7	2.2	500	6.7	2.8	50	7	.7	D205169
D211821	10	.5	2	3.1	150	4.9	2.1	20	10	.7	D211821
D205172	17	.5	7	2.0	200	7.8	2.8	50	15	1.5	D205172
D205171	20	.8	5	2.5	200	6.5	2.7	30	15	1.5	D205171
D211819	31	1.0	7	6.0	300	9.5	3.6	70	20	2	D211819
D211816	15	1.1	5	5.4	200	7.4	2.9	70	10	1	D211816
D211818	17	.8	5	5.8	200	4.9	1.9	30	15	1.5	D211818
D211817	11	.7	5	5.5	100	5.0	2.1	20	5	.5	D211817
D211815	32	.9	7	4.9	150	11	3.6	70	15	1.5	D211815
D205167	5.5	.6	7	2.4	150	3.1	1.2	20	15	1.5	D205167
D205168	6.3	.3	3	1.9	150	2.5	1.0	15	7	.7	D205168
D197012	13	1.4	5L	4.1	150	4.1	1.6	30	15	2	D197012
D197013	16	1.9	5	5.8	200	16	5.1	30	20	2	D197013
D197014	25	.4	5L	1.1	200	3.3	1.4	30	10	1.5	D197014

Table 5b.--Major-, minor-, and trace-element composition of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas--continued

Sample number	Zn (ppm)	Zr-S (ppm)
D186853	55	50
D186850	45	50
D186848	15	100
D186849	13	100
D186851	17	70
D211820	120	100
D205170	9.3	70
D205173	7.1	50
D205169	7.8	50
D211821	3.0	30
D205172	13	70
D205171	18	30
D211819	18	150
D211816	4.3L	70
D211818	5.1L	70
D211817	5.8	50
D211815	14	150
D205167	9.6	70
D205168	18	20
D197012	180	70
D197013	35	100
D197014	14	150

Table 6.--Elements looked for but not detected in lignite from the Eocene of southern and eastern Arkansas

[Approximate lower detection limits in ash, as determined by the six-step spectrographic method of the U.S. Geological Survey, are included for all elements]

Element name	Symbol	Lower limit of detection in ash (ppm)
Gold	Au	50
Bismuth	Bi	20
Dysprosium	Dy	100
Erbium	Er	100
Europium	Eu	200
Gadolinium	Gd	100
Hafnium	Hf	200
Holmium	Ho	50
Indium	In	20
Lutetium	Lu	70
Palladium	Pd	5
Platinum	Pt	100
Rhenium	Re	100
Tin	Sn	20
Tantalum	Ta	1,000
Terbium	Tb	700
Tellerium	Te	5,000
Thallium	Tl	100
Thulium	Tm	50
Tungsten	W	200

Table 7a.--Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, and heat of combustion, forms of sulfur, and ash-fusion temperatures of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas

[All values are in percent except kcal/kg, Btu/lb, and ash-fusion temperatures, and are reported on the as-received basis. °F = (°C x 1.8) + 32; kcal/kg = 0.556 x (Btu/lb). L, less than the value shown]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and ultimate analyses					
Moisture	39.7	29.6	57.0	39.3	1.1
Volatile matter	23.8	17.8	30.1	23.5	1.2
Fixed carbon	19.5	10.6	28.5	18.9	1.3
Ash	17.4	3.8	30.4	15.0	1.7
Hydrogen	6.8	5.7	8.2	6.7	1.1
Carbon	30.9	20.4	42.1	30.3	1.2
Nitrogen	.5	.3	.9	.5	1.3
Oxygen	44.7	35.4	59.9	44.4	1.1
Sulfur	.5	.2	1.0	.5	1.5
Heat of combustion					
Kcal/kg	2,940	1,890	4,010	2,870	1.2
Btu/lb	5,280	3,400	7,220	5,160	1.2
Forms of sulfur					
Sulfate	0.02	0.01L	0.09	0.01	1.8
Pyritic	.13	.01	.66	.07	2.9
Organic	.39	.02	.50	.32	1.9
Ash-fusion temperatures, °C					
Initial deformation	1,270	1,105	1,600+	1,260	1.1
Softening temperature	1,295	1,120	1,600+	1,285	1.1
Fluid temperature	1,330	1,140	1,600+	1,320	1.1

Table 7b.--Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, and heat of combustion, forms of sulfur, and ash-fusion temperatures of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas

[All values are in percent except kcal/kg, Btu/lb, and ash-fusion temperatures, and are reported on the as-received basis. °F = (°C x 1.8) + 32; kcal/kg = 0.556 x (Btu/lb). L, less than the value shown]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
Proximate and ultimate analyses					
Moisture	38.7	27.1	46.9	38.3	1.2
Volatile matter	25.6	19.0	31.1	25.4	1.1
Fixed carbon	16.6	10.2	23.0	16.3	1.2
Ash	19.4	6.9	39.7	17.3	1.6
Hydrogen	6.8	5.4	8.1	6.8	1.1
Carbon	30.0	23.1	37.3	29.6	1.2
Nitrogen	.5	.4	.8	.5	1.2
Oxygen	42.8	29.5	49.5	42.4	1.2
Sulfur	.7	.3	3.0	.5	1.9
Heat of combustion					
Kcal/kg	2,940	2,080	3,650	2,900	1.2
Btu/lb	5,280	3,740	6,570	5,210	1.2
Forms of sulfur					
Sulfate	0.03	0.01L	0.50	0.02	3.2
Pyritic	.19	.01	1.44	.07	4.4
Organic	.45	.24	1.06	.42	1.5
Ash-fusion temperatures, °C					
Initial deformation	1,280	1,090	1,600+	1,275	1.1
Softening temperature	1,310	1,115	1,600+	1,305	1.1
Fluid temperature	1,355	1,145	1,600+	1,350	1.1

Table 8a.--Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of nine major and minor oxides in the laboratory ash of 31 lignite samples from the Wilcox Group, southern and eastern Arkansas

[All samples were ashed at 525°C; all values except geometric deviation are in percent]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	27.8	5.2	46.8	24.1	1.7
SiO2	57	20	81	55	1.3
Al2O3	17	5.9	32	16	1.5
CaO	7.5	.31	19	4.5	2.8
MgO	1.56	.12	4.06	1.12	2.3
Na2O	.33	.090	1.27	.26	2.0
K2O	.73	.21	1.4	.65	1.6
Fe2O3	4.6	1.2	10	3.9	1.8
TiO2	1.3	.60	4.2	1.2	1.5
SO3	7.2	.62	22	5.0	2.3

Table 8b.--Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of nine major and minor oxides in the laboratory ash of 22 lignite samples from the Claiborne Group, southern and eastern Arkansas

[All samples were ashed at 525°C; all values except geometric deviation are in percent]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
(Ash)	30.0	11.3	52.9	27.5	1.5
SiO2	58	30	88	56	1.3
Al2O3	15	4.2	23	14	1.5
CaO	8.2	.60	20	5.9	2.2
MgO	1.41	.56	4.53	1.24	1.7
Na2O	.20	.090	1.09	.17	1.8
K2O	.52	.12	1.4	.42	2.0
Fe2O3	5.6	.60	27	4.2	2.1
TiO2	1.3	.60	2.0	1.2	1.4
SO3	5.4	1.6	15	4.6	1.8

Table 9a.--Arithmetic mean, observed range, geometric mean, and geometric deviation of 35 elements in 31 lignite samples from the Wilcox Group, southern and eastern Arkansas

[All analyses are in percent or parts per million and are reported on a whole-coal basis. L, less than the value shown]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
		Percent			
Si	8.4	0.47	16	6.2	2.2
Al	2.5	.46	6.1	2.0	2.0
Ca	1.1	.063	1.6	.77	2.4
Mg	.22	.013	.34	.16	2.1
Na	.057	.013	.11	.046	1.9
K	.19	.012	.45	.13	2.3
Fe	.80	.14	2.2	.66	1.9
Ti	.23	.031	.75	.18	2.1
		Parts per million			
As	5.4	1.3	26	4.3	2.0
B	150	50	500	150	2.0
Ba	200	50	1,000	200	1.9
Be	3	.5	15	2	2.4
Co	7.3	.1L	20	6.1	1.8
Cr	24	.1L	73	20	1.9
Cu	35	10	85	31	1.7
F	88	20	250	69	2.0
Ga	10	3	30	10	1.8
Hg	.30	.06	1.0	.24	1.8
Li	19	1.5	57	14	2.3
Mn	98	7.4	210	73	2.2
Mo	2	.7	10	1.5	2.4
Nb	10	1.5	70	5	3.4
Ni	20	3	70	15	1.9
Pb	15	4.7	44	12	1.9
Sb	1.3	.2	5.2	1.1	1.7
Sc	7	3	15	7	1.6
Se	6.4	1.8	16	5.7	1.6
Sr	300	30	500	200	2.0
Th	7.3	1.7	28	5.1	2.4
U	2.8	.5	7.2	2.3	1.9
V	50	15	150	50	1.7
Y	20	7	50	15	1.7
Yb	2	.7	5	1.5	1.7
Zn	28	3.6	200	18	2.6
Zr	70	7	200	50	2.3

Table 9b.--Arithmetic mean, observed range, geometric mean, and geometric deviation of 34 elements in 22 lignite samples from the Claiborne Group, southern and eastern Arkansas

[All analyses are in percent or parts per million and are reported on a whole-coal basis. L, less than the value shown]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation
		Minimum	Maximum		
		Percent			
Si	8.9	1.7	19	7.2	1.9
Al	2.3	.83	4.8	2.0	1.7
Ca	1.4	.14	2.2	1.1	1.9
Mg	.22	.079	.35	.21	1.5
Na	.039	.009	.099	.034	1.7
K	.15	.019	.38	.10	2.6
Fe	1.0	.13	4.1	.81	1.9
Ti	.21	.071	.46	.20	1.5
		Parts per million			
As	4.2	1.0	15	3.5	1.9
B	70	20	150	70	1.8
Ba	300	70	1,500	200	2.2
Be	1.5	.5L	5	1	2.2
Co	4.6	1.8	10	3.9	1.7
Cr	23	9.2	75	20	1.8
Cu	18	11	34	17	1.5
F	89	20L	210	64	2.3
Ga	10	3	20	7	1.6
Hg	.40	.08	1.0	.31	2.0
Li	15	4.3	39	12	1.8
Mn	120	25	250	97	1.9
Nb	10	3	20	7	1.9
Ni	10	3	70	10	2.1
Pb	16	5.5	32	15	1.6
Sb	.8	.1L	1.9	.7	1.6
Sc	7	2	10	5	1.7
Se	3.3	.1L	6.0	2.7	1.8
Sr	150	50	500	150	1.7
Th	7.1	2.5	16	6.4	1.6
U	2.8	1.0	5.1	2.5	1.6
V	50	15	100	50	1.7
Y	15	5	70	15	1.7
Yb	1.5	.5	7	1.5	1.8
Zn	27	3.0	180	14	3.2
Zr	70	20	150	70	1.7

Table 10.--Arithmetic mean, observed range, geometric mean, and geometric deviation of proximate and ultimate analyses, and heat of combustion, forms of sulfur, and ash-fusion temperatures of 53 lignite samples from the Eocene of southern and eastern Arkansas

[All values are in percent except kcal/kg, Btu/lb, and ash-fusion temperatures, and are reported on the as-received basis. °F = (°C x 1.8) + 32; kcal/kg = 0.556 x (Btu/lb). L, less than the value shown. For comparison, geometric means for 27 lignite samples from the Texas region, central and eastern Texas (Hildebrand and others, 1979, table 7), are included]

	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Texas region geometric mean
		Minimum	Maximum			
Proximate and ultimate analyses						
Moisture	39.2	27.1	57.0	38.9	1.2	30.2
Volatile matter	24.5	17.8	31.1	24.3	1.2	29.7
Fixed carbon	18.3	10.2	28.5	17.8	1.3	27.3
Ash	18.2	3.8	39.7	15.9	1.7	11.2
Hydrogen	6.8	5.4	8.2	6.8	1.1	6.4
Carbon	30.5	20.4	42.1	30.0	1.2	41.3
Nitrogen	.5	.3	.9	.5	1.3	.8
Oxygen	43.9	29.5	59.9	43.6	1.1	38.2
Sulfur	.6	.2	3.0	.5	1.6	.8
Heat of combustion						
Kcal/kg	2,930	1,890	4,010	2,880	1.2	3,960
Btu/lb	5,280	3,400	7,220	5,180	1.2	7,120
Forms of sulfur						
Sulfate	0.02	0.01L	0.50	0.02	2.5	0.02
Pyritic	.15	.01	1.44	.07	3.6	.12
Organic	.42	.02	1.06	.36	1.8	.55
Ash-fusion temperatures, °C						
Initial deformation	1,275	1,090	1,600+	1,270	1.1	1,180
Softening temperature	1,300	1,115	1,600+	1,295	1.1	1,225
Fluid temperature	1,340	1,140	1,600+	1,335	1.1	1,275

Table 11.--Arithmetic mean, observed range, geometric mean, and geometric deviation of ash content and contents of nine major and minor oxides in the laboratory ash of 53 lignite samples from the Eocene of southern and eastern Arkansas

[All samples were ashed at 525°C; all values except geometric deviation are in percent. For comparison, geometric means for 39 lignite samples from the Texas region, central and eastern Texas (Hildebrand and others, 1979, table 8), are included]

Oxide	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Texas region geometric mean
		Minimum	Maximum			
(Ash)	28.7	5.2	52.9	25.5	1.6	15.0
SiO2	58	20	88	55	1.3	35
Al2O3	16	4.2	32	15	1.5	13
CaO	7.8	.31	19	5.0	2.6	11
MgO	1.50	.12	4.06	1.17	2.0	2.29
Na2O	.27	.090	1.27	.22	2.0	.40
K2O	.65	.12	1.4	.54	1.8	.43
Fe2O3	5.0	.60	27	4.0	1.9	4.6
TiO2	1.3	.60	4.2	1.2	1.4	1.2
SO3	6.5	.62	22	4.9	2.1	13

Table 12.--Arithmetic mean, observed range, geometric mean, and geometric deviation of 35 elements in 53 lignite samples from the Eocene of southern and eastern Arkansas

[All analyses are in percent or parts per million and are reported on a whole-coal basis. L, less than the value shown. For comparison, geometric means for 39 lignite samples from the Texas region, central and eastern Texas (Hildebrand and others, 1979, table 9), are included]

Element	Arithmetic mean	Observed range		Geometric mean	Geometric deviation	Texas region geometric mean
		Minimum	Maximum			
			Percent			
Si	8.6	0.47	18	6.6	2.1	2.5
Al	2.4	.46	6.1	2.0	1.8	1.0
Ca	1.2	.063	2.2	.92	2.2	1.2
Mg	.22	.013	.35	.18	1.9	.21
Na	.050	.009	.11	.040	1.9	.045
K	.17	.012	.45	.11	2.4	.054
Fe	.88	.13	4.1	.72	1.9	.49
Ti	.22	.031	.75	.19	1.9	.10
			Parts per million			
As	4.9	1.0	26	3.9	1.9	2.9
B	150	20	500	100	2.1	150
Ba	300	50	1,500	200	2.0	150
Be	2	.5L	15	1.5	2.6	1.5
Co	6.2	.1L	20	5.0	1.9	2
Cr	24	.1L	75	20	1.9	15
Cu	28	7.0	85	24	1.7	18
F	88	20L	250	67	2.1	29
Ga	10	3	30	10	1.7	7
Hg	.34	.06	1.0	.27	1.9	.21
Li	17	1.5	57	13	2.1	7.8
Mn	110	7.4	250	82	2.1	120
Mo	2	.7	10	1.5	2.6	2
Nb	10	1.5	70	7	2.8	5
Ni	15	3	70	10	2.1	5
Pb	15	4.7	44	13	1.8	3.9
Sb	1.1	.1L	5.2	.9	1.8	.7
Sc	7	2	15	7	1.6	5
Se	5.2	.1L	16	4.2	1.9	6.8
Sr	200	30	500	200	1.9	100
Th	7.2	1.7	28	5.6	2.0	2.6
U	2.8	.5	7.2	2.4	1.8	1.8
V	50	15	150	50	1.7	30
Y	20	5	70	15	1.7	10
Yb	2	.5	7	1.5	1.7	1
Zn	27	3.0	200	16	2.8	7.7
Zr	70	7	200	50	2.1	30