

Stratigraphic Framework and Distribution of Lignite along  
the Wilcox Group Outcrop Belt, Mississippi  
by  
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Introduction

Eight geologic sections and one lignite-distribution map were constructed from published drill-hole data and measured sections from the outcrop area of the Wilcox Group in Mississippi. The Wilcox Group, believed to contain most of the lignite resources of Mississippi (Luppens, 1979), is Paleocene and Early Eocene in age. The outcrop area extends southward from the Mississippi-Tennessee State line, through the central part of Mississippi, to the Alabama State line on the east. The width of the outcrop belt of the Wilcox, from its base on the east to its top on the west, ranges from about 5 to 30 mi, and the belt is more than 200 mi long. The dip of the Wilcox Group is about 10 to 35 ft per mi westward along this arcuate belt. The direction of westerly dip ranges from slightly north of west at the north end of the Wilcox outcrop belt to southwest at the south end.

Lithologic descriptions from approximately 213 drill holes and measured sections were plotted onto strip logs by hand or computer and were correlated to define the stratigraphic framework of the lignite-bearing rocks and individual lignite beds. The data are derived from the Mississippi Geological Survey county bulletins, an investigation of Tertiary lignites in Mississippi (Williamson, 1976), and selected water-well logs provided by the Mississippi Geological Survey (see sources of information).

Geologic sections were constructed to illustrate the north-south regional stratigraphic variations along the strike of the Wilcox outcrop belt and from east to west across the strike in the northernmost county (Benton), the

southernmost county (Lauderdale), and two centrally located counties (Choctaw and Calhoun). Other geologic sections were constructed to illustrate continuity of specific lignite beds. A map showing the distribution of lignite beds 2.5 ft thick or more and less than 250 ft deep was constructed from the available data. The geologic significance of each section and lignite map is discussed separately.

## North-south Geologic Section, Lignite-bearing

### Wilcox Group, Mississippi (Plate 1)

This section was drawn using the top of the Wilcox Group as the datum. Strip logs or composites of strip logs were selected from drill-hole and measured-section data for Benton, Calhoun, Winston, and Lauderdale Counties. Sections from these counties are representative of the stratigraphic variations that occur from north to south along the Wilcox outcrop area. The most noticeable characteristic of this section is the thickening of the entire Wilcox Group from north to south. In Benton County near the Tennessee line, a test hole penetrated about 240 ft of Wilcox; in Calhoun County, a composite section of three test holes shows about 520 ft of Wilcox; in Winston County, a composite of one measured section and three drill holes shows slightly less than 800 ft of Wilcox; and in Lauderdale County near the Alabama border, a composite of one measured section and one water-well test hole shows slightly more than 800 ft of the Wilcox Group. These data indicate about 560 ft of thickening of the lignite-bearing Wilcox from north to south across the State.

In Lauderdale County, the Wilcox Group is divided from bottom to top into the Nanafalia Formation, with the Fearn Springs Member at the base; the Tuscahoma Formation; and the Hachetigbee Formation, including the Bashi Marl Member. These stratigraphic units apparently continue in part northward at least to Winston County, but only the Fearn Springs Member seems to be traceable to Benton County. The Wilcox Group is a cyclic sequence of unconsolidated sand, silt, and clay with thin beds of lenticular lignite. The lithologic variations reflect in part, transgressions and regressions of the sea during the early Tertiary Period. Most of the major

contacts are marked by erosional unconformities, especially in Alabama and east-central Mississippi (Lauderdale County), but fluctuations of the strand line is less apparent northward in Mississippi where the depositional environment is more fluvial and marker beds are lacking (Cleaves 1980).

The north-south geologic section suggests that only the lower part of the Wilcox Group occurs in Benton County at the north end of the outcrop belt. It is not known whether this thinning northward is due to non-deposition, bevelling, on-lap of the overlying Claiborne Group, or a combination of these three geologic factors. In many places along the Wilcox belt of Mississippi, there is evidence of an unconformity at the top of the Wilcox (see Mississippi Geological Survey county bulletins).

The columnar sections shown in Plate 1 indicate that relatively thin and discontinuous lignite beds are found throughout the Wilcox Group. It appears that where the sand content increases in the stratigraphic column the lignite beds decrease in number, or are non-existent. This could be related to the location of sand fluvial systems or delta front sand bars as opposed to interchannel swamps, or to back-bay marshes. Adequate data on lignite beds are not available except in a few areas as illustrated later in this report. Thus, correlating individual beds over large distances, such as is done with coal beds in the Appalachian Basin, is not yet possible, and most lignite correlations in the Gulf Coast region are done by zones of beds within discrete stratigraphic intervals.

## Plate 2

### Geologic Cross-Section, Lignite-Bearing Wilcox Group, Benton County, Mississippi

Benton County is at the northern end of the Wilcox outcrop belt, and the cross section is in the northern part of the county near the Tennessee stateline. There the Wilcox Group is underlain by the Porters Creek Formation of the Midway Group and is overlain by the Meridian Sand Member of the Tallahatta Formation in the Claiborne Group. This cross section shows rapid thickening of the Wilcox Group north-westward toward the axis of the Mississippi Embayment (Cushing and others, 1964). In Test Hole 11 at the southeast end of the outcrop area the Wilcox is about 90 feet thick, whereas, at the northwest end in Test Hole 10, the Wilcox is about 240 ft thick. Southeastward thinning of the Wilcox may be due to uplift and erosion along the flanks of the embayment prior to deposition of the Meridian Sand Member. The description given in the Benton County report (Lusk, 1956) indicates that the Fearn Springs Member of the Nanafalia Formation is present in Test Holes 9, 10, and 11, but this member is difficult to identify in many places.

Lignite beds were noted in the test holes of this section but they could not be correlated with any degree of certainty. This was true of several other cross sections drawn for Benton County (not shown) in which there were a number of lignite beds, most of which were discontinuous.

### Plate 3

#### Geologic Cross Section, Midway-Wilcox Contact, Calhoun County, Mississippi

There is little difference in lithology between the top of the Midway Group (Naheola Formation) and the base of the Wilcox Group. The contact in Test Holes 2 and 3 is clay against clay, and in Test Hole 7 the contact has been projected on dip. In the Calhoun County report, Lusk (1961) indicates that where the contact is well exposed there is evidence of an erosional unconformity. The Wilcox Group is undivided in Calhoun County and the Fearn Springs Member is not identified as in Benton County; a relationship that further indicates the difficulty in recognizing formation boundaries in the northern part of the Wilcox outcrop belt. Lignite beds are shown in the drill holes of the cross section, but none can be correlated because of their lenticular nature. However, it does appear that most of the lignite beds are concentrated in the lower half of the Wilcox in this county.

Plate 4

Geologic Cross Section, Lignite-Bearing Wilcox Group,  
Choctaw County, Mississippi

This cross section demonstrates the difficulty of correlation between a series of closely spaced, shallow holes typical of lignite investigations, and of earlier clay, iron ore, or bauxite investigations which penetrated lignite. The holes at the east end of the formation are in the Nanafalia Formation, the basal unit of the Wilcox Group, and the remainder of the holes are in the Tuscahoma Formation in the middle of the Wilcox. These shallow holes were studied because of their numerous lignite beds. Strippable lignite is generally considered to be up to 250 feet deep. Many of the beds in Choctaw County are within this range and are of resource thickness of 2.5 feet or more. Most of the beds, as mentioned for other counties, cannot be correlated with certainty because of their lenticular nature, and because of the rapid vertical and lateral facies changes of the associated sediments. However, some beds exhibit lateral continuity and one of these has been shown and described in Plate 6.

## Plate 5

### Geologic Cross Section, Lignite-Bearing Wilcox Group,

#### Lauderdale County, Mississippi

The geologic cross section drawn from drill hole data and measured surface sections in Lauderdale County shows the thickening of the Wilcox Group along its outcrop belt in Mississippi. Published well log data were supplemented with lithologic and electrical logs of selected water well test holes. The stratigraphic sequence and gross lithology of the Wilcox sediments were determined from the deep water well test holes; however, individual lignite beds were seldom logged. Self-potential and resistivity logs from the water well test holes show porosity and permeability of individual rock units but do not delineate lignite beds. In Lauderdale County, the Wilcox Group is subdivided into formations and members mainly on the basis of recognizable erosional unconformities. The characteristics of these unconformities, according to descriptions in the Lauderdale County bulletin (Foster, 1940), include, an irregular undulating surface, local erosion of the upper beds of underlying formations, bioturbation of the unconformity surface, and limonite and other iron oxide concretions suggesting an ancient weathered surface. The Bashi Marl Member of the Hatchetighee Formation is a distinctive unit that contains marine sediments including glauconite, marl, calcareous concretions and zones of marine fossils. The Wilcox Group thickens basinward along this section as indicated by Drill Hole GWI N5 which penetrated about 660 feet of Wilcox sediments, and by Drill Hole GWI M3, approximately 10 miles down-dip to the west which penetrated slightly less than 800 feet of the same stratigraphic interval.



An apparently continuous bed of lignite occurs at the northeastern end of the section in holes LS38-2, LS38-3, LS38-5, and in the measured surface section at Toney Creek. The continuity of this lignite bed is illustrated in plate 8.

## Plate 6

### Geologic Cross Section, Lignite Bed, Wilcox Group.

#### Choctaw County, Mississippi

The geologic cross section of lignite beds in Choctaw County was constructed to demonstrate that individual beds may be correlated locally, with wells approximately a mile apart. These beds range in thickness from .5 to 5' thick and occur at a depth of 100 feet or less. The cluster of 4 holes includes an area 2-1/2 miles long and a mile wide, and the lignite beds possibly continue up to 4 miles by 2 miles. The Phillips Coal Company (oral communication) has drilled the near-surface (up to 200 feet deep) Wilcox Group along the entire Mississippi Embayment from Georgia to Mexico at 2 mile spacings. The more favorable lignite deposits are then drilled at one mile spacings, and individual beds are blocked-out at 1/4 mile or less spacing. This pattern of drilling shows the lenticular nature of lignite in the Wilcox Group and demonstrates the need for close drill hole spacing to provide satisfactory resources calculation.

(Note: Because of leasing competition, private companies keep most of their drill hole data confidential and the information is not available for public use at the present time.)

## Plate 7

### Geologic Section, Lignite Bed-Tuscahoma Formation (Wilcox), Topton Area, Lauderdale County, Mississippi

An individual lignite bed has been correlated in the Topton area of north-central Lauderdale County and is shown in the geologic section. The associated sediments change rapidly, both vertically and horizontally, and appear to reflect fluctuations of the depositional system in a deltaic environment (Coleman, 1980). The cluster of seven drill holes span an area about 4 miles in diameter. The lignite bed within this area ranges from about 2 to 6 feet thick and are at depths of less than 40 feet. The longest spacing between holes is about 2.8 miles and this distance may exceed the limits of accurate correlation for most lignite beds. However, such podshaped beds could produce large tonnages of lignite. The Topton area as outlined by the seven holes shown in the cross section covers an area of 12.56 square miles. At 640 acres per square mile the total area is 8,038 acres. Using 3.5 feet as the average thickness of the Topton lignite bed, the total tonnage would be approximately 49.2 million tons (8,038 acres x 3.5 feet x 1,750 tons per acre-ft).

Other areas about the size of Topton or larger that contain one or more known beds of strippable lignite (see plate 9), could provide large tonnages of lignite resources from the Wilcox Group of Mississippi.

## Plate 8

### Geologic Section, Lignite Bed-Fearn Springs Member?

(Wilcox), Northeastern Lauderdale County, Mississippi

A lignite bed reported to be in the Fearn Springs Member at the base of the Nanafalia Formation of the Wilcox Group has been correlated across the northeastern corner of Lauderdale County (Foster and McKutcheon, 1940). This bed appears to be continuous from the Alabama border into Kemper County to the north. The relationship is shown in this cross section, and in the Lauderdale County section, Plate 5.

However, additional field investigations are necessary to determine whether this bed correlates with the Oak Hill Member of the Naheola Formation, at the top of the Midway Group just across the border in Sumter County, Alabama (Daniel, 1973). Stratigraphically, the Oak Hill Member underlies the Fearn Springs, but the lignite bed in northeast Lauderdale County appears to be at the same stratigraphic horizon.

The lignite bed of northeastern Lauderdale County as shown in the geologic section, ranges from 1 to 5.5 feet in thickness and the line of section is about nine miles long. The width of the bed, utilizing data not shown in the geologic section, ranges from about 2 to 6 miles (see Plate 9). This has proved to be one of the most continuous lignite beds revealed in this study of Mississippi Wilcox Group and may have significant resource potential.

## Plate 9

### Outcrop Map of the Wilcox Group in Mississippi with known thick lignite-bearing areas (shaded)

This map was prepared using available data from the Mississippi county bulletins and the Williamson report (1976). The map shows known potential areas of strippable lignite. Data not presently available from private companies would certainly delineate many more areas. The lignite-bearing areas that are shown include all beds 2.5 feet and more in thickness with up to 250 feet of overburden. A few areas contain a single bed, but most contain two or more beds with resource potential. Choctaw County contains the most extensive deposits followed by Lauderdale County. The largest single area shown is in northeastern Lauderdale County and southeastern Kemper County. This area is underlain by a single bed of lignite which is illustrated, in part, by the geologic section of Plate 8. Locally, the lignite bed is less than 2.5 feet thick (as seen in Plate 8), and not well defined, but the Lauderdale-Kemper County deposit is at least 13 miles long and apparently continues for some distance into Alabama.

Choctaw County contains five areas underlain by from one to 3 beds of lignite. One of these is illustrated in Plate 6. In some areas of the county, the beds can be correlated, but in others they are discontinuous and are treated as zones of lignite. The areas in Choctaw range from 2 to 9 miles long and 2 to 3 miles wide and span most of the width of the Wilcox outcrop belt.

Other areas scattered throughout the Wilcox outcrop of Mississippi range in size from about 1-1/2 miles to 3 miles wide and a maximum of 5 miles long.

### Explanation

Measured Section - Mt. Barton: Mississippi Geological Survey (County)  
Bulletin

Test Hole 10: Mississippi Geological Survey (County) Bulletin

Drill Hole LS 80-5: Mississippi Geological Survey Information Series  
MGS-74-1

Drill Hole GWI N-5: Mississippi Geological Survey Files, electric and  
lithologic logs.

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