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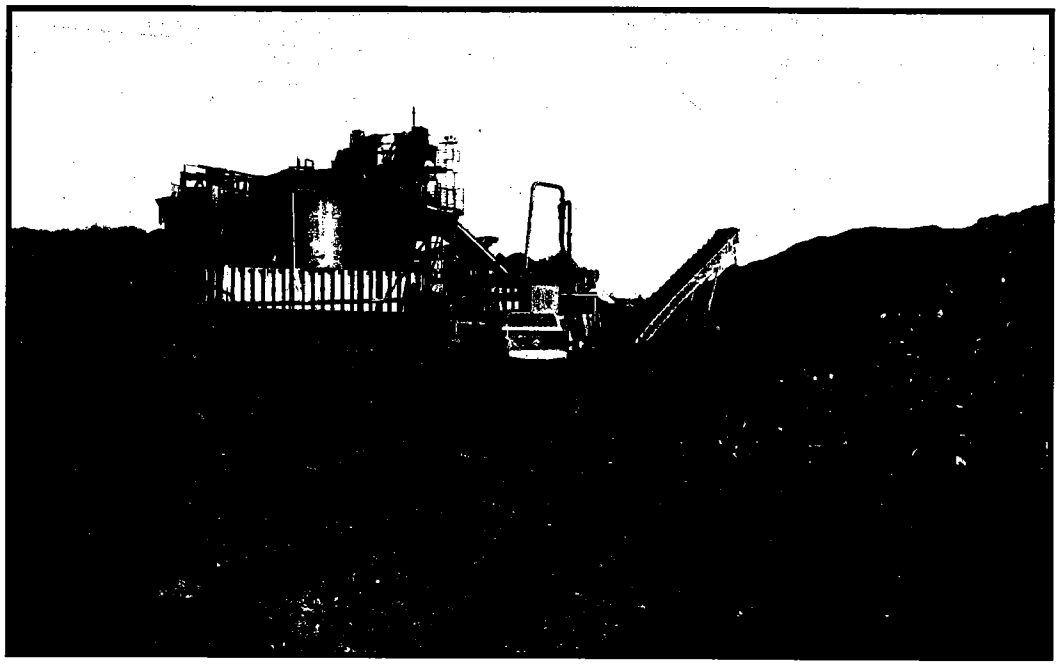
Coal Geology of Okmulgee County and Eastern Okfuskee County, Oklahoma

LeRoy A. Hemish



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With an underground coal mine map by
Samuel A. Friedman

Oklahoma Geological Survey
Charles J. Mankin, *Director*

The University of Oklahoma
Norman, Oklahoma

1994

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Front Cover

Preparation plant at the mouth of Pollyanna No. 4 underground coal mine, sec. 13, T. 12 N., R. 12 E., Okmulgee County. Croweburg (Henryetta) coal was being produced from this mine when the photograph was taken in the fall of 1989.

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Coal Geology of Okmulgee County and Eastern Okfuskee County, Oklahoma

LeRoy A. Hemish[1]

With an underground coal mine map by
Samuel A. Friedman[1]

ABSTRACT.—Okmulgee and Okfuskee Counties are located in the west-central part of the coal belt of northeastern Oklahoma. About 836 mi² of the 986 mi² underlain by coal-bearing strata of Desmoinesian and Missourian (Pennsylvanian) age in the two counties are in the shelf area. About 150 mi² are in the Arkoma basin. Remaining resources of coal in the two-county area total 496,088,000 tons (all tonnage figures are in short tons), and reserves total 15,707,000 tons. Methods used to classify and calculate resources and reserves are adaptations of standard methods used by the U.S. Bureau of Mines and the U.S. Geological Survey, as modified by Friedman (1974).

Four coal beds in Okmulgee and Okfuskee Counties are of minable thickness. They are (in stratigraphically ascending order): Mineral (Morris) coal, with reserves of 5,056,000 tons; Croweburg (Henryetta) coal, 10,185,000 tons; Dawson coal, 387,000 tons; and Tulsa coal, 79,000 tons.

Coals of the area are predominantly of high-volatile A bituminous (hvAb) and high-volatile B bituminous (hvBb) in rank. The Croweburg coal has the greatest potential for utilization because of its superior quality and greater bed thickness. More than 100 analyses indicate that the Croweberg coal averages 8.8% ash and 2.6% sulfur on an as-received basis. On the moist, mineral-matter-free basis, the Croweburg coal averages 13,753 Btu/lb. The other coals all have higher ash and sulfur contents, and lower heat values.

The Oklahoma Department of Mines has recorded a total of 32,664,742 tons taken from underground mines and strip mines in Okmulgee County since the first production of coal was reported in 1908. No production of coal has ever been reported officially from Okfuskee County, although there are old, abandoned mines in the southeastern part of the country. Production of coal from Okmulgee County for the year 1989 was only 45,497 tons, from one small stripping operation and a new underground mine in the Croweberg coal that opened late in the year.

INTRODUCTION

This is the fourth in a series of coal reports published by the Oklahoma Geological Survey (OGS) on a county-by-county basis. Figure 1 shows the status of the county reports.

The reports include maps showing outcrop boundaries of the various commercial coal beds; a structure-contour map; stratigraphic information; summaries of the coal resources and reserves by township, county, coal bed, overburden, and reliability categories; data on the quality of the coals; and discussions of coal economics.

The area studied in Okfuskee and Okmulgee Counties comprises ~986 mi² situated in the west-central part of the coalfield of eastern Oklahoma (Fig. 2). The region is characterized by W-dipping Pennsylvanian sandstones that form cuestas overlooking broad shale plains. The area is served by several major highways, including Interstate 40 (east-west) and U.S. 75 (north-south). Two railroads, Burlington Northern and Missouri Pacific, also serve the area. The two largest cities are Henryetta and Okmulgee, both in Okmulgee County.

Detailed data on estimated original, mined, and remaining coal resources and reserves are tabulated in Appendix 1 for each county according to coal thickness, overburden thickness, and reliability category.

This report contains two coal maps (Pls. 1,2) showing locations of data points used in the study, thickness of coal beds, mined-out areas, and thickness of overburden. These maps were prepared for the four beds for which the resources and reserves were tabulated—the Mineral (Morris), Croweburg, (Henryetta), Dawson, and Tulsa. Coal beds too thin to have economic importance are discussed briefly, but were not

[1]Oklahoma Geological Survey.

mapped in detail. Four cross sections (Pls. 3–6) show the succession of coals and associated strata throughout the study area.

Summary information on resources and reserves is presented in Table 1 according to township and coal thickness, and in Table 2 according to county and coal bed. All tonnage figures in this report are in short tons.

To be considered economically extractable, a high-sulfur coal (sulfur content ≥3.0%) must have a stripping ratio ≤20:1, and a low-sulfur coal (sulfur content ≤1.0%) must have a stripping ratio ≤30:1. No deductions from reserves were made for reasons such as adverse governmental regulations and policies, land-use conflicts, poor accessibility, or adverse geologic and engineering conditions. Reserves and recoverable reserves are used in the same sense. If the coal is >100 ft deep, it is considered recoverable only by underground mining. The minimum thickness considered for underground mining is 1.2 ft.

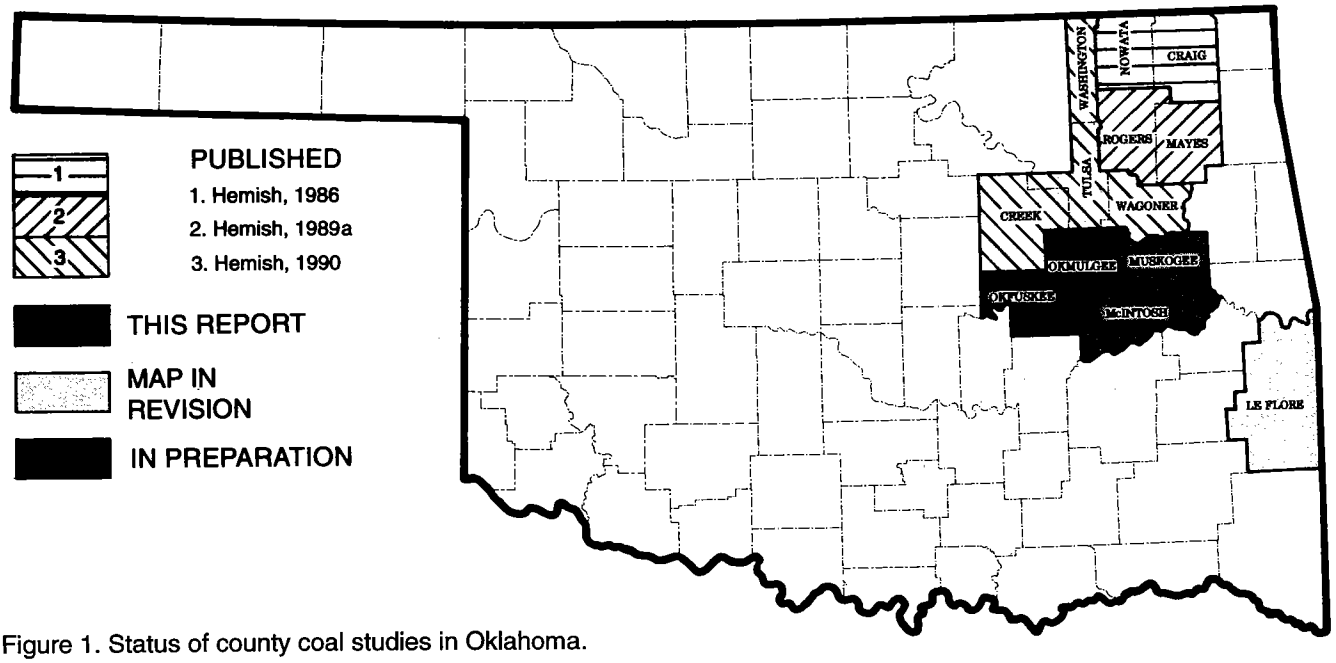

Figure 1. Status of county coal studies in Oklahoma.

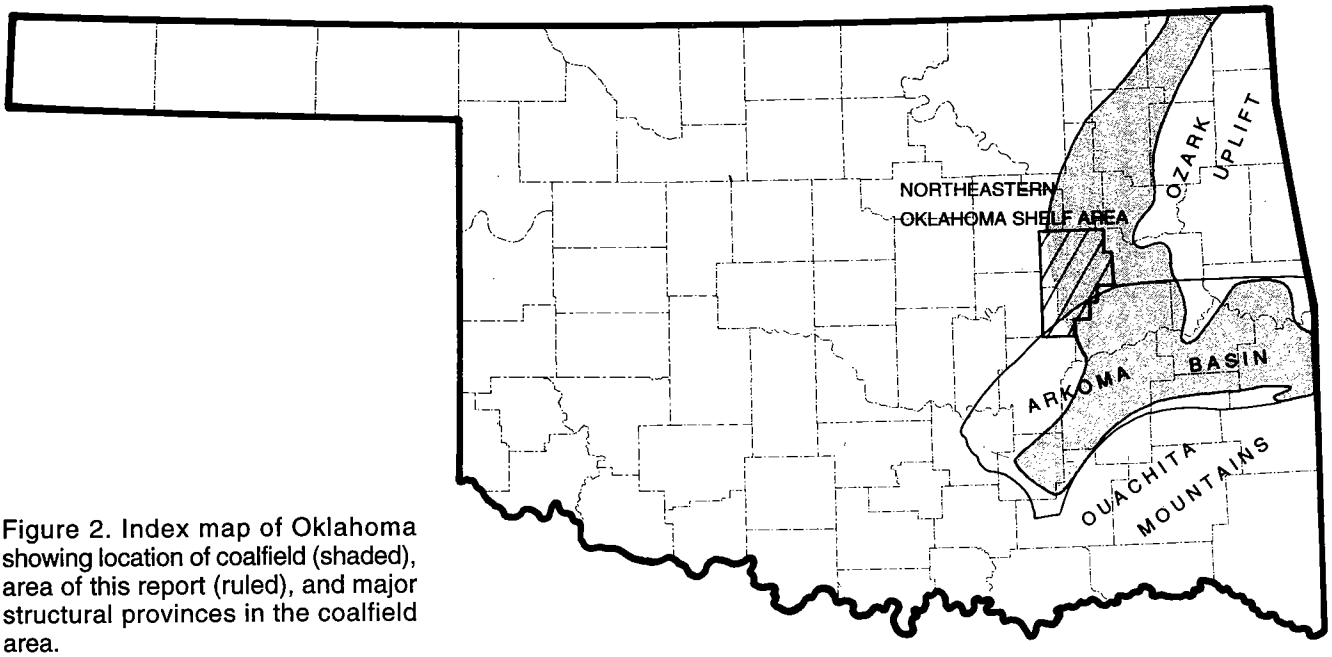

Figure 2. Index map of Oklahoma showing location of coalfield (shaded), area of this report (ruled), and major structural provinces in the coalfield area.

TABLE 1.—COAL RESOURCES AND RESERVES IN OKMULGEE AND OKFUSKEE COUNTIES ACCORDING TO TOWNSHIP AND COAL THICKNESS*

(thousands of short tons)

Township range, county	Remaining resources										Mined or lost in mining		Original resources		Reserves	
	0.8–1.2 ft		1.2–2.4 ft		2.4–3.5 ft		>3.5 ft		Total remaining resources							
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
T10N, R11E, Okfuskee	—	—	1,069	4,060	4,019	20,519	—	—	5,088	24,579	—	—	5,088	24,579	—	—
T10N, R12E, Okfuskee	709	1,363	11,016	38,987	2,360	11,038	—	—	14,085	51,388	1	4	14,086	51,392	771	1,826
T11N, R11E, Okfuskee	—	—	—	—	8,534	44,652	—	—	8,543	44,652	—	—	8,543	44,652	—	—
T11N, R12E, Okmulgee	—	—	4,644	18,573	14,890	78,018	—	—	19,534	96,591	3,437	17,251	22,971	113,842	—	—
T11N, R13E, Okmulgee	—	—	2,953	11,900	2,662	12,870	—	—	5,615	24,770	2,304	11,656	7,919	36,426	804	2,966
T12N, R11E, Okfuskee	—	—	8,098	30,572	1,061	4,773	—	—	9,159	35,345	—	—	9,159	35,345	—	—
T12N, R12E, Okmulgee	—	—	6,006	22,275	17,588	98,137	—	—	23,594	120,412	2,532	15499	26,126	135,911	—	—
T12N, R13E, Okmulgee	659	1,178	4,210	12,062	3,596	19,249	—	—	8,465	32,489	5,763	30,946	14,228	63,435	785	2,904
T12N, R14E, Okmulgee	51	88	39	100	—	—	—	—	90	188	2	7	92	195	53	99
T13N, R12E, Okmulgee	—	—	2,350	8,039	125	557	—	—	2,475	8,596	—	—	2,475	8,596	—	—
T13N, R13E, Okmulgee	1,888	3,443	7,553	20,544	42	191	—	—	9,483	24,178	559	2,107	10,042	26,285	653	1,579
T13N, R14E, Okmulgee	898	1,585	1,564	4,095	387	1,931	—	—	2,849	7,611	215	527	3,064	8,138	931	2,200
T13N, R15E, Okmulgee	—	—	22	68	—	—	—	—	22	68	—	—	22	68	19	49
T14N, R13E, Okmulgee	442	857	366	1058	68	332	—	—	876	2247	—	—	876	2247	—	—
T14N, R14E, Okmulgee	1,882	3,425	1,204	3,166	82	436	—	—	3,168	7,027	927	2,678	4,095	9,705	1,089	2,266
T14N, R15E, Okmulgee	6	12	106	307	42	231	—	—	154	550	90	255	244	805	89	282
T15N, R11E, Okmulgee	1,565	2,253	—	—	—	—	—	—	1,565	2,253	2	2	1,567	2,255	299	343
T15N, R12E, Okmulgee	199	286	—	—	—	—	—	—	199	286	—	—	199	286	108	123
T15N, R14E, Okmulgee	1,693	2,958	237	581	—	—	—	—	1,930	3,539	158	375	2,088	3,914	391	637
T16N, R14E, Okmulgee	606	1,193	3,037	8,126	—	—	—	—	3,643	9,319	5	13	3,648	9,332	232	433
TOTAL	10,598	18,641	54,474	18,4513	55,456	292,934	—	—	120,528	496,088	15,995	81,320	136,523	577,408	6,224	15,707

*See Appendix 1 for details.

TABLE 2.—COAL RESOURCES AND RESERVES IN OKMULGEE AND OKFUSKEE COUNTIES ACCORDING TO COUNTY AND COAL BED*

(thousands of short tons)

Coal	Total remaining resources		Mined or lost in mining		Original resources		Reserves	
	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
Okmulgee County:								
Tulsa	249	359	1	1	250	360	69	79
Dawson	1,515	2,180	1	1	1,516	2,181	338	387
Croweburg	67,084	302,772	15,003	78,711	82,087	381,483	2,688	8,359
Mineral	14,814	34,813	989	2,603	15,803	37,416	2,358	5,056
Total	83,662	340,124	15,994	81,316	99,656	421,440	5,453	13,881
Okfuskee County:								
Croweburg	36,866	155,964	1	4	36,867	155,968	771	1,826
Total	36,866	155,964	1	4	36,867	155,968	771	1,826
Grand Totals	120,528	496,088	15,995	81,320	136,523	577,408	6,224	15,707

*See Appendix 1 for details.

Previous Investigations

The earliest investigation of coal in Okmulgee County was by N. F. Drake (1897) when he did his reconnaissance of the coalfields of the Indian Territory. Taff (1905) described the Henryetta coal bed and correlated it with the coal bed mined at Broken Arrow, in Tulsa County. Oakes (1944) subsequently correlated the Broken Arrow coal with the Croweburg coal of Kansas. Shannon and others (1926) included the Henryetta mining district in a report on the coal resources of Oklahoma. The U.S. Bureau of Mines (1928) reported on analyses of mine samples of coal from the study area, and Moose and Searle (1929) made a chemical study of the coals of Oklahoma, including samples from 14 mines in southern Okmulgee County. Davis and others (1944) investigated the carbonizing properties of coal from the Croweburg (Henryetta) bed. Ries (1954) reported on the geology and mineral resources of Okfuskee County, but made only brief reference to coal deposits. Dunham and Trumbull (1955) described the coal beds and estimated the resources of the Henryetta coal-mining district. Trumbull (1957) estimated the coal resources of Oklahoma and included information from Okmulgee County. Oakes and Motts (1963) mapped the geology of Okmulgee County and wrote briefly on the coal resources of the area.

More recently, Friedman (1974) investigated and reported on the coals of Oklahoma and updated the resources and reserves of Okmulgee County. He also made the first estimates of resources and reserves of coal from Okfuskee County. Hemish (1987a) presented a compendium of coal nomenclature currently recognized by the OGS for the northeastern Oklahoma shelf area. Hemish (1988a) reported on OGS core-drilling (including 14 holes in Okfuskee and Okmulgee Counties) to gather information about the coal beds of Oklahoma. Results of a recent stratigraphic and structural study of the Eram coal in Okmulgee County were published by Hemish (1988b). Additional information on coal in Okmulgee County is included in theses by Lontos (1952), Leitner (1956), Campbell (1957), Luff (1957), Manhoff (1957), and Miller (1957).

Acknowledgments

The author is grateful to the individual landowners and to the various coal companies, particularly the P&K Coal Co. of Henryetta, who provided access to their properties and furnished information regarding coal beds discussed in this report. S. A. Friedman, senior coal geologist at the OGS, shared his unpublished data from the study area and also provided information about abandoned underground mines in the region (Pl. 7). Laurie Chisholm, while a research assistant at the OGS, helped to prepare a structure-contour map of the area (Pl. 8).

METHODS OF INVESTIGATION

Sources of Information

Data for compiling the maps, cross sections, and coal resources and reserve estimates were obtained from ~600 drill and core logs provided mostly by coal companies, from 18 OGS core-hole logs (Appendix 2), from 61 sections measured by the author in active and abandoned strip pits and on outcrops (Appendix 2), and from sections measured by workers who had previously made geologic studies in the area.

Analytical data for the various coal beds were compiled from information provided by coal companies or other industry-related sources, from records of Penn State University, the U.S. Bureau of Mines, the U.S. Geological Survey, and the OGS, and from 49 samples collected by the author during the investigation and analyzed by the OGS Laboratory (Appendix 3).

Procedures

Field investigations in the study area were begun in the fall of 1981 and were mostly completed by the end of 1982. Further work, such as sampling coal at active mines, core drilling, and measuring a few additional sections, was carried on up to 1989. Information was plotted on 7.5′ quadrangle topographic maps. Outcrop boundaries of the various coals were field checked, but natural exposures were difficult to find, owing to concealment by unconsolidated surficial materials or a dense cover of vegetation. Slumping and ponded water have obliterated most exposures of coal beds in abandoned strip mines, and abandoned underground mines are no longer accessible; therefore, the best data were gathered from active strip mines. Methods used to calculate resources and reserves are adaptations of standard methods used by the U.S. Bureau of Mines and the U.S. Geological Survey, as modified by Friedman (1974).

Outcrop boundaries of the four commercially important coal beds in Okfuskee and Okmulgee Counties are shown in Plates 1 and 2. The boundary lines generally show where coal may be found at strippable depths, although at the time of this writing most of the reserves have been mined at the more desirable locations. Surface-mined areas are shown on 1:63,360-scale maps (Pls. 1,2), and underground-mined areas are shown in Plate 7, at the same scale.

The accuracy of mapping coal boundaries depends on the amount of surface cover, nature of the topography, and the number and distribution of data points. Structural features, erosional cutouts, and areas in which the coal is lenticular or lacks persistence also hinder the mapping. Additional drill-hole information will modify the outcrop boundaries for some areas shown on the map.

Definitions

Coal resources comprise maximum estimates of original and remaining coal resources that are identified or presumed to exist within a coalfield and are based on the use of geologic judgment and the interpretation of geologic data (Friedman, 1974, p. 13). In this study, resource figures were not calculated for coal beds less than 0.8 ft thick (considered to be the minimum minable thickness), regardless of depth. At depths >100 ft, no resource figures were calculated for beds <1.2 ft thick.

The following definitions are paraphrased from Friedman (1974, p. 13–14):

Original coal resources. Original coal resources are determined from coal-datum points and include all coal (in all categories of reliability) that was present in beds prior to mining. New coal data can be used in updating estimates of original resources.

Remaining coal resources. Remaining coal resources include all coal (in all categories of reliability) now present in beds, excluding coal that has been mined or lost in mining. These estimates require periodic updating owing to coal production and new coal data. In areas of no mining, remaining resources equal original resources. Remaining resources are updated by subtracting coal mined or lost in mining, from the estimates of original resources.

Reserves. (In this report, reserves include only the portion of remaining resources that could be extracted profitably.) Reserves are calculated from estimates of maximum recoverable resources, using a 50% recovery for underground mining and an 80% recovery for surface mining. Estimates of remaining resources may change owing to additional coal data or coal production, and thus the recoverable reserves may change; both require periodic updating.

GEOLOGY

Structure

Okmulgee County and eastern Okfuskee County lie around the western edge of the Ozark uplift. About 836 mi^2 are in the shelf area, one of two major structural provinces dividing the coal-bearing region of northeastern Oklahoma. About 150 mi^2 are in the Arkoma basin, the other structural province (Fig. 2). The surface rocks have a regional strike of about N. 30° E. Beds generally dip N. 60° W. at 0.5–1°.

A major NE-trending fault zone extends across eastern Okmulgee County (Pl. 2). Hemish (1988b) found that strata are downthrown along normal faults as much as 200–450 ft in some areas within the fault zone, which is in alignment with the Seneca fault zone mapped by Huffman (1958, pl. 2) to the northeast in the Ozark uplift. A commercial coal bed, which was known as the Eram coal prior to Hemish's (1988b) mapping of the fault zone in Okmulgee County, occurs in a well-defined graben and on the downthrown side of other faults within the zone. Hemish's study showed the Eram coal to be equivalent to the Mineral (Morris) coal. The outlier of coal in T. 13–14 N., R. 14–15 E., shown in Plate 2 is the Eram coal.

Another prominent structural feature, the Schulter anticline, extends through T. 12 N., R. 13 E., from

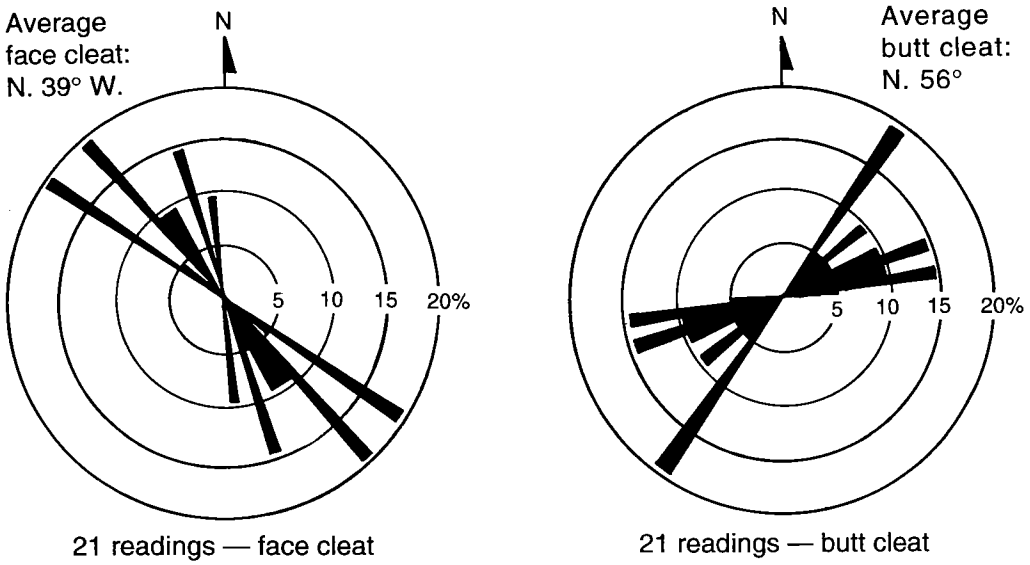

Figure 3. Rose diagrams of cleat orientations in the coal beds. Number of readings for each azimuth shown are given as percent of total.

Henryetta to Schulter. It is best described as an asymmetrical anticline with a gentle west limb and a steep, faulted east limb with dips attaining 25° locally and averaging about 5° (Oakes and Motts, 1963, p. 71–72). Knowledge of this structural feature is important to coal miners because it affects the minability of the Croweburg (Henryetta) coal bed.

Other structural features of lesser importance are discussed by Dunham and Trumbull (1955) and Oakes and Motts (1963). Small faults having displacements of only a few feet, and small-scale folds with closures ranging from 1 to ~30 ft have been found in many of the coal-mining operations. Structural configuration across the study area is shown by structure contours drawn on the Mineral and Croweburg coals (Pl. 8).

Rose diagrams (Fig. 3) were constructed from 21 measurements of cleat orientations made with a Brunton compass in the Okfuskee and Okmulgee Counties area (Appendix 4). Cleat is defined as a vertical joint or system of joints along which coal has fractured naturally (McCulloch and others, 1974, p. 2). Face cleat is the major, well-defined joint in a coal bed, and butt cleat is the poorly defined joint, commonly at right angles to the face cleat. According to McCulloch and others (1974, p. 1), "face cleats were formed as extension fractures during structural deformation, and butt cleats, as release fractures during erosion and uplift." Their studies indicate that "face cleat maintains a perpendicular orientation to the shifting axial trend of local structures." As the rose diagrams show, the face cleat strikes NW generally, and the butt cleat strikes NE. These trends suggest that the cleat structure was produced by tectonic forces associated with the Ozark uplift, which has a NE-trending axis.

Stratigraphy and Coal Resources

The coal horizons in the area studied are in rocks of Desmoinesian and Missourian (Pennsylvanian) age. These rocks consist mostly of sandstone, siltstone, and shale. Limestone and coal constitute a minor percentage of the whole. All but one of the coal beds have been named previously (Hemish, 1987a), and they have been correlated with coal beds mapped in counties to the north (Hemish, 1990). The outcrop boundaries of the four major coal beds and two minor coal beds are shown in Plates 1 and 2. A minor coal bed of no commercial value, the Tebo, was named in Missouri; the Mineral and Croweburg coals were named in Kansas; and the Jenks (another minor coal), the Dawson, and the Tulsa coals were named in Tulsa County, Oklahoma. A thin, noneconomic, unnamed coal bed is present locally in central Okmulgee County about 25–47 ft above the Croweburg coal (Fig. 4; Pl. 5; Appendix 2, measured section 31). Figure 4 shows the stratigraphic relationships of the various coal beds to the named coal-bearing units in Okmulgee and Okfuskee Counties.

Five coals have been mined at various times in the area of this report; only four are of minable thickness according to definitions given above. They are (in order of commercial importance) the Croweburg, Mineral, Dawson, and Tulsa coals. The fifth coal, the Tebo, was mined in the SE¼SE¼SE¼SW¼ sec. 24, T. 14 N., R. 14 E., where coal was taken for local use only from an outcrop along a creek. However, the outcrop and a core hole drilled <0.25 mi away (Fig. 5) indicate that the Tebo is probably not more than 0.6 ft thick in the area (Hemish, 1988a).

The Tebo coal is the oldest coal present in Okmulgee County. It occurs in the Senora Formation and is

identified by its association with a well-known marker bed, the Tiawah Limestone ("Pink lime" of surface terminology; Jordan, 1957, p. 157). Oakes (1977, pl. 1) mapped the Tebo coal and overlying Tiawah Limestone in northwestern Muskogee County but did not recognize these units in Okmulgee County (Oakes and Motts, 1963). Correlation with the Tebo coal in Muskogee County is shown in Plate 6.

The two most important commercial coals also occur in the Senora Formation. They are the Mineral coal (known locally as the Morris coal) and the Croweburg coal (known locally as the Henryetta coal).

A brachiopod-rich, sandy limestone, which in places is a highly calcareous, fossiliferous sandstone, is present in east-central Okmulgee County stratigraphically below the Mineral coal. Its known thickness ranges from 0.5 to 2.5 ft, and it occurs from <1 to >20 ft below the Mineral coal bed (Appendix 2: measured sections 33, 34, 36, 51, 56; core-hole log 8). The occurrence of this fossiliferous limestone or fossiliferous sandstone in places proved to be significant in Hemish's (1988b) substantiation of the equivalence of the Eram and Mineral (Morris) coal beds; no other coal beds in Okmulgee County are underlain by such a lithologically distinctive limestone.

The Mineral coal ranges in thickness from a featheredge to 3 ft, and it averages ~1.3 ft thick where minable; southward from the town of Morris, its thickness becomes very erratic. In the S½NW¼ sec. 6, T. 12 N., R. 14 E., the coal thins southwestward in <2,000 ft from 3 ft to 0.2 ft (Dunham and Trumbull, 1955, p. 197). In the vicinity of Lake Henryetta, in the southern part of the area, the Mineral coal occurs as thin lenses and stringers in a shaly zone and is not known to be of minable thickness. The bed could not be identified farther south. The Mineral coal also thins northward and ceases to be of minable thickness of Okmulgee County north of sec. 23, T. 15 N., R. 14 E. The interval between the Mineral coal bed and the stratigraphically higher Croweburg coal bed ranges from about 87 to 182 ft (Dunham and Trumbull, 1955, p. 197; Oakes and Motts, 1963, p. 73).

The Croweburg coal is the most important commercial bed in Okmulgee and Okfuskee Counties. In the Concharty Mountain area of northeastern Okmulgee County, the coal ranges from 1.4 to 1.7 ft in thickness. It is separated from the overlying Verdigris Limestone by only a few feet of black shale, and from the underlying McNabb Limestone by ~16 ft to as much as 67 ft of shale. The coal has not been mined extensively in the Concharty Mountains, owing to adverse topographic conditions. The coal bed thins southward to only a trace in the NW¼ sec. 11, T. 15 N., R. 14 E. From this point southward for a distance of ~4.5 mi, no evidence for deposition of the Croweburg has been found. In the north halves of secs. 4 and 5, T. 14 N., R. 14 E., the coal ranges from 0.2 to 0.5 ft thick. The coal becomes of minable thickness southward and has a maximum known thickness of 3.5 ft in the Schulter area, ~6 mi south of the city of Okmulgee (Pl. 1). A large, penecontemporaneous river channel apparently cut out the Croweburg coal in parts of secs. 26, 27, 34, and 35, T. 13 N., R. 13 E. The thickest coal in the study area is on either side of this sandstone mass. The Croweburg coal is split into several layers separated by carbonaceous shale and clay in southeastern Okfuskee County; it is doubtful that the bed is minable southward. The stratigraphic relationships of the Mineral and Croweburg coals in the study area are shown in cross sections B–B′ and C–C′ (Pls. 4,5).

Several hundred feet of sandstones and shales in the Marmaton Group separate the coal-bearing Senora Formation from the next highest named coal bed, the Jenks coal (Fig. 4). The coal occurs in the Holdenville Formation. near the top of the Marmaton Group. The Jenks coal is a thin, discontinuous, noneconomic coal first observed, but not named, in two places in northwestern Okmulgee County (Luff, 1957, p. 69, 74). The Jenks coal was named by Hemish (1990) in Tulsa County. The outcrops observed by Luff are mapped in Plate 1.

The youngest Desmoinesian-age coal bed, the Dawson coal, occurs just above the Jenks sandstone (also called the lower Cleveland sand, a subsurface name [Jordan, 1957, p. 45]). It is of only marginal commercial value and is not known to exceed 0.8 ft in thickness where observed in northwestern Okmulgee County. The Dawson coal thins southwestward and was not observed in outcrop in Okfuskee County. It was found in a core hole (No. 6, Appendix 2) drilled in the SE¼SW¼NW¼SW¼SE¼ sec. 31, T. 13 N., R. 10 E., Okfuskee County, where it is split into three thin stringers separated by thin underclays (Hemish, 1987a, p. 96). This occurrence of the Dawson coal is the southernmost known.

The Tulsa coal occurs 60–66 ft above the Dawson coal (Hemish, 1988a p. 139–140, 145–146) in Okmulgee and eastern Okfuskee Counties. It is the oldest Missourian coal and, for purposes of this report, is selected as the basal bed of the Skiatook Group (Fig. 4). The Tulsa coal is of marginal commercial value and is known to be 0.8 ft thick only locally in northwestern Okmulgee County. Outcrops of the coal were found in northeastern Okfuskee County, where it occurs <2 ft below the Checkerboard Limestone (measured sections 15 and 30, Appendix 2). The bed is split into three 0.1-ft-thick stringers separated by underclays in secs. 3 and 4. T. 12 N., R. 10 E., the southernmost known occurrences of the Tulsa coal (Hemish, 1987b, p. 172, 175). Relationship of the Dawson and Tulsa coal beds in northwestern Okmulgee County and northeastern Okfuskee County is shown in cross section A–A′ (Pl. 3).

COAL QUALITY

Coals of Okmulgee County and eastern Okfuskee County are predominantly of high-volatile A bituminous (hvAb) and high-volatile B bituminous (hvBb)

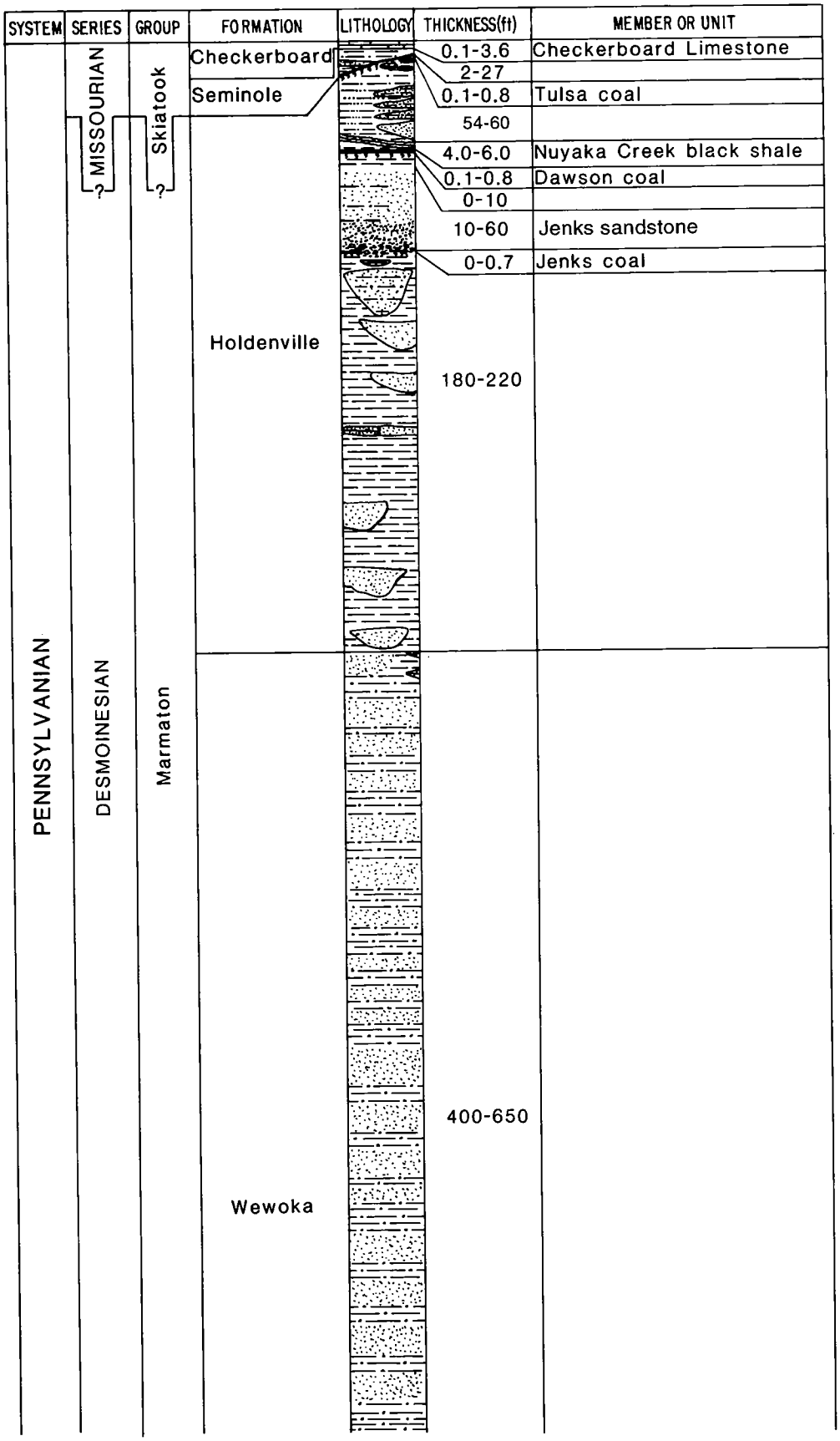

Figure 4 *(above and opposite page)*. Generalized columnar section of coal-bearing strata, Okmulgee and Okfuskee Counties, Oklahoma.

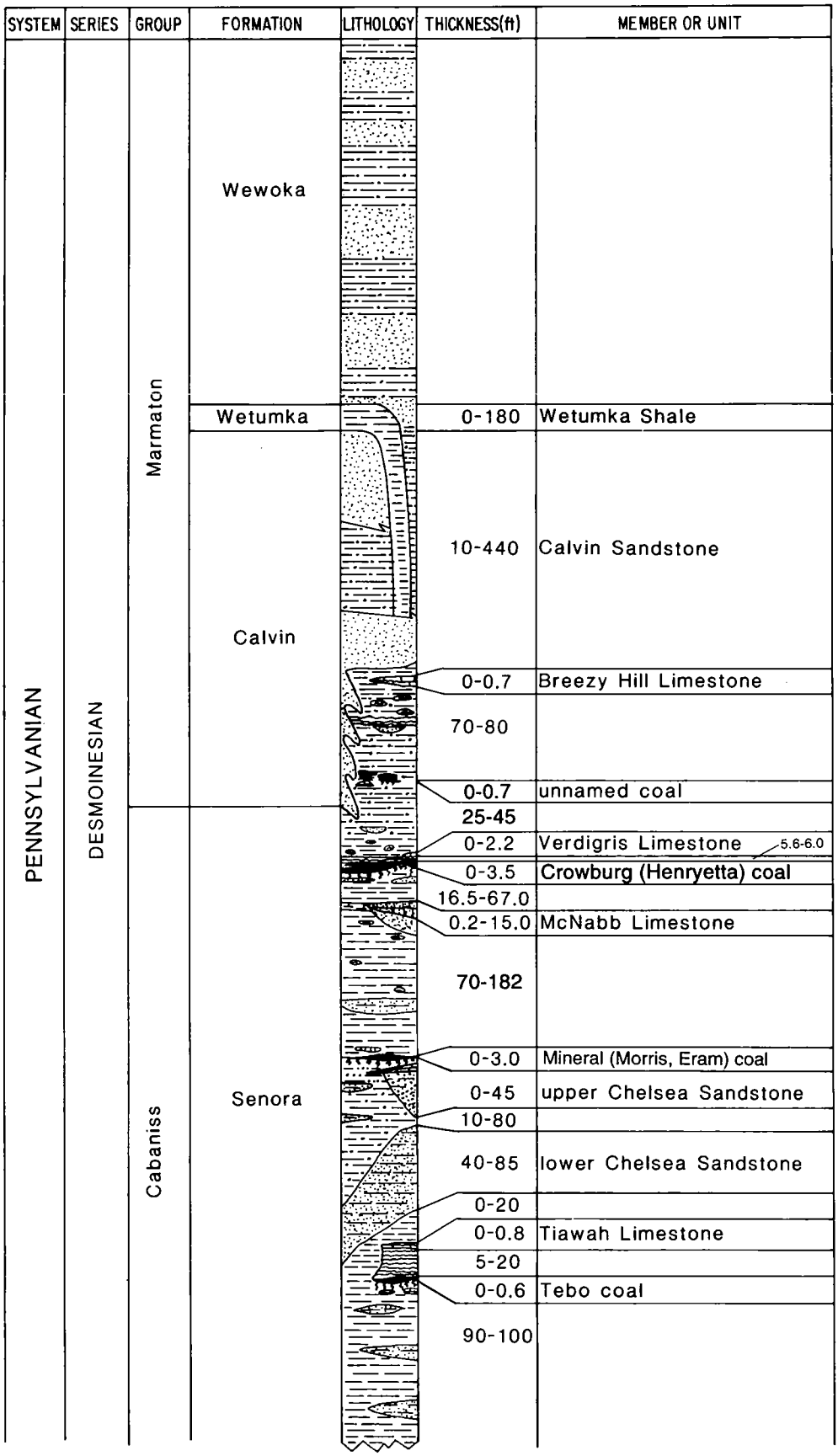

Figure 4 *(continued)*.

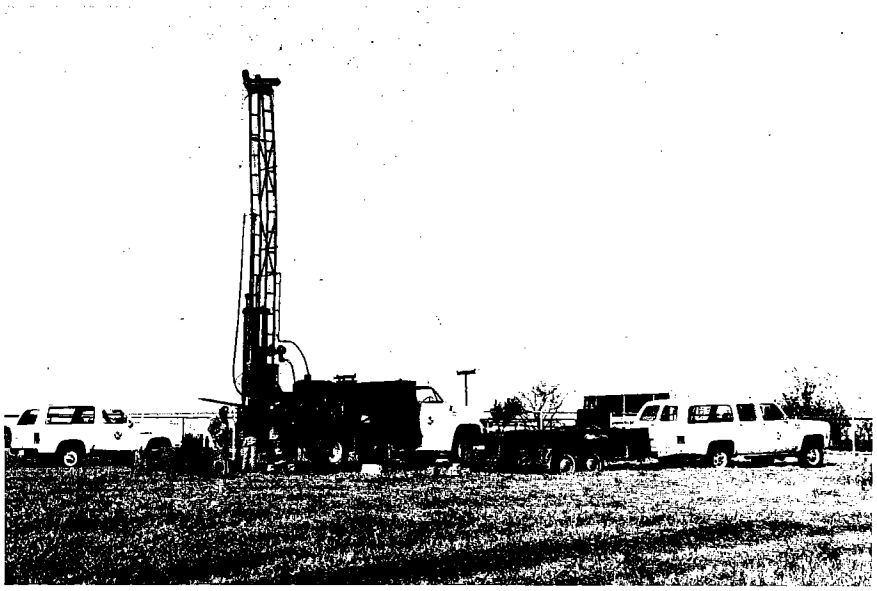

Figure 5. View of the Oklahoma Geological Survey drill rig coring the Tebo coal in the SW¼NW¼NE¼NW¼NE¼ sec. 25, T. 14 N., R. 14 E., Okmulgee County (core hole 12, Appendix 2; Pls. 2,6).

rank (Appendix 3). Rank was determined by standard procedures of the American Society for Testing and Materials (ASTM, 1987, p. 225–228). Average values for the various analytical properties of each coal are listed in Appendix 3, based on data from 171 analytical reports (Table A3-1). Only those analyses from samples collected and analyzed under conditions prescribed by the American Society for Testing and Materials were used (ASTM, 1987, p. 226, 7.1).

More than 100 analyses from Table A3-1 indicate that the Croweburg coal has the highest overall quality. On an as-received basis, its average fixed-carbon content is 50.3%, average ash content is 8.8%, and average sulfur content is 2.6%. On the moist, mineral-matter-free basis, the Croweburg coal averages 13,753 Btu/lb. The other coals all have lower fixed-carbon contents, higher ash and sulfur contents, and lower heat values (where more than two samples were averaged). Because of its superior qualities, greater bed thickness, and amenability to both surface and underground mining, the Croweburg coal has the greatest potential for utilization.

COAL ECONOMICS

Production

Coal-mining operations began in Okmulgee County in 1902 (Dunham and Trumbull, 1955, p. 203). The earliest reported production of coal was in 1908. Since that time, a recorded total of 32,664,742 short tons has been taken from underground mines and strip mines (Fig. 6). Production peaked in 1920 following World War I when 1,477,677 tons were mined. Production of coal declined during the 1930s. A period of rapid expansion occurred during and following World War II, and production reached 1,164,622 tons in 1947. Production again declined in the 1960s, and from 1971 to 1974, no coal was produced in Okmulgee County. There was another upturn in the industry from 1976 to 1983, during which production reached a high of 589,957 tons reported mined in 1980. All of the coal produced in Okmulgee County in the 1970s and 1980s was mined by surface methods (Fig. 7). In the early history of mining in Okmulgee County (and in the state as a whole) most of the coal was mined underground (Trumbull, 1957, p. 362). Friedman (1974, p. 48) showed that ~95% of the coal produced in Okmulgee County from 1953 to 1973 was mined by underground methods. A map of the abandoned underground mines in the study area was compiled by Friedman and is included in this report (Pl. 7). Coal production in the county for the year 1989, when this report was written, was only 45,497 tons, from one small stripping operation, and from one underground mine that opened in September 1989 (Fig. 8) (Hemish 1989b; Oklahoma Department of Mines, 1989).

No production of coal has ever been reported officially from Okfuskee County, although abandoned mine shafts are present in secs. 15 and 28, T. 10 N., R. 12 E. A local resident said that coal was mined during the 1940s in the hills southwest of the North Canadian River in sec. 28.

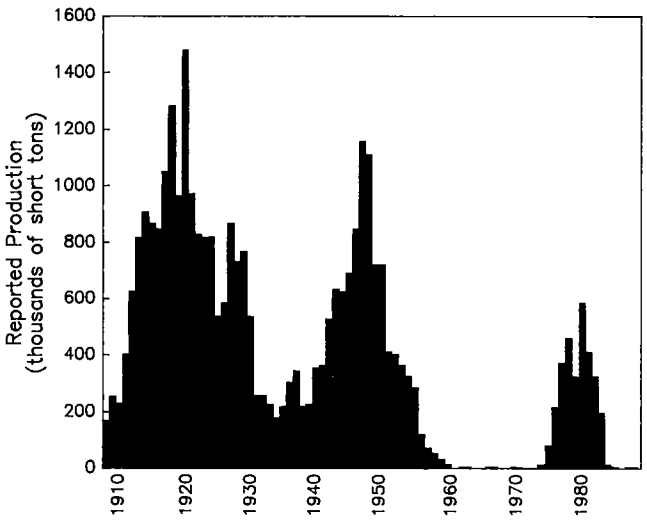

Figure 6. Histogram illustrating reported production of coal in Okmulgee County, 1908–88.

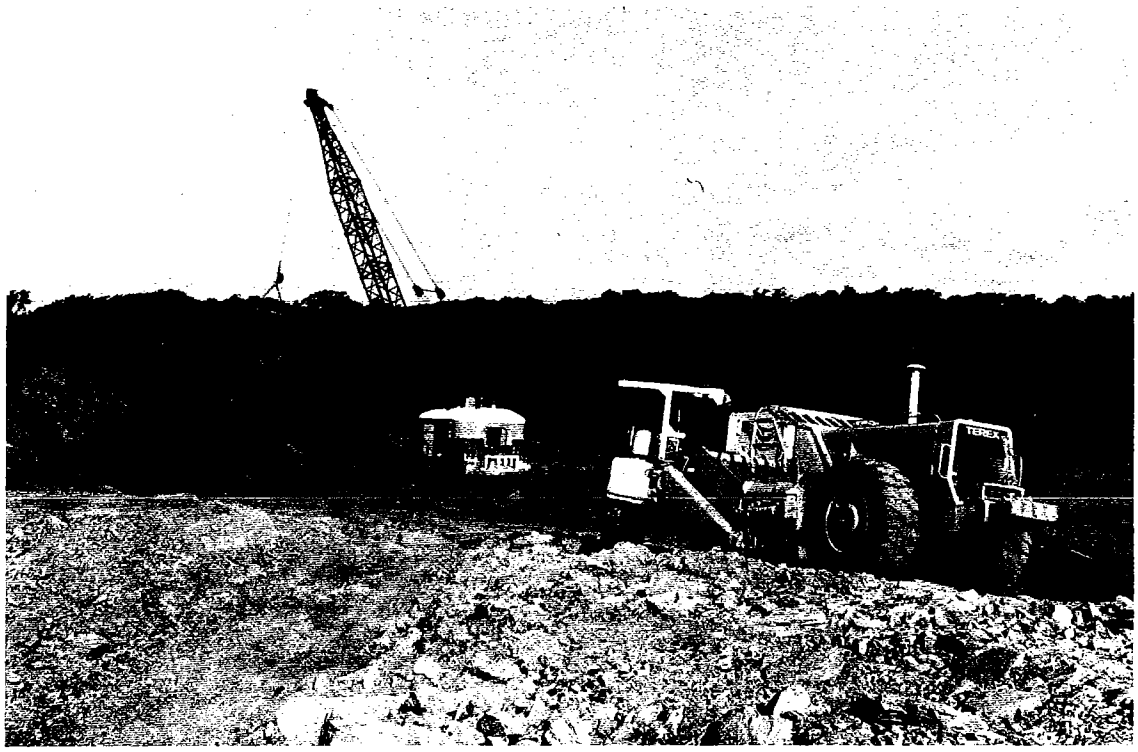

Figure 7. P&K Coal Co., Ltd. strip mining 2.5 ft of Croweburg coal in 1983 in the NW¼SE¼ sec. 17, T. 11 N., R. 13 E., Okmulgee County.

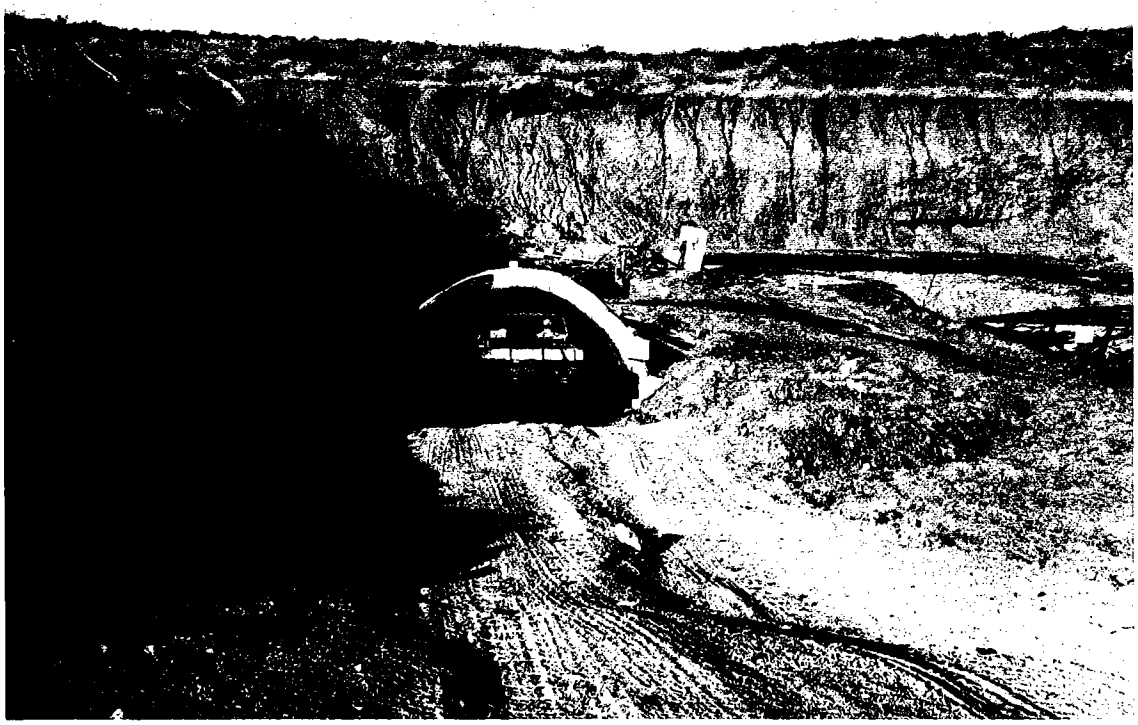

Figure 8. Diesel pickup entering the Pollyanna No. 4 Mine at the entry to the No. 1 tunnel (from Hemish, 1989b, fig. 4).

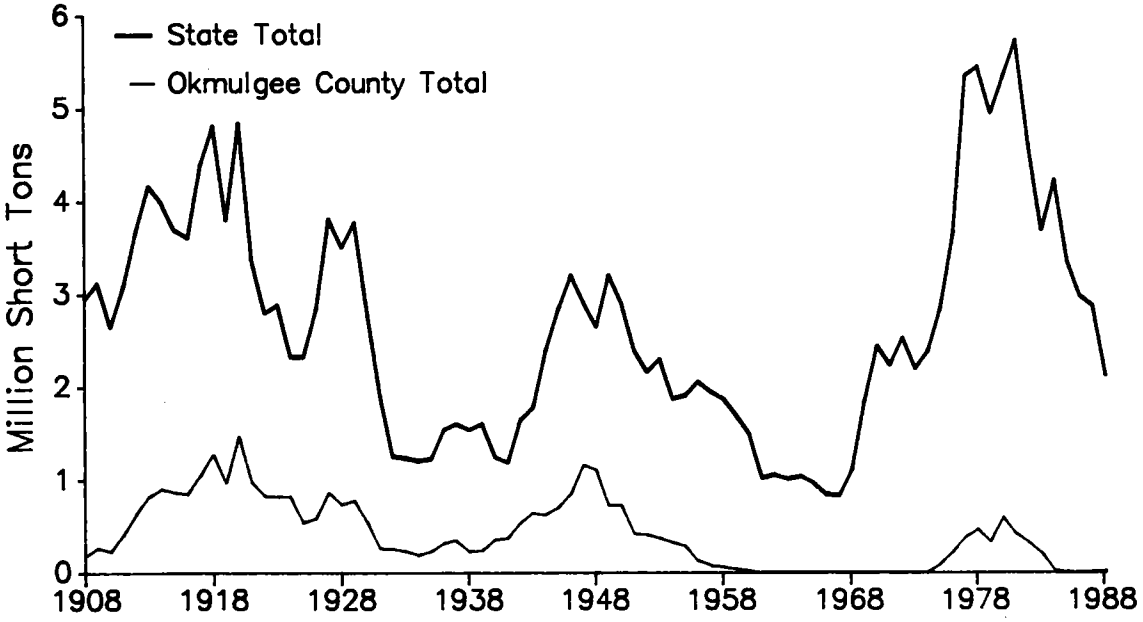

Figure 9. Production of coal in Oklahoma, by state total and by total of Okmulgee County, 1908–88. (Data from 1908 to 1931 from USGS, Mineral Resources of the United States; data from 1932 to 1948 from USBM, Minerals Yearbooks; data from 1949 to 1988 from Oklahoma Department of Mines Annual Reports.)

Figure 9 compares the total State production of coal in Oklahoma with the total production of coal from Okmulgee County for the years 1908–88. During that time ~15% of the State's total production came from Okmulgee County.

Resources and Reserves

Data on the resources and reserves of the coals described in this report are shown in Tables 1 and 2, and in Appendix 1. Original resources, remaining resources, coal mined or lost in mining, and reserves are tabulated by coal beds for each of the two counties. Grand totals for the two-county area as a whole are also listed.

Remaining resources of coal, for the area as a whole, total 496,088,000 short tons, of which 15,707,000 short tons are reserves.

In the two-county area as a whole, the Croweburg coal bed has the most remaining resources and reserves, 447,018,000 short tons and 10,185,000 short tons, respectively.

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APPENDIXES

Appendix 1: Coal Resources and Reserves by Township and Range and by Coal Bed

(thousands of short tons)

Coal	Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
		0.8 - 1.2 ft		1.2 - 2.4 ft		2.4 - 3.5 ft		> 3.5 ft		Total Remaining Resources							
		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
T10N, R11E, OKFUSKEE COUNTY																	
CROWEBURG																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100					448	2,298			448	2,298			448	2,298		
	Total					448	2,298			448	2,298			448	2,298		
	Indicated																
	0-20																
	20-40																
	40-100																
	>100			40	170	1,262	5,751			1,302	5,921			1,302	5,921		
	Total			40	170	1,262	5,751			1,302	5,921			1,302	5,921		
	Inferred																
	0-20																
	20-40																
	40-100																
	>100			1,029	3,890	2,309	12,470			3,338	16,360			3,338	16,360		
	Total			1,029	3,890	2,309	12,470			3,338	16,360			3,338	16,360		
	Grand Total			1,069	4,060	4,019	20,519			5,088	24,579			5,088	24,579		
T10N, R12E, OKFUSKEE COUNTY																	
CROWEBURG																	
	Measured																
	0-20	41	75	87	252					128	327	1	4	129	331	128	312
	20-40	63	117	138	383					201	500			201	500	82	194
	40-100	64	127	182	583	2	7			248	717			248	717	4	12
	>100			247	896	20	93			267	989			267	989		
	Total	168	319	654	2,114	22	100			844	2,533			845	2,537	214	518
	Indicated																
	0-20	52	97	119	348					171	445			171	445	171	427
	20-40	186	358	204	597					390	955			390	955	154	357
	40-100	268	520	725	2,123					993	2,643			993	2,643	3	9
	>100			2,066	6,964	664	3,187			2,730	10,151			2,730	10,151		
	Total	506	975	3,114	10,032	664	3,187			4,284	14,194			4,284	14,194	328	793
	Inferred																
	0-20	30	59	118	335					148	394			148	394	148	312
	20-40	5	10	117	356					122	366			122	366	81	203
	40-100			467	1,554					467	1,554			467	1,554		
	>100			6,546	24,596	1,674	7,751			8,220	32,347			8,220	32,347		
	Total	35	69	7,248	26,841	1,674	7,751			8,957	34,661			8,957	34,661	229	515
	Grand Total	709	1,363	11,016	38,987	2,360	11,038			14,085	51,388	1	4	14,086	51,392	771	1,826

T11N, R11E, OKFUSKEE COUNTY

CROWEBURG

Measured										
0-20										
20-40										
40-100										
>100			271	1,440		271	1,440		271	1,440
Total			271	1,440		271	1,440		271	1,440
Indicated										
0-20										
20-40										
40-100										
>100			1,937	10,278		1,937	10,278		1,937	10,278
Total			1,937	10,278		1,937	10,278		1,937	10,278
Inferred										
0-20										
20-40										
40-100										
>100			6,326	32,934		6,326	32,934		6,326	32,934
Total			6,326	32,934		6,326	32,934		6,326	32,934
Grand Total			8,534	44,652		8,534	44,652		8,534	44,652

T11N, R12E, OKMULGEE COUNTY

CROWEBURG

Measured										
0-20							3,437	17,251		
20-40										
40-100										
>100	325	1,311	3,798	19,093	4,123	20,404			7,560	37,655
Total	325	1,311	3,798	19,093	4,123	20,404			7,560	37,655
Indicated										
0-20										
20-40										
40-100										
>100	1,401	5,602	6,369	34,032	7,770	39,634			7,770	39,634
Total	1,401	5,602	6,369	34,032	7,770	39,634			7,770	39,634
Inferred										
0-20										
20-40										
40-100										
>100	2,918	11,660	4,723	24,893	7,641	36,553			7,641	36,553
Total	2,918	11,660	4,723	24,893	7,641	36,553			7,641	36,553
Grand Total	4,644	18,573	14,890	78,018	19,534	96,591	3,437	17,251	22,971	113,842

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
		0.8 - 1.2 ft		1.2 - 2.4 ft		2.4 - 3.5 ft		> 3.5 ft		Total Remaining Resources							
		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
								T11N, R13E, OKMULGEE COUNTY									
CROWEBURG																	
	Measured																
	0-20			52	217	199	942			251	1,159	2,304	11,656	2,555	12,815	251	926
	20-40			39	162	92	438			131	600			131	600	131	480
	40-100			129	523	456	2,261			585	2,784			585	2,784	147	584
	>100			192	801	552	2,752			744	3,553			744	3,553		
	Total			412	1,703	1,299	6,393			1,711	8,096			4,015	19,752	529	1,990
	Indicated																
	0-20			14	58	60	271			74	329			74	329	74	262
	20-40			9	37	67	303			76	340			76	340	76	272
	40-100			52	217	236	1,288			288	1,505			288	1,505	77	269
	>100			1,154	4,685	693	3,186			1,847	7,871			1,847	7,871		
	Total			1,229	4,997	1,056	5,048			2,285	10,045			2,285	10,045	227	803
	Inferred																
	0-20					19	87			19	87			19	87	19	70
	20-40					22	98			22	98			22	98	22	79
	40-100			12	51	22	100			34	151			34	151	7	24
	>100			1,300	5,149	244	1,144			1,544	6,293			1,544	6,293		
	Total			1,312	5,200	307	1,429			1,619	6,629			1,619	6,629	48	173
	Grand Total			2,953	11,900	2,662	12,870			5,615	24,770	2,304	11,656	7,919	36,426	804	2,966
								T12N, R11E, OKFUSKEE COUNTY									
CROWEBURG																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100			136	488					136	488			136	488		
	Total			136	488					136	488			136	488		
	Indicated																
	0-20																
	20-40																
	40-100																
	>100			991	3,569					991	3,569			991	3,569		
	Total			991	3,569					991	3,569			991	3,569		
	Inferred																
	0-20																
	20-40																
	40-100																
	>100			6,971	26,515	1,061	4,773			8,032	31,288			8,032	31,288		
	Total			6,971	26,515	1,061	4,773			8,032	31,288			8,032	31,288		
	Grand Total			8,098	30,572	1,061	4,773			9,159	35,345			9,159	35,345		

T12N, R12E, OKMULGEE COUNTY

CROWEBURG

Measured												
0-20									2,532	15,499		
20-40												
40-100												
>100			104	403	3,548	20,175	3,652	20,578			6,184	36,077
Total			104	403	3,548	20,175	3,652	20,578			6,184	36,077
Indicated												
0-20												
20-40												
40-100												
>100			671	2,538	10,141	56,840	10,812	59,378			10,812	59,378
Total			671	2,538	10,141	56,840	10,812	59,378			10,812	59,378
Inferred												
0-20												
20-40												
40-100												
>100			5,231	19,334	3,899	21,122	9,130	40,456			9,130	40,456
Total			5,231	19,334	3,899	21,122	9,130	40,456			9,130	40,456
Grand Total			6,006	22,275	17,588	98,137	23,594	120,412	2,532	15,499	26,126	135,911

T12N, R13E, OKMULGEE COUNTY

CROWEBURG

Measured														
0-20	1	3	7	23	69	360	77	386	5,763	30,946	5,840	31,332	77	309
20-40	1	3	9	26	71	367	81	396			81	396	76	305
40-100	40	70	147	558	760	4,014	947	4,642			947	4,642	308	1,298
>100			3	7	1,116	5,991	1,119	5,998			1,119	5,998		
Total	42	76	166	614	2,016	10,732	2,224	11,422			7,987	42,368	461	1,912
Indicated														
0-20	3	4					3	4			3	4	3	3
20-40	30	53					30	53			30	53		
40-100	79	144	392	1,364	301	1,563	772	3,071			772	3,071	114	436
>100			239	839	734	3,966	973	4,805			973	4,805		
Total	112	201	631	2,203	1,035	5,529	1,778	7,933			1,778	7,933	117	439
Inferred														
0-20														
20-40	11	19					11	19			11	19		
40-100	67	121	203	756	257	1,295	527	2,172			527	2,172	92	360
>100			452	1,555	288	1,693	740	3,248			740	3,248		
Total	78	140	655	2,311	545	2,988	1,278	5,439			1,278	5,439	92	360
Grand Total	232	417	1,452	5,128	3,596	19,249	5,280	24,794	5,763	30,946	11,043	55,740	670	2,711

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8 - 1.2 ft Acres	0.8 - 1.2 ft Tons	1.2 - 2.4 ft Acres	1.2 - 2.4 ft Tons	2.4 - 3.5 ft Acres	2.4 - 3.5 ft Tons	> 3.5 ft Acres	> 3.5 ft Tons	Total Remaining Resources Acres	Total Remaining Resources Tons	Mined or Lost in Mining* Acres	Mined or Lost in Mining* Tons	Original Resources Acres	Original Resources Tons	Reserves Acres	Reserves Tons
							T12N, R13E, OKMULGEE COUNTY *(continued)*										
MINERAL																	
	Measured																
	0-20	5	11	7	16					12	27			12	27	12	21
	20-40	19	34	5	12					24	46			24	46	3	5
	40-100	37	59	6	13					43	72			43	72		
	>100																
	Total	61	104	18	41					79	145			79	145	15	26
	Indicated																
	0-20	28	48	10	24					38	72			38	72	38	58
	20-40	38	62	34	87					72	149			72	149	16	33
	40-100	200	358	235	589					435	947			435	947		
	>100																
	Total	266	468	279	700					545	1,168			545	1,168	54	91
	Inferred																
	0-20	28	52	10	24					38	76			38	76	38	60
	20-40	24	45	16	41					40	86			40	86	8	16
	40-100	48	92	1,303	3,276					1,351	3,368			1,351	3,368		
	>100			1,132	2,852					1,132	2,852			1,132	2,852		
	Total	100	189	2,461	6,193					2,561	6,382			2,551	6,382	46	76
	Grand Total	427	761	2,758	6,934					3,185	7,695			3,185	7,695	115	193
	Combined Grand Total	659	1,178	4,210	12,062	3,596	19,249			8,465	32,489	5,763	30,946	14,228	63,435	785	2,904
							T12N, R14E, OKMULGEE COUNTY										
MINERAL																	
	Measured																
	0-20	12	20	15	43					27	63	2	7	29	70	27	51
	20-40	23	42	14	35					37	77			37	77	14	28
	40-100	7	10							7	10			7	10		
	>100																
	Total	42	72	29	78					71	150			73	157	41	79
	Indicated																
	0-20	2	4	8	18					10	22			10	22	10	17
	20-40	7	12	2	4					9	16			9	16	2	3
	40-100																
	>100																
	Total	9	16	10	22					19	38			19	38	12	20
	Inferred																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Grand Total	51	88	39	100					90	188	2	7	92	195	53	99

T13N, R12E, OKMULGEE COUNTY

CROWEBURG

Measured														
0-20														
20-40														
40-100														
>100														
Total														
Indicated														
0-20														
20-40														
40-100														
>100														
Total														
Inferred														
0-20														
20-40														
40-100														
>100			2,350	8,039	125	557	2,475	8,596			2,475	8,596		
Total			2,350	8,039	125	557	2,475	8,596			2,475	8,596		
Grand Total			2,350	8,039	125	557	2,475	8,596			2,475	8,596		

T13N, R13E, OKMULGEE COUNTY

CROWEBURG

Measured														
0-20	35	63	198	625	34	151	267	839	559	2,107	826	2,946	267	672
20-40	56	97	328	1,025			384	1,122			384	1,122	241	618
40-100	1	2	938	2,989	8	40	947	3,031			947	3,031	8	32
>100														
Total	92	162	1,464	4,639	42	191	1,598	4,992			2,157	7,099	516	1,322
Indicated														
0-20	11	23	4	9			15	32			15	32	15	26
20-40	4	6					4	6			4	6		
40-100	239	464	1,260	3,855			1,499	4,319			1,499	4,319		
>100														
Total	254	493	1,264	3,864			1,518	4,357			1,518	4,357	15	26
Inferred														
0-20														
20-40														
40-100	368	671	885	2,279			1,253	2,950			1,253	2,950		
>100			561	1,313			561	1,313			561	1,313		
Total	368	671	1,446	3,592			1,814	4,263			1,814	4,263		
Grand Total	714	1,326	4,174	12,095	42	191	4,930	13,612	559	2,107	5,489	15,719	531	1,348

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
		0.8 - 1.2 ft		1.2 - 2.4 ft		2.4 - 3.5 ft		> 3.5 ft		Total Remaining Resources							
		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
								T13N, R13E, OKMULGEE COUNTY *(continued)*									
MINERAL																	
	Measured																
	0-20	14	21	21	53					35	74			35	74	35	59
	20-40	36	54	59	147					95	201			95	201	24	47
	40-100	20	33	49	115					69	148			69	148		
	>100																
	Total	70	108	129	315					199	423			199	423	59	106
	Indicated																
	0-20	3	5	20	52					23	57			23	57	23	46
	20-40	122	190	76	190					198	380			198	380	38	75
	40-100	430	782	615	1,502					1,045	2,284			1,045	2,284		
	>100																
	Total	555	977	711	1,744					1,266	2,721			1,266	2,721	61	121
	Inferred																
	0-20																
	20-40	12	26	20	45					32	71			32	71	2	4
	40-100	537	1,006	213	535					750	1,541			750	1,541		
	>100			2,306	5,810					2,306	5,810			2,306	5,810		
	Total	549	1,032	2,539	6,390					3,088	7,422			3,088	7,422	2	4
	Grand Total	1,174	2,117	3,379	8,449					4,553	10,566			4,553	10,566	122	231
	Combined Grand Total	1,888	3,443	7,553	20,544	42	191			9,483	24,178	559	2,107	10,042	26,285	653	1,579
								T13N, R14E, OKMULGEE COUNTY									
CROWEBURG																	
	Measured																
	0-20			10	33					10	33	16	55	26	88	10	26
	20-40																
	40-100																
	>100																
	Total			10	33					10	33			26	88	10	26
	Indicated																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Inferred																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Grand Total			10	33					10	33	16	55	26	88	10	26

MINERAL															
Measured															
0-20	51	93	157	457	31	163	239	713	199	472	438	1,185	239	571
20-40	19	37	212	419	20	108	251	564			251	564	99	268
40-100	66	128	263	765	43	227	372	1,070			372	1,070	9	40
>100			58	167	34	173	92	340			92	340		
Total	136	258	690	1,758	128	671	954	2,687			1,153	3,159	347	879
Indicated														
0-20	84	156	193	498	29	141	306	795			306	795	306	637
20-40	390	668	188	559	26	124	604	1,351			604	1,351	177	457
40-100	184	305	352	901	94	448	630	1,654			630	1,654	15	58
>100			29	112	100	503	129	615			129	615		
Total	658	1,129	762	2,070	249	1,216	1,669	4,415			1,669	4,415	498	1,152
Inferred														
0-20	2	4	48	113	2	8	52	125			52	125	52	99
20-40	43	89	22	49	1	4	66	142			66	142	23	43
40-100	59	105	32	72	3	14	94	191			94	191	1	1
>100					4	18	4	18			4	18		
Total	104	198	102	234	10	44	216	476			216	476	76	143
Grand Total	898	1,585	1,554	4,062	387	1,931	2,839	7,578	199	472	3,038	8,050	921	2,174
Combined Grand Total	898	1,585	1,564	4,095	387	1,931	2,849	7,611	215	527	3,064	8,138	931	2,200

T13N, R15E, OKMULGEE COUNTY

MINERAL														
Measured														
0-20			15	47			15	47			15	47	15	38
20-40			6	18			6	18			6	18	4	11
40-100			1	3			1	3			1	3		
>100														
Total			22	68			22	68			22	68	19	49
Indicated														
0-20														
20-40														
40-100														
>100														
Total														
Inferred														
0-20														
20-40														
40-100														
>100														
Total														
Grand Total			22	68			22	68			22	68	19	49

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
		0.8 - 1.2 ft		1.2 - 2.4 ft		2.4 - 3.5 ft		> 3.5 ft		Total Remaining Resources							
		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
T14N, R13E, OKMULGEE COUNTY																	
CROWEBURG																	
	Measured																
	0-20																
	20-40	50	100	41	109					91	209			91	209	6	16
	40-100	148	280	255	806	68	332			471	1,418			471	1,418	71	274
	>100																
	Total	198	380	296	915	68	332			562	1,627			562	1,627	77	290
	Indicated																
	0-20																
	20-40																
	40-100	229	454	70	143					299	597			299	597		
	>100																
	Total	229	454	70	143					299	597			299	597		
	Inferred																
	0-20																
	20-40																
	40-100	15	23							15	23			15	23		
	>100																
	Total	15	23							15	23			15	23		
	Grand Total	442	857	366	1,058	68	332			876	2,247			876	2,247		
T14N, R14E, OKMULGEE COUNTY																	
CROWEBURG																	
	Measured																
	0-20	82	148	207	559					289	707	387	1,184	676	1,891	296	566
	20-40	253	456	178	479					431	935			431	935	128	287
	40-100	303	560	65	148					368	708			368	708		
	>100																
	Total	638	1,164	450	1,186					1,088	2,350			1,475	3,534	424	853
	Indicated																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Inferred																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Grand Total	638	1,164	450	1,186					1,088	2,350	387	1,184	1,475	3,534	424	853

MINERAL															
Measured															
0-20	141	275	149	394	11	62	301	731	540	1,494	841	2,225	301	596
20-40	194	353	214	566	48	257	456	1,176			456	1,176	166	458
40-100	419	759	331	874	23	117	773	1,750			773	1,750	23	94
>100			24	57			24	57			24	57		
Total	754	1,387	718	1,891	82	436	1,554	3,714			2,094	5,208	490	1,148
Indicated														
0-20	150	283					150	283			150	283	150	226
20-40	139	245	1	2			140	247			140	247	1	1
40-100	164	277	35	87			199	364			199	364		
>100														
Total	453	805	36	89			489	894			489	894	151	227
Inferred														
0-20	24	48					24	48			24	48	24	38
20-40	13	21					13	21			13	21		
40-100														
>100														
Total	37	69					37	69			37	69	24	38
Grand Total	1,244	2,261	754	1,980	82	436	2,080	4,677	540	1,494	2,620	6,171	665	1,413
Combined Grand Total	1,882	3,425	1,204	3,166	82	436	3,168	7,027	927	2,678	4,095	9,705	1,089	2,266

T14N, R15E, OKMULGEE COUNTY

MINERAL														
Measured														
0-20	6	12	30	78	18	93	54	183	90	255	144	438	54	146
20-40			22	61	16	92	38	153			38	153	27	99
40-100			39	120	8	46	47	166			47	166	8	37
>100			15	48			15	48			15	48		
Total	6	12	106	307	42	231	154	550			244	805	89	282
Indicated														
0-20														
20-40														
40-100														
>100														
Total														
Inferred														
0-20														
20-40														
40-100														
>100														
Total														
Grand Total	6	12	106	307	42	231	154	550	90	255	244	805	89	282

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources										Mined or Lost in Mining*		Original Resources		Reserves	
		0.8 - 1.2 ft		1.2 - 2.4 ft		2.4 - 3.5 ft		> 3.5 ft		Total Remaining Resources							
		Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons	Acres	Tons
								T15N, R11E, OKMULGEE COUNTY									
TULSA																	
	Measured																
	0-20	45	65							45	65	1	1	46	66	45	52
	20-40	26	38							26	38			26	38		
	40-100	4	5							4	5			4	5		
	>100																
	Total	75	108							75	108			76	109	45	52
	Indicated																
	0-20	24	34							24	34			24	34	24	27
	20-40	8	12							8	12			8	12		
	40-100	88	127							88	127			88	127		
	>100																
	Total	120	173							120	173			120	173	24	27
	Inferred																
	0-20																
	20-40																
	40-100	54	78							54	78			54	78		
	>100																
	Total	54	78							54	78			54	78		
	Grand Total	249	359							249	359	1	1	250	360	69	79
DAWSON																	
	Measured																
	0-20	53	76							53	76	1	1	54	77	53	61
	20-40	54	77							54	77			54	77		
	40-100	8	12							8	12			8	12		
	>100																
	Total	115	165							115	165			116	166	53	61
	Indicated																
	0-20	153	220							153	220			153	220	153	176
	20-40	124	179							124	179			124	179		
	40-100	479	690							479	690			479	690		
	>100																
	Total	756	1,089							756	1,089			756	1,089	153	176
	Inferred																
	0-20	24	34							24	34			24	34	24	27
	20-40	69	99							69	99			69	99		
	40-100	352	507							352	507			352	507		
	>100																
	Total	445	640							445	640			445	640	24	27
	Grand Total	1,316	1,894							1,316	1,894	1	1	1,317	1,895	230	264
	Combined Grand Total	1,565	2,253							1,565	2,253	2	2	1,567	2,255	299	343

T15N, R12E, OKMULGEE COUNTY

DAWSON

Measured								
0-20	17	24	17	24	17	24	17	19
20-40								
40-100								
>100								
Total	17	24	17	24	17	24	17	19
Indicated								
0-20	87	125	87	125	87	125	87	100
20-40	58	84	58	84	58	84		
40-100	33	47	33	47	33	47		
>100								
Total	178	256	178	256	178	256	87	100
Inferred								
0-20	4	6	4	6	4	6	4	4
20-40								
40-100								
>100								
Total	4	6	4	6	4	6	4	4
Grand Total	199	286	199	286	199	286	108	123

T15N, R14E, OKMULGEE COUNTY

CROWEBURG

Measured								
0-20	16	26	16	26	16	26	16	21
20-40	5	9	5	9	5	9		
40-100	17	12	17	12	17	12		
>100								
Total	38	47	38	47	38	47	16	21
Indicated								
0-20	1	1	1	1	1	1	1	1
20-40								
40-100								
>100								
Total	1	1	1	1	1	1	1	1
Inferred								
0-20								
20-40								
40-100								
>100								
Total								
Grand Total	39	48	39	48	39	48	17	22

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8 - 1.2 ft Acres	0.8 - 1.2 ft Tons	1.2 - 2.4 ft Acres	1.2 - 2.4 ft Tons	2.4 - 3.5 ft Acres	2.4 - 3.5 ft Tons	> 3.5 ft Acres	> 3.5 ft Tons	Total Remaining Resources Acres	Total Remaining Resources Tons	Mined or Lost in Mining* Acres	Mined or Lost in Mining* Tons	Original Resources Acres	Original Resources Tons	Reserves Acres	Reserves Tons
MINERAL							T15N, R14E, OKMULGEE COUNTY *(continued)*										
	Measured																
	0-20	220	388	115	296					335	684	158	375	493	1,059	336	547
	20-40	268	480	44	105					312	585			312	585	27	51
	40-100	354	641	73	168					427	809			427	809		
	>100																
	Total	842	1,509	232	569					1,074	2,078			1,232	2,453	363	598
	Indicated																
	0-20	6	9	5	12					11	21			11	21	11	17
	20-40	40	75							40	75			40	75		
	40-100	739	1,277							739	1,277			739	1,277		
	>100																
	Total	785	1,361	5	12					790	1,373			790	1,373	11	17
	Inferred																
	0-20																
	20-40																
	40-100	27	40							27	40			27	40		
	>100																
	Total	27	40							27	40			27	40		
	Grand Total	1,654	2,910	237	581					1,891	3,491	158	375	2,049	3,866	374	615
	Combined Grand Total	1,693	2,958	237	581					1,930	3,539	158	375	2,088	3,914	391	637
							T16N, R14E, OKMULGEE COUNTY										
CROWEBURG																	
	Measured																
	0-20	14	26	18	45					32	71	5	13	37	84	32	57
	20-40	12	23	26	66					38	89			38	89	9	18
	40-100	22	40	113	307					135	347			135	347		
	>100			56	161					56	161			56	161		
	Total	48	89	213	579					261	668			266	681	41	75
	Indicated																
	0-20	13	26	40	104					53	130			53	130	53	104
	20-40	16	31	45	115					61	146			61	146	19	39
	40-100	147	283	166	419					313	702			313	702		
	>100			443	1,277					443	1,277			443	1,277		
	Total	176	340	694	1,915					870	2,255			870	2,255	72	143
	Inferred																
	0-20	33	68	55	130					88	198			88	198	88	158
	20-40	28	59	86	201					114	260			114	260	31	57
	40-100	321	637	239	579					560	1,216			560	1,216		
	>100			1,750	4,722					1,750	4,722			1,750	4,722		
	Total	382	764	2,130	5,632					2,512	6,396			2,512	6,396	119	215
	Grand Total	606	1,193	3,037	8,126					3,643	9,319	5	13	3,648	9,332	232	433

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Appendix 2: Measured Sections and Core-Hole Logs

MEASURED SECTION 1

SW¼ sec. 14 and NW¼ sec. 23, T. 10 N., R. 12 E., Okfuskee County. Measured from top of hill in the NE¼SE¼SW¼SW¼ sec. 14 downhill slope to cutbank of southwest-flowing tributary of Parsley Creek, in NW¼NE¼SW¼NW¼ sec. 23, by LeRoy A. Hemish. Field notebook designation OO-1-82-H and OO-39-81-H (combined). (Estimated elevation at top of section, 920 ft.)

	Thickness (ft)
MARMATON GROUP	
Calvin Sandstone:	
Sandstone, reddish-brown, ferruginous, cross-bedded, ripple-marked, noncalcareous, fine-grained	5.5
Covered interval, forms low-angle slope; probably shale and shaly sandstone; numerous angular clasts of red to reddish-brown, ferruginous, fine-grained, noncalcareous, ripple-marked sandstone litter the ground surface	55.0
Sandstone, light-yellowish-brown with pinkish hue in places, thick-bedded to massive, fine-grained, noncalcareous, well-indurated, cross-bedded in part; forms prominent bluff near top of slope	18.5
Covered interval, forms low-angle slope	87.0
Sandstone, light-brown, massive, fine-grained, cross-bedded, noncalcareous, well-indurated, sole markings abundant; includes casts of *Stigmaria*	8.0
Sandstone and shale, interbedded. Sandstone is light-yellowish-grayish-brown, very fine-grained, silty, and very thin-bedded; sole markings and fossil leaf casts abundant. Shale is olive-gray and silty	10.5
CABANISS GROUP	
Senora Formation:	
Shale, gray, clayey, weathers olive-gray; contains abundant reddish-brown, discoidal clay ironstone concretions 0.5-1 in. thick and 4-6 in. in diameter	17.5
Covered interval	20.0
Shale, black to dark-grayish-brown with thin purplish-brown and yellowish-gray bands, fissile; grades into highly carbonaceous, coaly shale at base of unit	2.1
Coal, black (Croweburg coal)	1.3
Underclay, dark-gray with yellow bands; contains black carbonized plant fragments	0.7
Shale, black, highly carbonaceous; includes some thin laminae of bright, black coal	0.3
Underclay, dark-gray; contains black carbonized plant fragments (to water level in creek)	0.4
Total	226.8

MEASURED SECTION 2

SW¼NW¼NW¼ sec. 33, T. 10 N., R. 12 E., Okfuskee County. Measured in eroded area and shallow road cut east side of gravel road, by LeRoy A. Hemish. Field notebook designation OO-4-83-H. (Estimated elevation at top of section, 700 ft.)

	Thickness (ft)
Gravel, orange-brown, very coarse, contains abundant subangular clasts of sandstone up to cobble size (alluvial terrace deposit)	0.5

CABANISS GROUP
Senora Formation:

Shale, yellowish-gray, clayey	0.9
Shale, grayish-brown; includes a highly carbonaceous black layer about 1 in. thick near top of unit; weathers to thin, soft flakes on the outcrop	3.6
Coal, black, soft, very highly weathered (Croweburg coal)	0.5
Underclay, light-pinkish-gray with orange mottling	0.9
Coal, black, soft, very highly weathered (Croweburg coal)	0.2
Underclay, light-brownish-gray with orange mottling	0.8
Coal, black, soft, very highly weathered (Croweburg coal)	0.6
Underclay, light-gray with yellow and orange streaks; includes some brownish-black coaly streaks (base covered)	2.8
Total	10.8

MEASURED SECTION 3

E½NW¼ and NW½NE¼SW¼ sec. 11, T. 10 N., R. 12 E., Okfuskee County. Measured in road ditch from north section line at top of hill to covered area at base of slope, by LeRoy A. Hemish. Field notebook designation OO-2-82-H. (Estimated elevation at top of section, 884 ft.)

	Thickness (ft)
MARMATON GROUP	
Calvin Sandstone:	
Sandstone, yellowish-brown, highly weathered; fragments admixed with light-brown, sandy soil	2.0
Sandstone, yellowish-brown to reddish-brown, medium- to thick-bedded, noncalcareous, cross-bedded, fine-grained, well-indurated; sole markings abundant	19.0
Shale, yellowish-orange-gray, clayey	3.5
Sandstone and shale, interbedded, light-yellowish-brown; each bed about 1 ft thick; sandstone is thin- to medium-bedded, very fine-grained, noncalcareous, parallel-bedded, and extensively ripple-marked	6.0
Sandstone, yellowish-brown, thick-bedded to massive, fine-grained, noncalcareous; includes minor orange-yellow shale beds	54.0
Covered interval	20.0
Shale, olive-brown, silty	12.0
Sandstone, brown, massive, fine-grained, noncalcareous, cross-bedded; sole markings abundant	4.0
CABANISS GROUP	
Senora Formation:	
Covered interval	7.0
Shale, gray, clayey; weathers olive-gray; includes abundant, reddish-brown, discoidal clay ironstone concretions, mostly 0.5-1 in. thick and 2-6 in. in diameter	43.0
Limestone, brown to purplish-brown, impure, sandy, shaly in part; highly fossiliferous, brachiopods and crinoids predominant; forms resistant ledge in ditch; underlying unit concealed by water and alluvium (Verdigris Limestone?)	1.3
Total	171.8

MEASURED SECTION 4

SW¼NE¼NW¼NE¼ sec. 8, T. 11 N., R. 13 E., Okmulgee County. Measured from topographic bench northwest of abandoned oil well west (downslope) to valley bottom, by LeRoy A. Hemish. Field notebook designation OO-4-82-H. (Estimated elevation at top of section, 730 ft.)

	Thickness (ft)
MARMATON GROUP	
Calvin Sandstone:	
Sandstone, reddish-brown to light-grayish-brown, grades downward from fine-grained to very fine-grained, ferruginous in upper part, noncalcareous, medium- to thin-bedded, sole markings abundant, fissile in lower part, weathers to red soil	6.0
CABANISS GROUP	
Senora Formation:	
Shale, olive-gray with orange mottling, clayey, weathered, noncalcareous; contains abundant stringers of brown clay ironstone that weather to fragments on the outcrop	45.0
Limestone, grayish-brown, weathers reddish-brown, impure, sandy, fossiliferous, small brachiopods and crinoid fragments predominant, thin-bedded (Verdigris Limestone?)	0.4
Shale, light-gray, calcareous, clayey; includes some thin stringers of impure gray limestone	1.0
Shale, black, fissile, highly carbonaceous	0.3
Shale, gray to dark-grayish-brown, streaked with yellow and orange on stratification surfaces, noncalcareous	2.0
Limestone, grayish-brown, discontinuous; occurs as a zone of spheroidal concretions from 1 in. thick and 1.5 in. in diameter to 6 in. thick and 3 ft in diameter that weather out in relief on the outcrop	0.3
Shale, gray to dark-grayish-brown, streaked with yellow and orange on stratification surfaces, noncalcareous	15.0
Total	70.0

MEASURED SECTION 5

NE¼SW¼SW¼NE¼ sec. 9, T. 11 N., R. 13 E., Okmulgee County. Measured in highwall of active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-34-81-H. (Estimated elevation at top of section, 810 ft.)

	Thickness (ft)
Clay, light-brown to red, silty, sandy, gravelly; contains angular blocks of reddish-brown, fine-grained sandstone (colluvium)	3.0
CABANISS GROUP	
Senora Formation:	
Shale, dark-gray, weathers light-grayish-brown	49.0
Shale, black, hard, brittle; includes a few scattered fossil plant compressions as well as some isolated small fossil brachiopods	2.5
Coal, black, hard (Croweburg coal)	1.5
Shale, black, coaly, highly carbonaceous; includes abundant plant compressions	0.1
Coal, black; includes pyrite on cleat surfaces (Croweburg coal)	1.4
Underclay, light-gray; includes some black carbonized plant fragments	1.0
Total	58.5

MEASURED SECTION 6

SW¼NE¼NE¼SW¼ sec. 15, T. 11 N., R. 13 E., Okmulgee County. Measured from top of small hill down ravine to just above water in stock pond, by LeRoy A. Hemish. Field notebook designation OO-35-81-H. (Estimated elevation at top of section, 642 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, yellow to brownish-orange; very fine-grained, thin-bedded, noncalcareous; fossil burrows and trails abundant on soles of beds	2.5
Shale, medium-gray, silty, weathers yellowish-brown; contains small (pebble-size) orange clay ironstone concretions that weather out and litter the surface of the outcrop	12.0
Limestone, dark-gray to grayish-brown, impure, sandy, silty, irregularly thin-bedded; contains abundant fragments of fossil marine fauna	0.4
Shale, grayish-brown, clayey	0.4
Limestone, as above, but reddish-orange, ferruginous and highly oxidized in lower 2 in.	1.1
Coal, black, soft, weathered (Mineral coal)	0.4
Underclay, dark-gray with orange mottling, carbonaceous	1.1
Siltstone, dark-grayish-brown, very thin-bedded; contains black carbonized plant fragments; shaly in part; moderately well-indurated (to water level)	5.0
Total	22.9

MEASURED SECTION 7

NW¼SW¼SE¼SW¼ sec. 15, T. 11 N., R. 13 E., Okmulgee County. Measured in bluff directly north of dam spillway, by LeRoy A. Hemish. Field notebook designation OO-31-81-H. (Estimated elevation at top of section, 645 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-gray, silty and sandy, highly weathered	3.5
Sandstone, yellowish-gray, very fine-grained, very thin-bedded, cross-bedded, noncalcareous	1.5
Shale, yellowish-gray, silty and sandy	4.0
Sandstone, yellowish-brown, very fine-grained, noncalcareous, thin-bedded, flat-bedded, ripple-marked, well-indurated	2.2
Shale, medium-gray, highly silty; includes several layers of dark-brown, bean-sized ironstone concretions	11.5
Limestone, dark-gray, impure, sandy and shaly; irregularly thin-bedded; includes abundant fossil marine fauna	0.7
Coal, black with reddish-brown stain on cleat surfaces (Mineral coal)	0.2
Shale, black, highly carbonaceous, coaly in part	0.2
Shale, medium-gray	0.6
Coal, black with reddish-brown stain on cleat surfaces (Mineral coal)	0.1
Shale, dark-gray to black, highly silty, brittle; includes well-preserved plant compressions on stratification surfaces; contains very thin coal stringers in places	1.0
Siltstone, dark-gray with purplish-brown stain, contains black carbonized plant fragments; very thin-bedded; ripple-marked; trace fossils abundant on some strata; well-exposed below spillway in stream bed	9.0
Total	34.5

MEASURED SECTION 8

NW¼NW¼SW¼SE¼ sec. 16, T. 11 N., R. 13 E., Okmulgee County. Measured in eroded gully in pasture northeast of blacktop road downhill to trail, then in road ditch to covered area at base of hill, by LeRoy A. Hemish. Field notebook designation OO-30A-81-H. (Estimated elevation at top of section, 88 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, olive-gray; includes abundant reddish-brown, discoidal clay ironstone concretions 0.5-2 in. thick and up to 2 ft in diameter; weathers light-greenish-gray	45.0
Covered interval (exploration drilling by coal companies indicates that this interval contains black shale and 12 in. of coal)	3.0
Coal, black, soft, highly weathered (Croweburg coal)	1.3
Underclay, light-gray with orange streaks	1.7
Sandstone, light-yellowish-gray, very fine-grained, noncalcareous, very thin-bedded, ripple-drift cross-laminated; includes scattered dark-reddish-brown, ferruginous concretions; well-indurated in basal 18 in.	3.5
Shale, greenish-gray, orange-brown with orange spots where highly weathered; includes a 1-in.-thick, very fine-grained sandstone bed about 1 ft below top of unit	9.0
Shale, dark-gray, fissile	2.5
Ironstone, bright-purplish-red to orange; includes calcite fracture-fillings and some indistinct, poorly preserved marine fossils (McNabb Limestone?)	0.3
Shale, dark-gray, fissile	1.0
Ironstone, as above; crops out in ditch on northeast side of road; in ditch on southwest side of road, unit is dark-brown and enveloped by a 0.25-in.-thick crust of light-tannish-gray, fossiliferous limestone (McNabb Limestone?)	0.2
Shale, bluish-gray, fissile, weathers tannish-gray; poorly exposed in lower part of unit	10.0
Total	77.5

MEASURED SECTION 9

NW¼SE¼NE¼NW¼ sec. 17, T. 11 N., R. 13 E., Okmulgee County. Measured in highwall of active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field designation notebook OO-3-82-H. (Estimated elevation at top of section, 702 ft.)

	Thickness (ft)
Clay, dark-reddish-brown, sandy, silty, highly oxidized (alluvium associated with tributary of Coal Creek)	4.0
Clay, yellowish-brown with gray mottling, highly sandy (alluvium associated with tributary of Coal Creek)	5.0
Sand, yellowish-brown and light-gray, silty, very fine-grained, unbedded (eolian? material)	5.5
Gravel, reddish-brown with gray streaks, imbricated; includes abundant subangular, flat, gravel-sized clasts of clay ironstone as well as subangular rectangular-sided cobbles of clay ironstone (alluvium associated with tributary of Coal Creek)	2.5
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray, fissile, silty; includes scattered black, dense, iron sulfide-bearing nodules up to hen's egg size, as well as discoidal light-grayish-tan claystone concretions about 6 in. in diameter	14.0

Coal, black, banded; contains pyrite and white kaolinite on cleat surfaces (Croweburg coal) . .	1.3
Shale, very dark-grayish-brown, highly carbonaceous; includes thin stringers of bright, hard coal	0.4
Coal, black, banded; contains pyrite and white kaolinite on cleat surfaces (Croweburg coal) . .	1.3
Underclay, light-gray; includes scattered black carbonized plant compressions	1.2
Total	35.2

MEASURED SECTION 10

SW¼SW¼SW¼NE¼ sec. 17, T. 11 N., R. 13 E., Okmulgee County. Measured in highwall of active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-1-83-H. (Estimated elevation at top of section, 688 ft.)

	Thickness (ft)
Clay, light-brown, silty, sandy (alluvial valley fill)	8.0
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray, silty; contains two 1-in.-thick layers of light-tannish-gray claystone . . .	14.0
Shale, very dark-gray, hard, carbonaceous; includes scattered phosphatic nodules 0.5 in. in diameter	0.9
Shale, medium-gray, silty; contains ovate and discoidal claystone nodules 3-4 in. in diameter .	15.1
Coal, black, bituminous; white kaolinite and pyrite deposits on cleat surfaces, (Croweburg coal)	1.2
Shale, very dark-gray, highly carbonaceous; contains some streaks of soft light-gray clay . . .	0.4
Coal, as above (Croweburg coal)	1.5
Underclay, light-gray, silty (total thickness unknown)	0.5
Total	41.6

MEASURED SECTION 11

NE¼NW¼NW¼SE¼ sec. 17, T. 11 N., R. 13 E., Okmulgee County. Measured in highwall of active strip mine operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-6-83-H. (Estimated elevation at top of section, 695 ft.)

	Thickness (ft)
Spoils, light-gray, mostly shale rubble; contains some very dark-gray brittle, carbonaceous shale	10.0
CABANISS GROUP	
Senora Formation:	
Shale, grayish-brown to brown, silty; contains weakly calcareous concretions up to 1 ft in diameter and ironstone stringers about 1 in. thick	15.0
Shale, black, weathered, hard	0.6
Shale, very dark-gray; contains scattered brachiopods and plant fragments	0.4
Shale, medium-gray, silty	14.0

Coal, black, bright, moderately friable; minor deposits of calcite and pyrite on cleat surfaces; some pyrite on bedding planes and in lenses; includes a 6-in. parting of very dark-gray coaly shale 15 in. from top of unit (Croweburg coal)	3.0
Underclay, medium-gray	1.3
Shale, dark-gray, silty, hard (base covered)	0.2
Total	44.5

MEASURED SECTION 12

SW¼SW¼NW¼SE¼ sec. 17, T. 11 N., R. 13 E., Okmulgee County. Measured in highwall of active strip mine operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-9-83-H. (Surface elevation, estimated from topographic map, 702 ft.)

	Thickness (ft)
Silt, dark-brown, sandy; contains abundant organic material (soil)	1.3
Silt, rusty-brown, mottled with orange and dark-brownish-black spots, sandy	2.5
Gravel, dark-yellowish-brown, highly weathered, clayey; contains angular to rounded clasts of tan and reddish-brown sandstone and ironstone up to cobble size	6.2
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray, silty; rusty-brown stain on fracture surfaces in upper 5 ft; contains scattered stringers and discoidal concretions of grayish-tan and medium-gray siderite	30.0
Shale, black, hard, noncalcareous; contains black phosphatic nodules 0.5-1 in. in diameter; soft in lower 1 in. of unit	0.6
Shale, medium-gray, silty	13.9
Coal, black, bright, pyritic, moderately friable; white calcite on cleat surfaces (Croweburg coal)	1.3
Shale, black, soft, highly carbonaceous; contains a 0.75-in. layer of bright, hard coal in middle of unit	0.5
Coal, black, bright, pyritic, moderately friable; white calcite on cleat surfaces (Croweburg coal)	1.3
Underclay, medium-gray (total thickness unknown)	0.2
Total	57.8

MEASURED SECTION 13

NW¼SE¼NE¼NW¼SE¼ sec. 29, T. 11 N., R. 13 E., Okmulgee County. Measured in bank of small stream at upper end of small abandoned strip pit, by LeRoy A. Hemish. Field notebook designation OO-33-81-H. (Estimated elevation at top of section, 734 ft.)

	Thickness (ft)
Gravel, brown, silty, sandy; contains subangular boulders and cobbles of reddish-brown sandstone (alluvium)	3.0
CABANISS GROUP	
Senora Formation:	
Shale, black, platy, brittle	1.0
Shale, dark-gray to very dark-gray, carbonaceous in part; includes stringers of reddish-orange clay ironstone concretions; red to orange and highly ferruginous in lower 1 in.	3.5

Coal, black, hard (Croweburg coal)	1.1
Underclay, light-gray with orange streaks (to creek bed)	0.2
Total	8.8

MEASURED SECTION 14

SE¼SE¼NE¼NW¼SE¼ sec. 29, T. 11 N., R. 13 E., Okmulgee County. Measured in bank of small stream running through small abandoned strip pit, by LeRoy A. Hemish. Field notebook designation OO-32-81-H. (Estimated elevation at top of section, 731 ft.)

	Thickness (ft)
Disturbed ground (spoils from abandoned strip pit)	2.5
Gravel, brown, silty and sandy; includes abundant subangular cobble- to boulder-sized sandstone clasts (alluvium)	2.0
CABANISS GROUP	
Senora Formation:	
Shale, grayish-brown with orange streaks, weathered	0.2
Shale, dark-gray and black, coaly	0.4
Coal, black, cleat surfaces stained reddish-orange by iron oxides (Croweburg coal)	1.0
Underclay, light-gray with orange streaks (total thickness not exposed)	0.2
Total	6.3

MEASURED SECTION 15

SE¼NE¼SE¼SE¼ sec. 4, T. 12 N., R. 10 E., Okfuskee County, Oklahoma. Measured in cutbank of tributary of Nuyaka Creek, by LeRoy A. Hemish. Field notebook designation OO-1-86-H. (Surface elevation estimated from topographic map, 730 ft.)

	Thickness (ft)
Silt, brownish-gray, sandy; contains abundant organic material	0.8
Clay, pale-yellowish-brown with dark-yellowish-orange mottling, silty; includes scattered gravel clasts in lower 1 ft.	4.8
Gravel, grayish-orange, clayey; clasts range up to pebble size and are predominately very fine-grained sandstone; indistinctly imbricated	0.4
SKIATOOK GROUP	
Seminole Formation:	
Clay, light-gray and dark-yellowish-orange, plastic	0.1
Coal, black, soft, smutty, weathered; about 0.5 in. thick (Tulsa coal)	0.1
Underclay, medium-light-gray and dark-yellowish-orange, sticky, gypsiferous; includes a $^{1}/_{16}$-in.-thick stringer of coal smut at base of unit (Tulsa coal)	0.6
Underclay, medium-light-gray to light-olive-gray with dark-yellowish-orange mottling; sticky, carbonaceous in part	0.5
Coal, black, soft, smutty, weathered, about 0.75 in. thick (Tulsa coal)	0.1
MARMATON GROUP(?)	
Holdenville Formation(?):	
Underclay, medium-light-gray to light-olive-gray with dark-yellowish-orange mottling; contains black carbonaceous material; gypsiferous	1.0

Shale, light-olive-gray, noncalcareous	2.0
Siltstone, light-olive-gray to light-greenish-gray, extremely calcareous; crops out about 30 ft downstream	1.6
Total	12.0

MEASURED SECTION 16

SW¼SW¼SW¼SE¼ sec. 12, T. 12 N., R. 13 E., Okmulgee County. Measured from top of slope just east of fence line and inside of entrance to abandoned slope mine, by LeRoy A. Hemish. Field notebook designation OO-28-81-H. (Estimated elevation at top of section, 725 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, dark-brown to light-brown, ferruginous, fine-grained, noncalcareous, massive	10.0
Covered interval; massive blocks of sandstone from overlying unit litter the slope	40.0
Shale, light-grayish-brown with orange spots and streaks; includes abundant small to medium clay ironstone concretions	22.0
Coal, black, soft, weathered; includes a 0.5-in.-thick, grayish-brown clay parting about 2 in. from bottom of bed (Mineral coal)	1.3
Sandstone, reddish-brown to yellowish-brown, very fine-grained, well-indurated; contains abundant black carbonaceous material; grades laterally into gray and orange underclay	0.1
Underclay, light-gray with orange streaks	1.6
Shale, medium-gray with orange streaks; grades downward into silty shale	3.0
Siltstone, light-yellowish-gray, shaly, very thin-bedded	1.0
Sandstone, light-gray, shaly; weathers yellowish-gray with brown stain; flaky, micaceous, noncalcareous, very thin-bedded, very fine-grained	11.0
Sandstone, light-brown to dark-brown; weathers light-yellowish-brown; fine-grained, noncalcareous, well-indurated, ripple-marked; surface of bed well exposed over large area about 50 yd east of abandoned farm buildings	1.0
Covered to flood plain of Moore Creek	16.0
Total	107.0

MEASURED SECTION 17

NW¼SW¼NE¼SE¼ sec. 21, T. 12 N., R. 13 E., Okmulgee County. Measured in active strip pit operated by Joshua Coal Co., by LeRoy A. Hemish. Field notebook designation OO-2-83-H. (Estimated elevation at top of section, 660 ft.)

	Thickness (ft)
Clay, orange-brown, includes angular blocks of reddish-brown sandstone (soil and colluvium)	1.0
CABANISS GROUP	
Senora Formation:	
Shale, light-grayish-brown and light-gray with purplish-brown stain on fracture surfaces, partly oxidized	15.0
Coal, black, bituminous, with white kaolinite on cleat surfaces (Croweburg coal)	2.8
Underclay, orange-gray, soft (total thickness unknown)	0.2
Total	19.0

MEASURED SECTION 18

SW¼SW¼NE¼SE¼ sec. 21, T. 12 N., R. 13 E., Okmulgee County. Measured in highwall of active strip mine operated by Joshua Coal Co., by LeRoy A. Hemish. Field notebook designation OO-7-83-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
Clay and silt, light-brown with reddish stain; contains angular clasts of reddish-brown sandstone to boulder size (colluvium)	6.0
CABANISS GROUP	
Senora Formation:	
Shale, light-grayish-brown, stained by iron oxides, weathered, moderately friable	23.5
Coal, black with reddish-brown stain, hard; iron oxide, gypsum, and pyrite on cleat surfaces; upper 13 in. show effects of incipient weathering (Croweburg coal)	3.3
Underclay, light-gray, sticky (base covered)	0.3
Total	33.1

MEASURED SECTION 19

NE¼SE¼SE¼NE¼ sec. 21, T. 12 N., R. 13 E., Okmulgee County. Measured in road cut from curve in road at top of hill down to covered area at base of cut, by LeRoy A. Hemish. Field notebook designation OO-29-81-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-gray, silty; orange-brown, discoidal clay ironstone concretions 6 in. in diameter very abundant; well-preserved plant compressions common on stratification surfaces	8.0
Coal, black, weathered; bed has been displaced about 7 ft along a thrust fault at this outcrop (Croweburg coal)	3.4
Underclay, dark-gray with orange streaks; includes abundant black carbonaceous material and coal stringers locally	2.0
Sandstone, light-yellowish-brown, silty, very fine-grained, noncalcareous, cross-bedded; in places occurs in well-indurated lenses; includes scattered discoidal reddish-brown clay ironstone concretions up to 2 ft in diameter and 2 in. thick; also includes several shale beds, and in places grades laterally into shale at top of unit	15.6
Shale, dark-gray, weathers tannish-gray; includes black carbonized plant fragments on stratification surfaces; also includes two reddish-brown clay ironstone concretionary layers 2 ft and 1 ft from base of unit; becomes very dark-gray to black and flaky in lower half of unit	10.4
Limestone, very dark-gray with purplish-brown surface band, hard, thin-bedded; contains fragments of fossil marine fauna (McNabb Limestone)	0.2
Shale, medium-gray, marly, highly calcareous; contains a rich assortment of very well-preserved fossil marine fauna, with *Productid* brachiopods most abundant; outcrop has knobby appearance owing to abundance of fossil shells (McNabb Limestone equivalent)	3.4
Total	43.0

MEASURED SECTION 20

NE¼NE¼SW¼SW¼ sec. 22, T. 12 N., R. 13 E., Okmulgee County. Measured from head of gully southeast to covered area just east of oil pipeline, by LeRoy A. Hemish. Field notebook designation OO-36-81-H. (Estimated elevation at top of section, 640 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, light-grayish-brown with orange mottling; highly weathered; includes abundant fragments of orange clay ironstone concretions, some with fossil plant impressions	2.0
Coal, black, soft, highly weathered (Croweburg coal)	2.3
Underclay, light-grayish-tan with orange mottling	1.2
Shale, grayish-brown with orange mottling, silty; includes abundant black carbonized plant fragments	1.0
Siltstone, brown, laminated; includes dark-brown carbonized plant fragments on stratification surfaces	0.2
Shale, grayish-brown, interbedded with gray and dark-brown siltstone; black carbonized plant fragments abundant	5.0
Shale, very dark-gray, clayey; dark-reddish-brown ironstone concretions very abundant; includes two 1-in.-thick layers of clay ironstone 1 ft and 2 ft from base of unit	10.6
Limestone and ironstone, black with reddish-brown rind; limestone is impure and sandy and includes thin laminae of fossil hash (McNabb Limestone)	0.2
Shale, tannish-gray, highly calcareous; contains a great abundance of very well-preserved fossil brachiopod shells that weather out in relief on the outcrop	3.2
Shale, very dark-gray; includes some 1-in.-thick discoidal, dark-reddish-brown ironstone concretions; weathers to small flakes on the outcrop	14.6
Shale, olive-gray with light-orange mottling; lower part includes abundant dark-purplish-black ironstone concretions which weather into fragments on the outcrop	16.5
Sandstone, light-yellowish-brown to orange-brown, fine-grained, medium- to thin-bedded, noncalcareous, bioturbated, shaly in lower half of unit	1.2
Shale, olive-brown; (base of unit covered)	1.0
Total	59.0

MEASURED SECTION 21

NW¼NE¼NW¼SW¼ sec. 28, T. 12 N., R. 13 E., Okmulgee County. Measured in highwall of active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-40-81-H. (Estimated elevation at top of section, 611 ft.)

	Thickness (ft)
Clay, orange-brown, silty; contains carbonized rootlets (alluvium)	4.0
Clay, light-gray with orange mottling, silty; contains abundant rootlet molds (alluvium)	3.0
Sand, light-tannish-gray with abundant brown mottling, very fine-grained, unbedded; contains brownish-black carbonized plant fragments and fine rootlet molds; sharp contacts with overlying and underlying units (eolian deposits)	4.5
Clay, bluish-gray with orange-brown mottling; includes black carbonized rootlet fragments (alluvium)	3.4
Gravel, bright-reddish-orange, coarse, highly oxidized; characterized by imbricate bedding; contains flat, angular to subangular clasts up to large cobble size of reddish-brown, fine-grained sandstone also includes stringers of float coal scattered throughout the unit; very coarse in bottom 1 ft (alluvium)	2.5

Sand, bluish-gray, very fine-grained; contains some pebbles pressed downward from overlying unit (alluvium)	0.2
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray, silty, hard	10.5
Coal, black, hard; white calcite on cleat surfaces (Croweburg coal)	3.0
Underclay, light-gray, hard	0.9
Total	32.0

MEASURED SECTION 22

SE¼SW¼SW¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured from top of sandstone bluff down gully to water level in creek, by LeRoy A. Hemish. Field notebook designation OO-27-81-H. (Estimated elevation at top of section, 695 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, brown to reddish-brown, fine-grained, massive, noncalcareous; forms prominent resistant bluffs on both sides of valley	6.0
Covered interval; includes some minor exposures of grayish-brown shale; float in gully consists predominantly of brown to red fine-grained sandstone which is conglomeratic in part and is characterized by numerous cavities left by weathered-out pebbles; also includes abundant plant molds and casts. This sandstone was not observed in place--the likely source of most of the material is the sandstone unit at the top of the bluff, but other sandstones lower in the stratigraphic section are also possible sources	64.0
Shale, yellowish-gray; includes orange fragments of clay ironstone	2.0
Limestone, yellowish-gray, hard; characterized by excellent cone-in-cone structures	0.1
Shale, light-grayish-brown with orange streaks	2.9
Coal, black, soft, weathered (Mineral coal)	0.5
Underclay, yellowish-brown with orange streaks; highly weathered	1.0
Siltstone, light-yellowish-gray with orange-brown stain, shaly; contains small ironstone concretions and black carbonized plant fragments	1.5
Covered to creek	8.0
Total	86.0

MEASURED SECTION 23

NW¼SE¼SW¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured in slope of hill directly south of creek on recently cleared trail, by LeRoy A. Hemish. Field notebook designation OO-26-81-H. (Estimated elevation at top of section, 633 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, light-grayish-brown, weathered; contains abundant hard, reddish-brown clay ironstone concretions that weather into 0.5- to 1-in.-thick fragments on the outcrop	5.0
Limestone, yellowish-gray, hard; characterized by excellent cone-in-cone structures	0.1
Shale, light-grayish-brown, weathered; contains abundant reddish-brown clay ironstone fragments	2.9
Coal, black, soft, weathered (Mineral coal)	0.5

Underclay, light-gray and orange; contains abundant dark-brown carbonized plant fragments	1.0
Siltstone and very fine-grained sandstone, grayish-brown, shaly, micaceous; includes abundant carbonized plant fragments on stratification surfaces (to water in creek)	9.5
Total	19.0

MEASURED SECTION 24

NE¼SE¼SW¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured in west side of small gully south of creek, by LeRoy A. Hemish. Field notebook designation OO-25-81-H. (Estimated elevation at top of section, 633 ft.)

	Thickness (ft)
Silt, light-brown, gravelly (alluvium)	3.5
CABANISS GROUP	
Senora Formation:	
Coal, black, soft, weathered (Mineral coal)	0.8
Underclay, gray with orange streaks; includes black carbonized plant fragments	0.7
Total	5.0

MEASURED SECTION 25

SW¼NW¼SE¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured in small gully directly west of old, abandoned strip mine, by LeRoy A. Hemish. Field notebook designation OO-24-81-H. (Estimated elevation at top of section, 640 ft.)

	Thickness (ft)
Clay, yellowish-brown, highly weathered (colluvium)	6.0
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-gray, weathered; contains weathered fragments of clay ironstone	2.5
Coal, black, soft, weathered (Mineral coal)	1.8
Underclay, light-gray with orange streaks (total thickness not exposed)	0.3
Total	10.6

MEASURED SECTION 26

SE¼NW¼SE¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured in gully adjacent to creek, by LeRoy A. Hemish. Field notebook designation OO-23-81-H. (Estimated elevation at top of section, 635 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, yellowish-brown, well-indurated; characterized by excellent cone-in-cone structures	0.2
Shale, light-gray, weathers light-grayish-brown; includes thin stringers of orange clay ironstone	3.0

Coal, black (Mineral coal)	2.0
Underclay, dark-grayish-brown with yellow and orange streaks; siltstone in part; carbonaceous; contains some coalified plant material and well-preserved impressions of *Calamites* and other plant remains	1.0
Shale, medium-gray, highly silty; stained dark-reddish-brown in places by iron oxides; includes scattered small (1-in.-diameter) ironstone concretions (to water level in creek)	4.3
Total	10.5

MEASURED SECTION 27

NW¼NE¼SE¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured in side of old, abandoned strip mine, by LeRoy A. Hemish. Field notebook designation OO-20-81-H. (Estimated elevation at top of section, 640 ft.)

	Thickness (ft)
Disturbed ground (spoils from strip mine)	6.0
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray, weathers light-grayish-brown and orange; includes abundant brown to black carbonized plant material on stratification surfaces; contains hard, silty clay ironstone stringers	1.2
Coal, black, weathered (Mineral coal)	1.7
Underclay, dark-grayish-brown, highly carbonaceous	0.6
Total	9.5

MEASURED SECTION 28

SW¼NE¼SE¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured in cutbank of small stream just upstream from sharp, right-angle bend to the west, by LeRoy A. Hemish. Field notebook designation OO-22-81-H. (Estimated elevation at top of section, 647 ft.)

	Thickness (ft)
Covered interval	3.0
CABANISS GROUP	
Senora Formation:	
Shale, brown, weathered; outcrop littered with dark-reddish-brown and orange clay ironstone fragments	0.5
Coal, black, soft, highly weathered (Mineral coal)	0.7
Underclay, dark-grayish-brown with reddish-brown bands; contains abundant carbonized plant fragments; weathers light-yellowish-gray on outcrop	1.0
Shale, grayish-brown, silty; contains abundant stringers of well-indurated, orange, silty clay ironstone concretions	3.2
Total	8.4

MEASURED SECTION 29

NE¼SE¼SE¼NW¼ sec. 6, T. 12 N., R. 14 E., Okmulgee County. Measured at juncture of two small intermittent streams, by LeRoy A. Hemish. Field notebook designation OO-21-81-H. (Estimated elevation at top of section, 650 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-gray; includes abundant clay ironstone concretions that weather into hard, resistant fragments on the outcrop	2.0
Limestone, dark-gray, weathers grayish-tan; characterized by excellent cone-in-cone structures	0.1
Shale, dark-gray with reddish-brown streaks; weathers light-tannish-gray; includes abundant carbonaceous material	2.9
Coal, black, weathered (Mineral coal)	0.7
Underclay, dark-gray with light-gray and orange bands; contains abundant black, carbonized plant material	1.0
Total	6.7

MEASURED SECTION 30

S½SE¼ sec. 33, T. 13 N., R. 10 E., and N½NW¼ and N½NW¼NE¼ sec. 3, T. 12 N., R. 10 E., Okfuskee County, Oklahoma. Measured in road ditch from top of hill east to water level in Nuyaka Creek. Field notebook designation OO-5-86-H. (Estimated elevation at top of section, 890 ft.)

	Thickness (ft)
SKIATOOK GROUP	
Coffeyville Formation:	
Sandstone, moderate-reddish-brown to grayish-orange, very fine- to fine-grained, noncalcareous, bioturbated, medium-bedded	16.0
Shale, olive-gray with dark-yellowish-orange mottling, noncalcareous, poorly exposed	4.0
Sandstone, pale-yellowish-orange, very fine-grained, noncalcareous, cross-bedded, thin-bedded in part, ripple-marked, bioturbated; contains abundant well-preserved brachiopod molds and casts	5.5
Shale, greenish-gray with light-brown stain, clayey; noncalcareous in upper part, calcareous and fossiliferous in lower part; brachiopod shells and crinoid ossicles abundant	13.5
Limestone, moderate-yellowish-brown to grayish-red, fine-grained, dense, hard, sandy, fossiliferous, brachiopod shells abundant, cross-bedded in part, bioturbated in lower part, feels hackly on weathered surfaces, fossils concentrated in upper 1 ft	1.7
Shale, light-olive-gray with dark-yellowish-orange mottling, silty, calcareous	12.0
Sandstone, moderate-brown to moderate-reddish-brown, very fine-grained, noncalcareous, cross-bedded, bioturbated, well-indurated	1.2
Shale, greenish-gray with dark-yellowish-orange streaks, noncalcareous, silty, poorly exposed (base covered)	16.1
Covered interval (approximate thickness)	180.0
Shale, olive-gray to dark-yellowish-gray with light-brown mottling, calcareous, fossiliferous; includes conulariids, bryozoans, pelecypods, and brachiopods; contains abundant moderate-red to dark-yellowish-orange ironstone concretions that weather to pebble-sized fragments on the outcrop; also contains fossiliferous, discoidal, medium-gray limestone concretions and a thin (0.3 ft), soft, smutty, coal stringer	17.0
Covered interval (approximate thickness)	6.0

Shale, light-olive-gray, extremely calcareous, grades into underlying unit; weathers grayish-orange	0.4
Checkerboard Formation:	
Limestone, grayish-orange, impure; extremely shaly in upper 6 in.; fossiliferous, brachiopods abundant; feels hackly on weathered surface	1.6
Seminole Formation:	
Shale, grayish-orange with light-brown mottling, extremely calcareous	0.6
Shale, medium-gray, weathers dark-yellowish-orange; clayey, noncalcareous; contains some black carbonized plant fragments	1.4
Coal, black, soft, smutty, 1-2 in. thick; includes shale partings laterally along the outcrop (Tulsa coal)	0.1
Underclay, yellowish-gray with dark-yellowish-orange bands; locally includes lenses of coal up to 1 in. thick and 1 ft long	0.5
Coal, black, soft, smutty, weathered; about 0.75 in. thick (Tulsa coal)	0.1
MARMATON GROUP(?)	
Holdenville Formation(?):	
Underclay, yellowish-gray with dark-yellowish-orange streaks; includes abundant limonitic stains	0.7
Shale, medium-gray and light-olive-gray, partly weathered, noncalcareous, fossiliferous, with blocky fracture; includes stringers of grayish-orange clay ironstone concretions up to 1 in. thick	7.0
Shale, medium-dark-gray, silty, calcareous; weathers olive-gray (to water in creek)	6.6
Total	292.0

MEASURED SECTION 31

NW¼SE¼NE¼SW¼ sec. 22, T. 13 N., R. 13 E., Okmulgee County. Measured in cutbank of small creek just upstream from confluence with tributary stream flowing southwest from center of section, by LeRoy A. Hemish. Field notebook designation OO-38-81-H. (Estimated elevation at top of section, 640 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, grayish-brown, weathered; includes some 0.5-in.-thick stringers of brown clay ironstone	3.0
Limestone, purplish-brown, impure, silty, thin-bedded, highly fossiliferous, fragments of crinoid columnals predominant	0.2
Shale, olive-gray, highly calcareous; stained orange in part from weathering of overlying unit	0.3
Limestone, black and dark-reddish-brown, hard, dense, fossiliferous, with brachiopods predominant	0.3
Shale, dark-gray, streaked and mottled reddish-brown, tan, and black; noncalcareous	0.4
Coal, black, soft, weathered (unnamed coal)	0.3
Underclay, light-gray with orange banding	0.6
Shale, gray with light-yellowish-brown banding, silty; weathers to flakes on the outcrop; includes abundant black and reddish-brown carbonized plant fragments; noncalcareous	2.4
Total	7.5

MEASURED SECTION 32

NE¼SW¼SW¼SE¼ sec. 25, T. 13 N., R. 13 E., Okmulgee County. Measured from top of bluff down small ravine and in cutbank of creek, by LeRoy A. Hemish. Field notebook designation OO-19-81-H. (Estimated elevation at top of section, 672 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, dark-brown, ferruginous, fine-grained, thin- to medium-bedded, well-indurated, noncalcareous	2.0
Covered interval	13.0
Shale, medium-gray, fissile, silty	2.0
Covered interval	2.0
Shale, medium-gray with reddish-brown and orange mottling	1.0
Coal, black (Mineral coal)	0.8
Underclay, medium-gray with orange streaks	0.4
Shale, medium-gray with orange mottling; includes some 1-3 in. in diameter, weathered clay ironstone concretions (to water level)	2.8
Total	24.0

MEASURED SECTION 33

SE¼NE¼NW¼SE¼ sec. 1, T. 13 N., R. 14 E., Okmulgee County. Measured in bank of small, intermittent stream, by LeRoy A. Hemish. Field notebook designation OO-10-82-H. (Estimated elevation at top of section, 673 ft.)

	Thickness (ft)
Clay, grayish-brown with orange mottling, silty, contains some gravel (soil zone)	1.0
CABANISS GROUP	
Senora Formation:	
Sandstone, grayish-brown with reddish-brown streaks, weathers orange-brown, very fine-grained, micaceous, very thin-bedded, noncalcareous, carbonaceous flecks on stratification surfaces	2.5
Siltstone, purplish-brown, micaceous, carbonaceous, laminated, noncalcareous	0.3
Shale, light-grayish-brown, interlaminated with siltstone, micaceous	0.6
Covered interval	3.0
Limestone, medium-gray with pinkish hue, hard, dense, impure, silty; weathers brown with maroon blotches; highly fossiliferous, brachiopods and crinoids abundant; partially exposed in dry creek bed, total thickness not known	0.6
Total	8.0

MEASURED SECTION 34

NW¼NW¼SW¼SW¼ sec. 13, T. 13 N., R. 14 E., Okmulgee County. Measured in cutbank of Grave Creek about 100 ft east of bridge, by LeRoy A. Hemish. Field notebook designation OO-18-81-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
Silt, brown, clayey; contains small rounded clasts of gravel (alluvium)	4.0
CABANISS GROUP	
Senora Formation:	
Sandstone, orange-brown, fine-grained, noncalcareous, micaceous; includes abundant black carbonized plant fragments	0.1
Shale, brownish-gray, weathered	2.5
Shale, dark-gray; black, highly carbonaceous and calcareous in thin layer at base of unit	0.4
Limestone, very dark-grayish-brown to black, impure, shaly and sandy, sparsely fossiliferous; breaks into wavy-surfaced flakes	0.3
Shale, medium-gray, highly silty, calcareous; light-grayish-brown in upper 6 in. of unit	1.5
Limestone, light-brown to pink, impure, sandy, highly fossiliferous, brachiopods predominant, irregularly thin-bedded; characterized by rectangular joint pattern, with individual blocks measuring about 3 ft long and 2 ft wide (to water level in Grave Creek)	2.5
Total	11.3

MEASURED SECTION 35

NW¼NE¼NW¼NW¼ sec. 4, T. 14 N., R. 11 E., Okmulgee County. Measured in cutbank of small tributary stream of Tiger Creek about 100 ft southwest from bridge, by LeRoy A. Hemish. Field notebook designation OO-4-81-H. (Estimated elevation at top of section, 700 ft.)

	Thickness (ft)
SKIATOOK GROUP	
Checkerboard Formation:	
Limestone, yellowish-brown, very highly fossiliferous, fragments of crinoids, horn corals, bryozoans and brachiopods abundant; limestone is weathered, broken, and mixed with dark-brown, silty topsoil (Checkerboard Limestone)	2.0
Seminole Formation:	
Shale, light-gray with orange-brown oxidized bands, clayey; includes numerous thin stringers of light-brown clay ironstone	2.5
Shale, dark-grayish-brown, silty, carbonaceous	2.0
Coal, black, soft, weathered; locally includes partially coalified, silicified pieces of fossil wood >1 ft long and 8 in. in diameter (Tulsa coal)	0.1
MARMATON GROUP(?)	
Holdenville Formation(?):	
Underclay, light-greenish-gray, weakly calcareous	0.9
Limestone, orange; calcareous clay in part; highly weathered and fragmented; surface of outcrop has a hackly appearance; fossils rare	0.8
Limestone, brown, highly fossiliferous, hard, well-jointed, silty, massive	0.3
Shale, bluish-gray, clayey, highly calcareous; includes 0.5- in.-thick lenses of brown, impure limestone (to water level in stream)	0.4
Total	9.0

MEASURED SECTION 36

SE¼SW¼NE¼NW¼ sec. 3, T. 14 N., R. 14 E., Okmulgee County. Measured in cutbank of tributary of Little Cane Creek just east of small abandoned strip pit, by LeRoy A. Hemish. Field notebook designation OO-7-81-H. (Estimated elevation at top of section, 685 ft.)

	Thickness (ft)
Silt, dark-grayish-brown, clayey and gravelly (alluvium)	2.0
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-brown, highly weathered; contains abundant small, weathered clay ironstone flakes	2.0
Coal, black, soft, weathered (Mineral coal)	1.3
Underclay, light-gray with orange mottling	0.7
Limestone, purple to light-orange-brown, impure, sandy; fossiliferous, brachiopods abundant	0.5
Shale, bluish-gray with orange streaks; reddish-brown clay ironstone concretions near base of exposure	2.2
Total	8.7

MEASURED SECTION 37

SE¼NW¼NW¼SW¼ sec. 4, T. 14 N., R. 14 E., Okmulgee County. Measured in small, abandoned wagon pit on south side of Coal Creek, by LeRoy A. Hemish. Field notebook designation OO-13-81-H. (Estimated elevation at top of section, 698 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, grayish-brown with abundant layers of reddish-brown to orange clay ironstone concretions	5.0
Coal, black, soft, weathered (Croweburg coal)	0.5
Underclay, grayish-purple, weathers light-brown	0.5
Coal, black, soft, shaly (Croweburg coal)	0.1
Underclay, yellowish-gray	0.2
Coal, black (Croweburg coal)	0.1
Underclay, purplish-brown	0.6
Shale, dark-gray, silty; grades downward into underlying unit	0.5
Siltstone, grayish-brown, shaly, noncalcareous, very thin-bedded	1.5
Sandstone, buff, very fine-grained, noncalcareous, thin-bedded, ripple-marked	4.0
Shale, dark-gray, fissile (to water level in creek)	1.0
Total	14.0

MEASURED SECTION 38

NE¼SE¼NE¼SE¼ sec. 5, T. 14 N., R. 14 E., Okmulgee County. Measured in road cut where south branch of Coal Creek crosses gravel road, by Leroy A. Hemish. Field notebook designation OO-12-81-H. (Estimated elevation at top of section, 695 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, olive-gray with orange-brown mottling; includes some 0.5-in.-thick discoidal clay ironstone concretions	5.0
Coal, black with reddish-brown banding, soft, weathered (Croweburg coal)	0.8
Underclay, dark-gray with reddish-brown iron oxide stain; includes black carbonized plant fragments	0.6
Coal, black, soft, weathered (Croweburg coal)	0.1
Underclay, dark-gray with reddish-brown iron oxide stain; silty; contains abundant black carbonized plant fragments	0.5
Siltstone, grayish-brown, shaly, noncalcareous, very thin-bedded	2.0
Sandstone, light-grayish-brown, weathers tan, very fine-grained, noncalcareous, thin-bedded	4.0
Total	13.0

MEASURED SECTION 39

SW¼NE¼SE¼SE¼ sec. 9, T. 14 N., R. 14 E., Okmulgee County. Measured in highwall of active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-9-81-H. (Estimated elevation at top of section, 698 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-brown, weathered	12.0
Shale, medium-gray with reddish-brown streaks; includes thin clay ironstone layers (approximately 1 in. thick)	12.0
Coal, black with red iron oxide and white kaolinite deposits on cleat surfaces (Mineral coal)	1.3
Sandstone, very dark-gray, very fine-grained, well-indurated, noncalcareous; includes abundant black carbonized plant fragments (total thickness unknown)	0.2
Total	25.5

MEASURED SECTION 40

NW¼SE¼SW¼SE¼ sec. 9, T. 14 N., R. 14 E., Okmulgee County. Measured in active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-6-82-H. (Estimated elevation at top of section, 688 ft.)

	Thickness (ft)
Clay, brown	6.0
CABANISS GROUP	
Senora Formation:	
Shale, brown, silty	3.0
Shale, gray, silty; contains scattered, black, carbonized plant fragments	16.0

Coal, black with pyrite and white calcite on cleat surfaces (Mineral coal)	1.3
Underclay, very sandy; contains well-preserved *Stigmaria* as well as carbonized plant remains; includes streaks of coalified plant materials	0.7
Total	27.0

MEASURED SECTION 41

NW¼NE¼NW¼SW¼ sec. 9, T. 14 N., R. 14 E., Okmulgee County. Measured in highwall of active strip pit operated by Redman-Dunsted, Ltd., by LeRoy A. Hemish. Field notebook designation OO-8-81-H. (Estimated elevation at top of section, 712 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-brown, weathered; includes several 1- to 2-in.-thick stringers of reddish-brown clay ironstone	14.5
Shale, purplish-brown, carbonaceous; includes thin coal streaks and coalified plant fragments	0.2
Shale, dark-gray	1.5
Coal, black; pyrite on cleat surfaces (Croweburg coal)	1.0
Underclay, medium-gray; contains black carbonized plant fragments	1.0
Total	18.2

MEASURED SECTION 42

SW¼SW¼NW¼NW¼ sec. 10, T. 14 N., R. 14 E., Okmulgee County. Measured in active mine operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-9-82-H. (Estimated elevation at top of section, 684 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, brown, weathered	10.0
Shale, gray	12.0
Coal, black with white kaolinite and pyrite on cleat surfaces (Mineral coal)	0.2
Shale, black, coaly, contains hard stringers of coal	0.2
Coal, black, hard, with white calcite, white kaolinite, and pyrite on cleat surfaces (Mineral coal)	1.3
Underclay, black, highly carbonaceous	0.1
Sandstone, gray, very fine-grained, hard, highly calcareous (total thickness not known)	0.2
Total	24.0

MEASURED SECTION 43

NW¼NE¼SW¼NW¼ sec. 10, T. 14 N., R. 14 E., Okmulgee County. Measured in cutbank of Coal Creek, by LeRoy A. Hemish. Field notebook designation OO-10-81-H. (Estimated elevation at top of section, 678 ft.)

	Thickness (ft)
Disturbed ground (spoils from adjacent strip pit)	4.0

CABANISS GROUP	
Senora Formation:	
Shale, orange-brown, silty; fossil leaf impressions on stratification surfaces	2.0
Coal, black (Mineral coal)	1.3
Underclay, gray with reddish-brown iron oxide stain, calcareous, contains a few fossil brachiopods	0.1
Limestone, purple and gray, highly fossiliferous, surface knobby	0.5
Sandstone, gray, very fine-grained, noncalcareous; includes black carbonized plant fragments	1.2
Shale, gray, silty; includes discoidal and oblate clay iron-stone concretions (to water level in creek)	12.0
Total	21.1

MEASURED SECTION 44

SW¼SW¼SW¼NW¼ sec. 16, T. 14 N., R. 14 E., Okmulgee County. Measured in highwall of active strip mine operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-8-83-H. (Estimated elevation at top of section, 677 ft.)

	Thickness (ft)
Silt, dark-gray with brownish tint, unbedded (alluvial soil)	2.0
Gravel, grayish-brown with reddish-brown mottling, highly silty, poorly consolidated; contains rounded, subrounded, and subangular clasts of ironstone and sandstone	3.0
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray, interlaminated with light-gray siltstone; contains flat, reddish-brown ironstone concretions about 6 in. in diameter	14.0
Shale, medium-gray, silty; contains some 0.5-in.-thick stringers of light-gray claystone	18.0
Coal, black, bright, slightly friable; contains pyrite on cleat surfaces (Mineral coal)	1.2
Sandstone, very dark-gray, very fine-grained, highly calcareous, well-indurated; contains black carbonized plant compressions; total thickness not known	0.1
Total	38.3

MEASURED SECTION 45

NE¼SW¼SE¼NW¼ sec. 16, T. 14 N., R. 14 E., Okmulgee County. Measured in highwall of active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-3-83-H. (Estimated elevation at top of section, 685 ft.)

	Thickness (ft)
Clay, dark-grayish-brown, mottled and streaked with reddish-brown and gray; contains abundant selenite crystals and scattered clasts of sandstone and limonite gravel	2.5
Clay, yellowish-brown, mottled with light-gray and orange-brown, gypsiferous; includes gravel lenses 1-2 ft thick and 12 ft long near base of unit	4.0
Sand, yellowish-brown and dark-brown, mottled with gray, very fine-grained, very clayey and silty	1.0
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray, silty with reddish-brown stain on fracture surfaces in upper 4 ft	19.5

Coal, black with pyrite and white kaolinite on cleat surfaces, bituminous (Mineral coal)	1.2
Sandstone, black, hard (total thickness unknown)	0.1
Total	28.3

MEASURED SECTION 46

SE¼SW¼NW¼NE¼ sec. 16, T. 14 N., R. 14 E., Okmulgee County. Measured in highwall of active strip mine operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-7-82-H. (Estimated elevation at top of section, 690 ft.)

	Thickness (ft)
Clay, brown	5.0
CABANISS GROUP	
Senora Formation:	
Shale, brown to grayish-brown, silty, weathered	3.0
Shale, gray, silty	20.0
Coal, black with minor amounts of pyrite and white calcite on cleat surfaces (Mineral coal)	1.3
Sandstone, silty, well-indurated (total thickness undetermined)	0.1
Total	29.4

MEASURED SECTION 47

SW¼NW¼NE¼NE¼ sec. 16, T. 14 N., R. 14 E., Okmulgee County. Measured in highwall of active strip pit operated by P & K Coal Co., Ltd., by LeRoy A. Hemish. Field notebook designation OO-14-81-H. (Estimated elevation at top of section, 684 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, light-yellowish-brown with orange streaks, clayey in upper 3 ft, highly weathered	6.0
Shale, grayish-brown to orange with black streaks, coaly; shaly coal in part	0.3
Coal, black (Mineral coal)	1.2
Sandstone, light-yellowish-gray, impure, clayey; contains abundant black carbonized plant fragments	0.5
Total	8.0

MEASURED SECTION 48

SE¼SE¼SE¼SW¼ sec. 24, T. 14 N., R. 14 E., Okmulgee County. Measured in cutbank of tributary stream of Cane Creek, by LeRoy A. Hemish. Field notebook designation OO-16-81-H. (Estimated elevation at top of section, 640 ft.)

	Thickness (ft)
Covered (slumped material)	4.0

CABANISS GROUP
Senora Formation:

Shale, black, fissile; contains scattered phosphatic nodules about 0.75-1 in. in diameter; stained reddish-brown on joint surfaces in part	8.0
Coal, black; bed displaced by minor faulting in places (Tebo coal)	0.5
Underclay, light-yellowish-gray; in places contains coalified plant roots; occurs as lenses at the top of underlying unit	1.0
Shale, dark-gray, highly silty, weakly calcareous, unbedded; contains well-indurated calcareous nodules 0.5-4 in. in diameter; weathers olive-gray to reddish-brown on exposed surfaces	1.5
Shale, light-yellowish-gray, and dark-brownish-gray limestone with reddish-brown stain. Shale is clayey and very sticky, having the appearance of underclay. Limestone is impure and sandy in part; occurs as irregular, knobby masses that weather out of the clayey shale; unbedded; appears to contain only a few very poorly preserved fossil shell fragments (to water level in creek)	2.0
Total	17.0

MEASURED SECTION 49

NE¼SE¼NW¼SE¼ sec. 24, T. 14 N., R. 14 E., Okmulgee County. Measured in steep slope on east side of creek just southwest of juncture of Cane Creek with its southeast-flowing tributary, by LeRoy A. Hemish. Field notebook designation OO-17-81-H. (Estimated elevation at top of section, 639 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, black, fissile; contains phosphatic nodules up to 1 in. in diameter, and large discoidal black to reddish-brown ironstone concretions ≥1 ft in diameter	5.0
Limestone, brown, very hard, highly fossiliferous, massive, impure, silty; forms well-exposed ledge on hill slope; characterized by large rectangular joint pattern forming blocks approximately 2 × 3 ft (Tiawah Limestone)	0.6
Shale, black, fissile	15.0
Coal, black, soft, weathered (Tebo coal)	0.4
Underclay, light-gray with orange mottling and streaks; includes a very thin (0.5-in.-thick) stringer of soft, weathered coal at base of unit	2.2
Shale, light-gray with light-orange streaks; includes a zone about 2 in. thick of irregularly shaped masses of dark-brownish-gray impure, sandy limestone in upper part of unit	2.8
Total	26.0

MEASURED SECTION 50

SW¼NE¼NW¼ sec. 25, T. 14 N., R. 14 E., Okmulgee County. Measured in bank of spillway cut for stock pond, by LeRoy A. Hemish. Field notebook designation OO-5-83-H. (Estimated elevation at top of section, 645 ft.)

	Thickness (ft)
Clay, dark-brown, silty, gravelly, organic	1.5

CABANISS GROUP
Senora Formation:

Shale, light-yellowish-brown and orange-brown, highly weathered; contains fragments of ironstone concretions	2.5
Coal, black, soft, weathered (Tebo coal)	0.4
Underclay, purplish-gray with orange mottling; grades into underlying unit	0.6
Shale, light-gray with orange streaks, clayey	3.5
Sandstone, yellowish-gray, weathers reddish-brown, very fine-grained, thick-bedded to thin-bedded in lower part, well-indurated; base covered by water in creek	6.5
Total	15.0

MEASURED SECTION 51

SE¼NW¼SE¼SE¼ sec. 19, T. 14 N., R. 15 E., Okmulgee County. Measured in cutbank of stream directly south of old, abandoned strip pits, by LeRoy A. Hemish. Field notebook designation OO-15-81-H. (Estimated elevation at top of section, 620 ft.)

	Thickness (ft)
Disturbed ground (spoils from adjacent strip pit)	6.0
CABANISS GROUP	
Senora Formation:	
Shale, grayish-brown with orange mottling	0.3
Coal, black, soft, weathered (Mineral [Eram] coal)	1.1
Underclay, light-yellowish-gray; orange in 1-in.-thick layer directly above underlying limestone	0.5
Limestone, dark-grayish-brown, weathers yellowish-brown to pinkish-brown; impure, sandy, very highly fossiliferous, brachiopods abundant, coquinoidal in places; includes some minor, very thin stringers of coal; bedding highly disturbed; also includes some fossilized pieces of wood about 2 × 6 × 6 in.	0.6
Sandstone, dark-gray, micaceous, very thin-bedded, shaly, highly calcareous; includes abundant black carbonized plant fragments and some thin streaks of coal a fraction of an inch thick; contains scattered, dark-pink calcareous nodules about 2 in. in diameter (to water level in creek)	4.5
Total	13.0

MEASURED SECTION 52

SW¼SW¼SW¼SW¼ sec. 12, T. 15 N., R. 11 E., Okmulgee County. Measured from the southwest corner of the section northeast to exposure directly west of oil well in cutbank of stream, by LeRoy A. Hemish. Field notebook designation OO-1-81-H. (Estimated elevation at top of section, 733 ft.)

	Thickness (ft)
SKIATOOK GROUP	
Checkerboard Formation:	
Limestone, bluish-gray, weathers light-brown; includes abundant marine fossils (Checkerboard Limestone)	1.8
Seminole Formation:	
Shale, tan, weathered	0.5
Sandstone, brown, very fine-grained, highly calcareous	0.5

Shale, orange-brown, weathered, silty; olive-brown where less weathered	8.0
Sandstone, light-grayish-brown, highly silty, noncalcareous, weathers tannish-brown, ripple-drift cross-laminated; siltstone in part	3.0
Coal, black with reddish-brown stain, impure and shaly in upper 3 in. (Tulsa coal)	0.8
MARMATON GROUP(?)	
Holdenville Formation(?)	
Underclay, very dark-gray; grades downward to light-grayish-green; contains coal streaks and coalified wood fragments	1.0
Marlstone, light-grayish-white; includes scattered fossilized brachiopods	0.1
Limestone, reddish-purple, fossiliferous	0.2
Shale, grayish-green (to water level in creek)	0.6
Total	16.5

MEASURED SECTION 53

NW¼NW¼NE¼SE¼SE¼ sec. 22, T. 15 N., R. 11 E., Okmulgee County. Measured in low bluff on south side of Checkerboard Creek where stream bends to the east, by LeRoy A. Hemish. Field notebook designation OO-6-86-H. (Estimated elevation at top of section, 705 ft.)

	Thickness (ft)
Sand, silt, and gravel, grayish-brown with moderate-yellowish-brown mottling, poorly sorted; contains organic material; unit is an admixture of the above alluvial material lying directly on top of the weathered surface of the Checkerboard Limestone	3.5
SKIATOOK GROUP	
Checkerboard Formation:	
Limestone, grayish-orange to moderate-yellowish-brown, hard, dense, fine-grained, massive, well-jointed, very fossiliferous; contains abundant crinoid columnals, brachiopods, and fewer echinoid spines as well as other marine fauna (Checkerboard Limestone)	2.2
Seminole Formation:	
Shale, yellowish-gray, silty, micaceous, noncalcareous, soft, flaky; contains discontinuous layers up to 1.5 in. thick of dark-yellowish-orange clay ironstone concretions, then grades downward into light-olive-gray to medium-gray shale	12.0
Coal, black, soft, weathered, includes a light-medium-gray 0.5-in. shale parting in middle of unit (Tulsa coal)	0.2
MARMATON GROUP(?)	
Holdenville Formation(?)	
Underclay, medium-light-gray to dark-greenish-gray with dark-yellowish-orange mottling, contains black carbonized plant material	0.6
Shale, greenish-gray with moderate-reddish-brown mottling, clayey, noncalcareous, contains small flecks and streaks of black carbonized plant material; blocky fracture (to water level in Checkerboard Creek)	0.5
Total	19.0

MEASURED SECTION 54

W½NE¼NE¼ and NW¼SE¼NE¼ sec. 23, T. 15 N., R. 11 E., Okmulgee County. Measured from road cut southeast to base of bluff on west side of south-flowing tributary of Salt Creek, by LeRoy A. Hemish. Field notebook designation OO-1-84-H. (Estimated elevation at top of section, 725 ft.)

	Thickness (ft)
SKIATOOK GROUP	
Checkerboard Formation:	
Limestone, medium-gray, weathers moderate-brown, extremely fossiliferous, brachiopod shells and crinoid columnals abundant, fine-grained, dense, massive	2.0
Seminole Formation:	
Covered interval (approximate thickness)	10.0
MARMATON GROUP	
Holdenville Formation:	
Covered interval (approximate thickness)	46.0
Siltstone, light-gray, sandy, weathers light-yellowish-gray; extremely calcareous, fossiliferous; occurs as thin weathered flakes in weathered, soft, light-brown shale	2.0
Shale, grayish-brown, clayey, weathered; includes bands of dark-yellowish-orange limonitic clay	6.0
Shale, grayish-black, fissile; contains phosphatic nodules; weathers grayish-brown	6.0
Limestone, light-brownish-gray, weathers light-yellowish-gray, occurs as discontinuous layer of roughly spheroidal septaria up to 1 ft in diameter	0.3
Shale, brownish-gray, noncalcareous	1.7
Shale, dark-gray with dark-yellowish-orange streaks, noncalcareous	0.3
Coal, black with moderate-reddish-brown iron oxide stain on cleat surfaces, soft, very friable (Dawson coal)	0.8
Underclay, light-gray with dark-yellowish-orange streaks	1.0
Shale, light-brownish-gray, noncalcareous	5.0
Sandstone, moderate-reddish-brown, very fine-grained, noncalcareous; total thickness not known; well-exposed downstream along creek	1.9
Total	83.0

MEASURED SECTION 55

NE¼SE¼SE¼NW¼ sec. 23, T. 15 N., R. 14 E., Okmulgee County. Measured in side of old test pit just south of intermittent stream and east of oil well trail, by LeRoy A. Hemish. Field notebook designation OO-5-81-H. (Estimated elevation at top of section, 722 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, light-grayish-brown, very fine-grained, noncalcareous, micaceous, ripple-marked, thin-bedded; includes black carbonized fossil plant fragments; upper 3 ft highly weathered	9.0
Shale, grayish-brown to purplish-brown to black, carbonaceous, silty at top; includes some very thin stringers of coal	1.0
Coal, black, hard (Mineral coal)	1.1

Sandstone, dark-gray, very fine-grained, micaceous, stained reddish-brown in part; upper 4 in. soft; well-indurated in bottom 2 in.; total thickness not exposed	0.5
Total	11.6

Note: Downstream and updip, a thick, reddish-brown, ripple-marked, fine-grained sandstone is well exposed over a distance of several hundred yards (Chelsea Sandstone).

MEASURED SECTION 56

NE¼SE¼SW¼SW¼ sec. 26, T. 15 N., R. 14 E., Okmulgee County. Measured in cutbank of tributary to Little Cane Creek, by LeRoy A. Hemish. Field notebook designation OO-6-81-H. (Estimated elevation at top of section, 689 ft.)

	Thickness (ft)
Silt, dark-gray, clayey (alluvium)	2.5
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-brown with orange mottling; highly weathered; contains abundant pea-sized, weathered clay ironstone concretionary fragments	4.5
Coal, black (Mineral coal)	1.3
Sandstone, dark-gray, very fine-grained, noncalcareous, well-indurated (base covered)	0.1
Total	8.4

Note: About 100 yd downstream a well-indurated, massive, buff-weathering, fine-grained, highly calcareous sandstone containing fossil brachiopod shells and crinoid fragments forms the floor of the stream channel.

MEASURED SECTION 57

SE¼SW¼NE¼SE¼ sec. 27, T. 15 N., R. 14 E., Okmulgee County. Measured in active mine operated by Redman-Dunsted, Ltd., by LeRoy A. Hemish. Field notebook designation OO-8-82-H. (Estimated elevation at top of section, 696 ft.)

	Thickness (ft)
Clay, brown	5.0
CABANISS GROUP	
Senora Formation:	
Shale, brown, weathered	4.0
Shale, gray	17.0
Coal, black with minor pyrite and calcite on cleat surfaces (Mineral coal)	1.1
Sandstone, gray, hard, with undulose surface (total thickness undetermined)	0.2
Total	27.3

MEASURED SECTION 58

NE¼SE¼SE¼SE¼ sec. 27, T. 15 N., R. 14 E., Okmulgee County. Measured in highwall of active strip pit operated by Redman-Dunsted, Ltd., by LeRoy A. Hemish. Field notebook designation OO-11-81-H. (Estimated elevation at top of section, 702 ft.)

	Thickness (ft)
Clay, dark-grayish-brown, silty, organic (topsoil)	2.0
CABANISS GROUP	
Senora Formation:	
Shale, yellowish-brown with orange mottling, highly weathered	4.0
Shale, light-brown, micaceous; interlaminated with siltstone; some black carbonized plant fragments on stratification surfaces	6.2
Shale, light-bluish-gray; interlaminated with light-gray siltstone; noncalcareous	9.8
Coal, black, hard; pyrite on banding surfaces and cleavage surfaces (Mineral coal)	1.1
Sandstone, dark-brown, very fine-grained, well-indurated (total thickness unknown)	0.1
Total	23.2

MEASURED SECTION 59

NE¼SW¼SW¼NW¼ sec. 29, T. 16 N., R. 12 E., Okmulgee County. Measured in bluff on south side of South Duck Creek, by LeRoy A. Hemish. Field notebook designation OO-5-82-H. (Estimated elevation at top of section, 750 ft.)

	Thickness (ft)
MARMATON GROUP	
Holdenville Formation:	
Sandstone, light-yellowish-brown, fine-grained, micaceous, noncalcareous; massive in upper 2 ft; in lower part, thin-bedded, shaly, and silty, with abundant black carbonized plant fragments on stratification surfaces; unit contains scattered dark-brown, ferruginous concretions 0.5-3 in. in diameter	12.0
Shale, black, carbonaceous	1.3
Coal, black, weathered (Dawson coal)	0.2
Shale, olive-gray with orange streaks, clayey	0.2
Coal, bright, hard (0.5 in. Dawson coal)	0.1
Shale, olive-gray in upper part to dark-brownish-gray in lower part; clayey, carbonaceous in lower part	0.4
Coal, black, soft, impure (0.5 in. Dawson coal)	0.1
Underclay, light-yellowish-gray	0.5
Shale, bluish-gray with light-orange mottling, clayey (base covered)	1.2
Total	16.0

MEASURED SECTION 60

SE¼SE¼SW¼NE¼ sec. 35, T. 16 N., R. 14 E., Okmulgee County. Measured in cutbank of Concharty Creek, by LeRoy A. Hemish. Field notebook designation OO-3-81-H. (Estimated elevation at top of section, 680 ft.)

	Thickness (ft)
Silt, light-brown, clayey, sandy; includes sandstone pebbles and cobbles at contact with underlying unit (alluvium)	3.0
CABANISS GROUP	
Senora Formation:	
Sandstone, yellowish-brown, very fine-grained, noncalcareous, thin- to medium-bedded, micaceous; fills channel cut into underlying unit; top eroded	4.0
Shale and siltstone, tan with light-orange banding, interbedded	2.5
Shale, dark-gray, silty; contains oblate, purple, noncalcareous concretions up to 1 ft in diameter and 3 in. thick (to water level in creek)	4.5
Total	14.0

Note: Approximately 12 ft of shale separates base of sandstone unit (see above) from top of Mineral coal interval (see following measured section).

MEASURED SECTION 61

NW¼SE¼NE¼SE¼ sec. 35, T. 16 N., R. 14 E., Okmulgee County. Measured in cutbank of Concharty Creek and downstream to east section line, by LeRoy A. Hemish. Field notebook designation OO-2-81-H. (Estimated elevation at top of section, 675 ft.)

	Thickness (ft)
Silt, very dark-brown, clayey (alluvium)	3.0
Clay, light-brown, silty, sandy; includes layers of gravel containing subangular to rounded clasts of reddish-brown and buff sandstone (alluvium)	7.0
Sand, grayish-brown with dark-reddish-brown mottling, very fine-grained, clayey; contains abundant gravel (alluvium)	3.0
Gravel, dark-reddish-orange, very highly oxidized, clasts predominantly sandstone (alluvium)	1.0
CABANISS GROUP	
Senora Formation:	
Shale, orange-brown, weathered	0.1
Shale, very dark-gray and black, coaly, flaky; shaly coal in part; includes several thin seams of black, hard, shiny coal <0.25 in. thick, totaling <2 in. (Mineral coal)	1.2
Sandstone, light-gray, silty, very fine-grained, noncalcareous, thin-bedded (to water level in creek)	1.0
Total	16.3

Note: Downstream about 800 ft, approximately 4 ft of light-gray and orange, shaly, very fine-grained, thin-bedded sandstone is exposed at curve in road just east of east section line (upper part of Chelsea Sandstone).

CORE-HOLE LOG 1

SE¼NW¼NW¼NE¼SW¼ sec. 22, T. 10 N., R. 12 E., Okfuskee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in shale pit just north of road and west of railroad tracks. Field notebook designation C-00-2. (Surface elevation, estimated from topographic map, 678 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
CABANISS GROUP		
Senora Formation:		
Shale, grayish-orange, clayey, weathered; contains stringers of moderate-reddish-orange clay ironstone	0.0	4.5
Shale, moderate olive-brown with dark-gray and moderate-reddish-orange bands; some brownish-black stain on stratification surfaces; weathered, clayey	4.5	6.0
Shale, olive-gray with some brownish-black stain on stratification surfaces; includes a minor black shale band at 12 ft.	10.5	4.5
Shale, olive-gray with light-brown bands	15.0	1.5
Shale, olive-gray with very dark-gray and light-brown bands	16.5	0.3
Shale, black, soft, carbonaceous	16.8	0.2
Shale, olive-gray with very dark-gray and moderate-reddish-orange bands	17.0	0.8
Ironstone, dark-reddish-brown, hard	17.8	0.2
Shale, olive-gray to medium-gray with some moderate-reddish-orange ironstone concretions	18.0	1.7
Shale, medium-gray, clayey	19.7	5.6
Shale, black, hard; contains light-brown concretions about 0.5 in. thick, 3 in. from top of unit as well as selenite-filled fractures about ⅛ in. thick	25.3	4.4
Shale, black, hard, brittle	29.7	2.8
Coal, black, hard, banded; pyritic in lower 3 in. (Croweburg coal)	32.5	1.0
Shale, medium-gray, carbonaceous; contains abundant fossil plant fragments	33.5	0.9
Coal, black, impure, shaly (Croweburg coal)	34.4	0.2
Shale, dark-gray, coaly; contains very thin stringers of bright, hard, coal	34.6	0.3
Coal, black, very impure and shaly; includes pyrite and calcite (Croweburg coal)	34.9	0.5
Underclay, dark-gray to medium-gray; contains abundant black, carbonaceous plant fragments	35.4	1.6
Total Depth		37.0

CORE-HOLE LOG 2

SE¼SE¼NW¼NE¼SW¼ sec. 28, T. 10 N., R. 12 E., Okfuskee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture about 0.1 mi NW of farm building site. Field notebook designation C-00-1. (Surface elevation, estimated from topographic map, 705 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, grayish-brown to moderate-yellowish-brown, sandy, clayey; contains large, angular boulders of reddish-brown sandstone	0.0	2.2
Clay, moderate-yellowish-brown	2.2	2.3
CABANISS GROUP		
Senora Formation:		
Shale, grayish-brown with dark-gray and moderate-reddish-orange bands, becomes darker with depth, weathered; includes reddish-brown and moderate-reddish-orange ironstone concretions about 0.75 in. thick	4.5	5.5

Shale, medium-gray to grayish-brown with moderate-reddish-orange bands, partly weathered; contains some hard, reddish-brown ironstone concretions about 0.75 in. thick	10.0	9.5
Shale, moderate-olive-brown with reddish-brown stain on stratification surfaces	19.5	8.5
Shale, black, hard; includes selenite-filled fractures about 1/8 in. thick in upper part	28.0	1.5
Shale, black, hard; includes 1-in.-thick ironstone concretions	29.5	4.5
Shale, black, hard	34.0	1.0
Shale, black, soft, highly carbonaceous; contains a few small brachiopod fossils	35.0	0.5
Coal, black, banded; includes minor pyrite and calcite (Croweburg coal)	35.5	1.2
Shale, medium-gray, clayey; contains streaks of black, bright coal	36.7	1.1
Coal, black, banded, impure; contains 0.75 in. gray clay parting 4 in. from base of unit (Croweburg coal)	37.8	0.9
Shale, black, highly carbonaceous, coaly in part	38.7	0.5
Underclay, medium-gray to light-gray	39.2	0.3
Underclay, light-gray, shaly at bottom of unit	39.5	2.2
Total Depth		41.7

CORE-HOLE LOG 3

NW¼NE¼SE¼NW¼SW¼ sec. 31, T. 11 N., R. 13 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture about 130 ft south of driveway and about 100 ft west of blacktop road. Field notebook designation C-00-3. (Surface elevation, estimated from topographic map, 738 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, grayish-orange, clayey, sandy, unconsolidated; includes angular, reddish-brown sandstone clasts up to boulder size	0.0	5.0
Clay, moderate-yellowish-brown, highly weathered; contains some gravel clasts	5.0	4.0
CABANISS GROUP		
Senora Formation:		
Shale, light-olive-gray, clayey, slightly weathered; includes soft moderate-reddish-orange ironstone concretionary layers	9.0	9.0
Shale, olive-gray to medium-gray, clayey; includes layers of reddish-brown ironstone concretions	18.0	10.0
Shale, medium-gray, clayey; contains a few light-gray siderite concretions about 0.5-1 in. thick	28.0	42.0
Shale, dark-gray, fissile	70.0	0.5
Shale, medium-gray; includes bands of dark-gray fissile shale	70.5	4.5
Limestone, light-gray, silty	75.0	0.2
Shale, medium-gray, includes bands of dark-gray and grayish-black shale	75.2	2.8
Shale, dark-gray to grayish-black, hard	78.0	6.0
Shale, grayish-black, hard, carbonaceous	84.0	9.5
Shale, dark-gray	93.5	3.8
Coal, black, bright; contains white calcite on cleat surfaces; contains pyrite layers and lenses up to 0.5 in. thick (Croweburg coal)	97.3	1.2
Shale, dark-gray with grayish-black bands, carbonaceous; includes some thin layers of impure coal	98.5	0.7
Coal, black, bright, impure; contains pyrite and white calcite on cleat surfaces (Croweburg coal)	99.2	1.2

Underclay, medium-gray; contains dark-gray bands of highly carbonaceous shale in upper 3 in., includes abundant black carbonized plant fragments such as leaves and roots; very silty in lower 3 ft.	100.4	3.5
Total Depth		103.9

CORE-HOLE LOG 4

NW¼NW¼SE¼NW¼NE¼ sec. 5, T. 12 N., R. 13 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in meadow about 215 ft west of St. Louis-San Francisco Railroad tracks and about 60 ft north of driveway. Field notebook designation C-00-4. (Surface elevation, estimated from topographic map, 627 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Sand, moderate-brown with reddish tones, very fine-grained, silty, unconsolidated; contains organic matter (soil)	0.0	1.5
Sand, moderate-red, very fine-grained, clayey, unconsolidated; contains a minor amount of fine gravel	1.5	2.0
Clay, moderate-red, plastic; contains some sand and gravel streaks	3.5	4.5
Silt, moderate-red, highly clayey, soft	8.0	13.5
Clay, pale-reddish-brown, becomes light-brown at 25 ft; weathered, soft	21.5	8.5
Silt, moderate-red, coarse-grained; includes some clay and very fine sand	30.0	8.0
Silt, pale-reddish-brown, clayey; contains some very fine-grained sand	38.0	3.0
Silt, grayish-brown, clayey	41.0	2.0
Silt, light-gray; includes some very fine-grained sand	43.0	4.5
Peat, black and moderate-brown, soft, fibrous; includes some black lignitic material at base of unit	47.5	11.0
Sand, light-gray, poorly sorted, coarse, unconsolidated; contains abundant well-rounded clasts of quartz and white chert	58.5	0.5
CABANISS GROUP		
Senora Formation:		
Siltstone, light-bluish-gray, fine-grained, well-indurated	59.0	0.5
Shale, medium-gray, silty; contains well-preserved, black carbonized plant compressions and 1/16-in.-thick coal stringers at 63.4 and 69 ft	59.5	9.5
Siltstone, medium-gray, hard; contains abundant black carbonized plant fragments	69.0	0.3
Shale, olive-gray, silty; contains abundant black carbonized plant fragments	69.3	0.4
Shale, grayish-black, coaly; contains layers of coal 1/64 to 1/8 in. thick	69.7	1.8
Shale, dark-gray, highly carbonaceous; black carbonized plant compressions abundant on stratification surfaces	71.5	1.5
Shale, grayish-black; contains abundant black carbonized plant compressions and a 1-in.-thick layer of shaly coal 6 in. from bottom of unit	73.0	2.0
Shale, dark-gray; contains abundant black carbonized plant compressions on stratification surfaces	75.0	4.5
Shale, medium-gray, silty, hard; contains black carbonized plant fragments	79.5	1.5
Siltstone, dark-gray, hard; contains sparsely distributed black carbonized plant compressions	81.0	1.0
Shale, medium-gray; contains black carbonized plant compressions	82.0	1.1
Shale, grayish-black with black bands, very highly carbonaceous; contains several thin stringers of bright, hard coal 1/32 to 0.75 in. thick	83.1	3.2
Coal, black, bright, moderately friable, impure in upper 2 in.; contains white calcite on cleat surfaces as well as pyrite lenses and crusts (Croweburg coal)	86.3	0.7
Underclay, dark-gray to black, hard, silty; contains abundant black carbonized plant fragments; grades into underlying unit	87.0	0.5

Sandstone, light-gray with dark-gray bands, very fine-grained, silty, cross-laminated, micaceous; soft-sediment deformation structures such as slump-and-flow features common; contains abundant macerated black plant fragments . . .	87.5	3.5
Total Depth		91.0

CORE-HOLE LOG 5

NE¼SE¼SE¼SE¼SE¼ sec. 17, T. 12 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in meadow just southeast of farm building site, about 210 ft north of U.S. Highway 266, and about 50 ft west of E section line. Field notebook designation C-00-5. (Surface elevation, estimated from topographic map, 650 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Sand, grayish-brown, very fine-grained, silty; contains abundant organic material; includes angular clasts up to cobble size of moderate-yellowish-brown sandstone (soil)	0.0	1.0
CABANISS GROUP		
Senora Formation:		
Sandstone, moderate-reddish-brown, weathered, very fine- to fine-grained, noncalcareous, friable	1.0	12.5
Sandstone, moderate-yellowish-brown, weathered, very fine-grained, silty, noncalcareous, moderately friable	13.5	6.0
Sandstone, dark-yellowish-brown, slightly weathered, very fine-grained, silty, clayey	19.5	1.0
Siltstone, light-olive-gray, sandy	20.5	0.5
Siltstone, medium-gray, well-indurated, sandy; includes some black macerated plant fragments on stratification surfaces	21.0	1.0
Sandstone, light-gray, very fine-grained, micaceous; intricately interbedded and interlaminated with dark-gray shaly siltstone and silty shale, cross-laminated; black carbonized plant fragments abundant on stratification surfaces; cut-and-fill features common	22.0	6.0
Siltstone, dark-gray, micaceous, shaly in part; contains abundant black macerated carbonized plant material; intricately interbedded and interlaminated with light-gray, very fine-grained, micaceous sandstone	28.0	13.0
Sandstone, light-gray, very fine- to fine-grained, well-indurated, micaceous; includes black carbonized plant fragments on stratification surfaces	41.0	0.2
Siltstone, dark-gray, micaceous, shaly in part; contains abundant black macerated, carbonized plant material; intricately interbedded and interlaminated with light-gray, very fine-grained, micaceous sandstone	41.2	11.5
Sandstone, light-gray, very fine- to fine-grained, micaceous, intricately interbedded and interlaminated with dark-gray, shaly, carbonaceous, micaceous siltstone; even-bedded sandstone units 0.5-4 in. thick occur at repeated intervals between interlaminated siltstone and sandstone units, includes abundant black carbonized plant fragments on stratification surfaces	52.7	6.8
Siltstone, dark-gray, micaceous; contains abundant black carbonized plant fragments; intricately interlaminated and cross-laminated with light-gray, very fine-grained sandstone	59.5	2.5
Sandstone, very fine- to fine-grained, micaceous; includes abundant black carbonized plant fragments on stratification surfaces; intricately interbedded and interlaminated with dark-gray, shaly, micaceous siltstone; even-bedded sandstone units 0.5-3 in. thick occur at regular intervals between interlaminated and cross-laminated siltstone and sandstone units	62.0	2.4

Siltstone, dark-gray, well-indurated, shaly; contains a few black carbonized plant fragments in upper part of interval; interlaminated with thin laminae of light-gray, very fine-grained sandstone that in places thicken to form 1/16- to 1/8-in.-thick lenses about 1 in. long	64.4	19.6
Total Depth		84.0

CORE-HOLE LOG 6

SE¼SW¼NW¼SW¼SE¼ sec. 31, T. 13 N., R. 10 E., Okfuskee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture at southwest corner of farm pond 2,420 ft FEL and 700 ft FSL. Field notebook designation C-00-18. (Surface elevation, estimated from topographic map, 738 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, brownish-gray, contains organic material	0.0	3.5
Sand, grayish-orange, clayey, fine- to coarse-grained, poorly sorted	3.5	2.5
Sand and gravel, moderate-yellowish-brown, clayey; gravel clasts are predominantly subangular, moderate-reddish-brown sandstone	6.0	2.5
SKIATOOK GROUP		
Coffeyville Formation:		
Shale, pale-yellowish-brown to moderate-brown, soft, clayey, noncalcareous, weathered	8.5	1.7
Shale, brownish-gray with moderate-yellowish-brown bands, soft, clayey, noncalcareous, weathered	10.2	0.6
Shale, black with moderate-yellowish-brown bands, soft, flaky; iron oxide deposits on stratification surfaces	10.8	1.2
Shale, black, hard, brittle, fractured, noncalcareous; iron oxide deposits on fracture surfaces and stratification surfaces; contains small phosphatic nodules	12.0	5.1
Marlstone, medium-gray, soft, silty; contains abundant crinoid columnals, increasing in number downward	17.1	1.7
Sandstone and mudstone, medium-gray, marly, fine-grained; contains abundant crinoid ossicles	18.8	1.6
Shale, medium-gray, sandy, silty, noncalcareous; interfingers with underlying unit	20.4	1.1
Sandstone, light-gray with medium-dark-gray laminations, fine- to very fine-grained, noncalcareous, cross-stratified; thick-bedded and uniform in appearance, with grain size increasing to fine- to medium-grained, from about 33.0-41.0 ft; conglomeratic from 41.0-45.0 ft, with abundant greenish-gray shale pebbles; also conglomeratic from about 52.0-54.7 ft; includes abundant black macerated plant fragments in lower 5 ft of unit; sharp contact with underlying unit	21.5	33.2
Shale, medium dark-gray, silty, noncalcareous; bioturbated in lower part; includes some interbedded, light-gray, very fine-grained sandstone below 60 ft.	54.7	6.5
Sandstone, light-gray with medium dark-gray streaks and layers; fine- to very fine-grained, contains black macerated plant fragments, noncalcareous, cross-stratified, extensively bioturbated in part; shaly below 71 ft	61.2	14.2
Shale, medium dark-gray, silty, fossiliferous, noncalcareous, bioturbated in part; interbedded with lenses and layers of very fine-grained, fossiliferous, weakly calcareous sandstone up to 1.5 in. thick	75.4	6.6

Shale, medium dark-gray, silty, calcareous, fossiliferous	82.0	2.5
Limestone, medium dark-gray, very shaly, fossiliferous, contains abundant bryozoans, brachiopods, and crinoid columnals; grade into underlying unit	84.5	1.8
Shale, medium dark-gray, silty, calcareous, fossiliferous; contains abundant crinoid columnals and brachiopod valves, generally concentrated in layers up to 0.5 in. thick	86.3	6.5
Sandstone, medium dark-gray and medium light-gray, hard, shaly, very calcareous, fossiliferous, bioturbated in part; intricately convoluted and laminated; high-energy depositional features common	92.8	1.7
Sandstone, medium dark-gray, medium light-gray, and dark-gray, very fine-grained, shaly, noncalcareous, bioturbated, bedding contorted; contains fossil fragments	94.5	1.5
Sandstone, dark-gray with medium light-gray contorted bands, very fine-grained, shaly, silty, noncalcareous, bioturbated, fossiliferous	96.0	1.5
Limestone, very light-gray with brownish-gray mottling, hard, sandy, fossiliferous, includes abundant brachiopod and pelecypod fossils	97.5	2.0
Sandstone, light greenish-gray, very fine-grained, calcareous; conglomeratic in up per 3 in.; bedding obscure; bioturbated in part; includes some fossil fragments; becomes noncalcareous below 101 ft	99.5	4.5
Siltstone, medium dark-gray, sandy, muddy, calcareous, fossiliferous; contains scattered fossil brachiopod shells and crinoid columnals; laminated; bioturbated in places	104.0	15.5
Shale, medium dark-gray to olive-black, silty, weakly calcareous; contains lens-shaped, brownish-gray sideritic concretions about 0.5-1 in. thick	119.5	5.8
Shale, medium dark-gray to olive-black, silty, calcareous, interstratified with a few layers of very fine-grained, medium-light-gray, calcareous sandstone 0.25-3 in. thick; contains lens-shaped, brownish-gray sideritic concretions generally <0.75 in. thick	125.3	4.9
Shale, medium dark-gray to olive-black, calcareous; contains scattered marine fossil fragments and brownish-gray, sideritic burrow fillings; includes minor pyrite associated with trace fossils on stratification surfaces	130.2	19.1
Shale, grayish-black to black, brittle, noncalcareous; contains pyritized and calcareous marine fossils; contact with overlying unit sharp	149.3	4.7
Shale, dark-gray, very calcareous; includes abundant fossil shells	154.0	0.1
Shale, dark-gray, silty, calcareous, fractured; includes pyritized burrow fillings and fossil shells and shell fragments; contains rare brownish-gray sideritic concretions about 1-2 in. thick; burrows and fossils rare below 170 ft; grades into underlying unit	154.1	25.9
Shale, dark-gray, silty, noncalcareous; contains rare light brownish-gray sideritic concretions 0.25-2 in. thick; includes sparse brachiopod shells and pyritized trace fossils, as well as minor calcite veins along fracture surfaces	180.0	7.4
Shale, medium-gray to medium dark-gray, silty, hard, noncalcareous; contains rare light brownish-gray sideritic concretions about 0.5 in. thick and sparse marine fossils	187.4	3.4
Shale, medium dark-gray, silty, noncalcareous, interlaminated with light-gray, very fine-grained sandstone; contains numerous small, elongated, lens-shaped, light brownish-gray sideritic concretions	190.8	4.2
Shale, medium dark-gray to dark-gray, silty, noncalcareous; includes lens-shaped, light brownish-gray sideritic concretions up to 1 in. thick that are probably burrows; calcareous from 203-239 ft; contains scattered light brownish-gray fossil-cored concretions about 0.25 in. in diameter, and small pyritized trace fossils; grades into underlying unit	195.0	51.7
Limestone, very light-gray and dark-gray, interstratified with calcareous shale, fossiliferous; composed predominantly of small crinoid ossicles; grades into underlying unit	246.7	0.5

Shale, dark-gray to medium dark-gray, silty, calcareous; fossiliferous, with abundant small crinoid ossicles in upper 1 ft; includes a 1.5-in.-thick medium light-gray limestone concretion at 249.5 ft; bioturbated; contains numerous light brownish-gray sideritic bands and concretions that are probably burrows	247.2	27.7
Limestone, dark-gray, impure, shaly, fossiliferous brachiopod shells and shell fragments abundant	274.9	0.3
Shale, dark-gray, very calcareous, fossiliferous; contains scattered marine shells and shell fragments; includes some minor pyrite on stratification surfaces as well as pyrite-filled burrows	275.2	9.0
Shale, medium-dark-gray, noncalcareous; includes abundant closely spaced siltstone laminae; bioturbated	284.2	1.4
Shale, dark-gray to grayish-black, carbonaceous, weakly calcareous; contains gastropods, brachiopod shells and shell fragments; includes coalified plant fossils and stringers of coal up to 3/8 in. thick	285.6	0.2
Shale, medium-dark-gray, calcareous, fossiliferous; contains pelecypods and other marine fossils as well as scattered, black carbonized plant fragments; abundance of marine fossils increases markedly in lower 1 in. of unit	285.8	1.0
Coal, black, moderately friable; includes calcite on cleat surfaces (unnamed coal)	286.8	0.1
Underclay, dark-gray to medium-light-gray, carbonaceous in upper part; grades into underlying unit	286.9	0.2
Shale, medium-bluish-gray, clayey, noncalcareous, slickensided; includes some brownish-black carbonaceous shale layers up to 0.75 in. thick in bottom 2 ft of unit	287.1	3.7
Shale, medium-gray, calcareous, bioturbated; includes very fine-grained, light-brownish-gray sandstone laminae in lower 1 ft of unit	290.8	1.9
Siltstone, medium-gray, calcareous, hard, bioturbated; shaly in part; includes some lens-shaped laminae of very fine-grained, light-gray sandstone; contains sparsely distributed marine fossils such as crinoid columnals and brachiopod shells; fossil content increases markedly in bottom 6 in. of unit; grades into underlying unit	292.7	29.3
Checkerboard Formation:		
Limestone, medium-light-gray, extremely fossiliferous, brachiopods and crinoid columnals most abundant; very silty in upper 1 ft of unit; impure throughout (Checkerboard Limestone)	322.0	2.3
Seminole Formation:		
Shale, brownish-black, silty, very calcareous, carbonaceous; contains scattered small marine fossils	324.3	0.5
Shale, brownish-black to black, carbonaceous; contains abundant thin stringers of coal; noncalcareous	324.8	0.4
Shale, medium-dark-gray, clayey, noncalcareous, slickensided; becomes dark-gray and carbonaceous in lower 1 in. of unit	325.2	0.8
Coal, black, bright, slightly friable; includes white calcite on cleat surfaces (Tulsa coal)	326.0	0.1
MARMATON GROUP(?)		
Holdenville Formation(?):		
Underclay, medium-dark-gray, slickensided; grades into underlying unit	326.1	0.4
Shale, greenish-gray, blocky fracture, crumbly, noncalcareous, slickensided	326.5	3.9
Shale, medium-dark-gray with medium-gray bands, very silty, hard, interstratified with abundant layers of very fine-grained sandstone, extensively bioturbated; calcareous to about 350 ft, then weakly calcareous, becoming noncalcareous below 353 ft	330.4	29.6
Shale, dark-gray, silty, noncalcareous; contains thin stringers and small lenses of light-gray, very fine-grained sandstone; bioturbated, hard, fractured; white gypsum fills fractures; grades into underlying unit	360.0	6.0

Shale, dark-gray to grayish-black, noncalcareous, hard, brittle, fossiliferous; contains scattered brachiopod shells and shell fragments; includes small, pyritized trace fossils on stratification surfaces; grades into underlying unit . .	366.0	4.2
Shale, grayish-black to black, hard, brittle, noncalcareous; includes some minor pyrite and rare marine fossils; contains phosphatic nodules about 0.5 in. in diameter	370.2	6.1
Shale, medium-dark-gray, noncalcareous, bioturbated, fossiliferous; contains pyrite-filled burrows and brachiopod valves; slickensided	376.3	2.0
Coal, black, bright, pyritic; contains closely spaced veinlets of white gypsum (Dawson coal)	378.3	0.1
Underclay, greenish-gray, slickensided, thickness of unit irregular	378.4	0.2
Coal, black, bright, pyritic, contains closely spaced veinlets of white gypsum, thickness of unit irregular (Dawson coal)	378.6	0.1
Underclay, greenish-gray, slickensided, thickness of unit irregular	378.7	0.2
Coal, black, bright, pyritic, contains closely spaced veinlets of white gypsum, thickness of unit irregular (Dawson coal)	378.9	0.1
Underclay, greenish-gray, slickensided, includes some brownish-black layers of carbonaceous clay up to 1 in. thick; grades into underlying unit	379.0	1.0
Mudstone, greenish-gray, noncalcareous, interbedded with brownish-black carbonaceous sandstone and very fine-grained, silty, greenish-gray sandstone .	380.0	8.5
Sandstone, light-gray with medium-light-gray bands, well-indurated, very fine-grained, noncalcareous, cross-bedded	388.5	1.5
Total Depth		390.0

CORE-HOLE LOG 7

NE¼NE¼NE¼NE¼SE¼ sec. 35, T. 13 N., R. 13 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in field about 90 ft south of driveway and about 65 ft west of E section line. Field notebook designation C-00-6. (Surface elevation, estimated from topographic map, 703 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Sand, moderate-brown, very fine-grained; contains organic material	0.0	2.8
CABANISS GROUP		
Senora Formation:		
Sandstone, moderate-yellowish-brown, very fine-grained, silty, friable, noncalcareous	2.8	2.2
Sandstone, moderate-reddish-brown, very fine-grained, silty, well-indurated . . .	5.0	1.5
Sandstone, grayish-orange, very fine-grained, silty, moderately friable	6.5	1.5
Sandstone, dusky-yellow to moderate-yellowish-brown, fine-grained; contains cross-bedded intervals alternating with even-bedded intervals about 2 ft thick; includes a bioturbated zone from 17.3 to 17.8 ft; contains a few limonitic concretions about 0.25 in. thick and 0.5 in. long; contains black carbonaceous flecks in bottom 10 in.	8.0	12.9
Sandstone, light-olive-gray to light-olive-brown with black streaks, very fine-grained, noncalcareous; irregularly interlaminated with black, bright coal . . .	20.9	4.2
Sandstone, medium-light-gray with black streaks, very fine-grained, noncalcareous; irregularly interlaminated with black, bright coal; contains lenses of coal 1/32 to 1.25 in. thick	25.1	4.6

Sandstone, medium-light-gray and black, very fine-grained, noncalcareous; contains about 25% black, bright coal in very thin beds and laminae; includes 3/16-in.-thick layers of coal at top and bottom of interval (Croweburg coal)	29.7	0.6
Sandstone, medium-light-gray, very fine-grained, noncalcareous; includes a few thin laminae of black coal in upper 2 in.	30.3	0.6
Shale, dark-gray to grayish-black; includes a few brownish-gray siderite concretions 0.5-1 in. thick in upper 1 ft of unit	30.9	6.1
Shale, dark-gray; contains brownish-gray, very fine-grained silt bands and a few 0.25-in.-thick pyrite nodules	37.0	5.0
Shale, dark-gray, noncalcareous	42.0	1.8
Shale, dark-gray, weakly calcareous; includes a 0.75-in.-thick siderite layer at base of unit	43.8	3.5
Shale, medium-dark-gray, highly calcareous; contains several light-olive-gray layers of silty limestone 1/64 to 0.5 in. thick (McNabb Limestone)	47.3	7.5
Total Depth		54.8

CORE-HOLE LOG 8

NE¼NE¼NW¼SE¼ sec. 14, T. 13 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture about 36 ft south and 1,072 ft east from center of section. Field notebook designation C-00-14. (Surface elevation estimated from topographic map, 680 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, pale-yellowish-brown, sandy; contains organic material	0.0	2.5
CABANISS GROUP		
Senora Formation:		
Shale, moderate-yellowish-brown, clayey; contains dusky-brown, gravel-sized ironstone clasts; weathered	2.5	4.5
Shale, dark-yellowish-orange, weathered	7.0	1.5
Coal, black, very soft, highly weathered (Mineral [Eram] coal)	8.5	0.9
Underclay, light-gray to medium-gray with dark-yellowish-orange streaks, soft; includes abundant coalified plant material	9.4	1.4
Shale, dark-yellowish-brown to olive-gray, silty; includes several 0.5- to 0.75-in.-thick layers of dark-reddish-brown ironstone; stained light-brown on stratification surfaces; includes some black carbonized plant fragments	10.8	5.7
Shale, dark-gray, silty, some moderate-brown staining on stratification surfaces in upper 12 in.	16.5	6.0
Sandstone, medium-gray, shaly, very fine-grained, wavy-laminated, bioturbated; includes black macerated plant material on stratification surfaces; noncalcareous	22.5	7.8
Shale, dark-gray, calcareous	30.3	1.1
Limestone, light-gray to medium-gray, impure, sandy, highly fossiliferous, brachiopods most abundant	31.4	2.5
Shale, dark-gray, interbedded with light-gray, very fine-grained calcareous sandstone	33.9	0.5

Sandstone, light-gray, fine-grained, interstratified with dark-gray shale; abundant cut-and-fill features; noncalcareous	34.4	1.6
Total Depth		36.0

CORE-HOLE LOG 9

NW¼NE¼NW¼SE¼ sec. 14, T. 13 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture about 40 ft south and 762 ft east from center of section. Field notebook designation C-00-13. (Surface elevation, estimated from topographic map, 690 ft.)

	Depth to unit top (ft)	Thickness of unit (ft)
Silt, pale-yellowish-brown, contains organic material, well-sorted (soil)	0.0	3.0
CABANISS GROUP		
Senora Formation:		
Shale, moderate-yellowish-brown, clayey; contains brownish-black gravel-sized ironstone clasts; highly weathered; becomes sandy in lower part	3.0	7.5
Sandstone, moderate-yellowish-brown to dark-yellowish-brown, highly silty and shaly, weathered	10.5	2.0
Sandstone, dark-yellowish-brown with brownish-black stain, silty, micaceous, noncalcareous, laminated; includes black macerated plant fragments on stratification surfaces; weakly cemented	12.5	1.5
Sandstone, brownish-gray to medium-dark-gray, silty, shaly, very fine-grained, noncalcareous	14.0	2.3
Sandstone, medium-dark-gray to medium-light-gray, very fine-grained, silty, bioturbated; interlaminated with black carbonaceous shaly sandstone in some places; micaceous; grades into underlying unit	16.3	5.2
Limestone, light-gray, impure, sandy, highly fossiliferous, brachiopods most abundant	21.5	2.4
Shale, medium-gray, silty, noncalcareous, hard	23.9	0.1
No core recovery, cuttings unreadable, drilled like shaly sandstone	24.0	6.7
Shale, dark-gray, silty, sandy	30.7	0.3
Shale, dark-gray, silty, interlaminated with light-gray, very fine-grained sandstone	31.0	1.1
Sandstone, light-gray, fine-grained, noncalcareous, well-indurated	32.1	0.2
Sandstone, medium-dark-gray with light-gray bands, shaly, very fine-grained, noncalcareous, wavy-bedded, cross-laminated in part; includes some bioturbation features in upper 6 in.	32.3	2.2
Sandstone, medium-light-gray with dark-gray laminae, very fine-grained, noncalcareous, cross-laminated; shaly in part; includes thin layers of highly carbonaceous sandstone; black macerated plant material abundant; well-indurated	34.5	8.5
Total Depth		43.0

CORE-HOLE LOG 10

NW¼NW¼NW¼SE¼ sec. 14, T. 13 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture about 30 ft south and 30 ft east from center of section. Field notebook designation C-00-12. (Surface elevation, estimated from topographic map, 705 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, pale-yellowish-brown; contains organic material	0.0	3.0
CABANISS GROUP		
Senora Formation:		
Shale, moderate-yellowish-brown, sandy; includes particles of moderate-reddish-brown ironstone; highly weathered	3.0	5.0
Shale, grayish-orange, includes abundant dusky-brown ironstone concretions	8.0	3.0
Sandstone, light-brown, micaceous, very fine-grained, silty, weathered	11.0	1.0
Sandstone, grayish-orange, micaceous, very fine-grained, silty, partly weathered, weakly cemented; includes 0.5-in.-thick light-brown ferruginous layers; noncalcareous	12.0	4.0
Sandstone, grayish-brown to brownish-black, very fine-grained, shaly, interlaminated with layers of very highly carbonaceous sandstone; includes some soft-sediment deformation features	16.0	4.5
Sandstone, medium-light-gray with dark-gray laminae, very fine-grained, noncalcareous, cross-laminated, shaly in part; includes thin layers of highly carbonaceous sandstone; well-indurated; bioturbated from 31 to 64 ft	20.5	43.5
Total Depth		64.0

CORE-HOLE LOG 11

SW¼NE¼SW¼SE¼ sec. 14, T. 13 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture directly east of stock pond, 1,760 ft FEL and 900 ft FSL. Field notebook designation C-00-15. (Surface elevation, estimated from topographic map, 681 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, dark-yellowish-brown, sandy; contains organic material; unbedded (soil)	0.0	3.5
CABANISS GROUP		
Senora Formation:		
Shale, moderate-yellowish-brown, very clayey, weathered; includes dusky-brown, gravel-sized particles of ironstone	3.5	3.0
Shale, grayish-orange, clayey, weathered; includes light-brown, gravel-sized particles of ironstone	6.5	2.5
Sandstone, moderate-yellowish-brown with dusky-yellowish-brown bands, partly oxidized, noncalcareous, shaly, wavy-laminated, very fine-grained; includes abundant black macerated plant material on stratification surfaces	9.0	4.7

Sandstone, dark-gray with light-gray bands, very fine-grained, noncalcareous, cross-laminated in part, shaly; includes abundant black macerated plant material on stratification surfaces; contains some bioturbation features	13.7	12.3
Total Depth		26.0

CORE-HOLE LOG 12

SW¼NW¼NE¼NW¼NE¼ sec. 25, T. 14 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture 276 ft FNL and 1,940 ft FEL. Field notebook designation C-00-7. (Surface elevation, estimated from topographic map, 652 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, grayish-brown; contains abundant organic matter (soil)	0.0	1.8
Sand, dusky-brown, very highly weathered, silty, clayey, friable; contains gravel-sized clasts of reworked sandstone; contains minor organic matter	1.8	1.2
Sand, dark-yellowish-brown with dark-yellowish-orange bands, becoming dusky-yellowish-brown at 7 ft; weathered, gravelly, silty, clayey, poorly sorted, friable	3.0	5.0
CABANISS GROUP		
Senora Formation:		
Shale, black, weathered to grayish-brown with dusky-yellow streaks in upper 6 in., brittle; includes some dark-reddish-brown iron oxide deposits on joint surfaces; pyritic at 11 ft; contains a few brachiopod fossils	8.0	5.2
Shale, dark-gray to grayish-black	13.2	2.5
Shale, grayish-black, calcareous; contains a few small pyrite lenses	15.7	1.0
Limestone, dark-gray, impure, shaly; contains fossil brachiopods	16.7	0.2
Shale, grayish-black, highly calcareous	16.9	0.5
Limestone, dark-gray, impure, shaly; contains abundant fossil brachiopods along stratification surfaces	17.4	0.4
Shale, black, brittle, calcareous; contains pyrite nodules and veinlets	17.8	2.6
Limestone, medium-gray, nonfossiliferous; probably a concretion	20.4	0.1
Shale, grayish-black, hard, brittle, calcareous; pyritic zone from 22.5 to 23.0 ft; contains fossil brachiopods from 23.2 to 23.6 ft; includes a medium-gray siderite concretion from 25.3 to 25.5 ft; contains a pyritic zone from 28.2 to 28.4 ft	20.5	11.5
Limestone, medium-light-gray to medium-dark-gray, impure, silty; contains disseminated pyrite and pyritized fossil brachiopods; very highly fossiliferous, includes some fossil hash	32.0	0.8
Shale, black, brittle, pyritic	32.8	0.4
Limestone, medium-dark-gray, impure, silty, shaly; highly fossiliferous, contains fossil hash	33.2	0.1
Shale, grayish-black to black, calcareous; contains scattered phosphatic nodules, small brachiopod fossils, and disseminated pyrite, as well as crusts, veinlets, and laminae of pyrite	33.3	12.7
Coal, black, bright, moderately friable; includes pyrite and white calcite on cleat surfaces (Tebo coal)	46.0	0.6
Underclay, medium-gray, calcareous in lower 24 in.; includes some oblate impure limestone nodules 0.5 in. in diameter in lower 1 ft	46.6	3.0
Limestone, gray, fine-grained, hard, impure, silty; contains sparse, poorly preserved plant fossils	49.6	0.4
Shale, medium-gray, noncalcareous; contains disseminated pyrite	50.0	1.5

Shale, medium-dark-gray	51.5	1.0
Shale, dark-gray, silty, hard	52.5	2.5
Shale, medium-dark-gray, soft	55.0	1.3
Sandstone, light-gray, very fine-grained, micaceous, bioturbated; includes a 2-in.-thick zone of poorly preserved marine fossils directly below overlying shale unit	56.3	2.5
Sandstone, medium-gray with dark-gray laminae, very fine-grained, becomes fine-grained with depth, micaceous, bedding disturbed in places; contains scattered lenses of pyrite about 1/32 to 1/8 in. in diameter	58.8	9.2
Siltstone, medium-gray; includes some very fine-grained sandstone; contains sparse fossil brachiopods	68.0	0.2
Siltstone, dark-gray, hard; contains sparse fossil brachiopods	68.2	5.2
Shale, grayish-black	73.4	1.0
Sandstone, medium-gray with dark-gray bands, very fine- to fine-grained, noncalcareous, micaceous; bedding alternates from parallel- to wavy- to cross-bedded; interlaminated with siltstone in part	74.4	3.7
Siltstone, dark-gray, hard, micaceous; includes abundant black carbonized plant fragments on stratification surfaces	78.1	1.4
Sandstone, medium-gray with dark-gray bands, very fine-grained, noncalcareous, micaceous; interbedded with dark-gray siltstone; black carbonized plant fragments abundant; stratification alternates from cross-laminated to wavy-bedded to parallel-bedded; bioturbated in lower 1 ft of unit	79.5	7.8
Sandstone, light-olive-gray with grayish-black bands, fine-grained, noncalcareous, micaceous; even-bedded to cross-bedded; contains abundant black carbonized plant fragments; soft-sediment deformation features common; includes some burrow fillings and bioturbation features; becomes predominantly medium-gray with light-olive-gray and grayish-black bands, very fine-grained, and silty from 93.0 to 127.5 ft and 131.0 to 140.0 ft	87.3	52.7
Siltstone, medium-dark-gray, noncalcareous, micaceous; even-bedded and cross-bedded; interbedded with medium-gray, very fine-grained sandstone; coarsens upward; contains minor black carbonized plant fragments; includes some burrow fillings	140.0	6.0
Total Depth		146.0

CORE-HOLE LOG 13

NE¼NE¼NE¼NE¼NE¼ sec. 4, T. 14 N., R. 15 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture directly north of small pond, 160 ft FEL and 330 ft FNL. Field notebook designation C-00-16. (Surface elevation, estimated from topographic map, 648 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, pale-yellowish-brown, sandy, unbedded, contains organic material (soil)	0.0	2.0
CABANISS GROUP		
Senora Formation:		
Shale, dark-yellowish-brown, silty, highly weathered, soft	2.0	3.0
Shale, dark-yellowish-brown, clayey, weathered; contains gravel-sized particles of moderate-brown clay ironstone	5.0	3.0

Shale, grayish-orange to light-olive-gray, silty, micaceous; includes numerous 0.25-in.-thick dusky-brown clay ironstone layers; becomes dark-yellowish-brown below 10 ft; stained light-brown on stratification surfaces; sandy in lower 4 ft	8.0	8.0
Shale, moderate-yellowish-brown to dusky-yellowish-brown, very sandy; stained moderate-brown on stratification surfaces	16.0	1.4
Shale, light-olive-gray to medium-dark-gray, very silty and sandy; contains thin, lensing stringers of light-gray, very fine-grained sandstone	17.4	3.3
Siltstone, medium-dark-gray to dark-gray, noncalcareous, micaceous; contains numerous thin stringers and lenses of light-gray, very fine-grained sandstone	20.7	5.1
Sandstone, medium-dark-gray, very fine-grained, very silty and shaly, non-calcareous; includes stringers and burrows filled with light-gray, very fine-grained sandstone; cross-laminated in part; soft-sediment deformation features common; some black macerated plant material on stratification surfaces	25.8	40.2
Total Depth		66.0

CORE-HOLE LOG 14

SW¼NE¼NE¼NE¼SE¼ sec. 1, T. 15 N., R. 11 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture 148 ft FEL and 2,385 ft FSL. Field notebook designation C-00-11. (Surface elevation, estimated from topographic map, 781 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, grayish-brown to dark-yellowish-brown, coarse; contains some very fine sand grains and organic material (soil)	0.0	4.0
Silt, pale-yellowish-brown, clayey	4.0	2.0
Clay, yellowish-gray, silty	6.0	2.5
SKIATOOK GROUP		
Coffeyville Formation:		
Shale, yellowish-gray with dark-yellowish-orange mottling, weathered, soft	8.5	1.5
Shale, olive-gray with dark-yellowish-orange mottling and streaks, partly weathered, soft; includes several layers of moderate-reddish-brown clay ironstone 0.5-1 in. thick; jointed, with limonite deposits along fracture surfaces	10.0	21.0
Shale, medium-bluish-gray, jointed; moderate-yellowish-brown limonite deposits on fracture surfaces	31.0	8.6
Shale, medium-bluish-gray to medium-gray, highly calcareous	39.6	13.4
Checkerboard Formation:		
Limestone, medium-dark-gray and brownish-gray, hard, vuggy, fractured, shaly in upper 4 in.; highly fossiliferous, brachiopods predominant (Checkerboard Limestone)	53.0	3.5
Seminole Formation:		
Shale, dark-gray, highly silty, noncalcareous	56.5	3.7
Siltstone, dark-gray with light-gray banding, shaly; interstratified with shale and very fine-grained sandstone; cross-bedded and cross-laminated in part; contains several 0.25- to 1-in.-thick layers of brownish-gray calcareous siltstone spaced at irregular intervals; includes black macerated plant debris on stratification surfaces of sandstone layers	60.2	21.6
Shale, medium-gray	81.8	0.4

Shale, brownish-black, very highly carbonaceous; contains abundant thin stringers of bright, hard coal 1/64 to 1/8 in. thick (Tulsa coal interval)	82.2	0.7
Coal, black, bright, hard (Tulsa coal)	82.9	0.2
MARMATON GROUP		
Holdenville Formation:		
Underclay, grayish-black, carbonaceous, slickensided	83.1	0.1
Underclay, greenish-gray, noncalcareous	83.2	0.6
Limestone, light-olive-gray to greenish-gray, sandy, fossiliferous; brachiopods abundant in lower part, bioturbated in upper part	83.8	0.5
Shale, greenish-gray in upper 6 in.; medium-gray in lower part, calcareous	84.3	2.7
Shale, dark-gray, calcareous	87.0	14.0
Shale, dark-gray with light-gray streaks and spots, silty, calcareous; contains abundant very thin streaks and lenses of very fine-grained sandstone; also contains numerous round sandstone-filled burrows about 1/16 in. in diameter and lens-shaped burrows about 0.75 in. long and 0.25 in. thick; grades into underlying unit	101.0	11.0
Shale, dark-gray with light-gray laminae and spots, silty, sandy; as above, but with thin sandstone layers and streaks more closely spaced (4-8 per in.)	112.0	21.0
Shale, dark-gray with light-gray streaks and spots, weakly calcareous; includes minor bioturbation traces and thin streaks of very fine-grained sandstone, diminishing in abundance downward; cut by vertical veins of white calcite about 1/32 in. thick	133.0	4.0
Shale, dark-gray, weakly calcareous; cut by vertical veins of white calcite about 1/32 in. thick	137.0	3.0
Shale, grayish-black, hard; cut by vertical veins of white calcite; contains sparse fossil shells in bottom 1 ft of unit; noncalcareous	140.0	5.8
Shale, dark-gray, noncalcareous; carbonaceous in bottom 0.5 in.	145.8	3.7
Coal, black, hard; white calcite on cleat surfaces (Dawson coal)	149.5	0.7
Shale, medium-gray, soft, flaky; contains abundant compressed black carbonized plant fragments	150.2	3.0
Shale, light-greenish-gray, noncalcareous	153.2	1.6
Sandstone, light-gray with some medium-gray streaks in upper part; very fine and silty in upper part; very fine-grained and silty in upper part, becoming very fine- to fine-grained in lower 18 in.; wavy-bedded and cross-bedded in upper part, massive in lower part	154.8	2.2
Total Depth		157.0

CORE-HOLE LOG 15

NW¼NW¼NW¼NE¼NW¼ sec. 13, T. 15 N., R. 11 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in meadow 45 ft FNL and 1,515 ft FWL. Field notebook designation C-00-10. (Surface elevation, estimated from topographic map, 745 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, dark-yellowish-brown; contains abundant grains of very fine sand; includes organic matter (soil)	0.0	2.6
Clay, grayish-orange, weathered, sandy, silty	2.6	5.2
Sand, moderate-reddish-brown, very fine-grained, clayey	7.8	3.0
Sand, moderate-yellowish-brown with light-gray streaks, very fine-grained, clayey	10.8	8.0

Gravel, moderate-reddish-brown, coarse, clayey in part; contains clasts of rounded sandstone and ironstone	18.8	3.7
(No recovery; drill chattering; lost circulation and had to abandon hole. Probably drilled into the highly fractured Checkerboard Limestone)	22.5	0.5
Total Depth		23.0

CORE-HOLE LOG 16

NW¼NW¼NE¼SW¼NW¼ sec. 31, T. 15 N., R. 11 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled at northwest edge of pond 550 ft FWL and 1,450 ft FNL. Field notebook designation C-00-17. (Surface elevation, estimated from topographic map, 748 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Silt, brownish-gray, includes some moderate-reddish-orange mottling, unbedded; contains organic material	0.0	3.5
SKIATOOK GROUP		
Coffeyville Formation:		
Shale, grayish-orange, clayey, weakly calcareous; includes some dark-yellowish-orange limonitic concretions; weathered	3.5	5.5
Shale, light-olive-gray to olive-gray with dark-yellowish-orange mottling, clayey, calcareous, partly weathered; becomes olive-gray and dark-yellowish-brown at about 12 ft; fractured; gypsum and calcite occur as crusts along fractures; medium-light-gray in unweathered parts in lower part of unit	9.0	13.5
Shale, dark-gray and dark-yellowish-brown with dark-yellowish-orange bands, calcareous	22.5	1.5
Shale, dark-gray to brownish-black with dark-yellowish-orange limonitic crusts on parting surfaces, calcareous, fractured; contains some bioturbation traces and rare marine shell fragments	24.0	9.1
Shale, grayish-black to black, hard, brittle, noncalcareous; includes some disseminated pyrite and pyrite crusts on parting surfaces; contains phosphatic nodules up to 1 in. long and 0.5 in. thick	33.1	3.8
Limestone, dark-gray to medium-dark-gray, very shaly, fossiliferous; grades into underlying unit	36.9	0.2
Shale, medium-gray, silty, bioturbated, weakly calcareous in upper 3 in., noncalcareous in lower part; contains some pyritic trace fossils; includes numerous light-brownish-gray sideritic concretionary bands about ⅛ to 0.5 in. thick	37.1	15.0
Sandstone, medium-dark-gray, very fine-grained, shaly, calcareous; contains small fossil particles	52.1	0.4
Limestone, medium-gray, impure, silty, hard, nonfossiliferous, micritic	52.5	0.2
Mudstone, medium-dark-gray, noncalcareous	52.7	1.3
Limestone, light-brownish-gray, hard, nonfossiliferous, micritic	54.0	0.1
Shale and siltstone, medium-gray, interstratified with light-gray, very fine-grained sandstone; extensively bioturbated in part; noncalcareous, but some of the sandstone layers are highly calcareous; sandstone units are contorted and cross-laminated in part, with scour-and-fill features abundant; interstratified units range from thin laminae to beds up to 12 in. thick; includes some light-brownish-gray sideritic concretions about 0.5-1 in. thick	54.1	17.9

Sandstone, medium-gray, very silty, noncalcareous, wavy-laminated and cross-laminated in part; micro-faulted in places, with soft-sediment deformation and scour features abundant; fines upward	72.0	10.0
Shale and siltstone, medium-gray, interstratified with light-gray, very fine-grained sandstone; noncalcareous, bioturbated, laminated; interstratified sandstone units are cross-laminated and contorted in places; scour-and-fill features abundant; includes light-brownish-gray sideritic concretions up to 1.5 in. thick; becomes medium-dark-gray and finer grained below 96 ft	82.0	23.5
Sandstone, medium-light-gray to medium-gray, very fine-grained, noncalcareous, bioturbated, unbedded to cross-bedded; slump features common; shaly below 105.8 ft	105.5	2.7
Shale and siltstone, medium-dark-gray; sparsely interstratified with light-gray, very fine-grained sandstone; noncalcareous, bioturbated; includes some interbedded units of medium-light-gray, very fine-grained, highly contorted sandstone up to 1 ft thick; contains light-brownish-gray sideritic concretions about 0.25-0.5 in. thick	108.2	10.5
Shale, medium-dark-gray, very silty, noncalcareous; contains light-brownish-gray concretions up to 1 in. thick; includes several contorted beds of light-gray to medium-light-gray, very fine-grained sandstone 0.5-10 in. thick	118.7	8.3
Shale, medium-dark-gray to medium-gray, silty; includes abundant light-brownish-gray sideritic layers and burrow fillings; noncalcareous, but contains some widely spaced, thin layers of very fine-grained calcareous sandstone; includes a 0.25-in.-thick layer of black coal at about 137.5 ft; contains sparse, calcareous fossil shells; includes a fossiliferous 1.5-in.-thick sideritic concretion at 144.7 ft	127.0	18.4
Shale, medium-dark-gray to dark-gray, silty, calcareous; contains fossil marine shells as well as light-brownish-gray sideritic concretions and burrow fillings up to 1.25 in. thick; noncalcareous from 150 to 154 ft; includes rare black carbonized and pyritic plant fossils; proportion of brachiopod fossils increases markedly at 165 ft; grades into underlying unit	145.4	21.2
Limestone, dark-gray, impure, shaly, fossiliferous; fossil hash abundant, brachiopod and crinoid parts common; bioturbated in lower part	166.6	0.4
Shale, dark-gray, calcareous; contains some small, pyritic trace fossils and sparse calcitic and pyritic brachiopod shells	167.0	13.2
Shale, grayish-black to black, calcareous; contains disseminated pyrite, pyrite-filled burrows, and pyritic brachiopod shells; sparse fossils	180.2	9.1
Limestone, dark-gray, impure, shaly, fossiliferous; fossil hash abundant; light-gray and nonfossiliferous in lower 1 in.	189.3	0.5
Shale, dark-gray, silty, calcareous; includes a 1.5-in.-thick limestone concretion 3 in. above base of unit	189.8	1.2
Shale, dark-gray, silty, calcareous, interstratified with thin layers of siltstone and very fine-grained sandstone; bioturbated in lower part; contains several light-gray limestone concretions up to 2 in. thick	191.0	3.8
Limestone, medium-light-gray, impure, silty, shaly, fossiliferous; fossil hash abundant; includes a 1.5-in.-thick, medium-dark-gray shale parting in about the middle of the unit	194.8	0.5
Shale, dark-gray, calcareous, fossiliferous; well-preserved brachiopods abundant; contains pyritized burrow fillings	195.3	2.8
Shale, medium-dark-gray, silty, noncalcareous, bioturbated, contains pyrite and pyritized burrow fillings; includes abundant medium-light-gray laminae of siltstone to very fine-grained sandstone; scour-and-fill features common; proportion of sandstone increases markedly below 201 ft; unit grades downward into shaly sandstone; bedding greatly contorted from 203 to 203.5 ft; sequence fines upward	198.1	5.4

Sandstone, medium-light-gray, very fine-grained; calcareous from 203.5 to 206.6 ft; extensively bioturbated in upper 4 ft of unit; bedding disturbed and contorted; cross-laminated in part; pyritic in places; contains rare pelecypod shells; color darkens downward	203.5	6.5
Siltstone, medium-gray, sandy, calcareous; contains abundant fossil pelecypod shells from 211.8 to 214.4 ft; bioturbated in part, laminated; grades into underlying unit	210.0	9.0
Shale, medium-gray, bluish-gray in lower part, silty, calcareous; contains sparse marine shells and shell fragments; includes some thin wisps of light-gray, very fine-grained sandstone in upper part of unit; contains rare pyritic trace fossils; grades into underlying unit	219.0	33.8
Checkerboard Formation:		
Limestone, medium-gray to light-gray, silty, hard, fossiliferous; marine shells and crinoid columnals abundant; shaly in bottom 4 in. (Checkerboard Limestone)	252.8	3.6
Seminole Formation:		
Shale, medium-dark-gray with medium-light-gray, very fine-grained, silty sandstone laminae; noncalcareous; contains rare brachiopod valves and plant fragments as well as small pyritized trace fossils	256.4	3.9
Shale, dark-gray, carbonaceous, noncalcareous; contains disseminated pyrite and black carbonized plant fragments on stratification surfaces	260.3	0.6
Coal, black, bright, very friable, shaly in part; pyrite on cleat surfaces (Tulsa coal)	260.9	0.4
MARMATON GROUP		
Holdenville Formation:		
Underclay, greenish-gray, noncalcareous, silty, bioturbated; contains black carbonized plant fragments	261.3	1.3
Limestone, light-olive-gray to light-brownish-gray, impure, sandy, fossiliferous; contains brachiopod shell fragments and fossil hash, particularly in upper 2 in. (Glenpool? Limestone)	262.6	0.8
Siltstone and sandstone, greenish-gray, hard, extensively bioturbated, very calcareous, shaly in part	263.4	1.7
Shale, medium-dark-gray, silty, calcareous; contains rare, small limestone concretions, sparse marine fossils, and minor pyrite	265.1	10.4
Shale, dark-gray, very silty, hard, weakly calcareous, extensively bioturbated; contains abundant thin laminae and lenses of light-gray, very fine-grained sandstone; includes minor pyrite on stratification surfaces; grades into underlying unit	275.5	32.5
Shale, dark-gray to grayish-black, silty, calcareous; contains sparse marine fossils such as nautiloids and ammonoids, as well as trace fossils; grades into underlying unit	308.0	9.0
Shale, grayish-black to black, brittle, noncalcareous; contains lens-shaped phosphatic nodules; includes sparse, partially pyritized cephalopods and rare brachiopod shells and shell fragments	317.0	3.9
Shale, dark-gray to grayish-black, calcareous, slickensided, pyritic and carbonaceous in lower 1 in. of unit	320.9	0.5
Coal, black, slightly friable, includes white veinlets of gypsum; contains minor pyrite (Dawson coal)	321.4	0.5
Shale, brownish-black, very carbonaceous; includes thin stringers of coal	321.9	0.2
Underclay, medium-gray, soft, kaolinitic; contains black carbonized plant fragments	322.1	0.9

Sandstone, light-gray with medium-dark-gray and brownish-black streaks, noncalcareous, fractured, fine- to very fine-grained; bedding disturbed and indistinct; contains some oil stains	323.0	2.0
Total Depth		325.0

CORE-HOLE LOG 17

NW¼SW¼NW¼SW¼NW¼ sec. 11, T. 15 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in field 105 ft FWL and 1,820 ft FNL. Field notebook designation C-00-9. (Surface elevation, estimated from topographic map, 777 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Sand, dusky-brown, silty; contains sub-angular clasts of dark-reddish-brown sandstone up to cobble size	0.0	1.0
Sand, moderate-brown, silty, highly gravelly	1.0	1.5
CABANISS GROUP		
Senora Formation:		
Sandstone, grayish-orange with brownish-black and dark-reddish-brown streaks, highly weathered, very fine-grained, clayey, weakly indurated, silty, micaceous	2.5	5.1
Sandstone, moderate-yellowish-brown with olive-gray streaks, weathered, very fine-grained, silty, clayey, weakly indurated, micaceous; cross-bedded in lower 10 in.; includes some limonitic concretions about 3 in. in diameter	7.6	3.4
Shale, olive-gray with dark-yellowish-brown streaks and brownish-black deposits on fracture surfaces; partially weathered, silty	11.0	2.4
Shale, medium-dark-gray to dark-gray; includes some thin, dark-yellowish-orange clay ironstone layers in upper 3 ft, as well as light-olive-gray siderite layers about 0.75 in. thick at 23.5 and 26 ft	13.4	14.8
Sandstone, brownish-gray with black streaks, very fine-grained; contains abundant carbonized plant material including thin streaks of coal (Croweburg coal interval?)	28.2	0.2
Sandstone, medium-light-gray with dark-gray bands, very fine- to fine-grained, silty, micaceous, noncalcareous; bedding distorted, wavy-bedded, cross-bedded, cross-laminated, bioturbated; includes abundant black carbonized plant fragments; becomes predominantly dark-gray with medium-light-gray bands and finer grained below 40 ft	28.4	16.9
Shale, dark-gray, silty; includes a 0.5-in.-thick light-olive-gray siderite layer at 46.5 ft	45.3	5.1
Shale, black, carbonaceous	50.4	0.3
Shale, medium-dark-gray, silty	50.7	0.6
Limestone, medium-dark-gray and light-gray, impure, highly silty and sandy; includes some thin shaly streaks; fossiliferous, with greatest concentration of fossils in upper 4 in., brachiopods predominant; grades into underlying unit (McNabb Limestone)	51.3	4.9
Siltstone, medium-dark-gray and light-gray; bedding disturbed, very calcareous; contains sparse fossils; includes minor very fine-grained sandstone	56.2	2.8
Total Depth		59.0

CORE-HOLE LOG 18

NE¼NE¼NW¼SW¼SW¼ sec. 15, T. 15 N., R. 14 E., Okmulgee County, Oklahoma. Well cored by Oklahoma Geological Survey; lithologic descriptions by LeRoy A. Hemish. Drilled in pasture directly south of farm pond, 100 ft south of property line fence. Field notebook designation C-00-8. (Surface elevation, estimated from topographic map, 802 ft.)

	Depth to unit top (ft)	*Thickness of unit (ft)*
Clay, moderate-yellowish-brown with pale-yellowish-orange and dark-yellowish-orange mottling, sandy, gravelly; contains sub-angular clasts up to large cobble size of moderate-reddish-brown, fine-grained sandstone	0.0	2.0
Sand, grayish-red, weathered, silty, clayey, gravelly	2.0	3.0
Sand, moderate-yellowish-brown, weathered, very fine-grained, silty, clayey; contains some gravel-sized clasts of sandstone	5.0	4.0
Clay, dusky-yellow, sandy, silty; contains gravel-sized clasts of sandstone and ironstone	9.0	5.0
CABANISS GROUP		
Senora Formation:		
Shale, dark-yellowish-brown with moderate-brown bands; light-olive-gray at 15 ft with light-brown and olive-gray bands; includes very thin beds of limonite-cemented siltstone at 2- to 4-in. intervals	14.0	2.0
Shale, medium-dark-gray with light-brown sideritic bands	16.0	1.0
Shale, dark-gray with some thin layers of light-olive-gray, silty siderite	17.0	6.2
Limestone, medium-dark-gray, impure, sandy, silty in upper 1 ft; contains abundant marine fossils with crinoid columns most common; includes 2 in. of dark-gray shale 2 in. from top of unit (Verdigris Limestone)	23.2	1.5
Shale, black, very highly carbonaceous; includes a 1-in.-thick layer of shaly coal at top of unit	24.7	2.5
Shale, medium-dark-gray; includes some 0.25-in.-thick layers of brownish-gray siderite in lower 1 ft of unit	27.2	7.5
Sandstone, medium-light-gray with grayish-black laminae, very fine- to fine-grained, cross-laminated, noncalcareous, micaceous; includes abundant black carbonized plant fragments on stratification surfaces	34.7	5.3
Sandstone, light-olive-gray, fine-grained, even-bedded, micaceous; contains minor black carbonized plant fragments	40.0	1.9
Sandstone, medium-dark-gray, interlaminated with dark-gray siltstone, cross-bedded in part	41.9	16.1
Siltstone, medium-dark-gray	58.0	1.5
Shale, medium-dark-gray, silty	59.5	1.9
Shale, dark-gray; includes 0.5-in.-thick layers of light-olive-gray siderite at 69.2 and 69.9 ft	61.4	11.4
Sandstone, medium-dark-gray to brownish-gray with black streaks, very fine-grained, massive; contains horizontal layers of white calcite about 1/64 in. thick near base; includes numerous streaks of coalified plant remains (Croweburg coal interval?)	72.8	0.3
Sandstone, medium-dark-gray with thin medium-light-gray bands, very fine-grained, finer grained near bottom of unit, silty, noncalcareous, micaceous, even-bedded to cross-laminated in part; contains some distorted bedding and burrows in upper 3 ft; contains abundant black macerated plant debris; grades into underlying unit	73.1	9.0
Siltstone, medium-dark-gray, shaly; contains some minor streaks of light-gray very fine-grained sandstone in upper part of unit; includes sparse fossil pelecypods; grades into underlying unit	82.1	2.9

Shale, dark-gray, silty	85.0	4.3
Shale, grayish-black, silty	89.3	0.2
Shale, medium-dark-gray, silty	89.5	1.3
Sandstone, light-olive-gray with thin, grayish-black bands, becoming dark-gray downwards, fine- to very fine-grained, shaly in upper part, weakly calcareous; includes abundant black macerated plant debris; contains scattered fossil brachiopod shells in lower part	90.8	5.6
Limestone, medium-dark-gray, impure, highly sandy; very highly fossiliferous in middle 10 in. of unit; brachiopod fossils abundant; includes some fossil hash (McNabb Limestone)	96.4	2.6
Total Depth		99.0

Appendix 3: Analyses of Coals

In Table A3-1, the analyses are grouped first by township and range, progressing from south to north and west to east, respectively. Within each township block, coal analyses are listed according to the age of the data report, from oldest to youngest. Coal beds are arranged alphabetically by name within the age group. Averages of the data from two or more analyses were computed only if: (1) samples of the coal were collected in the same township; (2) data were reported in the same year; (3) analyses were performed on coal samples from the same coal bed; (4) analyses were reported under identical conditions, such as "as received basis" or "moisture free basis"; and (5) analyses were done in the same laboratory.

Table A3-2 contains data from individual samples of coal collected and analyzed by OGS personnel. Listing of analyses is alphabetical, by names of coal beds. Location of sample sites can be obtained by referring to the map numbers (see footnote a, Table A3-2).

TABLE A3-1. — AVERAGE ANALYSES OF COALS IN OKMULGEE AND OKFUSKEE COUNTIES, OKLAHOMA

			Proximate Analysis (%)									
Township/Range	Coal bed and rank[a]	Sample condition[b]	Moisture[c]	Volatile matter	Fixed carbon	Ash[c]	Sulfur (%)	Btu/lb	Free swelling index	Number of analyses (whole seam)	Data source[d]	Year reported
T10N, R12E	Croweburg	1	3.6	37.6	43.6	15.2	5.0	11,689		1	OGS	1976
	--	2	N/A	39.0	45.2	15.8	5.3	12,125				
		3	N/A	46.3	53.7	N/A		14,400				
	Croweburg	1	2.4	36.3	40.3	21.0	5.3	10,833	5	2	OGS	1983
	hvAb	2	N/A	37.2	41.3	21.5	5.5	11,108				
		3	N/A	47.4	52.6	N/A		14,144				
T11N,R12E	Croweburg	1	7.3	33.3	52.0	7.4	1.5	12,640		2	USBM	1910
	--	2	N/A	35.9	56.1	8.0	1.6	13,635				
		3	N/A	39.0	61.0	N/A		14,817				
	Croweburg	1	6.9	34.8	51.9	6.4	1.1	12,750		6	USBM	1926
	hvBb	2	N/A	37.4	55.7	6.9	1.2	13,696				
		3	N/A	40.1	59.9	N/A		14,706				
	Croweburg	1	7.9	34.2	52.6	5.3	1.2	12,760		1	OGS	1928
	hvBb	2	N/A	37.2	57.0	5.8	1.3	13,850				
		3	N/A	39.4	60.6	N/A		14,700				
	Croweburg	1	5.3	35.3	54.8	4.6	1.0	13,325		4	USGS	1931
	hvAb	2	N/A	37.3	57.9	4.8	1.1	14,071				
		3	N/A	39.1	60.9	N/A		14,793				
T11N, R13E	Croweburg	1	6.8	36.3	51.2	5.7	1.4			1	USBM	1904
	--	2	N/A	39.0	54.9	6.1	1.5					
		3	N/A	41.5	58.5	N/A						
	Croweburg	1	8.9	34.8	47.7	8.6	1.6	12,100		1	USBM	1904
	--	2	N/A	38.2	52.3	9.5	1.8	13,270				
		3	N/A	42.2	57.8	N/A		14,667				
	Croweburg	1	7.9	34.5	53.0	4.6	1.1	13,007		4	USBM	1926
	hvBb	2	N/A	37.5	57.5	5.0	1.2	14,126				
		3	N/A	39.4	60.6	N/A		14,869				
	Croweburg	1	7.8	33.6	53.1	5.5	1.4	12,820		4	OGS	1928
	hvBb	2	N/A	36.4	57.6	6.0	1.5	13,917				
		3	N/A	38.8	61.2	N/A		14,799				
	Croweburg	1	4.3	38.2	49.6	7.9	3.7	12,775		1	OGS	1975
	hvAb	2	N/A	39.9	51.8	8.3	3.9	13,349				
		3	N/A	43.5	56.5	N/A		14,550				
	Croweburg	1	7.2	37.3	50.0	5.5	2.5	12,854		3	Company	1980
	--	2	N/A	40.2	53.9	5.9	2.7	13,847				
		3	N/A	42.8	57.2	N/A		14,722				
	Croweburg	1	4.8	37.4	49.2	8.6	4.8	12,921	6	3	OGS	1982
	hvAb	2	N/A	39.3	51.7	9.0	5.0	13,572				
		3	N/A	43.2	56.8	N/A		14,920				
	Croweburg	1	4.4	38.9	49.0	7.7	3.1	12,970	5	4	OGS	1983
	hvAb	2	N/A	40.7	51.3	8.0	3.2	13,580				
		3	N/A	44.3	55.7	N/A		14,759				

TABLE A3-1 *(Continued)*. — AVERAGE ANALYSES OF COALS IN OKMULGEE AND OKFUSKEE COUNTIES, OKLAHOMA

Township/Range	Coal bed and rank[a]	Sample condition[b]	Proximate Analysis (%) Moisture[c]	Volatile matter	Fixed carbon	Ash[c]	Sulfur (%)	Btu/lb	Free swelling index	Number of analyses (whole seam)	Data source[d]	Year reported
T12N, R11E	Croweburg hvAb	1	2.2	41.2	49.0	7.6	4.9	13,059		1	OGS	1975
		2	N/A	42.1	50.1	7.8	5.0	13,353				
		3	N/A	45.7	54.3	N/A		14,478				
T12N, R12E	Croweburg hvAb	1	3.1	38.0	53.5	5.4	2.7	14,125		1	OGS	1975
		2	N/A	39.2	55.2	5.6	2.8	14,577				
		3	N/A	41.5	58.5	N/A		15,437				
T12N, R13E	Croweburg hvBb	1	7.4	34.7	52.7	5.2	2.1	12,956		12	USBM	1926
		2	N/A	37.5	56.9	5.6	2.3	13,984				
		3	N/A	39.7	60.3	N/A		14,819				
	Croweburg hvBb	1	7.3	34.3	51.7	6.7	2.7	12,627		8	OGS	1928
		2	N/A	37.0	55.8	7.2	2.9	13,587				
		3	N/A	39.9	60.1	N/A		14,686				
	Croweburg hvAb	1	2.4	38.0	55.7	3.9	1.7	13,581		2	OGS	1938
		2	N/A	39.0	57.0	4.0	1.7	13,909				
		3	N/A	40.6	59.4	N/A		14,481				
	Croweburg hvBb	1	6.8	33.5	54.8	4.9	2.1	12,987		4	USGS	1941
		2	N/A	35.9	58.8	5.3	2.2	13,942				
		3	N/A	37.9	62.1	N/A		14,718				
	Croweburg hvBb	1	7.1	35.9	53.5	3.5	1.8	13,056		1	OGS	1976
		2	N/A	38.6	57.6	3.8	1.9	14,054				
		3	N/A	40.2	59.8	N/A		14,609				
	Croweburg hvBb	1	5.6	32.8	54.8	6.8	2.3	12,830		4	PSU	1977
		2	N/A	34.7	58.0	7.2	2.4	13,589				
		3	N/A	37.5	62.5	N/A		14,640				
	Croweburg --	1	6.3	37.3	45.4	11.0	3.8	12,167		2	Company	1978
		2	N/A	39.8	48.5	11.7	4.1	12,978				
		3	N/A	45.1	54.9	N/A		14,693				
	Croweburg --	1	6.3	34.1	55.2	4.4	1.4	13,034		1	Company	1978
		2	N/A	36.4	58.9	4.6	1.5	14,239				
		3	N/A	38.1	61.8	N/A		14,933				
	Croweburg --	1	6.3	35.9	53.7	4.2	1.6	13,159		2	Company	1979
		2	N/A	38.3	57.3	4.4	1.7	14,037				
		3	N/A	40.1	59.9	N/A	N/A	14,688				
	Croweburg hvAb	1	5.0	34.7	55.7	4.6	1.7	13,451	4	1	OGS	1982
		2	N/A	36.5	58.6	4.9	1.8	14,159				
		3	N/A	38.4	61.6	N/A		14,879				
	Croweburg hvBb	1	5.4	33.4	47.0	14.2	4.3	11,552	3	3	OGS	1983
		2	N/A	35.4	49.9	14.7	4.4	12,272				
		3	N/A	41.9	58.1	N/A		14,327				
T13N, R13E	Croweburg hvBb	1	7.7	29.0	51.3	12.0	4.2	11,700		1	OGS	1928
		2	N/A	31.4	55.6	13.0	4.5	12,680				
		3	N/A	36.1	63.9	N/A		14,570				
T13N, R14E	Mineral (Eram) hvAb	1	3.1	38.1	45.5	13.3	5.1	12,188		1	OGS	1973
		2	N/A	39.3	47.0	13.7		12,578				
		3	N/A	45.6	54.0	N/A		14,579				
	Mineral (Morris) hvAb	1	4.3	37.3	48.9	9.5	3.6	12,468		1	OGS	1973
		2	N/A	39.0	51.1	9.9	3.8	13,028				
		3	N/A	43.3	56.7	N/A		14,464				
	Mineral (Morris) --	1	3.8	37.2	49.8	9.2	3.2	12,894		7	Company	1979
		2	N/A	38.7	51.7	9.6	3.3	13,406				
		3	N/A	42.8	57.2	N/A		14,832				
	Mineral (Morris) --	1	2.7	37.9	53.3	6.1	1.3	12,920	3½	1	Company	1979
		2	N/A	38.9	54.8	6.3	1.3	13,285				
		3	N/A	41.5	58.5	N/A		14,172				
	Mineral (Morris) --	1	4.6	38.0	52.1	5.3	1.5	13,449		1	Company	1979
		2	N/A	39.8	54.6	5.6	1.5	14,092				
		3	N/A	42.1	57.9	N/A		14,929				
	Mineral (Morris) --	1	4.9	37.2	53.0	4.9	3.0	13,430	6	1	OGS	1980
		2	N/A	39.1	55.8	5.1	3.2	14,119				
		3	N/A	41.2	58.8	N/A		14,878				
T14N, R14E	Mineral (Morris) --	1	4.0	39.9	39.9	16.2	1.3	11,226		1	Company	1978
		2	N/A	41.5	41.6	16.9	1.4	11,696				
		3	N/A	49.9	50.1	N/A		14,074				
	Croweburg --	1	6.3	32.9	53.1	7.7	2.5	12,488		3	Company	1979
		2	N/A	35.1	56.7	8.2	2.7	13,336				
		3	N/A	38.2	61.8	N/A		14,524				

TABLE A3-1 *(Continued).* — AVERAGE ANALYSES OF COALS IN OKMULGEE AND OKFUSKEE COUNTIES, OKLAHOMA

Township/Range	Coal bed and rank[a]	Sample condition[b]	Proximate Analysis (%) Moisture[c]	Volatile matter	Fixed carbon	Ash[c]	Sulfur (%)	Btu/lb	Free swelling index	Number of analyses (whole seam)	Data source[d]	Year reported
	Mineral	1	8.9	37.5	43.0	10.6	2.2	11,323		6	Company	1979
	(Morris)	2	N/A	41.2	47.2	11.6	2.4	12,424				
	--	3	N/A	46.6	53.4	N/A		14,066				
	Mineral	1	4.6	40.9	47.1	7.4	2.8	12,876		2	Company	1979
	(Morris)	2	N/A	42.9	49.4	7.7	3.0	13,497				
	--	3	N/A	46.5	53.5	N/A		14,632				
	Croweburg	1	4.9	37.3	47.3	10.5	4.3	12,288	1½	4	Company	1980
	--	2	N/A	39.2	49.7	11.0	4.5	12,925				
		3	N/A	44.2	55.8	N/A		14,532				
	Croweburg	1	6.5	31.6	44.8	17.1	3.2	11,000		5	Company	1980
	--	2	N/A	33.8	47.9	18.3	3.5	11,768				
		3	N/A	41.6	58.4	N/A		13,691				
	Mineral	1	6.9	34.2	47.1	11.8	2.6	11,567		2	Company	1980
	(Morris)	2	N/A	36.7	50.6	12.7	2.8	12,424				
	--	3	N/A	42.1	57.9	N/A		14,228				
	Croweburg	1	8.6	29.5	43.3	18.6	3.5	10,183		11	Company	1981
	--	2	N/A	32.3	47.4	20.3	3.8	11,141				
		3	N/A	40.5	59.5	N/A		13,988				
	Mineral	1	6.2	37.4	51.2	5.2	3.5	13,098		1	Company	1981
	(Morris)	2	N/A	39.8	54.6	5.5	3.7	13,958				
	--	3	N/A	42.2	57.8	N/A		14,778				
	Croweburg	1	6.5	32.2	52.1	9.2	2.7	12,180	2	1	OGS	1982
	hvBb	2	N/A	34.5	55.7	9.8	2.9	13,031				
	--	3	N/A	38.2	61.8	N/A		14,447				
	Mineral	1	14.4	32.4	47.3	5.9	2.0	10,774	3	2	OGS	1982
	(Morris)	2	N/A	37.9	55.4	6.7	2.2	12,471				
	--	3	N/A	40.7	59.3	N/A		13,387				
	Mineral	1	3.9	36.9	51.3	7.9	3.6	12,895	5½	5	OGS	1983
	(Morris)	2	N/A	38.4	53.4	8.2	3.7	13,416				
	hvAb	3	N/A	41.8	58.2	N/A		14,621				
	Tebo	1	2.1	40.2	46.5	11.2	3.8	12,858	7	2	OGS	1983
	hvAb	2	N/A	41.1	47.5	11.2	3.9	13,134				
		3	N/A	46.4	53.6	N/A		14,832				
T14N, R15E	Mineral	1	5.8			9.9	2.2	12,455		1	Company	1978
	(Eram)	2	N/A			10.6	2.4	13,229				
	--	3	N/A			N/A		14,792				
	Mineral	1	2.9	42.8	46.7	7.5	3.8	13,043		1	Company	1978
	(Eram)	2	N/A	44.2	48.1	7.7	3.9	13,436				
	--	3	N/A	47.8	52.2	N/A		14,560				
T15N, R11E	Dawson	1	5.2	39.4	36.3	19.1	3.3	10,331	4½	1	OGS	1984
	hvBb	2	N/A	41.6	38.2	20.2	3.5	10,901				
		3	N/A	52.0	48.0	N/A		13,660				
	Tulsa	1	7.3	34.8	35.2	22.7	1.4	9,526	1	1	OGS	1984
	hvCb	2	N/A	37.6	37.9	24.5	1.5	10,280				
		3	N/A	49.7	50.3	N/A		13,616				
T15N, R14E	Mineral	1	6.2	38.4	46.8	8.6	4.4	12,404		2	Company	1978
	(Morris)	2	N/A	40.9	49.9	9.2	4.7	13,224				
	--	3	N/A	45.4	55.3	N/A		14,662				
	Mineral	1	4.6	36.6	47.6	11.2	5.0	12,273		3	Company	1980
	(Morris)	2	N/A	38.4	49.9	11.7	5.2	12,865				
	--	3	N/A	43.5	56.5	N/A						
	Mineral	1	5.8	37.9	47.3	9.0	4.7	12,544		21	Company	1981
	(Morris)	2	N/A	40.2	50.2	9.6	5.0	13,316				
	--	3	N/A	44.5	55.5	N/A		14,723				
	Mineral	1	8.7	34.5	49.7	7.1	2.2	12,099	2½	3	OGS	1982
	(Morris)	2	N/A	37.8	54.4	7.8	2.4	13,252				
	--	3	N/A	41.0	59.0	N/A		14,369				
	Mineral	1	2.6	38.4	50.6	8.4	4.5	13,070	5½	1	OGS	1983
	(Morris)	2	N/A	39.5	51.9	8.6	4.6	13,426				
	hvAb	3	N/A	43.1	56.9	N/A		14,691				

[a]hvAb, high volatile A, bituminous; hvBb, bituminous; hvCb, high-volatile C bituminous; -- not classified.

[b]1 = as received; 2 = moisture-free; 3 = moisture- and ash-free.

[c]N/A, not applicable.

[d]Company, coal company or other industry-related source; OGS, Oklahoma Geological Survey; PSU, Penn State University; USBM, United States Bureau of Mines; USGS, United States Geological Survey.

TABLE A3-2. — ANALYSES OF COALS IN OKMULGEE AND OKFUSKEE COUNTIES, OKLAHOMA
(Samples collected by LeRoy Hemish and tested by the Oklahoma Geological Survey Chemistry Laboratory.)

Sample number	Site number[a] (Pl. 1,2)	Coal bed and rank[b]	Sample condition[c]	Proximate Analyses (%) Moisture[d]	Volatile matter	Fixed carbon	Ash[d]	Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site[e]
81C11H	41, Pl. 1	Croweburg	1	6.5	32.2	52.1	9.2	2.7	12,180	2	1981	AcSM
		hvBb	2	N/A	34.5	55.7	9.8	2.9	13,031			
			3	N/A	38.2	61.8	N/A		14,447			
81C16H (Upper 18 in. of benched sample)	5, Pl. 1	Croweburg	1	3.0	39.4	47.2	10.4	7.6	12,669	6	1981	AcSM
		hvAb	2	N/A	40.7	48.6	10.7	7.8	13,066			
			3	N/A	45.5	54.5	N/A		14,632			
81C17H (Lower 17 in. of benched sample)	5, Pl. 1	Croweburg	1	3.2	38.7	49.5	8.6	5.2	12,952	6½	1981	AcSM
		hvAb	2	N/A	40.0	51.2	8.8	5.4	13,383			
			3	N/A	43.9	56.1	N/A		14,674			
81C18H (Upper 12 in. of benched sample)	21, Pl. 1	Croweburg	1	4.7	36.5	53.6	5.2	2.8	13,321	4½	1981	AcSM
		hvAb	2	N/A	38.3	56.2	5.5	3.0	13,984			
			3	N/A	40.5	59.5	N/A		14,798			
81C19H (Middle 12 in. of benched sample)	21, Pl. 1	Croweburg	1	5.0	32.9	55.0	7.1	1.3	13,213	2½	1981	AcSM
		hvAb	2	N/A	34.6	57.9	7.5	1.4	13,908			
			3	N/A	37.4	62.6	N/A		15,036			
81C20H (Lower 12 in. of benched sample)	21, Pl. 1	Croweburg	1	5.2	34.7	58.6	1.5	0.9	13,818	5	1981	AcSM
		hvAb	2	N/A	36.6	61.8	1.6	1.0	14,574			
			3	N/A	37.2	62.8	N/A		14,341			
82C1H (Upper 15 in. of benched sample)	9, Pl. 1	Croweburg	1	6.6	35.0	52.4	5.9	2.1	12,945	4½	1982	AcSM
		hvBb	2	N/A	37.5	56.2	6.3	2.3	13,869			
			3	N/A	40.0	60.0	N/A		14,802			
82C2H (Lower 15 in. of benched sample)	9, Pl. 1	Croweburg	1	5.8	33.5	52.5	8.2	3.0	12,399	5	1982	AcSM
		hvBb	2	N/A	35.6	55.7	8.7	3.2	13,167			
			3	N/A	39.0	61.0	N/A		14,429			
83C9H (Upper 14 in. of benched sample)	10, Pl. 1	Croweburg	1	6.9	38.7	49.1	5.3	2.0	12,980	5	1983	AcSM
		hvBb	2	N/A	41.6	52.7	5.7	2.2	13,940			
			3	N/A	44.1	55.9	N/A		14,789			
83C10H (Lower 18 in. of benched sample)	10, Pl. 1	Croweburg	1	7.7	35.4	52.3	4.6	1.4	12,926	6	1983	AcSM
		hvBb	2	N/A	38.4	56.7	4.9	1.5	14,010			
			3	N/A	40.4	59.6	N/A		14,740			
83C11H (Upper 11 in. of sample)	17, Pl. 1	Croweburg	1	8.9	36.4	51.0	3.7	1.6	12,805	3	1983	AcSM
		hvBb	2	N/A	40.0	55.9	4.1	1.8	14,063			
			3	N/A	41.6	58.4	N/A		14,658			
83C12H (Middle 11 in. of benched sample)	17, Pl. 1	Croweburg	1	8.4	34.8	49.4	7.4	1.4	12,289	2½	1983	AcSM
		hvBb	2	N/A	37.9	54.1	8.0	1.5	13,415			
			3	N/A	41.3	58.7	N/A		14,585			
83C13H (Lower 11 in. of benched sample)	17, Pl. 1	Croweburg	1	10.0	33.4	53.8	2.8	1.3	12,675	2½	1983	AcSM
		hvBb	2	N/A	37.1	59.8	3.1	1.4	14,080			
			3	N/A	38.3	61.7	N/A		14,529			
83C27H (Upper 15 in. of split sample)	11, Pl. 1	Croweburg	1	3.5	42.9	47.1	6.5	2.7	13,278	4½	1983	AcSM
		hvAb	2	N/A	44.5	48.8	6.7	2.8	13,765			
			3	N/A	47.7	52.3	N/A		14,760			
83C28H (Lower 15 in. of split sample)	11, Pl. 1	Croweburg	1	5.2	37.0	51.9	5.9	3.3	13,049	2	1983	AcSM
		hvAb	2	N/A	39.0	54.8	6.2	3.5	13,765			
			3	N/A	41.6	58.4	N/A		14,673			
83C29H (Upper 13 in. of benched sample)	18, Pl. 1	Croweburg	1	5.3	37.6	52.8	4.3	1.8	13,098	2	1983	AcSM
		hvBb	2	N/A	39.7	55.8	4.5	1.9	13,828			
			3	N/A	41.6	58.4	N/A		14,479			
83C30H (Middle 13 in. of benched sample)	18, Pl. 1	Croweburg	1	5.2	35.2	51.6	8.0	2.1	12,649	4	1983	AcSM
		hvBb	2	N/A	37.2	54.4	8.4	2.2	13,343			
			3	N/A	40.6	59.4	N/A		14,575			

TABLE A3-2 *(Continued).* — ANALYSES OF COALS IN OKMULGEE AND OKFUSKEE COUNTIES, OKLAHOMA

Sample number	Site number[a] (Pl. 1,2)	Coal bed and rank[b]	Sample condition[c]	Proximate Analyses (%) Moisture[d]	Volatile matter	Fixed carbon	Ash[d]	Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site[e]
83C31H (Lower 13 in. of benched sample)	18, Pl. 1	Croweburg	1	4.8	36.0	55.4	3.8	1.2	13,392	5½	1983	AcSM
		hvBb	2	N/A	37.9	58.1	4.0	1.3	14,072			
			3	N/A	39.4	60.6	N/A		14,665			
83C45H (Upper 7 in.-bench of upper 14 in.-split)	2, Pl. 1	Croweburg	1	2.4	40.5	40.2	16.9	3.6	11,723	7	1983	CH
		hvAb	2	N/A	41.5	41.2	17.3	3.7	12,009			
			3	N/A	50.2	49.8	N/A		14,516			
83C46H (Lower 7 in.-bench of upper 14-in. split)	2, Pl. 1	Croweburg	1	3.0	39.9	45.7	11.4	5.9	12,517	7	1983	CH
		hvAb	2	N/A	41.2	47.0	11.8	6.1	12,912			
			3	N/A	46.6	53.4	N/A		14,641			
83C47H (Lower 11-in. split)	2, Pl. 1	Croweburg	1	3.0	30:0	36.0	31.0	6.6	9,150	1	1983	CH
		hvAb	2	N/A	30.9	37.1	32.0	6.8	9,437			
			3	N/A	45.5	54.5	N/A		13,872			
83C48H (Upper 12-in. split)	1, Pl. 1	Croweburg	1	2.2	41.3	45.3	11.2	4.6	12,605	6½	1983	CH
		hvAb	2	N/A	42.3	46.3	11.4	4.7	12,894			
			3	N/A	47.7	52.3	N/A		14,562			
83C49H (Middle 2-in. split)	1, Pl. 1	Croweburg	1	2.1	30.2	34.0	33.7	6.6	8,835	2½	1983	CH
		hvAb	2	N/A	30.8	34.8	34.4	6.7	9,024			
			3	N/A	47.0	53.0	N/A		13,756			
83C50H (Lower 6-in. split)	1, Pl. 1	Croweburg	1	2.1	30.1	34.1	33.7	5.5	8,020	1	1983	CH
		hvCb	2	N/A	30.8	34.8	34.4	5.6	8,190			
			3	N/A	46.9	53.1	N/A		12,490			
83C55H (Upper 15-in. split)	12, Pl. 1	Croweburg	1	3.5	42.1	50.3	4.1	1.7	13,696	4	1983	AcSM
		hvAb	2	N/A	43.6	52.2	4.2	1.8	14,196			
			3	N/A	45.6	54.4	N/A		14,823			
83C56H (Lower 15-in. split)	12, Pl. 1	Croweburg	1	4.3	36.1	55.8	3.8	1.6	13,536	5	1983	AcSM
		hvAb	2	N/A	37.8	58.3	3.9	1.7	14,143			
			3	N/A	39.3	60.7	N/A		14,725			
83C57H (Upper 7-in. bench of upper 14-in. split)	3, Pl. 1	Croweburg	1	1.7	44.2	41.6	12.5	6.1	12,701	6½	1983	CH
		hvAb	2	N/A	45.0	42.2	12.8	6.2	12,921			
			3	N/A	51.5	48.5	N/A		14,811			
83C58H (Lower 7-in. bench of upper 14-in. split)	3, Pl. 1	Croweburg	1	2.4	43.3	46.0	8.3	4.1	13,135	7	1983	CH
		hvAb	2	N/A	44.4	47.1	8.5	4.2	13,458			
			3	N/A	48.5	51.5	N/A		14,705			
83C59H (Upper 7.25-in. bench of lower 14.5-in. split)	3, Pl. 1	Croweburg	1	2.3	38.0	44.5	15.2	5.5	11,995	5½	1983	CH
		hvAb	2	N/A	38.9	45.5	15.6	5.6	12,281			
			3	N/A	46.1	53.9	N/A		15,542			
83C60H (Lower 7.25-in. bench of lower 14.5-in. split)	3, Pl. 1	Croweburg	1	2.5	32.9	37.7	26.9	8.0	9, 951	4	1983	CH
		hvAb	2	N/A	33.7	38.7	27.6	8.2	10,207			
			3	N/A	46.6	53.4	N/A		14,102			
83C61H	4, Pl. 1	Croweburg	1	2.1	29.1	36.2	32.6	9.7	9,021	2	1983	CH
		hvAb	2	N/A	29.8	36.9	33.3	9.9	9,217			
			3	N/A	44.6	55.4	N/A		13,814			
84C2H	14, Pl. 2	Dawson	1	5.2	39.4	36.3	19.1	3.3	10,331	4½	1984	CH
		hvBb	2	N/A	41.6	38.2	20.2	3.5	10,901			
			3	N/A	52.0	48.0	N/A		13,660			
81C9H	55, Pl. 2	Mineral	1	13.1	33.5	47.9	5.5	1.5	11,555	1½	1981	TP
		(Morris)	2	N/A	38.6	55.1	6.3	1.7	13,305			
		--	3	N/A	41.2	58.8	N/A		14,204			
81C10H	56, Pl. 2	Mineral	1	8.5	31.0	51.5	9.0	1.1	11,667	2	1981	Cb
		(Morris)	2	N/A	33.8	56.4	9.8	1.2	12,748			
		--	3	N/A	37.6	62.4	N/A		14,133			
81C12H	39, Pl. 2	Mineral	1	5.0	35.1	52.1	7.8	3.3	12,791	6½	1981	AcSM
		(Morris)	2	N/A	36.9	54.9	8.2	3.5	13,470			
		hvAb	3	N/A	40.3	59.7	N/A		14,673			

TABLE A3-2 *(Continued).* — ANALYSES OF COALS IN OKMULGEE AND OKFUSKEE COUNTIES, OKLAHOMA

Sample number	Site number[a] (Pl. 1,2)	Coal bed and rank[b]	Sample condition[c]	Proximate Analyses (%) Moisture[d]	Volatile matter	Fixed carbon	Ash[d]	Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site[e]
81C13H	58, Pl. 2	Mineral	1	4.4	38.9	49.7	7.0	4.0	13,076	4	1981	AcSM
		(Morris)	2	N/A	40.7	51.9	7.4	4.2	13,676			
		hvAb	3	N/A	43.9	56.1	N/A		14,769			
81C14H	47, Pl. 2	Mineral	1	23.7	29.8	42.5	4.0	0.6	8,758	0	1981	AcSM
		(Morris)	2	N/A	39.0	55.8	5.2	0.8	11,473			
		--	3	N/A	41.2	58.8	N/A		12,102			
82C14H	40, Pl. 2	Mineral	1	3.5	38.3	52.8	5.4	3.2	13,428	4½	1982	AcSM
		(Morris)	2	N/A	39.7	54.7	5.6	3.3	13,915			
		hvAb	3	N/A	42.0	58.0	N/A		14,745			
82C15H	46, Pl. 2	Mineral	1	3.3	34.2	48.7	13.8	5.6	11,948	5	1982	AcSM
		(Morris)	2	N/A	35.3	50.5	14.2	5.8	12,353			
		hvAb	3	N/A	41.3	58.7	N/A		14,406			
82C16H	57, Pl. 2	Mineral	1	2.6	38.4	50.6	8.4	4.5	13,070	5½	1982	AcSM
		(Morris)	2	N/A	39.5	51.9	8.6	4.6	13,426			
		hvAb	3	N/A	43.1	56.9	N/A		14,691			
82C20H (Upper 2 in. of benched sample)	42, Pl. 2	Mineral	1	3.3	33.3	47.2	16.2	6.9	11,616	4½	1982	AcSM
		(Morris)	2	N/A	34.4	48.9	16.7	7.1	12,008			
		hvAb	3	N/A	41.4	58.6	N/A		14,417			
82C21H (Middle 7 in. of benched sample)	42, Pl. 2	Mineral	1	3.3	37.0	52.1	7.6	3.4	13,166	5	1982	AcSM
		(Morris)	2	N/A	38.2	53.9	7.9	3.5	13,610			
		hvAb	3	N/A	41.5	58.5	N/A		14,780			
82C22H (Lower 9 in. of benched sample)	42, Pl. 2	Mineral	1	4.2	35.9	56.2	3.7	1.2	13,553	6½	1982	AcSM
		(Morris)	2	N/A	37.5	58.7	3.8	1.2	14,140			
		hvAb	3	N/A	39.0	61.0	N/A		14,702			
83C14H	45, Pl. 2	Mineral	1	5.7	36.9	50.7	6.7	3.0	12,864	7	1983	AcSM
		(Morris)	2	N/A	39.1	53.7	7.2	3.2	13,647			
		hvBb	3	N/A	42.1	57.9	N/A		14,698			
83C32H (Upper 7-in. bench of 14-in. bed)	44, Pl. 2	Mineral	1	3.0	39.4	49.8	7.8	5.1	13,031	6	1983	AcSM
		(Morris)	2	N/A	40.7	51.3	8.0	5.3	13,440			
		hvAb	3	N/A	44.2	55.8	N/A		14,613			
83C33H (Lower 7-in. bench of 14-in. bed)	44, Pl. 2	Mineral	1	3.7	38.4	51.3	6.6	2.5	13,073	6½	1983	AcSM
		(Morris)	2	N/A	39.8	53.4	6.8	2.6	13,581			
		hvAb	3	N/A	42.8	57.2	N/A		14,580			
83C65H	49, Pl. 2	Tebo	1	2.5	40.1	47.1	10.3	3.0	12,940	7½	1983	Cb
		hvAb	2	N/A	41.1	48.3	10.6	3.1	13,278			
			3	N/A	46.0	54.0	N/A		14,852			
83C66H	12, Pl. 2	Tebo	1	1.6	40.4	45.9	12.1	4.7	12,777	6½	1983	CH
		hvAb	2	N/A	41.1	46.6	12.3	4.8	12,991			
			3	N/A	46.8	53.2	N/A		14,813			
84C1H	14, Pl. 1	Tulsa	1	7.3	34.8	35.2	22.7	1.4	9,526	1	1984	CH
		hvCb	2	N/A	37.6	37.9	24.5	1.5	10,280			
			3	N/A	49.7	50.3	N/A		13,616			

[a]Data point number on map (sample site) corresponds to measured section number or core-hole number, Appendix 2, this report. For type of sample site, see right-hand column, above.

[b]hvAb, high volatile A bituminous; hvBb bituminous; hvCb, high-volatile C bituminous; -- not classified.

[c]1 = as received; 2 = moisture-free; 3 = moisture- and ash-free.

[d]N/A, not applicable.

[e]AcSM, Active Strip Mine; Cb, Cutbank of stream; CH, Core Hole; TP, Test Pit.

Appendix 4: Cleat Orientations in Coals Sampled in Okfuskee and Okmulgee Counties, Oklahoma

Coal	Face cleat	Butt cleat	Degrees of separation*	Location
Croweburg	N. 46° W.	N. 45° E.	91	NE¼SW¼SW¼NE¼ sec. 9, T11N, R13E
	N. 34° W.	N. 61° E.	95	SW¼SW¼NW¼SE¼ sec. 17, T11N, R13E
	N. 44° W.	N. 67° E.	111	NE¼NW¼NW¼SE¼ sec. 17, T11N, R13E
	N. 48° W.	N. 66° E.	114	SW¼SW¼SW¼NE¼ sec. 17, T11N, R13E
	N. 35° W.	N. 60° E.	95	NW¼SE¼NE¼NW¼ sec. 17, T11N, R13E
	N. 47° W.	N. 44° E.	91	SW¼SW¼NE¼SE¼ sec. 21, T12N, R13E
	N. 48° W.	N. 45° E.	93	NW¼SW¼NE¼SE¼ sec. 21, T12N, R13E
	N. 58° W.	N. 32° E.	90	NW¼NE¼NW¼SW¼ sec. 28, T12N, R13E
	N. 60° W.	N. 36° E.	96	NW¼NE¼NW¼SW¼ sec. 9, T14N, R14E
Mineral	N. 30° W.	N. 65° E.	95	NW¼SE¼SW¼SE¼ sec. 9, T14N, R14E
	N. 40° W.	N. 55° E.	95	SW¼NE¼SE¼SE¼ sec. 9, T14N, R14E
	N. 38° W.	N. 50° E.	88	SW¼SW¼NW¼NW¼ sec. 10, T14N, R14E
	N. 60° W.	N. 30° E.	90	SW¼SW¼SW¼NW¼ sec. 16, T14N, R14E
	N. 20° W.	N. 77° E.	97	NE¼SW¼SE¼NW¼ sec. 16, T14N, R14E
	N. 20° W.	N. 75° E.	95	SE¼SW¼NW¼NE¼ sec. 16, T14N, R14E
	N. 10° W.	N. 73° E.	83	SW¼NW¼NE¼NE¼ sec. 16, T14N, R14E
	N. 20° W.	N. 72° E.	92	NE¼SE¼SE¼NW¼ sec. 23, T15N, R14E
	N. 25° W.	N. 80° E.	105	NE¼SE¼SW¼SW¼ sec. 26, T15N, R14E
	N. 60° W.	N. 31° E.	91	NE¼SE¼SE¼SE¼ sec. 27, T15N, R14E
	N. 60° W.	N. 32° E.	92	SE¼SW¼NE¼SE¼ sec. 27, T15N, R14E
Tulsa	N. 12° W.	N. 77° E.	89	SW¼SW¼SW¼SW¼ sec. 12, T15N, R11E

*Separation is defined as the angular difference between the average face cleat and butt cleat directions. Ideal separation is 90°.