Smith County
Geology and Mineral Resources

EDWIN E. LUPER

RUNG ANGURAROHITA

WILBUR T. BAUGHMAN

BULLETIN 116

MISSISSIPPI GEOLOGICAL, ECONOMIC AND
TOPOGRAPHICAL SURVEY

WILLIAM HALSELL MOORE
Director and State Geologist

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LETTER OF TRANSMITTAL

Office of the Mississippi Geological, Economic and

Topographical Survey

Jackson, Mississippi

December 11, 1972

Mr. O. B. Curtis, Chairman, and

Members of the Board

Mississippi Geological, Economic and Topographical Survey

Gentlemen:

I am pleased to transmit to you Bulletin 116 of the Mississippi Geological Survey entitled, "Smith County Geology and Mineral Resources," by Edwin E. Luper and others.

Smith County is an important oil and bentonite producer and in addition has various other potentially valuable mineral resources. This Bulletin points out the location and size of these deposits and in addition gives an excellent treatment of the academic geology. Sections on water resources and ceramic properties of clays are included to give a comprehensive picture of the County's geology and mineral resources.

Respectfully,

William H. Moore

Director and State Geologist

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SMITH COUNTY GEOLOGY

Edwin E. Luper

ABSTRACT

Smith County is located in the south central section of Mississippi, lying within the parallels 31° 45′ and 32° 15′ north latitude and the meridians 89° 15′ and 89° 45′ west longitude. The area of the County is 642 square miles. The County lies within the Gulf Coastal Plain physiographic province and is further divided into three smaller units: the Jackson Prairie, the Vicksburg Hills and the Piney Woods. Raleigh is the County seat.

Stratigraphic units exposed are part of the Eocene, Oligocene and Miocene Series of the Tertiary System and Pleistocene and Recent Series of the Quaternary System. The units in ascending order are the Yazoo Formation of the Jackson Group of Eocene age; the Forest Hill Formation and the Vicksburg Group of Oligocene age; the Catahoula Formation and the Hattiesburg Formation of Miocene age; the Citronelle Formation and terrace deposits of Pleistocene age and alluvium of Recent age.

Determination of structure from the surface beds is inconclusive. Near-surface strata indicate a regional dip to the southwest of approximately 35 feet per mile. An anomalus area is indicated in the east central part of the County. Two shallow piercement type salt domes are present within the County.

Mineral resources of economic importance include clay and natural clay mixtures, sand, gravel, limestone, marl, bentonite, petroleum and salt.

INTRODUCTION

This report is a consumation of efforts in conducting a geological and hydrological investigation of Smith County, Mississippi. The purpose of the investigation was to determine the distribution, thickness and character of various geological units, appraise the known and potential mineral resources and study the surface and ground-water resources of the County.

Prior to the field work, a review and study of all the literature relating to the geologic conditions of Smith County and the surrounding area was made. This review was made in order to become familiar with all available previous information on Smith County in the broad fields of stratigraphic, structural, economic and hydrologic geology for the purposes of expediting the study and avoiding unnecessary work.

Field work commenced December 1, 1970. During the reconnaissance period elevations were established at prominent landmarks south of the 32°00′ latitude to the southern boundary of the County as there is no detailed topographic coverage on this part of the County. The first test hole was drilled on May 24, 1971, and the last test was completed on November 22, 1971. There was a total of 60 test holes drilled and cored in order to obtain stratigraphic, structural and hydrologic information, as well as collecting clay cores for various laboratory tests. The total footage drilled and cored was 11,106 feet. The Survey's Failing 1500 Holemaster rig was used to drill and core the 60 test holes and Widco 2-curve electrical logs were run on 44 of the test holes. The hydrological investigation consisted of securing chemical analyses of the water, running pumping tests and evaluating the aquifers in selecting wells and is included in the Water Resources section by Wilbur T. Baughman.

In addition to the information gathered by the Survey in the field, the core hole electrical logs of oil companies, oil tests, water well logs and logs furnished by the Water Resources Division of the U. S. Geological Survey furnished much valuable supplementary information.

PREVIOUS INVESTIGATIONS

Even though there has been no detailed geologic report published on Smith County, certain parts of the County have been studied: individual formations examined, fossil units and specific mineral resources investigated.

Wailes[1] in 1854, made reference to the fact that the "remains" of zeuglodons were frequently seen in the Jackson Prairie area of Smith County.

Hilgard[2], who wrote an excellent report on the geology and agriculture of the State of Mississippi in 1857, mentioned the zeuglodon bones being present in northern Smith County. He also states that "zeuglodon bones have been plowed up and washed out in gullies repeatedly". These zeuglodon beds are assigned to the Yazoo Formation of the Jackson Group. Mention is made of finding well-preserved Vicksburg fossils in a blue marl at Austin's Mill north of Raleigh. He also states that east of Raleigh, orange sand, outcrops of white friable sandstone and *Orbitoides* limestone can be seen on the slope of the valley at Shongelo Creek.

William N. Logan[3] in 1908 in his report of clays of Mississippi, mentions briefly the use of terrace clays in the operation of a small brick plant at Taylorsville, Mississippi. He also includes a chemical analysis of clay found on the Weatherly farm north of Taylorsville, Mississippi.

E. N. Lowe[4] in 1915 in his general geologic survey of the State, refers to two feet of lignite and fifteen feet of lignitic clay underlying the Vicksburg limestone at the "cave" near Sylvarena, Mississippi.

In 1916 William N. Logan[5] conducted an investigation of the marls and limestones of Mississippi. In this report he discusses briefly the distribution of the calcareous formations in the County and gives abbreviated chemical analyses of marl and limestone from three different localities.

Stephenson[6] and others in 1928 in cooperation with the Mississippi Geological Survey, published a paper on the groundwater resources of Mississippi. In this report a general description is given of six wells in Smith County.

Harry X. Bay[7] in 1935 compiled a report on the bleaching clays of Mississippi in which he listed areas where bentonite was known to be present in Smith County, described two typical sections, and gave tables showing bleach ratings of the various deposits.

Frederick F. Mellen[8] in 1942 stated in his report on Mississippi agricultural limestone, that an area near Sylvarena, Mississippi had a sufficient quantity of Vicksburg limestone and marl with an adequate amount of calcium carbonate to warrant commercial development of a lime plant. He also included a table showing the percentages of $CaCO_3$ and thicknesses of nine samples of limestone from three localities in Smith County.

In 1950 the Survey, in cooperation with the U. S. Geological Survey, Water Resources Division, published a report of the Surface Water of Mississippi in which pertient data of various streams of the County were given.

Henry N. Toler[9] in 1963 conducted an investigation for the U. S. Department of Commerce in an area north of Sylvarena, Mississippi. The object of this study was to determine the amount of raw material available for the operation of a cement plant in this area. This was authorized under the Area Redevelopment Administration program and about 30 bound copies of the report were distributed by Mid-Mississippi Development District, the principal sponsoring agency.

DESCRIPTION OF THE AREA

Location and Size

Smith County is located in the south central section of Mississippi. It is bounded on the north by Scott County, on the south by Covington and Jones Counties, on the west by

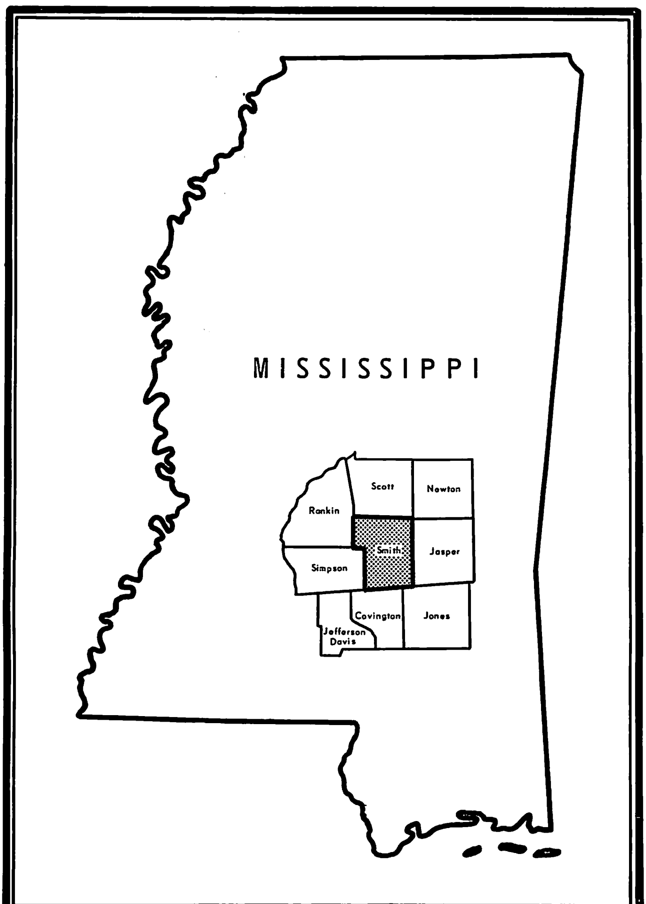

Figure 1.—Location of Smith County.

Rankin and Simpson Counties and on the east by Jasper County. The County has a maximum east-west extent of 24 miles and a maximum north-south extent of 30 miles. The area of the County is 642 square miles or 410,880 acres. Raleigh is the County seat and is located near the center of the County.

POPULATION

The 1970 census shows a population of 13,561 for Smith County. This is a decrease of 5.2 per cent from the 1960 census. Of the total 76.8 per cent are white and 23.2 per cent are black.

The population density for the County is 21.1 persons per square mile and many areas of the County are almost uninhabited.

Incorporated towns in the County are Mize (pop. 372), Raleigh (pop. 1,018) and Taylorsville (pop. 1,299). Small villages and communities shown on the general highway map are Burns, Lemon, Lorena, Pineville, Polkville, Summerland, Sylvarena, Trenton and White Oak.

CLIMATE

Smith County climatological data were compiled from U. S. Weather Bureau reports for a period of ten years from May 1, 1962, through April 30, 1972, and are shown on Table 1. Temperature readings were taken from a reporting station at Bay Springs, Jasper County, Mississippi, as there is no station reporting temperature in Smith County. Precipitation measurements were obtained from a reporting station at Mize, Mississippi. The average summer temperature in the 10-year period was 79.5°, average winter temperature 47.7°, and the average annual temperature was 64.1°. It is unusual that the coldest as well as the hottest temperature was recorded in the same year. On January 24, 1963, a reading of 4° was recorded and on June 13, 1963, a reading of 105° was noted. Precipitation is more abundant in the winter season and scarcer in fall months. The greatest amount of precipitation in one month was measured in February 1966, with a total of 11.35 inches recorded. The driest month

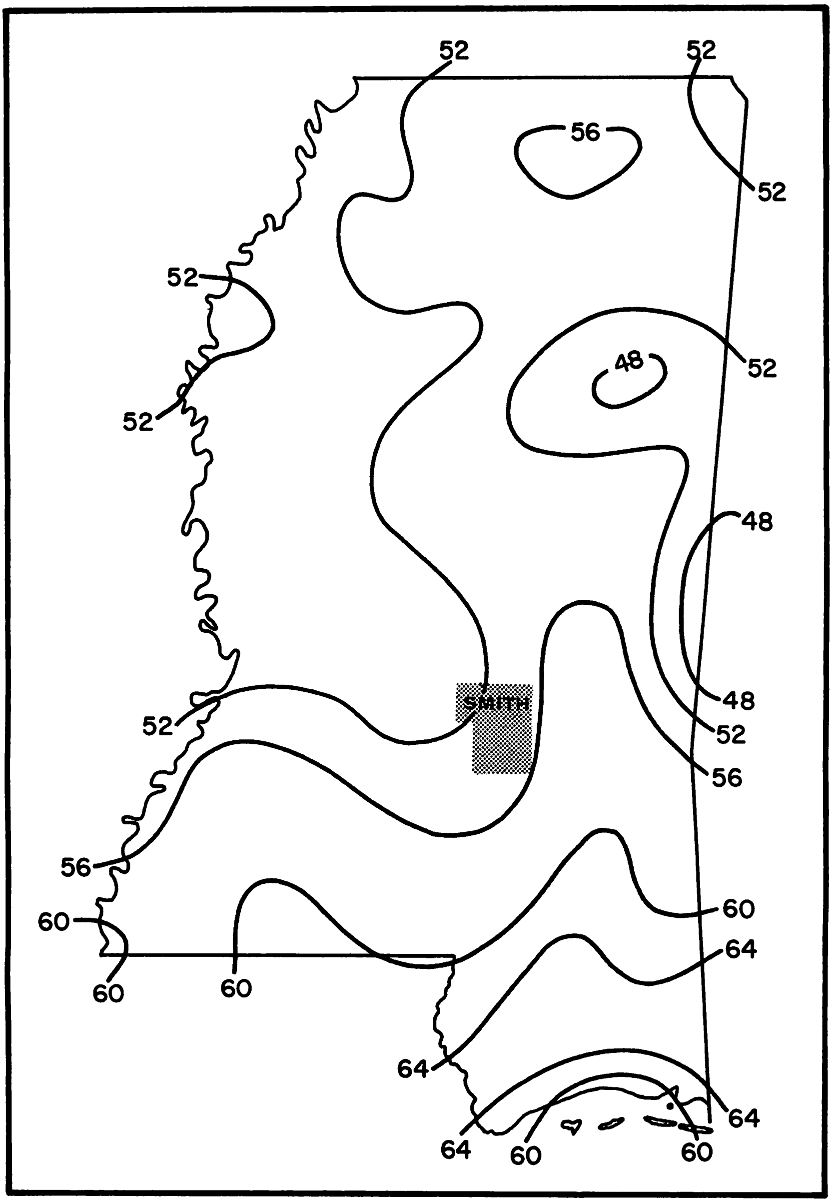

Figure 2.—Mean annual precipitation, in inches. From U. S. Weather Bureau, 1959, "Climate of the States." Based on 25 year period 1931-55. Smith County shown as stipled area.

Table 1

Normal, Monthly, Seasonal, and Annual Temperature and Precipitation in Smith County, Mississippi *

MONTH	TEMPERATURE			PRECIPITATION		
	Average	Absolute Maximum	Absolute Minimum	Average	Absolute Maximum	Absolute Minimum
	F°	F°	F°	inches	inches	inches
December	49.4	82	5	6.43	11.15	2.58
January	45.3	79	4	4.53	8.78	1.00
February	48.3	79	13	5.08	11.35	3.32
Winter	47.7	82	4	16.04	22.61	10.97
March	54.8	87	20	4.66	8.69	1.44
April	65.9	94	31	5.14	11.30	.36
May	72.0	96	39	3.52	7.54	.28
Spring	64.2	96	20	13.32	15.35	4.80
June	78.5	105	51	3.30	5.95	.32
July	80.8	101	54	4.19	9.12	2.26
August	79.3	100	56	3.95	5.97	1.68
Summer	79.5	105	51	11.44	14.75	4.73
September	74.5	97	36	3.04	5.15	.54
October	65.2	92	31	2.93	8.58	.25
November	55.6	83	18	2.87	6.64	.71
Fall	65.1	97	18	8.84	15.41	3.12
Year	64.1	105	4	49.64	68.23	36.43

* Average temperature and precipitation based on a 10-year record; compiled from available recordings in U. S. Department of Commerce, Weather Bureau, "Climatological Data," May 1962 through April 1972.

was October 1971, when .25 inch was measured. The average annual precipitation, in the 10-year period mentioned above, was 49.64 inches. The mean annual precipitation, based on a 25-year period from 1931-55, is 54 inches, as shown on Figure 2. In winter, snowfall and below freezing temperatures are rare, and temperatures near 100 degrees are fairly common in the summer months.

CULTURE AND INDUSTRY

The 1970 census shows a total employed labor force for Smith County of 4576. This number is made of 2860 males and 1716 females.

The entire county is classified as rural, and 811 persons are employed in agriculture. A large segment of the working force is self-employed in service oriented business.

The principle sources of farm income are livestock, poultry, and dairying, with some cotton and grain crops. Lumbering and pulpwood cutting is an important industry in the County although most lumbering operations are rather small. Seventeen per cent of the County or 69,913 acres are in the Bienville National Forest.

There are thirteen manufacturing plants in the County. These plants are located in the towns of Mize, Raleigh and Taylorsville. A variety of products are produced by these plants, such as specialized lumber products, men's, women's and children's clothing, specialized signs, meat products, galvanized and electroplated metal products and molds and dies. The industries related to mineral products will be discussed in the section on Economic Geology.

ACCESSIBILITY

Federal highways cross no portion of Smith County but a number of State highways and hard-surfaced County roads make most of the County accessible in all weather.

State Highway 35 traverses the County from north to south slightly to the west of the center of the County passing through the towns of Raleigh and Mize. State Highway 18 croses the County from east to west in central Smith County passing through Raleigh. State Highway 28 serves the southernmost portion of the County. This east-west highway passes through Taylorsville and Mize.

County Highways 481 and 501 serve the northern portion of the County, and the southern portion is served by County Highways 37 and 531. Numerous gravel and sand topped roads give access to more remote areas in the County.

A short line of the Illinois Central Railroad crosses the southern portion of the County passing through Mize and Taylorsville and connecting these towns with the Illinois Central mainline to the west and the town of Laurel to the southeast in Jones County.

The County has a 2200 foot private airstrip approximately 2 miles southwest of Taylorsville.

PHYSIOGRAPHY

Mississippi is located in the Gulf Coastal Plain of North America. The State is divided into 12 physiographic provinces, as designated by Priddy[10], with three of the provinces being found in Smith County.

The northeast corner of the County lies in the Jackson Prairie province and embraces approximately 1½ townships. This surface is underlain by the extensive Yazoo Clay. This belt extends from a point five miles east of Pineville on the Jasper-Smith County line in a generally northwesterly direction to a point 1½ miles southwest of Homewood at the Smith-Scott County line. The terrain is gently rolling with very few high hills.

South and southwest of the Jackson Prairie belt is an area originally designated by Lowe[11] as the Long Leaf Pine Hills. Priddy[12] later divided this province into three separate units. Two of these units occupy the remainder of the County. The Vicksburg Hills area is characterized at its northeast boundary by a rather steep slope near the contact of the Forest Hill and Yazoo Formations. To the southeast there are gentle slopes over the Forest Hill outcrops and overlying Vicksburg Group.

The Piney Woods belt is the third physiographic province in the County. A large part of this area is characterized by gently rolling hills, however there are some high ridges capped with terrace or Citronelle deposits.

TOPOGRAPHY

The topography of Smith County is varied with upland areas, rolling hills and some broad lowland areas. A prominent ridge extends through the central part of the County in a north-south direction and traverses almost the entire length of the County. This is a fairly narrow ridge in the northern part of the County, but becomes broader and splits into three ridges south of Raleigh. Elevations along this upland area vary from 350 feet to 600 feet near Lemon. This ridge forms the divide between Oakohay (pronounced "Cohay" locally) Creek and Leaf River drainage basins. It is on this ridge that the town of Raleigh is located and State Highway 35 was constructed. Another prominent ridge is located in the western part of the County, extending in a north-south direction for a distance of approximately 12 miles. Elevations along this ridge range from 400 feet to more than 600 feet. The highest elevation in the County is 605 feet and is located in Sec. 13, T. 3 N., R. 6 E., near the northern end of this narrow divide. This area is locally called "Heater Ridge". In southeastern Smith County a ridge extends from a point near the Jasper-Smith County line, approximately four miles southwest of Bay Springs in a southwesterly direction to a point approximately four miles northeast of Taylorsville. This is a rather broad divide covered with a thick mantle of terrace sands. Elevations range from 350 feet to 530 feet above sea level.

The rolling hills area is located in the southern and south central part of Smith County, except where interrupted by the ridges mentioned above. This surface is underlain by the Catahoula Formation of the Miocene Series.

The broad lowlands are made up of the alluvial plains of the Strong and Leaf Rivers as well as along the larger creeks in the County. The broadest plain is probably along the Strong River where it reaches a maximum width of approximately 2½ miles. The lowlands along Oakohay and West Tallahala Creeks

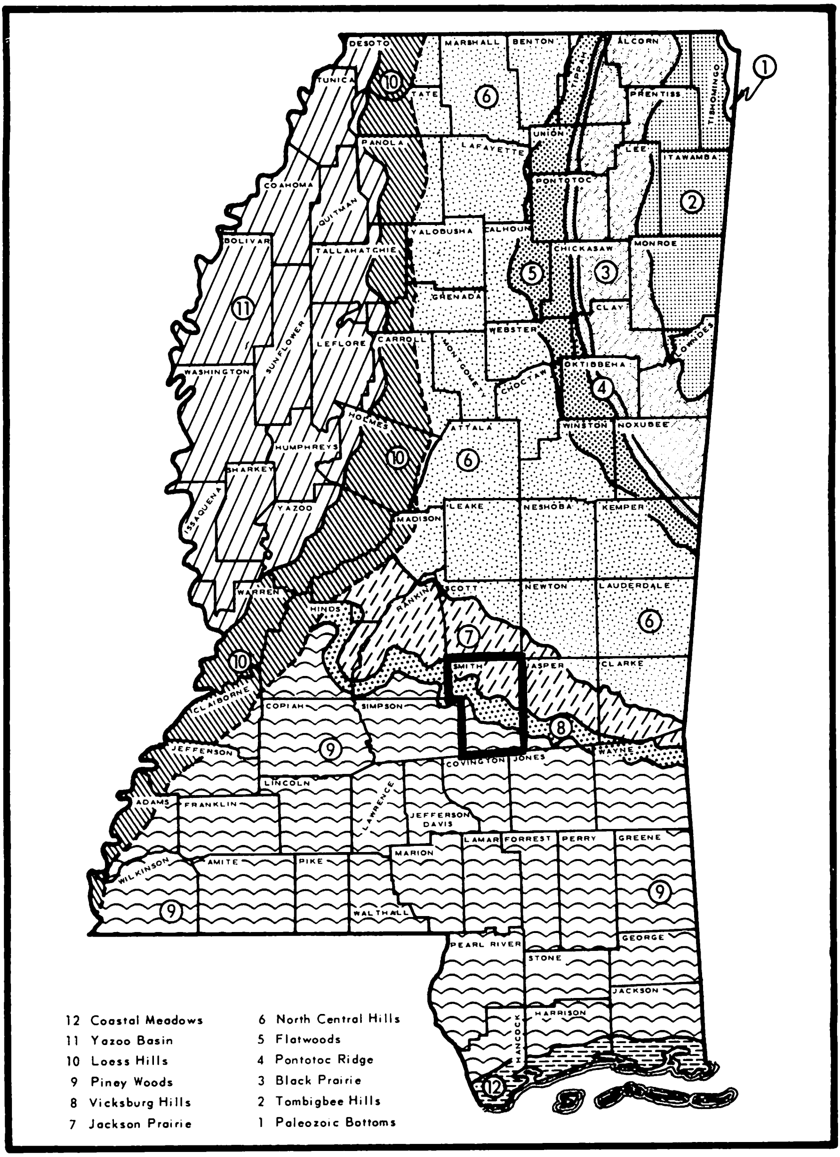

Figure 3.—Map showing physiographic provinces of Mississippi. After R. R. Priddy.

have maximum widths of approximately 1½ miles. The greatest relief in the County is along "Heater Ridge", where 200 feet is common. The lowest point is in the alluvial plain of Leaf River east of Taylorsville where an elevation of 250 feet was recorded in several places.

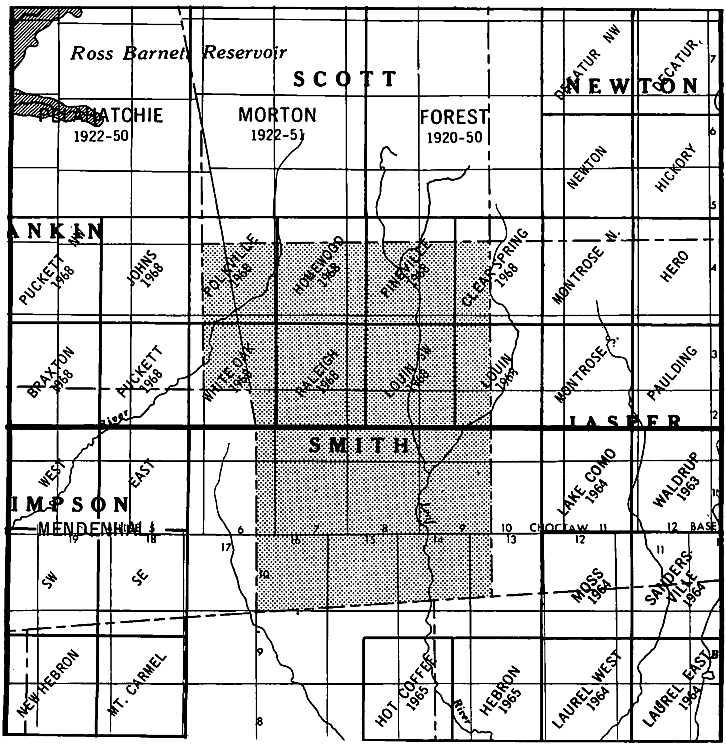

Figure 4.—Topographic map coverage of Smith County.

Surface work in the south half of Smith County was hindered because of the lack of topographic maps suitable for field work. The only map available was one on a scale of 1:250,000 with a contour interval of 50 feet. Efforts are being made to have the U. S. Geological Survey map this area in more detail as soon as possible. The northern half of the County has complete coverage, as shown in Figure 4.

The dates following the name of the maps indicate the year the mapping was completed. The 7.5 minute maps used were Polkville, 1968; Homewood, 1968; Pineville, 1968; Clear Springs, 1968; White Oak, 1968; Raleigh, 1968; Louin SW, 1968; and Louin, 1968. The 7.5 minute maps have a scale of 1:24,000 or 1″ = 2000′ and a contour interval of 10 feet. The topographic map is a very useful tool for the field geologist. It enables him to get a general idea of the topography of an area, gives indications as to where outcrops may be found, and can assist in accurate determination of the elevation and location of prominent physical features as well as of core holes and test holes.

The office of the Mississippi Geological Survey maintains a complete stock of all available topographic maps of Mississippi. These maps may be purchased at a nominal cost to the public by contacting the offices of the Survey by telephone or by mail.

DRAINAGE

Smith County has three major drainage basins and two minor drainage areas. The three major basins are the Leaf River, Oakohay Creek and Strong River. Leaf River and its tributaries drain approximately 46 per cent or 294 square miles of the County. Oakohay Creek and its tributaries drain approximately 31 per cent or 202 square miles of the west central part of Smith County. The northwest corner of the County is drained by the Strong River and its tributaries and accounts for an estimated 88 square miles or 13 per cent of the area under study. The remaining 10 per cent of the area of drainage lies within the two minor drainage areas mentioned above. The larger of the two is located in the southeast corner of the County, and the streams are tributaries of the Big Creek drainage basin that occupies northwestern Jones County. The remaining minor drainage area is in the southwest corner of the County and is part of the Okatoma Creek drainage basin.

Headwaters of the Leaf River form in southeastern Scott County approximately 12 miles north of Pineville with the river flowing in a southerly direction through the central part of the eastern half of Smith County. Principal tributaries on the east side of the river are the Ichusa, West Tallahala and Keys Mill Creeks. On the west side the principal tributaries are the Tallabogue, Tishkill, Shongelo and Fisher Creeks. There are numerous small creeks and branches that feed into these principal tributaries as well as directly into Leaf River.

Oakohay Creek's headwaters form in extreme south-central Scott County, approximately three miles north of Lorena. It flows in a southwesterly to southerly direction changing to a southeasterly course four miles north of Mize and maintaining this direction throughout the remainder of the County. Principal tributaries on the east side of the river are the Yellow Bill, Beaver, Ely and Dry Branch Creeks. Main west side tributaries are the Little Oakohay, Clear, Hatchapaloo, Little Hatchapaloo and Sullivan's Hollow Creeks.

Headwaters of Strong River originate in west-central Scott County about three miles east of Morton. The stream flows in a southwesterly direction across the northwest corner of Smith County. Caney, Beech, Old Field, Jump and White Oak Creeks are the principal tributaries that flow to the northwest into Strong River. The principal tributaries that empty into the stream from the northwest are the Line, Raspberry and Purvis Creeks.

SURFACE STRATIGRAPHY

General Statement

The strata observed at the surface in Smith County are the upper Eocene, Oligocene and Miocene Series of the Tertiary System and the Pleistocene and Recent of the Quarternary System. Figure 5 is a generalized section of the exposed strata in the County. The Geologic Map of Smith County (Plate 1) shows the areal distribution of the various stratigraphic units.

The sediments in Smith County were deposited in both marine and non-marine environments, consequently there have been several transgressions and regressions of ancient seas. Various lithologies such as clay, silt, sand, sandstone, marl, limestone and siltstone are found in the stratigraphic column. The oldest strata crop out in the northeastern part of Smith County, and the dip of the exposed strata is southwest and south. The youngest bedrock sediments are found in the southwestern part

SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT	THICKNESS	LITHOLOGIC CHARACTER
QUATERNARY	RECENT		Alluvium	0–40'	Sand, fine- to coarse-grained, silt, clay, some organic material, gravel.
	PLEISTOCENE		Terrace deposits	0–158'	Sand, light-tan to buff, fine- to coarse-grained. Gravel, chert and quartz, with scattered clay lenses.
			Citronelle Formation	0–135'	Sand, red to reddish-orange, fine- to coarse-grained. Gravel, chert and quartz, with scattered clay lenses.
TERTIARY	MIOCENE		Hattiesburg Formation	Up to 90'	Clay, tan, gray to reddish-gray, sandy in part, abundant ferruginous concretions, minor amount of gray to tan, fine- to medium-grained sand.
			Catahoula Formation	Up to 550'	Sand, gray, tan to buff, kaolinitic, silty, locally indurated, forming sandstone, fine- to medium-grained. Clay, gray, buff to light-tan, maroon. Silt, light-gray, white to tan, kaolinitic, locally indurated.
	OLIGOCENE	VICKSBURG	Bucatunna Clay	24'–84'	Clay, dark-gray to black, micaceous, sparingly fossiliferous, silty, finely carbonaceous, chocolate-brown on outcrop.
			Byram Marl	5'–22'	Marl, greenish-gray, glauconitic, fossiliferous, clayey.
			Glendon Limestone	15'–59'	Limestone, gray to light-gray, fossiliferous, slightly sandy with alternating beds of gray, fossiliferous marl.
			Mint Spring Marl	5'–23'	Marl, greenish-gray, sandy to very sandy, glauconitic, fossiliferous, pyritic. Sand is medium- to coarse-grained.
			Forest Hill Formation	97'–164'	Sand, gray to light-gray, fine-grained, silty, micaceous. Clay, dark-gray, carbonaceous, silty, thin beds of lignite.
	EOCENE	JACKSON	Yazoo Formation	200'–329'	Clay, blue-gray to light-olive-gray, fossiliferous, calcareous, weathers to pale-orange and gray mottled color.

Figure 5.—Generalized section of exposed strata in Smith County.

of the area. The total thickness of the exposed section is about 1350 feet. Figure 6 shows the test holes drilled and cored in preparation for this report.

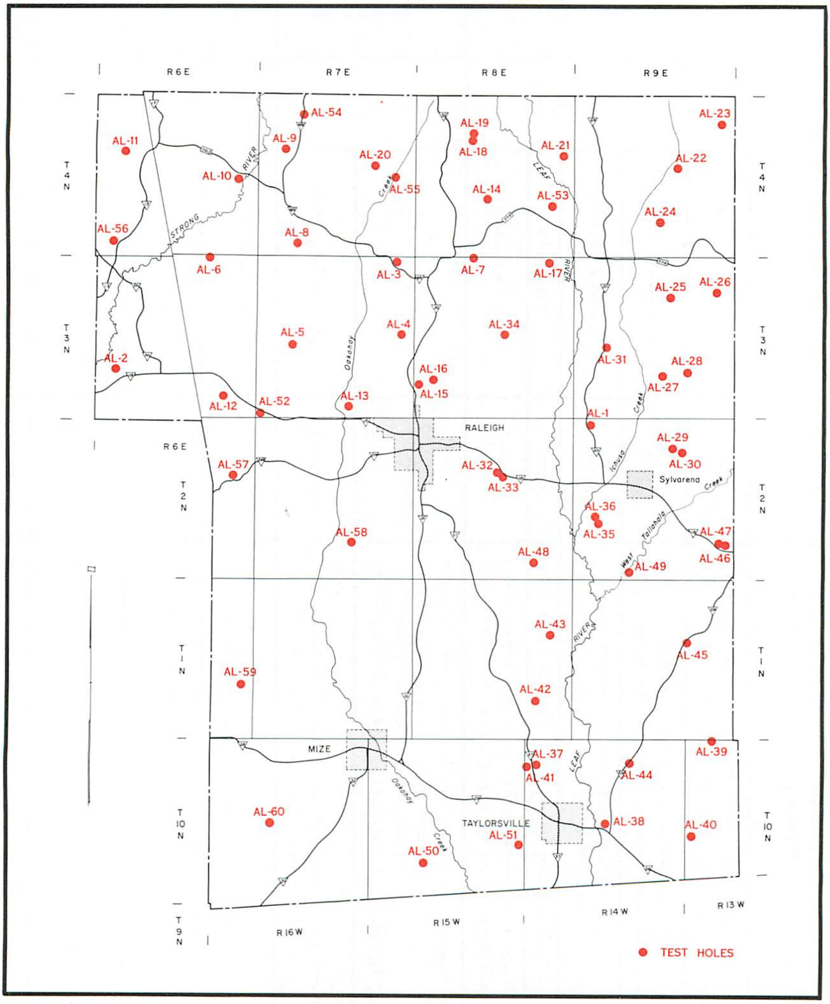

Figure 6.—Locations of test holes in Smith County.

EOCENE SERIES

YAZOO FORMATION

The term Yazoo Clay Marl first appeared in geologic literature in 1915, when Lowe[13] described the uppermost part of the Jackson Group exposed in the bluffs of the Yazoo River at Yazoo City, Mississippi. In 1918 Cooke[14] dropped Marl and referred to the sediments as the Yazoo Clay Member of the Jackson Formation. Murray[15] in 1943 divided the Yazoo into four lithologic units which cannot be recognized on the surface or subsurface of Smith County. Devries[16] in his report on Jasper County, referred to the Yazoo as a formation. Moore[17] in 1965 stated that many geologists thought of the Yazoo as a formation.

The Yazoo outcrop belt occupies approximately one and one-half townships in the northeast corner of the County. It has, more or less, a triangular-shaped outcrop pattern with Scott County bordering on the north, Jasper County bordering on the east, and the contact with the Forest Hill bordering on the south and southwest. The terrain is relatively flat to gently rolling, giving rise to the use of the terms "flatwoods" and "prairie."

The lithology of the unweathered Yazoo Clay in Smith County includes blue-gray to light olive-gray, calcareous to noncalcareous, fossiliferous, glauconitic, silty clays. The weathered zone has a pale-orange and gray mottled appearance and is usually very blocky and crumbly. Weathering penetrates 25 to 30 feet below the surface and in some localities the zone is noncalcareous, particularly near the top of the zone. Selenite crystals are sometimes found in the outcrop of the Yazoo Clay along the jointing planes and are commonly stained with limonite. The unweathered clay is fossiliferous to very fossiliferous in most of the section, denoting a marine environment of deposition. Numerous species of microfossils have been identified in the Yazoo Clay along the outcrop belt across the State. Huff[18] described 107 species of ostracods and mentioned many foraminifera in his report on the Jackson Eocene, published in 1970. Fragments of pelecypods and gastropods are found throughout the Yazoo Clay in Smith County. *Basilosaurus cetoides*, a large

Figure 7.—Weathered Yazoo Clay in channel of Leaf River. Location in N.E.¼, NE.¼, NE.¼, Sec. 36, T. 4 N., R. 8 E. March 1971.

whale-like mammal, is probably the best known fossil from the Yazoo Clay. Hilgard[19] reported remains of this animal being found in northern Smith County.

The normal thickness of the Yazoo Clay in Smith County is 300 feet, however only about 10 feet are exposed in the study area. There is a surprising uniformity in thickness of the interval throughout the County except near the two shallow piercement-type salt domes. In Sec. 5, T. 10 N., R. 13 W., near the crest of the New Home salt dome 202 feet of Yazoo was penetrated in an exploratory test for sulphur. Hole AL-19, located in Sec. 9, T. 4 N., R. 8 E., had 319 feet of Yazoo Clay which represented the entire thickness of the formation. The only other test which penetrated the entire Yazoo was AL-9, located in Sec. 17, T. 4 N., R. 7 E. There was 329 feet of Yazoo present in this hole. The normal thickness of the Yazoo was determined from oil well tests, water well logs and core hole logs.

The base of the Yazoo Clay is placed at the first evidence of green, glauconitic, fossiliferous sand of the Moodys Branch Formation. The Moodys Branch is overlain conformably by the Yazoo. The contact is gradational as minor amounts of glauconite and sand are found in the lower part of the Yazoo. The base of the Yazoo Clay is readily apparent on electrical logs due to the electrical response of the top of the Moodys Branch Formation on the self-potential and resistivity curves.

The upper limit of the Yazoo is placed at the contact of the pale-green to greenish-gray, calcareous to non-calcareous, fossiliferous clay with the overlying silty carbonaceous clay and fine-grained, micaceous, silty sand of the Forest Hill Formation.

Unweathered outcrops of the Yazoo Clay are scarce in Smith County, but a few weathered exposures can be found in the outcrop belt. In Sec. 36, T. 4 N., R. 8 E., where Forest Road 504 crosses Leaf River, the Yazoo is exposed in the channel of the River (Figure 7). This exposure is more extensive during the drier months of the year. The clay is overlain by approximately 6 to 8 feet of alluvium. In Sec. 28, T. 4 N., R. 9 E., a good exposure of weathered clay can be seen in the channel of Ichusa Creek where a county road bridge crosses the Creek in the southwestern part of the section.

Lithologic descriptions of all or part of the Yazoo Clay can be found in the records of Test Holes AL-3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 32, 34, 35, 47, 49, 53.

OLIGOCENE SERIES

FOREST HILL FORMATION

The term Forest Hill Sand first appeared in geologic literature in 1918 when Cooke[20] proposed the name to replace the Madison Sands mentioned by Lowe[21] for beds lying between the Jackson Group and the overlying Vicksburg Marls. Mellen[22] in 1940 assigned the Forest Hill to a member status in the Jackson Formation. MacNeil[23] stated that the Forest Hill Sand is believed to be Oligocene and placed the area of transition between the Forest Hill and Red Bluff in eastern Jasper County. It is the writer's opinion that the Red Bluff Formation interfingers with the Forest Hill in Jasper County and may extend into extreme eastern Smith County, but none of the test holes drilled in the eastern part of the County had sediments that could be definitely identified as Red Bluff. For the purpose of this report, the beds lying between the Jackson Group and Vicksburg Group are considered Forest Hill of Oligocene age.

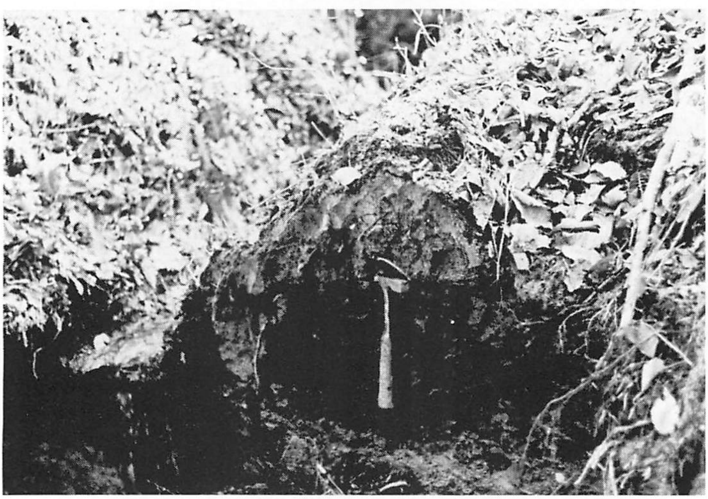

Figure 8.—Dark-brown, carbonaceous Forest Hill clay exposed along a tributary of Leaf River. Location in SE.¼, NW.¼, SE.¼, Sec. 12, T. 2 N., R. 8 E. February 1971.

The Forest Hill outcrop belt occupies a rather large band in a general northwest-southeast direction across Smith County. The widest area of outcrop is along the lower part of a ridge immediately east of Leaf River and north of Highway 18, extending in a northerly direction to Pineville and continuing along the ridge upon which Highway 501 is constructed to a point about one mile south of the Scott-Smith County boundary. Much of the area is covered with alluvium and low-lying terraces, but there are localities where good exposures can be observed.

The weathered sediments of the Forest Hill in Smith County are fine-grained micaceous sand and silty clay. The sand is typically gray and buff to yellow, and the clay is gray to reddish-gray, pink, or buff. Thin beds of lignite and lignitic sands as well as carbonaceous clays, are found in the outcrop belt. Figure 8 shows a bed of drak-brown carbonaceous clay about 16 inches thick exposed along a small tributary of Leaf River in Sec. 12, T. 2 N., R. 8 E. Most of the Forest Hill outcrops observed in Smith County are thin-bedded, as shown in Figures 9 and 10. Figure 9 is near the base of the Forest Hill and located in Sec. 14, T. 4 N., R. 8 E. Figure 10 is in the upper Forest Hill near the contact with the overlying Mint Spring Marl and is located along a county road, west of Highway 501 in Sec. 30, T. 3 N., R. 9 E. Leaf imprints were found along the bedding planes of the sandy clays. One leaf imprint found in an outcrop of carbonaceous clay was five inches long and two and one-half inches in width. Pieces of petrified wood were found at several of the Forest Hill outcrops. The unweathered Forest Hill consists of gray to light-gray fine-grained silty micaceous sand and gray to dark-gray carbonaceous clay. Lignite is present in the subsurface Forest Hill, but most beds are thin.

The thickness of the Forest Hill Formation where overlain by the Mint Spring varies from 97 feet to 164 feet. The Forest Hill appears to thin from east to west. Test Hole AL-47 located in Sec. 25, T. 2 N., R. 9 E., near the Jasper County line, had 164 feet of Forest Hill, while AL-6, located in Sec. 2, T. 3 N., R. 6 E., had 97 feet of Forest Hill sediments. Northeast of Lorena in Sec. 11, T. 4 N., R. 8 E., the Forest Hill is approximately 10 feet thick in Test Hole AL-19. This is the thinnest section penetrated in the outcrop belt. The normal thickness of the Forest Hill in the subsurface of Smith County is considered to be 126 feet.

The basal contact of the Forest Hill with the Yazoo Clay is reasonably easy to determine from the contrasting lithology of the sections. The base of the Forest Hill is predominately gray, to dark-gray carbonaceous clay with minor amounts of fine-grained sand and lignite. This lithology suggests a deltaic-type deposition. The top of the Yazoo is mainly fossiliferous, calcareous blue-gray clay indicating a marine depositional environment. On the basis of this evidence, and unconformable relationship exists between the Forest Hill and Yazoo.

Figure 9.—Thin-bedded sand and clay in basal Forest Hill Formation exposed in roadcut of primitive trail. Location in SE. ¼, SE. ¼, SW. ¼, Sec. 14, T. 4 N., R. 8 E. February 1971.

Several outcrops of Forest Hill were observed in the study area other than the ones mentioned previously and are listed below:

(1) in south roadcut of east-west county road just east of intersection with State Highway 481 in NW. ¼, SW. ¼, Sec. 20, T. 3 N., R. 7 E., where 6 feet of thin-bedded gray and red mottled clay and fine-grained silty gray sand are exposed;

(2) in east and west roadcuts of north-south asphalt county road located in NW. ¼, NE. ¼, Sec. 4, T. 4 N., R. 8 E., where approximately 8 feet of thin-bedded very silty fine-grained buff to gray, sand and gray to buff sandy clay, with small leaf imprints in bedding planes cropout. Outcrop is near concealed contact with the Mint Spring;

(3) in ditch on southwest side of asphalt county road in SE. ¼, SE. ¼, Sec. 14, T. 3 N., R. 9 E., where chocolate-brown clays with leaf imprints and bits of petrified wood are exposed, and where the large leaf mentioned previously, was found;

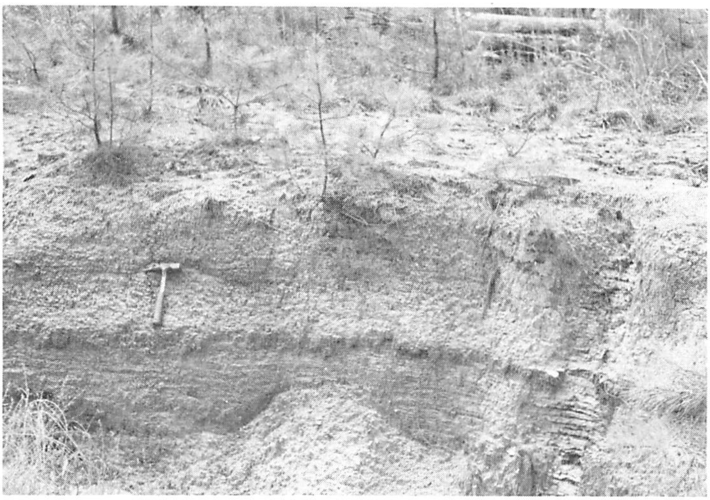

Figure 10.—Thin-bedded Forest Hill sand and clay in south roadcut along gravel county road. Exposure near the top of Forest Hill Formation. Location in NW.¼, SE.¼, SW.¼, Sec. 30, T. 3 N., R. 9 E. January 1971.

(4) in roadcut on southwest side of gravel road in SW. ¼, SE. ¼, Sec. 9, T. 3 N., R. 9 E., where a thin bed of dark-brown laminated lignitic sand is exposed.

Thirteen test holes penetrated full sections of Forest Hill, and lithologic descriptions can be found in the records of AL-4, 5, 6, 7, 8, 12, 13, 47, 49, 30, 31, 32, 34.

OLIGOCENE SERIES

Vicksburg Group

Conrad[24] in 1848 introduced the term Vicksburg Group and placed it in the upper Eocene. At that time the Tertiary had been divided into only three subdivisions (Eocene, Miocene and Pliocene) by Sir Charles Lyell[25]. In 1854, E. Beyrich[26], recognizing a need for a new name for a series of beds that were called upper Eocene by some geologists and lower Miocene by others, proposed the term Oligocene.

The Vicksburg Group is considered to be a rock-stratigraphic unit for the purpose of this report. A rock-stratigraphic unit as defined by the Code of Stratigraphic Nomenclature[27], "is a subdivision of the rocks in the earth's crust distinguished and delimited on the basis of lithologic characteristics." The Vicksburg Group consists of marine units of limestone, marl and clay, and includes in ascending order the Mint Spring Marl, the Glendon Limestone, the Byram Marl and the Bucatunna Clay. On the Geologic Map of the County (Plate 1) the Vicksburg Group is mapped as one unit.

The outcrop belt of the Vicksburg Group extends in a generally southeast-northwest direction except near the western boundary of the County. Here, the outcrop pattern assumes an east-west direction. To the north of the general outcrop pattern there are several outliers of Vicksburg sediments overlying the Forest Hill. The widest outcrop of the Vicksburg Group is in the east central part of the County extending from a point about one mile south of the confluence of West Tallahala Creek and Leaf River to a point approximately two miles northwest of Ted. A large part of this outcrop is covered with Citronelle, alluvium and other surficial material as well as scattered outliers of the Catahoula Formation.

Six test holes penetrated the entire Vicksburg section in Smith County. The maximum thickness was 120 feet in test hole AL-13. The minimum thickness was in test hole AL-2 and had 75 feet of Vicksburg sediments. It appears the normal thickness of the Vicksburg Group in the test holes drilled is 100 feet. The Vicksburg thickens downdip and the normal thickness is thicker in the southern part of the County.

Mint Spring Marl

The oldest unit in the Vicksburg Group is the Mint Spring Marl named by C. W. Cooke[28] in 1918 for the glauconitic sand and marl exposed below a waterfall on Mint Spring Bayou at the National Cemetery, Vicksburg, Mississippi. This is the type locality of this stratigraphic unit and is located in Sec. 12, T. 16 N., R. 3 E., Warren County, Mississippi.

Exposures of Mint Spring beds in Smith County are rare because the unit is fairly thin. As a consequence it is not exposed in very wide belts or areas. In the weathered state it is typically a reddish-brown, sparsely glauconitic sand. The presence of macrofossils in the Mint Spring on the outcrop is rare due to complete weathering. The Mint Spring in the subsurface is composed of greenish-gray, fossiliferous, glauconitic, pyritic, sandy marl and greenish-gray, medium- to coarse-grained, glauconitic, fossiliferous sand. In most every test hole microfossils were present in samples from the Mint Spring. Cushman[29] identified thirty-eight species of foraminifera from the Mint Spring at a collecting site in Sec. 13, T. 2 N., R. 8 E., Smith County, Mississippi. This site is along the east bluff of Leaf River and is near what was formerly called "Brown's Cave." This collection was made in 1921 and efforts to find this outcrop were unsuccessful.

Figure 11.—Fossiliferous and glauconitic Mint Spring marl exposed in channel of Ichusa Creek. Location in S.¼, SE.¼, SW.¼, Sec. 19, T. 2 N., R. 9 E. January 1971.

The thickness of the Mint Spring varies from five feet in test hole AL-30 to twenty-three feet in test hole AL-8. The average thickness of this stratigraphic unit in the test holes drilled is twelve feet. The Mint Spring appears to thin from west to east in Smith County.

The lower limit of the Mint Spring is determined by the first appearance of dark-gray, carbonaceous clay or fine-grained, gray sand of the Forest Hill. A sharp contact exists between the Mint Spring and the underlying Forest Hill and a well-defined unconformity is present between the lithologic units. The upper limit of the Mint Spring Marl is placed at the contact of the sandy marl with the overlying Glendon Limestone. In some areas of the County the limestone is indurated but this does not hold true throughout the study area.

Two of the more readily accessible outcrops of Mint Spring are shown below:

(1) in west roadcut of north-south asphalt county road located in NW. 1/4, NE. 1/4 of Sec. 4, T. 3 N., R. 8 E., where approximately five feet of reddish-brown sand and nodular marl are exposed;

(2) in channel of Ichusa Creek, when water is low, 200 yards west of clay pit in SE. 1/4, SW. 1/4 of Sec. 19, T. 2 N., R. 9 E., where greenish-gray, fossiliferous marl is exposed. (Figure 11).

Lithologic descriptions of the Mint Spring Marl may be found in the records of test holes AL-1, 4, 5, 7, 8, 12, 16, 29, 30, 32, 34, 36, 47, 49.

Glendon Limestone

The Glendon Limestone derives its name from exposures of hard limestone ledges with interbedded marl and soft limestone at its type locality at Glendon, Clarke County, Alabama, in SW/4, SE/4, Sec. 30, T. 7 N., R. 3 E.

The term Glendon Limestone first appeared in published geologic literature in 1917 when O. B. Hopkins[30] used it in describing the upper unit of the Marianna Limestone of Alabama and Florida. He gave credit to C. W. Cooke for the first use of the term in an unpublished manuscript. Cooke[31] considered the Mint Spring Marl as a lower member of the Marianna and the Glendon as an upper member of the Marianna in Mississippi, but he later elevated the Glendon to formational rank. The writer has omitted the use of the term Marianna in Smith County because of the difficulty in differentiating the faunal and lithologic characteristics of the Glendon and Marianna.

The Glendon Limestone is the most conspicuous lithologic unit in the outcrop belt of the Vicksburg Group in Smith County. The Glendon also occupies a larger area of outcrop than any of the other three stratigraphic units of the Vicksburg group.

The lithology of the Glendon is one of alternating beds of hard limestone and soft marl. The composition of the limestone and marl is essentially the same, consisting of gray glauconitic arenaceous argillaceous and fossiliferous sediments. The limestone is typically indurated to semi-crystalline and tends to develop ledges which resist erosion. The marl is generally soft to semi-indurated and clayey and is subject to erosional processes (Figures 12 and 13).

Exposures of the Glendon are numerous in Smith County. The most notable outcrop is located along the east bank of Tallahala Creek just north of State Highway 18 in Sec. 22, T. 2 N., R. 9 E., where the Smith County Lime Plant operates when weather permits. The outcrop occupying the greatest areal extent is a ridge along the east bank of the Leaf River extending in a north-south direction from near the center of Sec. 13, T. 2 N.,

Figure 12.—Glendon limestone ledge and soft marl exposed on property of P. D. Houston near abandoned agricultural lime plant. Location in SE. 1/4, NE. 1/4, NW. 1/4, Sec. 9, T. 2 N., R. 9 E. February 1971.

Figure 13.—Soft limestone and marl overlying resistant ledge of limestone, all of Glendon age, exposed in valley wall of Ichusa Creek. Location in SE.¼, SW.¼, SW.¼, Sec. 19, T. 2 N., R. 9 E. March 1971.

Figure 14.—Waddell Cave developed in Glendon Limestone located 950 feet north of State Highway 18 in NW.¼. SW.¼, NE.¼, of Sec. 13, T. 2 N., R. 8 E. February 1971.

R. 8 E., to an area southwest of Cedar Grove church in SE. 1/4, SW. 1/4, Sec. 30, T. 3 N., R. 9 E. The exposure is not continuous the entire distance of 3½ miles as it is covered in places by terrace material. It is along this ridge that Waddell Cave (Figure 14) is developed from chemical solution in the limestone. This cave is probably the same as "Brown's Cave" mentioned by Cushman[32]. David R. Williamson[33], a member of the Staff, partially explored Waddell Cave and gave the writer this information concerning its extent. The Cave entrance has an irregular shape and is 3½ to 4 feet high and 4 to 5 feet wide. Williamson and his party explored 105 feet into the cave and the maximum height from floor to ceiling was five feet and the greatest width was twelve feet. The cave is developed in highly fossiliferous Glendon Limestone.

The presence of bentonite in the Glendon of Smith County has been known for many years. Mellen[34] in 1939 visited a pit in operation in the north half of Sec. 32, T. 4 N., R. 6 E., about four miles south of Polkville, Mississippi, and stated that in this locality "bentonite was found to be lying on a pinnacled limestone surface approximately 12.2 feet below the top of the uppermost limestone bed. Two or three strata of limestone and several strata of marl are in the Glendon above the bentonite." The writer visited this site, which has been abandoned, and observed large ledges of limestone which were out of place and had apparently been removed in order to mine the bentonite. Another site in Smith County showing similar characteristics of deposition is located in the SE. 1/4, SW. 1/4 of Sec. 19, T. 2 N., R. 9 E. (Figure 15). Here approximately 3½ feet of bentonite lie between ledges of hard Glendon Limestone. The bentonite from this locality is cream-colored when freshly dug. Filtrol Corporation has operated three bentonite pits near the community of Burns, Mississippi in recent years. The Chisolm pit, located in NW. 1/4 of Sec. 10, T. 3 N., R. 7 E., has been abandoned. The Burns pit, located in SW. 1/4 of Sec. 31, T. 4 N., R. 8 E. has been abandoned recently. The only known pit being actively mined at this time (September 1972) is one southwest of Lorena in the SE. 1/4 of Sec. 19, T. 4 N., R. 8 E. The bentonite appears to be resting on Glendon ledges, but insufficient excavation has prevented a thorough study of its depositional characteristics.

Figure 15.—Bentonite mined from the Glendon Formation in SE.¼, SW.¼, SW. ¼, Sec. 19, T. 2 N., R. 9 E. March 1971.

The thickness of the Glendon ranges from fifteen feet in test hole AL-2 to fifty-nine feet in test hole AL-35. Fifteen test holes penetrated the complete Glendon section and the average thickness in the test holes was thirty-four feet. The Glendon appears to be thicker in the eastern part of the County.

The lower limit of the Glendon is placed at the first appearance of sandy greenish-gray marl of the Mint Spring. The Glendon overlies the Mint Spring conformably and underlies the Byram Marl conformably. The upper limit of the Glendon is placed at the contact of the first limestone bed with the overlying clayey, fossiliferous, greenish-gray, glauconitic marl in the Byram.

Listed below are some of the Glendon outcrops observed in the County, other than the ones mentioned previously:

(1) on west bank of Strong River, 100 feet south of highway bridge on State Highway 541, in southeast corner of Sec. 6, T. 3 N., R. 6 E., three-foot ledges of limestone overlain by terraces sands;

(2) limestone ledges crossing county road, and marl and soft limestone exposed in roadcut overlying the ledges in the SE. 1/4 of Sec. 30, T. 4 N., R. 7 E., approximately one mile southwest of Trenton;

(3) in north roadcut on west side of Oakohay Creek limestone ledges approximately three feet thick with thin beds of marl in NE. 1/4, SE. 1/4 of Sec. 3, T. 3 N., R. 7 E., about 1 1/4 miles southwest of Burns;

(4) limestone ledges crossing unpaved county road in NE. 1/4, SE. 1/4, Sec. 29, T. 3 N., R. 8 E., also along southwest bank of Little Shongelo Creek;

(5) in N. 1/2, NW. 1/4, Sec. 9, T. 2 N., R. 9 E., in north bluff of property owned by P. D. Houston, Jr., limestone ledges 4 1/2 to 5 feet thick overlying gray marl and soft limestone. An agricultural lime plant was in operation in this area at one time.

Additional lithologic information and thicknesses of the Glendon can be found in the records of test holes AL-1, 2, 4, 5, 6, 8, 13, 16, 29, 32, 35, 47, 48, and 49.

Byram Marl

The term Byram Marl was proposed by T. L. Casey[35] in 1902 for exposures in the bank of Pearl River near Byram, Hinds County, Mississippi. Casey presumed erroneously that the Byram was older than the Glendon at Vicksburg. His reasoning was that one fossil species found in the Byram, that was of Jackson age, had not been found at the exposures at Vicksburg. C. W. Cooke[36] later corrected this error and placed the Byram Marl in its correct stratigraphic position. Cooke did include, however, beds that this writer has assigned to the Bucatunna in this report.

The Byram Marl in Smith County is composed of greenish-gray, glauconitic fossiliferous clayey marl. Some of the Byram samples examined contained small amounts of sand, particularly in the lower part of the section, but the unit can be best described as a clay-marl. Fragments of megafossils as well as microfossils in the form of foraminifera were in abundance in the samples examined from the test holes. Cushman[37] described 95 species and varieties of foraminifera in the Byram Marl from 12 collecting localities in Mississippi and Alabama. Forty-two of these species and varieties were from a Byram outcrop on Leaf River near the center of Sec. 31, T. 2 N., R. 9 E., Smith County, Mississippi.

The thickness of the Byram Marl ranges from 22 feet in AL-2 to 5 feet in AL-8. The average thickness of this unit in the Vicksburg Group is 11 feet.

The lower limit of the Byram is placed at the first appearance of indurated ledges of Glendon limestone. The contact between the Byram and the underlying Glendon in Smith County is a conformable relationship. The upper limit of the Byram is placed at the contact of dark-gray, carbonaceous clay of the overlying Bucatunna with the greenish-gray, fossiliferous marl of the Byram. This contact, too, is considered to be conformable.

Outcrops of Byram Marl are rare in the study area, due to thinness of the stratigraphic unit. The most likely places exposures can be found are along the banks and channels of the streams. One such locality has been mentioned previously. Another locality is in the stream bed of West Tallahala Creek at low water level in the SE. ¼, NW. ¼, Sec. 5, T. 1 N., R. 9 E. Here, an oil field road bridge crosses the West Tallahala Creek and exposures of Byram can be seen on the north side of the bridge.

Lithologic descriptions and thicknesses of the Byram Marl can be studied in the test hole records of AL-1, 2, 4, 5, 6, 8, 13, 16, 32, 35, 42, 47, 48 and 49.

Bucatunna Clay

B. W. Blanpied and others[38] in 1934, proposed the name Bucatunna to "apply to a sequence of bentonitic clays, bentonite and cross bedded sands which rest upon the rocks of the Vicksburg Group with distinct unconformity". At this time, Blanpied assigned the Bucatunna to the Catahoula Group of Miocene age. C. W. Cooke[39] in 1935 questioned the unconformable relationship of the Bucatunna and the underlying Vicksburg sediments and also stated that "the grouping of the Bucatunna Clay with the Catahoula Sandstone seems entirely unjustified.

Until contradictory evidence is presented, the Bucatunna Clay should be treated as a member of the Byram Marl of the Vicksburg Group." The Bucatunna is generally accepted as being Oligocene in age and is considered to be the upper unit of the Vicksburg Group in this report. The type locality of the Bucatunna Clay is along Bucatunna Creek north of the old Denham Post Office. The Denham Post Office before its abandonment was located in Sec. 19, T. 8 N., R. 5 W., Wayne County, Mississippi.

Figure 16.—Weathered Bucatunna Clay exposed in west roadcut of State Highway 501. Location in NW.¼, NW.¼, SE.¼, Sec. 6, T. 2 N., R. 9 E. March 1971.

The Bucatunna consists of dark-gray to black micaceous sparingly fossiliferous silty finely carbonaceous clay. In the vicinity of Raleigh thin gray clayey fossiliferous marl beds were found in the subsurface. Sand is a minor constituent of the Bucatunna unit, but when found it is fine-grained and glauconitic. A thin bed of bentonite approximately 1½ inches thick was observed in one core hole (AL-36) southwest of Sylvarena, Mississippi 34 feet above the Byram Marl.

The weathered Bucatunna is typically chocolate-brown in color with gypsum crystals and limonite staining found along the fractures of the blocky clay. It is from the Bucatunna Clay that a filtrate (ferric sulphate) is leached and used as an addi tive in poultry and livestock feeds. This will be discussed in more detail under Economic Geology.

The thickness of the Bucatunna Clay ranges from 24 feet in AL-48 to 84 feet in AL-43. Eleven test holes were drilled through the entire Bucatunna section and the average thickness was 45 feet. This average thickness should not be assumed to be the normal thickness. Since there is evidence of pre-Catahoula erosion on the Bucatunna surface, a normal thickness cannot be determined. Marl beds were present in at least two test holes and microfauna were abundant in these sediments. The marl beds ranged in thickness from 6 to 8 feet.

The Bucatunna Clay overlies the Byram Marl conformably, and the lower limit of the Bucatunna is placed at the first appearance of the greenish-gray fossiliferous clayey marl of the Byram. The upper limit of the Bucatunna is placed at the contact of the dark-gray, silty, clays with the overlying gray to light-gray clay or silty kaolinitic sand of the Catahoula Formation. Evidence is strong to support the assumption that the contact between the Byram and the Catahoula is unconformable.

Outcrops of Bucatunna Clay are rare in Smith County due to intense weathering. Three of the more accessible outcrops are listed below:

(1.) On west side of State Highway 501 in NW. ¼, NW. ¼, SE.¼, Sec. 6, T. 2 N., R. 9 E., black blocky clay is isposed in ditch and along right-of-way surface (Figure 16);

(2.) in west roadcut of State Highway 501 in SE. ¼, SE. ¼, NW. ¼, Sec. 6, T. 2 N., R. 9 E., three feet of chocolate-brown gypsiferous limonitic clay is exposed;

(3.) in clay pit in SE. ¼, SW. ¼, Sec. 19, T. 2 N., R. 9 E., black slightly sandy clay is exposed along sides of pit.

Additional information as to lithology and thickness of the Bucatunna can be found in the test hole records of AL-2, 5, 6, 12, 13, 16, 35, 42, 43, 45 and 48.

MIOCENE SERIES

Catahoula Formation

A. C. Veatch[40] in 1905 proposed the term "Catahoula sandstone" for exposures in Catahoula Parish, Louisiana. He placed the Catahoula in the Oligocene and "includes the sandstone-bearing clays between the Vicksburg and Fleming Oligocene." The United States Geological Survey classifies the Catahoula as Miocene in age, and the writer agrees with that determination. The term "Fleming" was discarded by the U.S.G.S. from its classification in 1932.

The outcrop belt of the Catahoula Formation occupies approximately 40 percent of the County, primarily in the southern and western parts of the study area. The Catahoula is overlain by Citronelle deposits in the central area and by the Hattiesburg and Citronelle in the southwestern segment of the County. Surficial deposits and alluvium along the streams mask a good part of the Catahoula in the outcrop belt.

The unweathered Catahoula in Smith County consists of non-marine sands, clays and silts. The sands are gray tan to buff fine- to medium-grained kaolinitic and silty. Locally these sands are highly indurated at the surface, forming ledges that are prominent in the southern part of the County. The clays are gray buff tan and maroon in color locally lignitic and micaceous. The silt and siltstones are light-gray white to tan and sandy in places. The sandstones, which are highly indurated and hard at the surface, are friable and unconsolidated in the subsurface. There was no difficulty in pentrating the sandstones of the Catahoula in the drilling of the test holes as was experienced in the subsurface with the Glendon Limestone. The Catahoula sandstone is very lenticular in the subsurface. The discontinuous nature of these beds is also seen in the outcrops of the Catahoula.

The entire thickness of the Catahoula is present in the southwest corner of the County. None of the test holes drilled penetrated the complete Catahoula section. Studies from oil well test logs and core hole logs indicate the Catahoula to be approximately 550 feet thick.

The lower limit of the Catahoula Formation is placed at the first appearance of dark-gray carbonaceous clay of the

Figure 17.—Massive Catahoula sandstone showing vertical fracturing on campus of Turner Chapel School immediately east of Raleigh in SE.¼, SE.¼, NE.¼, Sec. 6, T. 2 N., R. 8 E. March 1971.

Bucatunna. The contact between the Bucatunna and Catahoula appears to be unconformable as there is a definite change in the lithology of the two stratigraphic units. Further evidence of an unconformable relationship is the erratic thickness of the Bucatunna probably caused by erosional processes, specifically deep channeling. The upper limit of the Catahoula in contact with the overlying Hattiesburg is difficult to determine. No outcrops were observed that showed the contact of the Catahoula and Hattiesburg, and only one test hole penetrated the Catahoula and Hattiesburg boundary. In this one test hole (AL-60) the top of the Catahoula was placed at the first appearance of a buff to light-tan fine- to medium-grained sand underlying a red and gray mottled clay.

No fossils either faunal or floral were found in the Catahoula Formation in Smith County. Berry[41] reported finding fossil plants at three localities in the Catahoula sediments of south Mississippi. The absence of marine fossils indicates that the Catahoula is of non-marine origin.

Numerous outcrops of Catahoula were found in the study area. Listed below are locations of some of the outcrops observed in the County:

(1.) in the town of Raleigh in the northeast corner of the intersection of Coursey Street and State Highway 543 in SE. ¼, NE. ¼, NE. ¼, of Sec. 12, T. 2 N., R. 7 E., a ledge of indurated tan fine-grained sandstone 3 feet thick overlying gray clay and siltstone;

(2.) in SE. ¼, SE. ¼, NE. ¼, Sec. 6, T. 2 N., R. 8 E., on campus of Turner Chapel School, massive-bedded light-gray sandstone showing vertical fracturing (Figure 17);

(3.) in Raleigh Oil and Gas Field in SE. ¼, NE. ¼, Sec. 33, T. 2 N., R. 7 E., three foot ledge of limonite-streaked, gray, hard sandstone. Exposure is approximately 150 yards northeast of compressor station;

(4.) In north and south roadcuts of gravel road in SW. ¼, SE. ¼, NW. ¼, Sec. 2, T. 2 N., R. 6 E., thin-bedded gray fine-grained sandstone overlain by gray silty clay.

Additional lithologic information can be obtained on the Catahoula Formation from the test hole records of AL-2, 5, 6, 13, 15, 16, 37, 38, 39, 40, 41, 42, 43, 44, 45, 48, 50, 51, 52, 58, 59, 60.

MIOCENE SERIES

HATTIESBURG FORMATION

The term Hattiesburg Formation first appeared in geologic print in 1893, when L. C. Johnson[42] described the exposure at Hattiesburg, Mississippi, as a third phase of the Miocene Grand Gulf Group. These outcrops were not as siliceous, according to Johnson, as the sediments exposed at the type locality at Grand Gulf. G. C. Matson[43] described the Hattiesburg Clay as "massive non-marine blue and gray clays with subordinate amounts of sand and sandstone". He further stated that the Hattiesburg conformably overlies the Catahoula Sandstone and reaches a maximum thickness of 450 feet in Mississippi.

The outcrop belt of the Hattiesburg Formation occupies approximately 1½ townships in the southwest corner of Smith

County. Isolated outliers of Hattiesburg are present to the east of the main outcrop pattern. Much of the belt is covered with Citronelle, terraces and alluvium.

Only the lower part of the Hattiesburg Formation is exposed in Smith County. The Hattiesburg consists primarily of clay, silty clay, siltstone and minor amounts of sand and sandstone. In the weathered state, the clays range in color from gray and tan, to reddish-gray. The sands are typically gray to light-gray and fine- to medium-grained. The unweathered clay and sands exhibit a darker shade of the colors mentioned above.

The thickness of the Hattiesburg Formation in Smith County is estimated to reach a maximum of 90 feet. Test Hole AL-60 was the only test hole penetrating the Hattiesburg sediments. The thickness of the stratigraphic unit in AL-60 was 80 feet.

At several outcrops of Hattiesburg Clay distinctive ferruginous concretions were found in abundance. These concretions weathered out of a reddish-purple and gray mottled to tan and gray mottled sandy clay. The concretions are dense, roughly rounded to sub-spherical and have a maroon and tan mottled color. Bicker[43] mentioned finding the same type concretions in

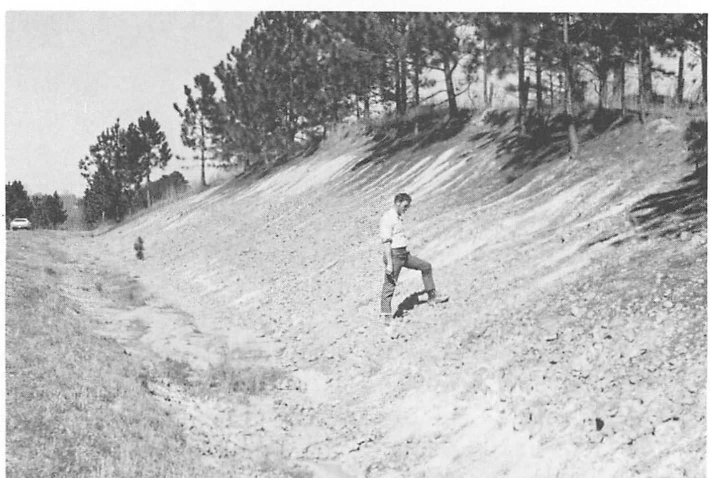

Figure 18.—Hattiesburg clay with ferruginous concretions exposed in east road-cut of State Highway 501, 3.8 miles northeast of Taylorsville in NW.¼, NW.¼, NE.¼, Sec. 10, T. 10 N., R. 14 W. April 1971.

the Hattiesburg Formation of Copiah County, Mississippi. Chemical analysis of the unweathered clay balls found in Copiah County showed them to contain 65.81% silicon dioxide, 17.50% ferric oxide, 12.05% aluminum oxide and the remainder, minor amounts of other chemical constituents.

Localities where the Hattiesburg Formation is exposed showing the clay-ball concretions are listed below:

(1.) in town of Mize at northeast corner of intersection of Chestnut Street and Fourth Street located 980′ south and 1175′ east of northeast corner of Sec. 1, T. 10 N., R. 16 W. Eight feet of yellow-tan sandy clay with maroon and tan mottled concretions;

(2.) in east roadcut of State Highway 531 located in the NW. ¼, NW. ¼, NE. ¼, Sec. 10, T. 10 N., R. 14 W., twelve feet of buff to tan silty clay with ferruginous concretions (Figure 18). There are other outcrops similar to the one mentioned above, north and south of this locality along the highway.

Localities of other Hattiesburg Formation outcrops are listed below:

(1.) in SW. ¼, NW. ¼, Sec. 29, T. 10 N., R. 15 W., on southwest side of unpaved county road, a two foot ledge of tan of buff sandy siltstone overlain by light-gray clay.

(2.) in NE. ¼, NW. ¼, of eSc. 30, T. 10 N., R. 16 W., on both sides of county road, gray very sandy clay exposed in ditches.

PLEISTOCENE SERIES

CITRONELLE FORMATION

G. C. Matson[44] in 1916 introduced the term Citronelle for non-marine sediments "that occur near the seaward margin of the Gulf Coastal Plain." Matson[45] considered the Citronelle to be Pliocene in age based on a study of the flora found by Berry[46] in a clay bed near the type locality Citronelle, Mobile County, Alabama, located in Sec. 36, T. 2 N., R. 3 W. In 1939 C. J. Roy[47] studied the type locality of the Citronelle and stated that the flora in the clay described by Berry was separated from the Citronelle by an unconformity. Roy further stated that "the clays are therefore pre-Citronelle and the plant fossils had no bearing on the age of the Citronelle except to indicate a post-Pliocene age for the Citronelle."

Figure 19.—Citronelle sand and gravel exposed in gravel pit in NW.¼, NW.¼, NW.¼, Sec. 13, T. 2 N., R. 6 E. April 1971.

Doering[48] in 1957 presented strong evidence in support of a Pleistocene age for the Citronelle Formation. For the purpose of this report the Citronelle Formation is considered to be Pleistocene in age.

The Citronelle Formation consists of fine- to coarse-grained sand, chert and quartz gravels with associated lenses of clay. The sand has a distinctive red to reddish-orange color due to disseminated particles of iron oxide. The clays are usually varying shades of red and due to their lenticular nature have limited areal extent. The gravel, which is typically found at the base of the Citronelle, has a brown to tan and buff color. Silica pseudomorphs of Paleozoic fossils as well as oolite and coral structures are common in the chert pebbles. Petrified wood is found in the Citronelle sediments in Smith County but usually in small fragments.

The areal extent of the Citronelle is confined to the upland areas of the County and covers approximately ten percent of the surface of the study area. A much larger part of the County was overlain by Citronelle at one time, but erosion has removed much of the sediments, leaving its present configuration.

The Citronelle unconformably overlaps all of the formations that have been previously discussed with the exception of the Yazoo Formation. At no place in the Yazoo outcrop belt could the Citronelle Formation be found.

Thickness of the Citronelle Formation ranges from zero feet to a maximum of about 135 feet. The thickness of the Citronelle is largely determined by the topography of the eroded surface. The thickest Citronelle sediments are along "Heater Ridge" located in the west central part of Smith County where the elevation exceeds 600 feet.

Outcrops of the Citronelle are numerous. Several of the roads in the County are constructed on ridges underlain by Citronelle sediments. Listed below are locations of outcrops of the Citronelle Formation:

(1.) in east and west road cuts of State Highway 35, 2½ miles north of Raleigh, Mississippi, in E. ½, NW. ¼, NE. ¼, of Sec. 25, T. 3 N., R. 7 E., approximately thirty-five feet of medimum- to coarse-grained red sand is exposed;

(2.) in gravel pit, in NW. ¼, NW. ¼, NW. ¼, of Sec. 13, T. 2 N., R. 6 E., approximately 13 feet of sandy gravel overlain by 20 feet of medimum- to coarse-grained red sand with red clay lenses (Figure 19);

(3.) in sand pit, in NE. ¼, NE. ¼, Sec. 22, T. 3 N., R. 8 E., approximately 10 feet of medimum- to coarse-grained reddish-orange sand is exposed.

Lithologic descriptions and thickness can be studied from the records of test holes AL-2, 12, 15, 16, 57 and 60.

PLEISTOCENE SERIES

Terrace Deposits

Terrace deposits is the term that has been applied to sand and gravel deposits that differ substantially from the Citronelle

Formation. The criteria for determining these sediments is two-fold; the elevation of the deposits and the lithologic characteristics of the material. In most localities, the terrace deposits are present where elevations are in excess of 400 feet above sea level.

The terrace deposits consist of sand, gravel and discontinuous lenses of clay. The sand is fine- to coarse-grained buff to light-tan and reddish-brown. There is a preponderance of finer-grained sand in the terrace deposits in comparison to the Citronelle sands. The gravels are composed of chert and quartz, and are smaller in size than the gravels of the Citronelle Formation. Most of the clay is red to pink with minor amounts of buff to yellow clay.

Terrace deposits that are of small areal extent and are not at least twenty feet in thickness are excluded from the geologic map. The stream terraces at the lower elevations were mapped with the alluvium and will be discussed in the following section.

Some of the larger terraces are:

In extreme north-central Smith County, located in parts of Sections 4, 5, 8, 9, 13, 15 and 16, T. 4 N., R. 8 E.; 3 miles northwest of Ted, located in parts of Sections 26 and 27, T. 3 N., R. 9 E.; 3½ miles southeast of Sylvarena in parts of Sections 23, 24, 25 and 26, T. 2 N., R. 9 E., along State Highway 531 in parts of Sections 1, 2, 10, 11, 12, 14, 15, 22, 26, 27 and 33, T. 1 N., R. 9 E.

Test hole AL-19, located in SW. ¼, SE. ¼, NW. ¼, Sec. 9, T. 4 N., R. 8 E., penetrated 86 feet of terrace material overlying dark-gray clay of the Forest Hill Formation. Lithologic description and thicknesses of terrace deposits can be studied from the record of test holes AL-1, 7, 11, 17, 18, 19, 21, 23, 24, 26, 29, 30, 31, 39, 40, 43, 44, 45, 46, 47, 56.

RECENT SERIES

Alluvium

The major streams of Smith County and their principal tributaries have developed extensive alluvial plains which cover a large part of the lowland areas of the County. The widest alluvial plain is developed along Strong River and its tributaries in the eastern part of T. 4 N., R. 6 E. and western part of T. 4 N., R. 7 E. Here this lowland area is in excess of three miles in width. The average width of the alluvium along the Strong River is approximately 1½ miles. The alluvial plains along the Leaf River, Oakohay Creek and West Tallahatta Creek are one to two miles in width.

The alluvium, which includes the low, stream terraces in this report, consists of gravel, sand, silt and clay. The coarser material is found at the base of the alluvial sediments. Organic matter is found in the alluvium along Strong and Leaf Rivers.

Records from logs available at the Survey indicate the maximum thickness of the alluvium in Smith County to be 40 feet. The thickest section of alluvium drilled in the test hole program was 24 feet in AL-49, located in NW. ¼, SE. ¼, SW. ¼, Sec. 33, T. 2 N., R. 9 E. This test hole was drilled in the alluvial plain of West Tallahala Creek.

Structure

Smith County is located on the northeast margin of the Interior Salt Basin of Mississippi. The study area also lies along the east flank of the Mississippi Embayment, which is a southward plunging syncline making up a part of the larger Gulf Coast Geosyncline. The axis of the Embayment extends in a north-south direction, roughly paralleling the course of the Mississippi River and lying between 10 to 15 miles east of the stream. Smith County lies approximately 70 miles east of this axis and immediately south of the Pickens-Pollard Fault Zone as shown on Figure 20.

The regional dip of the surface strata is to the southwest and south, but there are local variations in the vicinity of structurally anomalous areas. Because of the lenticular nature of the beds exposed at the surface there is no consistent bed on which to map, consequently no attempt was made to construct a surface structure map. Another hindrance to preparing a surface structure map in the study area is the fact that there is no detailed (7.5 minute) topographic map coverage in the southern part of the County. In order to obtain a structural interpretation of the County, it was necessary to rely on subsurface maps.

Two subsurface structure maps were constructed using datums on top of the Glendon Limestone (Plate 2) and on top of the Moodys Branch Marl (Plate 3). The datums used in the construction of the two maps were obtained from electrical logs of test holes drilled by the Survey, core hole tests drilled by private industry and oil well tests. In holes where samples were available, the datums used in the mapping were confirmed by the examination of the samples.

Plate 3 is a subsurface structure map contoured on top of the Moodys Branch Marl using a contour interval of 25 feet. The dip of the strata contoured on this upper Eocene formation is to the southwest in the northern and central parts of the County but is more southerly in the southern part of the study area. The rate of dip ranges from 25 feet per mile in the northeast corner to 40 feet per mile in the central and southern parts of the County. The regional strike of the beds as mapped on this marker is north 61° west in the central and northern part of the County but has a more westerly direction in the southern part. Deviations from normal dip are noted in the southern half of T. 3 N., R. 9 E., and parts of the townships adjoining to the west and south. Here two nosings are evident and normal dip is much flatter to the southeast. Other areas suggesting possible structural disturbances are in T. 4 N., R. 7 and 8 E., where gentle noses are developed. In Sections 21, 28 and 33, T. 2 N., R. 7 E., a nosing is developed in the area of the Raleigh Oil Field. Abnormally steep dips are found in the northwest corner of T. 10 N., R. 13 W., over the New Home Salt Dome. There is in excess of 200 feet of closure in this anomalous area.

Plate 2 is a subsurface structure map contoured on top of the Glendon Limestone with a contour interval of 25 feet. Configuration of the subsurface at this datum shows a southwesterly dip ranging from 32 feet per mile on the western side to 50 feet per mile on the eastern side of the County. The only departure from normal dip on this map is gentle nosing in the center of T. 1 N., R. 7 E., and in the northeast quarter of T. 3 N., R. 6 E.

Faulting on the surface and in the shallow subsurface was not detected by the writer in the course of the field reconnaissance or in the drilling program. There is faulting associated with deep subsurface structures where oil has accumulated and

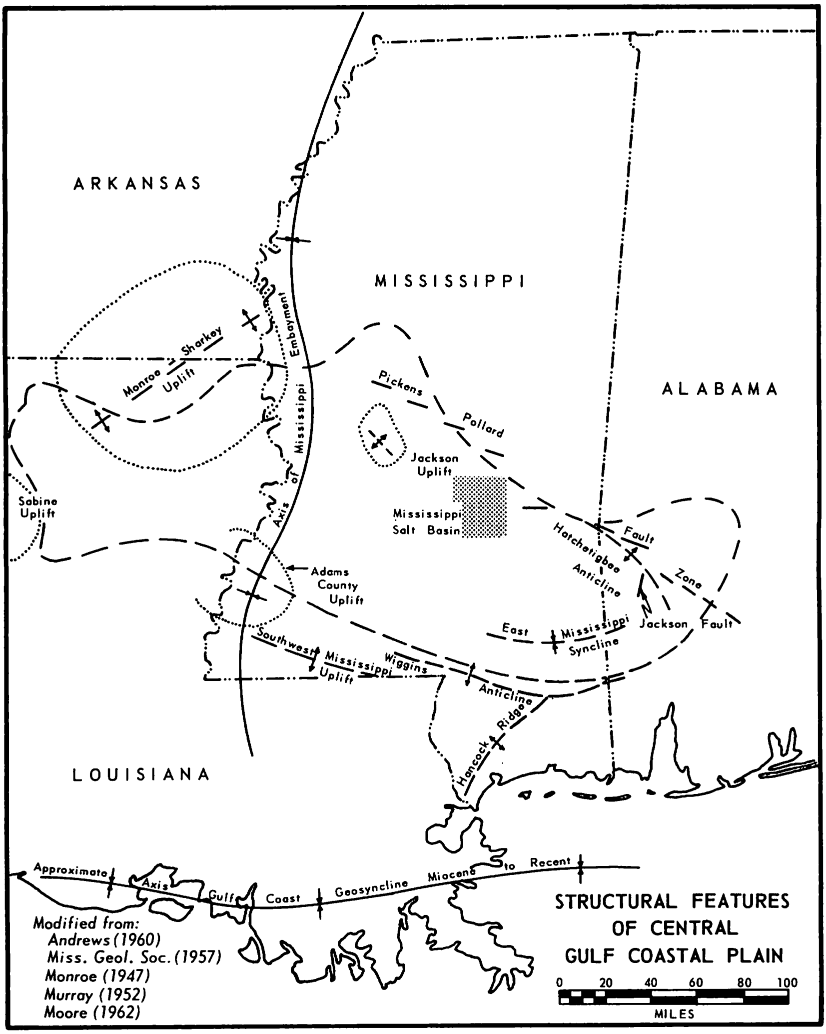

Figure 20.—Structural features of central Gulf Coastal Plain. Smith County shown as stipled area.

is presently being produced. At no place did the writer find evidence of these faults carrying through to the shallow subsurface or surface.

There are two known shallow piercement-type salt domes in the subsurface of Smith County. These domes are shown as stippled circles on Plates 2 and 3. The New Home Dome was discovered in August 1943 by Gulf Refining Company in their #1 Dykes Well, located in SE. ¼, NW. ¼, Sec. 5, T. 10 N., R. 13 W. The caprock material in this well was reached at a depth of 1823 feet and the salt at 2570 feet. Approximately one-half mile southeast of the discovery well Exploro Corporation drilled its #1 Stringer and found the caprock at 1520 feet which is 303 feet higher than the depth at which the caprock was found in the discovery well. Five wells were drilled in Sec. 8, T. 10 N., R. 13 W., three of them stopping in the caprock and one going to the base of the Upper Cretaceous and the remaining one penetrating the Lower Cretaceous. The Raleigh Salt Dome lies 2.3 miles southeast of the town of Raleigh, Mississippi. This dome was discovered by Central Oil Company drilling its Unit 17-14, located in the SE. ¼, SW. ¼, Sec. 17, T. 2 N., R. 8 E. The top of the caprock was reached at 1490 feet and the salt was found at 2140 feet. Only this one well has been drilled on this dome.

Economic Geology

One of the primary objectives of conducting a geologic investigation of Smith County is to find and report undeveloped mineral resources of economic value that would stimulate private industry to develop these resources and thereby cause economic growth in the County and State. Due to the limitation of funds, only representative samples from the various formations exposed at the surface were selected for coring and testing.

Clays and Natural Clay Mixtures

Smith County is endowed with an abundance of clays and clay-like mixtures. The results of tests that were performed on the samples collected from the study area indicate that the materials do have properties worthy of further investigation and possible commercial utilization.

Grim[49] defines the term clay in his text on clay mineralogy "as a rock term and also as a particle-size term in the mechanical analysis of sedimentary rocks, soil, etc. As a rock term it is difficult to define precisely because of the wide variety of

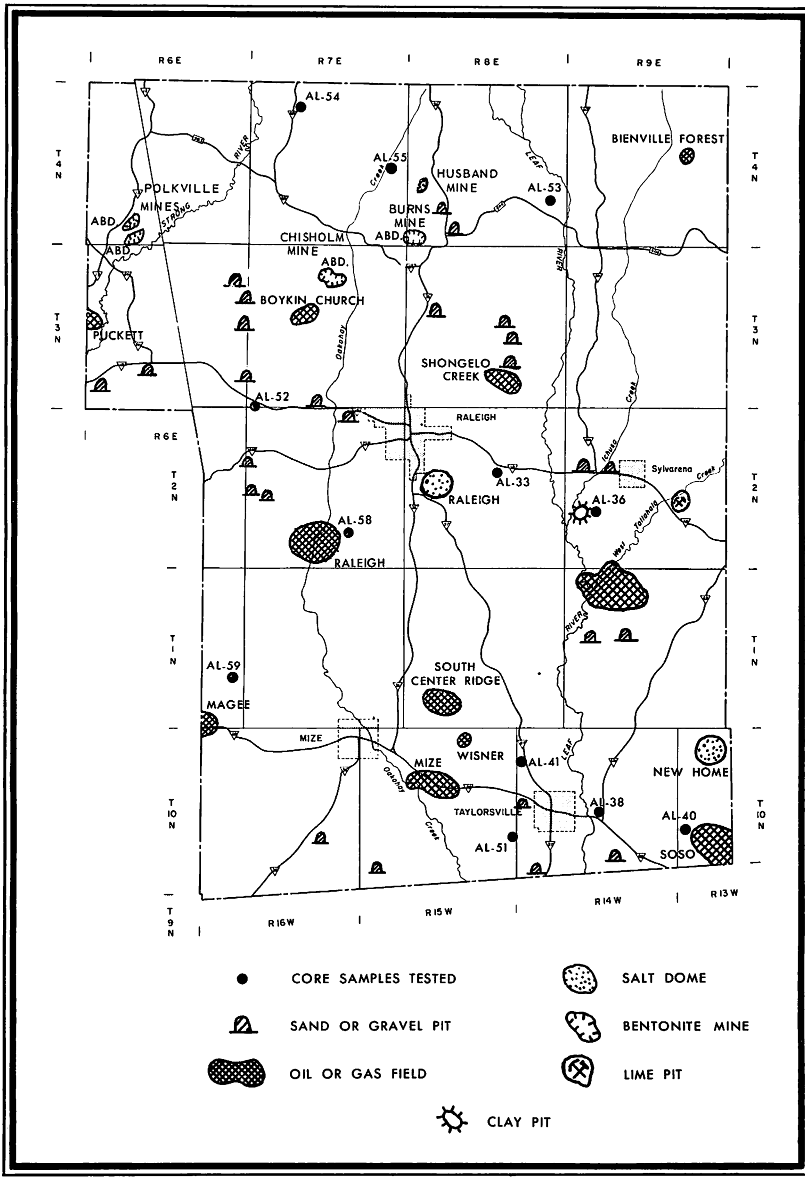

Figure 21.—Mineral resources map.

materials that have been called clays. In general the term clay implies a natural, earthy, fine-grained material which develops plasticity when mixed with a limited amount of water. By plasticity is meant the property of the moistened material to be deformed under the application of pressure with the deformed shape being retained when the deforming pressure is removed. Chemical analyses of clays show them to be essentially silica, alumina, and water, frequently with appreciable quantities of iron, alkalies and alkaline earths . . As a particle-size term, the clay fraction is that size fraction composed of the smallest particles. The maximum size of particles in the clay size grade is defined differently in different disciplines. In geology the tendency has been to follow the Wentworth scale and to define the clay grade as material finer than about 4 microns." Grim further states that the civil engineer considers the term clay to be a particle-size term.

Moore[50] introduced the term "natural clay mixtures" in his discussion of the fine-grained earthy, natural, argillaceous material of Hinds County, Mississippi. Since the clay samples collected in Smith County contain varying amounts of silt-sized and sand-sized particles they cannot be defined as pure clays, but they do have sufficient clay properties to be called clay mixtures.

Of the 60 test holes in the investigation, 15 of them were cored and 18 samples were selected for testing. Ten of the samples were from the Catahoula Formation, four from the Bucatunna Clay, two from the Forest Hill Formation and two from the Yazoo Formation.

The ceramic tests that were made on the samples selected were conducted by Rung Angurarohita, a native of Bangkok, Thailand and a graduate student in Materials Engineering at Mississippi State University, Starkville, Mississippi, under the direction and supervision of Dr. William B. Hall, Associate Professor, Materials Engineering, Mississippi State University. The chemical analyses were performed by the laboratories of the Mississippi State Chemist.

The results of the ceramic testing procedures are included in the section entitled Smith County Clay Tests. Chemical analyses are illustrated graphically in Figure 26 (Angurarohita) and in detail in Table 4 (Angurarohita). Of the 18 samples analyzed, 9 of the samples had properties suitable for use in the manufacturing of common structural clay products such as common brick, face brick, sewer pipe, drain tile, terra cotta and floor tile.

The Bucatunna Clay, particularly in eastern Smith County, has been used for many years in the preparation of a ferric sulfate solution which is used as an additive for poultry and livestock feed. Presently (October 1972) there is a pit, located in Sec. 19, T. 2 N., R. 9 E., where Bucatunna Clay is being mined and sold to Anvil Mineral Product Corporation, Bay Springs, Mississippi, as a mineral supplement to livestock and poultry feed. It is possible that other commercial uses can be found for this clay.

Limestone and Marl

The Vicksburg Group contains beds of limestone and marl that are exposed and in the near surface across the entire width of Smith County. These deposits are a valuable source of agricultural lime as well as a potential raw material for the manufacturing of cement. In adjoining Rankin County, to the west, Marquette Cement Manufacturing Company has been manufacturing cement since 1950 from the same formations that are present in Smith County. There are several localities that are favorable from the standpoint of available raw material for the establishment of cement manufacturing operation. One such location is in Sections 4 and 9, T. 2 N., R. 9 E., where in 1963 a raw material and feasibility study was made with the results being very encouraging. The project was not carried through to completion apparently due to inadequate financing. Another locality where there is an abundance of raw material is immediately east of Leaf River along a ridge located in Sections 12 and 13, T. 2 N., R. 8 E. There has been no detailed study made of this area, but field reconnaissance shows an abundance of limestone and marl.

Agricultural lime is presently (October 1972) being mined at the Smith County Lime Plant located in NE. ¼, SE. ¼, Sec.

22, T. 2 N., R. 9 E. Here, the Glendon limestone is exposed in the east valley wall of West Tallahala Creek. Mellen[51] presented interval analyses from nine samples of limestone from three localities in Smith County with the calcium carbonate ($CaCO_3$) ranging from 70.81 to 85.07 percent.

Another potential use for the limestone and marls available in Smith County is the production of rock wool. Mellen[52] discussed the possibilities of utilizing the limestone and marls from the Vicksburg Group in Warren County. The same ideas expressed in this text can be applied to limestone and marls of Smith County. In 1945, rock wool was produced in the Mississippi Geological Survey's laboratory from the Selma Chalk of Lee County, Mississippi. The results of this experiment were published in Bulletin 62, "Rock Wool."

Bentonite

The presence of commercial deposits of bentonite in Smith County has been known for many years. It is one of the five counties in the State that has produced bentonite commercially. The others are Itawamba, Monroe, Pontotoc and Prentiss. Monroe is the leading producer.

Bentonite that is mined in Smith County is found lying between ledges of Glendon Limestone. The average thickness of the bentonite is 3½ feet. The Attapulgus Clay Company operated a bentonite pit south of Polkville in Sections 29 and 32, T. 4 N., R. 6 E., in the late 1930's but abandoned the operation when the cost of removing the overburden became prohibitive. The Chisholm pit, located in NW. ¼ of Sec. 10, T. 3 N., R. 7 E., and the Burns pit located in SW. ¼ of Sec. 31, T. 4 N., R. 8 E., have been abandoned in recent years. Filtrol Corporation operated these two pits and is presently (October 1972) operating a pit southwest of Lorena in SE. ¼ of Sec. 19, T. 4 N., R. 8 E. The only outcrop of bentonite other than the ones mentioned above, found in the field study is in an area southwest of Sylvarena in SE. ¼, SW. ¼ of Sec. 19, T. 2 N., R. 9 E. Approximately 3½ feet of bentonite lies between ledges of Glendon Limestone. A small amount of bentonite was mined from this area, but operation ceased after a short time.

One core hole (AL-36) had a 1½ inch bed of bentonite in the Bucatunna. This is the only test or core hole that had bentonite in the samples. Mellen[53] reported finding a thin bed of bentonite in a small road cut along a county road in Sec. 23, T. 2 N., R. 8 E. Even though the beds are thin the presence of this bentonite is significant and is worthy of further investigation.

Sand and Gravel

Sand and gravel was probably the first mineral utilized for the benefit of the people of Smith County. Roads had to be constructed and sand and gravel helped build them. Smith County is endowed with an abundance of sand and has an adequate supply of gravel. The largest concentration of sand and gravel is found in the Citronelle Formation, but varying amounts are also found in the Catahoula Formation, Terrace deposits, and alluvium.

The thickest accumulation of sand and gravel is found along "Heater Ridge" in west central Smith County. Here the Citronelle attains a thickness of 135 feet. This ridge extends from the center of Sec. 12, T. 3 N., R. 6 E., in a southerly direction approximately nine miles. Numerous sand pits are along this ridge and gravel pits can be found at the lower elevations near the southern end of these deposits (Figure 22).

Another area of Citronelle sand and gravel deposits is located northeast of Raleigh in parts of Sections 15, 16, 21 and 22, T. 3 N., R. 8 E. Here, gravel has been taken for many years for topping on County roads.

A large gravel and sand pit is located in the southern part of the County in Sec. 27, T. 10 N., R. 14 W., approximately 2½ miles southeast of Taylorsville.

Most of the sand found in the Catahoula is indurated at the surface and is rather difficult to mine, but locally an unconsolidated outcrop is uncovered. Gravel is rare in the Catahoula in Smith County.

The terrace deposits are primarily sand with minor amounts of pea gravel. This holds true also for the alluvium as far as the gravel is concerned. The sand in the alluvium is usually silty and contains some organic material.

Figure 22.—Excavating gravel of Citronelle age with front-end loader for use on county roads.

Oil and Gas

Smith County ranked ninth in the production of oil and fifth in the production of gas of all the counties in the State for the year 1971. Table 2 shows the pertinent facts of the oil and gas fields in the County. All information concerning the fields listed below is of the date January 1, 1972.

Raleigh Field, the most prolific oil and gas field in the County, is located in Sections 27, 28, 29, 33 and 34, of T. 2 N., R. 7 E. At the time the field was fully developed, there were twelve producing reservoirs, but as of January 1, 1972, there were eight producing zones. Depths of the producing zones range from 11,750 feet to 13,100 feet with all of the reservoirs being in beds of Lower Cretaceous age. Twelve of the wells are producing by gas-lift and the remaining ten are flowing wells.

Boykin Church Field is located in Sections 16 and 17 of T. 2 N., R. 7 E. This two-well field produces from the Rodessa

Formation of Lower Cretaceous age with a producing depth range of 10,969 feet to 10,972 feet. Both of the wells have to be pumped to produce the oil.

Magee Field is located astride the Smith-Simpson County line. The part of the field that is in Smith County is in Sec. 35, T. 1 N., R. 7 E., and Sec. 6, T. 10 N., R. 16 W. When the field was producing at its peak, there were three reservoirs productive in the Smith County part of the field, but now only one well pumps oil from the Hosston reservoir at a depth range of 12,950 feet to 13,100 feet.

Soso Field is located in the southeastern corner of Smith County as well as part of Jasper and Jones Counties. The sections involved in Smith County are 19, 20, 29 and 30, T. 10 N., R. 13 W. Of the ten wells producing oil and gas in the Smith County part of the field, eight are producing by gas-lift and two are flowing wells. The Mississippi Oil and Gas Board recognized twenty-five separate reservoirs in the entire field at its peak production, but only five reservoirs in the Hosston and Rodessa Formations of Lower Cretaceous age are producing in Smith County. The depths from which oil and gas is produced range from 11,081 feet to 12,799 feet.

The one-well Bienville Forest Field in Sec. 14, T. 4 N., R. 9 E., produces from the Smackover reservoir of Jurassic age at a depth range of 14, 141 feet to 14, 161 feet. This discovery initiated the extensive exploration of Jurassic reservoirs in the southeastern United States.

South Center Ridge Field, located in Sections 29, 30, 31 and 32, T. 1 N., R. 8 E., produces from the Hosston, Sligo, Pine Island and Rodessa Formations of Lower Cretaceous age. Two of the wells are pumped and six are produced by gas lift. The depths of the producing reservoirs range from 11,567 feet to 12,330 feet.

The Puckett Field is located in Rankin and Smith Counties. Six reservoirs are recognized by the Mississippi Oil and Gas Board on January 1, 1972. Four wells produce oil or gas in the Smith County part of the field, which is located in Sec. 18, T. 3 N., R. 6 E. Three of the producing wells are oil wells and the other is a gas well. Oil is produced from a reservoir in the Lower

Tuscaloosa Formation of Upper Cretaceous age and from two reservoirs in the Washita-Fredericksburg Formation. Gas is produced from a reservoir in the Washita-Fredericksburg Formation of Lower Cretaceous age. The depths of the producing reservoirs range from 8,032 feet to 9,478 feet.

Wisner Field is a one-well field and is located in Sec. 2, T. 10 N., R. 15 W. It produces from a reservoir in the Pine Island Formation of Lower Cretaceous age at a depth of 12,360 feet to 12,368 feet.

The Tallahala Creek Field is located in Sections 5, 6, 8 and 9 of T. 1 N., R. 9 E. Six wells produce oil and gas from a reservoir in the Cotton Valley Formation and seven wells produce oil and gas from two reservoirs in the Smackover Formation. Both formations are of Jurassic age. Five of the wells are flowing producers and six are produced by gas lift. The depths of the producing reservoirs range from 15,598 feet to 16,590 feet.

The Shongelo Creek Field is located in Sections 27, 34 and 35 of T. 3 N., R. 8 E. One well is flowing oil from a reservoir in the Cotton Valley Formation of Jurassic age at a depth range of 14,908 feet to 15,008 feet.

The East Tallahala Creek Field produces oil from three reservoirs in the Smackover Formation of Jurassic age. Five wells produce from gas-lift energy and one well flows naturally. The range of producing depth is from 16,507 feet to 16,742 feet. The field is located in Sections 4 and 5, T. 1 N., R. 9 E., and Sec. 32, T. 2 N., R. 9 E.

Leasing and geophysical activity, exploratory drilling and production are all an integral part of the economy of Smith County. Wildcat drilling continues at a steady pace in this promising area. In 1971, oil and gas severance taxes returned to the County amounted to $210,884. Southern Natural Gas pipeline crosses the southern part of the County and Colonial pipeline, which is a products carrier, crosses the extreme southeast corner of the County. Humble Oil Company has a pipeline taking crude oil from the Raleigh Field.

Source for the information on the oil and gas fields of Smith County was obtained from the production bulletins of the Mississippi Oil and Gas Board.

TABLE 2

			Cummulative Prod. 1-1-72	
Field	Disc. Date	Prod. Wells	Oil Bbls.	Gas - MCF
Soso	1956	10	3,145,240	2,594,889
Raleigh	1957	22	18,701,001	84,496,653
Boykin Church	1958	2	249,145	444,870
Magee	1958	1	438,240	333,833
Mize	1962	8	2,766,974	673,840
Bienville Forest	1963	1	332,580	188,343
S. Center Ridge	1963	8	1,949,832	350,141
Puckett	1966	4	415,290	1,631,158
Wisner	1966	1	87,030	—0—
Tallahala Creek	1966	13	7,672,462	15,678,878
Shongelo Creek	1966	1	928,296	918,311
E. Tallahala Creek	1967	6	3,802,249	3,149,575
		77*	40,488,339	110,460,491

Source: Mississippi Oil and Gas Board
* as of January 1, 1972

ACKNOWLEDGMENTS

The writer wishes to express his sincere appreciation to the many citizens of Smith County who assisted and cooperated with the Survey in the course of the field investigation.

Special acknowledgments are extended to the various oil companies who donated core logs to the Survey and to the Water Resources Division of the United States Geological Survey for furnishing electrical logs of water wells in Smith County.

The staff of the Mississippi Geological Survey rendered valuable assistance in the course of the field work as well as providing helpful suggestions in the preparation of the manuscript and in editing the proofs.

Test Hole and Core Hole Records

The following are descriptions of cuttings and cores from holes drilled and/or cored during the investigation of the mineral resources of Smith County. The prefix AL preceding the hole numbers is the code designation used for all holes drilled in Smith County. This prefix establishes a permanent indexing and identification of all material obtained and tested in the course of the geological and mineral investigation.

Location of the holes was determined from topographic maps where available. Elevations used are ground level at the drill site and were derived from topographic maps or from a Paulin altimeter.

The purpose in drilling each hole is stated in the heading of the description and the availability of an electrical log is noted. All thicknesses and depths are expressed in feet.

AL-1

Location: NE/4, NW/4, SE/4, Sec. 6, T. 2 N., R. 9 E., on east side of Highway 501 right of way, approximately 15 feet southeast of R. O. W. marker.

Elevation: 444 feet (Topographic map) Date: May 24, 1971

Purpose: Drilled to 200 feet for stratigraphic information. Electrical log from 10 feet to 200 feet.

Thickness	Depth	Description
		Terrace deposit
12	12	Sand, salmon-red, medium-grained.
		Vicksburg Group (Bucatunna Clay)
8	20	Clay, gray to dark-gray, glauconitic.
		Vicksburg Group (Byram Marl)
6	26	Marl, gray to greenish-gray, glauconitic, fossiliferous.
		Vicksburg Group (Glendon Limestone)
8	34	Limestone, gray, fossiliferous, glauconitic.
4	38	Marl, gray, clayey, calcareous.
7	45	Limestone, gray, fossiliferous, glauconitic.
13	58	Marl, light-gray, clayey, calcareous, fossiliferous.
		Vicksburg Group (Mint Spring Marl)
10	68	Marl, gray to green-gray, fossiliferous, sandy.
		Forest Hill Formation
32	100	Clay, gray to dark-gray, carbonaceous, sandy in bottom.
19	119	Sand, gray, fine-grained, micaceous, silty.
29	148	Clay, gray to dark-gray, carbonaceous, micaceous; thin fine-grained sand laminae.
13	161	Sand, gray, fine-grained, silty, slightly carbonaceous.
14	175	Siltstone, light-gray to gray, micaceous, pyritic; thin sand laminae.
25	200	Clay, gray to dark-gray, carbonaceous, micaceous.

AL-2

Location: SW/4, NE/4, NE/4, Sec. 30, T. 3 N., R. 6 E., on west side of primitive trail, approximately 50 feet from center of trail, 0.4 of a mile northwest of intersection of trail and Highway 18.

Elevation: 411 feet (Topographic map) Date: May 26, 1971

Purpose: Drilled to 240 feet for stratigraphic information. Electrical log from 10 feet to 239 feet.

Thickness	Depth	Description
		Citronelle Formation
8	8	Sand, dark-yellowish-orange, medium- to coarse-grained, slightly silty.
11	19	Silt, buff, micaceous.
37	56	Sand, white to light-tan, coarse-grained, rare chert.

		Catahoula Formation
18	74	Sand, white to light-tan, medium-grained to fine-grained limonitic, micaceous in part.
8	82	Sand, white, fine-grained, kaolinitic, micaceous.
10	92	Clay, light-gray, slightly silty.
18	110	Clay, light-gray, very silty.
10	120	Silt, light-gray, sandy.
16	136	Sand, buff, fine- to medium-grained, very silty; medium-grained and less silty in bottom.
		Vicksburg Group (Bucatunna Clay)
30	166	Clay, dark-gray, micaceous, rare pyrite, slightly silty; glauconitic in part.
		Vicksburg Group (Byram Marl)
22	188	Marl, greenish-gray, fossiliferous, glauconitic, sandy.
		Vicksburg Group (Glendon Limestone)
4	192	Limestone, gray, glauconitic, fossiliferous, pyritic, moderately hard.
2	194	Marl, gray to light-gray, fossiliferous, glauconitic, clayey.
4	198	Limestone, gray, fossiliferous, clayey.
5	203	Marl, gray, fossiliferous, clayey with thin limestone streaks.
		Vicksburg Group (Mint Spring Marl)
8	211	Marl, greenish-gray, glauconitic, very sandy, fossiliferous.
		Forest Hill Formation
17	228	Clay, gray to dark-gray, silty, carbonaceous.
12	240	Sand, gray to light-gray, medium-grained, slightly silty.

AL-3

Location: SE/4, SW/4, NW/4, Sec. 1, T. 3 N., R. 7 E., on northeast side of Highway 481 right-of-way, approximately 200 feet northwest of bridge crossing Mile Branch.

Elevation: 415 feet (Topographic map) Date: May 27, 1971

Purpose: Drilled to 150 feet for stratigraphic information. Electrical log from 10 feet to 148 feet.

Thickness	Depth	Description
		Forest Hill Formation
14	14	Sand, tan and orange mottled, fine-grained, silty.
4	18	Clay, orange to tan, carbonaceous, micaceous (weathered).
8	26	Sand, gray, fine-grained, silty, carbonaceous.
30	56	Clay, gray to dark-gray, finely carbonaceous, micaceous, pyritic, sandy in upper part.
8	64	Sand, gray, fine- to very fine-grained, very silty, micaceous, finely carbonaceous.
6	70	Clay, gray, carbonaceous, micaceous.
28	98	Sand, gray, fine-grained, slightly silty, micaceous.
22	120	Clay, gray, micaceous, pyritic, finely carbonaceous; sandy in upper part.
		Yazoo Formation
30	150	Clay, light olive-gray, fossiliferous, calcareous.

AL-4

Location: SW/4, SW/4, SE/4, Sec. 13, T. 3 N., R. 7 E., at dead end of unimproved dirt road, approximately 60 feet east of center of road.

Elevation: 435 feet (Topographic map) Date: May 28, 1971

Purpose: Drilled to 210 feet for stratigraphic information. Electrical log from 10 feet to 208 feet.

Thickness	Depth	Description
		Vicksburg Group (Bucatunna Clay)
12	12	Clay, gray to salmon-red, sandy, very gypsiferous.
		Vicksburg Group (Byram Marl)
16	28	Marl, greenish-gray to tan, very fossiliferous, glauconitic.
		Vicksburg Group (Glendon Limestone)
4	32	Limestone, gray, glauconitic, calcareous, fossiliferous.
9	41	Marl, gray, sandy, fossiliferous.
3	44	Limestone, gray, glauconitic, fossiliferous.
		Vicksburg Group (Mint Spring Marl)
16	60	Marl, blue-gray to gray, very fossiliferous, sandy, slightly glauconitic.
		Forest Hill Formation
16	76	Clay, gray to dark-gray, micaceous, carbonaceous, silty.
10	86	Sand, gray to dark-gray, fine-grained, argillaceous, micaceous, carbonaceous.
12	98	Clay, gray, silty, finely carbonaceous.
2	100	Lignite, black.
7	107	Clay, gray to dark-gray, silty, micaceous.
2	109	Lignite, black to dark-brown.
11	120	Clay, gray to dark-gray, finely carbonaceous, micaceous, with fine-grained sand laminae.
5	125	Sand, gray to light-gray, very silty, carbonaceous.
5	130	Clay, gray, finely carbonaceous, micaceous.
4	134	Sand, light-gray to gray, very silty, carbonaceous.
6	140	Clay, gray to dark-gray, micaceous, carbonaceous.
6	146	Sand, gray to light-gray, fine-grained, silty, carbonaceous, pyritic.
5	151	Clay, gray to dark-gray, very micaceous, carbonaceous.
6	157	Sand, gray, fine-grained, slightly silty, carbonaceous.
9	166	Clay, gray to dark-gray, silty, carbonaceous, micaceous.
		Yazoo Formation
8	174	Clay, light-green, non-fossiliferous, bentonitic, non-calcareous, waxy luster.
16	190	Clay, gray, micaceous, silty.
20	210	Clay, light-olive-gray, fossiliferous, calcareous.

AL-5

Location: NE/4, SE/4, NW/4, Sec. 20, T. 3 N., R. 7 E., 50 feet northeast of center line of U. S. Forest Road 521-A, 1.2 mile north of intersection of roads 521 and 521-A.

Elevation: 400 feet (Topographic map) Date: June 2, 1971

Purpose: Drilled to 290 feet for stratigraphic information. Electrical log from 10 feet to 289 feet.

Thickness	Depth	Description
		Catahoula Formation
24	24	Clay, gray to light-gray, occasional carbonaceous streaks, slightly sandy, pyritic.
6	30	Sand, tan, fine-grained, very silty, micaceous, clayey.

		Vicksburg Group (Bucatunna Clay)
15	45	Clay, dark-gray to black, silty, blocky, gypsiferous.
22	67	Clay, dark-gray to black, fossiliferous, glauconitic, micaceous; sandy in bottom part.
		Vicksburg Group (Byram Marl)
13	80	Marl, green-gray, glauconitic, fossiliferous.
		Vicksburg Group (Glendon Limestone)
3	83	Limestone, gray, glauconitic, pyritic.
4	87	Marl, blue-gray to gray, fossiliferous, pyritic.
8	95	Limestone, gray to light-gray, glauconitic, fossiliferous.
9	104	Marl, gray to greenish-gray, very fossiliferous, glauconitic.
3	107	Limestone, light-gray, glauconitic, fossiliferous.
5	112	Marl, light-gray, clayey, fossiliferous, slightly glauconitic, bentonitic.
6	118	Limestone, gray, fossiliferous, slightly glauconitic.
		Vicksburg Group (Mint Spring Marl)
12	130	Marl, greenish-gray, sandy, fossiliferous, glauconitic.
		Forest Hill Formation
46	176	Clay, gray to dark-gray, carbonaceous, silty, blocky, micaceous; sandy in lower part.
14	190	Sand, gray, fine-grained, very silty, carbonaceous.
8	198	Clay, gray, carbonaceous, micaceous.
10	208	Sand, gray, fine-grained, slightly silty, micaceous.
3	211	Clay, gray to dark-gray, carbonaceous.
7	218	Sand, gray, fine-grained, silty, clayey.
36	254	Clay, dark-gray, carbonaceous, sandy, micaceous; lignitic in bottom part.
		Yazoo Formation
36	290	Clay, light-olive-gray, fossiliferous, calcareous.

AL-6

Location: NW/4, NE/4, NW/4, Sec. 2, T. 3 N., R. 6 E., 100 feet south of U. S. Forest Road 514-A, approximately 0.8 mile northwest of intersection of roads 514 and 514-A.

Elevation: 455 feet (Topographic map) Date: June 4, 1971

Purpose: Drilled to 310 feet for stratigraphic information. Electrical log from 10 feet to 310 feet.

Thickness	Depth	Description
		Catahoula Formation
10	10	Sand, fine- to medium-grained, reddish-orange, kaolinitic, rare pyrite.
9	19	Sand, fine-grained, tan to light-tan, limonitic.
43	62	Clay, gray to yellowish-gray, slightly sandy, pyritic, rare mica.
		Vicksburg Group (Bucatunna Clay)
28	90	Clay, dark-gray, silty, micaceous, rare fossils.
		Vicksburg Group (Byram Marl)
12	102	Marl, green-gray, glauconitic, very fossiliferous, clayey.
		Vicksburg Group (Glendon Limestone)
4	106	Limestone, brownish-gray, glauconitic, moderately hard, fossiliferous.
6	112	Marl, gray, glauconitic, clayey, fossiliferous.
4	116	Limestone, gray to light-gray, glauconitic, hard, pyritic, fossiliferous.
4	120	Marl, gray, glauconitic, fossiliferous.

10	130	Limestone, gray to light-gray, glauconitic, fossiliferous.
2	132	Marl, gray, glauconitic, clayey.
6	138	Limestone, gray to light-gray, glauconitic, fossiliferous.
10	148	Marl, gray to light-gray, clayey, fossiliferous.
6	154	Limestone, gray to light-gray, glauconitic, fairly soft, fossiliferous.
		Vicksburg Group (Mint Spring Marl)
12	166	Marl, light-brown to greenish-gray, very fossiliferous, very sandy, galuconitic, pyritic.
		Forest Hill Formation
10	176	Clay, gray to dark-gray, carbonaceous, finely micaceous, silty, lignitic.
10	186	Clay, gray, very carbonaceous, sandy, micaceous.
8	194	Clay, gray to dark-gray, carbonaceous, micaceous, lignitic.
10	204	Clay, dark-gray, micaceous, very sandy.
26	230	Clay, dark-gray, micaceous, carbonaceous.
24	254	Sand, gray, fine-grained, micaceous, carbonaceous; very silty near bottom.
9	263	Clay, gray to dark-gray, carbonaceous, micaceous, sandy.
		Yazoo Formation
47	310	Clay, light-olive-gray, fossiliferous, pyritic.

AL-7

Location: NW/4, NE/4, NW/4, Sec. 4, T. 3 N., R. 8 E., on east side of unimproved dirt road, approximately 0.4 of a mile northwest of intersection of unimproved dirt road and hard surfaced county road.

Elevation: 503 feet (Topographic map) Date: June 8, 1971

Purpose: Drilled to a depth of 180 feet for stratigraphic information. Electrical log from 10 feet to 179 feet.

Thickness	Depth	Description
		Terrace deposit
13	13	Sand, brick-red, fine- to medium-grained, clayey; brownish-red limonite nodules.
		Vicksburg Group (Mint Spring Marl)
11	24	Sand, buff, fine- to medium-grained, rare fossils, rare glauconite (badly weathered).
		Forest Hill Formation
3	27	Siltstone, gray, carbonaceous, micaceous, slightly sandy.
37	64	Clay, gray to dark-gray, finely carbonaceous, very silty, micaceous, with thin laminae of light-gray fine-grained sand.
26	90	Clay, dark-gray, smooth, blocky, sandy in lower part.
13	103	Sand, gray, fine-grained, micaceous.
7	110	Lignite, black, dull luster.
6	116	Siltstone, gray to dark-gray, sandy, micaceous.
6	122	Clay, gray to dark-gray, finely carbonaceous, micaceous.
8	130	Sand, gray, fine-grained, silty, micaceous.
8	138	Clay, gray to dark-gray, carbonaceous, micaceous.
9	147	Siltstone, gray, micaceous, sandy in upper part.
7	154	Clay, dark-gray, carbonaceous in part, micaceous.
		Yazoo Formation
26	180	Clay, light olive-gray, fossiliferous, calcareous, pyritic.

AL-8

Location: NW/4, NW/4, SE/4, Sec. 32, T. 4 N., R. 7 E., on east side of unimproved dirt road, approximately 0.25 of a mile south of dead end of road.

Elevation: 460 feet (Topographic map) **Date:** June 14, 1971

Purpose: Drilled to a depth of 230 feet for stratigraphic information. Electrical log run from 10 feet to 230 feet.

Thickness	Depth	Description
		Vicksburg Group (Bucatunna Clay)
10	10	Clay, tan to brownish-red, silty, limonitic, (badly weathered).
10	20	Clay, tan to light-brown, slightly sandy, limonitic, micaceous.
11	31	Clay, brown, limonitic staining, sandy, micaceous.
		Vicksburg Group (Byram Marl)
5	36	Marl, gray-green, glauconitic, fossiliferous.
		Vicksburg Group (Glendon Limestone)
6	42	Limestone, gray, glauconitic, fossiliferous.
6	48	Marl, gray, very fossiliferous, pyritic, trace of bentonite.
14	62	Limestone, light-gray, slightly glauconitic, psaringly fossiliferous, fairly hard.
8	70	Limestone, gray to light-gray, very gauconitic.
		Vicksburg Group (Mint Spring Marl)
23	93	Marl, gray, glauconitic, very sandy, fossiliferous.
		Forest Hill Formation
11	104	Clay, gray to dark-gray, silty, micaceous, finely carbonaceous.
14	118	Silt, gray, slightly sandy, slightly micaceous, carbonaceous.
28	146	Clay, gray to dark-gray, sparingly carbonaceous, micaceous in lower part.
16	162	Silt, gray, micaceous, lignitic, slightly sandy.
22	184	Sand, gray to white, fine- to very fine-grained, slightly glauconitic; silty in bottom.
4	188	Clay, gray to dark-gray, micaceous, slightly sandy.
4	192	Lignite, black.
8	200	Silt, gray, very sandy, micaceous.
12	212	Clay, gray to dark-gray, micaceous.
		Yazoo Formation
18	230	Clay, greenish-gray, calcareous, fossiliferous, pyritic.

AL-9

Location: NW/4, NW/4, NW/4, Sec. 17, T. 4 N., R. 7 E., 50 feet north of center line of U. S. Forest Trail 504-F, approximately 0.5 mile southwest of intersection of 504-F and Highway 481.

Elevation: 400 feet (Topographic map) **Date:** June 15, 1971

Purpose: Drilled to 400 feet for stratigraphic information. Electrical log run from 10 feet to 400 feet.

Thickness	Depth	Description
		Forest Hill Formation
10	10	Clay, gray, yellow mottled with red, very sandy, badly weathered.
12	22	Clay, tan, with laminae of very fine-grained sand, carbonaceous.
4	26	Silt, gray, very sandy, micaceous, carbonaceous.
21	47	Clay, gray to dark-gray, micaceous, carbonaceous.

		Yazoo Formation
33	80	Clay, greenish-gray, abundant shell fragments, rare pyrite.
10	90	Clay, greenish-gray, fossiliferous, trace of bentonite.
47	137	Clay, greenish-gray, fossiliferous, sparingly micaceous.
59	196	Clay, gray, very fossiliferous, occasional pyrite.
24	220	Clay, gray to greenish-gray, sparingly fossiliferous.
80	300	Clay, green-gray, fossiliferous, occasional pyrite.
23	323	Clay, light-greenish-gray, fossiliferous, silty.
17	340	Clay, gray, calcareous, fossils rare, glauconitic, limy, micaceous in part.
34	374	Clay, gray to light-gray, fossiliferous, silty, glauconitic in lower part.
		Moodys Branch Formation
12	386	Marl, gray, glauconitic, fossiliferous, sandy; very sandy in bottom.
		Cockfield Formation
14	400	Clay, gray, carbonaceous, silty.

AL-10

Location: NW/4, SE/4, NW/4, Sec. 24, T. 4 N., R. 6 E., 0.2 mile south of U. S. Forest Road 563, approximately 40 feet west of center line of Strong River.

Elevation: 360 feet (Topographic map) Date: June 18, 1971

Purpose: Drilled to 80 feet for stratigraphic information. Electrical log from 10 feet to 78 feet.

Thickness	Depth	Description
		Alluvium
10	10	Sand, tan to orange, medium-grained, argillaceous.
12	22	Sand, white to light-tan, medium- to coarse-grained, iron staining in part.
		Forest Hill Formation
8	30	Clay, gray, slightly sandy, carbonaceous.
6	36	Sand, very fine-grained, gray to light-gray, very silty, carbonaceous.
6	42	Clay, gray to dark-gray, abundant mica, carbonaceous.
13	55	Silt, gray, carbonaceous, micaceous.
		Yazoo Formation
15	70	Clay, light-gray, calcareous, rare pyrite, fossiliferous (foraminifera)
10	80	Clay, light-greenish-gray, very fosiliferous, calcareous.

AL-11

Location: SE/4, NW/4, NW/4, Sec. 17, T. 4 N., R. 6 E., on south side of unimproved dirt road, approximately 0.7 of a mile west of the intersection of dirt road and Highway 13.

Elevation: 445 feet (Topographic map) Date: June 21, 1971

Purpose: Drilled to a depth of 160 feet for stratigraphic information. Electrical log from 10 feet to 159 feet.

Thickness	Depth	Description
		Terrace deposit
10	10	Sand, reddish-orange, fine- to medium-grained.
9	19	Sand, white to light-tan, medium-grained.
4	23	Clay, red to orange, sandy in part.

		Forest Hill Formation
7	30	Clay, gray to dark-gray, very sandy in part, slightly micaceous.
10	40	Clay, gray to dark-gray, slightly sandy, carbonaceous, micaceous.
32	72	Clay, dark-gray, very carbonaceous in upper part, silty, micaceous.
8	80	Sand, gray to light-gray, very fine-grained, silty, carbonaceous, micaceous.
10	90	Silt, gray, micaceous in part, slightly sandy.
10	100	Sand, gray, very fine-grained, silty, micaceous.
12	112	Silt, gray to light-gray, carbonaceous, micaceous.
13	125	Clay, gray to dark-gray, sandy, micaceous.
12	137	Sand, gray, fine- to medium-grained, very silty, rare pyrite.
		Yazoo Formation
23	160	Clay, light-greenish-gray, fossiliferous, calcareous.

AL-12

Location: NW/4, SE/4, NE/4, Sec. 35, T. 3 N., R. 6 E., 300 feet northwest of center line of U. S. Forest Road 549, approximately 0.4 of a mile southwest of intersection of road 549 and Highway 18.

Elevation: 507 feet (Topographic map) Date: June 24, 1971

Purpose: Drilled to 470 feet for stratigraphic information. Electrical log from 10 feet to 470 feet.

Thickness	Depth	Description
		Citronelle Formation
28	28	Sand, buff to light-tan, medium-grained; rare mica.
6	34	Sand, light-tan to white, medium- to coarse-grained, micaceous.
		Catahoula Formation
18	52	Silt, light-gray, micaceous, slightly sandy, limonite streaks.
43	95	Sand, light-tan to white, fine- to medium-grained, slightly kaolinitic, rare mica.
9	104	Clay, light-red and gray mottled, silty, with dark-yellowish-orange limonite laminae.
21	125	Clay, buff to light-gray, sandy, kaolinitic.
45	170	Clay, gray, silty, sandy in part, rare pyrite.
20	190	Sand, light-tan to white, medium-grained, very kaolinitic.
10	200	Clay, gray, blocky, slightly sandy.
18	218	Clay, gray to dark-gray, pyrite, very sandy.
18	236	Clay, gray to light-gray, silty, pyritic.
4	240	Sand, light-gray, fine-grained, silty, rare glauconite, micaceous.
		Vicksburg Group (Bucatunna Clay)
34	274	Clay, dark-gray to black, silty, slightly calcareous; rare fossil fragments, more numerous near bottom of interval.
		Vicksburg Group (Byram Marl)
10	284	Marl, greenish-gray, fossiliferous, sandy.
		Vicksburg Group (Glendon Limestone)
6	290	Limestone,gray, fossiliferous, glauconitic, fairly hard.
7	297	Marl, gray to dark-gray, fossiliferous, glauconitic, clayey.
5	302	Limestone, gray, glauconitic, fossiliferous, hard.
8	310	Marl, greenish-gray, glauconitic, fossiliferous.
4	314	Limestone, gray to light-gray, glauconitic, pyritic, fossiliferous.
		Vicksburg Group (Mint Spring Marl)
10	324	Marl, greenish-gray, fossiliferous, very sandy, glauconitic.

		Forest Hill Formation
14	338	Clay, gray to dark-gray, carbonaceous, micaceous.
10	348	Sand, dark-gray, fine-grained, silty, clayey, carbonaceous.
4	352	Clay, gray to dark-gray, carbonaceous.
11	363	Sand, gray to light-gray, fine-grained; rare glauconite.
29	392	Clay, dark-gray, finely carbonaceous, micaceous, silty.
5	397	Sand, gray to light-gray, fine-grained, pyrite.
4	401	Clay, dark-gray, finely micaceous, carbonaceous.
15	416	Sand, light-gray, fine-grained, rare mica.
28	444	Clay, dark-gray, silty, micaceous, carbonaceous.
		Yazoo Formation
26	470	Clay, light-olive, gray, fossiliferous, calcareous.

AL-13

Location: SW/4, NW/4, SE/4, Sec. 34, T. 3 N., R. 7 E., 500 feet northeast of the dead end of unmarked county road, approximately 0.4 of a mile north of intersection of county road and Highway 18.

Elevation: 422 feet (Topographic map) Date: June 29, 1971

Purpose: Drilled to 350 feet for stratigraphic information. Electrical log from 10 feet to 349 feet.

Thickness	Depth	Description
		Catahoula Formation
34	34	Sand, reddish-orange, fine- to medium-grained, clayey, rare kaolin.
4	38	Clay, gray, plastic, silty.
11	49	Sand, tan, fine- to medium-grained; small limonite nodules.
7	56	Clay, dark-gray, finely carbonaceous, micaceous; rare pyrite.
10	66	Sand, yellowish-gray, fine- to very fine-grained, very silty.
16	82	Siltstone, brownish-gray, sandy in top part.
		Vicksburg Group (Bucatunna Clay)
7	89	Clay, dark-gray to black, blocky.
40	129	Clay, gray to greenish-gray, slightly glauconitic, fossiliferous, sandy.
		Vicksburg Group (Byram Marl)
19	148	Marl, green-gray, glauconitic, very fossiliferous.
		Vicksburg Group (Glendon Limestone)
6	154	Limestone, gray, hard, glauconitic, fossiliferous.
32	186	Marl, buff to light-gray, calcareous, fossiliferous, clayey.
		Vicksburg Group (Mint Spring Marl)
16	202	Marl, gray to light-tan, glauconitic in part, fossiliferous, sandy.
		Forest Hill Formation
20	222	Clay, gray to dark-gray, finely carbonaceous, micaceous, with fine-grained sand laminae.
17	239	Sand, gray, fine-grained, silty, micaceous.
23	262	Clay, gray to dark-gray, very micaceous in part, carbonaceous, fine-grained thin sand laminae.
26	288	Sand, gray, fine-grained, slightly glauconitic.
40	328	Clay, gray to dark-gray, finely carbonaceous, micaceous, silty in part, thin fine-grained sand laminae in part.
		Yazoo Formation
22	350	Clay, light-olive-gray, fossiliferous, calcareous.

AL-14

Location: SW/4, SE/4, SE/4, Sec. 21, T. 4 N., R. 8 E., 60 feet northeast of unimproved dirt road, approximately 1.2 miles northwest of intersection of dirt road and U. S. Forest Road 504.

Elevation: 418 feet (Topographic map) Date: June 29, 1971

Purpose: Drilled to a depth of 110 feet for stratigraphic information. Electrical log from 10 feet to 108 feet.

Thickness	Depth	Description
3	3	Soil, sand and silt.
		Forest Hill Formation
17	20	Sand, buff to light-tan, fine-grained, micaceous.
2	22	Clay, tan, very sandy, micaceous, limonitic.
12	34	Sand, buff, fine-grained, micaceous.
22	56	Clay, gray to dark-gray, carbonaceous, micaceous, sandy in upper part.
		Yazoo Formation
54	110	Clay, light-olive-gray, fossiliferous, pyritic, calcareous.

AL-15

Location: NW/4, SE/4, SW/4, Sec. 30, T. 3 N., R. 8 E., 200 feet south of primitive trail, approximately 0.5 mile from intersection of primitive trail and Highway 35.

Elevation: 565 feet (Topographic map) Date: June 30, 1971

Purpose: Drilled to 90 feet for stratigraphic information, lost mud circulation, unable to drill deeper or run electrical log.

Thickness	Depth	Description
		Citronelle Formation
30	30	Sand, salmon-red, medium- to coarse-grained, clayey.
21	51	Sand, buff, medium- to coarse-grained, trace of pea gravel.
13	64	Sand, light-tan to light-gray, medium-grained.
		Catahoula Formation
9	73	Clay, light-gray and purple mottled, sandy, kaolinitic.
9	82	Siltstone, light-yellow and gray mottled, sandy.
8	90	Sand, light-tan, medium-grained.

AL-16

Location: SW/4, NE/4, SE/4, Sec. 30, T. 3 N., R. 8 E., on south side of primitive trail, approximately 1.1 miles east of intersection of primitive trail and Highway 35.

Elevation: 522 feet (Topographic map) Date: July 1, 1971

Purpose: Drilled to a depth of 340 feet for stratigraphic information. Electrical log from 10 feet to 340 feet.

Thickness	Depth	Description
		Citronelle Formation
34	34	Sand, medium- to coarse-grained, light-reddish-orange becoming buff colored, occasional pebbles.
		Catahoula Formation
12	46	Siltstone, light-purple, sandy, finely micaceous.
16	62	Sand, tan, fine- to medium-grained, silty, limonitic.
11	73	Clay, light-gray, micaceous, slightly sandy.

17	90	Clay, gray to dark-gray, micaceous, carbonaceous in part; very silty in lower part.
11	101	Clay, green, blocky, tough.
		Vicksburg Group (Bucatunna Clay)
5	106	Clay, gray to dark-gray, finely carbonaceous.
6	112	Marl, gray, fossiliferous, clayey, glauconitic.
12	124	Clay, dark-gray, calcareous, micaceous.
8	132	Marl, gray to green-gray, fossiliferous, glauconitic.
8	140	Clay, gray, carbonaceous, micaceous.
		Vicksburg Group (Byram Marl)
16	156	Marl, gray to green-gray, fossiliferous, glauconitic, sandy.
		Vicksburg Group (Glendon Limestone)
2	158	Limestone, gray, glauconitic, pyritic, fossiliferous.
4	162	Marl, gray, fossiliferous, sandy.
4	166	Limestone, gray, glauconitic, pyritic, fossiliferous.
3	169	Marl, gray, glauconitic, clayey.
7	176	Limestone, gray, glauconitic, fossiliferous, hard; pyritic.
5	181	Marl, gray, fossiliferous, glauconitic.
5	186	Limestone, gray, glauconitic, fossiliferous.
		Vicksburg Group (Mint Spring Marl)
14	200	Marl, greenish-gray, sandy, glauconitic, fossiliferous.
		Forest Hill Formation
14	214	Clay, dark-gray to black, finely carbonaceous, micaceous, with thin fine-grained sand streaks.
6	220	Clay, gray to dark-gray, sandy.
8	228	Sand, gray, fine-grained, silty.
37	265	Clay, gray to dark-gray, carbonaceous, micaceous, sandy in part; lignite streaks.
19	284	Sand, gray, fine- to medium-grained, silty, carbonaceous, clayey in bottom part.
22	306	Clay, gray to dark-gray, carbonaceous, micaceous, lignitic.
		Yazoo Formation
34	340	Clay, light-olive-gray, fossiliferous, calcareous, pyritic.

AL-17

Location: NW/4, SW/4, NW/4, Sec. 1, T. 3 N., R. 8 E., on northeast side of unimproved dirt road, approximately 2 miles south of intersection of dirt road and U. S. Forest Road 504.

Elevation: 408 feet (Topographic map) Date: July 2, 1971

Purpose: Drilled to 80 feet for stratigraphic information. Electrical log run from 10 feet to 78 feet.

Thickness	Depth	Description
		Terrace deposit
14	14	Sand, reddish-orange, medium- to coarse-grained; minor amount of pea gravel.
		Forest Hill Formation
37	51	Clay, gray to dark-gray, micaceous, carbonaceous, silty; some orange and gray mottled clay at top (weathered Forest Hill).
		Yazoo Formation
29	80	Clay, light-olive-gray, fossiliferous, pyritic, calcareous.

AL-18

Location: NE/4, NW/4, SW/4, Sec. 9, T. 4 N., R. 8 E., in road fork of primitive trail, approximately 500 feet northeast of intersection of primitive trail and U. S. Forest Road 541.

Elevation: 515 feet (Topographic map) Date: July 7, 1971

Purpose: Drilled to 70 feet for stratigraphic information. Lost mud circulation at 70 feet, unable to continue drilling or run electrical log.

Thickness	Depth	Description
		Terrace deposit
18	18	Sand, salmon-red, fine- to medium-grained, clayey, rare mica.
32	50	Sand, buff to light-orange, fine- to medium-grained, with streak of light-gray and purple clay.
20	70	Sand, tan, fine- to medium-grained, rare black chert, micaceous.

AL-19

Location: SW/4, SE/4, NW/4, Sec. 9, T. 4 N., R. 8 E., on east side of primitive trail, approximately 0.2 of a mile northeast of intersection of trail and U. S. Forest Road 541.

Elevation: 500 feet (Topographic map) Date: July 9, 1971

Purpose: Drilled to a total depth of 420 feet for stratigraphic information. Electrical log run from 11 feet to 419 feet.

Thickness	Depth	Description
		Terrace deposit
20	20	Sand, buff to light-orange, fine- to medium-grained, trace of mica.
66	86	Sand, white to light-tan, trace of mica; rare kaolin.
		Forest Hill Formation
10	96	Clay, gray to dark-gray, finely carbonaceous, micaceous.
		Yazoo Formation
45	141	Clay, greenish-gray, calcareous, fossiliferous; inclusion of dark-gray clay in upper part.
93	234	Clay, light-olive-gray, fossiliferous, rare pyrite, silty.
51	285	Clay, light-olive-gray, very fossiliferous, micaceous, pyritic.
21	306	Clay, light-olive-gray, sparingly fossiliferous, slightly micaceous.
32	338	Clay, light-olive-gray, fossiliferous, pyritic.
44	382	Clay, light-olive-gray, fossiliferous, calcareous, trace of sand.
16	398	Clay, light-olive-gray, very fossiliferous, rare glauconite.
17	415	Clay, light-olive-gray, very fossiliferous, glauconitic, sandy.
		Moodys Branch Formation
5	420	Marl, gray, very fossiliferous, glauconitic, very sandy.

AL-20

Location: SE/4, NE/4, SW/4, Sec. 14, T. 4 N., R. 7 E., in National Forest, approximately 1375 feet north 30° 30′ east of the most easterly intersection of U. S. Forest Road 502 and U. S. Forest Road 559.

Elevation: 490 feet (Topographic map) Date: July 13, 1971

Purpose: Drilled to a depth of 160 feet for stratigraphic information. Electrical log run from 10 feet to 159 feet.

Thickness	Depth	Description
		Forest Hill Formation
18	18	Sand, buff to orange, fine-grained, rare mica, (weathered).
4	22	Silt, buff to light-gray and orange, micaceous, sandy.

13	35	Clay, gray, carbonaceous, very sandy.
28	63	Clay, gray to dark-gray, carbonaceous, micaceous, rare pyrite, silty.
19	82	Clay, gray, micaceous, carbonaceous, sandy to very sandy.
12	94	Clay, gray, micaceous, carbonaceous.
10	104	Sand, gray to dark-gray, fine- to very fine grained, very silty, carbonaceous.
6	110	Clay, gray, micaceous, carbonaceous.
12	122	Sand, gray to dark-gray, micaceous, lignitic, clayey.
14	136	Clay, gray to dark-gray, micaceous, carbonaceous, silty.
		Yazoo Formation
24	160	Clay, greenish-gray, fossiliferous, pyritic, calcareous.

AL-21

Location: SE/4, SW/4, NE/4, Sec. 13, T. 4 N., R. 8 E., 25 feet northeast of unimproved dirt road, approximately 1.8 miles southwest of intersection of dirt road and Highway 501.

Elevation: 495 feet (Topographic map) Date: July 15, 1971

Purpose: Drilled to a depth of 110 feet for stratigraphic information. Electrical log from 10 feet to 109 feet.

Thickness	Depth	Description
		Terrace deposit
8	8	Sand, orange-red, fine-grained, iron staining on grains.
57	65	Sand, buff, fine-grained, occasional black chert, rare kaolin, rare mica; streak of purple clay at base.
		Forest Hill Formation
11	76	Clay, gray to dark-gray, micaceous, finely carbonaceous.
		Yazoo Formation
34	110	Clay, light-olive-gray, fossiliferous, calcareous.

AL-22

Location: NW/4, SE/4, SE/4, Sec. 15, T. 4 N., R. 9 E., 100 feet northwest of U. S. Forest Road 517, approximately 1.5 miles southwest of intersection of Road 517 and U. S. Forest Road 504.

Elevation: 420 feet (Topographic map) Date: July 22, 1971

Purpose: Drilled to 370 feet for stratigraphic information. Electrical log from 10 feet to 370 feet.

Thickness	Depth	Description
		Yazoo Formation
10	10	Clay, pale orange and gray mottled, blocky, (weathered).
22	32	Clay, tan, fossiliferous, calcareous.
61	93	Clay, dark-greenish-gray, calcareous, sparingly fossiliferous.
79	172	Clay, light-olive-gray, fossiliferous, calcareous, blocky.
48	220	Clay, light-gray, fossiliferous, very silty, calcareous.
22	242	Clay, gray, slightly glauconitic, sparingly fossiliferous.
		Moodys Branch Formation
16	258	Sand, gray-green, fine-grained, fossiliferous, glauconitic.

		Cockfield Formation
14	272	Clay, dark-gray, silty, micaceous.
20	292	Sand, gray, fine-grained, silty.
14	306	Clay, brown-gray, finely carbonaceous, silty.
28	334	Sand, gray, fine-grained, silty, carbonaceous.
36	370	Clay, brownish-gray, silty; streak of fine-grained sand in bottom part.

AL-23

Location: SW/4, NW/4, NE/4, Sec. 12, T. 4 N., R. 9 E., 30 feet southwest of intersection of two primitive trails, approximately 0.65 of a mile northwest of U. S. Forest Road 506.

Elevation: 389 feet (Topographic map) Date: July 26, 1971

Purpose: Drilled to a depth of 400 feet for stratigraphic information. Electrical log from 10 feet to 400 feet.

Thickness	Depth	Description
		Terrace deposit
13	13	Sand, buff to light-tan, medium-grained.
		Yazoo Formation
7	20	Clay, light-tan and orange mottled, calcareous, fossiliferous.
44	64	Clay, light-olive-gray, fossiliferous, tough, calcareous.
31	95	Clay, light-gray, calcareous, sparingly fossiliferous, very slightly sandy.
37	132	Clay, light-gray, very silty, calcareous, non-fossiliferous.
24	156	Clay, light-olive-gray, fossiliferous, calcareous, tough, glauconitic.
		Moodys Branch Formation
16	172	Sand, gray to greenish-gray, fine to very fine-grained, glauconitic, fossiliferous, micaceous.
		Cockfield Formation
20	192	Clay, dark-gray, silty, finely carbonaceous, micaceous.
18	210	Clay, gray, sandy, micaceous.
39	249	Sand, gray, fine-grained, micaceous, slightly silty; glauconitic in lower part.
13	262	Clay, gray to dark-gray, silty, carbonaceous.
32	294	Sand, light-gray, fine-grained, micaceous, lignitic.
6	300	Clay, gray, silty, carbonaceous.
		Cook Mountain Formation
30	330	Clay, dark-gray, micaceous, tough.
4	334	Limestone, light-gray, soft, calcareous, sparingly fossiliferous.
66	400	Clay, dark-gray, micaceous; sandy in bottom. (Poor samples).

AL-24

Location: NE/4, SW/4, SW/4, Sec. 27, T. 4 N., R. 9 E., 30 feet east of light-duty road, approximately 1.5 miles northwest of intersection of road with U. S. Forest Road.

Elevation: 495 feet (Topographic map) Date: July 30, 1971

Purpose: Drilled to a depth of 110 feet for stratigraphic information. Electrical log run from 10 feet to 109 feet.

Thickness	Depth	Description
		Terrace deposit
14	14	Sand, salmon-red, fine- to medium-grained.
18	32	Siltstone, yellow and mottled, and trace of purple, very sandy.

		Forest Hill Formation
11	43	Clay, dark-gray, micaceous, carbonaceous, platy.
27	70	Clay, gray, very silty, micaceous, carbonaceous.
		Yazoo Formation
40	110	Clay, light-olive-gray, fossiliferous, calcareous.

AL-25

Location: NW/4, NW/4, SE/4, Sec. 10, T. 3 N., R. 9 E., at dead end of primitive trail, approximately two miles south of intersection of primitive trail and U. S. Forest Road 504.

Elevation: 400 feet (Topographic map) Date: August 2, 1971

Purpose: Drilled to a depth of 100 feet for stratigraphic information. Electrical log run from 10 feet to 99 feet.

Thickness	Depth	Description
		Terrace deposit
15	15	Sand, buff to reddish-tan, fine- to medium-grained.
		Forest Hill Formation
22	37	Clay, dark-gray, finely carbonaceous, with thin laminae of fine-grained gray sand.
		Yazoo Formation
63	100	Clay, light olive-gray, fossiliferous, pyritic, calcareous.

AL-26

Location: SE/4, SE/4, NW/4, Sec. 12, T. 3 N., R. 9 E., in primitive trail, approximately 200 feet south of intersection of primitive trail and U. S. Forest Road 534.

Elevation: 435 feet (Topographic map) Date: August 4, 1971

Purpose: Drilled to a depth of 100 feet for stratigraphic information. Electrical long run from 10 feet to 99 feet.

Thickness	Depth	Description
		Terrace deposit
10	10	Sand, reddish-tan, fine- to medium-grained; limonite staining.
		Forest Hill Formation
6	16	Clay, tan and orange mottled, sandy, (weathered).
8	24	Sand, tan, fine-grained, lignitic, silty.
46	70	Clay, dark-gray, sandy, carbonaceous, platy; thin laminae of fine-grained sand.
		Yazoo Formation
19	89	Clay, gray to gray-green, fossiliferous, calcareous.
11	100	Clay, light-olive-gray, calcareous, fossiliferous, occasional pink sand grains.

AL-27

Location: NW/4, NE/4, SW/4, Sec. 27, T. 3 N., R. 9 E., in abandoned road, approximately 950 feet northeast of County Road.

Elevation: 423 feet (Topographic map) **Date:** August 5, 1971

Purpose: Drilled to a depth of 160 feet for stratigraphic information. Electrical log run from 10 feet to 159 feet.

Thickness	Depth	Description
		Forest Hill Formation
11	11	Clay, gray and yellow mottled, sandy, micaceous, (weathered); carbonaceous in lower part.
19	30	Clay, gray to dark-gray, finely carbonaceous, micaceous, silty.
4	34	Lignite, black, shiny.
6	40	Clay, dark-gray, very carbonaceous, silty, micaceous.
10	50	Clay, dark-gray, carbonaceous; thin laminae of fine-grained gray sand.
10	60	Clay, dark-gray, very carbonaceous, lignitic, silty.
2	62	Lignite, black, shiny.
64	126	Clay, dark-gray, carbonaceous, micaceous, very sandy.
		Yazoo Formation
34	160	Clay, light olive-gray, fossiliferous, calcareous, pyritic.

AL-28

Location: SE/4, SW/4, NW/4, Sec. 26, T. 3 N., R. 9 E., 35 feet east of center line of private road, approximately 0.25 of a mile south of intersection of road and county road.

Elevation: 472 feet (Topographic map) **Date:** August 6, 1971

Purpose: Drilled to a depth of 190 feet for stratigraphic information. Electrical log run from 10 feet to 190 feet.

Thickness	Depth	Description
		Terrace deposit
11	11	Sand, orange-red, fine- to medium-grained, clayey.
21	32	Clay, dark-red to maroon-and-gray mottled, very sandy in part.
		Forest Hill Formation
6	38	Clay, gray, sandy, micaceous.
14	52	Siltstone, light-gray, micaceous, sandy.
8	60	Sand, gray, fine-grained, silty, micaceous.
32	92	Clay, gray, sandy, micaceous.
16	108	Sand, gray, fine-grained.
42	150	Clay, dark-gray, carbonaceous, lignitic; thin sand laminae.
25	175	Clay, gray, carbonaceous, silty.
		Yazoo Formation
15	190	Clay, light-olive-gray, calcareous, fossiliferous.

AL-29

Location: SW/4, NE/4, NE/4, Sec. 10, T. 2 N., R. 9 E., 20 feet northeast of center line of unimproved road, approximately 0.25 of a mile northwest of intersection of road and paved county road.

Elevation: 410 feet (Topographic map) Date: August 9, 1971

Purpose: Drilled to a depth of 144 feet for stratigraphic information. Electrical log run from 10 feet to 143 feet.

Thickness	Depth	Description
		Terrace deposit
13	13	Sand, red to light-red, medium-grained, clayey.
10	23	Clay, red-and-gray mottled to orange-and-gray mottled, sandy, micaceous.
		Vicksburg Group (Glendon Limestone)
4	27	Clay, orange-brown, calcareous, glauconitic, bentonitic, (badly weathered).
14	41	Marl, gray, fossiliferous, clayey, glauconitic; thin streaks of gray limestone.
		Vicksburg Group (Mint Spring Marl)
7	48	Marl, greenish-gray, fossiliferous, sandy, glauconitic.
		Forest Hill Formation
30	78	Clay, gray to dark-gray, sandy; slightly fossiliferous in upper part, finely carbonaceous in lower part.
12	90	Clay, dark-gray, carbonaceous, sandy, silty, micaceous.
6	96	Sand, dark-gray, very silty, carbonaceous.
44	140	Clay, dark-gray, carbonaceous, silty; very lignitic in bottom part.

AL-30

Location: NW/4, SW/4, NW/4, Sec. 11, T. 2 N., R. 9 E., on paved county road right-of-way, 60 feet southeast of center line of road, approximately 250 feet southwest of intersection with unimproved dirt road.

Elevation: 395 feet (Topographic map) Date: August 10, 1971

Purpose: Drilled to a depth of 210 feet for stratigraphic information. Electrical log run from 10 feet to 210 feet.

Thickness	Depth	Description
		Terrace deposit
17	17	Sand, buff to orange-tan, medium- to coarse-grained, clayey.
		Vicksburg Group (Glendon Limestone)
4	21	Clay, brown to tan, bentonitic, glauconitic, (weathered badly).
		Vicksburg Group (Mint Spring Marl)
5	26	Marl, gray to greenish-gray, fossiliferous, very sandy, glauconitic.
		Forest Hill Formation
34	60	Clay, dark-gray, sandy, micaceous, platy.
10	70	Clay, dark-gray, very sandy, micaceous, carbonaceous.
16	86	Clay, dark-gray, silty, very micaceous, carbonaceous.
10	96	Sand, gray, fine-grained, silty, micaceous.

5	101	Clay, dark-gray, carbonaceous, platy, very silty.
21	122	Sand, gray to dark-gray, fine-grained, micaceous, carbonaceous.
27	149	Clay, gray, micaceous, silty.
		Yazoo Formation
61	210	Clay, light olive-gray, fossiliferous, calcareous, pyritic.

AL-31

Location: SW/4, SE/4, NW/4, Sec. 20, T. 3 N., R. 9 E., 40 feet south of center line of county road, approximately 550 feet southeast of intersection of county road and Highway 501.

Elevation: 445 feet (Topographic map) Date: August 11, 1971

Purpose: Drilled to a depth of 200 feet for stratigraphic information. Electrical log run from 10 feet to 200 feet.

Thickness	Depth	Description
		Terrace deposit
5	5	Sand, brownish-red, medium- to coarse-grained, clayey.
		Vicksburg Group (Mint Spring Marl)
5	10	Sand, brownish-red, medium-grained, fossiliferous; rare glauconitic; pyrite, (weathered).
		Forest Hill Formation
20	30	Clay, light gray and yellow mottled, sandy, platy, micaceous.
74	104	Sand, buff, medium-grained, occasional mica.
10	114	Siltstone, gray, carbonaceous.
4	118	Sand, gray, fine-grained, silty, micaceous.
20	138	Siltstone, gray, carbonaceous, micaceous; lignite streaks.
26	164	Sand, gray, fine-grained, silty, micaceous, pyritic.
10	174	Clay, gray, carbonaceous, micaceous.
		Yazoo Formation
26	200	Clay, light olive-gray, fossiliferous, calcareous.

AL-32

Location: SW/4, NE/4, NW/4, Sec. 15, T. 2 N., R. 8 E., 70 feet southwest of center line of Highway 18 on highway right-of-way.

Elevation: 336 feet (Topographic map) Date: August 17, 1971

Purpose: Drilled to a depth of 240 feet for stratigraphic information. Electrical log run from 10 feet to 240 feet.

Thickness	Depth	Description
		Vicksburg Group (Bucatunna Clay)
15	15	Clay, tan and pale-orange mottled, slightly sandy, (weathered).
		Vicksburg Group (Byram Marl)
8	23	Marl, greenish-gray, very fossiliferous, calcareous, pyritic, glauconitic.
		Vicksburg Group (Glendon Limestone)
6	29	Limestone, gray, glauconitic, fossiliferous, fairly hard.
5	34	Marl, light-gray, clayey, fossiliferous.
9	43	Limestone, gray, glauconitic, fossiliferous, hard, pyritic.
14	57	Marl, light-gray, clayey, slightly fossiliferous.

		Vicksburg Group (Mint Spring Marl)
18	75	Marl, greenish-gray, very fossiliferous, very sandy, pyritic.
		Forest Hill Formation
9	84	Clay, brownish-gray, carbonaceous, lignitic, silty.
8	92	Sand, gray, fine-grained, very silty.
28	120	Clay, dark-gray, silty, carbonaceous lignitic; thin sand, laminae, micaceous.
22	142	Sand, gray, fine-grained, silty, micaceous.
45	187	Clay, dark-gray, carbonaceous, lignitic, micaceous, silty.
		Yazoo Formation
14	201	Clay, dark-gray to brownish-gray, slightly fossiliferous.
39	240	Clay, light olive-gray, fossiliferous, calcareous, pyritic.

AL-33

Location: SW/4, NE/4, NW/4, Sec. 15, T. 2 N., R. 8 E., 70 feet southwest of center line of Highway 18 on highway right-of-way, approximately 30 feet southeast of AL-32.

Elevation: 336 feet (Topographic map) Date: August 17, 1971

Purpose: Cored to a depth of 23 feet to obtain samples for analysis. No Electrical log run.

Thickness	Depth	Description
		Vicksburg Group (Bucatunna Clay)
1	1	Clay, dark-gray to black, carbonaceous.
4	5	Clay, ochre and dark-gray mottled, lignitic.
5	10	Clay, pale-orange to ochre with streaks of gray to dark-gray.
5	15	Clay, dull-gray, mottled with orange; abundant fossils in bottom 1½ feet.
		Vicksburg Group (Byram Marl)
8	23	Marl, greenish-gray, glauconitic, fossiliferous, sandy in upper part.

AL-34

Location: SE/, SE/4, SW/4, Sec. 15, T. 3 N., R. 8 E., 100 feet northeast of center line of county road, approximately 0.5 mile east of Trinity Church.

Elevation: 535 feet (Topographic map) Date: August 19, 1971

Purpose: Drilled to a depth of 270 feet for stratigraphic information. Electrical log run from 10 feet to 270 feet.

Thickness	Depth	Description
		Citronelle Formation
10	10	Sand, orange-red, medium- to coarse-grained; rare small pebbles.
10	20	Sand, orange-red, medium- to coarse-grained, abundant pea gravel.
20	40	Sand, orange-red, medium-grained; rare small pebbles.
25	65	Sand, light-tan to white, coarse-grained.
25	90	Sand, light-tan, medium- to coarse-grained; scattered pebbles.
		Vicksburg Group (Glendon Limestone)
10	100	Clay, brown to black, bentonitic, (weathered).
5	105	Limestone, gray, very sandy, glauconitic, calcareous.
12	117	Marl, gray, clayey, calcareous.

		Vicksburg Group (Mint Spring Marl)
8	125	Marl, green-gray, glauconitic, sandy, fossiliferous.
		Forest Hill Formation
6	131	Silt, gray, carbonaceous, slightly sandy.
11	142	Clay, dark-gray, lignitic, carbonaceous, micaceous, slightly sandy.
8	150	Sand, gray, very silty, carbonaceous, fine-grained.
52	202	Clay, gray, micaceous, carbonaceous; thin laminae of fine-grained, gray sand.
9	211	Sand, gray, fine-grained, carbonaceous.
48	259	Clay, gray to dark-gray, finely carbonaceous.
		Yazoo Formation
11	270	Clay, light olive-gray, fossiliferous, calcareous.

AL-35

Location: SE/4, SE/4, SE/4, Sec. 19, T. 2 N., R. 9 E., 250 feet north of center line of county road.

Elevation: 382 feet (Altimeter) Date: August 20, 1971

Purpose: Drilled to a depth of 230 feet for stratigraphic information. Electrical log run from 10 feet to 230 feet.

Thickness	Depth	Description
		Vicksburg Group (Bucatunna Clay)
25	25	Clay, tan to chocolate-brown, bentonitic, upper two feet orange and gray (weathered), gypsiferous.
5	30	Clay, tan to dark-tan, slightly sandy, carbonaceous.
10	40	Clay, dark-gray to brown, silty, gypsiferous.
8	48	Clay, dark-gray, slightly carbonaceous, very silty.
		Vicksburg Graup (Byram Marl)
9	57	Marl, gray-green, very fossiliferous, glauconitic, pyritic.
		Vicksburg Group (Glendon Limestone)
4	61	Limestone, gray to cream, glauconitic, fossiliferous, fairly soft.
5	66	Marl, cream to light-gray, clayey, calcareous.
3	69	Limestone, light-gray, glauconitic, calcareous.
19	88	Marl, light-gray, clayey, fossiliferous.
3	91	Limestone, cream to light-gray, glauconitic, fossiliferous.
5	96	Marl, cream to gray, clayey, fossiliferous.
6	102	Limestone, light-gray, glauconitic, fossiliferous.
8	110	Marl, cream to light-gray, clayey.
6	116	Limestone, light-gray, fossiliferous, glauconitic.
		Vicksburg Group (Mint Spring Marl)
16	132	Marl, greenish-gray, sandy, fossiliferous, glauconitic.
		Forest Hill Formation
35	167	Clay, dark-gray, finely carbonaceous, platy, micaceous.
21	188	Sand, gray, fine-grained, carbonaceous.
37	225	Clay, dark-gray, silty, carbonaceous, micaceous; thin silty fine-grained sand streaks.
		Yazoo Formation
5	230	Clay, light olive-gray, fossiliferous, calcareous.

AL-36

Location: SE/4, SE/4, SE/4, Sec. 19, T. 2 N., R. 9 E., 275 feet north of center line of county road.

Elevation: 382 feet (Altimeter) Date: August 23, 1971

Purpose: Cored to a depth of 52 feet to obtain samples for analysis. No Electrical log run.

Thickness	Depth	Description
		Vicksburg Group (Bucatunna Clay)
6	6	Clay, gray and pale-orange, mottled.
6	12	Clay, light-gray to gray, carbonaceous.
18	30	Clay, gray, slightly sandy; 1" streaks of bentonite in upper three feet.
5	35	Clay, gray to dark-gray, very gypsiferous.
13	48	Clay, dark-gray to black, slightly fossiliferous.
		Vicksburg Group (Byram Marl)
4	52	Marl, dark-greenish-gray, fossiliferous, slightly sandy.

AL-37

Location: NE/4, SE/4, SW/4, Sec. 6, T. 10 N., R. 14 W., in pasture, approximately 1200 feet east of Highway 37.

Elevation: 310 feet (Altimeter) Date: August 26, 1971

Purpose: Drilled to a depth of 390 feet for stratigraphic information. Electrical log run from 10 feet to 390 feet.

Thickness	Depth	Description
		Catahoula Formation
10	10	Sand, tan, fine to medium-grained, clayey.
14	24	Clay, light-gray and yellow mottled; streak of sand.
14	38	Silt, light tan-and-orange mottled, clayey; sand streaks.
22	60	Sand, pale-pink and gray, very silty, fine-grained.
10	70	Clay, light-maroon, silty.
45	115	Sand, buff, fine-grained, rare black chert, grading to fine- to medium-grained in bottom.
28	143	Clay, tan, sandy, finely mficaceous.
17	160	Sand, tan to light-gray, fine- to medium-grained, silty; abundant very coarse frosted quartz grains in bottom.
28	188	Clay, tan, silty.
14	202	Siltstone, light-tan, sandy, finely micaceous.
14	216	Sand, light-tan to white, medium-grained, kaolinitic.
44	260	Clay, tan, slightly sandy; rare carbonaceous material.
40	300	Siltstone, grayish-tan, finely micaceous; thin beds of medium-grained sandstone.
9	309	Sand, gray, medium- to coarse-grained, silty.
47	356	Clay, gray, silty, finely carbonaceous.
		Bucatunna Formation
34	390	Clay, dark-gray to black, waxy.

AL-38

Location: NE/4, NW/4, NW/4, Sec. 22, T. 10 N., R. 14 W., 70 feet west of center line of Highway 531, approximately 600 feet north of intersection of Highway 531 and Highway 28.

Elevation: 305 feet (Altimeter) Date: August 30, 1971

Purpose: Cored to a depth of 37 feet to obtain samples for analysis. Electrical log run from 10 feet to 37 feet.

Thickness	Depth	Description
		Catahoula Formation
3	3	Clay, gray to dark-gray, carbonaceous; inclusion of lignite.
9	12	Sand, gray with streak of orange, kaolinitic, fine-grained.
4	16	Sand, light-gray, fine-grained.
4	20	Sand, light-gray, fine-grained, clayey in bottom foot.
4	24	Clay, gray, very sandy.
2	26	Clay, dark-gray, mottled; orange streak in bottom foot.
6	32	Sand, fine-grained, gray.
2	34	Sand, fine-grained, light-gray, silty.
3	37	Sand, fine-grained, orange to gray.

AL-39

Location: NW/4, NW/4, NW/4, Sec. 5, T. 10 N., R. 13 W., 70 feet northwest of center line of hard surfaced county road on highway right-of-way.

Elevation: 491 feet (Altimeter) Date: August 31, 1971

Purpose: Cored to a depth of 24 feet to obtain samples for analysis. No Electrical log run.

Thickness	Depth	Description
		Terrace deposit
4	4	Sand, tan to orange, medium- to coarse-grained.
		Catahoula Formation
4	8	Clay, maroon, slightly sandy to very sandy in bottom.
4	12	Sand, brick-red, very fine-grained, very clayey.
8	20	Sand, purplish-gray with streaks of red, very clayey.
4	24	Sand, fine- to medium-grained tan to orange.

AL-40

Location: SW/4, SE/4, NE/4, Sec. 19, T. 10 N., R. 13 W., 65 feet north of center line of hard surfaced county road on highway right-of-way.

Elevation: 365 feet (Altimeter) Date: September 8, 1971

Purpose: Cored to 32 feet to obtain samples for analysis. Drilled on to 260 feet for stratigraphic information. Electrical log run from 10 feet to 259 feet.

Thickness	Depth	Description
		Terrace deposit
8	8	Sand, medium- to coarse-grained, tan to reddish-brown.
2	10	Clay, reddish-tan to orange.
.5	10.5	Sand, orange, medium-grained, very clayey.
1.5	12	Clay, orange, sandy; gray in bottom 3"; silty.

		Catahoula Formation
8	20	Clay, gray mottled with brick-red, slightly sandy.
12	32	Sand, fine- to very fine-grained, light-gray, silty.
8	40	Sand, fine- to very fine-grained, tan to buff, silty, clayey in upper part.
16	56	Clay, tan to buff, sandy.
14	70	Sand, tan to buff, fine- to medium-grained.
24	94	Sand, tan to buff, medium- to coarse-grained.
26	120	Clay, gray and maroon-mottled, slightly sandy.
16	136	Sand, buff to light tan, very silty.
14	150	Clay, light-gray, silty.
10	160	Clay, light-gray and maroon mottled, limonite streak, slightly sandy.
14	174	Clay, gray and maroon, carbonaceous, sandy in bottom.
11	185	Sand, tan, fine- to medium-grained.
5	190	Clay, tan to gray, sandy, micaceous.
10	200	Sand, medium-grained, limonitic, clayey.
5	205	Clay, gray- to light-gray, micaceous.
25	230	Sand, tan, fine-grained, silty; streak of dark-gray clay.
30	260	Clay, tan, silty, platy.

AL-41

Location: NW/4, SE/4, SW/4, Sec. 6, T. 10 N., R. 14 W., in woods, approximately 150 feet west of center line of Highway 37.

Elevation: 330 feet (Altimeter) Date: September 13, 1971

Purpose: Cored to a depth of 43 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Catahoula Formation
4	4	Sand, red, fine-grained, micaceous.
2	6	Clay, gray, laminated; limonite streak.
2	8	Clay, gray, pure.
4	12	Clay, gray, laminated with limonite streaks, sandy at 10 feet.
8	20	Clay, light-chocolate; limonite streak.
2	22	Clay, dark-brown; lignite streak.
6	28	Sand, fine-grained; limonite streak.
8	36	Clay, gray, silty; limonite streak in bottom.
7	43	Sand, gray to pink to red, fine-grained, clayey.

AL-42

Location: SE/4, NW/4, SE/4, Sec. 26, T. 1 N., R. 8 E., 70 feet west of center line of hard surfaced county road, in highway right-of-way.

Elevation: 362 feet (Altimeter) Date: September 15, 1971

Purpose: Drilled to a total depth of 360 feet for stratigraphic information. Electrical log run from 10 feet to 359 feet.

Thickness	Depth	Description
		Catahoula Formation
10	10	Sand, light-brown, fine- to medium-grained, clayey.
10	20	Sand, buff, fine- to medium-grained, trace of kaolin.
24	44	Sand, light-tan to white, kaolinitic, fine- to medium-grained.
19	63	Sand, buff, fine-grained.
30	93	Clay, gray, mottled with red, sandy.
19	112	Siltstone, gray, micaceous, slightly sandy.

51	163	Clay, gray, micaceous.
13	176	Sand, light-tan to white, medium-grained; silty in bottom part.
19	195	Clay, gray, sandy.
6	201	Sand, gray to light-tan, fine- to medium-grained, rare carbonaceous material.
13	214	Clay, gray, micaceous.
20	234	Siltstone, gray to light-gray, sandy, micaceous.
34	268	Clay, medium-gray, platy.
22	290	Clay, gray-to-medium-gray, pyritic.
		Vicksburg Group (Bucatunna Clay)
52	342	Clay, dark-gray, carbonaceous, slightly fossiliferous.
		Vicksburg Group (Byram Marl)
6	348	Marl, green-gray, fossiliferous, clayey.
		Vicksburg Group (Glendon Limestone)
4	352	Limestone, gray, glauconitic, fairly soft, calcareous.
8	360	Marl, gray, clayey, fossiliferous.

AL-43

Location: NW/4, NE/4, NW/4, Sec. 13, T. 1 N., R. 8 E., in woods, approximately 125 feet east of center line of hard surfaced county road.

Elevation: 320 feet (Altimeter) Date: September 22, 1971

Purpose: Drilled to a depth of 208 feet for stratigraphic information. Electrical log run from 10 feet to 207 feet.

Thickness	Depth	Description
		Catahoula Formation
10	10	Sand, grayish-orange, fine- to medium-grained; trace of kaolin.
14	24	Sand, light-tan, medium-grained to coarse-grained; streaks of light-gray clay.
18	42	Siltstone, light-gray, sandy, finely micaceous.
14	56	Sand, tan, fine- to medium-grained, micaceous, silty.
16	72	Siltstone, light-gray, sandy.
18	90	Sand, gray, very silty, micaceous.
20	110	Clay, gray, sandy.
		Vicksburg Group (Bucatunna Clay)
51	161	Clay, dark-gray, gypsiferous, micaceous, blocky.
12	173	Clay, dark-gray to black, micaceous, slightly sandy.
21	194	Clay, dark-gray to black, sandy; slightly fossiliferous in upper part.
		Vicksburg Group (Byram Marl)
14	208	Marl, green-gray, very fossiliferous.

AL-44

Location: NW/4, SE/4, SE/4, Sec. 3, T. 10 N., R. 14 W., on highway right-of-way, 75 feet southeast of center line of Highway 531, approximately 0.25 of a mile southwest of cross roads.

Elevation: 405 feet (Altimeter) Date: September 29, 1971

Purpose: Drilled to a total depth of 370 feet for stratigraphic information. Electrical log run from 10 feet to 370 feet.

Thickness	Depth	Description
		Terrace deposit
10	10	Sand, reddish-orange, medium- to coarse-grained, limonite staining.
50	60	Sand, buff, medium- to coarse-grained, rare quartz pebbles.
60	120	Sand, buff to pale-orange, fine- to medium-grained.
20	140	Sand, buff to white, medium- to coarse-grained, clear quartz grains with magnetite? inclusions.
18	158	Sand, buff, medium- to coarse-grained; abundant pea gravel; limonitic.
		Catahoula Formation
44	202	Clay, yellowish-tan, silty.
18	220	Siltstone, grayish-tan, sandy, platy.
12	232	Sand, buff, fine- to medium-grained.
26	258	Clay, grayish-orange, slightly sandy.
47	305	Sand, tan, fine- to medium-grained; abundant dark-gray chert.
35	340	Clay, tan, silty.
		Vicksburg Group (Bucatunna Clay)
30	370	Clay, dark-gray, carbonaceous, sparingly fossiliferous in part.

AL-45

Location: SW/4, NE/4, NW/4, Sec. 14, T. 1 N., R. 9 E., on highway right-of-way, 60 feet southeast of center line of Highway 531, approximately 300 feet northeast of intersection of Highway 531 and hard surfaced county road.

Elevation: 490 feet (Altimeter) Date: October 1, 1971

Purpose: Drilled to a depth of 300 feet for stratigraphic information. Electrical log run from 10 feet to 300 feet.

Thickness	Depth	Description
		Terrace deposit
10	10	Sand, buff to tan, medium-grained.
10	20	Sand, buff to tan, medium-grained; with thin streak of orange-red clay; occasional pebbles.
		Catahoula Formation
5	25	Siltstone, buff to white, very sandy kaolinitic.
21	46	Sand, tan, medium- to coarse-grained, silty.
16	62	Sand, light-brown, fine- to medium-grained, kaolinitic.
14	76	Clay, tan and orange mottled, silty, sandy in part.
12	88	Clay, pale reddish-brown, sandy.
4	92	Clay, tan, smooth, slightly sandy.
23	115	Clay, light-tan, bentonitic.
97	212	Sand, light-tan, fine- to medium-grained, clayey.
		Vicksburg Group (Bucatunna Clay)
28	240	Clay, dark-gray, finely carbonaceous.
40	280	Clay, dark-gray, finely carbonaceous, sparingly fossiliferous in upper part, gypsiferous.
		Vicksburg Group (Byram Marl)
11	291	Marl, gray to gray-green, glauconitic, fossiliferous.
		Vicksburg Group (Glendon Limestone)
9	300	Limestone, gray, soft, fossiliferous, calcareous.

AL-46

Location: SW/4, SW/4, SE/4, Sec. 25, T. 2 N., R. 9 E., on highway right-of-way, 60 feet northeast of center line of Highway 18, approximately 40 feet southeast of private drive.

Elevation: 400 feet (Altimeter) Date: October 31, 1971

Purpose: Drilled to a depth of 73 feet for stratigraphic information. No electrical log run due to hole conditions.

Thickness	Depth	Description
		Terrace deposit
30	30	Sand, buff, fine- to medium-grained; rare black chert.
12	42	Sand, light-tan to light-orange, medium-grained, limonite staining.
		Vicksburg Group (Bucatunna Clay)
24	66	Clay, dark-gray, carbonaceous, micaceous, slightly fossiliferous in bottom part.
		Vicksburg Group (Byram Marl)
7	73	Marl, gray, glauconitic, fossiliferous.

AL-47

Location: SW/4, SW/4, SE/4, Sec. 25, T. 2 N., R. 9 E. in field, approximately 100 feet northeast of center line of Highway 18.

Elevation: 400 feet (Altimeter) Date: October 25, 1971

Purpose: Drilled to a total depth of 300 feet for stratigraphic information. Electrical log run from 10 feet to 298 feet.

Thickness	Depth	Description
		Terrace deposit
28	28	Sand, buff to light-tan, medium-grained; light-gray clay in bottom part.
11	39	Sand, light-tan, medium-grained, limonite nodules, rare clear chert pea gravel.
		Vicksburg Group (Bucatunna Clay)
24	63	Clay, dark-gray, micaceous, carbonaceous in part.
		Vicksburg Group (Byram Marl)
6	69	Marl, gray, fossiliferous, slightly glauconitic.
		Vicksburg Group (Glendon Limestone)
2	71	Limestone, gray, fossiliferous, glauconitic.
5	76	Marl, gray to cream, clayey, fossiliferous.
6	82	Limestone, gray, glauconitic, calcareous.
35	117	Marl, gray, fossiliferous, slightly sandy in part; some indurated streaks.
		Vicksburg Group (Mint Spring Marl)
6	123	Marl, greenish-gray, very sandy, glauconitic, pyritic.
		Forst Hill Formation
19	142	Clay, dark-gray, carbonaceous, micaceous, slightly sandy in lower part.
14	156	Sand, fine- to medium-grained, slightly silty, rare pyrite.

37	193	Clay, dark-gray, carbonaceous, silty in part.
23	216	Sand, dark-gray, fine- to medium-grained, silty in part.
10	226	Silt, gray, carbonaceous.
61	287	Clay, dark-gray, micaceous, carbonaceous.
		Yazoo Formation
13	300	Clay, light olive-tan, calcareous, fossiliferous.

AL-48

Location: NW/4, NW/4, SE/4, Sec. 35, T. 2 N., R. 8 E., on county road right-of-way, approximately 40 feet northeast of center of cross road of two county roads.

Elevation: 342 feet (Altimeter) Date: October 27, 1971

Purpose: Drilled to a depth of 150 feet for stratigraphic information. Electrical log run from 10 feet to 149 feet.

Thickness	Depth	Description
		Catahoula Formation
24	24	Sand, tan to buff, fine- to medium-grained, silty in bottom part.
6	30	Clay, gray to light-gray, silty.
10	40	Sand, buff to light-tan, fine- to medium-grained; trace of kaolinite.
		Vicksburg Group (Bucatunna Clay)
24	64	Clay, gray to dark-gray, fossiliferous, clayey.
		Vicksburg Group (Byram Marl)
6	70	Marl, greenish-gray, fossiliferous, clayey.
		Vicksburg Group (Glendon Limestone)
3	73	Limestone, light-gray, glauconitic, fossiliferous.
4	77	Marl, gray, calcareous, clayey.
7	84	Limestone, gray, slightly sandy, hard.
24	108	Marl, gray to light-gray, clayey; indurated streaks near bottom.
		Vicksburg Group (Mint Spring Marl)
10	118	Marl, greenish-gray, glauconitic, fossiliferous.
4	122	Marl, greenish-gray, glauconitic, sandy, fossiliferous.
		Forest Hill Formation
8	130	Clay, gray to dark-gray, silty, carbonaceous.
12	142	Clay, dark-gray, very sandy.
7	149	Sand, gray, very fine-grained, carbonaceous.

AL-49

Location: NW/4, SE/4, SW/4, Sec. 33, T. 2 N., R. 9 E., 80 feet northwest of center line of hard surfaced county road, approximately 300 feet northeast of the intersection of paved road and dirt road.

Elevation: 313 feet (Altimeter) Date: October 29, 1971

Purpose: Drilled to a depth of 260 feet for stratigraphic information. Electrical log run from 10 feet to 259 feet.

Thickness	Depth	Description
		Alluvium
5	5	Sand, reddish-brown, fine- to medium-grained.
19	24	Sand, buff to light-tan, fine- to medium-grained, rare black chert, sand increasingly coarse-grained in bottom part.

		Vicksburg Group (Bucatunna Clay)
20	44	Clay, gray to dark-gray, silty, platy, rare fossil fragments.
		Vicksburg Group (Byram Marl)
9	53	Marl, greenish-gray, very sandy, fossiliferous, pyritic.
		Vicksburg Group (Glendon Limestone)
6	59	Limestone, gray, glauconitic, fairly hard, fossiliferous.
12	71	Marl, gray to light-gray, clayey, calcareous.
5	76	Limestone, gray, calcareous, glauconitic.
		Vicksburg Group (Mint Spring Marl)
13	89	Marl, gray, very sandy, fossiliferous, glauconitic.
		Forest Hill Formation
37	126	Clay, gray to dark-gray, carbonaceous, silty.
8	134	Sand, gray, fine-grained, carbonaceous.
26	160	Clay, gray to dark-gray, carbonaceous, lignitic.
18	178	Sand, gray, fine-grained, carbonaceous, silty, micaceous.
4	182	Clay, gray, carbonaceous.
5	187	Sand, gray, fine-grained.
57	244	Clay, gray to dark-gray, silty, carbonaceous, micaceous.
		Yazoo Formation
16	260	Clay, light olive-gray, fossiliferous, calcareous.

AL-50

Location: SE/4, SW/4, NW/4, Sec. 28, T. 10 N., R. 15 W., 70 feet south of center line of hard surfaced county road, approximately 0.3 mile east of bridge over Sullivans Hollow Creek.

Elevation: 293 feet (Altimeter) Date: November 2, 1971

Purpose: Drilled to a depth of 210 feet for stratigraphic information. Electrical log run from 10 feet to 209 feet.

Thickness	Depth	Description
		Alluvium
18	18	Sand, light-tan to buff, medium- to coarse-grained, silty in part; quartz granules in bottom part.
		Catahoula Formation
33	51	Clay, gray, silty, sandy; very sandy in bottom.
11	62	Sand, buff to tan, medium-grained.
32	94	Clay, gray to dark-gray, carbonaceous, lignitic; sandy in upper part.
16	110	Clay, tan, silty, micaceous.
10	120	Sand, light-tan, fine- to medium-grained, very silty.
24	144	Siltstone, light-gray, slightly sandy.
16	160	Sand, light-tan to white, medium-grained.
9	169	Clay, tan, slightly silty.
17	186	Siltstone, light-gray, clayey.
6	192	Clay, gray to dark-gray, silty.
6	198	Sand, tan, fine- to medium-grained.
12	210	Clay, gray, slightly sandy.

AL-51

Location: NE/4, SE/4, SE/4, Sec. 24, T. 10 N., R. 15 W., in woods, 250 feet southeast of center line of graveled road, approximately 0.2 of a mile southwest of bridge over Lyon Creek.

Elevation: 330 feet (Altimeter) Date: November 8, 1971

Purpose: Cored to a depth of 40 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Catahoula Formation
2	2	Clay, brick-red-and-gray mottled, silty.
4	6	Clay, ochre-and-gray mottled.
12	18	Clay, ochre-and-gray mottled, blocky, tough.
2	20	Sand, very fine-grained, tan, clayey.
6	26	Sand, very fine-grained; limonite streak; clayey in bottom 1 foot.
9	35	Clay, gray to blue-gray, tough.
3	38	Clay, dark-brown, very lignitic, plastic.
2	40	Clay, gray to light-gray, sandy in bottom foot.

AL-52

Location: NE/4, NE/4, SW/4, Sec. 31, T. 3 N., R. 7 E., in woods, approximately 400 feet southwest of center line of State Highway 18.

Elevation: 445 feet (Topographic map) Date: November 4, 1971

Purpose: Cored to a depth of 40 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Catahoula Formation
2	2	Clay, pale-orange and gray mottled, slightly sandy, silty.
2	4	Clay, gray, micaceous, blocky, silty.
2	6	Clay, gray; with limonite streaks; plastic, sandy.
3	9	Clay, gray to dark-gray, silty.
3	12	Sand, gray, very fine-grained, silty, limonitic, clayey.
4	16	Clay, light-brown, silty, tough, limonite streaks.
4	20	Clay, gray, very silty, blocky.
6	26	Clay, light-brown, limonitic, very sandy.
4	30	Sand, orange and tan mottled, fine-grained, limonitic, clayey.
4	34	Clay, light-brown, sandy.
6	40	Clay, blue-gray, silty, micaceous, slightly sandy; very sandy in bottom.

AL-53

Location: SW/4, NE/4, NW/4, Sec. 25, T. 4 N., R. 8 E., 35 feet west of center of unimproved dirt road.

Elevation: 365 feet (Topographic map) Date: November 5, 1971

Purpose: Cored to a depth of 32 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Yazoo Formation
2.5	2.5	Soil, sandy, buff to gray.
9	11.5	Clay, gray and brownish-orange mottled, sandy.
15.5	27	Clay, greenish-gray, tough, very fossiliferous.
5	32	Clay, greenish-gray, tough; less fossiliferous than above.

AL-54

Location: NE/4, SW/4, SE/4, Sec. 5, T. 4 N., R. 7 E., in highway right-of-way 125 feet east of center line of Highway 481, approximately 0.7 of a mile south of the Smith and Scott County line.

Elevation: 383 feet (Topographic map) Date: November 10, 1971

Purpose: Cored to a depth of 22 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Forest Hill Formation
7.5	7.5	Sand, very fine-grained, mottled orange and gray, very clayey.
.5	8.0	Clay, gray, very sandy.
6.5	14.5	Sand, orange to brownish-orange, very fine-grained, very clayey.
5.5	20	Sand, very fine-grained, orange and gray mottled, very clayey.
2	22	Sand, gray, very fine-grained, clean.

AL-55

Location: SW/4, NE/4, NW/4, Sec. 24, T. 4 N., R. 7 E., in woods, 60 feet south of center line of U. S. Forest Road 559, approximately 1200 feet east of bridge over Oakohay Creek.

Elevation: 430 feet (Topographic map) Date: November 10, 1971

Purpose: Cored to a depth of 36 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Forest Hill Formation
8	8	Clay, brick-red, gray and buff, becoming very sandy in bottom.
4	12	Clay, gray to buff, silty.
4	16	Clay, gray and orange mottled, slightly sandy.
2	18	Clay, gray to brown with laminae of fine-grained sand.
6	24	Clay and sand in thin laminae: clay, brown to gray; sand, gray, very fine-grained.
6	30	Clay, dark-gray; platy laminae of sand, very fine-grained.
6	36	Clay and sand in thin laminae: clay, dark-brown, lignitic; sand, very fine-grained.

AL-56

Location: SW/4, SE/4, NE/4, Sec. 31, T. 4 N., R. 6 E., on highway right-of-way, 70 feet northwest of center line of Highway 13, approximately 300 feet northeast of intersection of Highway 13 and graveled county road.

Elevation: 370 feet (Topographic map) Date: November 11, 1971

Purpose: Cored to a depth of 14 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Terrace deposit
14	14	Sand, tan, medium- to coarse-grained, clean.

AL-57

Location: SW/4, SE/4, NW/4, Sec. 13, T. 2 N., R. 6 E., on highway right-of-way, 70 feet north of the center line of hard surfaced county road, approximately 0.6 of a mile east of Traxler Crossroad.

Elevation: 548 feet (Topographic map) Date: November 16, 1971

Purpose: Drilled to a depth of 74 feet for stratigraphic information. Electrical log run from 10 feet to 73 feet.

Thickness	Depth	Description
		Citronelle Formation
20	20	Sand, salmon to reddish-orange, medium-grained.
10	30	Sand, buff, coarse to very coarse-grained.
20	50	Sand, light-tan, medium- to coarse-grained, rare rose quartz grains.
10	60	Sand, light-tan, medium- to coarse-grained; 50% sample quartz pea gravel.
14	74	Gravel, buff, quartz, pebble size, coarser in bottom.

AL-58

Location: NE/4, SW/4, SE/4, Sec. 27, T. 2 N., R. 7 E., on highway right-of-way, 60 feet east of center line of hard surfacen county road, approximately 0.5 of a mile south of country church.

Elevation: 370 feet (Altimeter) Date: November 17, 1971

Purpose: Cored to a depth of 42 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Catahoula Formation
4	4	Clay, red to maroon and gray mottled, silty.
4	8	Sand, gray, medium-grained, very silty and clayey.
2	10	Sand, gray, very fine-grained, silty, limonite streaks.
4	14	Sand, gray, very fine-grained, layey.
1	15	Sand, orange, fine-grained, clean.
1	16	Clay, dark-gray, sandy.
3	19	Siltstone, dark-gray, sandy.
6	25	Clay, maroon and dark greenish-gray mottled, silty.
2	27	Siltstone, dark greenish-gray inclusion of dark-green pure clay, very sandy.
1	28	Sand, greenish-gray, very fine-grained.
4	32	Clay, greenish-gray, platy, sandy.
5	37	Clay, light greenish-gray, very sandy, blocky.
2	39	Sand, light greenish-gray, very fine-grained, silty.
3	42	Clay, light greenish-gray, very sandy, blocky.

AL-59

Location: NW/4, NW/4, NE/4, Sec. 25, T. 1 N., R. 6 E., in pasture, 60 feet north of center line of graveled road, approximately 0.4 of a mile west of country church.

Elevation: 412 feet (Altimeter) Date: November 18, 1971

Purpose: Cored to a total depth of 36 feet to obtain samples for analysis. No electrical log run.

Thickness	Depth	Description
		Catahoula Formation
4	4	Sand, pale-orange and light-gray mottled, very clayey.
2	6	Clay, light-gray, slightly sandy.
8	14	Clay, light-gray, tough, pure.
2	16	Clay, light-gray, sandy.
10	26	Clay, brick-red and gray mottled; inclusion of limonite; slightly sandy.
2	28	Clay, gray and orange mottled, slightly sandy.
8	36	Sand, gray to dark-gray, fine- to very fine-grained; abundant limonite streaks.

AL-60

Location: NW/4, NE/4, NW/4, Sec. 21, T. 10 N., R. 16 W., on Highway right-of-way, 50 feet southwest of center line of hard surfaced county road, approximately 200 feet west of intersection of county road and Ross Barnett Lake Road.

Elevation: 490 feet (Altimeter) **Date:** November 25, 1971

Purpose: Drilled to a total depth of 315 feet for stratigraphic information. Unable to run electrical log due to hole conditions.

Thickness	Depth	Description
		Citronelle Formation
10	10	Sand, brownish-orange, medimum- to coarse-grained, clayey.
10	20	Siltstone, orange and pale-purple mottled, sandy.
30	50	Sand, buff, medium- to coarse-grained, limonitic.
10	60	Gravel, buff; average pebble size 6mm.
		Hattiesburg Formation
30	90	Siltstone, gray and orange mottled, sandy.
40	130	Clay, gray, orange and dull red mottled very sandy, silty in part.
10	140	Clay, orange-red and gray mottled, very sandy, micaceous.
		Catahoula Formation
20	160	Sand, buff to light-tan, fine- to medium-grained.
10	170	Sand, tan to light-brown, medium to coarse-grained, clayey, micaceous.
10	180	Clay, tan, orange and dull-red mottled, sandy in part, bentonitic in part.
30	210	Clay, gray, purple and dull-red mottled, sandy.
10	220	Clay, gray to dark-gray, carbonaceous.
10	230	Sand, buff, fine- to medium-grained, carbonaceous in part.
20	250	Sand, tan, medium- to coarse-grained, clayey.
10	260	Siltstone, gray-and-purple mottled, carbonaceous, sandy.
10	270	Sand, buff, medium- to coarse-grained.
45	315	Sand, buff, fine- to medium-grained.

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SMITH COUNTY CLAY TESTS

by

Rung Angurarohita

ABSTRACT

Nine deposits of clay from Smith County, Mississippi, were examined for physical and mechanical properties required in brick-making. The color and work ability were observed, and the water of plasticity, shrinkage, porosity, water absorption and modulus of rupture were measured. The measurements were performed in both green and fired states. Three temperatures of 1800° F., 1900° F., and 2000° F. were selected for the examinations. The clay minerals of the nine deposits were also identified by X-ray diffraction, differential thermal analysis (DTA) and scanning electron microscopy.

INTRODUCTION

Clay is one of the natural mineral resources of Smith County in Mississippi. Generally speaking, clays in this County are secondary deposits that are classified in the Jackson, Vicksburg and Catahoula groups. Although most of the deposits have not really been investigated, the presence of bentonite clay has been well known for a long time. At the present time, brick manufacturing is one of the large industries of Mississippi because the state has many suitable clays for brick-making. Although many deposits, such as those in Hinds, Claiborne, and George counties have been utilized, the supply still does not meet the demand of the factories. In 1969, the average number of bricks produced by all the factories in the state was approximately 1800 per hour and at the present time the rate of production is higher. Many deposits have been used up and new deposits are still being investigated. Preparation and firing of the specimens closely approximates the methods of the brick-making industry. Clay minerals are identified by X-ray, differential thermal analysis (DTA), and the scanning electron microscope. Thus, the decisions of possible utilization of the deposits are based on measurements of the physical and mechanical properties and analysis of the clay. Many deposits are suitable for brick-making, while some are not. The evaluation of clay deposits in Smith County, Mississippi, for utilization in the structural clay industry, was the purpose of this investigation.

MATERIALS AND METHODS

The clay samples, which were received from the Mississippi Geological Survey, were classified according to their natural color. The symbol "B" was given after the coring number to indicate that this sample was a minor portion of the clay coring. Each sample was completely dried in a drying oven at 110°C, crushed in a porcelain mortar, ground and mixed by a muller for about 30 minutes, and then screened. The part of the clay samples which passed a U. S. standard sieve number 10 was tempered with water by the trial-and-error method, with the amount of water being recorded as the water of plasticity, and then kept in a closed damp place for aging at least 24 hours. The clay was then extruded using a Fate-Root-Heath laboratory extruder, Model CH-TK.

The specimen used in the physical testing was a rectangular bar with dimensions about 5″ x 1″ x 0.5″, and was formed by the extrusion machine with the size of die 1″ x 0.5″ and under a vacuum of 21 inches of Hg.

The Physical and Mechanical Properties Measurements

1) The Per Cent of Water Plasticity: The water of plasticity was calculated as a percentage of the weight of the dry clay bar by the following formula (1)

$$T = \frac{W_p - W_d}{W_d} \times 100$$

in which T was per cent water of plasticity

W_p was weight of plastic test piece

W_d was weight of dry test piece

Plastic Weight: The edges and corners of the test piece were rubbed lightly with the finger to prevent loss in handling and was weighed on a balance to an accuracy of 0.1 grams.

Drying: The test piece was dried at 64°C for 5 hours and at 110°C until approximately constant in weight. The results of these measurements were tabulated in Table IV.

2) Linear Drying Shrinkage: The shrinkage marks on each test piece were initially 3 inches apart. The per cent of linear drying shrinkage was calculated from the following formula (1):

$$a_p = \frac{l_p - l_d}{l_p} \times 100$$

in which a_p was per cent of linear drying shrinkage

l_p was plastic length (3 inches)

l_d was dry length

Three test pieces were selected in these measurements. The dry length was determined after the test pieces were completely dry. The drying was performed at 64°C for 5 hours and 110°C for 10 hours. The accuracy of these measurements were 0.001 inches, and the results were tabulated in Table IV.

Firing shrinkage: The test pieces were fired to the required temperature and maintained for 30 minutes. The fired length was determined after the test pieces were allowed to cool slowly down to room temperature, and the accuracy of these measurements was 0.001 inches. The formula of these measurements was as follows:

$$b_p = \frac{l_p - l_f}{l_p} \times 100$$

where b_p was plastic length or original length (3 inches)

l_f was fire length

Three test pieces were prepared for each measurement, and the results were tabulated in Table IV.

3) Modulus of Rupture: Dry strength was determined when the test pieces were dried at 64°C for 5 hours and at 110°C until approximately constant weight and were cooled in a desiccator. The testing machine used in this measurement was similar to the one described in the report by the American Ceramic Society Committee on Standards. The formula commonly employed to determine the dry strength for bars of rectangular cross section

$$M = \frac{3\,PL}{2bd^2}\,(X)$$

where M was modulus of rupture in psi

P was breaking load in lbs.

L was distance between knife edges in inches

b was breadth of bar in inches

d was depth of bar in inches

X was multiplying factor of this machine is 4

Three bars, processed under the same parameters, were broken and the results were tabulated in Table IV.

4) Apparent Porosity: The apparent porosity was calculated by means of the following formula (1):

$$P = \frac{S_f - W_f}{V_f} \times 100$$

where P was the per cent apparent porosity

S_f was weight of the saturated fired test piece in gms.

W_f was weight of the fired test piece in gms.

V_f was volume of the fired test piece in cc.

The test pieces were placed in distilled water in a suitable vessel, in which they were not allowed to make contact with the heated bottom of the container, were boiled for two hours, and then were allowed to cool to room temperature while they were still immersed in water. Suspended weight and saturated weight were determined with an accuracy of 0.1 grams. Fired volume was determined from the following formula:

$$V_f = \frac{W_f - W_s}{S}$$

Where V_f was volume of the fired test piece in cc.

W_f was weight of the fired test piece in gms.

W_s was weight suspended in water in grams.

S was the specific gravity of distilled water which in this case was approximately 1.

Three test pieces were measured and the results were tabulated in Table I.

5) Water Absorption: The per cent of water absorption was calculated from the following formula (1):

$$c = \frac{S_f - W_f}{W_f} \times 100$$

where c was the per cent of water absorption

S_f was weight saturated with water

W_f was weight of the fired test piece

Three test pieces of each sample were measured and the results were tabulated in Table I.

Mineral Identification

The mineralogical identifications were based upon the X-ray diffraction analysis, the differential thermal analysis, and the scanning electron microscopy analysis.

1) X-Ray Diffraction Analysis: The specimens for x-ray diffraction analysis of each deposit were prepared by the method shown in Appendix A, Appendix B, and Appendix C. The oriented samples were mounted on the x-ray diffractometer, which was manufactured by the General Electric Company and had the following specification:

KVP 50, Ma 12, Target Cu, Ni Filter

Chart speed 1″/minute, Scanning speed 2° 2θ per minute

Full Scale Deflection - 5000 CPS

The scanning occurred over the range from 1 to 13 degree 2 0 and the defractograms are shown in Figures 1-18.

2) Differential Thermal Analysis: The DTA thermograms were made on a Delta Therm Differential Thermal Analyzer, Model D2000, Serial number 255, equipped with a four channel recorder and was manufactured by Technical Equipment Corporation. The samples, which were packed into nickel holders, were prepared by the method in Appendix D. The DTA thermograms were plotted from 25°C to 1000°C. The heating rate was constant at 10°C per minute and the standard or inert material was alpha alumina, which was preheated at 1000°C. The thermograms were shown in Figures 19-23.

3) Scanning Electron Microscopy Analysis: The scanning electron micrograms were prepared by Dr. Gary G. Paulson of Louisiana State University.

X-Ray Diffraction Analysis

The sample for X-ray analysis required special consideration because of the major importance placed on the basal or (00L) diffraction spacings. The d/n value for the different peaks of montmorillonite, vermiculite, and various interstratified minerals was dependent upon the cation exchange saturation and on the liquid medium that was absorbed on the layer surfaces. The interplanar spacing of many clay minerals was made greater by saturation with Mg^{+2} or Ca^{+2} than with K^{+} or Na^{+}. The diffractograms of the oriented samples are shown in Figures 1-18, and the clay mineral identifications are shown in Table II.

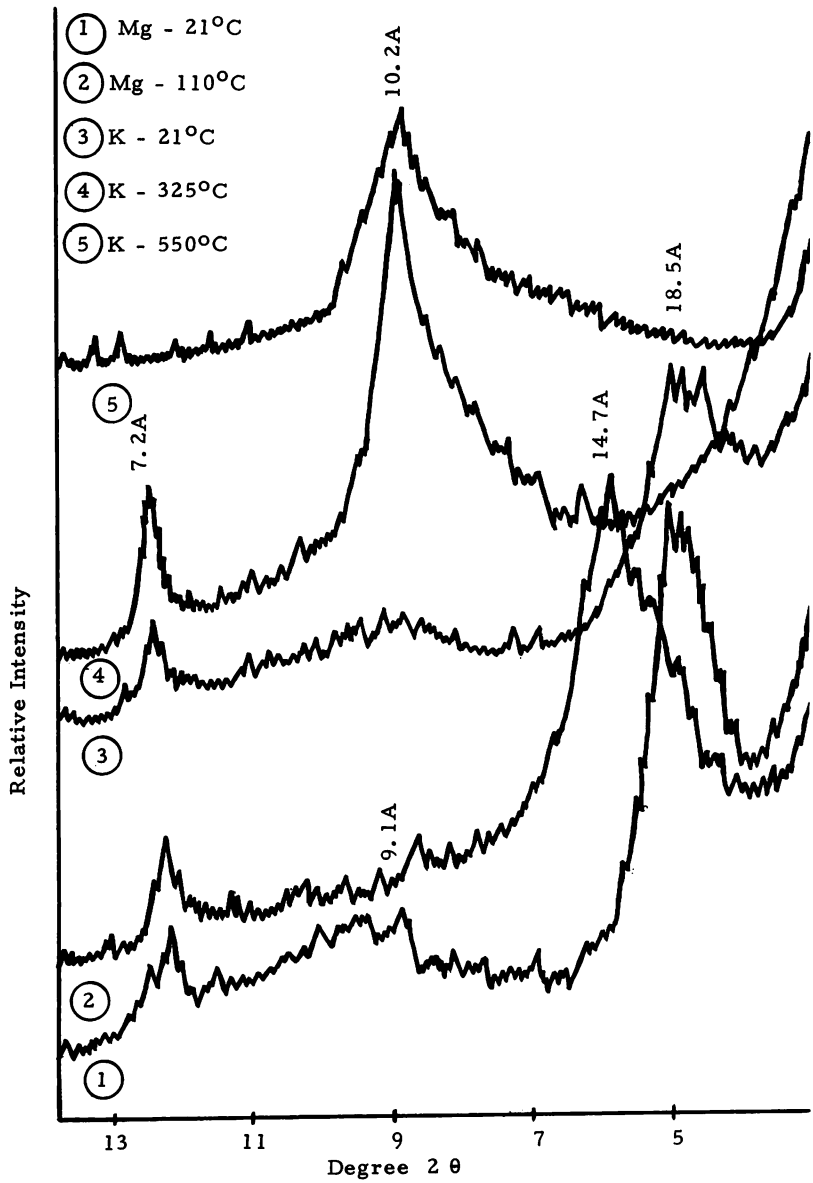

Figure 1 X-Ray Diffractograms of Oriented Sample
Core No. A1-33 <2μ fraction

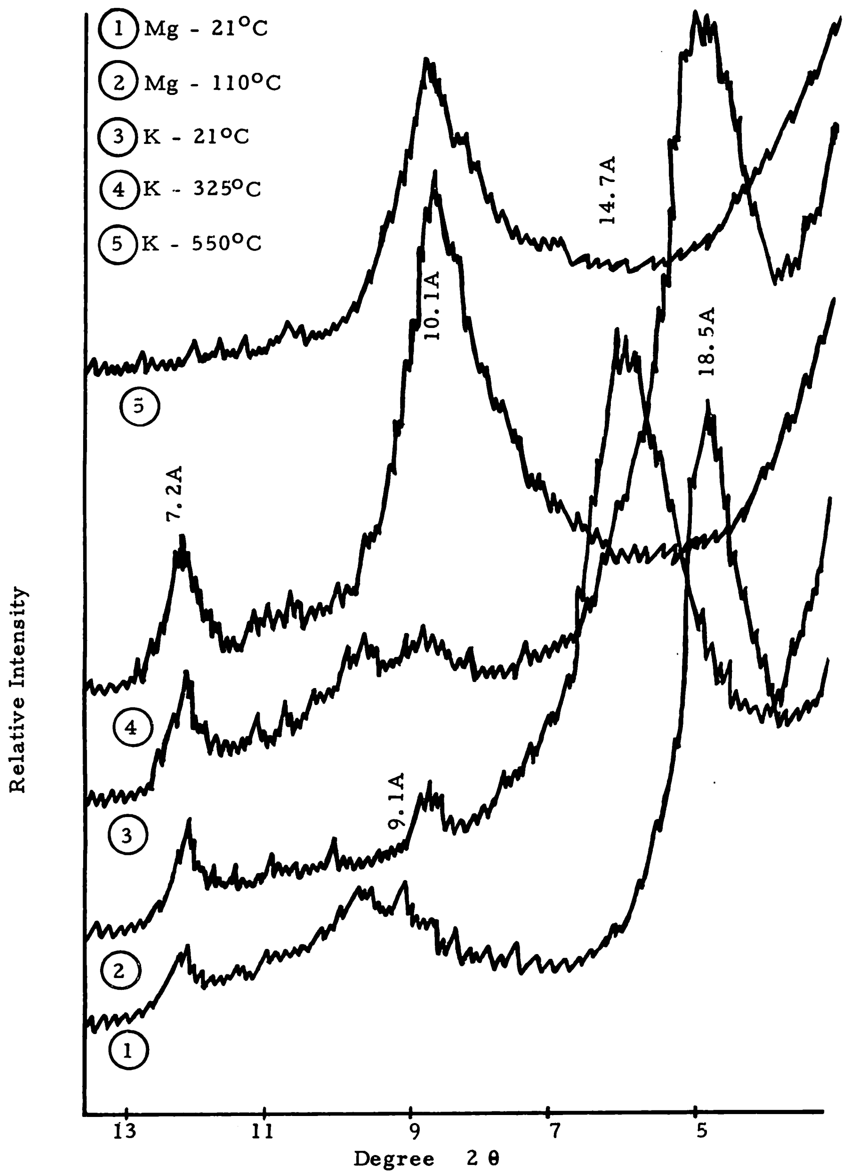

Figure 2 X-Ray Diffractograms of Oriented Sample
Core No. Al-33(B) < 2μ fraction

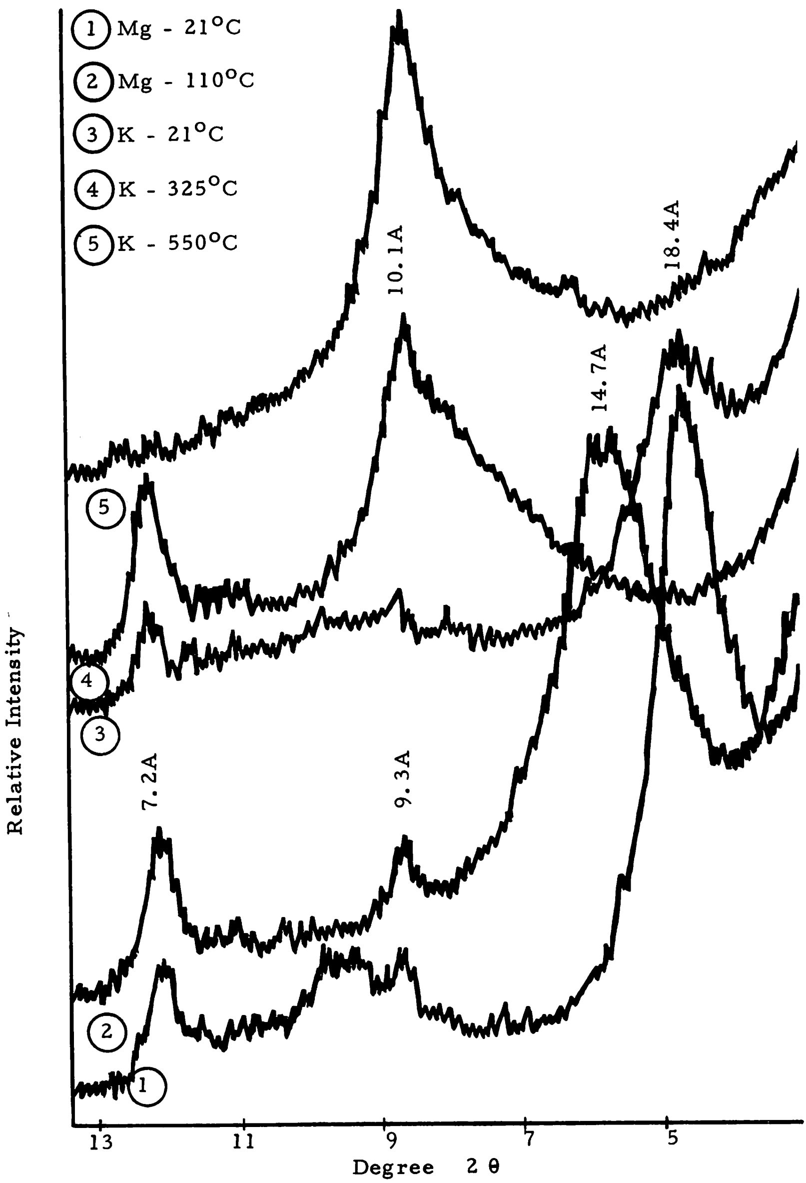

Figure 3 X-Ray Diffractograms of Oriented Sample
Core No. Al-36 < 2μ fraction

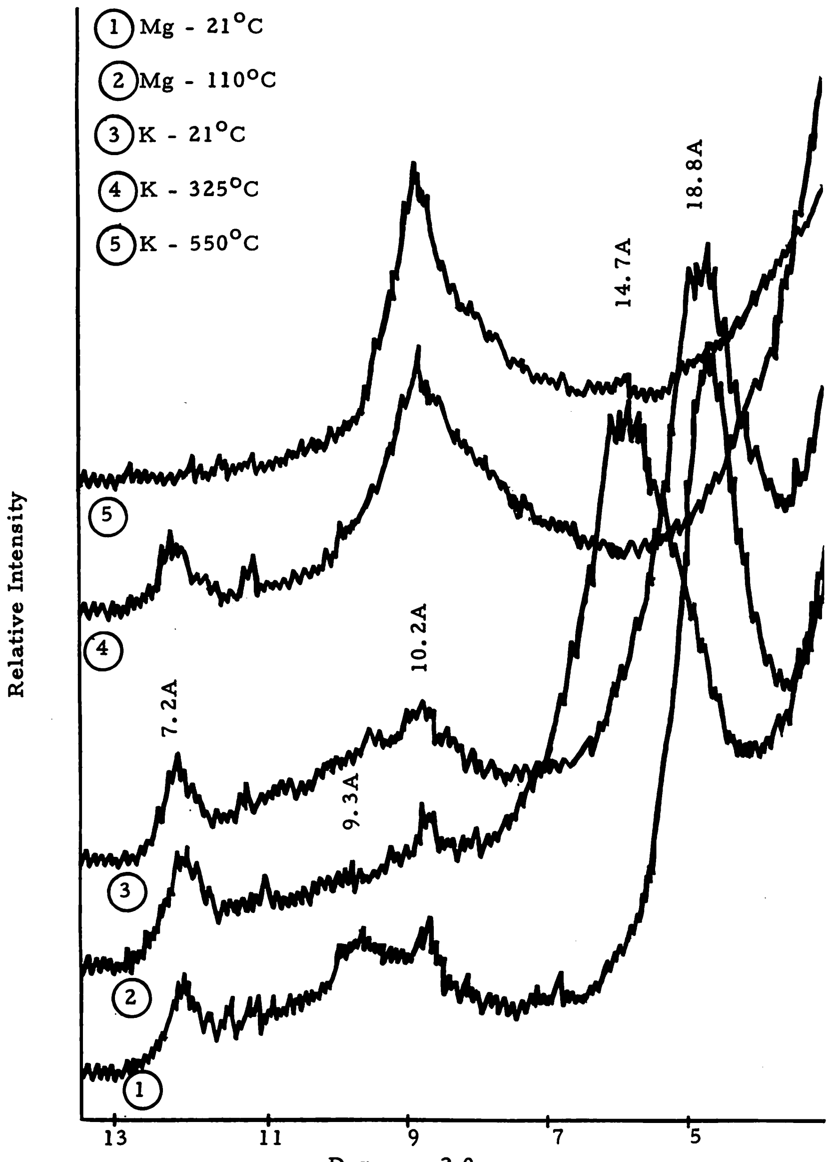

Figure 4 X-Ray Diffractograms of Oriented Sample Core No. Al-36(B) < 2 μ fraction

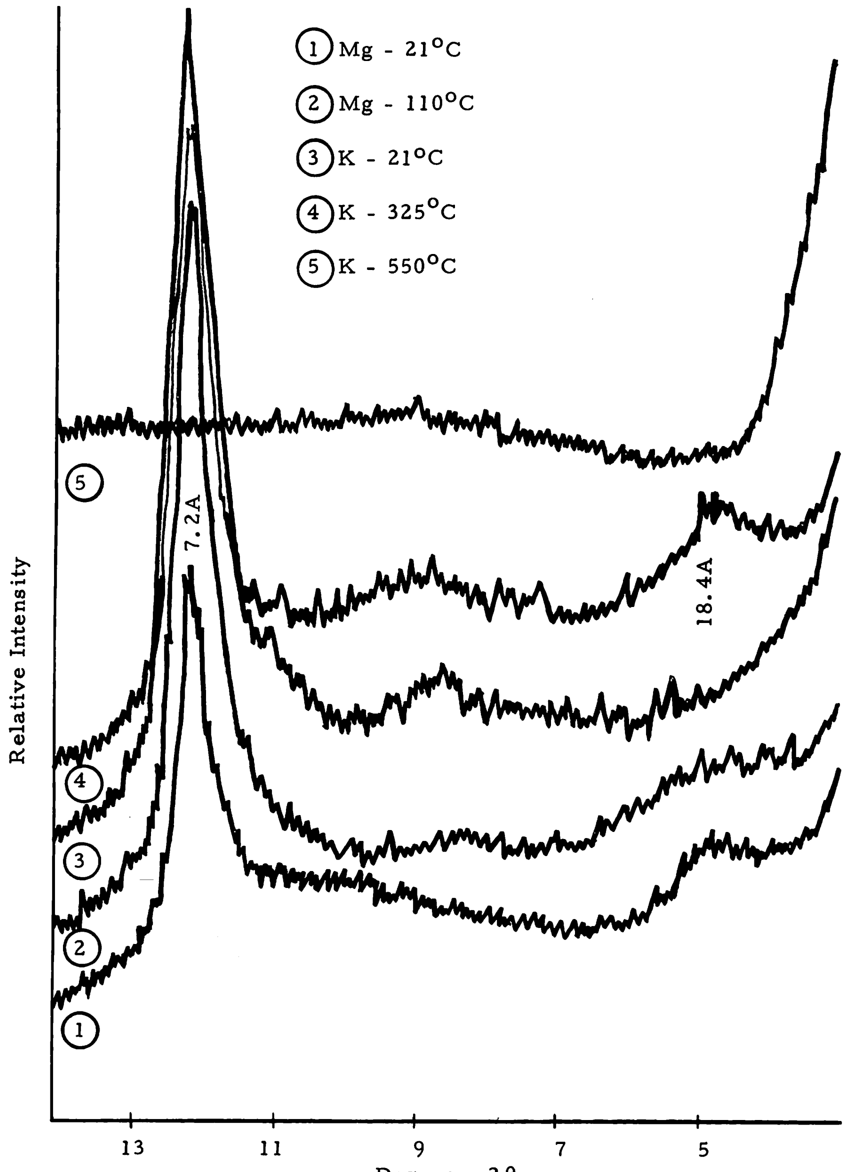

Figure 5 X-Ray Diffractograms of Oriented Sample Core No. Al-38, $<2\mu$ fraction

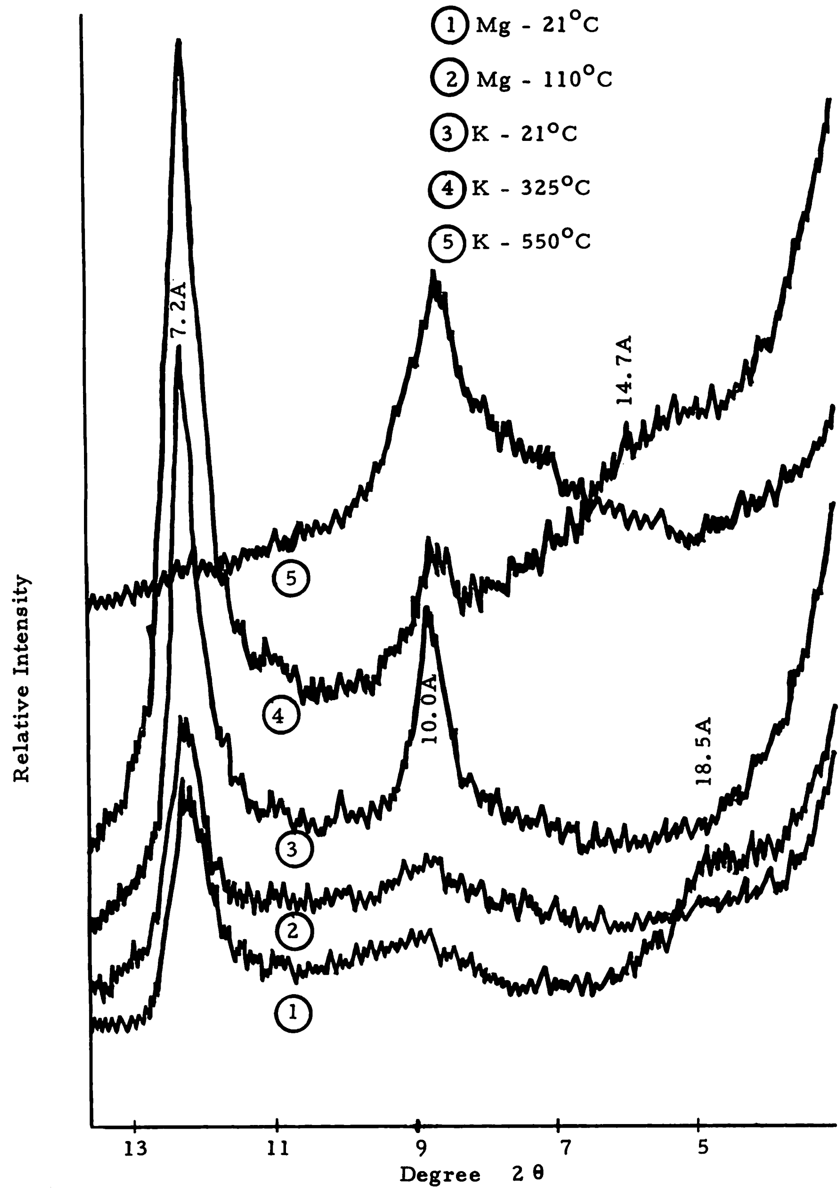

Figure 6 X-Ray Diffractograms of Oriented Samples
Core No. Al-38(B) < 2 μ fraction

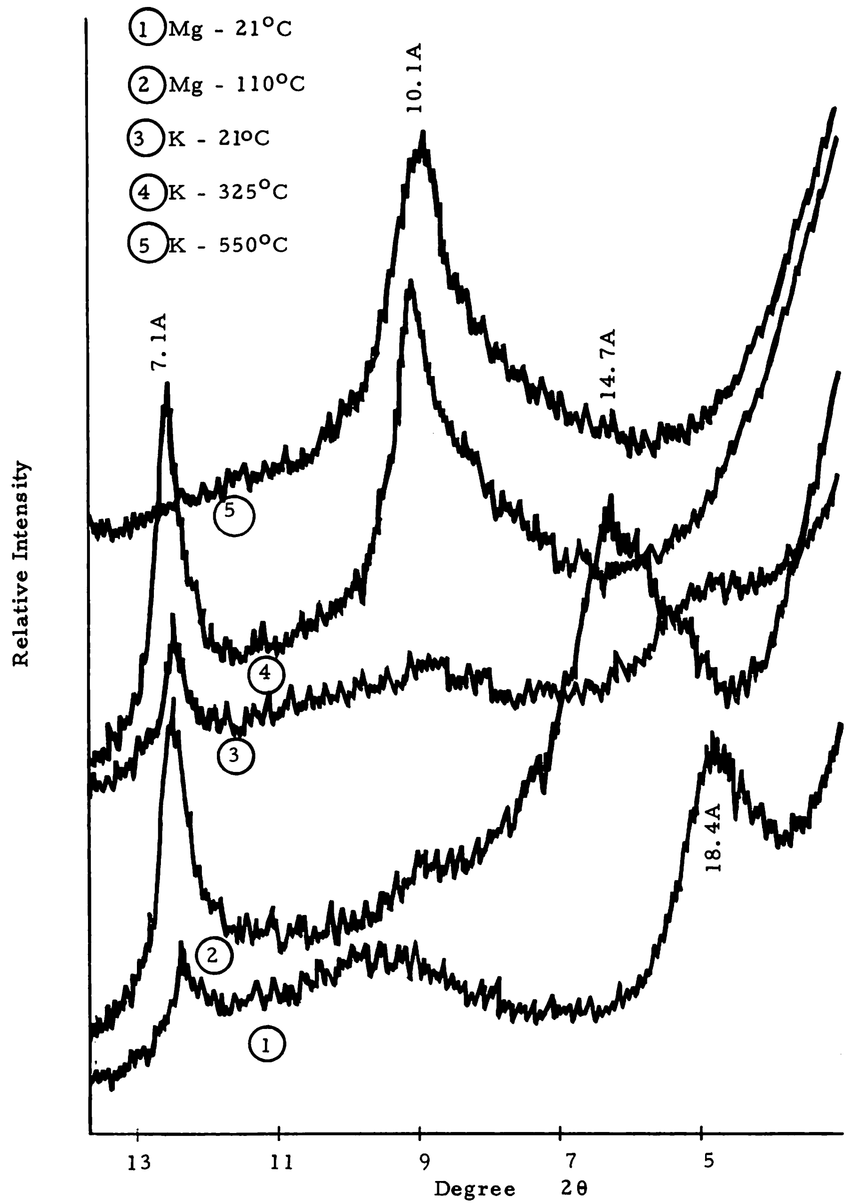

Figure 7 X-Ray Diffractograms of Oriented Sample Core No. Al-40, < 2μ fraction

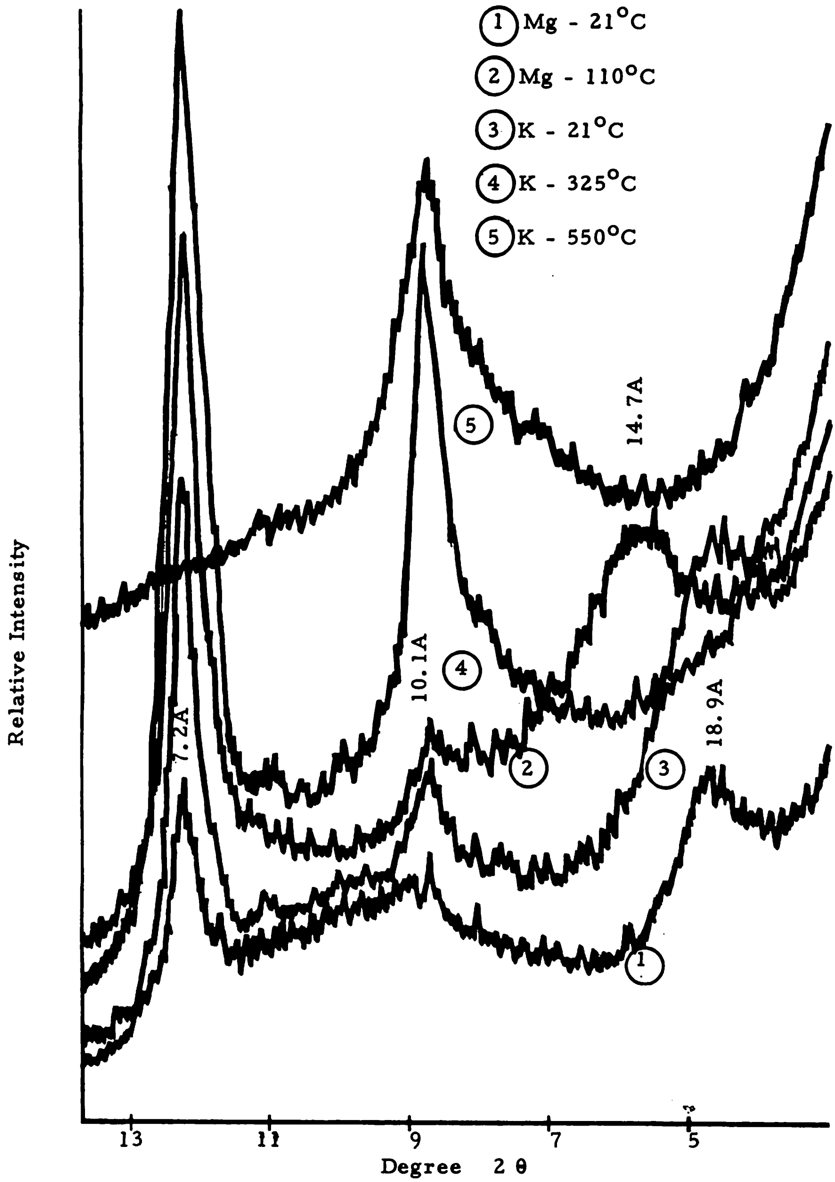

Figure 8 X-Ray Diffractograms of Oriented Sample Core No. Al-41(4'-22') < 2 μ fraction

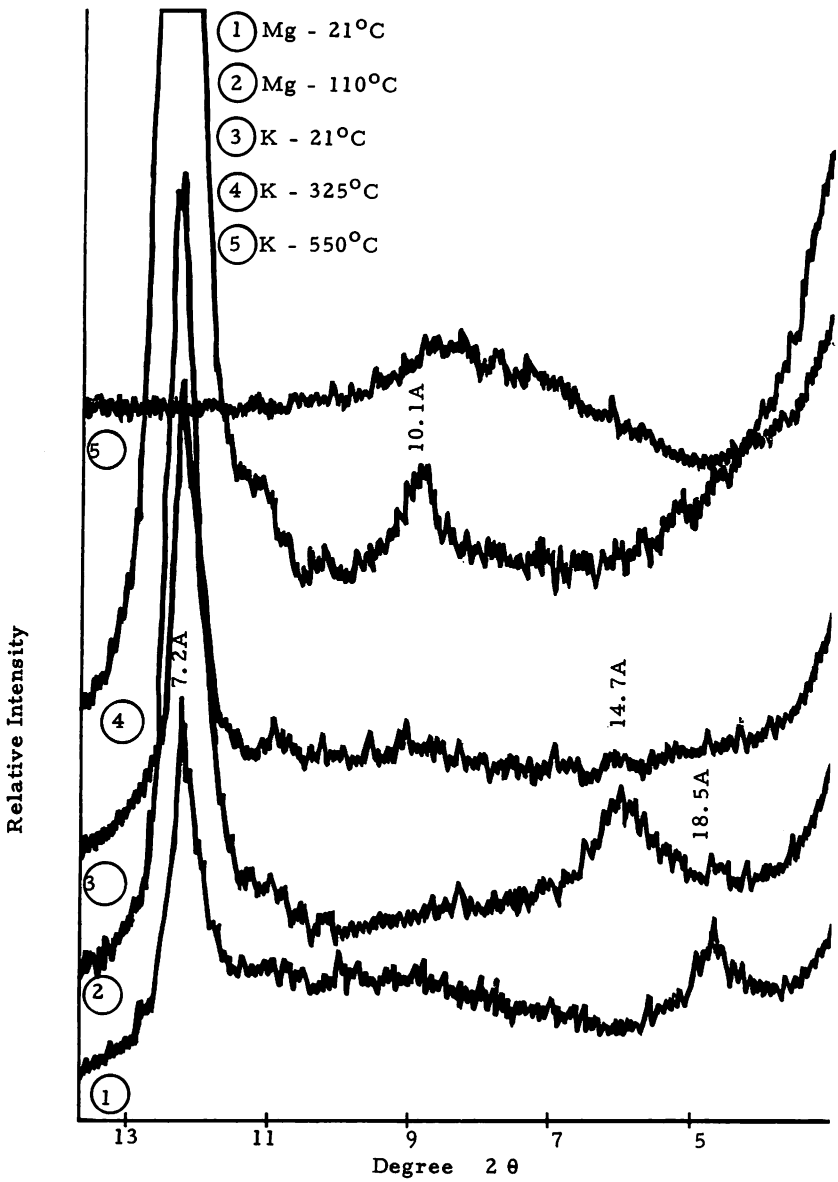

Figure 9 X-Ray Diffractograms of Oriented Sample Core No. Al-41(22'-36') < 2 μ fraction

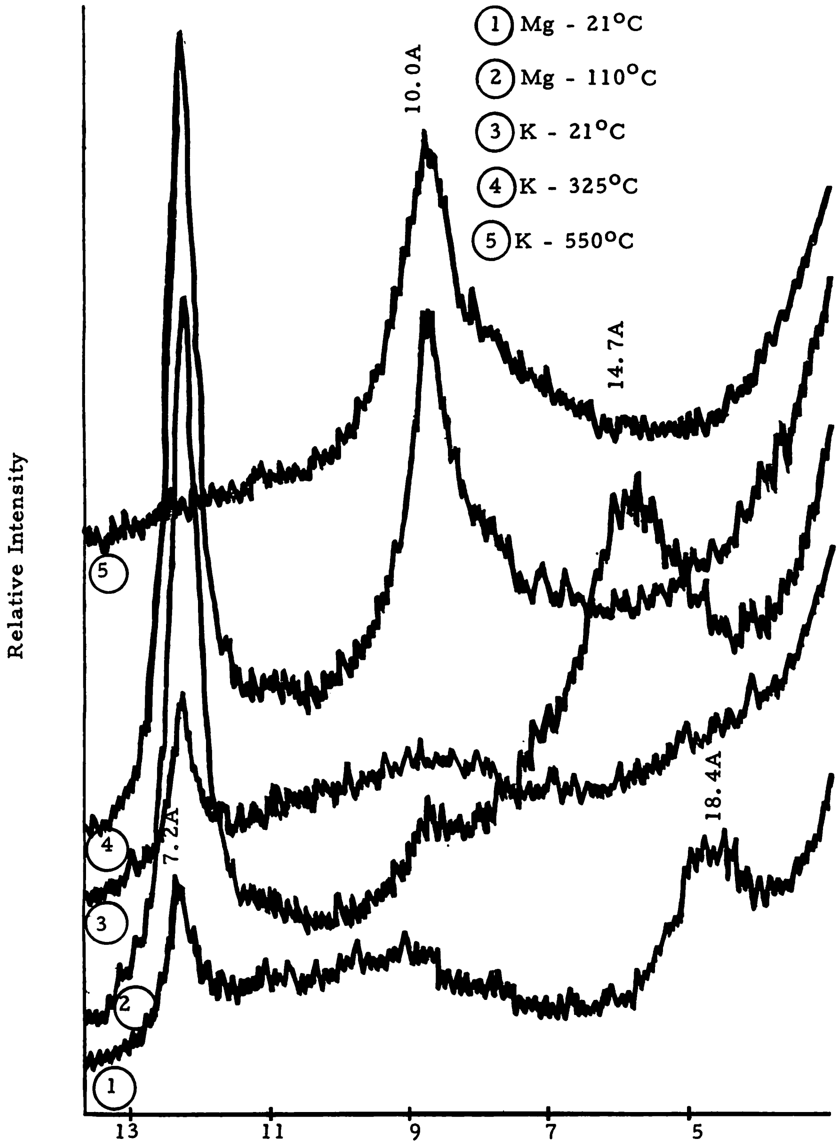

Figure 10 X-Ray Diffractograms of Oriented Sample Core No. Al-51(0-18') < 2μ fraction

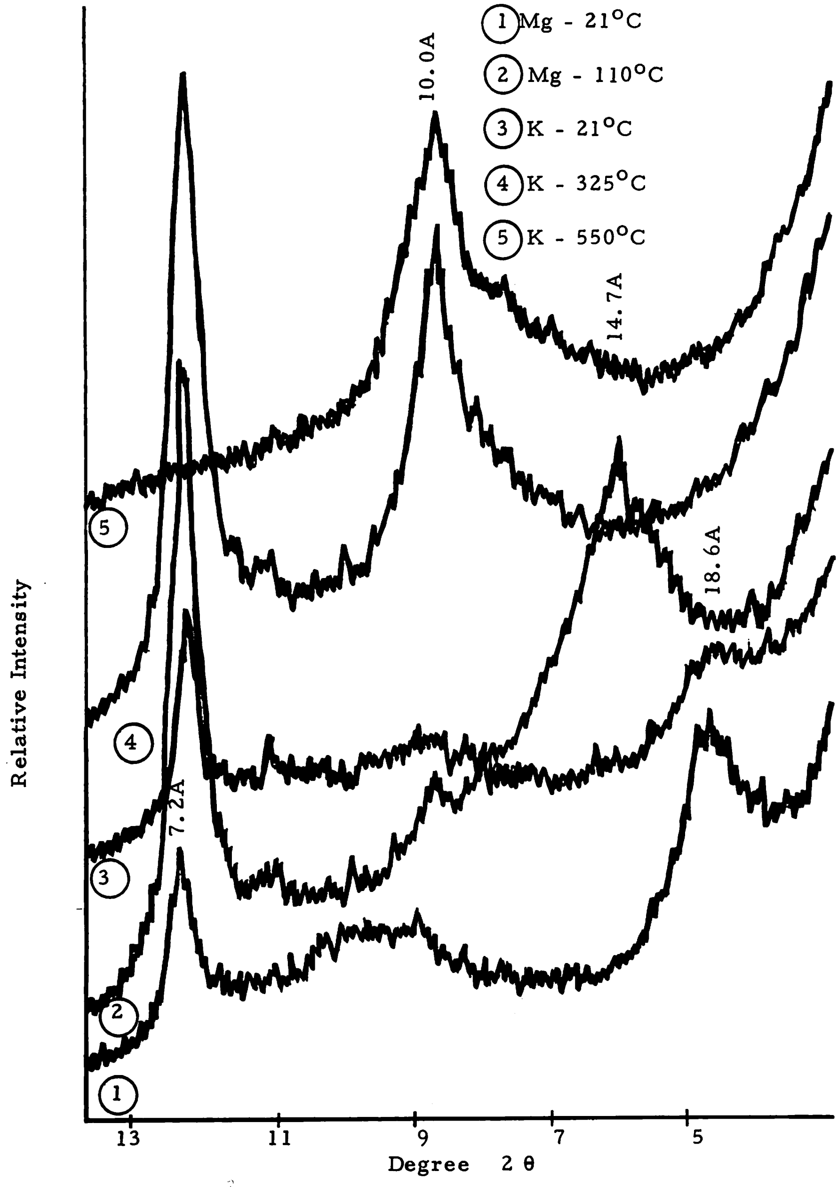

Figure 11 X-Ray Diffractograms of Oriented Sample Core No. A1-51(26'-38') < 2μ fraction

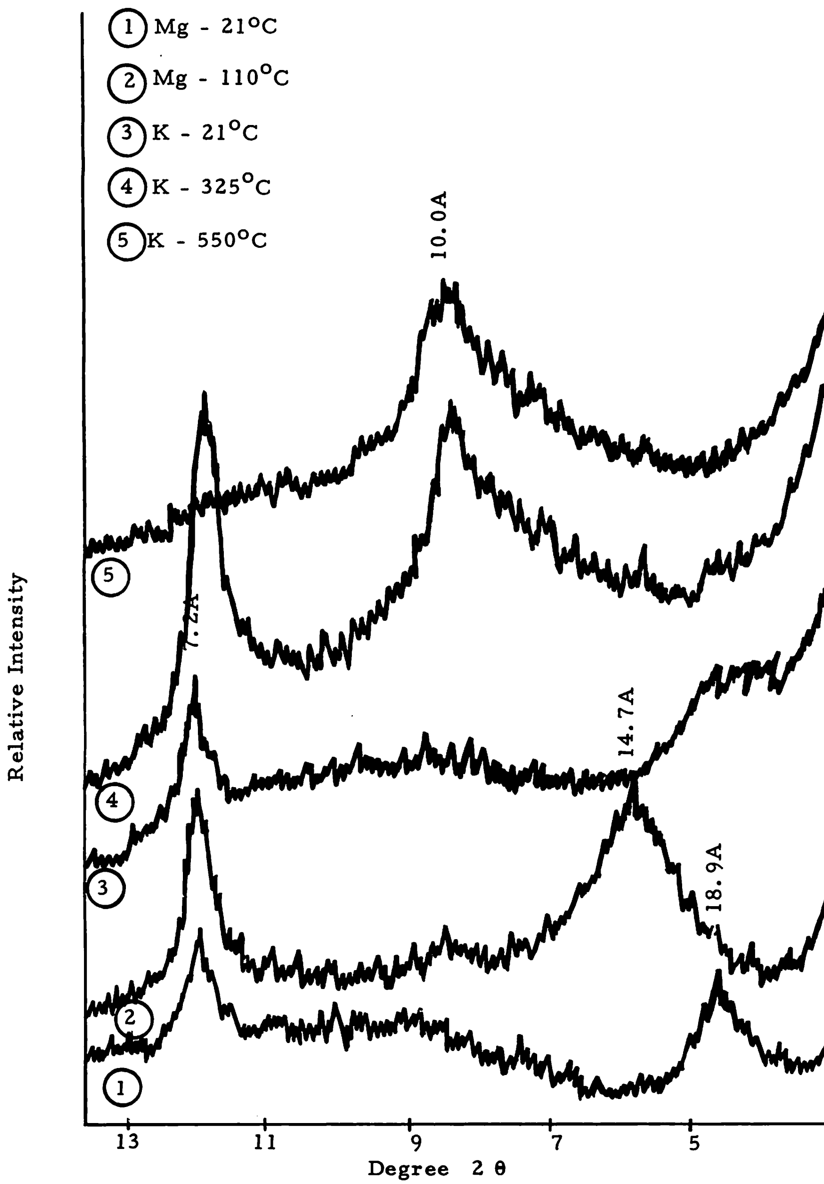

Figure 12 X-Ray Diffractograms of Oriented Sample Core No. A1-52 < 2μ fraction

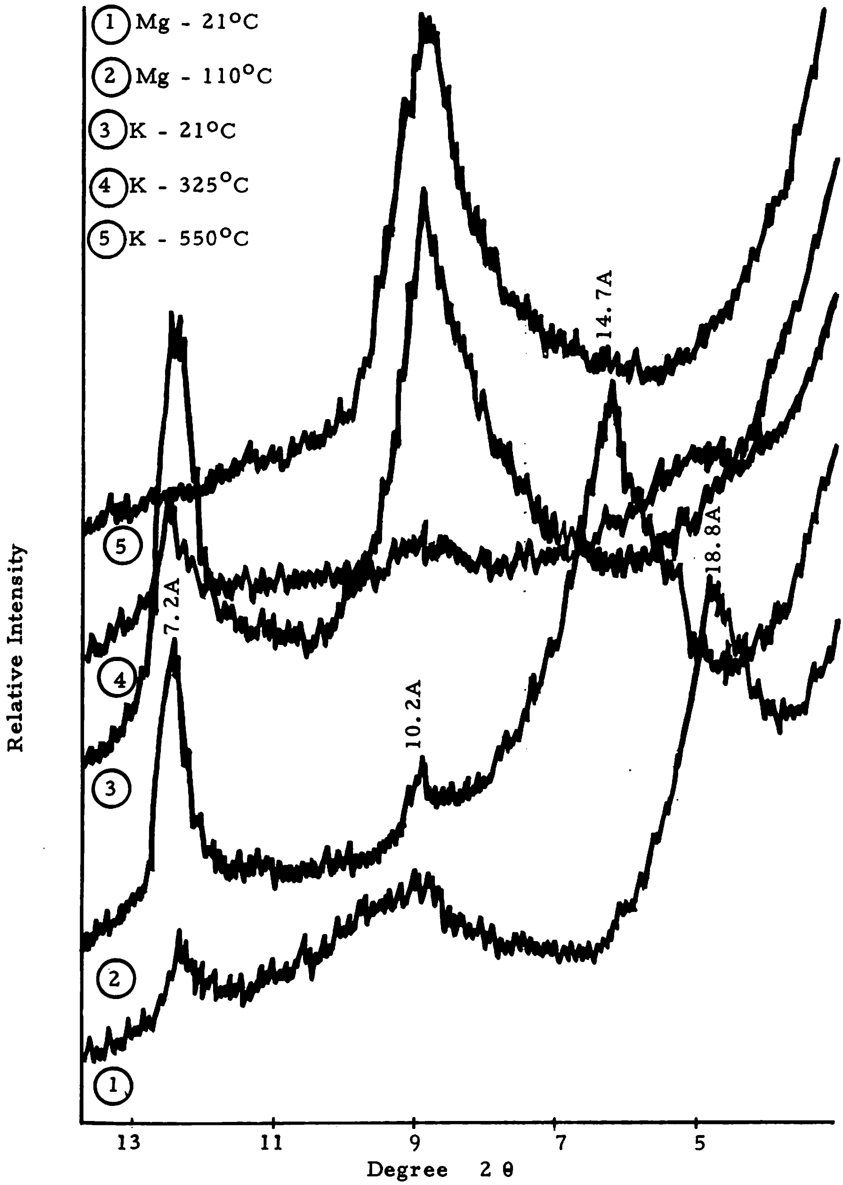

Figure 13 X-Ray Diffractograms of Oriented Sample Core No. Al-53 < 2 μ fraction

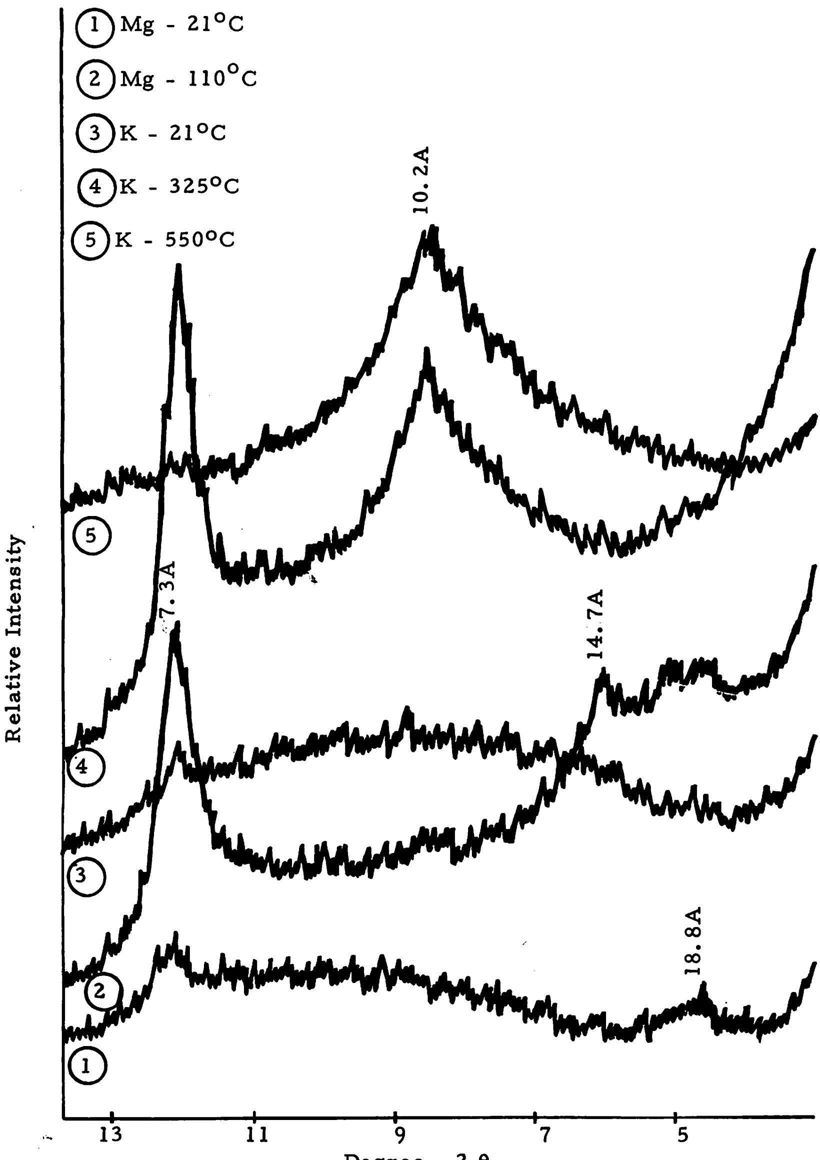

Figure 14 X-Ray Diffractograms of Oriented Sample Core No. A1-53(B) < 2μ fraction

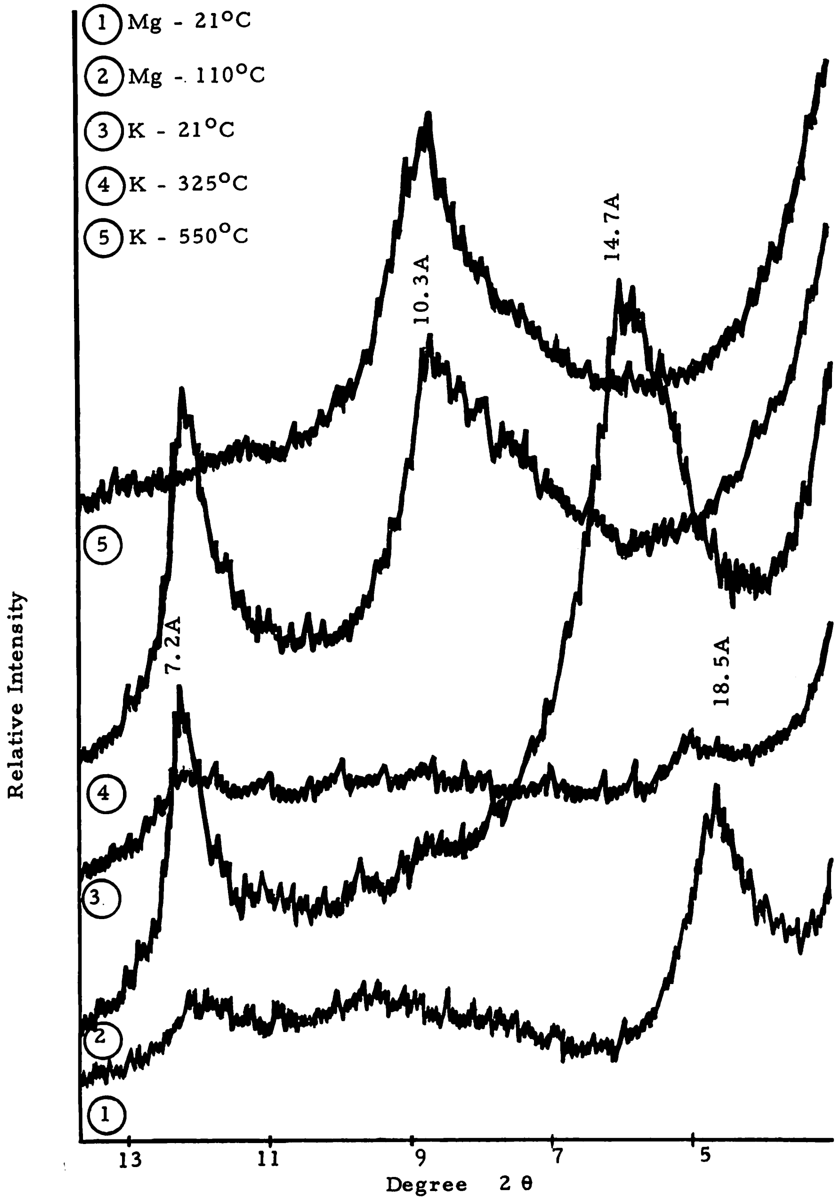

Figure 15 X-Ray Diffractograms of Oriented Sample Core No. Al-55(0-16') < 2μ fraction

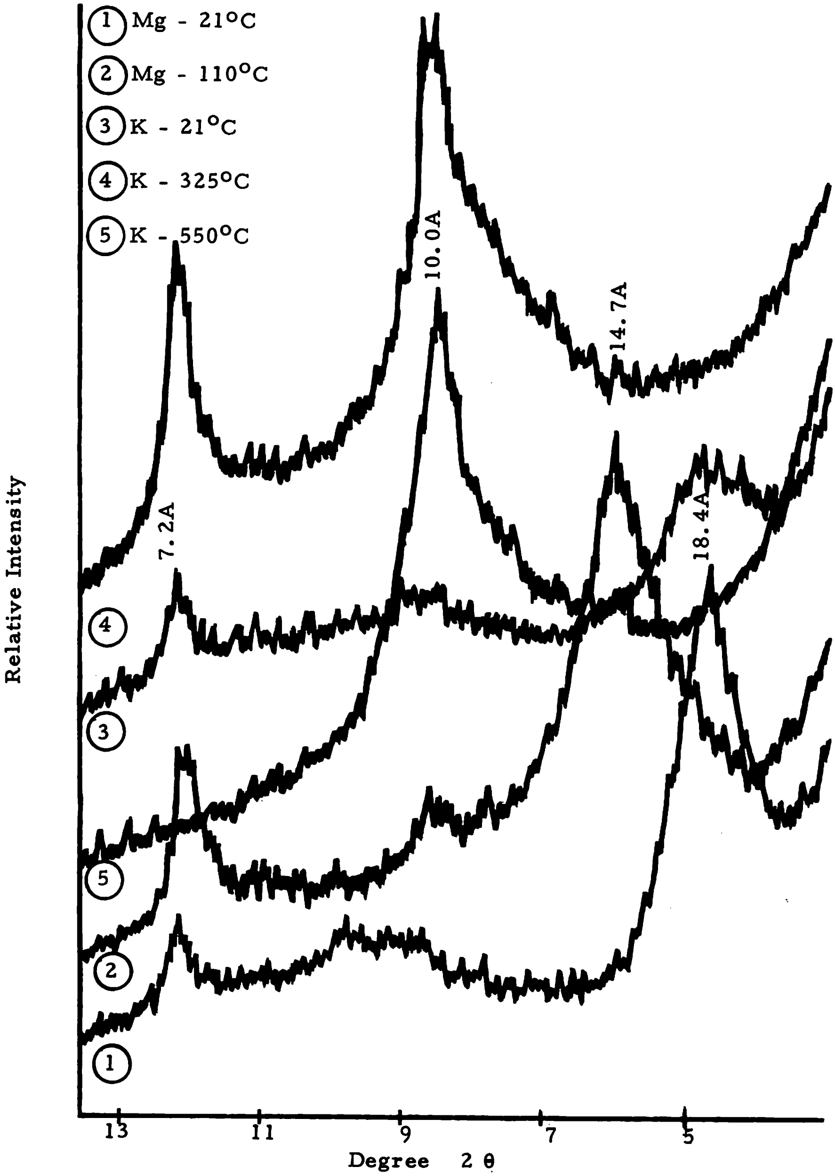

Figure 16 X-Ray Diffractograms of Oriented Sample Core No. Al-55(16'-37') < 2μ fraction

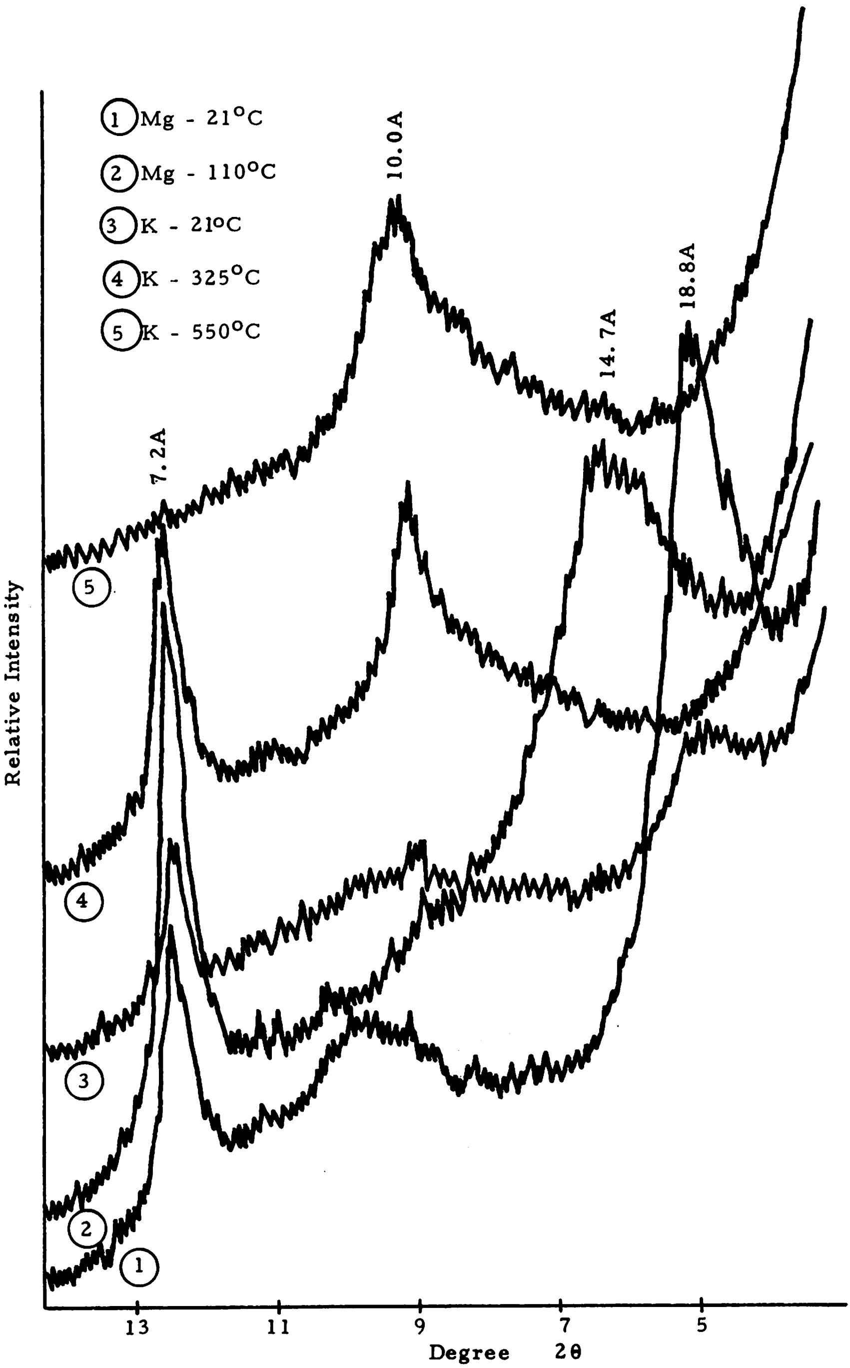

Figure 17 X-Ray Diffractograms of Oriented Sample Core No. Al-58 (0-42') $\leq 2\mu$ fraction

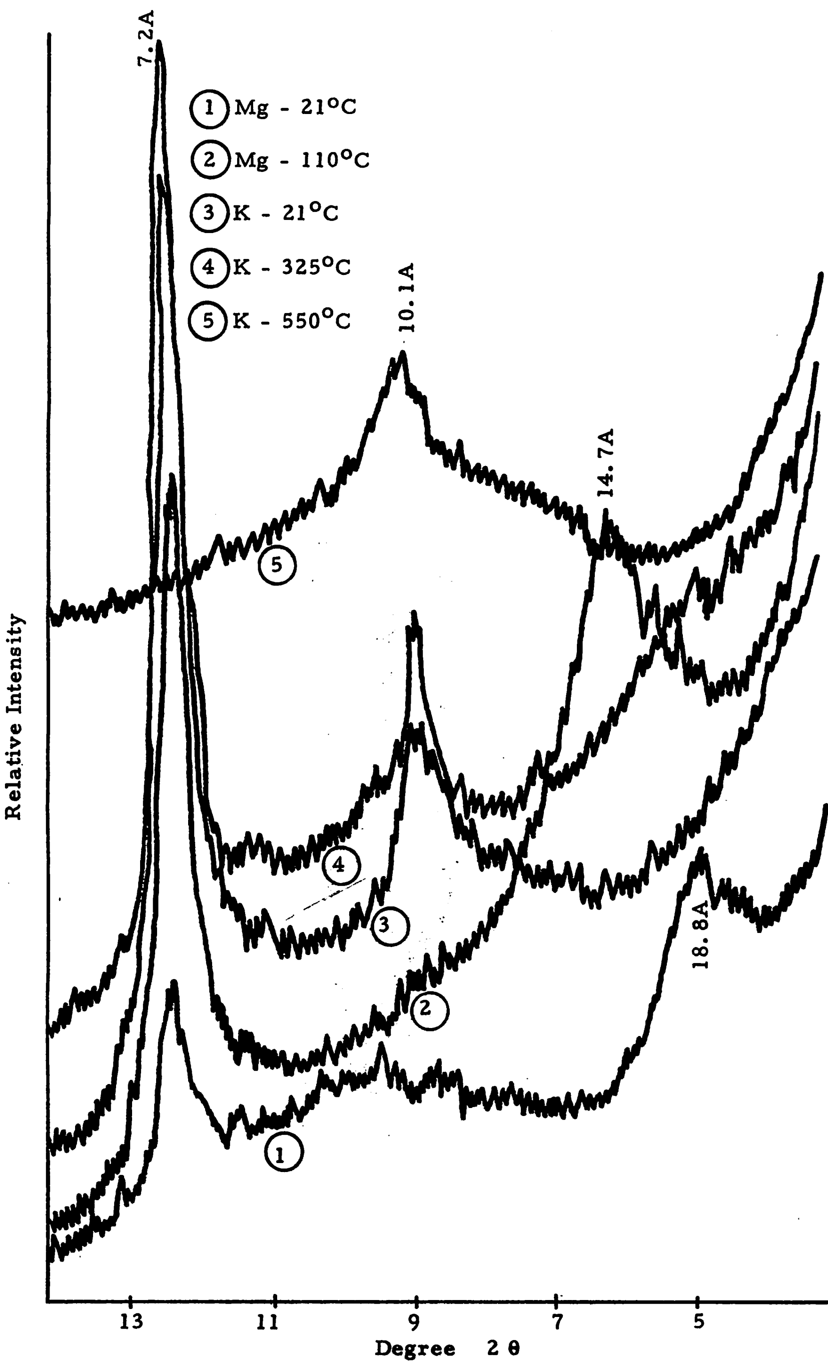

Figure 18 X-Ray Diffractograms of Oriented Sample
Core No. Al-59(0-36') < 2 μ fraction

Differential Thermal Analysis

DTA is a sensitive test for the presence of hydroxyl minerals in the samples and for some mineral species that are not readily differentiated by diffraction properties (2). The identification of a clay mineral by DTA takes into consideration the heat of endothermic and exothermic reactions. The heat of the endothermic reaction is indicated by the loss of OH-groups and the dehydration of the mechanical water. The oxidation of the organic matter and the recrystallization and its growth have the characteristics of exothermic reactions. The thermal diagrams from Figures 19-23 show the character of montmorillonite, illite, and kaolinite, which was indicated by the various shapes of the curves. The endothermic reaction, based on the dissociation of OH groups from Al and OH group from Mg, evidenced montmorillonite by a doublet peak while the exothermic reaction evidenced recrystallization of the samples. Illite was identified by the heat absorption and heat evolution curves, while it differed from montmorillonite by the doublet peak at the dehydration temperature. Kaolinite was indicated by two endotherms and one exotherm in this identification range. The first endothermic reaction is the dehydration of absorbed water, and the second is the loss of OH group from the structure. The loss of the OH group destroyed the structure, and the sample became amorphous as indicated by the broad peak. The exothermic reactions were the result of the recrystallization of the amorphous compound. The other amorphous materials, such as stable and unstable allophane, silica, alumina, rutile, and 2:1 layer silicate relics, were found in the deposits by the flat and rough shape of the endothermic reaction at the dehydration period. Amorphous ferric oxide was also found in core number Al-33(B) and Al-36(B); this was indicated by the maximum exothermic reactions of 425°C and 440°C respectively. The results of these identifications are tabulated in Table III.

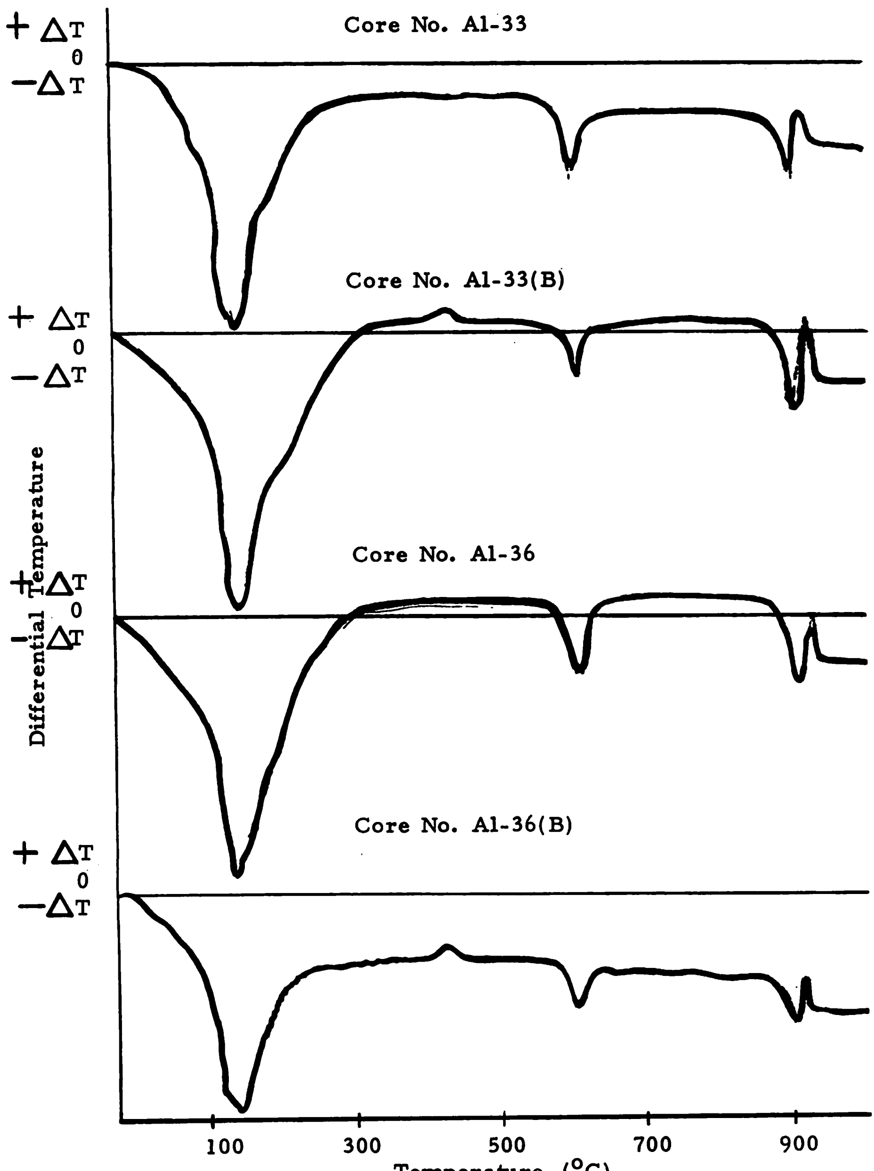

Figure 19 Differential Thermal Curves

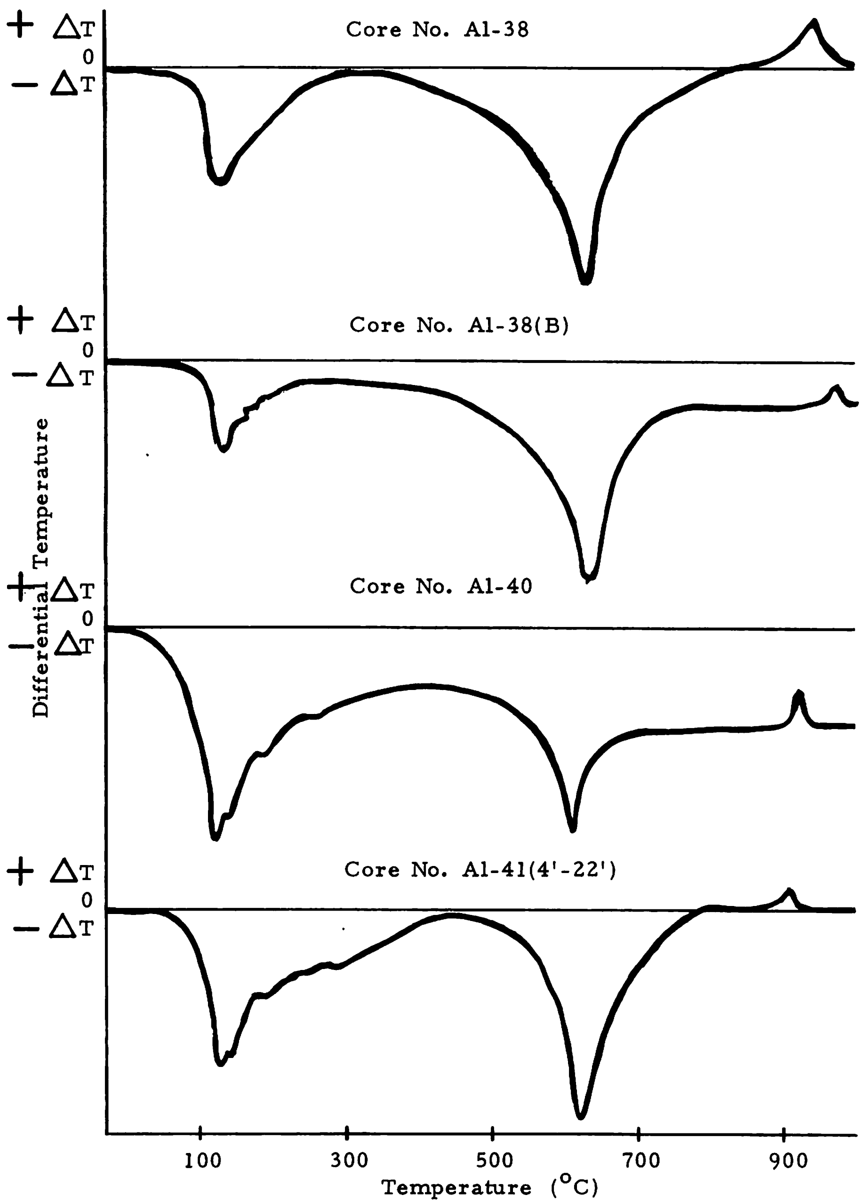

Figure 20 Differential Thermal Curves

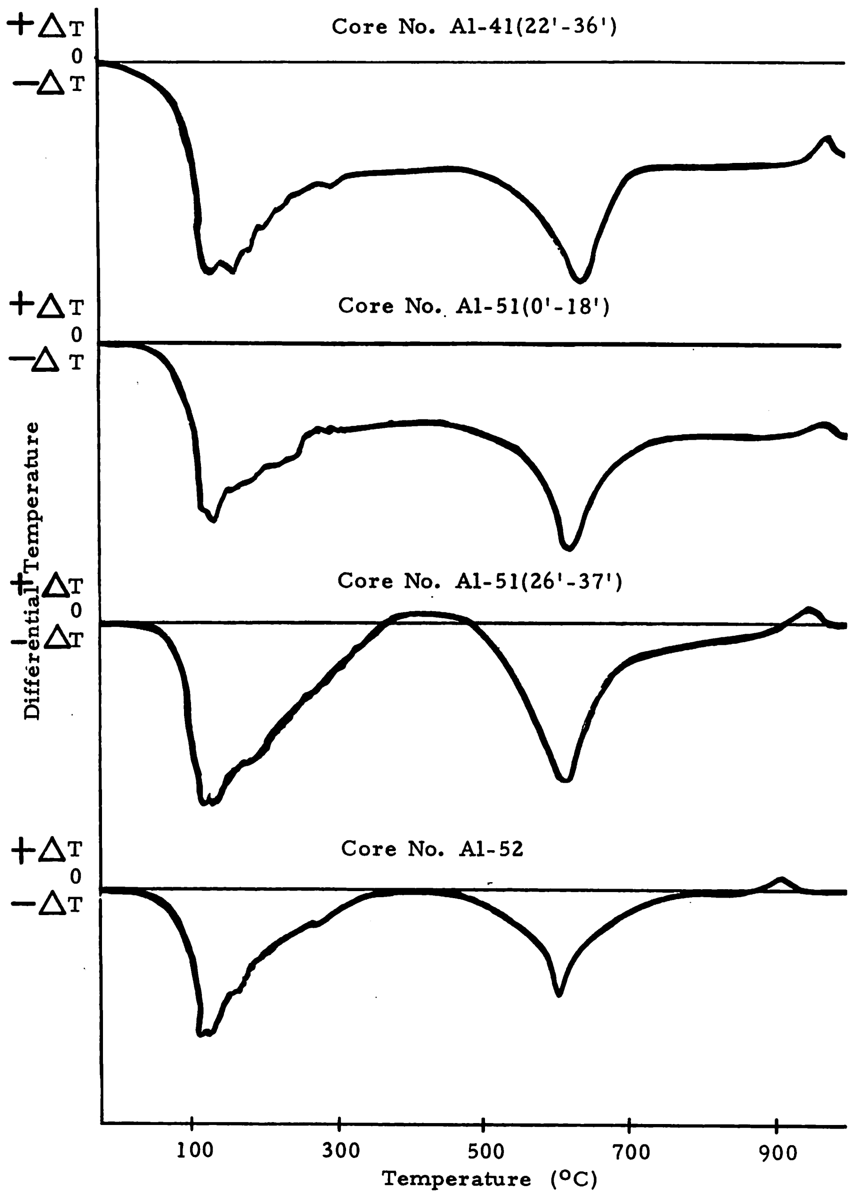

Figure 21 Differential Thermal Curves

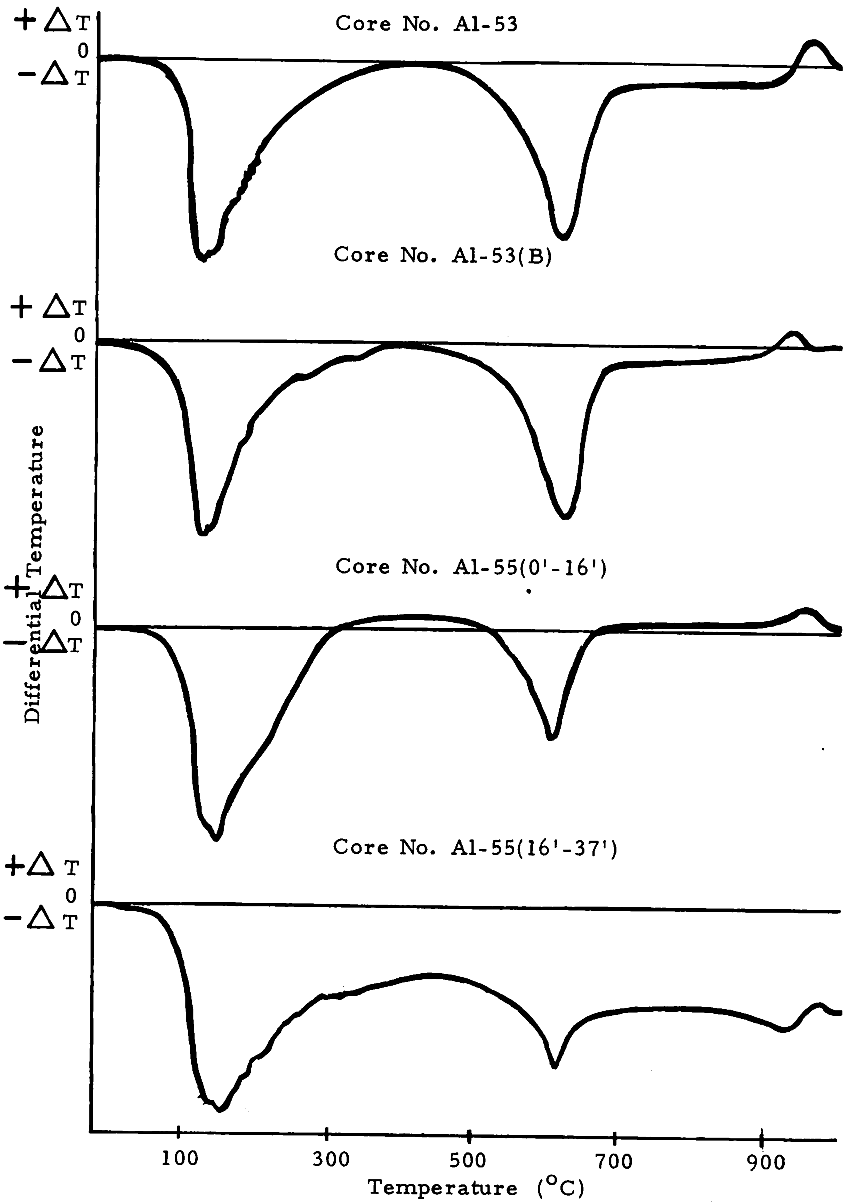

Figure 22 Differential Thermal Curves

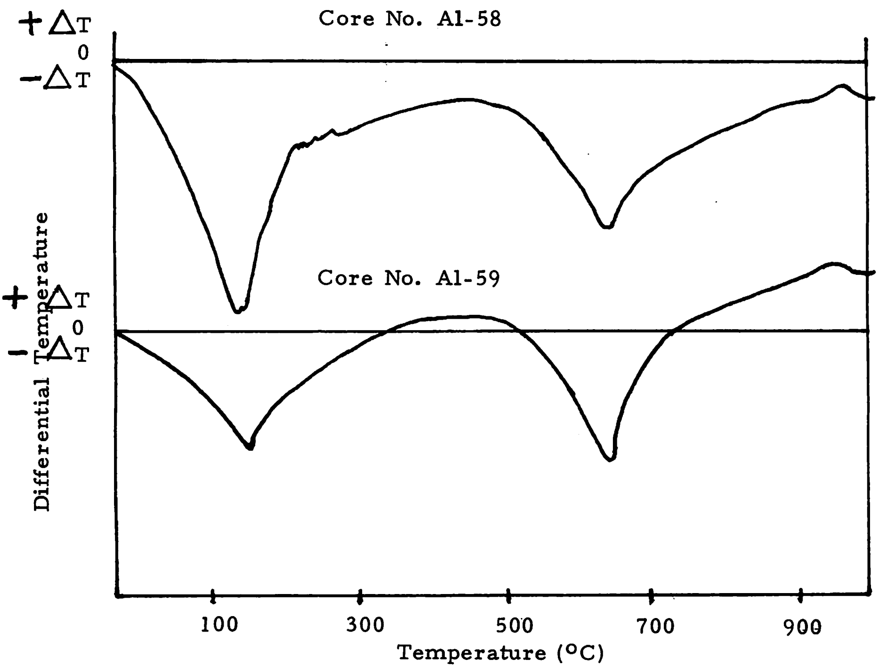

Figure 23 Differential Thermal Curves

Scanning Electron Microscopy Analysis

Figure 24 shows the irregular flake-shaped aggregates that are characteristic of poorly crystallized kaolinite as indicated by Grim (3). Montmorillonite also was indicated by the stackings of irregular flake shape and curled edge aggregates at the left corner. These results corresponded to the results obtained by X-ray and DTA.

Figure 25 shows the stackings of irregular flake shape and curled edge aggregates. According to Grim (3), this has the characteristics of montmorillonite. The flaky crude hexagonal outlines and disorder stackings have the character of illite, which are present at the lower part of the Figure. Kaolinite was not present here because it was a minor constituent. However, the results of the major constituent corresponds to the results obtained by X-ray and DTA.

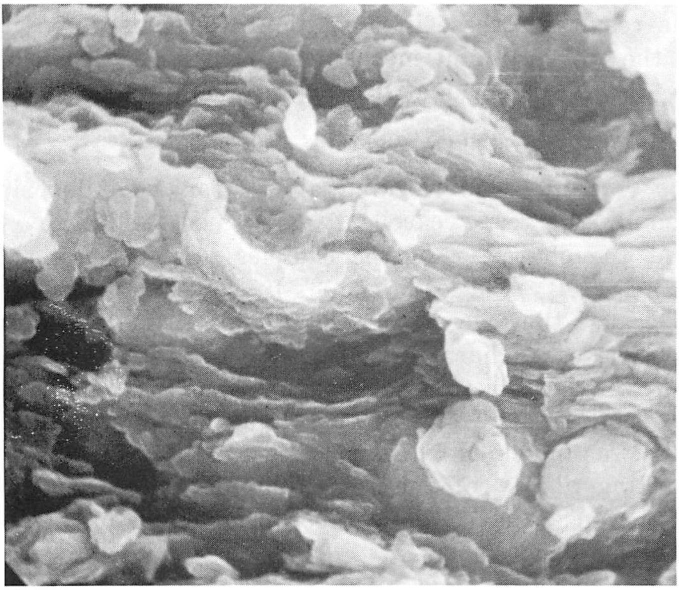

Figure 24.—Scanning electron micrograph of core no. Al-38 (6500X).

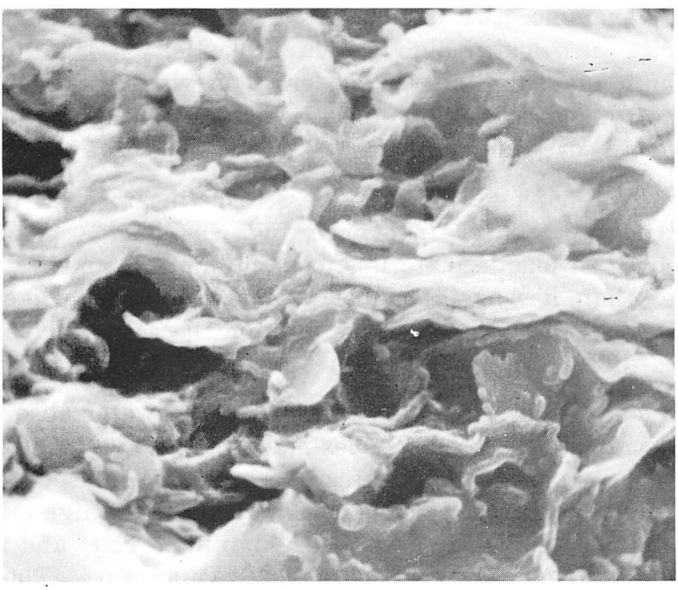

Figure 25.—Scanning electron micrograph of core no. Al-33 (6500X).

RESULTS AND DISCUSSION

The results of these investigations were discussed in two parts: the physical and mechanical properties measurements and the clay mineral identification.

Physical and Mechanical Properties Measurements

Working Ability: The working ability for each deposit was indicated by the terms excellent, fair, good, and poor, which represent the character of the samples during testing. Core number Al-36(B) and Al-55(16′-37′) showed a poor working ability because they were too high in organic matter and plasticity. These were characterized by black bodies, black coring, and high water in plasticity and shrinkage. Core number Al-41 (22′-36′) had a fair working ability but was too highly nonplastic, as was indicated by its porosity and water of absorption. The working ability of the remaining deposits was good or excellent because they contained good proportions of plastic and nonplastic materials.

Water of Plasticity: Water of plasticity, which was defined as the amount of water necessary to obtain good working consistency, depended on the quantity of plastic and nonplastic materials. For example, core number Al-33 which was high in montmorillonite, also had a high water of plasticity. Core number Al-38, high in kaolinite, was moderate in water of plasticity. The water of plasticity of nonplastic materials was low, as was indicated by core number Al-41(22′-36′).

Shrinkage: Shrinkages were expressed in linear scales by the total length change after firing or drying. Shrinkage was greater in clay high in plastic materials, organic matter, and water of plasticity than it was in nonplastic material. Shrinkage also increased with the firing temperature and the results have been tabulated in Table IV.

Porosity and Water Absorption: Porosity and water absorption were determined after the samples had fired at 1800°F, 1900°F, and 2000°F. Porosity and water absorption decreased as the firing temperature was increased. Clays containing high organic matter and plastic materials were also high in porosity and water absorption when they were fired at low temperature. The porosity and water absorption were reduced rapidly by firing at higher temperature. By clarification the increasing of porosity and water absorption at low temperature was proportional to the number of pores resulting from the oxidation of the organic matter. The porosity and water absorption of the sample at higher processed temperature decreased as the result of partial fusion of the clay materials.

Modulus of Rupture: From Table I, the modulus of rupture of clays that contained a suitable quantity of plastic and nonplastic materials increased with the firing temperature.

The loss of bond strength at low temperature occurred as the result of oxidation of carbonaceous materials leaving a highly porous structure and the increase of strength at high temperature occurred as the result of glass formation by partial fusion of clay materials.

Color: Color of the clay in the green state depended on the amount of organic matter, ferric oxide, and carbonate present. Clays containing large amounts of organic matter were black in color, were various shades of brown when they contained ferric oxide, and were white when they contained high amounts of carbonate in the form of sea fossils. In firing, color depended on the amount of ferric oxide and the degree of oxidation. The colors were examined by visualization and the results were tabulated in Table IV.

Core number Al-36(B) bloated as the result of over-firing. Black coring was also found in the specimens, indicating that the rate of firing was too fast and the clay deposit was also high in organic matter. Core number Al-51 (0-18′) gave satisfactory results at 1800°F, but the samples bloated as the result of over-firing at the higher temperature. Core number Al-53 bloated because the deposit contained excess carbonate. The carbonate in this deposit, indicated by the vigorous reaction in Appendix A (1), decomposed with the endothermic reaction at 930°C, as is shown by the thermal diagram in Figure 26.

The cation Mg^{+2} was selected to detect the 2:1 and 2:2 layers of silicated system at room temperature and the cation K^{+} was selected to detect the same layers in heat treatments. At room temperature 21°C, the interplanar spacing (00L) of many clay minerals were the same but they were different at medium saturation and in heat treatment. The clay minerals which have similar characteristic peaks are discussed below, and the method of identifying specific minerals is indicated.

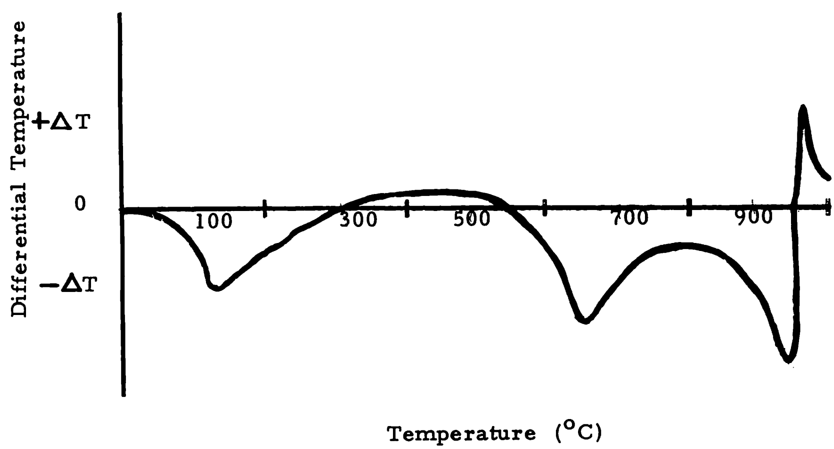

Figure 26.—Differential Thermal Curve of Core No. Al-53, showing the Endothermic Reaction of the Carbonates.

Table I Summary of the Physical and Mechanical Properties Measurements

Core No.	Working Ability	% Water of Plasticity	Drying or Firing (°F)	% Shrinkage	% Porosity	% Water Absorption	Modulus of Rupture (psi)	Color
			198	6.11	-	-	525	Olive
Al-33	Excellent	27.5	1800	7.71	16.6	9.0	665	Dark Red
			1900	7.90	13.4	8.5	850	Dark Red
			2000	9.79	9.9	5.4	935	Brown
			198	6.56	-	-	1270	Light Brown
Al-36	Good	36.6	1800	8.71	13.6	8.0	1320	Light Brown
			1900	8.86	12.4	7.6	1340	Dark Red
			2000	9.46	8.9	5.5	1355	Brown
			198	8.51	-	-	835	Black
Al-36	Poor	41.9	1800		No Data, Bloating			
(B)			1900		No Data, Bloating			
			2000		No Data, Bloating			
			198	4.08	-	-	935	Buff
Al-38	Excellent	15.6	1800	4.37	25.4	14.1	1180	Light Brown
			1900	4.85	24.4	14.2	1270	Brown
			2000	6.25	20.0	11.2	1350	Brown

Table I (Continued)

Core No.	Working Ability	% Water of Plasticity	Drying or Firing (°F)	% Shrinkage	% Porosity	% Water Absorption	Modulus of Rupture (psi)	Color
			198	4.70	-	-	1215	Tan
Al-40	Excellent	16.1	1800	5.01	23.9	13.7	1000	Light Brown
			1900	5.26	22.7	13.1	1195	Light Brown
			2000	5.98	17.5	10.0	1110	Brown
			198	7.57	-	-	1530	Buff
Al-41	Excellent	29.9	1800	9.16	19.0	10.5	1170	Light Brown
(4'-22')			1900	11.22	9.5	4.8	1280	Light Brown
			2000	12.21	4.5	2.5	1740	Light Brown
			198	4.00	-	-	580	Buff
Al-41	Fair	19.9	1800	4.12	27.0	16.5	700	Dark Red
(22'-36')			1900	4.29	27.0	16.2	860	Brown
			2000	5.46	23.0	13.8	855	Brown
			198	5.30	-	-	1520	Olive
Al-51	Excellent	27.3	1800	7.61	10.2	5.7	670	Dark Red
(0-18')			1900		No Data, Bloating			
			2000		No Data, Bloating			

Table I (Continued)

Core No.	Working Ability	% Water of Plasticity	Drying or Firing (°F)	% Shrinkage	% Porosity	% Water Absorption	Modulus of Rupture (psi)	Color
			198	7.05	-	-	1540	White
Al-52	Excellent	28.6	1800	9.11	26.4	15.4	2070	Light Brown
			1900	8.83	22.7	13.3	2805	Brown
			2000	8.66	16.6	9.8	3090	Brown
			198	7.99	-	-	850	Olive
Al-53	Excellent	32.6	1800	No Data, Bloating				
			1900	No Data, Bloating				
			2000	No Data, Bloating				
			198	7.27	-	-	1340	Light Brown
Al-55	Excellent	24.6	1800	8.10	23.4	13.8	1310	Brown
(0-16')			1900	8.47	21.6	12.9	1300	Brown
			2000	8.84	16.0	9.4	1610	Dark Red
			198	8.73	-	-	1800	Black
Al-55	Poor	37.4	1800	10.73	22.7	13.3	1020	Light Brown
(16'-37')			1900	11.53	21.0	13.2	760	Light Brown
			2000	12.19	16.6	11.1	440	Light Brown
			198	4.27	-	-	650	Tan
Al-58	Excellent	20.7	1800	6.33	28.5	13.0	2070	Brown
			1900	6.83	27.6	12.8	2035	Brown
			2000	7.53	22.1	10.0	1570	Brown
			198	4.50	-	-	750	Brown
Al-59	Excellent	15.7	1800	5.46	25.5	12.4	3230	Brown
			1900	6.33	22.3	10.1	3540	Brown
			2000	8.06	14.1	6.9	2645	Brown

Table II Clay Mineral Identification by X-Ray Diffraction Analysis

Core No.	"d" spacing (A)	Crystal face	Clay mineral	Relative Amount
	18.5	(001)	Montmorillonite	High
Al-33	10.2	(001)	Illite	Low
	7.2	(001)	Kaolinite	Low
	18.5	(001)	Montmorillonite	High
Al-33 (B)	10.1	(001)	Illite	Low
	7.2	(001)	Kaolinite	Low
	18.4	(001)	Montmorillonite	High
Al-36	10.1	(001)	Illite	Low
	7.2	(001)	Kaolinite	Low
	18.8	(001)	Montmorillonite	High
Al-36 (B)	10.2	(001)	Illite	Low
	7.3	(001)	Kaolinite	Low
	18.4	(001)	Montmorillonite	Low
Al-38				
	7.2	(001)	Kaolinite	High
	18.5	(001)	Montmorillonite	Low
Al-38 (B)	10.0	(001)	Illite	Low
	7.2	(001)	Kaolinite	High
	18.4	(001)	Montmorillonite	High
Al-40	10.2	(001)	Illite	Medium
	7.1	(001)	Kaolinite	Medium
	18.9	(001)	Montmorillonite	Medium
Al-41	10.1	(001)	Illite	Medium
(4'-22')	7.2	(001	Kaolinite	Medium
	18.5	(001)	Montmorillonite	Low
Al-41				
(22'-36')	7.2	(001)	Kaolinite	High

Table II (Continued)

Core No.	"d" spacing (A)	Crystal face	Clay mineral	Relative Amount
	18.4	(001)	Montmorillonite	Medium
Al-51	10.0	(001)	Illite	Low
(0-18')	7.2	(001)	Kaolinite	Medium
	18.6	(001)	Montmorillonite	Medium
Al-51	10.0	(001)	Illite	Low
(26'-37')	7.2	(001)	Kaolinite	Medium
	18.9	(001)	Montmorillonite	Medium
Al-52	10.0	(001)	Illite	Low
	7.3	(001)	Kaolinite	Medium
	18.8	(001)	Montmorillonite	High
Al-53	10.1	(001)	Illite	Low
	7.2	(001)	Kaolinite	Low
	18.8	(001)	Montmorillonite	Medium
Al-53 (B)				
	7.3	(001)	Kaolinite	Low
	18.5	(001)	Montmorillonite	High
Al-55				
(0-16')	7.2	(001)	Kaolinite	Low
	18.5	(001)	Montmorillonite	High
Al-55				
(16'-37')	7.1	(001)	Kaolinite	Low
	18.8	(001)	Montmorillonite	Medium
Al-58	10.0	(001)	Illite	Low
	7.2	(001)	Kaolinite	Medium
	18.8	(001)	Montmorillonite	Medium
Al-59	10.1	(001)	Illite	Low
	7.2	(001)	Kaolinite	High

Kaolinite and Chlorite:

Kaolinite was identified by the basal interplanar spacing (00L) at 21°C and by heat treatment at 550°C for 4 hours. Although the interplanar spacing (001) of kaolinite at 21°C is the same as that of chlorite, after heat treatment, only one characteristic peak of chlorite remained and always enhanced the interplanar spacing (001) at 14.0A. The X-ray diffractograms from Figures 1-18 indicated that no chlorite was present. The basal interplanar spacing (001) of kaolinite varied from 7.1A - 7.3A. Jackson explained that the increasing of the interplanar spacing depended on the crystallinity (2). The results of these identifications were tabulated in Table II.

Montmorillonite and Vermiculite:

The (001) interplanar spacing of montmorillonite is different from vermiculite at 18.0A when it is saturated with glycerol, although the interplanar spacing of both is at 14.0A when it is saturated with water. The X-ray diffractograms from Figures 1-18 indicated that no vermiculite was present. Grim (3) suggested that montmorillonite did not give sharp peaks because it was poorly crystallized and of small particle sizes. Montmorillonite was identified by the basal interplanar spacing (001) at 21°C, followed by heat treatment at 325°C for 4 hours and by heat treatment at 550°C for 4 hours. The interplanar spacing (001) varied from 18.3A to 18.9A at 21°C and it decreased to approximately 10.0A in heat treatment at 325°C or 550°C for 4 hours. The variation of the interplanar spacing of montmorillonite at room temperature depends on the crystallinity and the amount of water between the basal planes.

Illite and Halloysite:

When halloysite is at room temperature and saturated with water its basal interplanar spacing is about 10.3A, and when it is completely dried at 110°C, the interplanar spacing reduces to approximately 7.1A(3). The X-ray diffractograms from Figures 1-18 indicated that no halloysite was present. In Grim's work (3) illite did not give sharp peaks because it was poorly crystallized and of small particle size. Illite was identified by the constant interplanar spacing at approximately 10.0A.

The outcome of the mineral identifications were tabulated in Table II. The X-ray diffractograms from Figures 1-18 indicated more than the clay minerals identified. For example, sample number Al-33 and Al-33(B) showed interplanar spacing at 9.1A, and sample number Al-36 and Al-36(B) showed interplanar spacing at 9.3A. The X-ray diffractograms at 21°C indicated that these interplanar spacings might be the basal reflection (002) of mixed layer clay mineral or of pyrophyllite. According to Glenn (4), when mixed layers of clay mineral are heat treated at 550°C for 4 hours, they always enhance the interplanar spacing at 12.0A. In these same deposits no pyrophyllite was indicated by differential thermal diagram shown in Figure 17, so these interplanar spacings were the interplanar spacings (002) of montmorillonite. Such amorphous materials as silica, iron oxide, alumina, and rutile, et cetera, were also found in many clay deposits. These were indicated by the broad peaks between the crystal planes (001) of montmorillonite, which was heat treated at 350°C for 4 hours.

Jackson (2) suggested that the relative amounts of each deposit might be estimated from the intensity of the basal reflection (001). The results were reported in the terms "High", "Medium" and "Low" as shown in Table II.

Table III Clay Mineral Identification by DTA

Core No.	Min. Endotherm (°C)	Min. Endotherm (°C)	Min. Endotherm (°C)	Max. Exotherm (°C)
Al-33	130 (dbl)	610	910	940
Al-33 (B)	148 (dbl)	605	910	935
Al-36	135 (dbl)	610	910	935
Al-36 (B)	145 (dbl)	612	910	940
Al-38	120	620	-	955
Al-38 (B)	140	623	-	963
Al-40	130 (dbl)	615	-	935
Al-41 (4'-22')	180 (dbl)	618	-	955
Al-41 (22'-36')	183	620	-	963
Al-51 (0-18')	130 (dbl)	625	-	955
Al-51 (26'-37')	135 (dbl)	605	-	950
Al-52	180 (dbl)	613	-	950
Al-53	135 (dbl)	620	915	970
Al-53 (B)	120 (dbl)	620	-	955
Al-55 (0-16')	135 (dbl)	605	-	940
Al-55 (16'-37')	135 (dbl)	620	930	990
Al-58	130 (dbl)	615	-	960
Al-59	135	620	-	950

Table III Clay Mineral Identification by DTA (continued)

Clay Mineral Identified:

Core No.	Al-33	Montmorillonite, Illite, Kaolinite
	Al-33 (B)	Montmorillonite, Illite, Kaolinite
	Al-36	Montmorillonite, Illite, Kaolinite
	Al-36 (B)	Montmorillonite, Illite, Kaolinite
	Al-38	Kaolinite
	Al-38 (B)	Kaolinite
	Al-40	Kaolinite, Montmorillonite, Illite
	Al-41 (4'-22')	Kaolinite, Montmorillonite
	Al-41 (22'-36')	Kaolinite, Montmorillonite
	Al-51 (0-18')	Montmorillonite, Kaolinite, Illite
	Al-51 (26'-37')	Montmorillonite, Kaolinite, Illite
	Al-52	Montmorillonite, Kaolinite, Illite
	Al-53	Montmorillonite, Kaolinite, Illite
	Al-53 (B)	Montmorillonite, Kaolinite
	Al-55 (0-16')	Montmorillonite, Kaolinite
	Al-55 (16'-37')	Montmorillonite, Kaolinite
	Al-58	Kaolinite, Montmorillonite, Illite
	Al-59	Kaolinite, Montmorillonite, Illite

TABLE IV
CHEMICAL ANALYSIS OF CLAYS
SMITH COUNTY, MISSISSIPPI
MISSISSIPPI STATE UNIVERSITY LABORATORY, ANALYST
NOS. 452, 778 - 452, 795

Sample No. *	Geologic Unit	SiO_2	Al_2O_3**	Fe_2O_3	CaO	MgO	K_2O	Na_2O	SO_3	P_2O_5	Ignition Loss	Total
AL-33 (0'-15')	Bucatunna	55.11	22.87	6.07	1.20	1.09	0.95	0.52	1.64	0.04	10.51	100.00
AL-33B (0'-15')	Bucatunna	51.05	16.45	4.44	7.31	1.54	0.95	0.51	1.33	0.05	16.37	100.00
AL-36 (0'-48')	Bucatunna	61.12	15.54	4.42	1.74	1.31	0.97	0.54	0.86	0.07	13.43	100.00
AL-36B (0'-48')	Bucatunna	53.27	16.58	4.73	4.42	1.82	1.26	0.51	1.22	0.04	16.15	100.00
AL-38 (0'-26')	Catahoula	64.17	21.25	3.10	2.19	0.47	0.25	0.31	0.61	0.07	7.58	100.00
AL-38B (0'-26')	Catahoula	48.65	30.08	1.10	0.34	0.70	1.34	0.30	0.32	0.01	17.16	100.00
AL-40 (8'-20')	Catahoula	72.00	15.94	2.38	0.28	0.51	1.40	0.56	0.45	0.02	6.46	100.00
AL-41 (4'-22')	Catahoula	57.45	23.66	3.74	0.29	0.69	1.32	0.12	0.94	0.05	11.74	100.00
AL-41 (22'-36')	Catahoula	74.98	15.66	1.90	0.17	0.51	0.30	0.01	0.33	0.03	6.11	100.00
AL-51 (0'-18')	Catahoula	60.60	21.13	4.20	0.30	1.16	1.36	0.18	0.60	0.06	10.41	100.00
AL-51 (26'-38)	Catahoula	61.48	19.00	2.71	0.33	0.68	0.90	0.12	1.30	0.03	13.36	100.00
AL-52 (0'-40')	Catahoula	68.36	15.34	2.91	0.35	0.57	0.97	0.19	0.42	0.02	10.87	100.00
AL-53 (3'-32')	Yazoo	33.86	17.23	4.40	18.41	1.33	1.31	0.08	0.88	0.09	22.41	100.00
AL-53B (3'-32')	Yazoo	76.80	11.39	4.83	0.35	0.31	0.57	0.09	0.41	0.02	5.23	100.00
AL-55 (0'-16')	Forest Hill	68.46	15.86	3.85	0.38	0.69	1.00	0.20	0.23	0.03	9.30	100.00
AL-55 (16'-37')	Forest Hill	61.64	17.32	2.74	1.47	1.17	1.36	0.29	0.68	0.04	13.29	100.00
AL-58 (0'-42')	Catahoula	64.22	18.16	4.96	0.45	0.63	1.03	0.13	0.60	0.03	9.79	100.00
AL-59 (0'-36')	Catahoula	63.10	21.37	3.74	0.35	0.52	0.77	0.13	0.30	0.02	9.70	100.00

* Corresponds to core hole number

Percent, recalculated to 100% total

** Includes TiO_2

The suffix (B) indicates a minor portion of sample

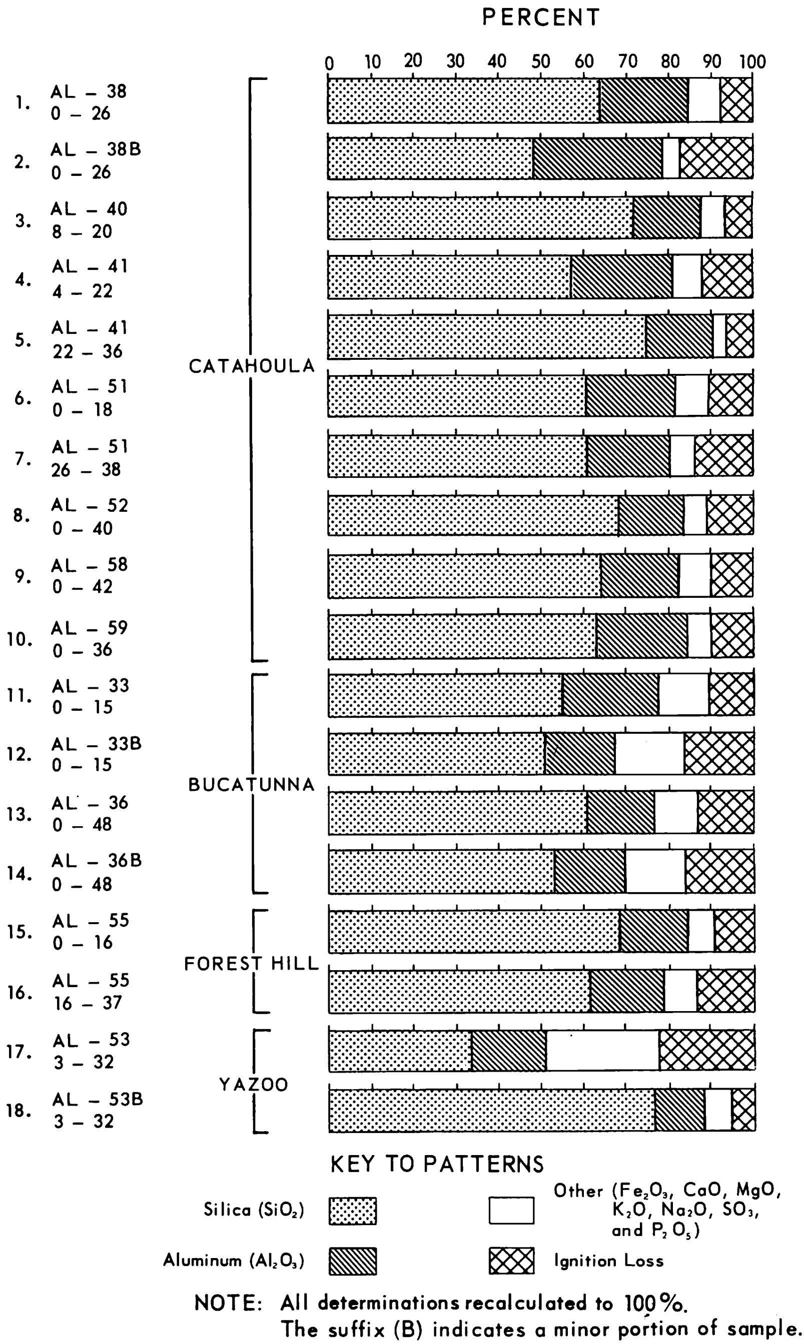

Figure 27.—Plotted chemical analysis of the 18 Smith County samples tested. See data table.

CONCLUSION

The purpose of this study was to evaluate specific clay deposits in Smith County, Mississippi, for potential use in structural clay products. The more common structural clay products in which these clays could be utilized in the manufacturing process are common brick, face brick, sewer pipe, drain tile, terra cotta, and floor tile. Clays that are suitable for use in structural clay products could also be used in some pottery applications.

Based on the test conducted in this study, clay deposits from the following cores are suitable for use in the manufacture of structural clay products:

Core Al-33	
Al-36	Al-52
Al-38	Al-55 (0′-16′)
Al-40	Al-58
Al-41 (4′-22′)	Al-59

Core Al-51 (0′-18′) is suitable for use in the manufacture of structural clay products when the firing temperature is not over 1800°F. Core Al-41 (22′-36′) needs to be improved by the addition of a plastic clay. This is no problem, as Core Al-41 (4′-22′) is lying just above it with suitable plasticity.

Core Al-36 (B) was not suitable for structural clay products application as it contained an excessive amount of carbonaceous material. Core Al-53 was not suitable for structural clay products application as it contained an excessive amount of carbonates. Core Al-55 (16′-37′) was not suitable for structural clay products application as the clay had very poor extrudability.

RECOMMENDATIONS FOR FUTURE WORK

In order to utilize all of the available deposits in this County and to reach the optimum quality of clay products, it is recommended that the physical and mechanical properties of modified deposits be studied. For example, the addition of grog, sand or calcined clay to the various clay deposits which were high in montmorillonite clay. In addition, blending should be prepared from different depths of the same core and between the different cores.

APPENDICES

APPENDIX A

REMOVAL OF SOLUBLE SALTS, DIVALENT EXCHANGE CATIONS, ORGANIC MATTER, AND FREE MANGANESE DIOXIDE.

1) Destroy the Carbonates and Remove the Exchangable Divalent Cations (2).

   a) 50 grams of samples, which particles are smaller than 2 mm., were boiled with 500 ml of 1N NaCOAc pH5.

   b) Centrifuge and decant.

2) Decomposition of Organic Matter and Dissolution of MnO_2 by H_2O_2 treatment (2).

   a) Treat the precipitate from Appendix A (1) with 25 ml of 30% H_2O_2.

   b) Thin paste samples are preferable and should be evaporated if it is necessary.

   c) If organic matter is not completely removed, add more 30% H_2O_2 in a ratio of 2:1 and let it digest in a covered beaker for 2-4 hours. Repeat this process until all the organic matters are removed.

   d) Wash twice with 1N NaOAc pH5.

   e) Wash twice with 95% methanol pH3.

   f) Wash one time with 99% methanol.

3) Remove Free Iron Oxides (2).

   a) Boil the precipitate from Appendix A (2) with 400 ml 0.3M Sodium citrate, 50 cc 1M $NaHCO_3$ and 10 grams $Na_2S_2O_4$ at temperature 75-80°C in water bath about 15 minutes.

b) Add 10 ml saturated NaCl.

c) Centrifuge and decant.

d) Repeat until all the extractable Fe_2O_3 are removed.

e) Wash the precipitate 3 times with 0.3M Sodium citrate.

f) Keep the precipitate in water, acetone or methanol.

APPENDIX B

PARTICLE SEGREGATION

1) Disperse by Na_2CO_3 Solution.

   a) Boil the precipitate from Appendix A (3) with 200 ml 2% Na_2CO_3 solution in the nickel crucible and then agitate it with high-speed rotary stirrer.

2) Separate the Sands from Silts and Clays.

   a) The thoroughly dispersed sample is allowed to stand about a minute and then is decanted through the seive No. 270.

   b) Keep decantate the particles that are smaller than 53 microns.

3) Separate the Coarse Silt from Clay and Fine Silt, by Gravity Sedimentation.

   a) The settling times have been calculated by means of Stokes' law and combined with differential specific gravity, thus giving the working form of Stokes' law (2).

$$t = \frac{18\ h\ nu}{g\ (S_p - S_l)\ D^2}$$

where t is settling time in sec.

h is distance of falling particle in cm.

nu is viscosity in poise approximately at S_p 2.65 and 21°C about 0.00981

g is the gravitational constant about 980 cm./sec.^{2}

$S_p - S_l$ is differential specific gravity between the particle and liquid, which is approximately 1.652

D is particle diameter in cm.

b) Keep the decantate.

4) Separate the Fine Silt from the Clays.
Sedimentation time under centrifugal force is calculated from (2)

$$t_{(min)} = \frac{63\ 10^8\ nu \log \frac{R}{S}}{(N^2)\ (D)^2 \triangle S}$$

Where *nu* is viscosity in poise at 21°C, S_p is 2.65, is approximately 0.00981

R is distance from the axis of rotation to the top of the sediment in cm.

S is distance from the axis of rotation to the top of the liquid in cm.

N is in R.P.M.

D is diameter of particle in microns.

$\triangle S$ is the differential specific gravity between particle and liquid and is approximately 1.652.

APPENDIX C

PREPARATION OF THE ORIENTED SPECIMENS FOR X-RAY ANALYSIS

1) Saturate with 1N $MgCl_2$ and Glycerol.

a) Take 0.5 grams of clay from Appendix B (4).

b) Wash 4 times with 1 N $MgCl_2$.

c) Wash with 1 N methyl alcohol until all the chloride is removed.

d) Centrifuge and decant.

e) Add 3 ml 10% glycerine in methyl alcohol at least 4 hours.

f) Centrifuge and decant.

g) Add 1 ml of distilled water, disperse, and transfer to glass slide.

2) Saturate with 1N KCl and Glycerol.

a) Take 0.5 grams of clay from Appendix B (4).

b) Wash 4 times with 1N KCl.

c) Follow the same procedure in Appendix C (c-g).

APPENDIX D

PREPARATION OF THE SAMPLE FOR DTA.

a) Take 0.5 grams of clay prepared from Appendix B (4).

b) Wash 4 times with 1N $MgCl_2$.

c) Wash 4 times with methyl alcohol.

d) Wash 1 time with acetone.

e) Wash 1 time with benzene.

f) Keep sample in dissicator that has relative humidity 50% (in saturated $MgNO_3$ solution).

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WATER RESOURCES OF SMITH COUNTY

Wilbur T. Baughman

ABSTRACT

The available ground water underlying Smith County greatly exceeds the present demands placed on it. Little or no treatment is required for ground water produced from the aquifers presently used for water supply in the County.

The larger municipal and industrial wells yield moderate to large quantities of water from Catahoula, Cockfield and Kosciusko aquifers. Moderate yield is being produced from a Vicksburg aquifer in only one well in the County.

Wells in Smith County vary in depth from less than 100 feet to more than 1400 feet. The majority of wells in the County are less than 500 feet deep. There is an abundance of water of good quality for general use in practically all of Smith County. Water from aquifers near and in the outcrop area tend to have higher concentrations of iron. Most of the water is soft, sodium bicarbonate type with low to moderate mineralization. Low pH, or acid water is a problem with some of the water in the County, however, generally this is a problem only with Catahoula and shallower aquifers. Color is a problem in certain areas from the Forest Hill and deeper aquifers. Generally, the only treatment required for water produced from the several aquifers available in Smith County is for pH adjustment and iron removal.

Surface water of good quality is available for use in Smith County provided storage facilities are constructed. Major streams in the County of potential use as water supply include Leaf River, Strong River and Oakohay Creek. The quality is generally good, having a low total dissolved solids content, low hardness and low pH. Color is infrequently a problem.

Minor flooding occurs along the flood plains of many of the streams after heavy rains. The highest flow is normally in late winter and early spring while low flows usually occur in late summer and fall.

INTRODUCTION

A study of the water resources of Smith County is included in this report because water is an essential natural resource of any area. It is a natural resource which feeds, cleanses, carries, cools, warms and protects all living things and is essential to our very existence. It is taken for granted far too often and rarely appreciated adequately until availability of it has ceased.

Availability of water of good to excellent quality, in most cases, can aid in orderly and desirable growth within Smith County. The County is endowed with great quantities of available water and the potential for ground-water development is great. Surface water potential is hardly touched and offers great possibilities.

A study of the water resources of Smith County was begun in January of 1972. Information has been gathered for this report and presented in a manner that should be beneficial to the development of dependable, economical and useable water supplies for industrial, municipal and domestic uses within the County.

Purpose of Investigation

Properly planned water supplies are essential to successful development of residential, commercial, manufacturing and recreational areas. Properly planned water supplies for farm operations are an important asset to any farming venture. Inadequate planning of water supplies can be very costly in any venture and can hinder proper and desirable development of other resources in a given area. It is with this in mind that this portion of the Smith County report is written.

A basic understanding of geology is very important in developing water supplies from ground-water aquifers. Far too often water supplies are planned with little or no competent geological advice, leading to the loss of untold thousands of dollars to the public and industry. Proper use of skilled geologic advice can result in dependable, economical water supplies to attract industry and to develop an area more readily and properly.

Information contained in this report should be extremely helpful to those involved in the development of water supplies for individuals, communities, municipalities and industry.

Methods of Investigation

The drilling of wells in recent years for water supplies throughout Smith County has enabled the Mississippi Geological Survey to gain considerable geologic and hydrologic information. This data has been enhanced by the electrical logging program conducted by the Survey. This logging program has greatly benefitted many hundreds of residents in Smith County while enabling the Survey to backlog ground-water and geologic information.

Included in this report is information on water levels, chemical quality of water from the different aquifers, aquifer thicknesses, physical and chemical characteristics of water from each of the aquifers and availability of aquifers. A determination of the approximate base of fresh water throughout Smith County was made and is included as a part of this report.

Data used in this report were obtained by: (1) collection of information on location, elevation, depth, diameter, yield, chemical quality, water level and source aquifers on hundreds of water wells in the County, (2) examination of electrical logs on 44 test holes drilled in conjunction with this report, (3) field examination of numerous water wells to verify locations and determine elevations, (4) collection and analysis of water from selected water wells, (5) aquifer testing at two sites to determine aquifer characteristics. The locations of selected water wells used in this report are shown in Figure 1.

Cooperation and Acknowledgments

The writer wishes to express appreciation for the cooperation received from the many well drillers and well owners, as well as Federal, County, City and other State Agencies for their help during the course of this investigation. The writer expresses appreciation for information provided for this report that had been previously gathered by the Mississippi Board of Water Commissioners on well completions, chemical analyses made by the Water Resources Division of the U. S. Geological Survey and Mississippi State Board of Health and other helpful information supplied by each of them. Results from pumping tests conducted by the U. S. Geological Survey were most helpful.

Present Water Use

Ground water is the source of all water for municipal, industrial and domestic supplies in Smith County. Raleigh, Taylorsville and Mize are served by municipal water systems. Thirteen rural water associations were serving areas of the County in September 1972[1]. Private ground-water supplies furnish several industries in the County.

Some industries located in the areas of Raleigh and Taylorsville have individual water supplies. Georgia Pacific Corporation, located near Taylorsville, is the largest single industrial user of ground water in Smith County.

The large capacity wells in the Taylorsville area are completed in Catahoula aquifers of the Miocene Group. This is also the most heavily pumped area in the County. The Kosciusko aquifers are used for large capacity wells in the Raleigh area. Kosciusko aquifers also supply ten rural water associations, Cockfield aquifers supply three rural water associations and a Catahoula aquifer supplies one rural water association. The water supply for the town of Mize is produced from a Vicksburg aquifer, water supply for the town of Raleigh is from the Kosciusko and the water supply for Taylorsville is obtained from Catahoula aquifers.

Five permits for withdrawal of surface water were on record with the Mississippi Board of Water Commissioners as of September 1972[2]. Two of these permits were for recreational purposes and held by the U. S. Forest Service. Three permits were held by individuals who used the water for irrigation.

GROUND WATER

Availability

The major aquifers in Smith County are sands in the Wilcox, Meridian, Kosciusko, Cockfield, Forest Hill and Catahoula Formations (Table 1). Other aquifers of local importance are the sands and marly sands of the Vicksburg Group, sands of the Hattiesburg Formation and sands and gravels in the deposits of Pleistocene and Recent ages. Some of the water-bearing sands pinch out locally, whereas others are widely distributed and have a relatively predictable occurrence. Each of the aquifers has distinctive water-bearing characteristics, however the sands themselves vary considerably in thickness, grain size, mineral content and permeability.

Recharge of aquifers in Smith County is primarily from precipitation on the outcrops of permeable material within the formations having aquifers. Water movement in the aquifers is generally in a southwestward direction.

SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT	THICKNESS (feet)	PHYSICAL CHARACTER	WATER RESOURCES
QUATERNARY	RECENT		Alluvium	0–40	Silt, sand and gravel	Generally not an aquifer. Some deposits along larger streams such as Leaf River and Strong River offer potential for small supplies to shallow wells. Water quality would be poor.
	PLEISTOCENE		Terrace deposits	0–158	Clay, sand and gravel	Generally not an aquifer. Some domestic wells have been completed in these deposits. Water quality is poor.
			Citronelle Formation	0–135	Sand and gravel	Generally not an aquifer. Supplies small wells in some parts of the County.
TERTIARY	MIOCENE		Hattiesburg Formation	Up to 90	Silty clays, sands	Generally not an aquifer. Possibly supplies small yields to some shallow dug and bored wells in extreme southwestern Smith County.
			Catahoula Formation	Up to 550	Sands, clays, shales, siltstones and sandstones	An important aquifer in southwestern one-half of Smith County. Most domestic wells in that area are completed in this aquifer. Large municipal and industrial wells completed in this aquifer in southern Smith County. Deepest wells in this aquifer in the County are less than 500 feet. Quality of water is generally good. Water is generally acidic.
	OLIGOCENE	VICKSBURG	Bucatunna Clay Byram Marl Glendon Limestone Mint Spring Marl	70–150	Limestone, clay, marl, carbonaceous clay and sand	Generally not an aquifer. Small, low yield wells could be constructed in Mint Spring in some parts of the County. Moderate yield from Mint Spring has been achieved from only one well in the County. Water quality is good to excellent.
			Forest Hill Formation	97–164	Silty clays, sands and lignite	Supplies a great number of domestic wells in central part of Smith County. Water is generally of good to excellent quality downdip. Iron is a problem updip near the outcrop, but tends to be within acceptable limits downdip. Color is sometimes a problem, due primarily to lignites in the formation.
	EOCENE	JACKSON	Yazoo Formation	200–329	Fossiliferous, homogeneous clay	Aquiclude.
			Moodys Branch Formation	10–30	Glauconitic, fossiliferous marl and sand	Small yields to some domestic wells.
		CLAIBORNE	Cockfield Formation	140–295	Sand, clay, silts and lignite	An important aquifer in Smith County. Supplies small to moderate yields to industrial, municipal and domestic wells. Used mainly in northeastern two-thirds of the County. Quality of water is generally good. Iron tends to be a problem locally updip.
			Cook Mountain Formation	125–220	Silty clays, sandy chalks, marls and limestones	Aquiclude.
			Kosciusko Formation	290–570	Sand, shale and lignite	An important aquifer in Smith County. Supplies moderate to large quantities of water to municipal and industrial wells. A frequently used aquifer for domestic wells in northern Smith County. Quality of water is good to excellent. Color is an objectionable quality of water from this aquifer in southernmost Smith County. Is most desirable aquifer in the County with potential for high yield. Costs due to depth in Smith County has limited its use.
			Zilpha	145–230	Shale	Aquiclude.
			Winona Formation	45–78	Glauconitic, fossiliferous sandy, chalky marls	Not an aquifer.
			Tallahatta Formation: Undifferentiated	160–390	Shale and sand	Not an aquifer.
			Tallahatta Formation: Meridian sand	85–245	Sand and shale	A potential aquifer in Smith County, particularly in northern Smith County. No wells have been made in this aquifer in the County. May contain slightly brackish water in southwestern Smith County.
		WILCOX	Undifferentiated	2000–2840	Sand and shale	A potential aquifer in northern Smith County. Capable of yielding large volumes of water in some localities within the County. No wells have been made in this aquifer in the County. Lower and middle sands contain brackish water in southern Smith County based on electrical log interpretations.

Table 1.—Stratigraphic column and water resources of Smith County.

The aquifers of Smith County are separated by aquicludes (confining beds) in some areas while in other areas they are separated by aquitards (leaky beds). Aquifers separated by aquitards are hydraulically connected to some degree and therefore when hydrostatic pressure differences exist between aquifers, water will leak from the aquifer having the most pressure into the aquifer having less pressure. Thus, some aquifers function as distinct hydrologic systems while others are more complex due to this interconnecting relationship. Wells constructed in aquifers confined by aquitards can often result in undesirable water due to leakage from another aquifer having water of poor quality.

Most of Smith County is underlain by two or more aquifers, varying in depth, grain size, permeability, quality of water and thickness. Aquifers can often be selected optionally on the basis of cost of development, quality and quantity of water desired, or other physical requirements. This is very good in cases where large volumes of water are needed and aquifer characteristics are such that heavy pumping produces undesirable results such as excessive drawdown. In such cases, additional wells can be constructed in other aquifers to prevent over-producing an aquifer.

Fresh water is available in Smith County to a maximum depth of more than 3200 feet (Fig. 1). Contours shown on base of fresh-water map are based on electrical log interpretations by the writer and do not reflect the use of data from actual chemical analyses of ground water in the County. Fresh water implies a water having less than 1000 Mg/l (milligrams per liter) of dissolved solids.

Wells in Smith County vary in depth from less than 100 feet to more than 1400 feet (Fig. 2, Table 2). Generally, the shallowest aquifer producing sufficient water of usable quality is used. Small supplies of ground water for home and stock use are generally secured from the shallowest aquifer available in an area.

This is not always a good and wise choice since generally these aquifers are near the recharge area and usually contain acid water (low pH), excessive iron content and is often hard. Generally, iron content and hardness decreases downdip and the water is softer.

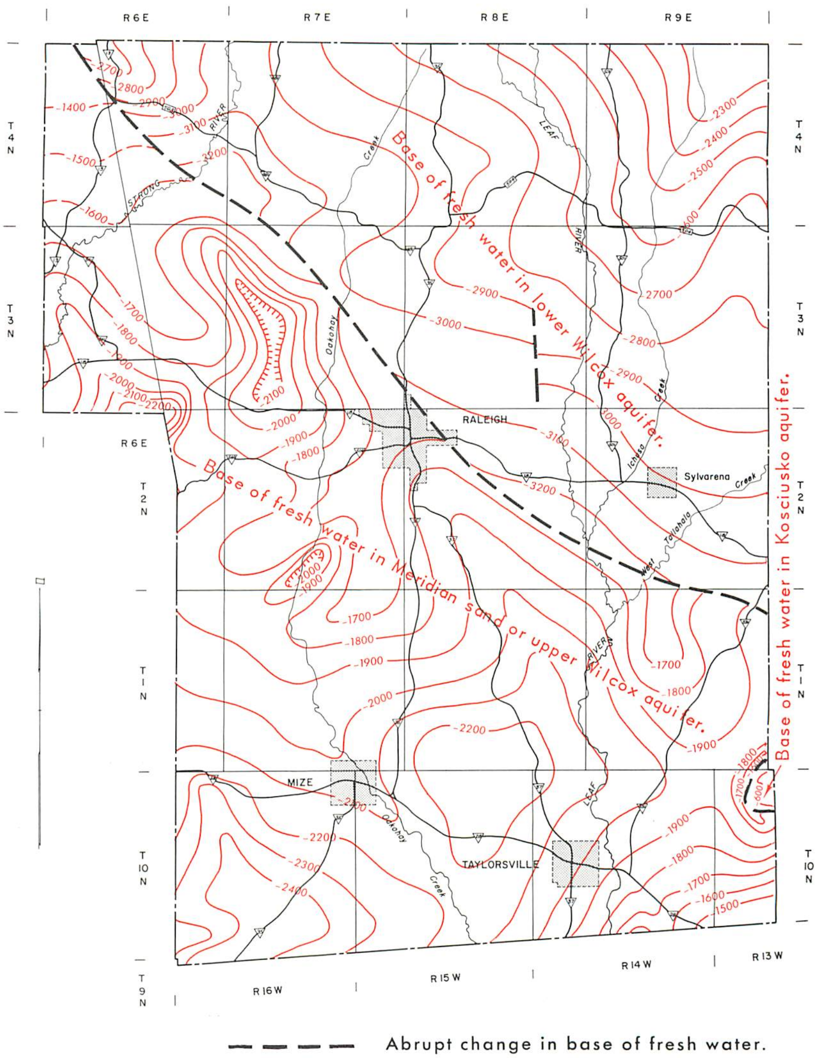

Figure 1.—Configuration of the base of fresh water in Smith County.

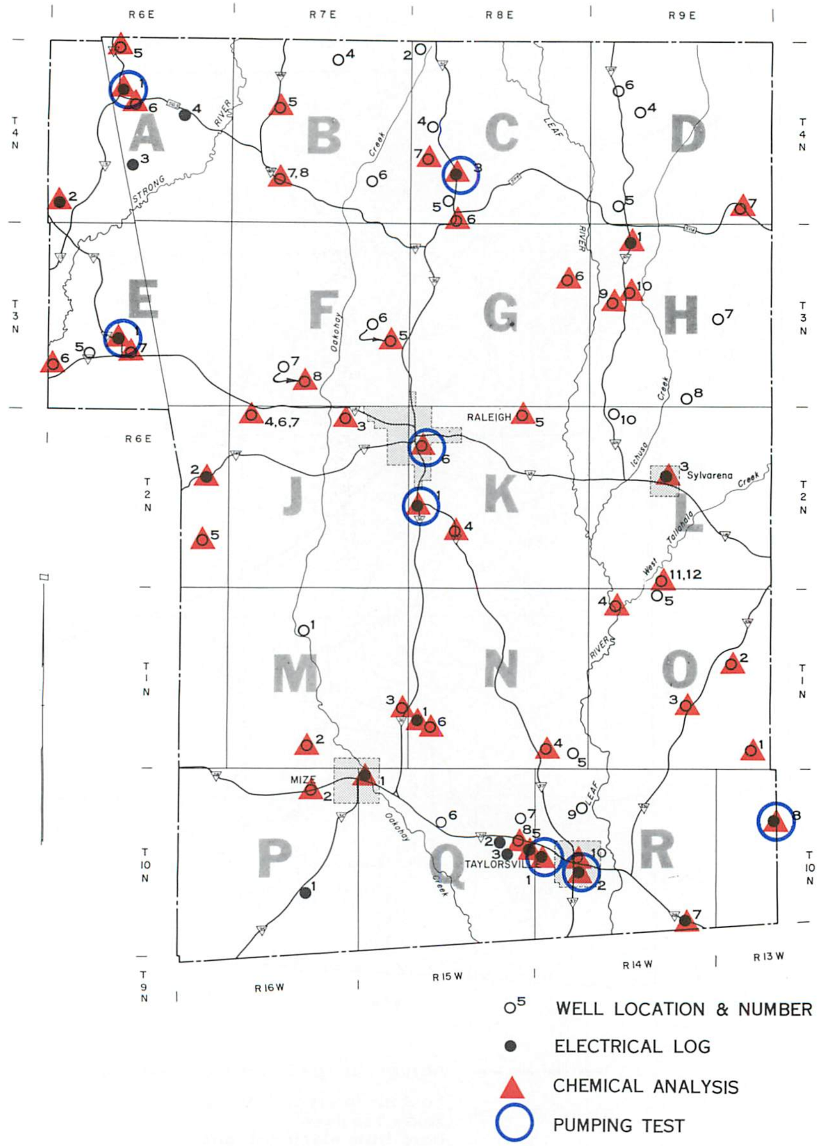

Figure 2.—Locations of selected wells in Smith County.

Well No.: Numbers correspond to those on well-location map, chemical-analysis tables and pumping test tables.

Majority of wells are rotary drilled.

Water Level: M, Measured; R, Reported.

Method of Lift: A, Air Lift; C, Cylinder; F, Natural Flow; J, Jet; N, None; P, Pitcher; T, Turbine; S, Submersible; B, Bucket.

Elevation: Elevations determined mostly from topographic maps having contour intervals of 10 or 20 feet.

Use of Well: D, Domestic; I, Industrial; IR, Irrigation; N, None; O, Observation; P, Public Supply; S, Stock; T, Test.

Remarks: C, Chemical Analysis; O, Observation Well; P, Pumping Test; E, Electrical Log.

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above (+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
A1	Polkville Water Assn.	1966	645	8,6	Cockfield	500	238 R	1966	S	P	113	1968	E,C,P
A2	William Bradshaw	1966	700	4,2	Cockfield	395	100 R	1966	S	D,S	20 R	1966	E,C
A3	J. C. Guy	1968	641	2	Cockfield	373			A	D			E
A4	O. Z. Evans	1970	70	2	Forest Hill	400	47 R	1970	J	D	6 R	1970	E
A5	James Hamilton	1963	55	2	Forest Hill		35 R	1963	P	D			C
A6	Mrs. G. W. Smith	1965	1060	2	Kosciusko		210 R	1965	A	S			C
B4	Billie R. Black	1970	126	2	Forest Hill	505	91 R	1970	J	D	7 R	1970	
B5	W. C. Phipps	1963	582	2	Cockfield	425	120 R	1963	A	D,S			
B6	R. H. Gaskin	1968	1066	2	Kosciusko	485	251 R	1968	A	D	15 R	1968	
B7	J. C. Hawkins	1961	135	2	Forest Hill	477			J	D			C
B8	J. C. Hawkins	1972	617	2	Cockfield	477	205 R	1972	A	D,S	15 R	1972	
C2	Randall Gainey	1970	643	2	Cockfield	470	135 R	1970	A	D			E
C3	Lemon-Lorena Burns Wtr. Assn.	1970	1080	8,6	Kosciusko	528	285 R	1970	S	P	250 R	1970	E,C,P
C4	Gordon Harris	1968	111	2	Forest Hill	520	75 R	1968	J	D	6 R	1968	
C5	H. J. Berryhill	1967	173	2	Forest Hill	540	90 R	1967	J	D	5 R	1967	C
C6	Walter Hegwood	1969	167	2	Forest Hill	538	110 R	1967	J	D,S	3 R	1967	C
C7	W. N. Currie	1965	637	2	Cockfield		190 R	1965	A	D			C

Table 2.—Records of selected wells in Smith County.

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above (+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
D4	Robert Carr	1970	479	2	Cockfield	490	131 R	1970	A	D	12 R	1970	
D5	A. W. Roberts	1963	550	2	Cockfield	390	83 R	1963	A	S			
D6	C. D. Harris	1969	487	2	Cockfield	472	126 R	1969	A	D	14 R	1967	
D7	C. O. Carr	1963	493	2	Cockfield		98 R	1963	J	S			C
E1	White Oak Water Assn.	1967	880	8,6	Cockfield	445	183	1967	T	P	126	1967	E,C,P
E5	Walter Ray Ware	1961	186	2	Forest Hill	340	30 R	1961		D			Abn'd.
E6	Clarence Cook	1962	312	2	Forest Hill				A	D			C
E7	E. B. Canterbury	1963	70	2	Catahoula	413				D			C
F5	Harold Arender	1970	125	2	Catahoula	565	104 R	1970	J	S	8 R	1967	C
F6	Dewey Arender	1961	326	4	Forest Hill	568	200 R	1961	S	D			Abn'd.
F7	Walter Sanderford	1967	200	2	Forest Hill	400	45 R	1967	J	D	12 R	1967	
F8	Carrie Sanford	1967	190	2	Forest Hill		45 R	1967	J	D	12 R	1967	C
G6	B. M. Ward	1969	478	2	Cockfield	342	14 R	1969	J	D	14 R	1969	C
H1	Pineville Water Assn.	1970	946	8,4	Kosciusko	410	187 R	1970	T	P	200	1970	E,C
H7	R. J. Williamson	1968	572	2	Cockfield	426	90 R	1968	A	D	12 R	1968	
H8	Lavestus Dove	1971	90	2	Forest Hill	418	70 R	1971	J	D	6 R	1971	
H9	E. O. Webb	1966	68	2	Forest Hill		27 R	1966	J	D	7 R	1966	C
H10	Paul Nelson	1964	486	2	Cockfield		30 R	1964	A	D,S			C
J2	Traxler Water Assn.	1972	1099	8,6	Cockfield	512	310 R	1972	T	P	240 R	1972	E,C
J3	Billie C. Smith	1970	95	2	Catahoula	375	50 R	1970	J	S	15 R	1970	C
J4	Simon Puckett	1963	327	2	Forest Hill	416	109 R	1963	A	S			C
J5	Alton Frith	1970	190	2	Catahoula	372	81 R	1970	J	D	15 R	1970	C
J6	Simon Puckett	1968	130	2	Catahoula	420			A	S			C
J7	Simon Puckett	1962	80	2	Catahoula	420	50 R	1962	J	S			C

Table 2.—Records of selected wells in Smith County. (continued)

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above(+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
K1	Center Ridge Water Assn.	1968	1400	10,8	Kosciusko	522	280 R	1968	T	P	200	1968	E,C,P
K4	Harvey Yelverton	1960	69	2	Catahoula		63 R	1960		S			C
K5	Mavis Saxon	1969	504	2	Cockfield	378	70 R	1969	J	D	10 R	1969	C
K6	Town of Raleigh	1956	1200	8	Kosciusko	530	273	1957	S	P	80	1957	C
L3	Sylvarena Wtr. Dist., Inc.	1970	1086	8,6	Kosciusko	365	127 R	1970	S	P	220 R	1970	E,C
L10	Lamar Moss	1970	687	2	Cockfield	450	140 R	1970	A	D	20 R	1970	
L11	J. R. Stringer	1970	170	2	Forest Hill	308	+.5 R	1970	J	D	8 R	1970	C
L12	Lace Hancock	1966	168	2	Forest Hill	308	+	1966	J	D			C
M1	Willie B. Cockrell	1962	138	2	Catahoula		55 R	1962	J	D			Abn'd
M2	Jimmy Wilson	1971	220	2	Catahoula	450	80 R	1971	J	D	5 R	1971	C
M3	Vernice Sellers	1960	200	2	Catahoula		+ R	1960	J	D			C
N1	Morris Water Assn.	1970	1520	8,4	Kosciusko	484	255 R	1970	S	P	220 R	1970	E,C
N4	Larry Strickland	1970	220	2	Forest Hill	352	60 R	1970	J	D	6 R	1970	C
N5	Don Robinson	1968	82	2	Catahoula		51 R	1968	J	D	6 R	1968	
N6	G. I. Nobles	1967	125	2	Catahoula		115 R	1967	J	D			C
O1	Rex Ishee	1970	121	2	Catahoula	485	104 R	1970	J	D	10 R	1967	C
O2	Terry Windham	1971	265	4	Catahoula		140 R	1971	S	S	35 R	1970	C
O3	Bill Stringer	1969	106	2	Catahoula		70 R	1969	J	D	10 R	1969	C
O4	Central Oil Co.	1970	196	2	Forest Hill	275	+	1972	J	I	15 R	1970	C
O5	Latrell McMullen	1966	285	2	Forest Hill		165 R	1966	A	D	8 R	1966	
P1	C. D. Horn	1969	140	2	Catahoula	463	70 R	1969	J	D	6 R	1969	E
P2	J. C. Sullivan	1961	30	2	Catahoula		18 R	1961		D			C

Table 2.—Records of selected wells in Smith County. (continued)

Well No.	Owner	Year Drilled	Depth (ft.)	Casing Diameter (in.)	Water Bearing Unit	Elev. of land surface datum (ft.)	Water Level: Above(+) or below land surface (ft.)	Water Level: Date of Measurement	Method of Lift	Use	Yield: Gallons per Minute	Yield: Date	Remarks
Q1	Town of Mize	1965	424	10,6	Mint Spring	292	+2 R	1967	T	P	175 R	1965	C
Q1a	Town of Mize	1965	300	4	Catahoula	292	+ R	1965		T			E,C
Q1b	Town of Mize	1965	480	4	Forest Hill	292	+ R	1965		T			E,C
Q2	Georgia Pacific Corp.	1969	351	8,6	Catahoula					I			E
Q3	Georgia Pacific Corp.	1970	408	8,6	Catahoula	336				I	450 R	1970	E
Q5	Town of Taylorsville	1972	240	16,10	Catahoula	395	128 R	1972	T	P	500 R	1972	E,C
Q6	L. D. Craft	1969	172	2	Catahoula		80 R	1969	A	D	20 R	1969	
Q7	Ray Standizola	1970	175	2	Catahoula		57 R	1970	J	D	12 R	1970	
Q8	Georgia Pacific Corp.	1969	402	4,2½	Catahoula	300	68 R	1969	S	I	150 R	1969	C
R1	Fellowship Wtr. Assn.	1967	440	4,2	Catahoula	370	96	1967	S	T	60 R	1967	E,C,P
R1a	Fellowship Wtr. Assn.	1967	212	4,2	Catahoula	370	99	1967	S	T	60 R	1967	E,C,P
R2	Town of Taylorsville	1969	346	12,8	Catahoula	270	22 R	1969	T	P	517 R	1969	E,C,P
R7	Tri County Water Assn.	1972	1478	4,2	Kosciusko	335	128 R	1972	T	T	40 R	1972	E,C
R8	Tri County Water Assn.	1972	1434	10,8	Kosciusko	418	172	1972	T	P	333	1972	E,C,P
R9	Charles Craft	1970	450	4	Catahoula	360	53 R	1970	S	S	120 R	1970	
R10	Town of Taylorsville	1963	354	16,10,6	Catahoula	280	30 R	1963	T	P	350 R	1963	C

Table 2.—Records of selected wells in Smith County. (continued)

Quality of Water

The chemical and physical properties of water are the criteria for determining its usefulness. Water of good quality is desirable for domestic and industrial use. Highly mineralized water is undesirable for most purposes. The dissolved minerals in ground water affect its utilization for various purposes in industry as well as for domestic use. Wide variations in chemical quality of ground water is possible within small geographic regions. Table 3 shows selected available chemical analyses of various samples of water from wells in Smith County.

Metal corrodes in contact with low pH (acid) water. Blue and green stains pinpoint acid water corrosion when copper pipes are used.

High iron concentrations in water (in excess of 0.3 ppm) deposits rust stains in sinks, tubs and water closets. High concentrations of iron results in eventual clogging of pipes and pumps, and commonly affects the taste of water.

Hard water leaves a scale in water pipes and hot water heaters. Hardness of water is demonstrated most commonly by the amount of soap needed to produce suds. All the minerals (almost always calcium and magnesium) causing the hardness must be removed before sudsing can be achieved. The material removed in softening the water to produce suds is evidenced as an insoluble scum such as the familiar bath tub ring. Water with a hardness of less than 50 ppm is considered soft, a hardness of 50-150 ppm is not objectionable for most purposes and hardness in excess of 200 ppm needs to be treated for household use. Municipal water supplies are normally softened to a hardness of approximately 85 ppm.

Water that contains too much dissolved mineral matter is unsatisfactory for varying uses. Water containing less than 500 ppm is generally satisfactory for domestic and most industrial purposes. Total dissolved solids content in excess of 1000 ppm usually contains minerals which gives water a disagreeable taste or in some other respect makes it undesirable for most purposes. High dissolved minerals content of water is potentially corrosive to metal well screens, pipes, etc.

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
				Analyses in Parts per million																		
A1	645	Cockfield	1968	35.0	2.9	6.6	2.8	78.0	3.8	167	0	52.0	13.0	0	0.1	287	28	0	432	7.2	72	20
**A2	700	Cockfield	1967		0.1												2			9.0		0
A5	55	Forest Hill	1968	18.0	4.0	4.5	2.1	21.0	0.4	50	0	0.6	14.0	0	4.6	86	20	0	149	6.3	69	10
A6	1060	Kosciusko	1968	32.0	0.04	5.1	0.6	83.0	2.2	220	0	16.0	4.0	0	1.9	248	15	0	376	7.5	74	20
B7	135	Forest Hill	1968	24.0	0.23	171.0	11.0	17.0	1.8	308	0	217.0	26.0	0.1	0	641	472	219	921	7.5	70	15
*C3	1080	Kosciusko	1970	3.2	0.5	8.81	2.19	43.01	3.25			18.76	10	0		146.2	31		195	6.3	79.7	<5
C5	173	Forest Hill	1968	42.0	5.1	27.0	3.1	5.0	2.8	94	0	16.0	2.0	0.1	0.1	159	80	3	204	6.8		15
**C6	167	Forest Hill	1967		0.7												188		340	7.8		
C7	637	Cockfield	1968	54.0	2.9	37.0	9.1	128.0	6.0	98	0	96.0	13.0	0.1	2.0	291	130	50	405	7.2	71	5
D7	493	Cockfield	1968	47.0	6.8	18.0	4.4	16.0	3.6	88	0	19.0	7.0	0.1	0.1	161	63	0	204	6.7	70	15
E1	880	Cockfield	1967	17.0	0.3	0.8	0	140.0	1.5	244	0	68.0	34.0	0.2	0.1	390	2		617	7.9	82	15
E6	312	Forest Hill	1968	14.0	0	4.4	1.0	74.0	1.3	200	0	12.0	4.0	0.3	0.1	209	15	0	333	7.9	72	30
E7	70	Forest Hill	1968	3.5	2.6	2.0	1.2	5.5	0.7	21	0	0.4	5.0	0.0	0.1	28	10	0	53	6.5	69	15
**F5	125	Catahoula	1972		0.5												17			<5.5	68.5	
F8	190	Forest Hill	1968	13.0	0.55	13.0	5.2	96.0	3.6	248	0	60.0	1.0	0	0.1	313	54	0	523	7.8	68	10
**G6	478	Cockfield	1972		3.2												137		523	6.6	67	

* Analysis by Mississippi State Board of Health
** Field analysis
All other analyses by U. S. Geological Survey

Table 3.—Chemical analyses of water from selected wells in Smith County.

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$		Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
																	Calcium, Magnesium	Non-carbonate				
									Analyses in Parts per million													
*H1	946	Kosciusko	1971		0.5	2.48	1.51	73.37	2.0			15.47	6	0		199.3	13.4			7.0		0
H9	68	Catahoula	1968	12.0	0.91	3.9	2.5	6.5	0.8	21	0	0	10.0	0	7.5	63	20	2	85	6.8	68	5
H10	486	Cockfield	1968	19.0	0.38	7.5	4.2	66.0	3.4	141	0	39.0	20.0	0.2	1.2	224	36	0	370	7.9	70	5
*J2	1099	Cockfield	1972		0.3	2.2	0.07	143.98				60.90	37	0.2		366.5	8		580	8.3	**79	25
**J3	95	Catahoula	1972		0.4												34		72	6.0	67	
J4	327	Forest Hill	1968	12.0	0.05	1.0	0.6	107.0	1.2	256	0	14.0	8.2	0.4	1.2	275	5	0	426	8.0	73	20
**J5	190	Catahoula	1972		7.5												34		152	5.5	65	
J6	130	Catahoula	1968	42.0	0.6	4.5	1.6	5.5	1.2	17	0	13.0	4.5	0.1	0.1	89	18	4	70	6.4	70	10
J7	80	Catahoula	1968	38.0	3.9	7.9	4.0	8.2	2.0	30	0	16.0	11.0	0.2	0.1	111	36	11	133	5.9	74	15
K1	1400	Kosciusko	1972	20.0	0.39	2.0	0.2	80.0	4.5	210	0	9.8	2.0	0.1	0.1	217	6	0	348	7.8	85	5
K4	69	Catahoula	1968	8.2	0.47	2.7	1.3	3.4	0.9	6	0	0	5.6	0	7.8	30	12	7	41	6.1	68	5
K6	1200	Kosciusko	1967	16.0	0.09	0	0	88.0	0.9	214	0	8.4	2.8	0.2	0.1	227	0	0	350	7.9	81	15
*L3	1086	Kosciusko	1970		<0.1								4				Trace			8.5		45
**L11	170	Forest Hill	1972		0												<34		330	8.3	68	
L12	168	Forest Hill	1969	9.8	0	7.7	1.6	78.0	2.4	214	0	16.0	4.0	0.2	0.1	221	26	0	356	8.0		0
**M2	220	Catahoula	1972		1.0												34			6.5	70	
M3	200	Catahoula	1968	43.0	12.0	3.7	1.2	4.7	1.5	26	0	4.2	2.0	0	0	75	14	0	57	6.7	67	20

* Analysis by Mississippi State Board of Health
** Field analysis
All other analyses by U. S. Geological Survey

Table 3.—Chemical analyses of water from selected wells in Smith County. (continued)

Well No.	Depth	Water Bearing Unit	Date Analyzed	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total Dissolved Solids	Hardness as $CaCO_3$: Calcium, Magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific Conductance (micromhos at 25° C)	pH	Temperature (°F)	Color
									Analyses in Parts per million													
N1	1520	Kosciusko	1972	17.0	0.05	0	0.2	110.0	1.3	266	0	11.0	5.5	0.2	0.3	301	1	0	773	8.3	86	20
**N4	220	Forest Hill	1972		0.3												<34		190	6.8	67	
N6	125	Catahoula	1968	10.0	0.07	1.0	0.4	2.7	0.3	6	0	0	2.9	0	0.8	20	4	0	19	6.0	68	5
**O1	121	Catahoula	1972		0												<17		58	5.7	67	
**O2	265	Catahoula	1972		0.3												<34		100	5.8	72	
**O3	106	Catahoula	1972		0.3												<17		50	5.5	67	
**O4	196	Forest Hill	1972		0												<51		400	8.4	66	
P2	30	Catahoula	1968	10.0	0.19	2.0	1.0	4.3	0.6	2	0	0.2	5.2	0	9.3	35	9	7	49	5.9	68	5
Q1	424	Mint Spring	1967	13.0	0.06	7.6	2.4	180.0	2.6	236	0	1.2	2.4	0.4	0.0	220	29		370	7.5	67	5
*Q1a	300	Catahoula	1965		0.3								4				20			6.5		
*Q1b	480	Forest Hill	1965		0.1								12				20			8.6		240
Q5	240	Catahoula	1972		<0.1	3.0	2.1	11.5				15.14	13	0.1			16.2			5.4	67.5	
Q8	402	Catahoula	1970	47.0	0.74	3.6	0.7	17.0	2.4	45	0	12.0	1.8	0.1	0	108	12	0	106	7.1		5
R1	440	Catahoula	1967	44.0	0.58	4.0	0.5	27.0	2.5	75	0	11.0	2.6	0.2	0.1	132	12		150	6.7	68	5
R1a	212	Catahoula	1967	14.0	0.25	3.0	0.6	3.1	0.8	1	0	10.0	3.3	0	0	47	10		49	4.6	66	20
*R2	346	Catahoula	1969		0.3								5				28			7.0	68	
R7	1478	Kosciusko	1972		0								9				3			8.8		140
*R8	1434	Kosciusko	1972		<0.1	0	0	149.5				11.85	14	0.3		336.5		Trace	522**	8.8	91	90
R10	354	Catahoula	1967	52.0	0.85	2.1	0.7	20.0	1.5	48	0	10.0	2.4	0.1	0.3	119	8	0	111	6.4	68	5

* Analysis by Mississippi State Board of Health
** Field analysis
All other analyses by U. S. Geological Survey

Table 3.—Chemical analyses of water from selected wells in Smith County.
(continued)

The quality of ground water in Smith County is generally good and for most purposes can be used without treatment. Most of the water is soft with low to moderate mineralization and is of the sodium or calcium bicarbonate type. The pH varies from 4.6 to 9.0, with the low pH (acid) water usually being in the shallow aquifers near and in the outcrop areas of the aquifers. High pH (alkaline) water is available in deeper, downdip aquifers further removed from their outcrop. The most frequent probelms with water quality are excessive iron concentrations and excessive color. Other problems include low pH, high concentrations of carbon dioxide and hardness.

Ground-water pollution in Smith County is low and is related to man's activities such as wells located downgrade of barn lots, sewage field lines, septic tanks and improperly sealed well casings which allow percolation of drainage waters into wells. Shallow aquifers have perhaps been polluted by brine storage in open pits in local areas of oil field activity.

Water Levels

Static water levels in Smith County vary from flowing to more than 450 feet above mean sea level, with the majority of wells having water levels of less than 100 feet below ground level. Flowing wells are possible only at the lower elevations in the County while deeper water levels are found at higher elevations. Flowing wells are possible primarily at lower elevations along the Oakohay Creek and along the Leaf River in the south half of the County.

Water levels in Smith County are probably declining less than 1 foot per year except in certain areas of relatively heavy pumping where the declines are estimated from less than 1 foot per year to perhaps 2 feet per year.

Test Drilling

Test drilling is an important and essential part of each county geologic study conducted by the Mississippi Geological Survey. The Survey drilled 60 test holes in Smith County (Figure 6, Luper). A number of the test holes were beneficial in delineating and identifying aquifers. The potential use of certain aquifers was clarified through information gained in the drilling and electrical logging of the many test holes.

Aquifer Tests

Aquifer tests are valuable for many reasons. They are very helpful to a drilling contractor in providing information needed for the selection of the proper pump. A properly selected pump results in a more economically and efficiently operated well, which is very important on moderate and large yield wells. Properly planned pumping tests can furnish valuable information and important facts about the ground-water aquifers. Such information cannot be gained otherwise and the practical use and application of this information can aid in adequately and properly developing ground water for domestic, industrial, municipal and rural water association supplies.

An explanation of various terms used in pumping tests are as follows:

Transmissibility (T) is the rate of flow of water through a vertical section of an aquifer 1 foot wide under a hydraulic gradient of 1 foot per foot. Transmissibility is an index of an aquifer's ability to transmit water. Units are gallons per day per foot.

Permeability (P) is the rate of flow of water through a 1 foot square section of an aquifer under unit hydraulic gradient of 1 foot per square foot. It is usually obtained by dividing the transmissibility by the aquifer thickness.

Coefficient of storage (S) is the volume of water an aquifer releases from storage per unit of surface area to the unit decline in the component of head normal to that surface. The storage coefficient is an index of the amount of water released from storage in an aquifer.

Specific capacity is the gallons of water per minute produced for each foot of drawdown of the water level in the well. Specific capacity is usually calculated or measured for a 24 hour period.

Table 4 shows a tabulation of selected pumping test results on public supply wells in Smith County. Figure 2 shows the locations of the various wells from which the results were obtained.

Well No.	Owner	Depth of Well (Ft.)	Aquifer Thickness (Ft.)	Hydraulic Coefficients: Transmissibility (gpd/ft.)	Hydraulic Coefficients: Permeability (gpd/ft^2)	Hydraulic Coefficients: Storage	Specific Capacity (gpm/ft. at the end of 24 hours)	Remarks
				CATAHOULA AQUIFER				
R1	Fellowship Water Assn.	440	70	63,000	900	--	3.4	USGS Test
R1a	Fellowship Water Assn.	212	100	16,000	160	--	1.9	USGS Test
R2	Town of Taylorsville	346	36	30,000	830	--	11	USGS Test
				COCKFIELD AQUIFER				
A1	Polkville Water Assn.	645	70	30,000	420	--	4.8	USGS Test
E1	White Oak Water Assn.	880	60	600	10	--	.4	USGS Test
				KOSCIUSKO AQUIFER				
C3	Lemon-Lorena-Burns Water Assn.	1080	120	75,000	620	--	2.6	USGS Test
K1	Center Ridge Water Assn.	1400	150	41,000	270	--	6.3	USGS Test
K6	Town of Raleigh	1200	120	80,000	660	.0003	12	USGS Test
R8	Tri County Water Assn.	1434	90	22,500	250	--	7.9	MGS Test

Table 4.—Aquifer and well characteristics determined from pumping tests.

Results tabulated (Table 4) on nine of the ten wells were obtained from the U. S. Geological Survey and one well (R8, Table 4) was obtained from a pumping test conducted by the Mississippi Geological Survey. Three of the test results listed are on Catahoula aquifers, two are on Cockfield aquifers and four are on Kosciusko aquifers.

Hydraulic characteristics of the different aquifers vary greatly across the County. Each of the test results represent specific local information on particular wells pumped and is not applicable to any generalization of aquifer characteristics on a county-wide basis.

Aquifer tests were not possible on Wilcox and Meridian aquifers because no wells have been constructed in these formations in Smith County.

Large volumes of water are available from properly developed wells constructed in Kosciusko aquifers. Transmissibility values vary from 22,500 to 80,000 gpd per foot and the permeability varies from 250 to 660 gpd per square foot. Aquifer permeability varies considerably in the County. The Kosciusko aquifer will yield adequate quantities of water for industrial, municipal or other purposes in most of the County.

The Cockfield aquifer will yield adequate quantities of water for small domestic to medium sized wells in practically all of Smith County. Transmissibility values on Cockfield aquifers vary from 600 to 30,000 gpd per foot and permeability varies from 10 to 420 gpd per square foot. Large capacity wells are possible in certain areas of the County. Small to moderate yield wells are possible in most of the County.

The potential for developing moderate to large yield wells in Forest Hill aquifers is very poor. Moderate yield wells are a remote possibility in very rare instances in very local areas. Adequate well yields for home use is available in Forest Hill aquifers in much of the southern two-thirds of Smith County. No moderate or large yield wells have been completed in the formation in Smith County due primarily to lack of sand development. No aquifer tests were made.

The Mint Spring Marl of the Vicksburg Group supplies one moderate yield well which supplies the Town of Mize (Table 2, Well No. Q1). This is a rare development of sand in the Mint Spring Marl and other such developments of sand in the formation are not known to exist elsewhere in the County. No aquifer tests were performed on this well. The Mint Spring Marl is capable of yielding small amounts of water to wells in other parts of the County.

The Catahoula aquifers are fair to good in the southern part of Smith County. A well yielding in excess of 500 gpm from a Catahoula aquifer is in use by the town of Taylorsville. Other wells in Catahoula aquifers in the area yield as much as 500 gpm. Transmissibility values vary from 16,000 to 63,000 gpd per foot and permeability values vary from 160 to 900 gpd per square foot. Catahoula aquifers in other areas in southern and southwestern Smith County may be capable of moderate to large yields.

AQUIFERS

Wilcox Aquifers

No water wells have been drilled to the Wilcox in Smith County. It is, however, a potentially important aquifer-bearing formation in the County. Aquifers in the Wilcox have not been produced due to the depth and costs of such wells. Shallower aquifers are much cheaper to produce and are available in virtually all of Smith County. Lower, middle and upper Wilcox aquifers are a potential source of large quantities of ground water in various areas of the County.

Water of good quality is thought to be available in Wilcox aquifers in Smith County (Fig. 1). Water from Wilcox aquifers would likely be soft, sodium-bicarbonate type with high pH and low iron content. Color is difficult and often impossible to predict, but would likely be a problem only in isolated instances.

Water levels would probably be in the range of 100 to 150 feet above sea level. Upper Wilcox aquifers would probably have the highest water levels.

Movement of water in Wilcox aquifers is in a southwestward direction. Sand thicknesses of Wilcox aquifers vary from less than 50 feet to several hundred feet. Large yields of 1000-2000 gpm or even more may be possible in parts of Smith County from Wilcox aquifers.

Meridian Sand Aquifer

No water wells have tapped the Meridian Sand aquifer in Smith County. It is a potential aquifer in many areas of the County. The Meridian aquifer is a potential source of moderate to large yields of ground water in several local areas of the County. Cost of well construction to produce this aquifer in Smith County limits the use of it at this time. Were it not for the fact that shallower aquifers are available, it no doubt would be in use today in parts of Smith County.

Quality of water in the Meridian is expected to be good. It is probably sodium bicarbonate type. High iron concentrations found updip and near the outcrop belt should be lacking in Smith County. Water is expected to be slightly alkaline and have a relatively high pH. Color is not expected to be objectionably high.

Water levels for the Meridian Sand aquifer would probably be 150 to 200 feet above sea level.

Water movement in the Meridian is in a southwestward direction. The Meridian Sand aquifer is poorly developed in portions of Smith County while in other areas it is not developed at all. In these areas it does not exist as a potential aquifer, though in other areas it is well developed and is a definite potential source of ground water. In areas of well developed and hydraulically connected Upper Wilcox sands, the complete interval is considered as Meridian Sand. The aquifer is as much as 100 feet thick in the County and when considered with the hydraulically connected Upper Wilcox sands, the total thickness of the interval may be more than 200 feet locally.

Kosciusko Aquifers

The Kosciusko sands are among the most important water-bearing aquifers in Smith County. They are the source of water for five of the community water association wells located in the County and are also the source of water for the town of Raleigh. Many domestic wells in the northeastern part of Smith County are completed in aquifers of the Kosciusko Formation. The lack of demand for large quantities of water has made more rapid development of water supplies from the Kosciusko unnecessary. Moderate to large quantities of good to excellent quality water is available in Kosciusko aquifers in almost all of Smith County. Color is a deterrent to its further development as a source of water supply in some parts of the County.

The chemical quality of Kosciusko water is good to excellent in Smith County. The water is a sodium bicarbonate type. High iron concentrations found updip and northeast of Smith County are absent, leaving low to very low iron content in Kosciusko water in the County. The water is soft, has a high pH and is relatively low in total dissolved solids. Color is a problem locally and in southernmost Smith County. Water from a test well in that part of the County (Fig. 3, Well No. R7) had a color of 140. Water from still another Kosciusko well (Fig. 3, Well No. R8) had a color of 90. The chemical quality of the water from the two wells was very good. Color is objectionable for many industrial purposes and must be removed in order to be used for some industrial purposes. Color in water is esthetically objectionable for domestic uses and also because it may discolor articles of clothing washed in it.

Water levels on the Kosciusko aquifers in Smith County vary from approximately 223 feet above sea level to approximately 257 feet above sea level. Flowing wells are a slight possibility only in the lowest stream valleys.

Water movement in Kosciusko aquifers is in a southwestward direction. Sand development in the Kosciusko Formation is fair to very good in Smith County, therefore it is a potential source of small to large quantities of water in many areas of the County. Sand developments in excess of 150 feet thick are present in many areas of Smith County as revealed by electrical logs on oil tests and thicknesses greater than 200 feet are present at some locations. Sands are fine- to coarse-grained, commonly containing interbedded lignitic or carbonaceous silts and clays.

Cockfield Aquifers

Cockfield aquifers supply numerous wells in Smith County (Table 2), particularly in the northern part of the County. Many domestic wells are completed in the Cockfield in the northeastern one-third of the County where it is the shallowest dependable source of ground water in much of the area. The Cockfield aquifers are the source of water for three community water associations in the County. Cockfield aquifers are a potential source of ground water in virtually all of Smith County, where they may be considered for small to moderate yield wells for domestic, industrial, municipal and community water supplies. Lack of sand development limits its potential use in parts of the County.

The chemical quality of Cockfield water is generally good for most purposes. Concentrations of iron varies in Cockfield aquifers but can normally be expected in objectionable quantities (more than .3 ppm) in parts of the northern third of the County. Low pH is also common in that portion of the County. Lower iron concentrations and higher pH is characteristic of Cockfield water downdip, where the water is generally soft and of the sodium bicarbonate type. Air wells are generally satisfactory solutions to low pH and high iron concentrations and have been used successfully to obtain good quality water in certain parts of Smith County from Cockfield aquifers as well as from other aquifers. Color can be a minor problem in some areas but is generally low enough to go unnoticed.

Water levels on Cockfield aquifers in Smith County vary from approximately 200 feet above sea level to approximately 365 feet above sea level. Flowing wells from Cockfield aquifers are possible in several areas of Smith County.

Water movement in the Cockfield is southwestward. Sand development in the Cockfield Formation is generally fair to good. Poor sand developments in the Cockfield were noted in some areas of the County. Sands are very fine- to fine-grained, micaceous and commonly lignitic or contain thin lenses of lignite and are rarely 150-200 feet thick, more commonly less than 100 feet thick. The Cockfield is often irregularly bedded and thin bedded with better sand development near the base of the formation.

Forest Hill Aquifers

Forest Hill aquifers are important in parts of Smith County for domestic wells. They are the source of no moderate to large yield wells in the County due mainly to lack of sand development within the Forest Hill Formation. Colored water is locally a problem in Forest Hill aquifers due to lignite beds and lenses in aquifers. A test well sampling Forest Hill water in Mize produced water with a color of 240 (Table 3, Well No. Qlb).

The chemical quality of water from Forest Hill aquifers varies considerably in Smith County. Water of good to excellent quality is produced by several domestic wells completed in Forest Hill aquifers in central and southern Smith County. High iron concentrations along with low pH is a common occurrence in and short distances downdip from the outcrop of the Forest Hill Formation. High total dissolved solids of 641 ppm was analyzed in northern Smith County (Table 3, Well No. B7). Hardness was exceptionally high as was the sulfate concentration (217 ppm). Water from the well was calcium-magnesium bicarbonate type, low in iron. Most of the water from the Forest Hill aquifers is sodium bicarbonate but some is calcium bicarbonate. It is soft to moderately hard, generally being harder in and immediately downdip of the outcrop area.

Static water levels on the Forest Hill vary (Table 2) from 292 to 368 feet above sea level in Smith County. Flowing wells are possible at lower elevations in various parts of the County south of the Forest Hill outcrop (Plate 1, Luper).

Water movement in the Forest Hill aquifers is in a southwestward direction. Poor sand developments in the formation limit its potential as a source of ground water in most of the County. Other aquifer characteristics such as lignites and carbonaceous silts and clays interbedded in the sands limit its desirability as a ground-water source in many localities within the County.

Mint Spring Aquifer

The Mint Spring aquifer is a potential source of ground water for small yield wells in various areas in the southwestern one-third of Smith County. It is the source of water for a moderate yield well for the town of Mize in southwestern Smith County. The Mize well has an unusually good development of sand in the Mint Spring and has a reported yield of 175 gpm. Such a development of the Mint Spring aquifer is unknown in other areas of the County. Lack of sand content and formation development limits its potential use in other areas.

The chemical quality of Mint Spring water is very good to excellent in the Mize well (Table 3, Well No. Q1). Comparable quality water is expected from the aquifer in other areas of possible use within the County. The water is soft, sodium bicarbonate type with high pH and low to moderate dissolved solids. Color is expected to be too low to be noticeable.

Static water level on the Mint Spring well in Mize was reported to be 294 feet above sea level in 1965. Wells completed in the Mint Spring aquifer in southern Smith County are expected to flow at elevations of less than 290 feet above sea level.

Water movement in the Mint Spring aquifer is southwestward. Poor sand development in the formation limits its potential use as a source of ground water in much of the County where it can be considered as a ground-water source. Sand developments in excess of 5 to 10 feet in thickness are exceptional in Smith County.

Catahoula Aquifers

The Catahoula aquifers are an important source of ground water for public supply as well as for domestic use in the southwestern one-half of Smith County. Most of the domestic wells in southern Smith County within the outcrop belt of the Catahoula Formation are completed in this formation provided sufficient sand developments are found. Many bored and dug wells furnishing homes receive ample water from shallow Catahoula aquifers. The entire supply of water for the town of Taylorsville is produced from wells completed in Catahoula aquifers. Large industrial wells in the Taylorsville area are made in Catahoula aquifers. The aquifers developed in the Catahoula Formation in southernmost Smith County are potential producers of large quanties of ground water in several localities.

Chemical quality of Catahoula water is fair to good, but high iron concentrations and low pH are frequent problems. Water from Catahoula aquifers is generally soft to slightly hard, acidic, sodium bicarbonate type with color seldom high enough to be noticeable. Treatment for pH adjustment and iron removal is needed for much of the Catahoula water produced in the County. Most of the Catahoula water produced in Smith County is corrosive to metal.

Water levels on Catahoula aquifers vary from 250 to 461 feet above sea level and flowing wells are possible in several stream valleys in southwestern Smith County.

Water movement in Catahoula aquifers is southwestward. Thick massive sands in some areas of Smith County are capable of producing large quantities of water from Catahoula aquifers. Prediction of aquifer thickness in the Catahoula aquifers is extremely difficult because of the lenticular character of the sands. Correlation of sands within the formation is impossible to make to any degree of certainty even over short distances. Sands in excess of 50 feet thick in the Catahoula Formation can be found in many localities in southern Smith County. Permeability is good in most Catahoula aquifers in the County.

Hattiesburg Aquifers

The Hattiesburg aquifers are relatively unimportant in Smith County because they are present primarily at higher elevations in extreme southwest Smith County. They supply some small, shallow domestic wells in that part of the County.

Citronelle Aquifers

The Citronelle is generally not used as a ground-water aquifer in Smith County. Small shallow domestic wells are completed in the Citronelle at higher elevations where the formation is of sufficient thickness.

Quality of water from the Citronelle is expected to be poor, probably moderately hard to hard and acidic.

Water levels vary due to seasonal climatic conditions.

Few deposits of Citronelle sands and gravels are present in Smith County in sufficient thickness to make it an important source for ground water.

Terrace deposits

Some small wells (mainly dug or bored) are completed in terrace sands. Few wells are completed in it due to very poor water quality and seasonal fluctuations of water levels. Terrace deposits overlie bedrock formations in various locations in Smith County (Plate 1, Luper).

Alluvium

Alluvium is present in low elevations adjacent to most of the streams in the County. It can be utilized to supply shallow wells in flood plains along streams in some localities. Few wells are made in the alluvium due to poor water quality and fluctuations in water levels due to varying amounts of rainfall.

SURFACE WATER

Drainage

Principal streams in Smith County are: Leaf River, Oakohay Creek and Strong River (Fig. 3). Leaf River is the larger of the three streams and along with Oakohay Creek, which is actually a tributary of Leaf River, drains all of Smith County except a small portion in the northwest corner of the County. Strong River drains the northwestern corner of the County. Oakohay Creek drains the west-central part of the County and empties into the Leaf River downstream in adjoining Covington County. Other minor drainages are small upstream tributaries of Okatoma Creek in southwestern Smith County and small upstream tributaries of Big Creek in the southeastern corner.

Leaf River drains approximately 46 per cent or 294 square miles, Oakohay drains appoximately 31 per cent or 202 square miles, Strong River drains approximately 13 per cent or 88 square miles and a little less than 10 per cent or 58 square miles is drained by upstream tributaries of Okatoma Creek and Big Creek. The floodplain of Leaf River is well developed and is more than two miles wide in some places. Flood plains of other streams in the County are not as wide.

Availability

Leaf River is the largest source of surface water in Smith County. It flows through the eastern one-half of the County in a southerly direction. Oakohay Creek flows from northern Smith County through the west-central part of the County in a southerly direction and empties into Leaf River approximately six miles downstream in Covington County. Strong River flows across the northwestern corner in a southwesterly direction.

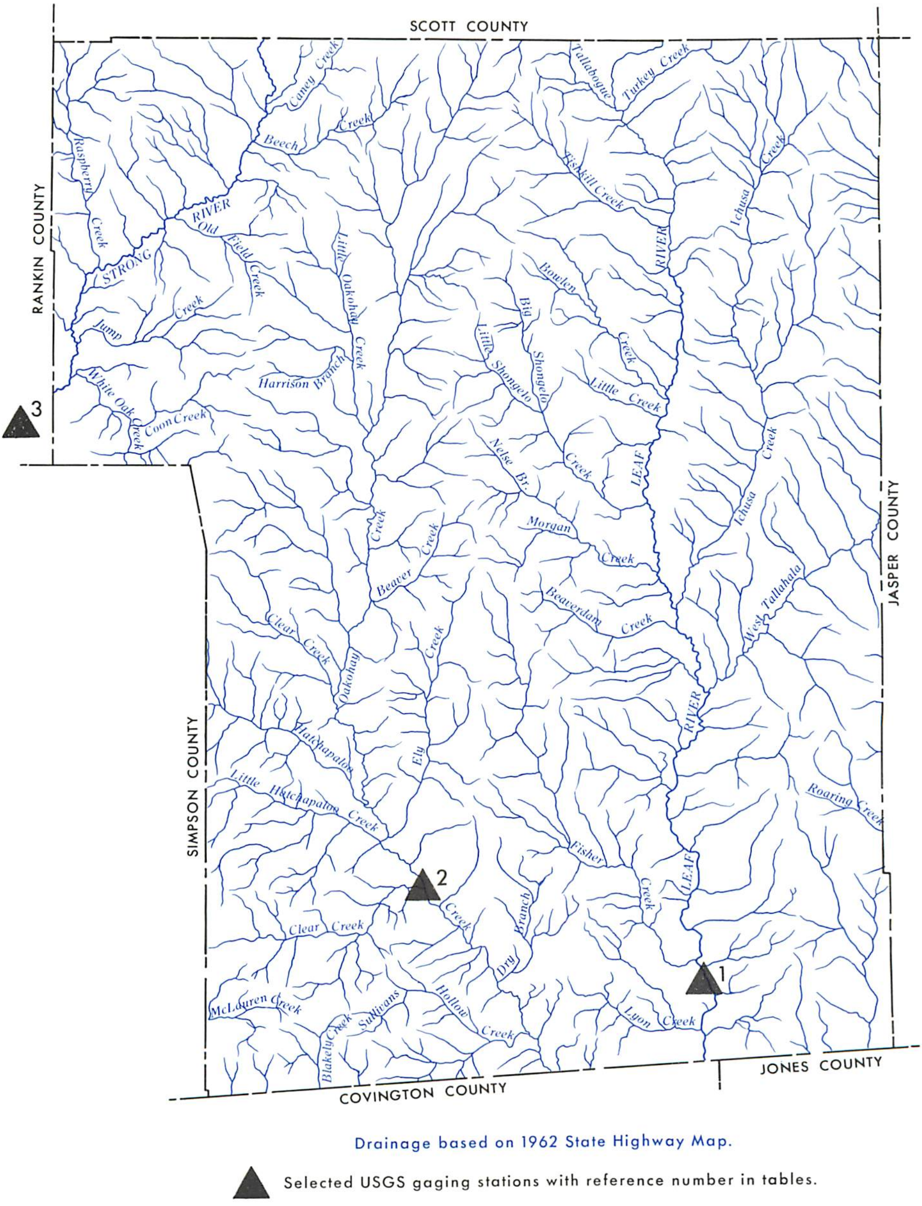

Figure 3.—Locations of streams and U.S.G.S. gaging stations.

Tributaries of Leaf River in Smith County include Lyon, Fisher, West Tallahala, Beaverdam, Ichusa, Morgan, Shongelo, Little, Bowlen, Tishkill, Turkey and Tallabogue Creeks (Fig. 3). Tributaries of Oakohay Creek include Sullivan's Hollow, Clear, Little Hatchapaloo, Hatchapaloo, Ely and Beaver Creeks. Strong River tributaries in Smith County include White Oak, Jump, Raspberry, Old Field, Beech and Caney Creeks.

Stream flow records on Strong River (Table 5) show an average discharge of 533 cfs (cubic feet per second) for the 43 year period from 1928 through 1971[3]. Stream flow records on the Oakohay Creek (Table 5) show an average flow of 335 cfs for the 6 year period from 1943 through 1949[4], a maximum flow of 9,710 cfs and a minimum flow of 13 cfs. Gaging station records on stream flow at that station were discontinued in 1949[5]. Adequate stream flow records on the Leaf River in Smith County are not available. Stream flow records on the Leaf, approximately 6 miles downstream in Covington County, for the 33 year period from 1938 through 1971[6] show an average discharge of 1000 cfs, a maximum discharge of 48,500 cfs and a minimum discharge of 55 cfs. The stream gaging station is located 2 miles downstream from the point Oakohay Creek empties into the Leaf River.

Most of the stream flow on smaller streams depends on precipitation within the drainage basin. Springs contribute insignificant flows to most streams in the County. In some cases springs sustain a flow in small streams and branches during seasonal periods of little precipitation. Stream flow, however, is low during much of the year except for short periods of much precipitation.

No impoundments of surface water for flood control have been constructed in Smith County. A comprehensive basin study of the Pascagoula River recommended two reservoirs in the County for inclusion in the early-action program. This study was conducted jointly by various federal agencies and agencies of the States of Alabama and Mississippi for the Pat Harrison Waterway District. One of the reservoirs would have a normal pool area of 3600 acres and be located on the Oakohay Creek near Mize. The other reservoir would have a normal pool area of 3500 acres and be located on the Leaf River near Taylorsville.

Ref. No.	Stream and Location	Drainage area (sq. mi.)	Records Available	Average discharge in cubic feet per second (cfs): Average Discharge Years	Average Discharge (cfs)	Minimum Daily Discharge (cfs)	Minimum Daily Discharge Date	Maximum Discharge (cfs)	Maximum Discharge Date	Remarks
2	* Oakohay Creek at Mize	217	1943-49	6	335	13	Oct. & Nov., 1943	9,710	Jan. 20, 1947	
3	** Strong River at D'Lo	429	1928-71	43	533	12	Sept. 1, 1954	24,800	Jan. 7, 1950	

* Geological Survey Water-Supply Paper 1304, Compilation of Records of Surface Waters of the United States through September 1950, page 360.

** Records from U. S. Geological Survey Water Resources Data for Mississippi 1963-71.

Table 5.—Summary of data from stream gaging stations.

The two reservoirs have since been removed from the early-action program and probably will not be constructed for perhaps 10 to 20 years.[8]

Several recreational lakes of less than 100 acres in size are located in the County. These lakes offer boating, swimming, skiing, fishing and camping sites for those interested.

Quality

Quality of surface water from the natural streams in the County is good. Pollution is a problem at some localities, but is not known to be a serious problem as in some other areas of the State. Organic pollution is a problem in some cases within the County.

Selected analyses of surface water are shown in Table 6. High and low flow analyses were chosen to represent varying conditions of stream flow.

Flood Hazard

Many streams in Smith County are subject to minor flooding during periods of excessive rainfall. Generally floods are more likely in late winter and early spring. Record floods can, however, occur at any time of the year. Rivers and creeks having large drainage areas are more likely to flood due to upstream runoff. Small streams respond rapidly to excessive rainfall within the drainage basin and flooding is less severe and shorter in duration.

Severe flooding occurred on the Strong River in 1930 and again in 1950. A record flood was recorded on January 7, 1950 (Table 5). The flood of 1930 has been estimated to be of similiar magnitude.

Portions of Smith County along the Leaf River and Oakohay Creek are subject to flooding during extended periods of excessive rainfall. Flooding along these streams is greater in the southern portions of the County.

(Analytical results in parts per million, except as indicated)

(Analyses by U. S. Geological Survey)

Reference No.	Date of Collection	Discharge[a] (cfs)	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids: Residue on evaporation at 180°C	Hardness: Calcium, Magnesium	Hardness: Noncarbonate	Specific conductance (micro-mhos at 25°C)	pH	Color
	Leaf River at Taylorsville *																			
1	Feb. 9, 1967	1550		5.9	.31	12	1.3	3.6	1.4	28	9.4	7.7	.2	.6	74	35	12	94	6.1	50
	Aug. 21, 1967	47		10	.09	7.9	.8	3.5	.9	25	4.2	5.7	.1	.2	56	23	3	70	6.1	20
	Oakohay Creek at Mize *																			
2	Feb. 9, 1967	260		8.1	.09	8.6	1.6	14	1.6	7	5.0	36	.1	.6	96	28	22	145	5.7	20
	Aug. 21, 1967	26		9.9	.14	1.6	1.0	2.8	.3	10	.4	3.5	.1	.8	32	8	0	33	6.1	15
	Strong River near Puckett *																			
3	Feb. 8, 1967	784		4.9	.20	15	1.1	5.3	4.0	28	20	8.0	.2	1.3	90	42	19	125	6.0	50
	Apr. 11, 1967	13.4		8.9	.20	13	2.3	7.0	2.0	44	9.2	8.1	.0	.3	86	42	6	126	6.7	40

* Records from U. S. Geological Survey
Quality of Surface Waters of the United States, 1967, pp. 809 and 814.

Table 6.—Chemical analyses of water from streams.

CONCLUSIONS

Smith County does not contain an abundance of surface water for potential use without proper storage. Ample water supply is available at practically any location within the County from ground-water aquifers.

Most of the ground-water pumpage in the County is from Cockfield, Catahoula and Kosciusko aquifers. Cockfield aquifers are more widely used for small to moderate yield wells in the northern portion of the County due to depth and water quality. Deeper aquifers are available for use in the Wilcox Formation and the Meridian Sand. Kosciusko aquifers are utilized in the County for moderate yield wells in all but the southwestern portion of the County and are frequently the source of water for low yield wells in northernmost Smith County. Catahoula aquifers are utilized for water supply in the southwestern one-half of the County and are a potential source of moderate to large yield wells in various locations within this area.

Availability of shallower aquifers has limited the exploitation of deeper aquifers in all of Smith County. Large quantities of water are available from presently used aquifers in much of the County and deeper ground-water aquifers are available for use when the need demands their utilization for water supply.

Quality of ground water is generally good and meets the requirements for general use. Quality varies from low acid to alkaline, and from calcium bicarbonate to sodium bicarbonate type. Water quality is generally better downdip and at greater depths. Excessive iron content, low pH, high carbon dioxide and color are the most common problems with water quality. Better quality water is available in most areas of the County where these problems exist in water produced from shallower aquifers.

Water quality problems in the County can almost invariably be solved by minor treatment or the selection of another aquifer. Most of the water is good in quality and used without treatment.

Surface water is available for use only in small quantities, unless proper storage facilities are constructed. Low flow is a limiting factor to the utilization of surface water on larger streams. Base flow is zero or near zero on most of the smaller streams during various times of the year, thus limiting their potential for water supply. Quantity available and pollution are the primary factors affecting utilization of surface water.

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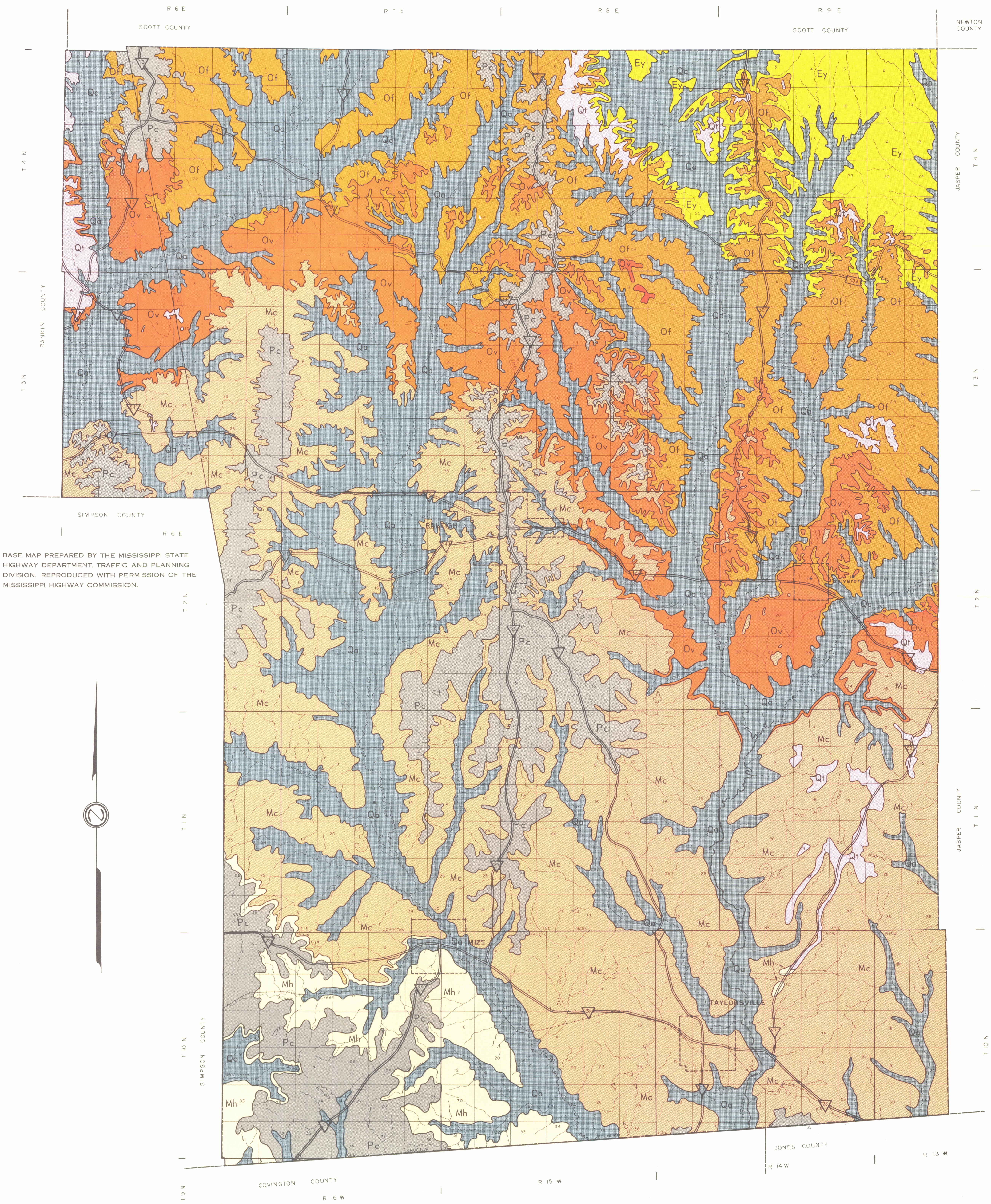

SMITH COUNTY, MISSISSIPPI

GEOLOGIC MAP

GEOLOGY BY EDWIN E. LUPER

MISSISSIPPI GEOLOGICAL SURVEY

1972

SCALE 1 0 1 2 3 4 MILES

THIS MAP IS BASED ON DATA AVAILABLE TO THE DATE MAY 1, 1972.

LEGEND

QUATERNARY

RECENT
- Qa — Alluvium—sand, fine-to coarse-grained; gravel, chert and quartz; clay and silt; includes low terraces.

PLEISTOCENE
- Qt — Terrace deposits—sand, fine-to coarse-grained; gravel, chert and quartz; clay lenses.
- Pc — Citronelle Formation—gravel, chert and quartz; sand, fine-to coarse-grained, occasional clay lenses.

TERTIARY

MIOCENE
- Mh — Hattiesburg Formation—clay, silty; sand, fine-grained.
- Mc — Catahoula Formation—siltstone; clay, sandy; sand, fine-to medium-grained; indurated sandstone.

OLIGOCENE
- Ov — Vicksburg Group—includes in ascending order; Mint Spring marl and sand; Glendon limestones and marl; Byram marl; Bucatunna clay.
- Of — Forest Hill Formation—sand, fine-grained, silty; clay, carbonaceous; lignite.

EOCENE
- Ey — Yazoo Formation—clay, fossilferous, calcareous.

PREPARED BY MERCURY MAPS INC. JACKSON, MISSISSIPPI

SMITH COUNTY, MISSISSIPPI

STRUCTURE MAP

DATUM TOP OF GLENDON LIMESTONE

CONTOUR INTERVAL 25 FEET

GEOLOGY BY EDWIN E. LUPER

MISSISSIPPI GEOLOGICAL SURVEY

1972

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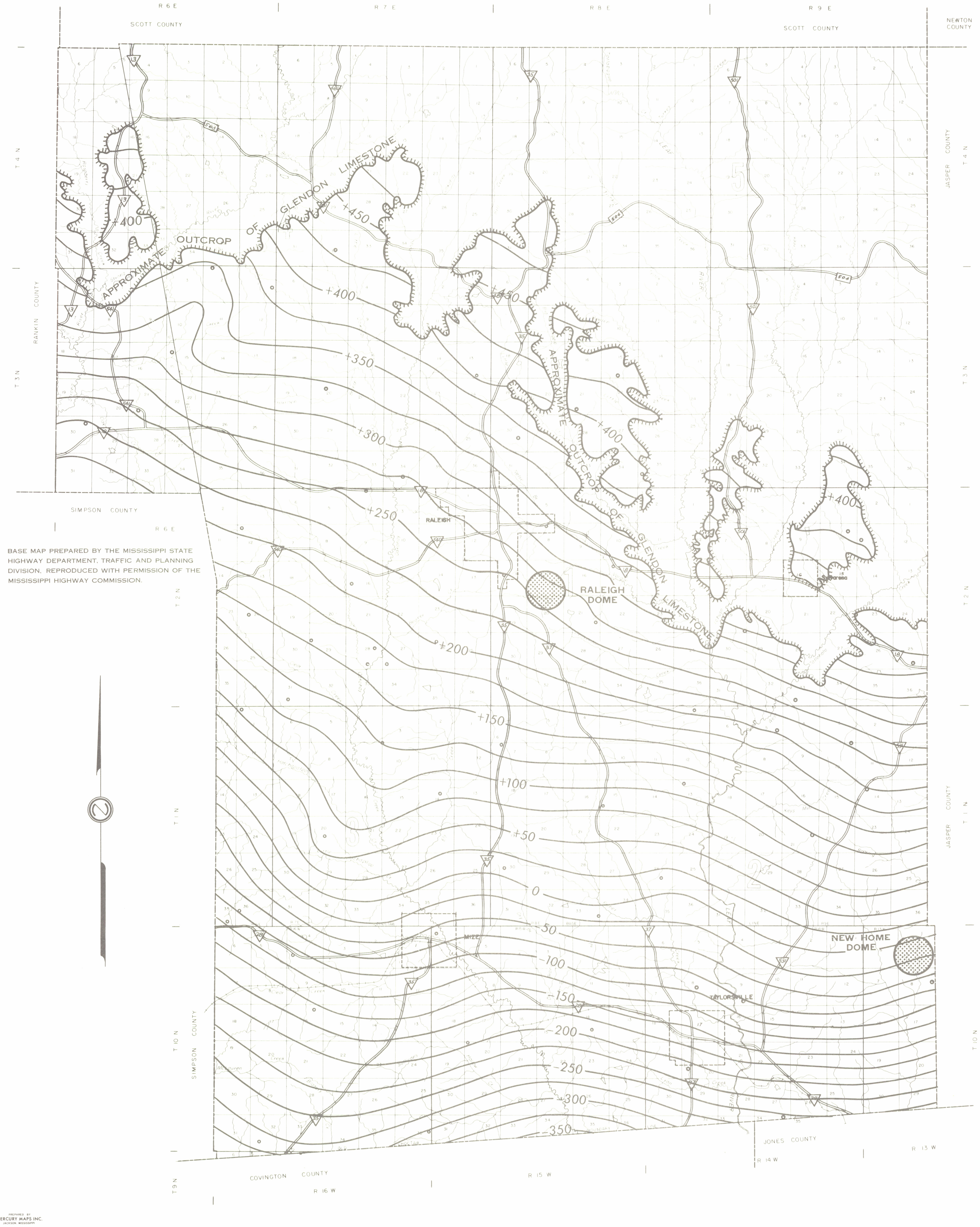

BASE MAP PREPARED BY THE MISSISSIPPI STATE HIGHWAY DEPARTMENT, TRAFFIC AND PLANNING DIVISION. REPRODUCED WITH PERMISSION OF THE MISSISSIPPI HIGHWAY COMMISSION.

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SMITH COUNTY, MISSISSIPPI

STRUCTURE MAP

DATUM TOP OF MOODYS BRANCH MARL

CONTOUR INTERVAL 25 FEET

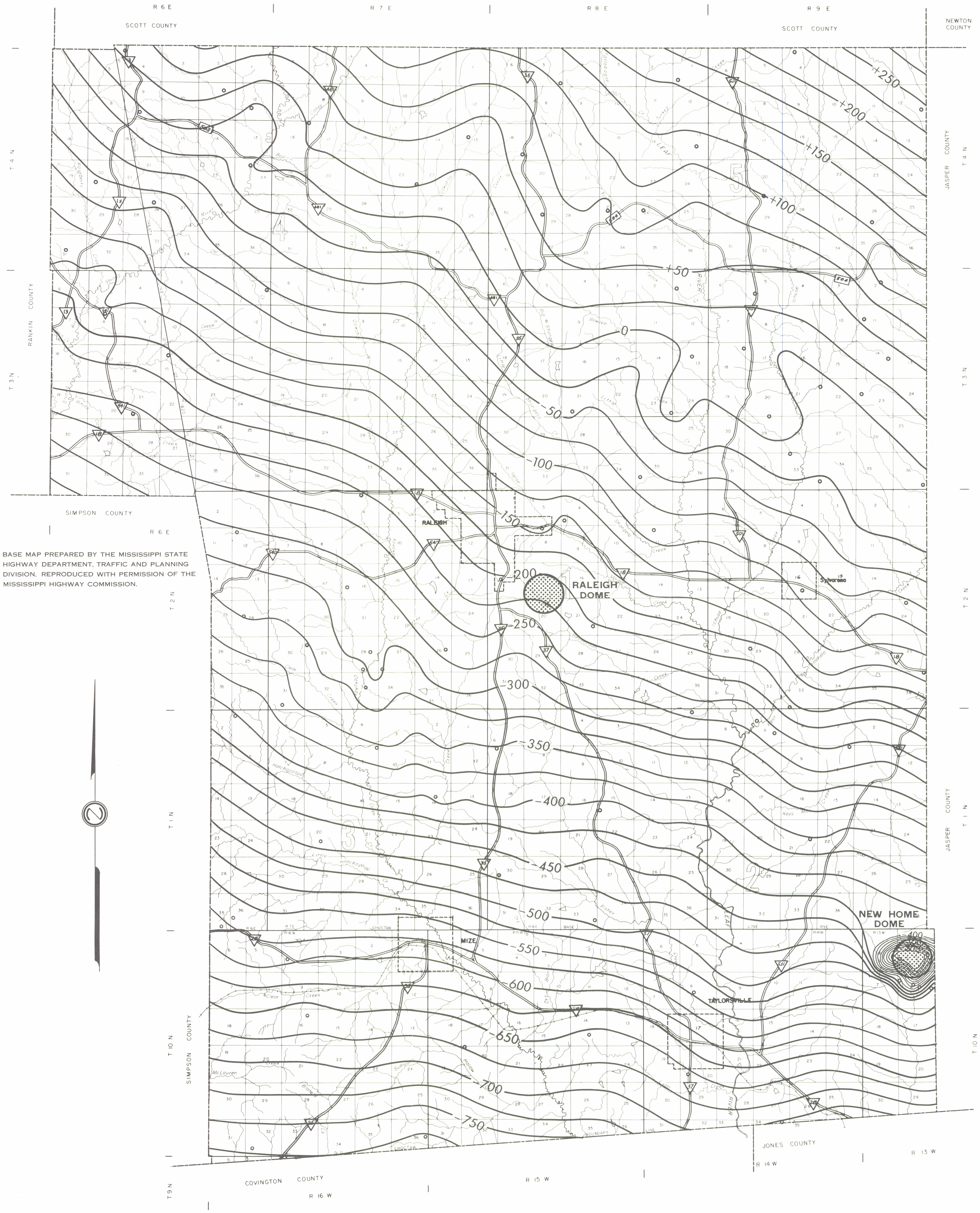
GEOLOGY BY EDWIN E. LUPER

MISSISSIPPI GEOLOGICAL SURVEY

1972

SCALE

THIS MAP IS BASED ON DATA AVAILABLE TO THE DATE MAY 1, 1972.



• DENOTES CONTROL POINT

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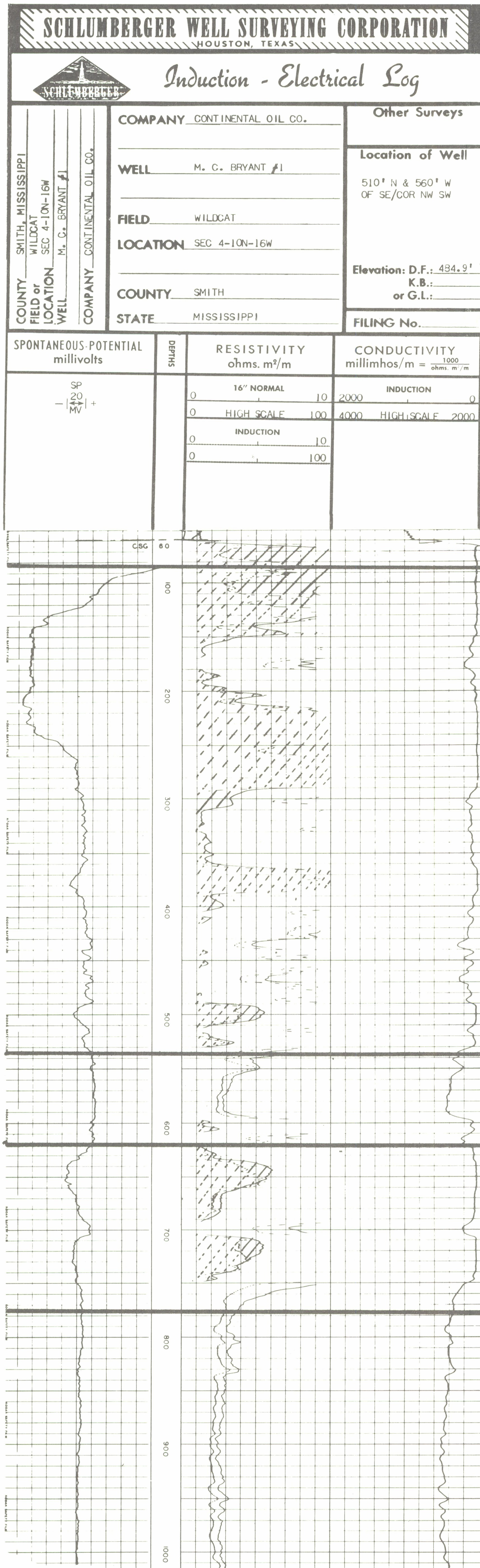
ELECTRICAL LOG OF BEDROCK UNITS EXPOSED AT THE SURFACE IN SMITH COUNTY, MISSISSIPPI



Hattiesburg Formation

Catahoula Formation

Vicksburg Group

Forest Hill Formation

Yazoo Formation