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Review of the Geology and Mining Engineering of Mississippi Lignites

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The Mississippi Mineral Resources Institute
University, Mississippi 38677

REVIEW OF THE GEOLOGY AND MINING ENGINEERING OF MISSISSIPPI LIGNITES

By

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INTRODUCTION

Lignite, a low grade coal, is found primarily in the Wilcox and Claiborne Groups (Eocene) of Mississippi. Lesser quantities of little economic importance are found in the Jackson Group (Eocene), Forrest Hills Formation (Oligocene), and in the Catahoula Formation (Miocene) (Figure 1).

One of the earliest references to lignite in Mississippi is by John Millington (1852), who reported the presence of near surface deposits in many locations throughout the state. A more comprehensive study was conducted by Brown in 1907. Since then, lignite has been described in several Mississippi Survey bulletins, the most recent being Williamson's investigation of Tertiary lignite in Mississippi (1976). Additionally, several private coal companies have drilled numerous test holes throughout the state attempting to delineate the extent of mineable accumulations. As a result of this latest exploration more than 400,000 acres have been leased.

Although near surface lignite has been studied in detail, deep basin deposits in Mississippi have received less attention. Two studies (Cleaves, 1980 and O'Neill, 1982) reported on the distribution of the deep basin lignite of the Wilcox Group in northwestern and southeastern parts of the state.

GENERAL GEOLOGIC SETTING AND STRATIGRAPHY

The Wilcox and Claiborne Groups crop out from north-central to east-central Mississippi (Figure 2); and are affected by various structural features (Figure 3). The outcrop belt is characterized by various ridges, domes, and basins with the southern limit marked by intense faulting.

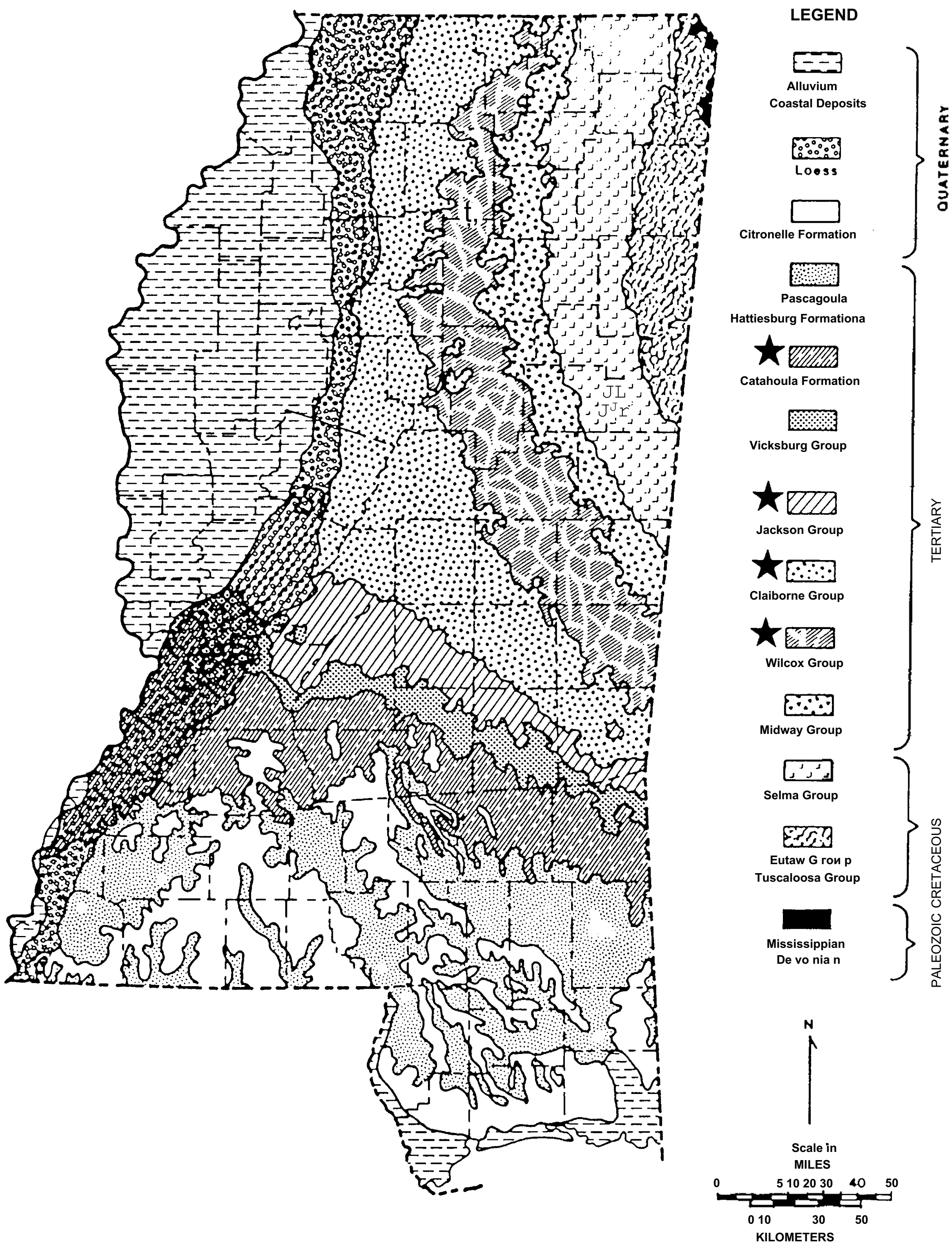

Figure 1. Geologic Map of Mississippi, Stars Designate Lignite Bearing Strata.

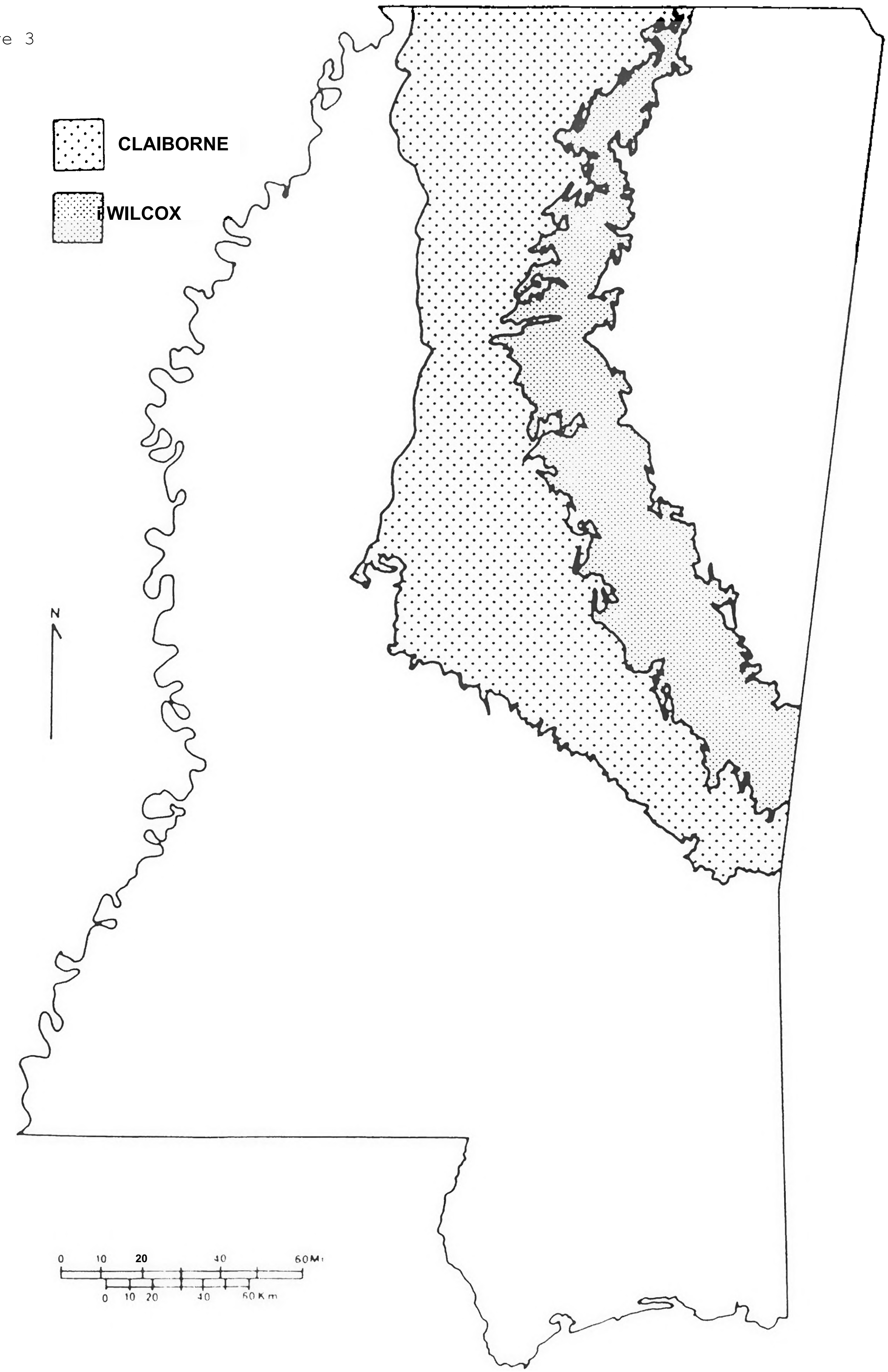

Figure 2. Outcrop Area of the Wilcox and Claiborne Groups.

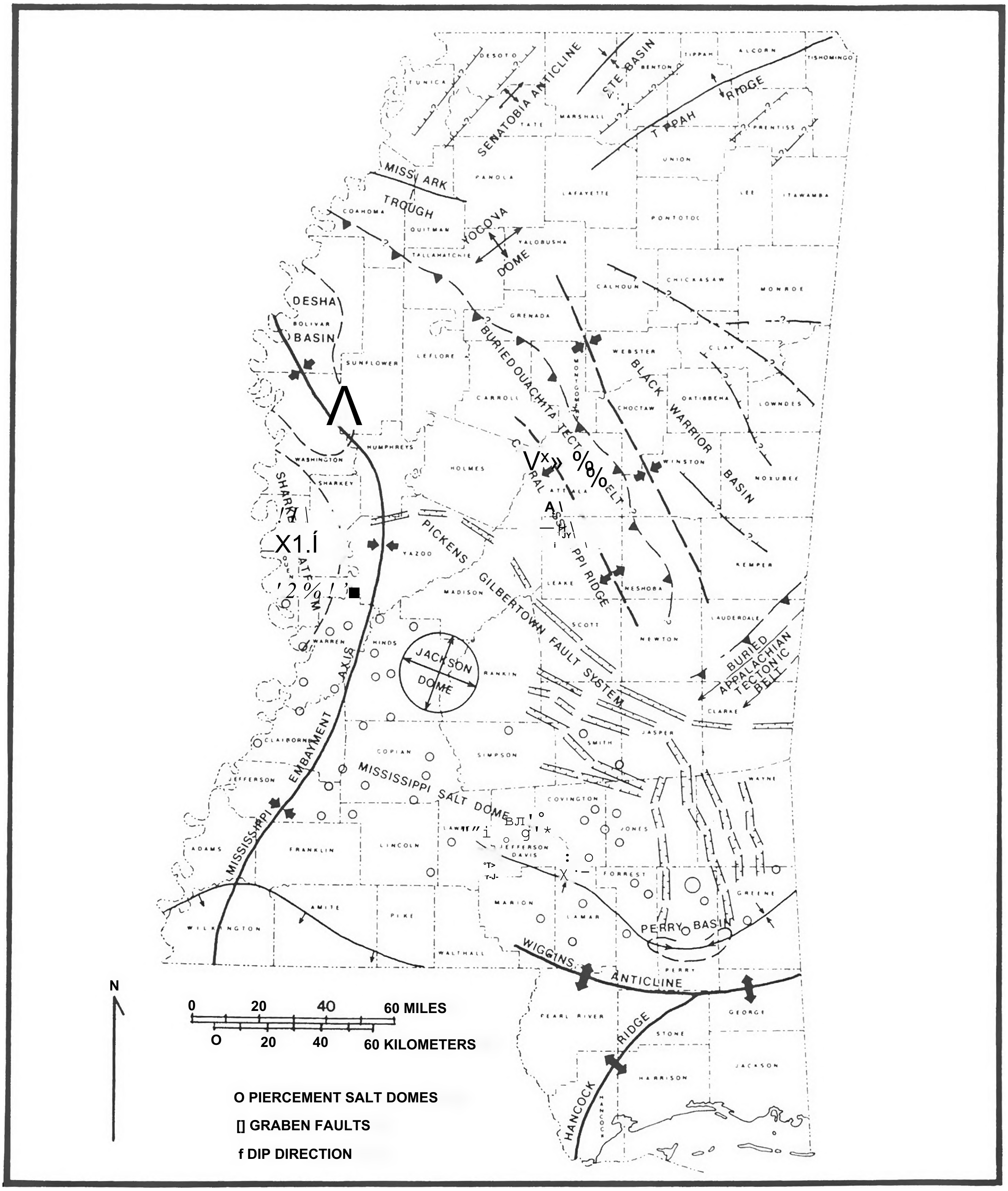

Figure 3. Structural Features of Mississippi.

The strata of these groups regionally dip to the west-southwest at 25 to 35 feet per mile. They underlie the entire extent of the state south and west of their outcrops, each attaining thicknesses of over 2000 feet in the subsurface.

THE WILCOX GROUP

The base of the Wilcox Group (Nanafalia Formation) is in contact with the Betheden (also referred to as the Naheola) Formation (Figure 4). The Betheden is lithologically similar to the Nanafalia Formation but contains fossils of the Paleocene Age as well as significant amounts of lignite (particularly in the subsurface). For purposes of discussion the Betheden will be considered along with the Wilcox Group.

Wilcox strata consist of fluvial to deltaic (from north to south) deposits of sand, silt, clay, and lignite with local iron concretions (iron stones) and marine marls (Figure 5). The clays are silty, micaceous, and sandy, while the silts are generally lighter in color and in thinner beds. Sands are usually fine to medium grained, argillaceous, micaceous, occasionally carbonaceous, and contain lignite fragments, glauconite, heavy minerals, and traces of pyrite (Williamson, 1976).

From the Betheden Formation (Paleocene) upward, the Wilcox Group consists of the Nanafalia, Tuscahoma, and Hatchetigbee Formations. The greatest accumulation of lignite in Mississippi is within these four formations with most being in the lower three (Figures 4 and 5). Toward the north the stratigraphy is considerably more difficult to delineate by clearly definable formations. The Wilcox Group north of Kemper County has been described as "a, more or less, heterogenous body of very lenticular, highly irregularly bedded, non-marine

SERIES	EUROPEAN STAGE	TEXAS	LOUISIANA	MISSISSIPPI	ALABAMA	VIRGINIA and MARYLAND	NEW JERSEY
MIDDLE EOCENE	LUTETIAN	CARRIZO SAND	CARRIZO SAND	MERIDIAN SAND	—	—	SHARK RIVER
LOWER EOCENE	CUISIAN	SABINETOWN	SABINETOWN	HATCHE- TIGBEE	HATCHE- TIGBEE; BASHI MARL	NANJE- MOY	MANASQUAN
	YPRESIAN	ROCKDALE	PENDLETON	TUSCAHOMA	TUSCA- HOMA; 0ELLS LDG MARL; GREGGS LDG MARL	AQUIA	VINCENTOWN
		SEGUIN; CALDWELL KNOB	MARTHAVILLE	NANAFALIA	NANA- FALIA; GRAMPIAN HILLS; GRAVEL CREEK SAND		
PALEOCENE	LANDENIAN	SOLOMON CREEK	HALL SUMMIT	BETHEDEN	NAHEOLA		HORNERS- TOWN

Figure 4. Stratigraphic Correlation of the Paleocene and Lower and Middle Eocene Series (Sabine Stage); From Toulmin, 1977.

sediments" which is classified as "Wilcox undifferentiated" (Parks, 1961).

THE CLAIBORNE GROUP

The Claiborne Group is composed of sand, shale, clays, marls, and lignite (Figures 5 and 6). The sands vary from clayey to clean, some are fossiliferous, glauconitic, and carbonaceous and others are silty or sandy. Clays are carbonaceous, sandy or silty, fossiliferous, and glauconitic.

Six formations make up this group. From the base upward these are the Tallahatta, Winona, Zilpha, Kosciusko, Cook Mountain, and Cockfield Formations. The chief lignite bearing unit is the Cockfield (also referred to as the Yegua) Formation but lignite has also been identified in the Zilpha, Kosciusko (or Sparta), and Cook Mountain Formations (Williamson, 1976). The Tallahatta, Zilpha, and Cook Mountain Formations are subdivided into several members (Figure 5).

ENVIRONMENTS OF DEPOSITION

A knowledge of the depositional environment is necessary to understand the significance of the geometry of a lignite body. It is clear that lignite forms under anaerobic (oxygen-free) conditions but it is the environment which controls thickness, lateral extent, and quality.

THE WILCOX GROUP

Examination of the Wilcox Group suggests that the environment varies from fluvial in northern Mississippi to deltaic and lagoonal in the central and southern parts of the state. Study of the outcrop and analysis of the subsurface using sand facies maps prepared from oil well data support these conclusions. The sand facies maps display a linear sand body geometry in northwestern Mississippi (west of the outcrop) and a lobate sand body geometry (south of the

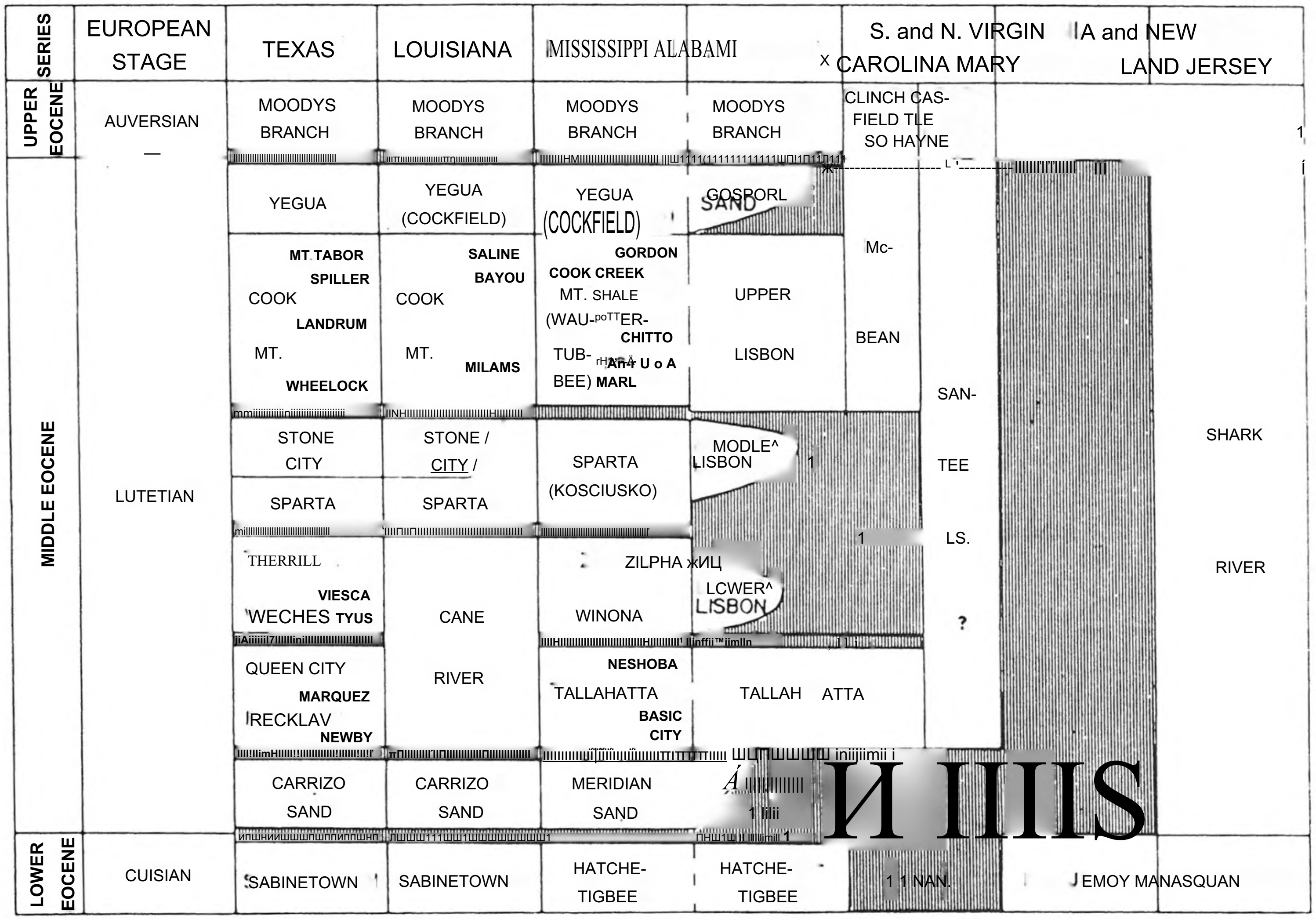

Figure 6. Stratigraphic Correlation of the Lower, Middle and Upper Eocene Series (Claiborne Stage); From Toulmin, 1977.

outcrop). These are indicative of fluvial and deltaic environments, respectively. (Cleaves, 1980 and O'Niell, 1982).

As seas regressed at the end of the Paleocene Epoch the non-marine Naheola Formation was deposited. Following this, deposition of the Wilcox Group began with the Nanafalia Formation. This formation, the most widespread in the Gulf Coast, varies from shallow marine to fluvial from south to north. Overlying the Nanafalia are the non-marine beds of the Tuscahoma Formation. A transgressive period followed deposition of the Tuscahoma and a shallow marine marl, the Bashi marl of the Hatchetigbee Formation, was laid down. The later phases of the Hatchetigbee Formation consist of non-marine deposits similar to the other non-marine sections of this group. The non-marine intervals are interpreted as fluvial to the north and deltaic toward the south.

THE CLAIBORNE GROUP

The Claiborne is composed of an assembly of near shore to marine deposits. Marine to neritic conditions prevailed until deposition of the Zilpha Formation which is transitional from marine to non-marine. The non-marine Kosciusko Formation was then laid down, followed by the neretic (east) to non-marine (west) Cockfield (Yegua) Formation was deposited. Thomas (1947) lists a depositional sequence which took place during Claiborne time.

1. Advancement of the sea over a low lying deltaic plain (Hatchetigbee Formation)

2. Deposition of the main marine section (Tallahatta and Winona Formations) under off-shore shallow water conditions

3. Shoaling of the sea

4. A rapid advance of the coastal marsh over the marine sediments (non-marine Zilpha material)

5. Flooding of the marsh by stream deposited sands (Kosciusko Formation)

6. Gradual replacement of stream deposition by more marshy conditions (Cook Mountain, Formation)

7. Another advance of the sea over the deltaic plain (Cockfield Formation)

Conditions favorable to peat development began with deposition of the non-marine Zilpha Formation but most of the Claiborne lignite is found in the deltaic plain deposits of the Cockfield Formation. Lignite has been recognized in the Zilpha, Kosciusko, and Cook Mountain Formations but only in minor amounts.

LIGNITE OF MISSISSIPPI

Lignite is defined as a brownish-black coal that is intermediate in coalification between peat and subbituminous coal or consolidated coal with a calorific value less than 8300 BTU/lb. on a moist, mineral-free basis. This type of coal is divided into two groups, A and B. Lignite A has a calorific value of 6300 to 8300 BTU/lb. and is known as black lignite while lignite B, or brown lignite, is rated at less than 6300 BTU/lb.

Mississippi (Wilcox) lignites contain less than two to as much as four percent sulphur, most of which is in an organic form. Remaining sulphur is either pyritic or in the form of sulfates. Kaiser (1978) interprets low sulphur lignite (northern Mississippi) as being fluvial in origin. Moderate and high amounts of sulfur are found in marginal marine (deltaic) and marine (lagoonal) lignite bodies (southern Mississippi). Ash content of the Wilcox lignite is moderate to high. Lignite which yields large amounts of ash, will have lower calorific values. Typical calorific value of Mississippi lignite is 7000 to 11,000 BTU/lb. when dehydrated and up to 5000 BTU/lb. when moisture is present. Moisture content of the lignite is high, generally about 40 to 50 percent.

FORMATION OF LIGNITE

Lignite is formed by the alteration and compaction of organic matter. An anaerobic environment such as a marsh or swamp is essential for this process. As vegetation in the swamp flourishes, the demand for oxygen increases. Swamps form in low lying areas with restricted flow and stagnant conditions so anoxic conditions prevail. The organics begin to decay and are submerged. The material cannot be oxidized so it accumulates in this oxygen-free environment.

Sediments, usually silts and clays, are deposited upon and between the organic layers. The pressure and subsequent heat due to burial initiate the process of coalification. Water and volatile matter are driven off and the relative amount of carbon is increased. First peat forms, then lignite, bituminous coal, and eventually anthracite coal.

Figures 7 and 8 illustrate the accumulation of peat in a deltaic environment. The peat builds up along and over the channels of the delta (Figure 8). Thick blanket peats cover the abandoned channels while thinner amounts are found in interdistributary areas (Figure 8).

ANALYSIS OF MISSISSIPPI LIGNITE

Williamson (1976) collected analyses of lignite in Mississippi and, for purpose of comparison, of eight other states. Tests include proximate analyses (moisture, volatile matter, carbon, and ash contents), an ultimate analyses (percentages of selected elements), a test of the calorific value (in BTU's),

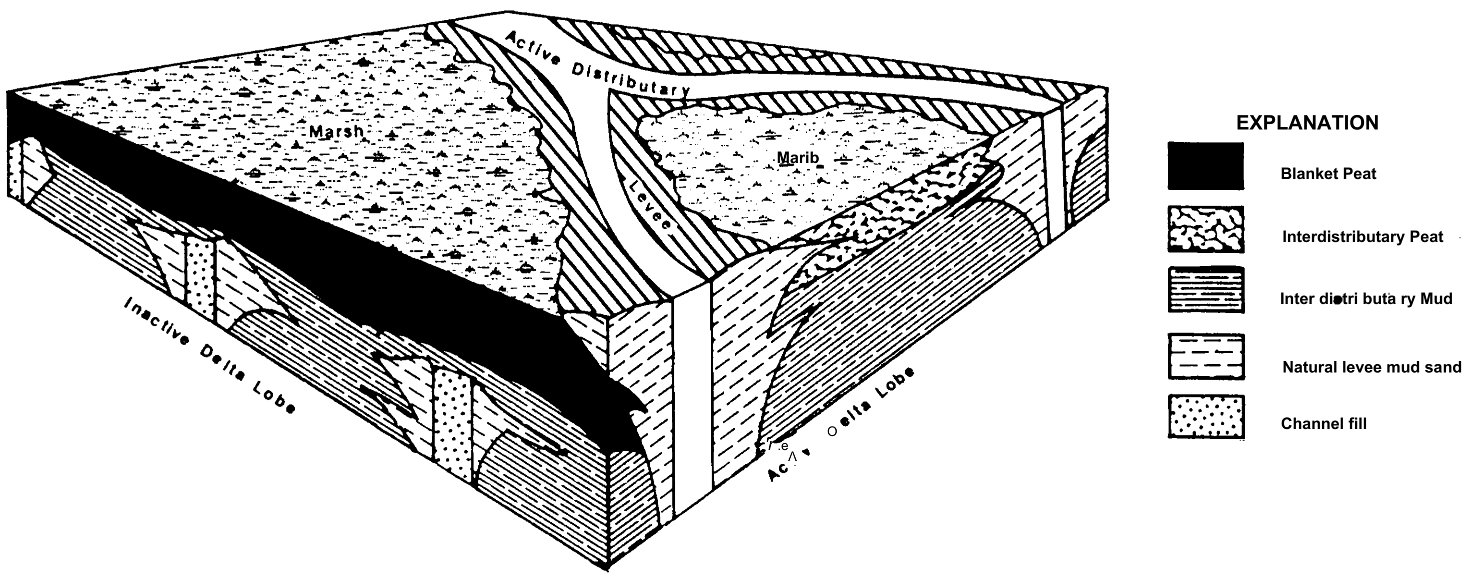

Figure 7. Modern Deltaic Peat Accumulation; Blanket vs. Interdistributary; From Kaiser, 1978.

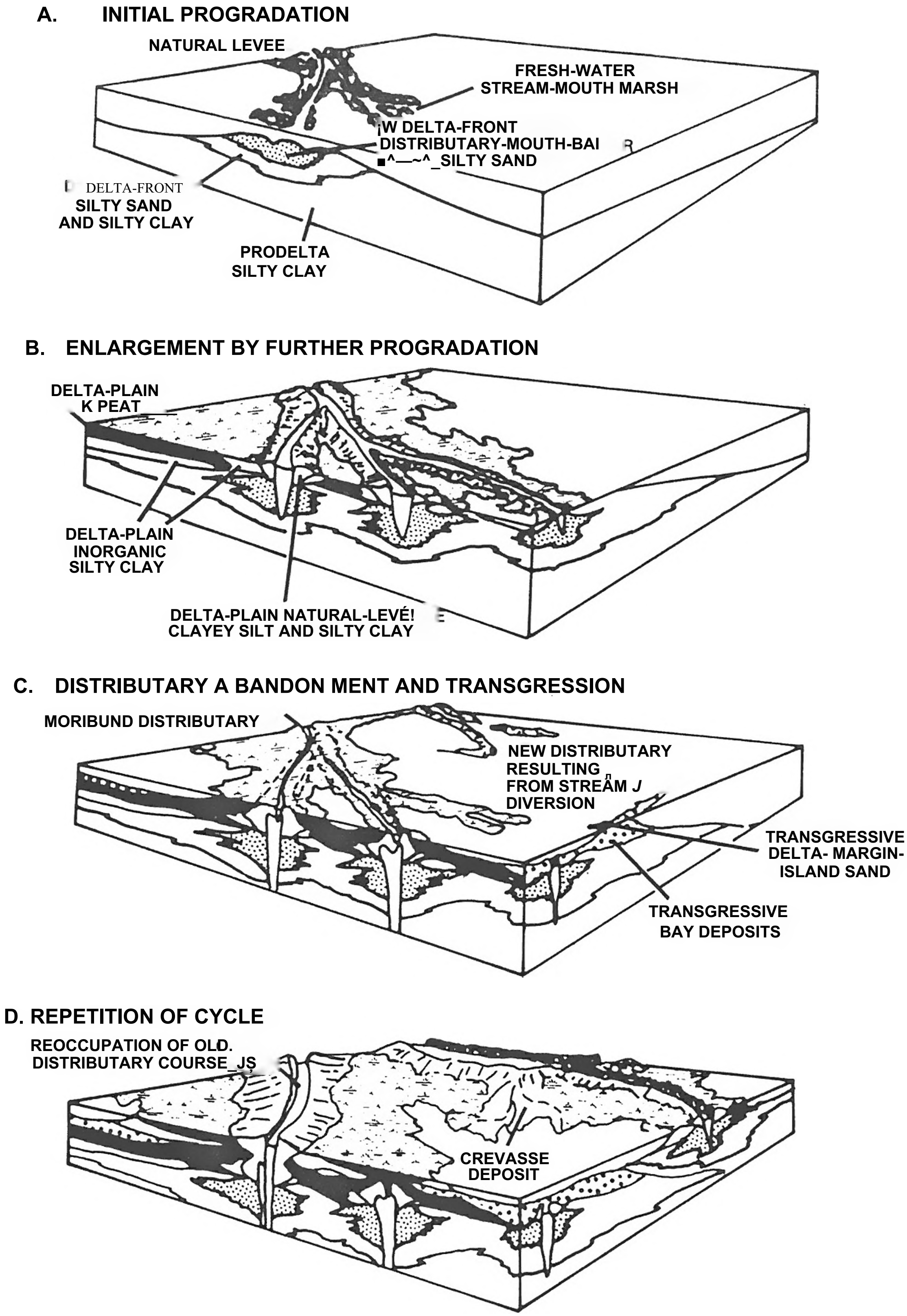

Figure 8. Development of a Delta. Black Deposits Represent Peat; From Frazier, 1967.

and fusibility test of the ash. These are listed in Tables 1 and 2.

Lignites average about 8800 BTU/lb. when air dried and about 9860 BTU/lb. moisture free. The calorific values range from 2750 BTU/lb. (tested as received) in Benton County to 12,730 BTU/lb. (moisture and ash free) in Holmes County.

Moisture makes up about 40 to 50 percent of the lignite. The highest value, at 51.58 percent, was in a sample from Lafayette County. Air drying helps remove much of the moisture. Most air dried samples contain 10 to 15 percent moisture.

Air dried samples are made up of about 37.3 percent volatile matter and 18.5 percent ash. IJhen moisture free, average values are 60.4 percent and 24.7 percent, respectively. Fixed carbon was the last constituent tested in the proximate analysis. An average of 33.7 percent fixed carbon makes up air dried lignite samples and 37.7 percent of the moisture free samples.

Lignite from other states contains less moisture, 30-35 percent versus 40-50 percent, and lignite from Mississippi has lower calorific values, 5428 versus 5665 BTU/lb. (on an as received basis) for other states. Mississippi lignite contains more ash, 16.3 percent versus 9.5 percent, and less volatile matter, 23.8 percent versus 28.1 percent, and fixed carbon 20.2 percent versus 25.7 percent, on the average than lignite from other states. Mississippi lignite is slightly lower in quality than other deposits, but the quantity of reserves, approximately five billion tons, is the second highest in the nation.

Ultimate analyses reveal greater percentages of carbon, nitrogen, and sulfur in Mississippi and relatively lesser amounts of hydrogen and oxygen.

These calculations do not take into account the extent of lignite reserves in each of these states. When compared to areas with major accumulations of

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of[1] Analysis	Type	Condition[2]	Moisture	Volatile * Matter	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
BENTON COUNTY																	
SEi Sec.28-3S-2E Shelby Creek Church	32	AMC	Surf	AD	5.54	19.81	11.06	63.6	-	-	-	-	3.02	-	-	-	-
Sec.33-3S-2E J. C. Orman	30	AMC	Surf	AD	14.29	47.38	30.73	7.6	-	-	-	-	1.26	8584	-	•	-
Sec.33-3S-2E J. D. Rutledge	31	AMC	Surf	AD	7.48	23.75	20.74	48.0	-	-	-	-	0.53	—	-	«	-
SE¿ NE¿ Sec.22-5S-IW North Side of HWY 78	1	STL	Surf	AR	41.73	19.74	8.97	29.6	-	-	-	-	0.97	2750	2700	-	-
do	do	do	do	MF	-	33.87	15.39	50.7	-	-	-	-	1.66	4719	-	-	-
do	2	do	Surf	AR	44.34	22.48	8.94	24.2	-	-	-	-	0.93	3294	2700	-	-
do	do	do	do	MF	-	40.38	16.08	43.5	-	-	-	-	1.66	5919	-	-	-
CALHOUN COUNTY																	
SE¿ NEa Sec. 11-11S-2W J. A. Head	1	BRAINARD	Surf	AD	13.91	46.03	37.32	2.8	-	-	-	-	-	-	-	-	-
do	2	BRAINARD	Surf	AD	9.31	50.20	34.25	6.2	-	-	-	-	-	-	-	-	-
SWiSEi Sec.7-13S-IW	LS-7-7	USBM	Core	AR	13.4	33.1*	21.0	32.5	34.0	4.4	0.8	27.9'	0.4	5550	2580	2780	2910+
do	do	do	do	MF	-	38.2*	24.3	37.5	39.3	3.3	1.0	18.4	0.5	6400	-	-	-
do	do	do	do	MAF	-	61.2*	38.8	-	62.9	5.3	1.5	29.6	0.7	10250	-	-	-
SWi SWi Sec.18-13S-1W Camp Spring	43	AMC	Surf	AD	12.20	46.27	30.86	10.7	-	-	-	-	0.76	9173	-	-	-
do	43	UNIV ILL	Surf	AR	44.09	-	-	13.4	58.83	1.86	-	-	4.18	9878	-	-	-

Table 1. Analysés of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of Analysis	Type	Condition [2]	Moisture	Volatile * Matter	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
CALHOUN COUNTY (Continued)																	
NEi Sec. 19-13S-1W Pittsboro	42	AMC	Surf	AD	13.96	39.97	38.58	7.5	-	-	-	-	0.56	9342	-	-	-
Sec. 17-22N-9E John McPhail	44	AMC	Surf	AD	11.46	40.74	37.59	10.2	-	-	-	-	0.78	9875	-	-	-
NE¿ SEà Sec. 19-22N-9E Near Slate Springs	45	AMC	Surf	AD	12.26	37.43	41.94	6.4	-	-	-	-	0.94	9959	-	-	«
CHOCTAW COUNTY																	
ŠWàSEà Sec. 8-18N-10E	LS-10-5A No.l	USBM	Core	AR	11.8	24.6	16.5	47.1	26.4	3.7	0.5	21.7	0.6	4460	2580	2800	2910+
do	do	do	do	MF	-	27.9	18.7	53.4	29.9	2.7	0.6	12.7	0.7	5050	-	-	-
do	do	do	do	MAF	-	59.8	40.2	-	64.2	5.7	1.3	27.4	1.4	10840	-	-	-
do	LS-10-5A No.2	USBM	Core	AR	12.2	24.7*	17.4	45.7	26.8	3.8	0.5	22.7	0.5	4490	2910+	-	-
do	do	do	do	MF	-	28. Γ	19.8	52.1	30.5	2.8	0.6	13.4	0.6	5120	-	-	-
do	do	do	do	MAF	-	58.7*	41.3	-	63.7	5.9	1.3	27.9	1.2	10680	-	-	-
do	LS10-5A No.3	USBM	Core	AR	14.1	32.9*	25.6	27.4	38.8	4.8	0.8	27.2	1.0	6550	2630	2680	2730
do	do	do	do	MF	-	38.3	29.8	31.9	45.1	3.8	0.9	17.1	1.2	7630	-	-	-
do	do	do	do	MAF	-	56.2	43.8	-	66.2	5.6	1.3	25.2	1.7	11200	-	-	-
Sec.32-18N-10E Patrick Ray	9	AMC	Surf	AD	10.79	41.59	36.54	11.1	-	-	-	-	1.18	9560	-	-	-
Sec.33-18N-10E Moses Bridges	8	AMC	Surf	AD	14.29	38.90	37.71	9.1	-	-	-	-	0.86	9032	-	-	-

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of Analysis	Type	Condition[2]	Moisture	Volatile Matter*	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
CHOCTAW COUNTY (Continued)																	
SWi NW¿ Sec.l6-18N-1 IE	25914	USBM	Mine	AR	47.20	24.99	21.28	6.5	-	-	-	-	0.46	5693	-	-	-
do	do	do	do	MF	-	47.33	40.30	12.4	-	-	-	-	0.87	10782	-	-	-
do	do	do	do	MAF	-	54.01	45.99	-	-	-	-	-	0.99	12305	-	-	-
do	25915	USBM	Mine	AR	48.76	24.24	21.24	5.8	-	-	-	-	0.42	5567	-	-	-
do	do	do	do	MF	-	47.31	41.45	11.2	-	-	-	-	0.82	10865	-	-	-
do	do	do	do	MAF	-	53.30	46.70	-	-	-	-	-	0.92	12240	-	—	-
SEi — 18N-1 IE W. A. Collins	6	AMC	Surf	AD	11.44	36.57	38.56	13.4	-	-	-	-	2.05	9207	-	-	-
SW| Sec.3-17N-10E Chester	7	AMC	Surf	AD	11.39	39.79	38.72	10.1	-	-	«	-,	2.83	9425	—	-	-
Sec. 2-17N-11 E E. W. Oswalt	10	AMC	Surf	AD	11.61	34.61	42.47	11.3	-	-	-	-	2.66	10071	-	-	-
Sec. 15-17N-11E Snow's Field	11	AMC	Surf	AD	11.07	42.92	39.70	6.3	-	-	-	«	1.92	9947	-	-	-
HOLMES COUNTY																	
Sec. 24-16N-4E 4 Miles west of West	38	AMC	Surf	AD	7.24	38.49	14.06	40.2	-	-	-	-	0.76	-	-	-	-
Sec.9-15N-1E Shenoah Hill	23	AMC	Surf	AD	15.22	42.38	34.91	7.5	-	-	«	-	0.91	9201	-	-	-
do	23	UNIV ILL	Surf	AR	43.40	-	-	14.4	59.10	2.7	-	-	0.84	10310	-	-	-
swi si Sec. 27-15N-1E	LS-26-3	USBM	Core	AR	37.2	22.6*	14.5	25.7	27.0	6.4	0.4	40.2	0.3	4730	-	-	-

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Locution	Number	Source of[1] Analysis	Type	Condition[2]	Moisture	Volatile Matter*	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
HOLMES COUNTY (Continued)																	
do	do	do	do	MF	-	36. o'	23.0	41.0	42.9	3.6	0.6	11.4	0.5	7520	-	-	-
do	do	do	do	MAF	-	61.o'	39.0	-	72.7	6.1	1.1	19.2	0.9	12730	-	-	-
14N-1W G. F. Nixon	20	AMC	Surf	AD	13.20	40.16	32.24	15.4	-	-	-	-	1.20	9090	-	—	-
Sec. 19-14N-1E Tolarsvil le	22	AMC	Surf	AD	10.07	41.71	22.86	25.4	-	-	-	-	1.64	8696	-	-	•
Sec. 22-14N-2E "Burning Bed"	21	AMC	Surf	AD	13.87	36.32	34.46	15.4	-	-	-	-	1.39	8426	-	-	-
JASPER COUNTY																	
Sec.8-4N-11E Gorlandville	17	AMC	Surf	AD	12.51	41.40	33.93	12.2	-	-	-	-	2.77	9090	-	-	-
KEMPER COUNTY																	
SEA Sec. 12-11N-14E	K101C JMV-8	CONSOL	Core	AR	42.6	17.4	11.9	28.1	-	-	-	-	0.55	3460	-	-	-
do	do	do	do	AD	8.4	27.8	19.0	44.8	-	-	-	-	0.88	5520	-	-	-
do	do	do	do	MF	-	30.4	20.7	48.9	-	-	-	-	0.96	6030	-	-	-
do	do	do	do	MAF	-	59.5	40.5	-	-	-	-	-	-	11800	-	-	-
SEi Sec. 12-11N-14E	K101C JMV-9	CONSOL	Core	AR	50.0	21.6	19.7	8.7	-	-	-	-	0.83	5190	-	-	-
do	do	do	do	AD	15.3	36.6	33.3	14.8	-	-	-	-	1.41	8780	-	-	-
do	do	do	do	MF	-	43.2	39.3	17.5	-	-	-	-	1.66	10370	-	-	-

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source oP Analysis	Type	Condition 2	Moisture	Volatile Matter *	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
KEMPER COUNTY (Continued)																	
do	do	do	do	MAF	-	52.4	47.6	-	-	-	-	-	-	12570	-	-	-
Sec. 16-11N-16E 1? Mile North of DeKalb	15	AMC	Surf	AD	11.40	32.61	37.00	19.0	-	-	-	-	1.80	9201	-	-	-
Sec. 16-11N-16E 1? Mile North of DeKalb	1	LONG	Mine	AD	2.13	46.82	41.83	7.9	-	-	-	-	1.28	-	-	-	-
do	2	PITTMAN	Mine	AD	ND	41.48	40.80	17.6	-	-	-	-	1.57	-	-	-	-
Sec. 14-10N-16E Pool's Mill	16	AMC	Surf	AD	13.61	37.14	42.10	7.2	-	-	-	-	2.64	9790	-	-	-
NWi SW¿ Sec. 23-9N-15E	LS-35-S 1	USBM	Surf	AR	45.9	21.1*	17.9	15.1	27.4	7.2	0.5	48.6	1.2	4710	-	-	-
do	do	do	do	MF	-	39.0*	33.0	28.0	50.6	4.0	1.0	14.1	2.3	8700	-	-	-
do	do	do	do	MAF	-	54.1*	45.9	-	70.2	5.5	1.3	19.8	3.2	12090	-	-	-
SEI SWà Sec.34-9N-15E	LS-35-2A No.I	USBM	Core	AR	41.9	22.1	19.8	16.2	30.0	6.9	0.7	45.5	0.7	5140	2760	2810	2860
do	do	do	do	MF	-	38.0	34.2	27.8	51.6	3.8	1.1	14.5	1.2	8850	-	-	-
do	do	do	do	MAF	-	52.7	47.3	-	71.5	5.3	1.6	20.0	1.6	12260	-	-	-
SEà SW¿ Sec.34-9N-15E	LS35-2A No.2	USBM	Core	AR	46.8	25.2	22.5	5.5	34.2	7.8	0.7	51.3	0.5	5870	2030	2080	2130
do	do	do	do	MF	-	47.3	42.3	10.4	64.2	4.8	1.3	18.3	1.0	11040	-	-	-
do	do	do	do	MAF	-	52.8	47.2	-	71.7	5.3	1.5	20.4	1.1	12310	-	-	-
do	LS-35-2A No.3	USBM	Core	AR	46.3	24.5	23.8	5.4	34.5	7.5	0.8	51.4	0.4	5870	2030	2080	2130

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of Analysis	Type	Condition	Moisture	Volatile Matter	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
KEMPER COUNTY (Continued)																	
do	do	do	do	MF	-	45.5	44.5	10.0	64.2	4.5	1.4	19.2	0.7	10920	-	-	-
do	do	do	do	MAF	-	50.6	49.4	-	71.3	5.0	1.6	21.3	0.8	12130	-	-	-
do	LS-35-2A No. 4	USBM	Core	AR	48.7	22.0	24.0	5.3	32.9	7.6	0.7	53.0	0.5	5460	2030	2080	2130
do	do	do	do	MF	-	42.8	46.9	10.3	64.1	4.2	1.4	19.0	1.0	10640	-	-	-
do	do	do	do	MAF	-	47.7	52.3	-	71.4	4.7	1.6	21.2	1.1	11870	-	-	-
do	LS-35-2A No.5	USBM	Core	AR	47.2	23.2	22.3	7.3	32.5	7.6	0.7	51.0	0.9	5500	2030	2080	2130
do	do	do	do	MF	-	44.0	42.2	13.8	61.5	4.4	1.3	17.3	1.7	10420	-	-	-
do	do	do	do	MAF	-	51.0	49.0	-	71.4	5.1	1.6	20.0	1.9	12080	-	-	-
LAFAYETTE COUNTY																	
SEâ Sec.23-6S-4W Old Wyatte	37	AMC	Surf	AD	9.82	24.56	26.41	39.2	-	-	-	-	1.63	-	-	-	-
Sec.30-6S-3W Bi 11 ingsl ey 's Shop	33	AMC	Surf	AD	7.42	20.94	22.43	49.2	-	-	-	-	0.87	-	—	-	-
Sec.30-6S-3W Tallahatchie River	34	AMC	Surf	AD	9.35	25.35	20.50	44.8	«	-	-	-	2.09	-	-	-	-
SWi — 7S-1W Near Caswell	35	AMC	Surf	AD	9.60	30.54	28.86	31.0	-	-	-	-	0.57	7238	-	-	-
NEj Sec.32-9S-2W W. J. Hogan	47	AMC	Surf	AD	11.84	34.15	35.68	18.3	-	-	-	-	0.48	8276	-	-	-
SE¿ Sec.33-9S-2W Near Delay	48	AMC	Surf	AD	14.61	38.51	39.10	7.8	-	-	-	-	1.28	9398	-	-	-

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of[1] Analysis	Type	Condition[2]	Moisture	Volatile Matter*	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
LAFAYETTE COUNTY (Continued)																	
do	48	UNIV ILL	Surf	AR	50.66	-	-	-	-	-	-	-	-	-	-	-	-
Sec.26-10S-2W R. V. Edwards	50	AMC	Surf	AD	14.60	38.59	35.21	11.6	-	-	-	-	1.83	8780	-	-	-
do	50	UNIV ILL	Surf	AR	51.58	-	-	-	-	-	-	-	-	-	-	-	-
LAUDERDALE COUNTY																	
SW| SE| Sec.35-8N-18E	L48C JMV-10	CONSOL	Core	AR	47.8	22.6	21.8	7.8	-	-	-	-	3.55	5480	2130	-	-
do	do	do	do	AD	8.2	39.7	38.3	13.8	-	-	-	-	6.24	9630	-	-	-
do	do	do	do	MF	-	43.3	41.7	15.0	-	-	-	-	6.80	10490	-	-	-
do	do	do	do	MAF	-	50.9	49.1	-	-	-	-	-	-	12340	-	-	-
SW| SE| Sec.33-7N-17E	LS-38-S 1	USBM	Surf	AR	48.4	24.7*	20.4	6.5	27.3	7.3	0.5	55.9	2.5	4340	-	-	-
do	do	do	do	MF	-	47.8*	39.5	12.7	52.8	3.7	1.0	25.0	4.8	8410	-	-	-
do	do	do	do	MAF	-	54.7*	45.3	-	60.5	4.3	1.1	28.6	5.5	9630	-	-	-
NE| SW| Sec.34-7N-17E	LS-38-S 2	USBM	Surf	AR	51.7	22.8*	22.3	3.2	30.7	7.9	0.6	56.5	1.1	5200	-	-	-
do	do	do	do	MF	-	47.3*	46.2	6.5	63.7	4.5	1.2	21.8	2.3	10760	-	-	-
do	do	do	do	MAF	-	50.6*	49.4	-	68.1	4.8	1.3	23.3	2.5	11520	-	-	-
NE| SW| Sec.34-7N-17E	LS-38-S 2A	USBM	Surf	AR	50.5	24.8*	22.3	2.4	32.4	8.1	0.6	55.7	0.8	5710	-	-	-

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of Analysis	Type	Condition[2]	Moisture	Volatile Matter*	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
LAUDERDALE COUNTY (Continued)																	
do	do	do	do	MF	-	50.0*	45.1	4.9	65.5	5.0	1.3	21.7	1.6	11540	-	-	-
do	do	do	do	MAF	-	52.6*	47.4	-	68.9	5.3	1.3	22.8	1.7	12120	-	-	-
PANOLA COUNTY																	
SEi Sec.8-10S-8W Tocowa	25	AMC	Surf	AD	11.84	38.96	29.36	19.8	-	-	-	-	0.69	8471	-	-	-
do	25	UNIV ILL	Surf	AR	47.91	-	-	-	-	-	-	-	-	-	-	-	-
do	do	do	do	MF	-	-	-	12.5	59.70	2.42	-	-	0.73	10217	-	-	-
SEi Sec. 10-27N-2E 1 Mile from Tocowa	2	AMC	Surf	AD	13.93	44.65	35.17	6.3	-	-	-	-	0.70	9930	-	-	-
SCOTT COUNTY																	
NWi Sec.34-9N-5E Coal Bluff	18	AMC	Surf	AD	13.50	39.66	36.50	10.3	-	-	-	-	4.10	8950	-	-	-
TALLAHATCHIE COUNTY																	
Sec.3-25N-2E B. M. Baker	24	AMC	Surf	AD	10.45	32.20	30.64	26.7	-	-	-	-	6.16	-	-	-	-
TATE COUNTY																	
SEi SWi Sec. 12-6S-10W Sarah	27	AMC	Surf	AD	12.01	38.51	25.88	23.6	-	-	-	-	1.40	8022	-	-	-
WEBSTER COUNTY																	
SEi Sec. 29-21N-8E 3 Miles NE of Alva	39	AMC	Surf	AD	13.04	36.68	35.62	14.7	-	-	-	-	0.48	8247	—	-	-

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of' Analysis	Type	Condition[2]	Moisture	Volatile * Matter	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
WEBSTER COUNTY (Continued)																	
SEi Sec. 26-21N-9E Bellefontaine	40	AMC	Surf	AD	14.90	39.21	35.57	10.3	—	-	«	-	0.56	9117	—	-	-
WINSTON COUNTY																	
SEi NEi — 15N-12E C. L. Taylor	14	AMC	Surf	AD	14.20	35.24	41.80	8.8	-	-	-	-	0.63	9459	-	-	-
do	do	UNIV ILL	Surf	AR	48.70	-	-	-	-	-	-	-	«	-	—	-	-
do	do	do	do	MF	-	-	-	12.6	60.56	1.85	-	-	0.76	9986	-	-	-
NW| NE1 Sec.2I-I5N-I2E	LS-80-S 1	USBM	Mine	AR	49.9	22.1*	21.1	6.9	30.4	7.7	0.6	54.1	0.3	5090	-	-	-
do	do	do	do	MF	-	44.0*	42.3	13.7	60.6	4.3	1.3	19.5	0.6	10160	-	-	-
do	do	do	do	MA F	-	51.0*	49.0	-	70.3	5.0	1.5	22.5	0.7	11780	-	-	-
NWi NE¿ Sec. 23-I5N-I2E Drip Spring	13	AMC	Surf	AD	11.59	37.49	43.76	7.2	-	-	-	-	1.29	9819	-	-	-
N| Sec.31-15N-I2E W. E. Huntley	12	AMC	Surf	AD	9.91	37.08	36.42	16.6	-	-	-	-	2.95	8977	-	-	-
YALOBUSHA COUNTY																	
Sec.5-24N-7E J. J. Milton	46	AMC	Surf	AD	12.62	40.85	39.94	6.6	-	-	-	-	2.05	9706	-	-	-
do	46	UNIV ILL	Surf	AR	49.25	-	-	-	-	-	-	-	-	-	-	-	-
do	do	do	do	MF	-	-	-	5.2	64.90	2.55	-	-	1.17	11068	-	-	-

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source oH Analysis	Type	Condition[2]	Moisture	Volatile Matter *	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
YAZOO COUNTY																	
Sec. 26-13N-1W Free Run	19	AMC	Surf	AD	8.72	34.64	22.84	33.8	-	-	-	-	2.76	-	-	-	-

NOTE:

1. Source of Analyses. AMC------------------------ Agriculture and Mechanical College (Miss. State Univ.), Dr. W. F. Hand, State Chemist. M.G.S. Bull. 3.

   STL---------------Southern Testing Laboratories, Inc., Birmingham, Alabama.

   BRAINARD—Alfred F. Brainard, Birmingham, Alabama. U.S.G.S. Bull. 283, pg. 88.

   USBM------------ United States Bureau of Mines, Pittsburgh Energy Research Center, Forrest E. Walker, Chemist-in-Charge.

   CONSOL------ Consolidation Coal Company.

   LONG------------J. C. Long. U.S.G.S. Bull. 283, pg. 88.

   PITTMAN—R. T. Pittman. U.S.G.S. Bull. 283, pg. 88.

2. Condition.

   AR---------------As Received

   AD----------------Air Dried

   MF-------------- Moisture Free

   MAF------------- Moisture and Ash Free

* Volatile Matter — Determined by Modified Method

Percentages of ASH Have Been Rounded-off to Nearest Tenth.

Table 1. Analyses of Mississippi Lignites (From Williamson, 1976).

SAMPLE					PROXIMATE (PERCENT)				ULTIMATE (PERCENT)					British thermal units (B.t.u.)	FUSIBILITY OF ASH (°F)		
Location	Number	Source of Analysis	Type	Condition	Moisture	Volatile * Matter	Fixed Carbon	Ash	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur		Initial Deformation Temperature	Softening Temperature	Fluid Temperature
ALABAMA																	
NWi SWi Sec.34-8N-I9E Pike County	-	AL Geo Sur Bull. 101	Min«	AR	51.0	20.7	19.9	8.4	29.1	7.7	0.5	52.3	2.0	4880	2250,	2300	2350
ARKANSAS																	
SWi SWi Sec. 25-85-17W Dallas County	46108	USBM Bull. 482	Face	AR	37.4	30.9	24.7	7.0	39.7	7.4	0.7	44.8	0.4	6930	-	2910	-
LOUISIANA																	
9 Miles SW of Mansfield DeSoto Parish	16	LA Geo Sur Bull. 8	Surf	AR	32.79	37.09	22.91	7.2	—	-	-	-	1.18	7763	-	-	-
MONTANA																	
NWi SWi Sec. 16-I8N-44E McCone County	McCone No. 11	MTB.M.G. Bull. 78	Core	AR	30.5	27.7	35.9	5.9	46.6	6.2	0.8	39.9	0.6	7660	-	-	-
NORTH DAKOTA																	
SEi NWi Sec. I0-I39N-88W Morton County	GUC-3-1	USGS Map C-54	Core	AR	37.6	26.1*	25.8	10.5	-	-	-	-	0.6	6400	—	-	-
SOUTH DAKOTA																	
Sec.7-17N-11E Perkins County	12488	USGS Bull. 627	Mine	AR	42.5	23.2*	25.3	9.0	35.22	7.07	0.62	46.93	1.16	5950	-	-	-
TEXAS																	
Big Brown Freestone County	Fr-8	Bur Ec Geo R.I. 79	Core	AR	33.79	32.01	27.10	7.1	-	-	-	-	0.68	7435	-	-	-
WASHINGTON																	
Sec. 15-IIN-IE Lewis County	1-15TW	USBM Bull. 482	Core	AR	27.7	27.3	24.2	20.8	35.5	6.0	0.4	36.6	0.7	6160	-	2650	-

Table 2. Comparative Analyses of Lignite (From Williamson, 1976).

lignite, Mississippi lignite has low to moderate sulfur content, moderate to high amounts of moisture and ash, and moderate to low calorific values. These values are comparable to those of lignite currently being mined in other areas.

MEASURED THICKNESS OF LIGNITE SEAMS IN MISSISSIPPI

The source of this information is outcrop and drill test data gathered by the Mississippi Geological Survey. Table 3 lists the number of drill holes or outcrop exposures and the total and average measured thicknesses of lignite.

Data was collected in seventeen counties within the outcrop area of the Wilcox Group, which is generally considered to have the greatest economic potential for lignite in the state. The locations of major accumulations of lignite are indicated in Figure 9, a lignite isopach map of the outcrop.

Of these counties, Grenada, Noxubee, and Montgomery, have no reported lignite in either drill tests or outcrop exposures. Three other counties, Union, Pontotoc, and Neshoba contained no lignite in outcrop.

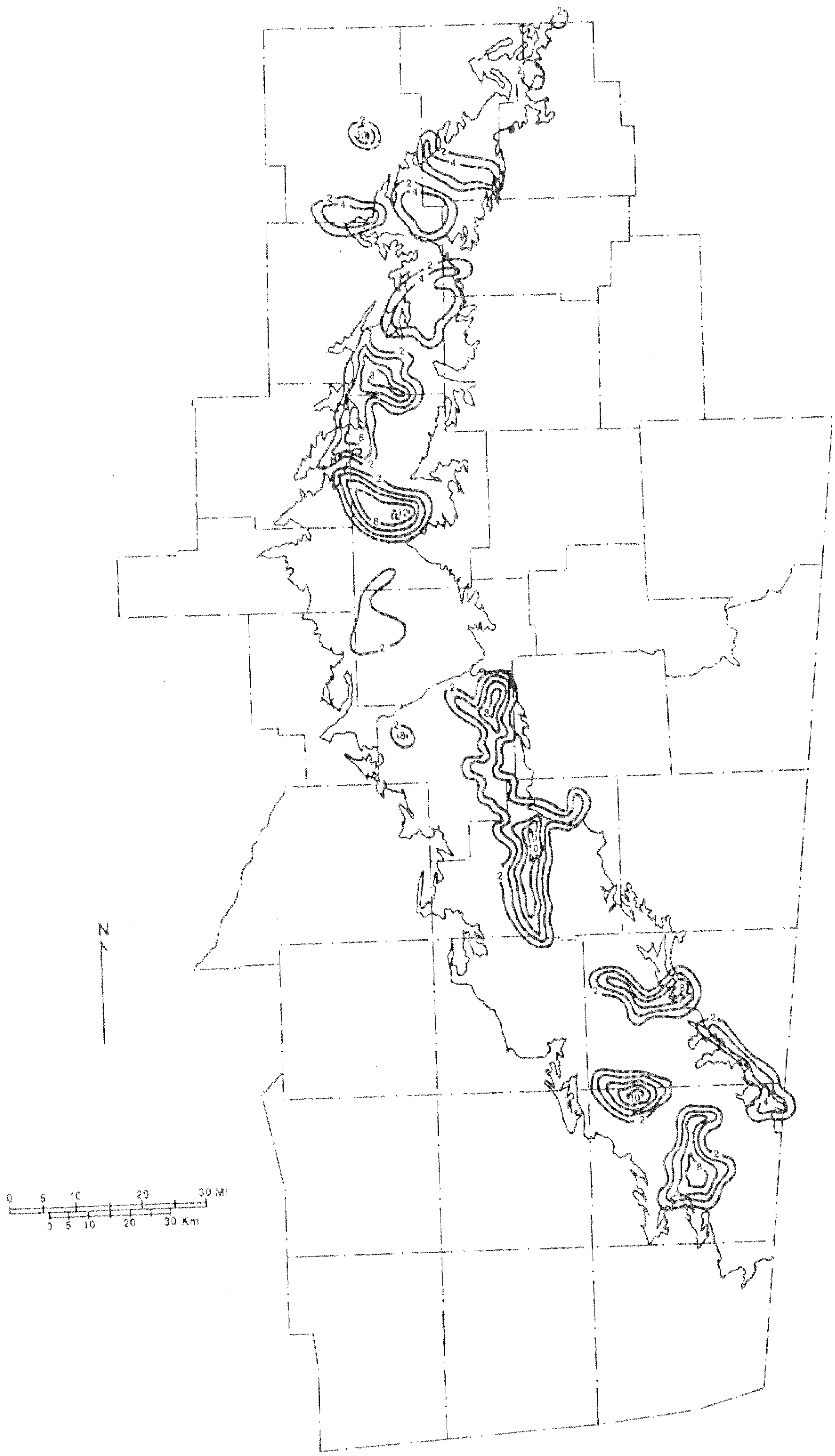
In the 152 holes drilled and 69 surface exposures examined, the average thickness of lignite is 51.1 inches (4.26 feet or 1.3 meters) in drill tests and 27.9 inches (2.33 feet or .71 meters) in outcrop.

Marshall, Calhoun, Choctaw, and Kemper Counties each contained greater than average thicknesses of lignite in both the surface and subsurface. Winston County, in drill tests, and Lauderdale County, in outcrop measurements, were the only others to have greater than average thicknesses of lignite.

Major accumulations, as indicated by the isopach map (Figure 9), are in Lafayette, Calhoun, Choctaw, Winston, Kemper, and Lauderdale Counties. The average thicknesses of lignite in these counties are 58.8 inches (4.90 feet or

COUNTY	NQOF HOLES	INCHES OF LIGNITE	AVG PE R HOLE		NO. OF SĂPQSURE2	INCHES OF LIGNITE...	AVG PER EXP.	
			In.	Ft.			In.	Ft
TIPPAH	4	56"	14"	1.2'	2	48"	24"	2.0'
BENTON	16	288"	18"	1.5'	5	86"	17.2"	1.4'
MARSHALL	8	462"	57.8"	4.8'	1	66"	66"	5.5'
UNION	5	148"	29.6"	2.5'	0			
LAFAYETTE	6	198"	33.0"	2.8'	10	226"	22.6"	1.9'
PONTOTOC	1	30"	30.0"	2.5'				
CALHOUN	15	772"	51.5"	4.3'	8	280"	35.0"	2.9'
YALOBUSHA	2	81"	40.5"	3.4'	4	56"	14.0"	1.2'
GRENADA								
WEBSTER	3	63"	21"	1.8"	2	24"	12.0"	1.0'
MONTGOMERY								
CHOCTAW	31	2011"	64.9"	5.4'	8	238"	29.8"	2.5'
WINSTON	18	1652"	91.7"	7.6'	6	133"	22.2"	1.9'
NOXUBEE								
KEMPER	9	483"	53.6"	4.5'	11	421"	38.2"	3.2'
NESHOBA	1	48"	48"	4.0'				
LAUDERDALE	33	1479"	44.8"	3.7'	12	348"	29"	2.4'
TOTAL	152	7771"	51.1"	4.26'	69	1926"	27.9"	2.33'

TABLE 3. LIGNITE DATA FOR DRILL HOLES AND OUTCROP EXPOSURES OF THE WILCOX GROUP, MISSISSIPPI.



Survey,

1.49 meters) in drill tests and 29.9 inches (2.49 feet or .76 meters) in outcrop. These values do not vary significantly from the total average but thicknesses of eight to ten feet cover relatively large areas in these six counties, creating an economic potential.

Williamson (1976) recognized three areas in Mississippi with potentially commercial lignite accumulations (Figure 9). These are Northeastern Lauderdale, Western Kemper, and Northeastern Neshoba Counties; central Winston and Choctaw Counties; and Northwestern Calhoun and Southeastern Lafayette Counties. Mining activity will probably be confined to these areas.

Estimates of the tonnage of lignite present in Mississippi vary. Values up to five billion mineable tons have been suggested for the entire state. A more realistic estimate is about one billion mineable tons for the areas of major accumulation.

USES OF LIGNITE

Fuel uses of lignite can be separated into two major catagories, direct and indirect combustion. Indirect combustion involves the development of synthetic fuels and use as a source of chemical feedstock. Synthetic fuels include Synthetic Natural Gas (SNG), which can be produced in situ for deep basin deposits or by other means for conventionally mined lignite, and liquid fuels such as motor fuels and methanol. Chemical feedstocks can be obtained directly from lignite by first converting it to SNG. It can then be used to synthesize parraffins and olefins.

Direct combustion uses include production of electricity and direct heating. Direct heating of kilns, used to produce lightweight aggregate (mined along with the lignite), is one of the "dual uses" suggested for lignite. Direct heating has also been proposed for home use.

Production of electricity produces by-products such as ash. Fly ash is used in concrete production and bottom ash has been used as a road surfacing material.

Lignite is also used to produce filters, carbon electrodes, and waxes. Many other applications are possible for lignite in food, chemical, electrical, and metallurgical industries (Williamson, 1975).

RECLAMATION AND MINING

Claiborne and Wilcox lignite were mined in the early 1900s using stripping and underground excavation methods. These projects were abandoned and interest in lignite decreased.

In the early 70's, higher fuel prices stimulated a new interest in Mississippi lignite. Since then much of the mineable land has been leased by several coal companies. Many test holes have been drilled but no actual mining has begun.

Stripmining is the most effective method of recovering the near surface lignite. Current economic conditions indicate that the maximum depth to which the lignite can be stripped in Mississippi is 150 to 200 feet. A deposit is generally considered mineable if there are 10 or less feet of overburden for each foot of lignite present. Approximately 75 to 90 percent recovery is possible using this mining method (Williamson, 1975).

When stripmining is chosen as a recovery method, land reclamation must also be planned. Area stripping is the preferred method of mining this type of deposit. It begins with a box cut made in the overburden. The topsoil is saved and is replaced on the backfill after the mining is completed. Successive strips are then made down dip into the deposit. This is achieved using draglines or scrapers since the overburden is composed of unconsolidated sands and clays.

Reclamation begins as mining progresses. The overburden is used to fill in the previously mined areas (Figure 10) (Brummett, 1976). After the pit has been refilled it must be graded and reshaped. Following this, the topsoil is replaced and the soil is reconditioned, fertilized, and revegetated. The land is then closely monitored and managed until reclamation is complete.

Stripmining and land reclamation are not unknown in this area. Several gravel deposits in Mississippi and Tennessee have been mined in this manner. With proper planning, land reclamation can be successful.

While surface deposits may be stripmined, deeper lignites require other methods for recovery. One of the most promising methods is underground coal gasification. Synthetic Natural Gas (SNG) can be produced in situ from lignite by injecting hot gases into one part of a seam and recovering the gas produced from another part of the seam (Figure 11).

Another method, currently in the experimental stage, involves the use of microwave radiation. Two electrodes are placed at selected positions in the seam and microwaves are produced between them converting the lignite to a more fluid, "oil-like" state which can be transferred to the surface.

Presently there is little or no interest in recovery of deep basin lignite which, unlike near surface deposits, would not require reclamation of the land. Advances in technology may make this a viable alternative to stripmining in the future.

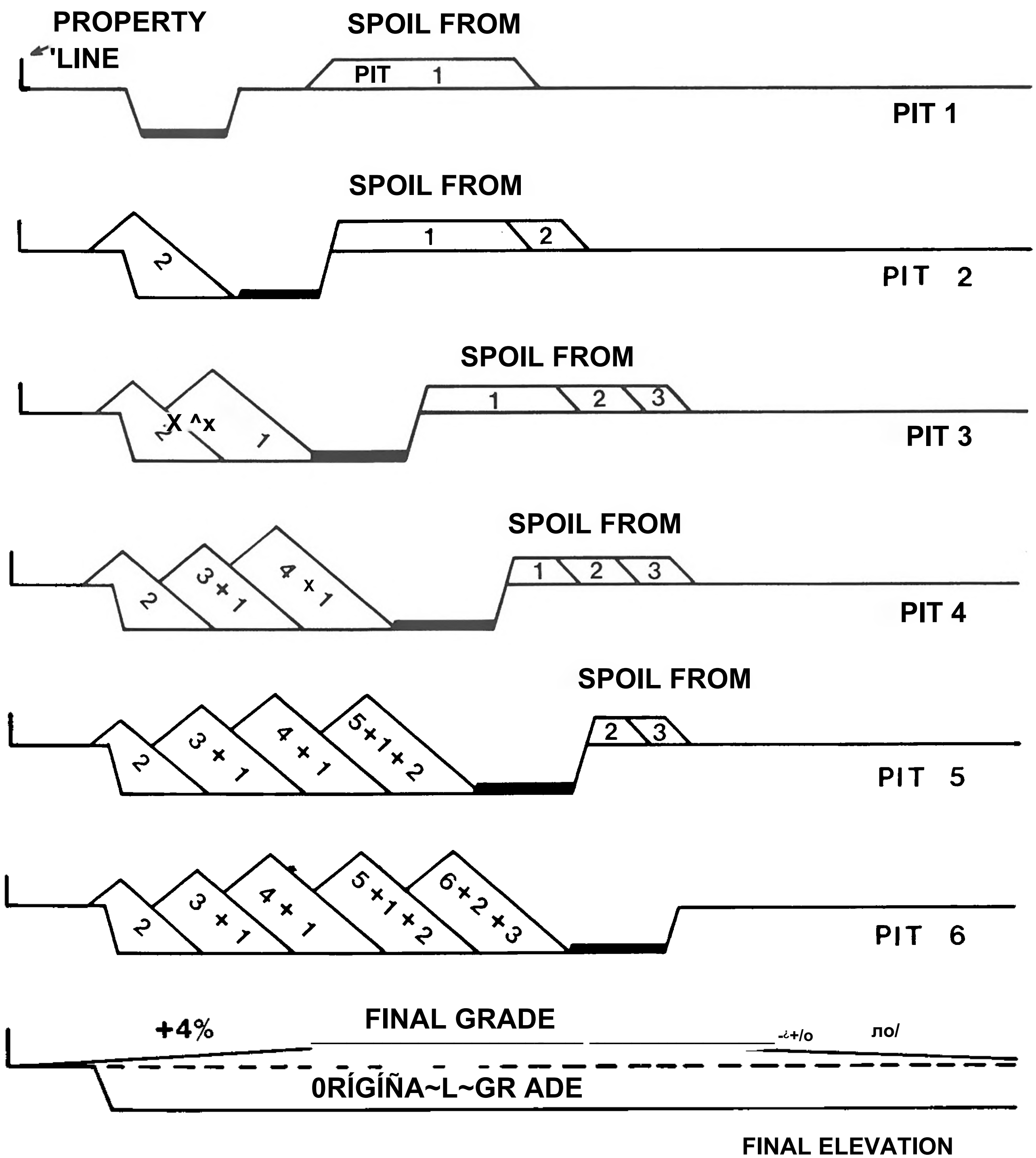


Figure 10. Strip Mining Soil Placement Design; From White, 1978.

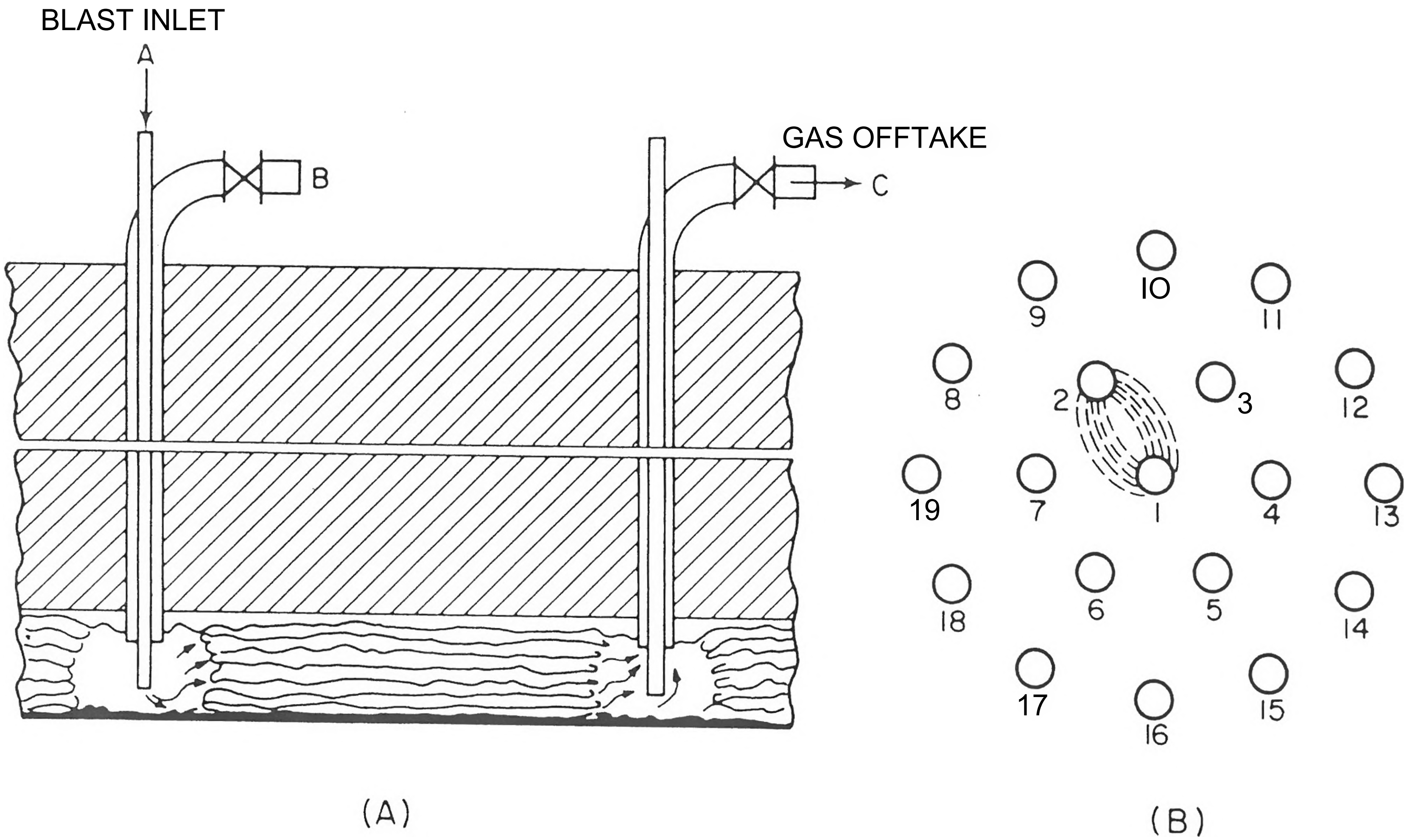


Figure 11. Cross Section (A) and Plan View (B) of an in Situ Gasification Process; From Edgar, 1978.

STRIPMINING RULES AND REGULATIONS

Environmental considerations necessitate establishment of regulations governing surface mining operations. The Mississippi Geological, Economic and Topographical Survey has been given the authority to provide and administer these guidelines. The Survey formulated the Mississippi Surface Mining and Reclamation Act which became effective April 15, 1978.

All lignite mining operations, regardless of size, must conform with the provisions of this Act. Lignite is classified as a Class I material. After the Survey accepts a Class I permit application, various state agencies receive a copy of it. The agencies then submit any comments, recommendations or evaluations of the operation to the Survey. The public is also allowed 30 days to make any similar statements.

Before a Class I permit is approved and issued, an initial site inspection of the affected area must be made and a public hearing must take place. If the operation complies with all requirements of the Act and any other state and federal laws, a permit for five years, will be approved. A temporary suspension of the mining operation, which remains in compliance with the Act, does not affect the effective life (five years) of the permit.

The operator and/or permittee must meet a number of requirements. These include establishment and maintenance of monthly records; providing the Survey with annual reports and certificates of compliance; installation, use and maintenance of monitoring equipment; and posting of signs with the operators name, address and permit number. The operator must have on file a current certificate of public liability insurance at the Survey. Permits may be transferred or renewed at the discretion of the Survey.

A performance bond is required for Class I mining operations. Its purpose is to insure that the operator satisfactorily performs all requirements of the Act. The bond must be no less than $500 and no more than $2500 per acre.

Certain land, such as ecologically sensitive areas, national monuments, and wildlife refuges, is designated as unsuitable for mining. The operator may petition the Survey to have this designation lifted.

Special rules and regulations may be issued by the Survey for any operation where the sole purpose is exploration. A written notice must be provided to the Survey before exploration begins. Extraction of material (lignite) must not exceed one acre and may be removed only for testing purposes. Lands affected by this exploration must be reclaimed according to the reclamation standards of this Act.

A reclamation plan, suitable for the mining area, must be presented to the Survey and soil and water conservation district(s) with a permit application. Where practical, reclamation must be performed concurrently with mining.

The Survey or its authorized representative has the right to inspect any mining operation a minimum of once annually. This includes photographing, taking samples, and inspecting any equipment, records, or grounds.

Any violations of the Act may result in cease and desist orders, action to revoke or suspend the permit, or other such action as deemed necessary.

CONCLUSIONS

Lignite is present throughout much of the Tertiary sequence in Mississippi, however, most is found in the Wilcox and Claiborne Groups. The Wilcox lignite is formed under fluvial and deltaic conditions and the Claiborne lignite is formed in a deltaic plain environment.

Seams are generally stacked and have lobate or linear geometries with limited lateral extent. Average thickness of the lignite is about five feet in the Wilcox Group. The Claiborne Group has undergone little testing so an accurate estimate of its lignite potential is not possible, however, it is known that the seams are thinner, smaller, and less widespread than those of the Wilcox Group.

Mississippi lignite contains from two to four percent sulphur which is generally considered to be a low to moderate level. Calorific values are approximately 5000 BTU/lb. when wet and 7000 to 11000 BTU/lb. when dehydrated. These are relatively low to moderate levels.

Moisture content is about 40 to 50 percent which is rather high. This increases any transportation costs. Ash contents are also high; on the average these are about 20 to 30 percent. Disposal of the ash is a major concern and the greater the ash content, the lower the calorific value.

Area stripping is the most economically feasible method of excavating this resource. Past experience proves that with proper planning and control, land reclamation can be successful.

The geometry of these lignite seams complicates mining and increases the cost. This coupled with relatively low BTU values in comparison to other coals and high reclamation costs, rule out the probability of anything other than in state use. A ”mine-mouth” operation, where lignite is converted into electrical power at the mine site seems to be one of the more practical applications of these deposits. Of course it has many potential uses but the practicality of these are unproven.

As long as large quantities of good quality bituminous coal are relatively inexpensive and readily available, the demand for Mississippi lignite as an energy resource may be minimal.

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