NEWTON COUNTY GEOLOGY AND MINERAL RESOURCES

Robert K. Merrill
James J. Sims, Jr.
Delbert E. Gann
Kenneth J. Liles

BULLETIN 126

MISSISSIPPI DEPARTMENT OF NATURAL RESOURCES
BUREAU OF GEOLOGY

ALVIN R. BICKER, JR.
Bureau Director

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COVER: View from the Citronelle terrace showing its elevation with respect to the surrounding terrain. Location: NE/4, SW/4, Sec. 24, T.5N., R.10E.

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LETTER OF TRANSMITTAL

Mississippi Department of Natural Resources
Bureau of Geology

Mr. Robert C. Travis, Chairman, and
Members of The Commission
Department of Natural Resources

Commissioners:

The Bureau of Geology is pleased to transmit to you Bulletin 126, entitled "Newton County Geology and Mineral Resources," by Robert K. Merrill, James J. Sims, and others.

This bulletin details the mineral resources of the county, and summarizes tests performed on certain clay minerals, as well as groundwater resources. This information should be an excellent contribution to the growing knowledge of the state's geology, and the extent and value of its mineral resources.

Respectfully submitted,

Alvin R. Bicker, Jr.
Director and State Geologist

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NEWTON COUNTY GEOLOGY

Robert K. Merrill

ABSTRACT

Newton County is located in east-cental Mississippi, within the parallels 32° 13' and 32° 35' north latitude and the meridians 88° 54' and 89° 20' west longitude. The county is square in outline, with a land area of 371, 200 acres, or 580 square miles. The 1980 census shows a population of 19,944, and a population density of 34.3 persons per square mile. Primary access is by State Highways 492, 489, 503, and 15; U.S. Highway 80, Interstate Highway 20; and the Illinois Central Gulf Railroad.

Newton County is located in the Gulf Coastal Plain Physiographic Province of North America and is subdivided into two smaller provinces: the North Central Hills and the Jackson Prairie.

Exposed stratigraphic units in Newton County are Eocene and part of the Pliocene Series of the Tertiary System, and the Pleistocene and Recent Series of the Quaternary System. The units, from older to younger are: the Hatchetigbee Formation of the Wilcox Group of Eocene age; the Meridian, Tallahatta, Winona, Zilpha, Kosciusko, Cook Mountain, and Cockfield formations of the Claiborne Group of Eocene age; the Moodys Branch and Yazoo formations of the Jackson Group of Eocene age; the Citronelle Formation and terrace deposits of late Pliocene-Pleistocene age; and alluvium of Recent age.

Newton County is located on the eastern flank of the Mississippi Embayment and on the northern flank of the Gulf Coast Geosyncline. The updip limit of the Louann Salt and the northeastern boundary of the Mississippi Salt Basin lie at the southwest extremity of Newton County. The Pickens-Gilbertown Fault Zone lies near the southwest corner of Newton County. No faults are reported in near-surface or subsurface strata in Newton County.

Mineral resources include clay, sand, and gravel. No oil or gas of economic importance has been reported from Newton County. Clays found in the county have potential uses in the manufacture of lightweight aggregate and brick.

INTRODUCTION

The objectives of this study were to determine the distribution, thickness, and lithologic character of near-surface geologic units; evaluate natural resources of potential economic value; and examine the ground-water resources in Newton County.

The initial stages of this study included field reconnaissance and the mapping of stratigraphic units on topographic base maps, determining geologically advantageous test hole sites, and permitting selected test hole sites. Field reconnaissance began on 7 April 1981. This phase of the study included systematic descriptions and sampling of geologic units observed at the surface, and delineating the areal distribution of geologic units on topographic maps. The drilling program began on 13 September 1982, and the last test hole was completed on 15 December 1983. A total of 21 test holes was drilled in Newton County. Samples were recovered at 10 foot intervals, washed, and dried for microscopic examination.

Representative clay samples from each geologic unit were analyzed by Ken Liles at the U.S. Bureau of Mines, Tuscaloosa Research Center, Alabama, and Dr. D. E. Gann at Millsaps College, Jackson, Mississippi, for physical properties and mineralogy, respectively. The results of the analyses are given in the Physical Properties of Clays and Clay Mineralogy sections of this report.

The ground-water resource investigation of Newton County was conducted by Jay Sims. This investigation included chemical testing, pumping tests, and ground-water aquifer evaluation. The results of this investigation are included in the Ground Water Section of this report.

ACKNOWLEDGMENTS

The writer is grateful to the residents of Newton County for their cooperation during the field investigation and test hole drilling program necessary in the completion of this report. The author also wishes to thank International Paper Company and Weyerhaeuser Company for access to property under their jurisdiction.

Special acknowledgments are extended to David T. Dockery, III, for his professional assistance and

support in all stages of this study. Gratitude is extended to Michael B. E. Bograd for editing the manuscript. The author wishes to express special gratitude to Alvin R. Bicker, Jr., for bestowing the honor of this assignment and continual support throughout the course of this study.

The staff members of the Mississippi Bureau of Geology were very helpful in the course of field work and test hole drilling.

DESCRIPTION OF AREA

LOCATION AND SIZE

Newton County is located in east-central Mississippi, within the parallels 32 degrees 13 minutes and 32 degrees 35 minutes north latitude and the meridians 88 degrees 54 minutes and 89 degrees 20 minutes west longitude. It adjoins Leake, Neshoba, and Kemper counties to the north and Smith, Jasper, and Clarke counties to the south. Scott and Lauderdale counties adjoin Newton County to the west and east, respectively (Figure 1). Newton County is square in outline, having a land area of 371,200 acres or 580 square miles (Murphree, 1960). The county seat is the town of Decatur.

Figure 1 — Location of Newton County.

BRIEF HISTORY

The Choctaw Indians occupied Newton County before the first white settlers arrived. The ancestors of the Choctaws were probably Paleo Indians. The area now known as Newton County was excellent range land with fertile soils and vegetation, thus offering excellent hunting ground. Open, flat prairie land in the southwestern portion of the county offered space and opportunity for recreation (Brown, 1894). The main sport was stickball, which is still played regularly by the Choctaw Indians (Warsham et al., 1981).

Distribution of Choctaw Indians in Mississippi evolved through a succession of eight treaties: (1) the treaty of Hopewell, concluded 3 January 1786; (2) Fort Adams, 17 December 1801; (3) Hobak I Topa, 31 August 1803; (4) Mount Dexter, 16 November 1805; (5) Trading House, 24 October 1816; (6) Doak's Stand, 18 October 1820; (7) Washington, 20 January 1825; (8) Dancing Rabbit Creek, 28 September 1830. Newton County is a part of the purchase secured by the United States Government in the Dancing Rabbit Creek Treaty (also known as the Choctaw Purchase). The area of this purchase includes the counties of Noxubee, Neshoba, Leake, Newton, Scott, Smith, Jasper, Clarke, and Lauderdale (Brown, 1894). Although provisions were made for Choctaw individuals to stay and claim land, strong inducement was given the tribe to move to land set aside for them in Oklahoma (Warsham et al., 1981). In the year 1910, 1,253 Choctaws remained in Mississippi, and in 1918 the United States Government acknowledged that complete removal of the Choctaws should not take place. This precipitated the establishment of the Choctaw Agency in Philadelphia, Mississippi, in 1918. About 400 Choctaws now reside in Newton County (Warsham et al., 1981).

After completion of the Choctaw Purchase, individual counties within the boundaries of the purchase were admitted in December, 1833; however, Newton County was at that time contained in Neshoba County. An act of the legislature of the State of Mississippi, approved 26 February 1836, defined the County of Newton as a separate county. This county comprised the southern half of the area previously occupied by Neshoba County (Brown, 1894). The areal relationship of the above mentioned counties is depicted in Figure 1.

POPULATION

Newton County had a population of 19,944 according to the 1980 census count. The 1970 census reported a population of 18,983, giving a population increase of 5.1 percent, or 961 persons, from 1970 to 1980. The 1980 population density is 34.39 persons per square mile. According to the 1980 census count, Newton is the largest town in Newton County, with a population of 3,708. Union has a population of 1,931 and Decatur, the County Seat, has a population of 1,148. The U.S. Bureau of the Census, Census of Population, 1970 and 1980, also reported a population of less that 1,000 for the remaining towns and communities in Newton County: Lawrence, Conehatta, Roberts, Duffee, Little Rock, Prospect, Hickory, and Chunky.

INDUSTRY AND LAND DISTRIBUTION

Agriculture is the main industry of Newton County, although there is a growing trend toward manufacturing and commercial interests. According to Mississippi Employment Security Commission annual averages, the number of people employed in the farming industry decreased from 510 in 1971 to 390 in 1981, a decrease of 23.5 percent over a ten year period. This indicates that most successful farming is done on larger acreage plots of land, with the smaller plots of farmland leased or sold to larger farming organizations. The main incomes from agricultural production, in decreasing order, are poultry and eggs, forestry, dairy, and beef cattle (U. S. D. A. County Extension Service, Decatur, Mississippi, personal communication).

There are 48,000 acres of cropland and 60,000 acres of pasture land in Newton County. Timber land occupies 226,000 acres, of which 116,300 acres are pine, 29,300 acres are mixed pine and hardwood, and the remainder hardwood. National Forest land occupies approximately 6 percent of the land (U.S.D.A. County Extension Service, personal communication). Approximately 37,200 acres are occupied by manufacturing plants or private land (homes, gardens, etc.). Some timber land that has been farmed for pulpwood or hardwood is leased to private hunting clubs. Wild game, including deer, quail, rabbit, squirrel, and turkey is abundant in Newton County.

There are a total of 16 commercial manufacturing plants in Newton County, most of which are very small. The five leading manufacturers are listed in Table 2 (Mississippi Research and Development Center, 1983 Mississippi Manufacturers Directory).

Employment by number of persons as reported by the Mississippi Employment Security Commission is listed in Table 1.

EDUCATION

There are two junior (2 year) colleges in Newton County: East Central Junior College at Decatur, and Clarke Memorial Junior College at Newton. There are no senior colleges in Newton County. Almost 9 percent of persons 25 years or older have 4 or more years of college, and 53 percent of persons 25 years or older completed high school (U.S. Bureau of the Census, Census of Population, 1980, and the Mississippi State Board of Education).

TABLE 1
Employment In Newton County

EMPLOYMENT	NUMBER OF PERSONS	
	1971	1981
Total employment (by residence)	6,790	6,860
Nonagricultural wage and salaried employment (by place of work)	4,790	5,190
Manufacturing	2,200	2,310
Mining	—	—
Construction	120	80
Transportation, Communication & Public Utilities	110	80
Wholesale & Retail trade	630	720
Finance, Insurance & Real Estate	100	130
Services and Miscellaneous	570	740
Government	1,060	1,120
Agriculture (by residence)	510	390
Unemployment rate (by residence)	6.5%	7.2%

Compiled from Mississippi Employment Security Commission.

TABLE 2
Five Largest Manufactures In 1982
Newton County

La-Z-Boy South, Inc.	650	Upholstered Reclining and Rocking Chairs
The Newton Company	460	Men's Dress Slacks
Boystone Shirt Co., Inc.	450	Boy's Sport and Dress shirts
Midland Shirt Co., Inc.	386	Men's Shirts
ESCO Corporation	321	Steel Castings

Mississippi Research and Development Center, 1983 Mississippi Manufacturers Directory.

ACCESSIBILITY

Newton County is served by several major highways and one interstate. Interstate 20 traverses the county from west to east, entering the county boundary about .25 mile south of Lake, passes through the northern extremity of Newton, serving Hickory approximately 1.5 miles north of the city limits, and exits the county approximately 1 mile northeast of the Chunky city limits. U.S. Highway 80 approximately parallels Interstate 20, but passes directly through the towns of Lake, Newton, Hickory, and Chunky. Most, if not all, east-west freight truck traffic utilizes Interstate 20. State Highway 15 traverses the approximate center of the county from north to south, passing through the towns of Union, Decatur, and Newton. The northern county boundary passes through the town of Union. State Highway 492 serves the northwest extremity of Newton County, entering approximately .9 mile south of the northwest corner and exiting at the north central portion of the county at Union. State Highway 489 enters the western county boundary, passes through the northwest corner of Lake, then passes through Conehatta, continues northeast, and terminates in Union where it intersects State Highway 492. State Highway 505 serves the southwest portion of Newton County, entering the southern county boundary at the community of Roberts, and terminates at the community of Lawrence where it intersects U.S. Highway 80. State Highway 494 enters the eastern county boundary about 5 miles south of the northeast corner of Newton County, passes through Little Rock, and terminates approximately .8 mile south of the north central county boundary in Union where it intersects Highway 15. State Highway 503 serves the southeast portion of the county, entering at the southern boundary about 5 miles east of Highway 15, continues north through Hickory, and continues northwest to Decatur, terminating at its intersection with State Highway 15. State Highway 19 passes northwest to southeast through the extreme northeast corner of Newton County. There are numerous other paved roads of lesser quality in the county, with the more remote areas served by unpaved gravel and dirt roads. During wet periods, many, if not most, of the unpaved roads are impassable in areas of lowest elevation such as the prairie lands in the southwest portion and flood plain areas throughout Newton County. Figure 2 depicts major highways, the interstate, and railroad lines.

Illinois Central Gulf Railroad serves several portions of Newton County. One line of the railroad enters the western county boundary at Lake and runs east-west parallel to Interstate 20 through Newton, Hickory, and Chunky, and exits the eastern county boundary approximately .5 mile east of Chunky. Another line of the railroad enters the northern county boundary in Union, continues through the towns of Decatur and Newton, and exits the southern county boundary approximately .25 mile south of the community of Roberts. This line of railroad has a junction in Union with another line of railroad which passes southeast through Little Rock and exits the eastern county boundary approximately 6 miles south of the northeast corner of the county. A very small portion of the northwest corner of Newton County is traversed by the railroad line in a north-

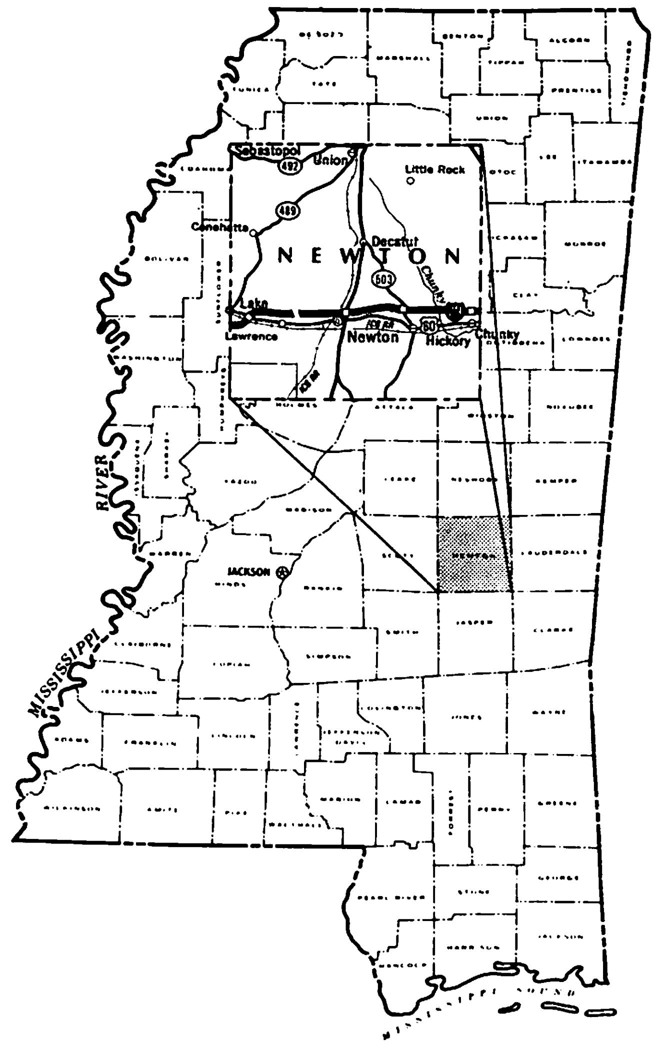


Figure 2 — Location of Newton County and major transportation routes.

east-southwest direction, re-entering the county at Union and continuing as described above.

CLIMATE

Newton County is characterized by a humid subtropical climate. Prevailing southerly winds bring in moist subtropical air during the summer. During the spring and winter seasons, prolonged rains are prevalent due to the warm air from the Gulf of Mexico rising above cooler air present at the surface during these months. In winter months dry polar air may result in freezing temperatures, but sub-zero temperatures have not occurred during the 13 year time period studied. In general, spring is the wettest season and fall the driest, October being the driest month. The lowest rainfall reported was in October 1978, when only .28 inch of rain was recorded. The largest amount of rainfall generally occurs in March;

11.73 inches of rain occurred in March of 1977, and 14.97 in March of 1976. The humidity is generally very high, and varies between 60 and 100 percent most of the year. July is the only month in which temperatures in excess of 100 degrees (F) have been recorded in the last 13 years, reaching 102 degrees (F) in 1969, 1970, and 1981. The coldest months of the year are January and February. A low of 4 degrees (F) was recorded in January of 1977.

Figure 3 illustrates the general rainfall trends for the State of Mississippi. Climatological data for Newton County were compiled from the U.S. Weather Bureau's annual reports for a 13 year time period and results are given in Table 3.

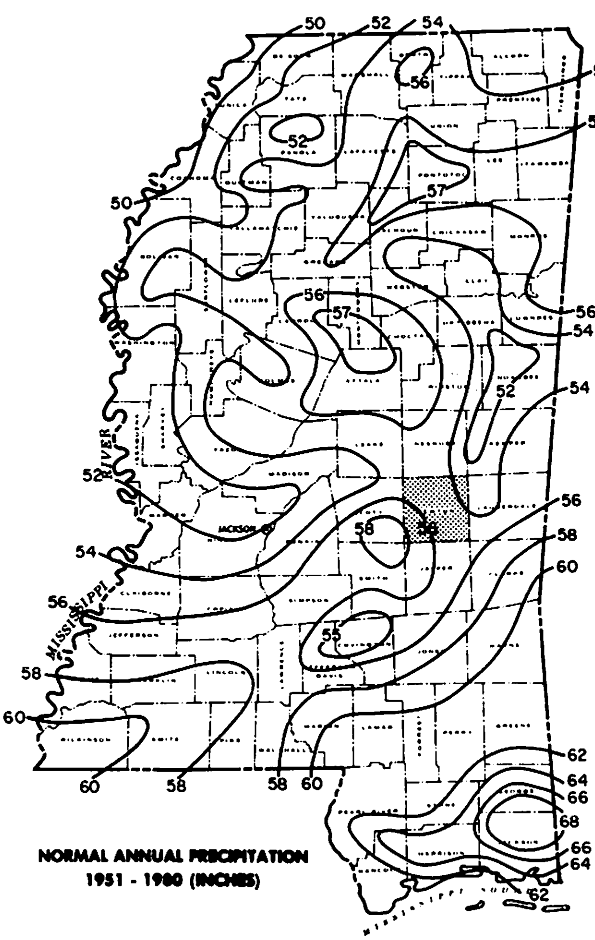


Figure 3 — Mean annual precipitation in inches. From U.S. Weather Bureau, Jackson, Mississippi. Based on the 30 year period 1951-1980. Newton County is shown as the shaded area.

TABLE 3

Average Monthly And Yearly Temperature And Precipitation Data; January 1970 Through December 1982. Compiled From Available Data In U.S. Department Of Commerce 'Climatological Data' January 1970, Through December 1983.

	1982		1981		1980		1979		1978		1977		1976	
	T	P	T	P	T	P	T	P	T	P	T	P	T	P
January	43.2	3.87	40.8	1.61	47.0	7.30	37.6	11.02	36.2	3.83	34.0	6.63	41.6	2.86
February	46.4	6.36	47.2	3.48	43.4	2.99	43.8	7.83	38.3	3.02	46.5	4.85	54.7	1.21
March	58.3	3.69	53.2	8.02	52.8	13.27	56.4	7.45	51.0	3.45	57.7	11.73	58.3	14.97
April	61.0	6.68	68.2	4.54	59.9	8.91	64.6	12.35	64.1	3.74	64.0	8.07	63.3	0.92
May	71.5	1.56	67.8	3.29	....	....	70.4	4.79	70.3	5.77	72.1	2.44	65.9	5.87
June	77.0	3.79	79.7	3.43	77.9	3.15	75.8	2.09	78.5	2.49	79.7	2.62	74.7	2.68
July	80.5	6.08	82.2	1.66	83.1	3.10	80.7	8.56	81.4	3.26	81.9	7.79	78.8	3.46
August	79.6	5.17	81.5	2.20	82.2	2.11	79.3	5.73	80.7	2.91	80.2	2.26	78.0	2.77
September	72.0	1.88	71.9	2.55	79.9	2.20	73.2	7.10	77.6	0.61	77.2	7.71	73.2	2.32
October	63.4	4.71	62.1	3.36	60.5	3.26	63.6	0.99	62.3	0.28	....	6.93	58.2	2.12
November	54.9	5.17	55.6	2.90	52.4	5.45	51.6	7.72	59.9	3.37	57.1	6.62	45.6	3.99
December	52.8	9.06	42.9	5.14	45.5	1.07	45.9	3.21	46.8	5.88	45.9	2.61	43.2	3.85
Year	63.4	58.92	62.8	42.18	....	....	61.9	78.84	62.3	38.61	....	70.24	61.3	46.52
Highest F°	97		102		104		100		100		99		96	
Date	7-23		7-25		7-15		7-6		7-1		7-9		8-27	
Lowest F°	23		12		14		13		17		4		14	
Date	12-13		12-21		3-3		1-9		2-22		1-19		1-9	

	1975		1974		1973		1972		1971		1970	
	T	P	T	P	T	P	T	P	T	P	T	P
January	....	7.13	56.0	7.31	....	4.43	52.4	5.55	48.6	4.22	41.6	2.58
February	....	5.97	50.1	4.48	....	5.57	50.5	3.56	49.2	6.88	47.2	2.90
March	57.1	2.32	62.8	3.36	62.1	11.19	58.5	4.71	53.4	8.94	54.4	5.94
April	61.6	5.27	61.9	11.71	....	....	64.8	1.72	62.6	4.27	67.1	4.35
May	72.9	7.20	73.8	2.85	....	....	70.4	2.27	68.2	4.55	71.2	2.62
June	7.2	5.19	73.1	3.95	....	....	77.0	2.37	78.9	4.55	76.5	2.37
July	79.8	6.03	80.1	3.13	80.9	8.10	78.6	5.84	79.2	7.24	80.0	3.33
August	79.4	10.14	....	4.84	77.7	3.81	80.6	1.50	78.9	1.35	80.4	5.08
September	71.3	4.42	72.1	6.06	76.5	4.79	79.8	5.20	76.9	5.90	....	3.07
October	63.5	4.07	60.0	1.25	68.7	3.17	66.0	1.49	69.3	1.22	....	8.34
November	55.3	1.17	....	8.76	....	3.51	51.2	3.96	52.9	1.62	....	1.85
December	45.8	3.32	49.9	6.99	47.4	9.55	....	8.53	57.0	9.25	51.4	6.32
Year	....	62.23	....	64.69	....	....	....	46.70	64.6	59.49	....	48.75
Highest F°	94		98		94		99		96		102	
Date	7-8		7-29		7-30		9-15		7-15		7-3	
Lowest F°	15		18		-		13		13		6	
Date	12-19		2-26		-		1-16		2-10		1-9	

PHYSIOGRAPHY

Mississippi lies mainly in the Gulf Coastal Plain of North America; however, the northeast corner of the state contains the Paleozoic Bottoms upon which Coastal Plain sediments rest nonconformably. Only two of the physiographic provinces described by R. R. Priddy (1960) are present in Newton County (Figure 4). The North Central Hills Province covers approximately 90 percent of the county, and the Jackson Prairie covers the remaining area in the southwest portion.

Geologic formations comprising the North Central Hills Province are the Hatchetigbee, Tallahatta, Winona, Zilpha, Kosciusko, Cook Mountain, and Cockfield. The Hatchetigbee, Tallahatta, Kosciusko, Cook Mountain, and Cockfield formations are comprised mainly of marine and terrigenous delta sands and silt; however, varying amounts of distal delta clays are contained in each. The Zilpha Formation is composed entirely of clay and silt, but is not thick enough to warrant classification of the outcrop belt into a separate province. The calcareous sandy and silty clays of the Jackson Group comprise the flat to very gently rolling hills characteristic of the Jackson Prairie. Figure 4 illustrates the areal distribution of physiographic provinces in Mississippi.

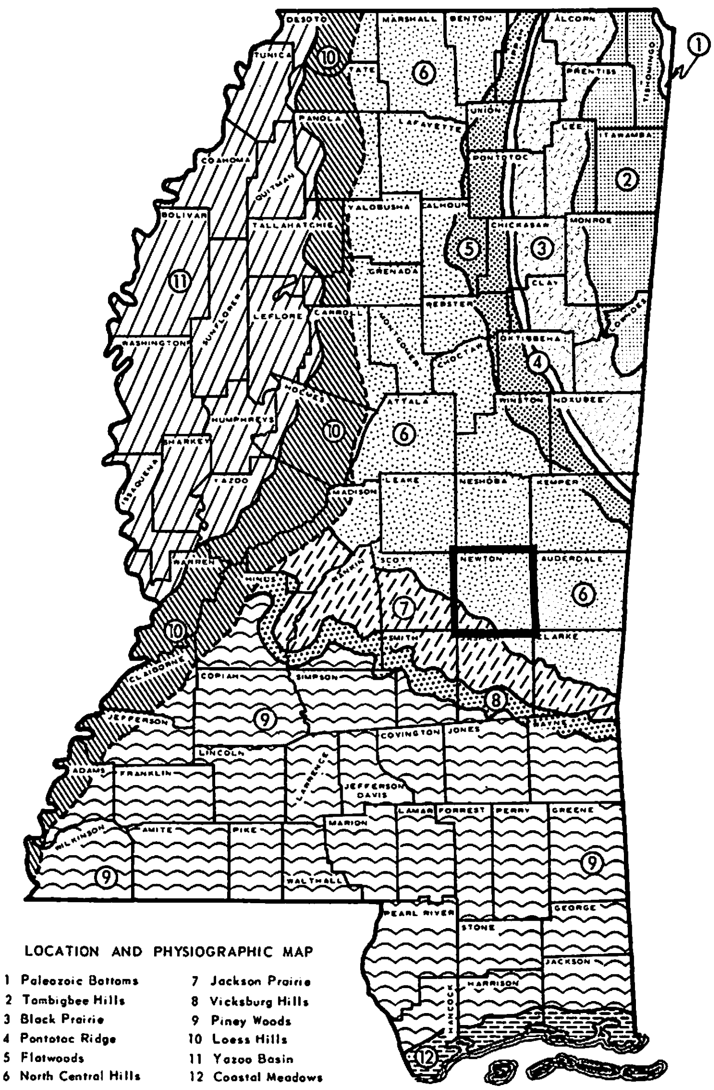


Figure 4 — Physiographic provinces of Mississippi.

TOPOGRAPHY

Complete topographic map coverage is available for Newton County. Topographic maps utilized in this study are: Sebastopol, Union West, Union East, Post, Forest, Decatur Northwest, Decatur, Chunky, Newton, Hickory, Clear Springs, Montrose North, and Hero. Figure 5 depicts topographic map coverage of Newton County. The Forest, Enterprise, and Chunky quadrangle maps are 15 minute series, and the rest 7.5 minute maps.

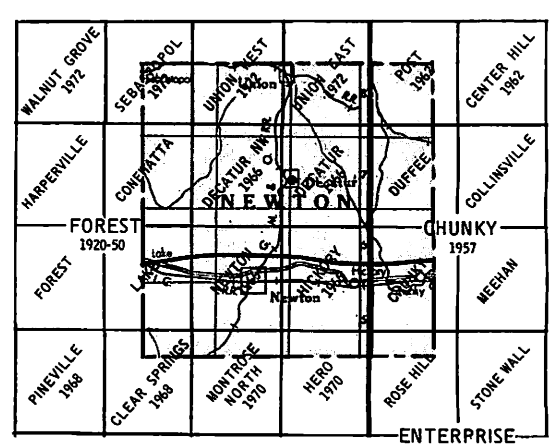


Figure 5 — Topographic map coverage of Newton County.

The topography of Newton County is highly variable, with narrow ridges of relatively high relief, rolling hills, and broad, gently rolling plains. The highest elevation (640 feet) occurs at the northeast corner of the county where lithified, resistant Tallahatta Formation materials occupy hilltops. Scattered terrace deposits also occupy high elevations in this area, although the deposits are thin and have been almost completely eroded away, sometimes leaving a thin, highly resistant, ferruginous-cemented, chert-pebble conglomerate characteristic of the basal portions of terrace material. Local relief along the Tallahatta Formation outcrop belt is as much as 145 feet along a horizontal distance of .5 mile. The topography of areas underlain by less consolidated materials of the Kosciusko and Cockfield formations is relatively less rugged, with smooth, rolling hills. The dip section in Plate 2 illustrates this topography, where the hilltops in the vicinity of Newton are composed of sands comprising the Cockfield Formation, and the valley walls and bottoms are composed of sandy to silty shales comprising the uppermost Cook Mountain Formation. To the northeast, between Turkey and Potterchitto creeks, clayey materials of the Cook Mountain Formation form a slightly smoother topography (dip section, Plate 2).

To the southwest, the clays comprising the Jackson Group form the relatively flat terrain of the Jackson Prairie (dip section, Plate 2). This province is characterized by very broad, gently rolling hills and broad flood plains and has the lowest relief in Newton County. The lowest elevation observed in Newton County is 310 feet above sea level in the Potterchitto Creek flood plain south of Hickory (strike section, Plate 2). Plate 2 (dip section) illustrates areas in northeastern Newton County, which are underlain by highly varied materials comprising the Kosciusko, Zilpha, Winona, and Tallahatta formations.

Resistant materials of the Tallahatta Formation underlie Little Rock Creek, Chunky Creek, and Chunky Canal to the southwest. The hilltops between Chunky Creek and Okahatta Creek are composed entirely of sands and silts of the Kosciusko Formation, giving a hilly topography of moderate relief. Between Okahatta and Turkey creeks, hilltops are composed of marine sands and shales of the Cook Mountain Formation, and lower elevations are occupied by sandy materials of the Kosciusko Formation (Plate 2).

In southwestern Newton County, sands and gravels of the Citronelle Formation form hills of high relief. These hills indicate significant erosion of the area since Pliocene-Pleistocene time when these sediments were deposited in the flood plains of braided streams. A good example of this is Nance Hill, where approximately 150 feet of coarse sand and gravel rest unconformably upon clays of the Yazoo Formation of the Jackson Group. The top of Nance Hill attains an altitude of 600+ feet, and marks one of the highest elevations of Newton County.

The overall, total relief of Newton County is 330 feet.

DRAINAGE

Newton County lies within the Pearl River and Pascagoula River drainage basins. The Pascagoula River Drainage Basin covers approximately 243,000 acres and the Pearl River Drainage Basin approximately 128,200 acres within the Newton County boundaries. The drainage divide between the basins trends generally northeast to southwest. Figure 6 shows the general distribution of the drainage basins and the major rivers and streams.

Tuscolameta Creek flows northwest and joins the upper waters of the Pearl River in southwestern

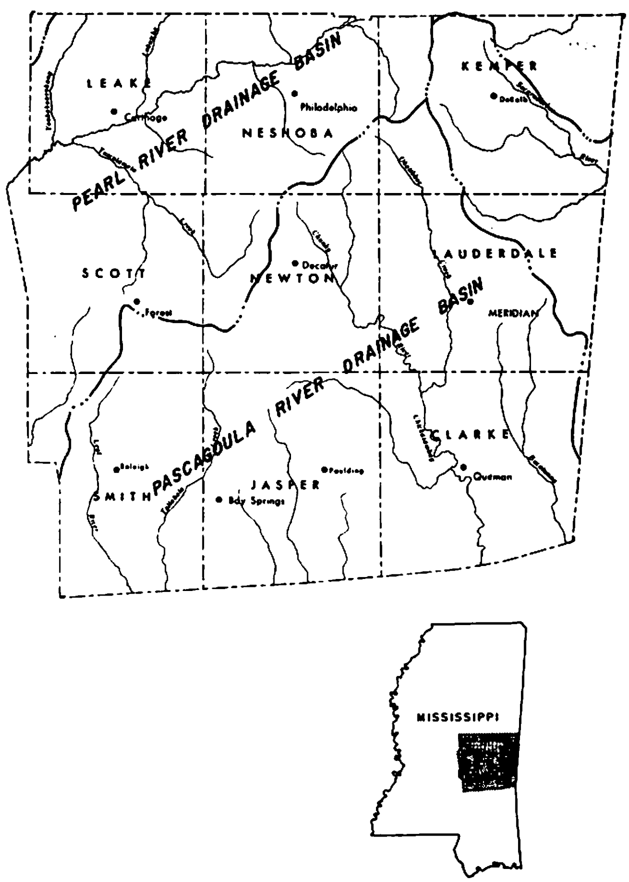


Figure 6 — Location of Newton County with respect to the Pearl River and Pascagoula River drainage basins.

Leake County. The Chunky River flows south and joins the Chickasawhay River, which in turns forms the Pascagoula River at the confluence of the Leaf and Chickasawhay rivers in northernmost George County. Conehatta, Sellers, and Warrior creeks join Tuscolameta Creek approximately 4 miles north of Lake. Tributaries of Conehatta Creek are Caney Creek, Bushy Creek, and numerous smaller tributaries such as Pumpkin and Gum creeks, and its upper reaches extend north of the Newton County boundary. The upper reaches of Warrior Creek extend across the western county boundary. The upper reaches of Sellers Creek extend to the drainage divide.

The extreme upper reaches of Chunky Creek are within and just outside the town of Union, and extend across the northern county boundary. Smith Branch, Huckleberry Creek, Rock Branch, Cleveland Branch, Hale Branch, Witt Creek, and McMullan Branch join Chunky Creek before its junction with Tallasher, Okahatta, and Potterchitto creeks 3 miles west of Chunky, where it becomes the Chunky River. Little Rock and Tallashua creeks join Tallasher

Creek. The upper basin of Tallashua Creek contains Nelson Creek, Double Bend Branch, Big John Branch, Townsend Branch, and Reece Branch. Tallahatta Creek runs basically parallel to the eastern county boundary and drains Threat Branch, Mayatte Creek, Bogue Flower Creek, Bogue Statinea and Cow Creek before joining with the Chunky River in Lauderdale County 2 miles east of Newton County. The upper reaches of Okahatta Creek extend north to within 4 miles of the northern county boundary. Okahatta Creek is joined by Gum Pond Branch, Dry Branch, Reeves Branch, and Carlton Branch before its junction with the Chunky River. Potterchitto Creek drains Bogue Falema Creek, Tarlow Creek, Turkey Creek, Riser Creek, Dry Branch, Dunnagin Creek, and Walker Branch.

All the rivers and streams, except in the very upper reaches, are characterized by wide flood plains formed as they meander between valley walls. Stream outlines are highly sinuous, except for portions that have been channelized, and a highly dendritic drainage pattern exists. These characteristics indicate a mature drainage in relatively soft coastal plain materials of Newton County. There are many more smaller tributaries serving larger streams in Newton County, but only larger streams and rivers are discussed herein.

Streams flowing southeast within the Pascagoula River Drainage Basin exhibit stratigraphic control. Tallahatta, Tallashua, Little Rock, Chunky, Turkey, and Potterchitto creeks flow southeast, parallel to strike, and are separated by cuestas formed by stream erosion of strata of the Claiborne and Wilcox groups. The confluence of Chunky, Okahatta, and Potterchitto creeks, 2 miles west of Chunky, marks the beginning of the Chunky River. The Chunky River turns east at this point, and flows across strike to the western Newton County boundary, then turns southeast along strike. Chunky Creek generally follows the Winona-Tallahatta formational contact, and Tallashua Creek closely follows the Meridian-Hatchetigbee formational contact in the northeastern portion of Newton County.

Streams within the Pearl River Drainage Basin in Newton County do not exhibit stratigraphic control as clearly as those within the Pascagoula River Drainage Basin. Connehatta, Brushy, and Carney creeks flow down stratigraphic dip (southwest) before their confluence into Tuscolameta Creek, which exhibits stratigraphic control and flows northwest along strike beginning 2.5 miles east of the western Newton County boundary.

SURFACE STRATIGRAPHY

GENERAL STATEMENT

Stratigraphic units which occur at the surface in Newton County are Tertiary and Quaternary in age. Tertiary units include Eocene deposits represented by the Wilcox, Claiborne, and Jackson groups and in part the Pliocene-Pleistocene Citronelle Formation. Quaternary units are comprised of the Citronelle Formation, Pleistocene terrace deposits at lower elevations than the Citronelle Formation, and Recent stream alluvium and colluvium.

Sedimentary structures, mineralogy, paleontology, and textures of sediments comprising Eocene strata indicate that varied marine and nonmarine sediment accumulation was governed by several marine transgressions and regressions (Table 4). Pliocene-Pleistocene terrace deposits comprising the Citronelle Formation are found at higher elevations, in areas less degraded by erosion, and are generally a product of braided stream processes which occurred after deposition of older Tertiary sediments. Pleistocene terrace deposits, which occur at lower elevations than the Citronelle Formation, are the result of post-Citronelle fluvial reworking of Citronelle and older Tertiary sediments. Recent stream alluvium is a product of stream processes, whereas colluvium is generated by downslope movement of unconsolidated, previously deposited sediments.

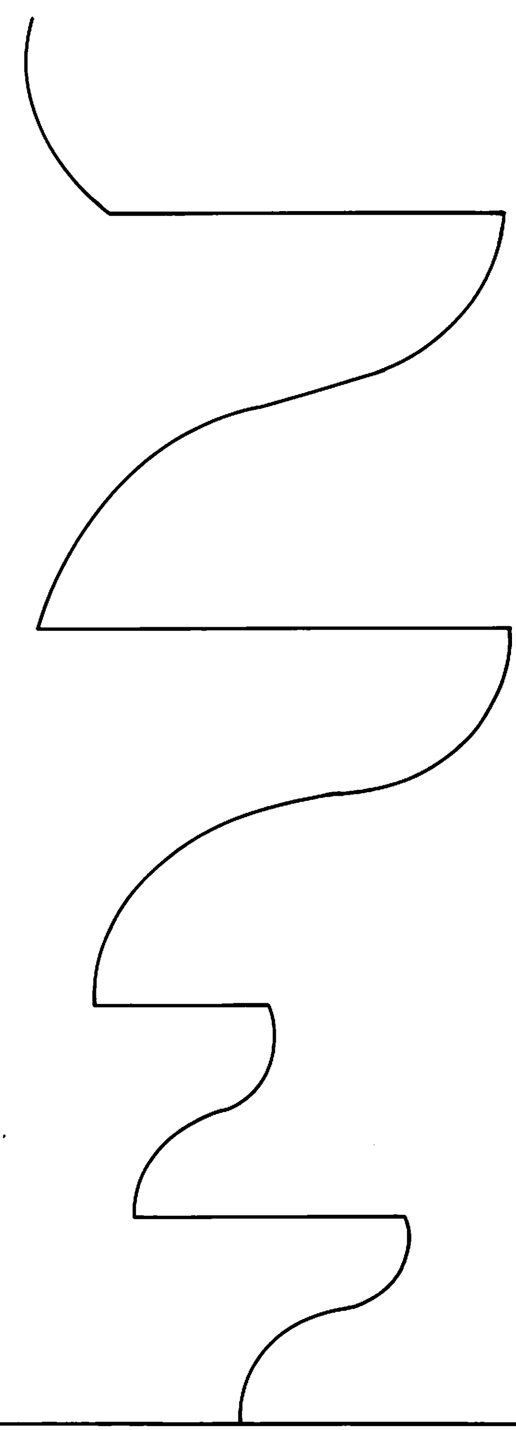
Collectively, the strata exposed in Newton County are composed of varying amounts of clay, silt, sand, and gravel, with varying amounts of lime in the form of re-crystallized calcite, as well as calcite and aragonite comprising the remains of marine organisms. Figure 7 illustrates the time-stratigraphic relationships and lithologic character of strata exposed in Newton County.

The detailed lithologic descriptions were prepared with the use of a binocular microscope and the standard Rock Color Chart distributed by the Geological Society of America. Lithologic descriptions in Figure 7 are a generalization of test hole descriptions discussed in the Test and Core Hole Records section of this report.

The areal distribution of formations exposed in Newton County is illustrated via the Geologic Map of Newton County (Plate 1). The surface of the land in Newton County is almost completely covered by vegetation, thus substantially thick exposures of unaltered sediments are uncommon. Weathering has altered the original lithologic character of sediments exposed at the surface, so that material from a particular formation usually appears lithologically different in the subsurface than at the surface. Subtropical climatic conditions present in Newton County have produced thick, highly leached soil zones. The characteristic red coloring of these soils is due to the oxidation of metallic elements (chiefly iron) not completely removed by the leaching of the parent material. The Winona Formation, for example, is characterized by high percentages of the mineral

TABLE 4
Sea Level Curve For Newton County As Indicated By The Stratigraphic Sequence

STRATIGRAPHIC UNIT	DEPOSITIONAL ENVIRONMENT	SEA LEVEL CURVE Transgression Regression
Yazoo Formation	Marine Shelf	
Moodys Branch Formation	Destructional Shelf	
Cockfield Formation		
Upper Cockfield	Delta Plain	
Lower Cockfield	Delta Front	
Cook Mountain Formation		
Gordon Creek Shale Mbr.	Prodelta	
Potterchitto Mbr.	Marine Shelf	
Kosciusko Formation		
Upper Kosciusko	Delta Plain	
Lower Kosciusko	Delta Front	
Zilpha Formation	Marine Shelf Prodelta	
Winona Formation	Marine Shelf	
Tallahatta Formation		
Neshoba Sand Mbr.	Strandplain	
Basic City Shale Mbr.	Marine Shelf	
Meridian Sand	Fluvial	
Hatchetigbee Formation	Estuarine	



SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT		THICKNESS	LITHOLOGIC CHARACTER
QUATERNARY	RECENT		ALLUVIUM		0-25'+	Sand, light- to yellowish-gray, very fine- to very coarse-grained, subangular to subrounded quartz, silty, traces of dark minerals; contains some organic matter and small pebbles.
QUATERNARY	PLEISTOCENE		TERRACE DEPOSITS		0-20'+	Sand, light gray to pale yellowish-brown, mottled, very fine- to very coarse-grained, subangular to subrounded quartz, silty; frequent thin layers and lenses of well-rounded quartz and chert pebbles; occasional thin ironstone beds.
QUATERNARY	PLEISTOCENE		CITRONELLE FORMATION		0-90'	Sand, moderate reddish-brown to very light-gray, medium- to very coarse-grained, subangular to subrounded quartz; frequent well-rounded quartz and chert pebbles; cross bedded; well-cemented quartz-chert pebble conglomerate at base.
TERTIARY	EOCENE	JACKSON	YAZOO FORMATION	SHUBUTA CLAY	80'+	Clay, very light- to yellowish-gray, silty, sandy, sparingly fossiliferous.
TERTIARY	EOCENE	JACKSON	YAZOO FORMATION	PACHUTA MARL		Clay, very light-gray to white, silty, sandy, fossiliferous, calcareous, glauconitic.
TERTIARY	EOCENE	JACKSON	YAZOO FORMATION	NORTH TWISTWOOD CREEK CLAY		Clay, light- to greenish-gray, silty, slightly sandy, calcareous, micaceous
TERTIARY	EOCENE	JACKSON	MOODYS BRANCH FORMATION		12'-15'	Sand, light-gray, fine- to medium-grained, silty, clayey, highly fossiliferous, glauconitic.
TERTIARY	EOCENE	CLAIBORNE	COCKFIELD FORMATION		168'-194'	Sand, dark yellowish-orange to dark yellowish-brown, very fine- to coarse-grained, subangular quartz, silty, clayey, carbonaceous; shaly in upper portions.
TERTIARY	EOCENE	CLAIBORNE	COOK MOUNTAIN FORMATION	GORDON CREEK SHALE	8'-38'	Silt, dark yellowish-brown, carbonaceous, clayey, glauconitic, micaceous, sandy.
TERTIARY	EOCENE	CLAIBORNE	COOK MOUNTAIN FORMATION	POTTERCHITTO	35'-78'	Sand, light-gray to pale yellowish-brown, very fine- to coarse-grained, subangular quartz, fossiliferous, silty, clayey, glauconitic.
TERTIARY	EOCENE	CLAIBORNE	KOSCIUSKO FORMATION		136'-228'	Sand, light-gray to grayish-brown, fine- to coarse-grained, subangular to subrounded quartz, silty, clayey, micaceous, carbonaceous; shaly in upper portions, cross bedded in lower portions.
TERTIARY	EOCENE	CLAIBORNE	ZILPHA FORMATION		12'-68'	Silt, medium-gray to dark yellowish-brown, clayey, sandy, carbonaceous, micaceous.
TERTIARY	EOCENE	CLAIBORNE	WINONA FORMATION		35'-72'	Sand, light olive-gray to pale yellowish-brown, fine- to coarse-grained, subangular quartz, silty, clayey, glauconitic, fossiliferous, micaceous; frequent thin indurated layers.
TERTIARY	EOCENE	CLAIBORNE	TALLAHATTA FORMATION	NESHOBA SAND	8'-15'	Sand, medium light- to yellowish-gray, fine- to coarse-grained, subangular to subrounded quartz, silty, micaceous.
TERTIARY	EOCENE	CLAIBORNE	TALLAHATTA FORMATION	BASIC CITY SHALE	83'-130'	Silt, light- to medium-gray, sandy, clayey, glauconitic, micaceous. Sand, fine- to medium-grained, silty, glauconitic, micaceous, sandstone and siltstone in weathered zone near the surface.
TERTIARY	EOCENE	CLAIBORNE	MERIDIAN SAND		9'-40'	Sand, medium- to very light-gray, fine- to coarse-grained, subangular to subrounded quartz, cross bedded, micaceous, glauconitic.
TERTIARY	EOCENE	WILCOX	HATCHETIGBEE FORMATION		190'+	Sand, light- to medium-gray, very fine- to coarse-grained, subangular quartz, silty, micaceous, carbonaceous, glauconitic, interbedded or interlaminated with clayey silt.

Figure 7 — Generalized section of exposed strata in Newton County.

glauconite, which gives green color to fresh material collected in the subsurface, from which the term "greensand" was derived. The Winona Formation is manifested at the surface as a dark reddish-brown, clayey sand due to the oxidation of the iron-rich glauconitic sediments. This example is given in order to illustrate the importance of drilling test holes which allow examination of unweathered material. Several test and/or core holes were drilled in order to determine the thickness and lithologic character of subsurface sediments, revealing the three-dimensional aspects of the overall geology (Figure 8). Descriptions of test hole samples representing 10-foot intervals and of core samples taken for economic

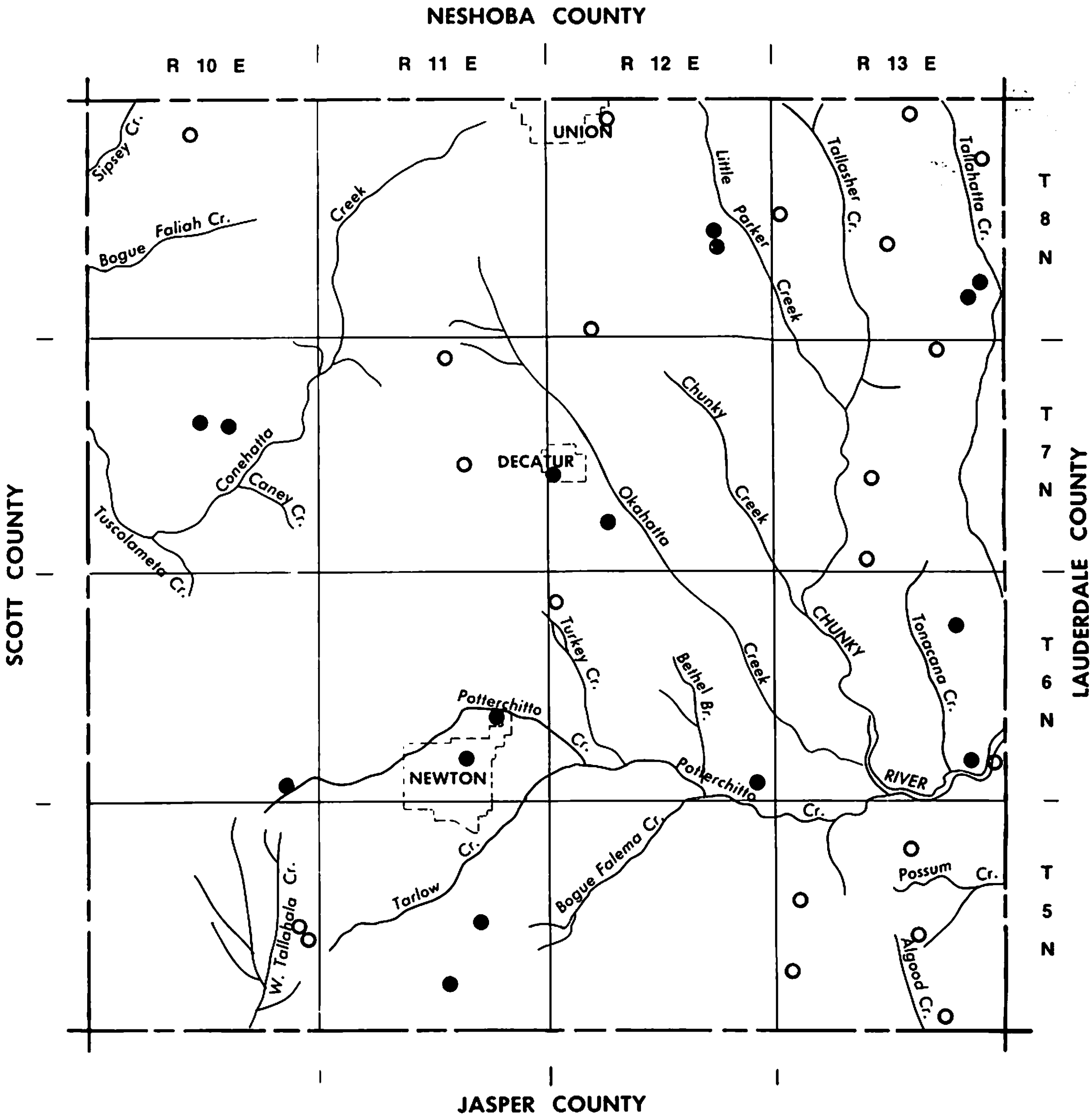


Figure 8 — Locations of test holes and water wells with available electric logs and/or samples collected at 10-foot intervals.

mineral evaluations are given in the Test and Core Hole Records section of this report. The geologic units exposed at the surface or encountered in the shallow subsurface of Newton County are discussed individually below.

TERTIARY SYSTEM
EOCENE SERIES
WILCOX GROUP

The Wilcox Group is divided into four formations in eastern Mississippi and western Alabama, the youngest of which is the Hatchetigbee Formation (Figure 7). In Mississippi, the Wilcox Group represents principally fluvial-deltaic depositional environments, with the exception of the Bashi Formation. Fossil faunas of marine units within the Wilcox Group in Alabama indicate an open marine depositional environment. Facies changes from principally fluvial-deltaic deposition in Mississippi to more open marine deposition in Alabama are indicated by an increase in number and thickness of marine beds in the Wilcox strata of Alabama. Wilcox source material in Mississippi was supplied mainly by fluvial systems entering the Mississippi Embayment from the north, while Wilcox material in Alabama was deposited by marine environments of the open Gulf (Lowe, 1933). The Wilcox of Mississippi is composed chiefly of sands, clays, and thin lignitic zones. Dockery (1980) noted that the Bashi Formation is the only Wilcox formation in Mississippi that is abundantly fossiliferous, and that marine fossil-bearing upper Wilcox units of Alabama and eastern Mississippi (Lauderdale County) grade north and west into fluvial-deltaic deposits.

Hatchetigbee Formation

The Hatchetigbee Formation derived its name from Hatchetigbee Bluff, Washington County, Alabama, and the first use of the term in the literature was by Smith (1886). Smith and Johnson (1887) described the Hatchetigbee Series to include all strata between the base of the buhrstone (present Tallahatta Formation) and the uppermost Bashi Marl. Lowe (1933) recognized the separate lithology of the nonfossiliferous sand between the Basic City Shale and the clays of the Hatchetigbee Formation. This sand unit, the Meridian Sand, is included in the basal portion of the Claiborne Group, with the Hatchetigbee Formation comprising the uppermost portion of the Wilcox Group (Dockery, 1981).

The Hatchetigbee Formation is exposed at the surface along various roadcuts along the north-south road paralleling the eastern county boundary in Sections 12 (SW/4) and 13 (NW/4) of T.8N., R.13E., and along Highway 19 in Sections 12 (NE/4) and 1 (SW/4). The Hatchetigbee Formation is manifested at the surface as light-brown to reddish-brown to gray mottled, thinly interbedded sand, silt, and silty clays. The irregularity of bedding (Figure 9) is probably due to channeling, as well as differential settling from the loading effect provided by overlying sediment (Figure 11). Thinly interbedded and interlaminated sands, silts, and carbonaceous clays, as well as the absence of marine sediments and fauna, indicate an estuarine depositional environment with terrigenous sediment input. Berry (1917) described abundant land plants from the Hatchetigbee Formation at Meridian, Mississippi, some of which grew exclusively in shallow, still, fresh or very slightly brackish water.

Figure 9 — Hatchetigbee Formation in a road cut at NE/4, NE/4, Sec. 9, T.8N., R.13E.

Lignite beds are not apparent in surface exposures of the Hatchetigbee Formation in Newton County; however, small amounts of lignitic silts and clays were observed in well cuttings of test holes. The Hatchetigbee Formation material sampled in the subsurface is light- to medium dark-gray, micaceous, sandy, clayey, quartz silt. Neither the basal Hatchetigbee Formation nor the Bashi Formation is exposed at the surface in Newton County, so no marine fossils were observed. Trace amounts of glauconite were observed near the bottom of Test Hole A0-3, however, where 190 feet of Hatchetigbee sediments were penetrated without encountering the Bashi Formation. The Hatchetigbee Formation is 260 feet thick to the southeast in adjoining Clarke County (Gilliland, 1980). Foster (1940) described the Hatchetigbee Formation in Lauderdale County, which borders Newton County to the east, as being of

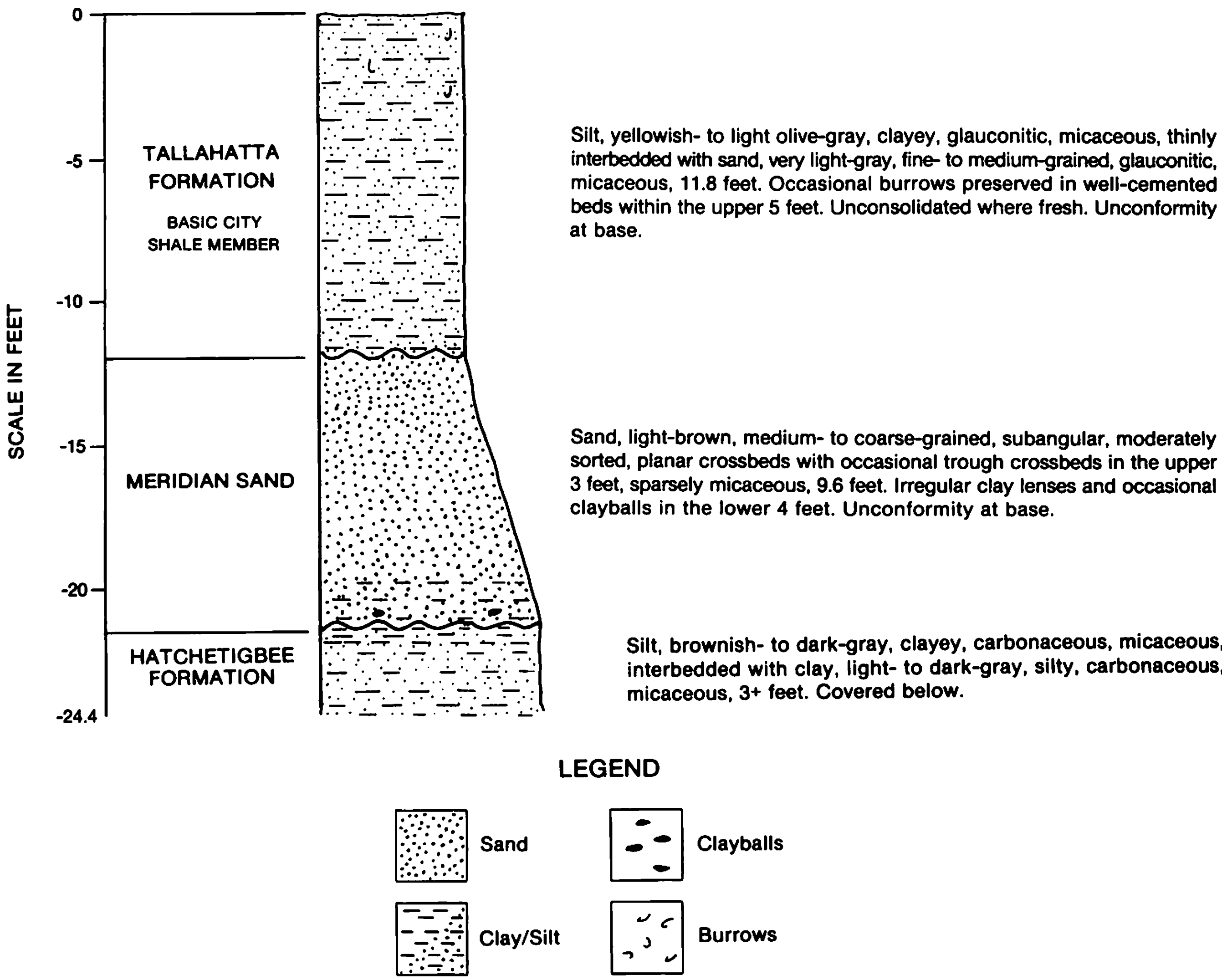


Figure 10 — Measured section including the uppermost Hatchetigbee Formation, the Meridian Sand, and lowermost Tallahatta Formation at SW/4, NW/4, NW/4, Sec. 11, T.8N., R.13E.

variable thickness, ranging from 70 to 150 feet. Only the upper portions (less than 75 feet) of the Hatchetigbee are exposed in Newton County. Figure 10 gives a measured section illustrating the stratigraphic relationship of the Hatchetigbee Formation and its disconformable contact with the overlying Meridian Sand. Figure 12 also illustrates the disconformable Hatchetigbee-Meridian contact.

CLAIBORNE GROUP

The type locality of the Claiborne Group is located at Claiborne Bluff on the Alabama River, Alabama. Conrad (1847) introduced the Claiborne Group into the literature in the course of his study of the marine fauna at Vicksburg, Mississippi. Hilgard (1860) divided the Claiborne Group in Mississippi into the upper "Calcareous Claiborne Strata" and lower "Siliceous Claiborne Strata." Subsequent geologic research has resulted in separation of the Claiborne Group into the following formations and members:

- Cockfield Formation
- Cook Mountain Formation
  - Gordon Creek Shale Member
  - Potterchitto Member
  - Archusa Marl Member
- Kosciusko Formation
- Zilpha Formation
- Winona Formation
- Tallahatta Formation
  - Neshoba Sand Member
  - Basic City Shale Member
- Meridian Sand

Figure 11 — Channel outline in the silty clays of the Hatchetigbee Formation. Location: NE/4, SE/4, SE/4, Sec. 13, T.8N., R.13.E

Figure 12 — Silty clays of the Hatchetigbee Formation, disconformably overlain by the Meridian Sand. Location: SW/4, NW/4, NW/4, Sec. 11, T.8N., R.13E.

Thomas (1942) described the stratigraphy of the Claiborne Group in Mississippi; however, he placed the Meridian in the Wilcox Group. Recent literature places the Meridian Sand in the Claiborne Group with formational rank (Dockery, 1980), as does less recent literature (Foster, 1940). Classification of the formations and members comprising the Claiborne Group into specific depositional environments is given in Table 5.

Meridian Sand

The nonfossiliferous cross-bedded sand unit underlying the Basic City Shale Member of the Tallahatta Formation and overlying the Hatchetigbee Formation was first recognized in the literature by Lowe (1933) as a member of the Tallahatta Formation. Foster (1940) provided the first description of the Meridian Sand in the literature as a separate formation.

The Meridian Sand disconformably overlies the Hatchetigbee Formation (Figures 10 and 12). Clayballs formed as underlying clays of the Hatchetigbee

TABLE 5
The Claiborne Group, Older To Younger

Formation	Member	Depositional Environment
Meridian Sand		Fluvial - northern Miss. "Neritic bar" - southern Miss.
Tallahatta Fm.	Basic City Shale	Marine shelf and strand-plain
Tallahatta Fm.	Neshoba Sand	Deltaic and strandplain
Winona Fm.		Destructional shelf (marine)
Zilpha Fm.		Marine shelf and prodelta
Kosciusko Fm.		Deltaic
Kosciusko Fm.	Dobys Bluff Tongue	Destructional shelf (marine)
Cook Mtn. Fm.	Archusa Marl	Carbonate shelf (marine)
Cook Mtn. Fm.	Potterchitto Mbr.	Marine shelf
Cook Mtn. Fm.	Gordon Creek Shale	Marine shelf and prodelta
Cockfield Fm.	Lower Sand Mbr.	Delta front
Cockfield Fm.	Upper Shale Mbr.	Delta plain
Cockfield Fm.	Transition Zone	Sound-lagoon
Jackson Group	Moodys Branch Fm.	Destructional shelf (marine)

Dockery, 1980

Formation were reworked into Meridian sediments during deposition. This has resulted in well-rounded clayballs, up to 4 inches in diameter, in the lower portions of the Meridian Sand (Figure 13).

The Meridian Sand in Newton County is characteristically light brown, medium- to coarse-grained, moderately- to well-sorted, subangular quartz sand with minor amounts of mica. Iron staining on quartz grains gives a reddish-brown hue to the formation in outcrop and in the subsurface. In outcrop, the Meridian Sand is characteristically a tabular cross-bedded sand, but cross-bedding is not apparent in badly weathered exposures. Figure 14 illustrates the cross-bedding, and Figure 15 shows a closeup view of the laminae within each cross-bed set.

In the subsurface, the Meridian Sand appears as light-gray to brown, medium- to coarse-grained, moderately- to well-sorted, quartz sand with 1 to 3 percent mica. The quartz grains are subangular in outline, indicating only a moderate amount of transport.

The Meridian Sand varies considerably in thickness because the formation is bounded above and below by erosional surfaces. The minimum thickness of the Meridian Sand occurs in Test Hole A0-8, where the sand measures 9 feet in thickness, and the maximum thickness is 40 feet in water wells K1 and K2. In general, the Meridian Sand is 20 to 30 feet thick in Newton County.

The Meridian Sand is disconformably overlain by the Basic City Shale Member of the Tallahatta Formation. Figure 16 illustrates the highly weathered but sharp contact of the sands of the Meridian and the clays of the overlying Basic City Shale. Figure 17 shows the Basic City-Meridian disconformity in measured section.

The Meridian Sand represents an upslope fluvial facies, probably braided stream or coarse-grained meanderbelt. This resulted from a change in gradient and/or source material subsequent to deposition of upper Wilcox fine-grained fluvial systems described by Duplantis (1975).

Tallahatta Formation

Professor E. A. Smith suggested the term "Tallahatta" to W. H. Dall, and Dall (1898) introduced the Tallahatta Formation into the literature. The Tallahatta was referred to as "Buhrstone" as early as 1823 (Dall, 1898), and later as "Siliceous Claiborne" (Hilgard, 1860). Professor E. A. Smith suggested the name Tallahatta in reference to the Tallahatta Hills in Alabama, where the formation crops out.

The Tallahatta Formation was initially subdivided, in Mississippi, by Lowe (1919) into the Winona Sand and Basic Claystone Members. The Winona is presently classified as a separate formation. Thomas (1942) introduced the Neshoba Sand into the literature, and recognized it and the Basic City Shale as upper and lower members, respectively, of the Tallahatta Formation.

Basic City Shale Member

The first reference to the Basic City Shale was made by Lowe (1919) as the Basic "Claystone" in the vicinity of Basic City, Clarke County, Mississippi. Lowe (1919), further, noted a change from shale facies near Basic City to sand and quartzite facies west of Newton County. This change is apparent in Newton County exposures, as the thick sequence of shale is interbedded and interlaminated with sand and silt; much of what seems to be clay upon immediate inspection, appears as silt under the microscope. Re-

Figure 13 — Clayballs in basal Meridian Sand. Location: NW/4, SW/4, Sec. 22, T.8N., R.13E.

cent literature identifies this stratigraphic interval as the Basic City Shale Member (Parks, 1963), as does the most recently published stratigraphic column of Mississippi (Dockery, 1981).

The Basic City Shale Member is the lowermost portion of the Tallahatta Formation, and disconformably overlies the Meridian Sand.

Exposures of the Basic City Shale Member occur mainly in the eastern portion of Newton County in Townships 7 and 8 North of Range 13 East. These outcrops are not as spectacular as those to the east, especially the type locality north of Basic City in Clarke County. Figures 17 and 20 illustrate the Basic City Shale in measured section and its disconformable contact with the underlying Meridian Sand. Figures 18 and 19 show the conformable contact with the overlying Neshoba Sand Member. As Figure 19 illustrates, the Neshoba-Basic City Shale contact appears to be locally disconformable; however, this appearance is probably due to lithification or partial lithification of the Basic City Shale, as well as the sharp color contrast between the two members. The contrast in lithology is not as sharp. The disconformable contact of the Basic City Shale with the Meridian Sand is consistent texturally, even in highly weathered areas where surface exposures are in the soil weathering horizon (Figure 16).

Burrowing is common in the Basic City Shale, especially in the middle and upper portions (Figure 21). Individual burrows are conspicuous where the Basic City Shale is less indurated, and lithified sandstone burrows remain as the less resistant, unconsolidated sand, silt, and clay weather from the outcrop.

Surface exposures of the Basic City Shale usually reveal light- to very light-gray, well lithified sandstone, interbedded or interlaminated with lithified siltstone and claystone (Figure 22). Darker colors usually prevail in areas where the Basic City Shale is not lithified, giving a dark-gray to dark greenish-gray color in outcrop (Figure 23). Lithified portions usually occur where the Basic City Shale occupies the weathering zone above the water table, and nonlithified portions in areas near or below the water table.

The Basic City Shale is sparingly fossiliferous, although evidence of bioturbation is very common, especially in lithified portions (Figure 24) where pres-

Figure 14 — Cross-bedding in the Meridian Sand. Location: SE/4, SE/4, SE/4, Sec. 26, T.8N., R.13E.

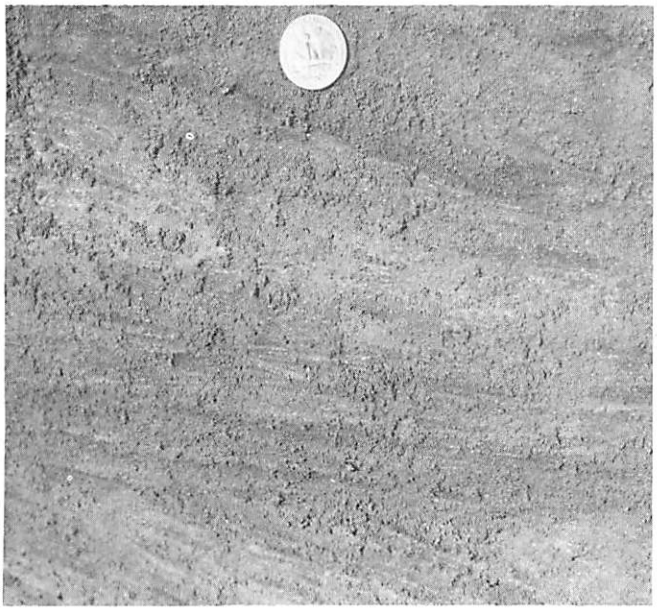


Figure 15 — Close-up view of cross-bedding shown in Figure 14, illustrating the laminae within each cross-bed set. Location: SE/4, SE/4, SE/4, Sec. 26, T.8N., R.13E.

Figure 16 — Contact of the Meridian Sand with the overlying Basic City Shale; pick is at the contact. Location: SW/4, NW/4, NW/4, Sec. 11, T.8N., R.13E.

ervation of burrows in sandstone is more complete. The burrows are relatively large (Figure 21) in some instances, and do not appear to have any particular orientation, as horizontal, vertical, and oblique burrows occur with respect to the bedding plane. This bioturbation probably represents the burrowing activity of decapods. Remains of bivalves are less numerous, and occur in finer sediments of the Basic City Shale. Figure 25 illustrates an important guide fossil, *Anodontia augustana* Gardner, 1951, common to the Basic City Shale in Alabama. Well preserved specimens of this species are rare in Mississippi.

The thickness of the Basic City Shale, in Newton County, ranges from a minimum of 83 feet in Test Hole A0-5 to a maximum thickness of 130 feet in water well L1. Samples collected from the subsurface indicate a more energetic depositional environment than ocurrences in eastern Mississippi and Alabama. Very little clay was detected, as microscopic examination of test hole samples collected at 10-foot intervals revealed silty sand with minor amount of

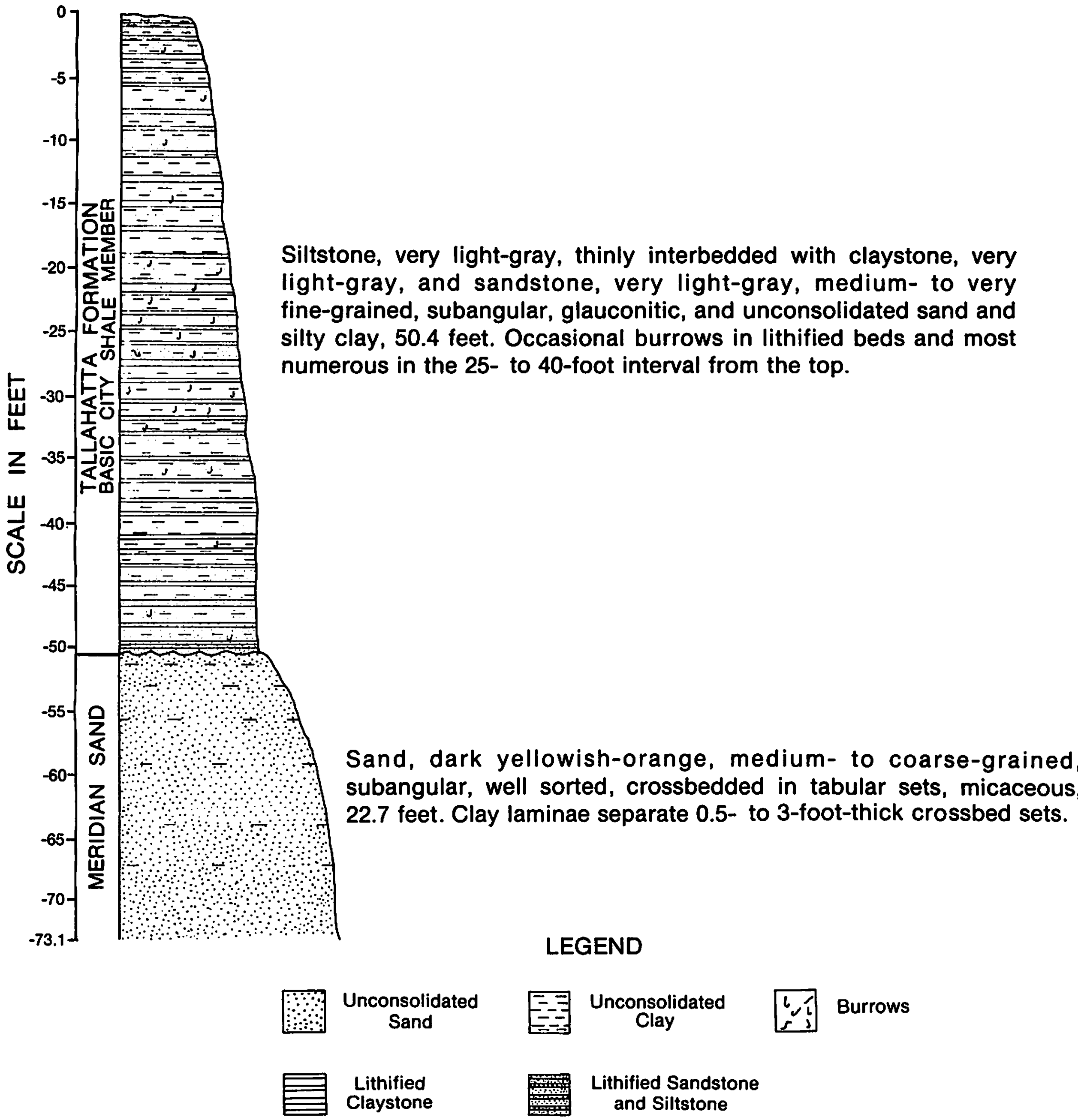


Figure 17 — Measured section including uppermost Meridian Sand and lower Basic City Shale in outcrop at SW/4, NE/4, Sec. 6, T.8N., R.13E.

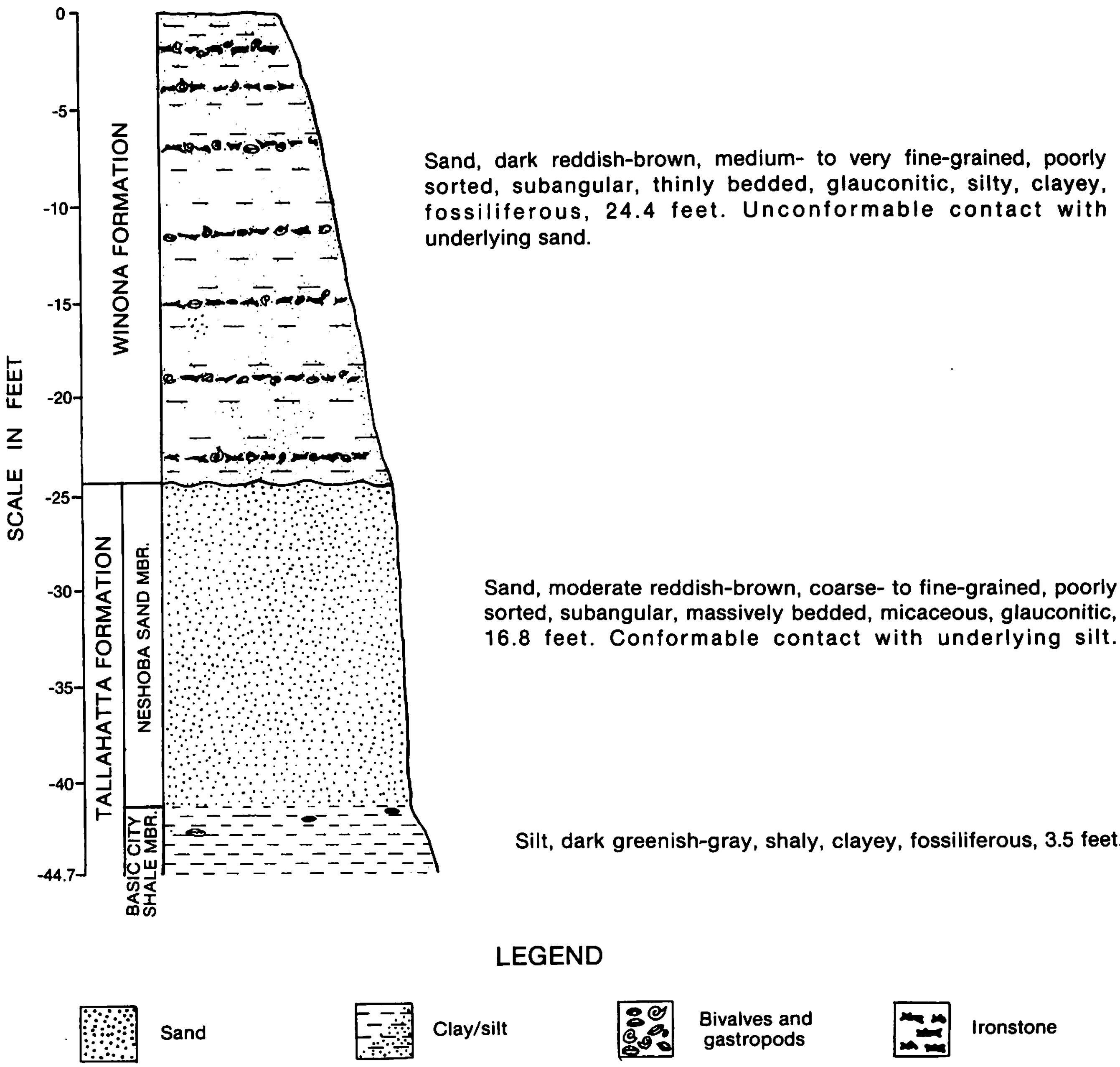


Figure 18 — Measured section including uppermost Tallahatta Formation and lower Winona Formation at NE/4, SW/4, Sec. 34, T.8N., R.12E.

Figure 19 — Contact of the Basic City Shale with the overlying Neshoba Sand Member of the Tallahatta Formation. Location: NE/4, NW/4, NE/4, Sec. 24, T.8N., R.12E.

clay as matrix material, and appreciable glauconite and mica. Colors range from pale- to dark yellow-brown at surface exposures, and medium-light to dark-gray in the subsurface. Mineralogy and economic geological aspects of the Basic City Shale are discussed in the Economic Geology Section of this report.

Differences in lithology and thickness of the Basic City Shale between Alabama and Newton County occurrences are of geological as well as economic importance. Reynolds (1970) described 80 feet of claystone and an additional 20 feet of nonlithified zeolite-bearing clay in western and west-central Alabama. Gilliland (1980) described the Basic City Shale as siliceous claystone with minor silt and sand size fractions, having a maximum thickness of 202 feet in Clarke County, Mississippi. In Lauderdale County, Foster (1940) described 60 to 80 foot thick sequences of claystone with minor sand and silt. Newton County surface exposures of the Basic City Shale, as well as subsurface investigation, reveal a much sandier facies, with lesser amounts of pure clay than reported in eastern Mississippi and western Alabama. This is consistent with Lowe's (1919) ob-

Figure 20 — Contact of the Basic City Shale with the underlying Meridian Sand. Location: SW/4, NW/4, NW/4, Sec. 11, T.8N., R.13E.

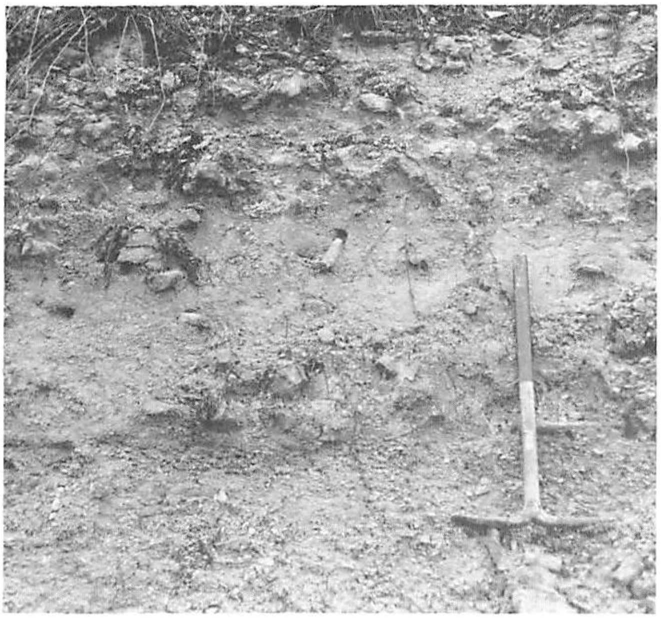


Figure 21 — Lithified remains of burrows weathering from less consolidated sediments of the Basic City Shale. Location: NW/4, NE/4, NW/4, Sec. 10, T.8N., R.13E.

servation that the dominant clay lithology of the Basic City Shale in eastern Mississippi gives way to sand west of Newton County. Lithologic changes in the Basic City Shale reflect facies changes in the high-constructive, wave-dominated Tallahatta Delta system described by O'Donnell (1974), wherein Newton County material represents nearshore, marine shelf sediments, changing northwestward to strandplain sand facies and channel mouth bar sand facies.

Neshoba Sand Member

The Neshoba Sand Member of the Tallahatta Formation was named by Thomas (1942) after the village of Neshoba, Neshoba County, Mississippi, in reference to sparingly glauconitic sand previously considered to be lower Winona sediments.

The Neshoba Sand is disconformably overlain by the Winona Formation (Figure 26) and conformably underlain by the Basic City Shale (Figure 19). The Neshoba Sand is not encountered at the surface in Clarke County (Gilliland, 1980), and not considered

Figure 22 — Well lithified sandstone, interbedded with well lithified siltstone and claystone in the Basic City Shale. Location: NE/4, SE/4, SE/4, Sec. 26, T.8N., R.13E.

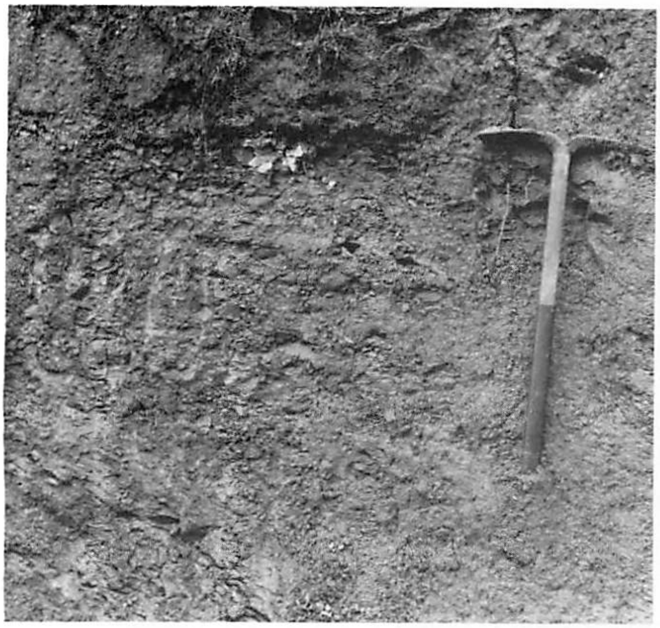


Figure 23 — Nonlithified, interlaminated and thinly interbedded sand, silt, and clay of the Basic City Shale. Location: SW/4, NW/4, NW/4, Sec. 10, T.8N., R.13E.

Figure 25 — Specimen of *Anodontia augustana* Gardner, 1951, collected from the Basic City Shale. Scale in centimeters. Location: SW/4, NE/4, SW/4, Sec. 34, T.8N., R.12E.

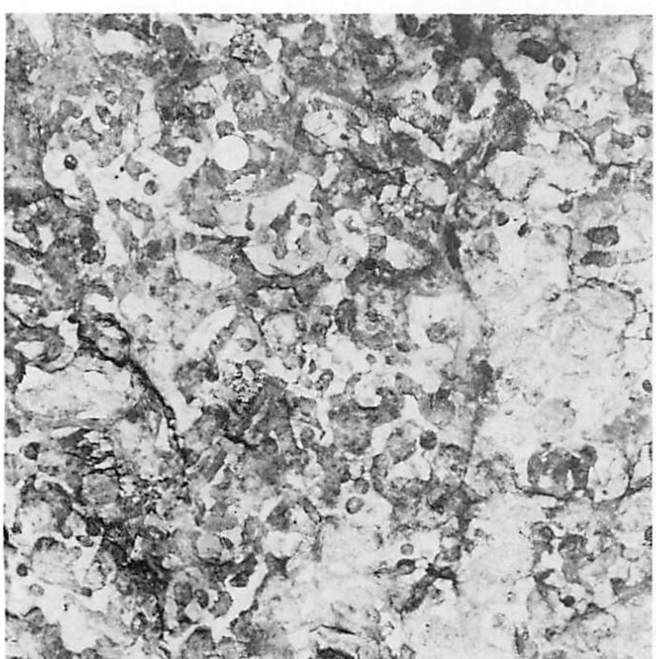


Figure 24 — Burrows in lithified sandstone of the Basic City Shale. Quarter in upper left center for scale. Location: SE/4, NE/4, NE/4, Sec. 1, T.6N., R.13E.

as a separate geologic unit in Lauderdale County (Foster, 1940). The Neshoba Sand is typically exposed in Newton County as moderate- to dark reddish-brown, coarse- to fine-grained, micaceous, glauconitic, massive, nonfossiliferous sand. Figure 18 illustrates the Neshoba Sand Member in measured section. The disconformity with the overlying Winona is, generally, not clearly distinctive at the surface due to weathering, but is obvious in relatively fresh roadcuts (Figure 26). The Neshoba Sand usually has a mottled appearance, probably due to downward movement of clays and iron oxides leached from the overlying Winona. Neshoba sediments are locally glauconitic, and consistently micaceous.

In the subsurface, the Neshoba Sand is typically grayish-orange, very coarse- to fine-grained, poorly sorted, subangular quartz sand, with appreciable glauconite and mica. The member is generally 10 feet thick, with a minimum thickness of 8 feet encountered in Test Hole A0-15, and maximum thickness of 15 feet in Test Hole A0-9 and water wells K1 and K2.

The Neshoba Sand represents a coarsening upward sequence of sediments produced as the sea

Figure 26 — Contact of the Neshoba Sand with the overlying Winona Formation. Hammer is at the contact. Location: NE/4, SW/4, Sec. 34, T.8N., R.12E.

regressed after deposition of the underlying Basic City Shale Member. In this manner, terrigenous sediments were reworked in the energetic shoreline environment into the strandplain sand facies of the Neshoba Sand Member.

Winona Formation

The Winona Formation was initially described in the literature by Lowe (1919) as a member of the Tallahatta Formation. Thomas (1942) raised the Winona to the rank of formation. Priddy (1943) described the Winona at the type locality (Winona, Mississippi) as a member of the Lisbon Formation. Subsequent classification has divided the strata such that the Lisbon Formation designation is no longer used in Mississippi. The present stratigraphic column of Mississippi (Dockery, 1981) classified the Winona as a separate formation, as did Thomas (1942), and this classification is utilized in this report.

The Winona Formation is well exposed in eastern and northeastern Newton County. It is manifested at the surface as dark reddish-brown, medium- to very fine-grained, poorly sorted, silty, clayey, glauconitic, fossiliferous sand. The glauconite content is high, at many places well over 50 percent. The formation weathers to a deep reddish-brown where exposed at the surface, but in fresh exposures unweathered glauconite gives the formation a light olive-gray to greenish-gray color. The Winona Formation is highly fossiliferous, with molds and casts of bivalves and gastropods preserved in lithified portions exposed at the surface. These lithified, limonitic, irregular, discontinuous, ironstone beds are probably the result of weathering of glauconite. Figure 27 illustrates irregular ironstone layers in the Winona Formaton, at the same location as the measured section describing the Winona and underlying strata in Figure 18. The disconformable contact with the underlying Neshoba Sand Member is depicted in Figure 26. The uppermost portion of the Winona Formation and overlying strata are described in the Zilpha Formation section of this report (see measured section in Figure 30).

Figure 27 — Irregular fossiliferous ironstone layers in the Winona Formation. Location: SW/4, NE/4, SW/4, Sec 34, T.8N., R.12E.

The highly ferruginous sediments of the Winona Formation form interesting patterns upon weathering of limonitic concretions (Figure 28) and provide good conditions for preservation of limonitic molds and casts. Figure 29 illustrates a specimen of *Barbatia* sp. that filled in with pellets which altered to glauconite, and later weathered to limonite, leaving a replica of the pellets after the original shell had dissolved.

The most common bivalve fossil occurrences observed in outcrop are: *Nemocardium* sp., *Cras-*

Figure 28 — Banded weathering pattern produced by weathering of limonitic concretions in the Winona Formation. Location: NE/4, NE/4, NE/4, Sec. 13, T.6N., R.13E.

satella sp., *Chlamys* sp., and *Cubitostrea* sp. The gastropods *Lacinia alveata* (Conrad), *Calyptraphorus* sp., and *Athleta* sp. also occur frequently as molds and casts in the ironstone. These and other fauna were described in the Winona Formation in neighboring Clarke County by Dockery (1980).

In the subsurface, the Winona Formation is very fine- to very coarse-grained, silty, clayey, fossiliferous, glauconitic sand, with calcite cemented layers of glauconitic sandstone and siltstone, interbedded and interlaminated with non-cemented layers. The colors range from pale yellowish-brown, light olive-gray, to greenish-gray. The maximum thickness of the Winona Formation in Newton County occurs in Test Hole A0-1, where 72 feet of cemented and non-cemented, fossiliferous, green sand occurs. The minimum thickness of 35 feet occurs in Test Hole A0-14.

The Winona Formation represents a destructional shelf facies deposited in a marine transgression above the nearshore deltaic and strandplain sediments of the underlying Neshoba Sand Member of the Tallahatta Formation. The Winona is separated from underlying strandplain sediments of the Neshoba Sand Member by a disconformity that marks the beginning of the transgression recorded by Winona shelf sediments. The conformably overlying Zilpha represents prodelta and shelf muds that were deposited offshore in a deeper and less energetic marine environment.

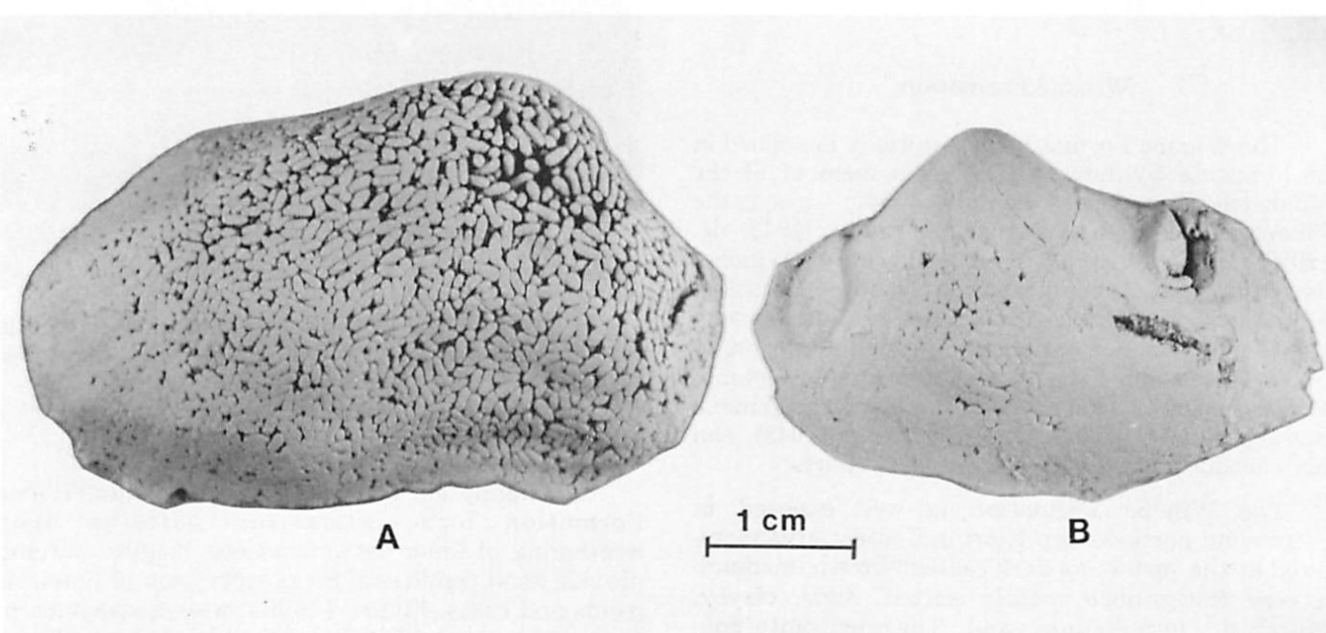


Figure 29 — Ferruginous internal molds of *Barbatia* sp. (A) and *Bathytormus* sp. (B) showing the outlines of pellets which initially filled the shells. Location: SW/4, NE/4, SW/4, Sec. 34, T.8N., R.12E.

Zilpha Formation

Hughes (1940) introduced the term Zilpha into the literature. Thomas (1942) formally named the Zilpha as a formation, and described the type locality at Bucksnort Hill in the vicinity of Zilpha Creek, along a country road in the center of Sec. 8, T.16N., R.16E., Attala County. The Zilpha Formation is 54 feet thick at the type locality, and consists of carbonaceous shale and glauconitic, sandy clay. The contact with the underlying Winona Formation is conformable at the type locality (Thomas, 1942).

Figure 30 illustrates a measured section of the Zilpha Formation and its relationship to enclosing strata. The lower contact of the Zilpha Formation with the Winona Formation is conformable, with a downward increase in glauconite and quartz percentages. The upper contact with the overlying Kosciusko Formation is also gradational as the lowermost 3 to 5 foot interval of the Kosciusko Formation has glauconite concentrations of up to 55 percent. Clay percentages increase downward in this interval until a shale texture is attained. This upper gradational contact marks a transition from marine shelf and prodelta mud facies to the non-marine deltaic sand and mud facies of the Kosciusko Formation. In weathered outcrop, the transition from Kosciusko to Zilpha Formation sediments is abrupt, as most of the glauconite and clay has weathered from lowermost Kosciusko sands. The Kosciusko-Zilpha Formation contact is erosional locally, where diastems probably are a result of channel cutting by Kosciusko distributary systems. Figure 31 is an example of a typical exposure of the Kosciusko-Zilpha contact. Figure 32 shows a typical exposure of the Zilpha Formation.

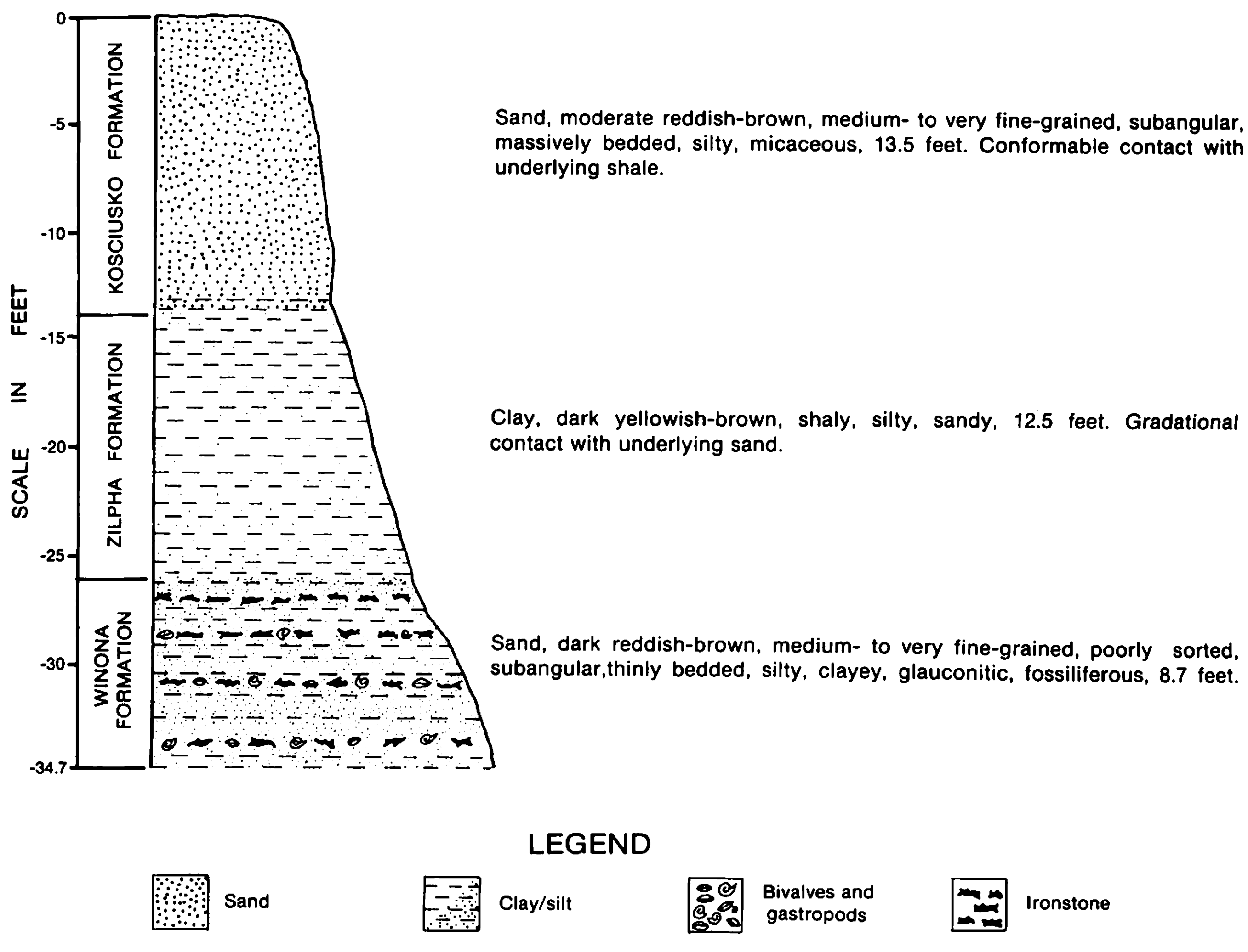


Figure 30 — Measured section illustrating the Kosciusko - Zilpha - Winona transition. Location: SE/4, SE/4, Sec. 12, T.7N., R.12E.

Figure 31 — Kosciusko - Zilpha contact as seen in measured section described in Figure 30. Location: SE/4, SE/4, Sec. 12, T.7N., R.12E.

Figure 32 — Zilpha Formation in outcrop. Location: SE/4, NE/4, Sec. 5, T.8N., R.12E.

O'Donnell (1974) recognized the Winona and lower Zilpha Formation as the marine destructional phase of Tallahatta shallow shelf, strandplain, and deltaic systems, and the upper Zilpha as prodelta carbonaceous clays and interbedded clays and sands of the Kosciusko delta systems.

In Newton County, the Zilpha Formation occurs at the surface as dark yellowish-brown to grayish-brown, sandy, silty, glauconitic, carbonaceous clay, with sand lenses and thin beds occurring mostly in the lower portions. In the subsurface, the dark yellowish-brown, sandy, silty clays of the Zilpha Formation range from 12 feet thick in Test Hole A0-13 to 68 feet thick in water well K2. The thickness of the Zilpha usually varies inversely with that of the Winona Formation; this interval is often obscure in outcrop, appearing as a clayey zone in the uppermost few feet of Winona type sediments. Therefore the Zilpha and Winona formations are mapped as a single unit on the surface Geologic Map (Plate 1). However, these units can be easily distinguished downdip (Plate 2).

Kosciusko Formation

The Kosciusko was established as a member of the Lisbon Formation by Cooke (1925). Thomas (1942) redefined the Kosciusko to include all strata above the Zilpha and below the Wautubbee Formation (present Cook Mountain Formation) and raised the Kosciusko to formation status. This interval has been recognized as the Sparta Sand, an equivalent unit in Texas and Louisiana, by Spooner (1926) and Shearer (1930). Cooke (1925) observed the transition between the deltaic clastic facies of the Kosciusko Formation in Mississippi and equivalent marine shelf sediments of the Lisbon Formation in Alabama. Because of this transition, carbonaceous sands and clays occur in Mississippi at the same interval occupied by marine sands and limestones in Alabama.

The thick sequence of nonmarine sands and shales of the Kosciusko indicates constructive deltaic deposition. The fossiliferous marine sand representing the destructional phase of the Kosciusko delta system, described by Dockery (1980) as the Dobys Bluff Tongue, does not occur in Newton County. Instead, the upper Kosciusko Formation is composed of carbonaceous, nonfossiliferous shale, disconformably overlain by marine shelf sediments of the Cook Mountain Formation.

The Kosciusko Formation seldom exhibits bedding where exposed at the surface in Newton County, except in the upper shaly portions. Figures 30 and 31 illustrate the lower Kosciusko and the lower contact with the Zilpha Formation. The upper contact of the Kosciusko with the overlying Cook Mountain Formation is shown in Figure 33. The upper portions of the Kosciusko Formation are characterized by thin to medium bedded, tabular cross-beds, truncated by thin shale beds composed of light to dark gray clayey silt (Figure 34). Fossil occurrences are absent at surface exposures of the Kosciusko Formation in Newton County, possibly due to weathering, as most exposures occur in the soil weathering zone. No fossils ascribed to the Kosciusko occur in test hole samples, although shell fragments attributable to uphole contamination from the Cook Mountain Formation were frequent. The upper shaly portion of the Kosciusko Formation has a maximum thickness of 88 feet, encountered in water well K2. This interval is 78 feet thick in Test Hole A0-15, where most of the Kosciusko Formation is characterized by high percentages of carbonaceous shale. According to the electric log, the upper shale interval is 48 feet thick to the northwest in Test Hole A0-14. These particular test holes are only two miles apart, suggesting highly variable thickness of the upper Kosciusko shaly interval. Farther northwest, thicknesses are more consistent, as exemplified by thicknesses of 62 and 52 feet in Test Holes A0-12 and A0-2, respectively.

The lower portions of the Kosciusko Formation are characterized by very coarse- to very fine-grained quartz sand. Near the base (lower 30 feet) the Kosciusko is characterized by very coarse- to medium-grained, well-sorted quartz sand, with increasing percentages of glauconite toward the lower contact with the Zilpha Formation. This interval often shows no bedding in outcrop, probably due to weathering of the highly permeable material, as most exposures of the Kosciusko Formation occur in the thick, highly leached "A" soil horizon (Figure 35). A color change, from brownish-gray to black in the shaly upper Kosciusko to pale brown in the lower sandy facies, accompanies a coarsening downward trend, characteristic in subsurface sampling. The thickness of the lower Kosciusko sands ranges from a minimum of 56 feet in water well E2 to a maximum of

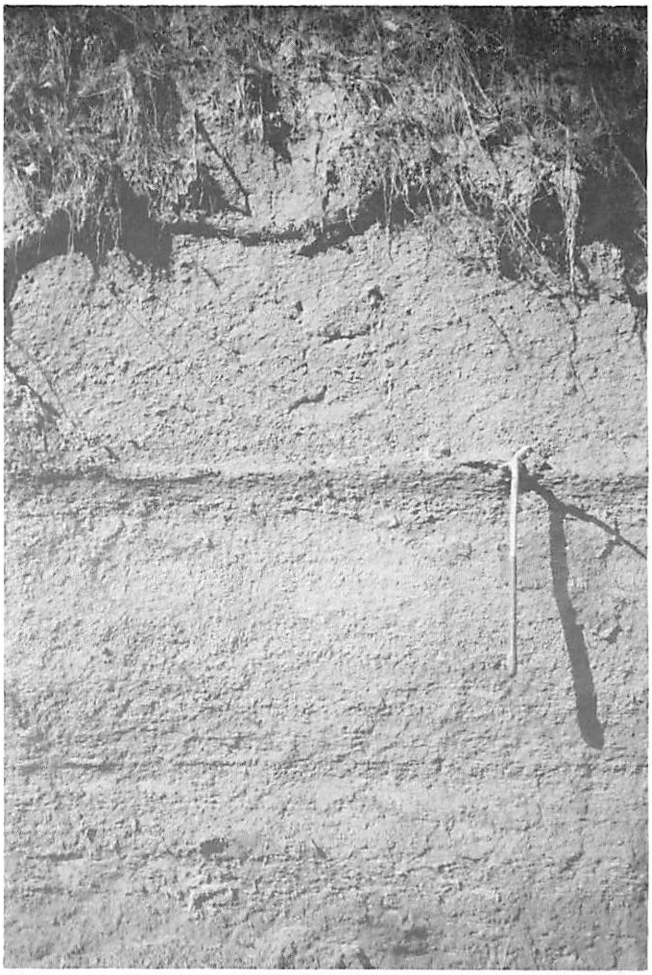


Figure 33 — Contact of the Kosciusko Formation with the overlying Cook Mountain Formation. Hammer is at contact. Location: NW/4, SE/4, Sec. 2, T.5N., R.12E.

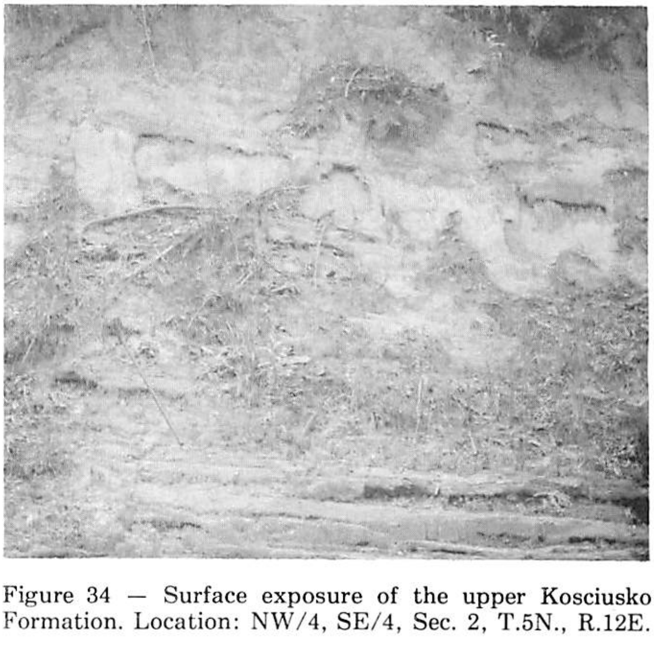


Figure 34 — Surface exposure of the upper Kosciusko Formation. Location: NW/4, SE/4, Sec. 2, T.5N., R.12E.

Figure 35 — Surface exposure of the lower Kosciusko Formation. Location: SE/4, SE/4, Sec. 12, T.7N., R.12E.

160 feet in water well K2. The sand and shale facies usually vary inversely in thickness. A maximum overall thickness for the Kosciusko Formation of 228 feet occurs in water well K2, and the minimum thickness (136 feet) occurs in Test Hole A0-15. These holes show a northwest thickening of the formation along strike. This northwest thickening is further illustrated by a maximum thickness of 280 feet reported in neighboring Attala County to the northwest (Parks, 1963), and by a thickness of 167 feet in neighboring Clarke County to the southeast (Gilliland, 1980).

Surface exposures of the Kosciusko Formation reveal significant occurrences of petrified wood and well-lithified siltstone in the lower sandy portion of the formation. Figure 36 illustrates a well-lithified boulder of silty sandstone, probably formed as downward percolation of ground water was retarded by underlying clays of the Zilpha Formation, resulting in an abundance of silica cement necessary to form sandstone ledges. Parks (1963) described caves and sinkholes developed by undercutting of less resistant sediments below quartzitic rock ledges in the Kosciusko Formation in Attala County.

Thomas (1942) described rare occurrences of petrified wood as characteristic of the Kosciusko Formation throughout the outcrop belt. Some occurrences of petrified wood were noted within the Kosciusko Formation in Newton County (Figure 37).

Figure 36 — Sandstone boulder from the Kosciusko Formation, excavated from Highway 503 roadbed between Hickory and Decatur, Mississippi.

Figure 37 — Petrified wood in the Kosciusko Formation. Location: NE/4, SE/4, SW/4, Sec. 17, T.7N., R.12E.

Cook Mountain Formation

The Cook Mountain Formation was named by Kennedy in 1892 in reference to marine deposits at Cook Mountain, Houston County, Texas (Wilmarth, 1938). Lowe (1919) named equivalent strata in Mississippi the Wautubbee marls, in reference to marine deposits near Wautubbee, Clarke County, Mississippi. Thomas (1942) applied formation rank to the Wautubbee; however, Priddy (1960) named it as a member of the Lisbon Formation. Most recent literature uses the name Cook Mountain Formation for the interval above the Kosciusko Formation and below the Cockfield Formation (Dockery, 1981), with subdivision into members (Archusa Marl, Potterchitto, and Gordon Creek Shale) as described by Thomas (1942). Thomas (1942) noted that this three-fold subdivision cannot be extended northwest of central Newton County because the different facies become laterally discontinuous. Weathering has nearly completely altered many of the fresh exposures observed by Thomas, but the homogeneous, resistant limestones characteristic of the Archusa Marl Member are not apparent at the surface, or in the subsurface, in Newton County. Subdivision of the Cook Mountain is thus two-fold, with the upper Gordon Creek Shale and lower Potterchitto members comprising the variable 47 to 110 foot thickness of the formation in Newton County.

The Cook Mountain Formation is best exposed in Newton County on the south side of I-20 at the Newton exit, in the NW/4 of NE/4 of Sec. 26, T.6N., R.11E. A measured section of this exposure is illustrated in Figure 38. The Cook Mountain Formation varies in thickness in the subsurface, from an unusually thin interval of 47 feet in Test Hole A0-2, to a maximum of 135 in Test Hole A0-7. The Cook Mountain Formation thickens downdip. The areal geologic map identifies the Cook Mountain Formation as a single unit, even though the two members are discussed separately in the text. Because the members of the Cook Mountain Formation are difficult to differentiate on electric logs, thicknesses for these members are given from test holes from which samples were taken.

Potterchitto Member

The Potterchitto Member of the Cook Mountain Formation was introduced to the literature by Thomas (1942), who designated the type locality near Potterchitto Creek, two miles north of Newton, Mississippi. Weathering and vegetation have altered the fresh roadcuts described by Thomas (1942), and the reader is referred to that publication for excellent photographs of the Potterchitto type locality. This member is well exposed at the outcrop described in Figure 38 of this report. Figure 39 illustrates a portion of the outcrop from which the measured section, illustrated in Figure 38, is derived.

The Cook Mountain Formation was deposited in a marine environment, with marine shelf sediments of the Potterchitto Member overlain by marine shelf and prodelta sediments of the Gordon Creek Shale Member. Faunal diversity is greatest toward the bottom of the Potterchitto Member, as illustrated in Figure 38.

The Potterchitto Member disconformably overlies the Kosciusko Formation (Figure 33). At the surface, the Potterchitto Member is characteristically light- to brownish-gray, silty, clayey, glauconitic, calcareous, fossiliferous, bioturbated sand, with discontinuous sandstone and siltstone ledges as well as ironstone concretions. These lithified zones offer good preservation conditions for the remains of burrows (Figure 40). Figure 41 illustrates the most common fossils observed in the Potterchitto Member. It should be noted that the lowermost portions of the Cook Mountain Formation are not exposed in the outcrop shown in Figures 38 and 39.

The Potterchitto Member varies in thickness from 35 feet in Test Hole A0-2, where an unusually thin interval of Cook Mountain Formation is encountered, to a maximum of 78 feet in Test hole A0-16. Test hole samples collected in the subsurface indicate that the Potterchitto Member is composed of light-gray to pale yellowish-brown, very fine- to very coarse-grained, silty, clayey, calcareous, glauconitic, fossiliferous sand, with appreciable amounts of carbonaceous clay.

The Potterchitto Member is conformably overlain by the Gordon Creek Shale Member of the Cook Mountain Formation. The contact between these two units is illustrated in Figures 38 and 39.

Gordon Creek Shale Member

The Gordon Creek Shale Member was named by Thomas (1942) in reference to the small creek flowing through Wautubbee Station, Clarke County, Mississippi. The Gordon Creek Shale is similar in lithology and appearance to other carbonaceous shales in the Claiborne and Wilcox groups, such as the Zilpha and portions of the Hatchetigbee Formation. In Newton County, the Gordon Creek Shale is manifested at the surface as grayish-brown to medium dark-gray, sandy, silty, thinly bedded shale, as well as silty, clayey, well-cemented, glauconitic sandstone and siltstone interbedded and interlaminated with unconsolidated sand, silt, and clay. Figure 42 illustrates the general appearance of the Gordon Creek Shale at the surface in Newton County.

The Gordon Creek Shale is 21 feet thick in the measured section described in Figure 38; however,

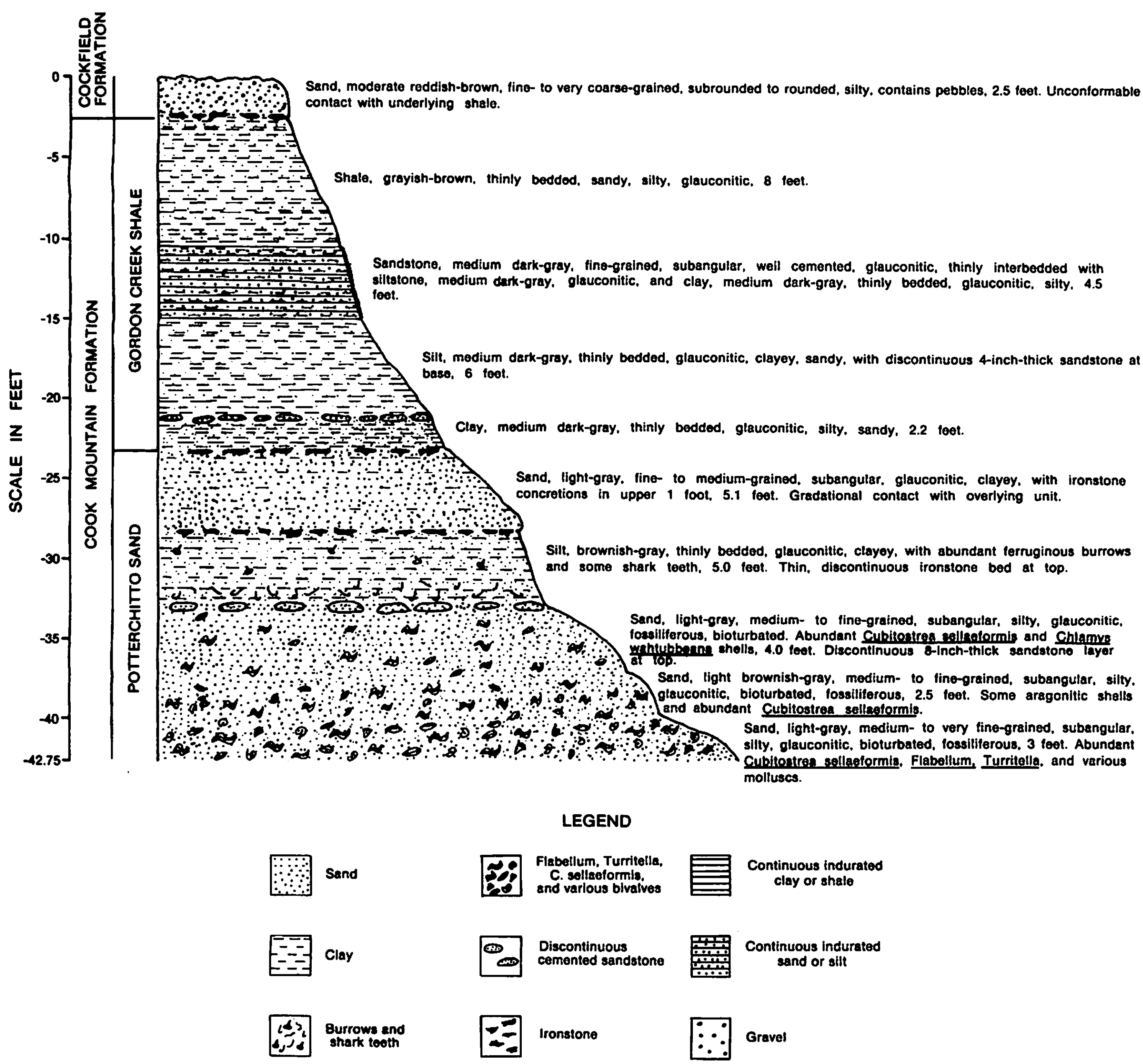


Figure 38 — Measured section of the Cook Mountain Formation. Location: NE/4, NW/4, NE/4, Sec. 26, T.6N., R.11E.

Figure 39 — Upper interval of the Potterchitto Member in outcrop. Hammer is at the contact with the Gordon Creek Shale Member; yardstick in foreground for scale. Location: NE/4, NW/4, NE/4, Sec. 26, T.6N., R.11E.

Figure 40 — Burrows in the Potterchitto Member of the Cook Mountain Formation. Location: NE/4, NW/4, NE/4, Sec. 26, T.6N., R.11E.

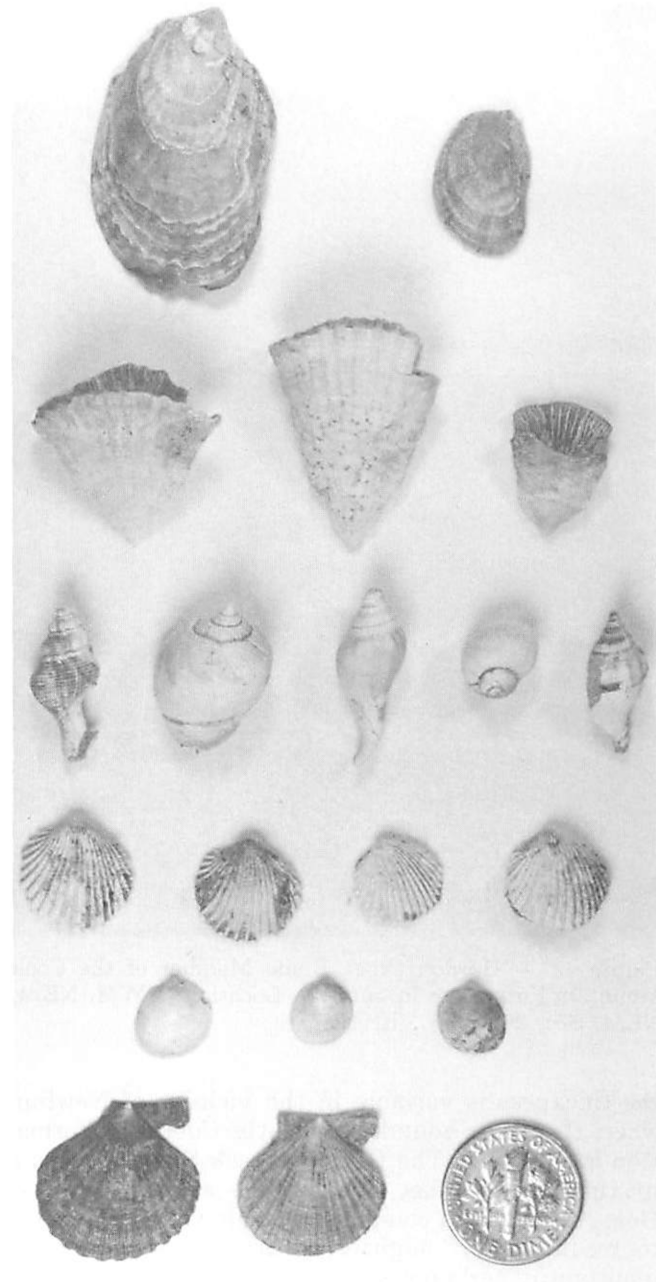


Figure 41 — Most common fossils in the Potterchitto Member, Cook Mountain Formation: Row 1, *Cubitostrea sellaeformis* (Conrad); Row 2, *Flabellum cuneiforme pachyphyllum* Gabb and Horn; Row 3, left to right, *Latirus moorei* (Gabb), *Pseudoliva vetusta carinata* Conrad, *Caricella stenzeli* Palmer, *Neverita* sp., *Athleta petrosa* (Conrad); Row 4, *Venericardia (Rotundicardia) rotunda* Lea; Row 5, *Limopsis aviculoides* (Conrad); Row 6, *Chlamys wahtubbeana* Dall. MGS Locality 65: NE/4, NW/4, NE/4, Sec. 26, T.6N., R.11E.

Figure 42 — Gordon Creek Shale Member of the Cook Mountain Formation in outcrop. Location: NW/4, NE/4, NE/4, Sec. 26, T.6N., R.11E.

Figure 43 — Contact between the Gordon Creek Shale Member of the Cook Mountain Formation and the overlying Cockfield Formation. Location: NE/4, SW/4, NW/4, Sec. 17, T.7N., R.10E.

the thickness is variable in the vicinity of Newton, where the upper boundary with the Cockfield Formation is erosional. The Gordon Creek Shale reaches a maximum of 38 feet thick in the subsurface (Test Hole A0-7), and is composed of pale yellowish-brown to medium-gray, slightly calcareous, silty, sandy, glauconitic, carbonaceous shale. The Gordon Creek Shale is conformably overlain by the Cockfield Formation (Figure 43) except for an area encompassing the town of Newton, where local channeling by Cockfield distributary systems has produced an erosional contact.

Cockfield Formation

The Cockfield Formation was introduced into the literature by Vaughan (1895) in reference to exposures at Cockfield Ferry on the Red River about halfway between St. Maurice and Montgomery, Louisiana. The name is applied to lignitic sands and clays which underlie the Jackson Group and overlie what is presently termed the Cook Mountain Formation. Lowe (1915) classified these beds, which he termed the Cockfield Lignite, as a member of the Lisbon Formation. Thomas (1942) identified the Cockfield as a formation that occupies the stratigraphic interval above the Wautubbee (present Cook Mountain) and below the Moodys Branch Formation of the Jackson Group. The Cockfield Formation is referred to in some literature (Bergquist, 1942) as the Yegua Formation, utilizing Texas terminology.

The upper shaly zone and lower sandy zone of the Cockfield are not as apparent in outcrop as in the subsurface. The uppermost 90 feet of the formation are dominated by carbonaceous clays and silts with high percentages of lignitic clay and silt separated by thin beds of glauconitic, micaceous, quartz sand and silt. The lower 75 feet of the Cockfield Formation are dominantly medium-grained, sightly micaceous, quartz sand, with trace amounts of heavy minerals and occasional thin beds of carbonaceous silt and clay. Colors range from black to dark gray in carbonaceous clay intervals to light brown in sand intervals sampled in the subsurface.

The Cockfield Formation ranges in thickness from 112 feet to the east in neighboring Clarke County (Gilliland, 1980), to 280 feet to the west in neighboring Scott County (Bergquist, 1942). Test Hole A0-7, the only test hole to penetrate a complete section of the Cockfield Formation in Newton County, recorded a thickness of 173 feet. These thicknesses indicate that the Cockfield Formation thickens to the northwest along strike across Clarke, Newton, and Scott counties. The Cockfield Formation reaches a maximum known thickness in Newton County of 194 feet in water well J2.

In outcrop, the Cockfield Formation appears as massively bedded, very coarse- to very fine- (but predominantly medium-) grained, moderately sorted quartz sand. Colors vary according to the amount of oxidation and leaching, and range from moderate reddish-brown to white. Figure 44 illustrates the appearance of the Cockfield Formation in outcrop. Note the nearly vertical slope, characteristic of Cockfield sediments. Thin beds and laminae of medium- to light-gray clay and silt appear occasionally in outcrop, but no lignite beds have been observed by the author. Bergquist (1942) reported deciduous leaf imprints in the carbonaceous shales of the upper Cockfield Formation in Scott County. Lowe (1915) noted that carbonaceous clays and lignite, characteristic of the Cockfield Formation, extend across Louisiana and have been described in several areas of Mississippi. Lignite is apparent in small quantities in Newton County test hole samples, but not at the surface. The carbonaceous interbedded shales and sand of the upper Cockfield Formation represent a delta plain depositional environment, and the lower sand facies represents a delta front depositional environment as described by Dockery (1976).

The lower contact of the Cockfield Formation with the Cook Mountain Formation is erosional locally in the area around and to the south of Newton, due to channeling by Cockfield distributary systems. This facies of the Cockfield Formation represents a more energetic depositional environment, and is characterized by stringers and discontinuous lenses of chert pebbles. Outside of this area, along the outcrop belt, the lower contact of the Cockfield Formation is conformable and gradational, as sand gives way downward to interlaminated silty and sandy clay, then to the shales of uppermost Cook Mountain sediments. The upper contact of the Cockfield Formation with the overlying Moodys Branch Formation is erosional.

Figure 44 — Cockfield Formation in outcrop. Location: NW/4, NW/4, NE/4, Sec. 26, T.6N., R.11E.

JACKSON GROUP

The Jackson Group was named by Conrad (1856), in reference to fossiliferous marine sediments of Jackson, Mississippi. Lowe (1915) subdivided the Jackson Group into three formations: Yazoo Clay Marl, Moody's Branch Green Marls, and Madison Sands. Cooke (1918) removed the Madison Sands resulting in a two-fold division of the Jackson Group, and later (1933) named a new unit, the Cocoa Sand, in reference to an abandoned post office called Cocoa in Choctaw County, Alabama. Subsequently, names of formations designated by Lowe (1915) were altered, and in some literature (Cooke, 1933, for example) the Jackson was designated as a formation. The Yazoo Formation was subdivided, in addition to the Cocoa Sand named by Cooke (1933), into North Creek Clay, Pachuta Marl, and Shubuta Clay members (Murray, 1947). Murray subsequently changed the North Creek Clay to the North Twistwood Creek Clay Member (DeVries, 1963) as a contributing author in the Jasper County Mineral Resources bulletin. Thus the Jackson Group has become subdivided into the following classification, recognized by the Mississippi Bureau of Geology:

Jackson Group
- Yazoo Formation
  - Shubuta Clay Member
  - Pachuta Marl Member
  - Cocoa Sand Member
  - North Twistwood Creek Clay Member
- Moodys Branch Formation

The stratigraphic sequence of the Jackson Group in Newton County indicates deepening of the marine environment from the destructional shelf deposits of the Moodys Branch Formation to the shelf clays of the Yazoo Formation.

Moodys Branch Formation

The Moodys Branch Formation was introduced into the literature by Lowe (1915) as the Moody's Branch Green Marls. As previously discussed, present terminology designates this unit as the Moodys Branch Formation, which disconformably overlies the Cockfield Formation.

The Moodys Branch Formation is composed of fossiliferous, glauconitic, clayey sand with varying amount of quartz sand and clay when sampled in the subsurface. The unit is 15 feet thick in Newton County. The thickness to the southeast in Clarke County ranges from 10 to 25 feet (Gilliland, 1980), and to the northwest in Scott County the thickness ranges from 12 to 25 feet.

Weathering has destroyed the lithologic character of the Moodys Branch at the surface in Newton County. Calcium carbonate and glauconite are among the least stable minerals when exposed to surface conditions, especially in an area such as Newton County where humid subtropical conditions give rise to highly leached, oxidized, acidic soil conditions. The lithologic characteristics having been removed, the Moodys Branch Formation cannot realistically be traced in outcrop across Newton County. Therefore, description of the Moodys Branch Formation and its contact with the Cockfield Formation are based entirely on subsurface data, and extrapolation of that data to the surface, respectively. To make matters worse, low terrace deposits cover much of the surface outcrop belt in Newton County. Similar weathering conditions exist in adjacent Scott County, where the Moodys Branch was depicted entirely on the basis of subsurface data (Bergquist, 1942). The Moodys Branch Formation is composed of light gray, glauconitic, calcareous, fossiliferous, quartz sand in the subsurface. The molluscan fauna of the Moodys Branch Formation was described in detailed bulletin form by Dockery, 1977. Figure 45 illustrates the diversity of fauna of the Moodys Branch Formation as encountered in Test Hole A0-7. The Moodys Branch Formation is conformably overlain by the North Twistwood Creek Clay Member of the Yazoo Formation.

Yazoo Formation

The Yazoo Formation was named by Lowe (1915) for calcareous clays and sands (which he termed marl) and nonmarine sediments exposed in the vicinity of Yazoo City, Mississippi.

In Clarke County, Mississippi, and western Alabama, the Yazoo Formation is divisible into four distinct members. These members grade westward into an undifferentiated clay sequence in Hinds County, Mississippi. The divisions in Newton County are tentatively correlated with formal stratigraphic members in Clarke County, Mississippi, in terms of the equivalent units described below.

The lowermost North Twistwood Creek Clay Member of the Yazoo Formation conformably overlies the Moodys Branch Formation. The Cocoa Sand Member pinches out in the western part of Clarke County and is not present in Newton County. At the surface, calcareous, fossiliferous clays equivalent to the Pachuta Marl Member crop out in a belt that is intermediate between the outcrop belts of less calcareous clays to the north and south, which are equivalent to the North Twistwood Creek and Shubuta Clay members, respectively. Generally, the Yazoo Formation outcrop belt occupies the southwest portion of T.5N., R.11E., and all of T.5N., R.10E., in the southwestern corner of Newton County.

North Twistwood Creek Clay Member (Equivalent)

The North Twistwood Creek Clay Member was initially named by Murray (1947) as the North Creek Clay, subsequently altered by Murray (DeVries, 1963) to North Twistwood Creek Clay. The North Twistwood Creek Clay is sparsely calcareous and glauconitic, sandy, silty, stiff clay, with no apparent bedding. Colors range from bluish-gray to various shades of brown and gray when weathered, and usually give a mottled appearance in outcrop. This clay produces a terrain that is relatively flat with smooth, low hills within the Yazoo Formation outcrop belt, so exposure usually occurs in roadside ditches and creekbanks. A few roadcuts, such as the exposures along a road in the E/2, Sec. 2, and NW/4, Sec. 1, T.5N., R.10E., offer substantial exposures to study the member in outcrop.

Pachuta Marl Member (Equivalent)

The Pachuta Marl was introduced into the literature by Cooke (1933), in reference to calcareous,

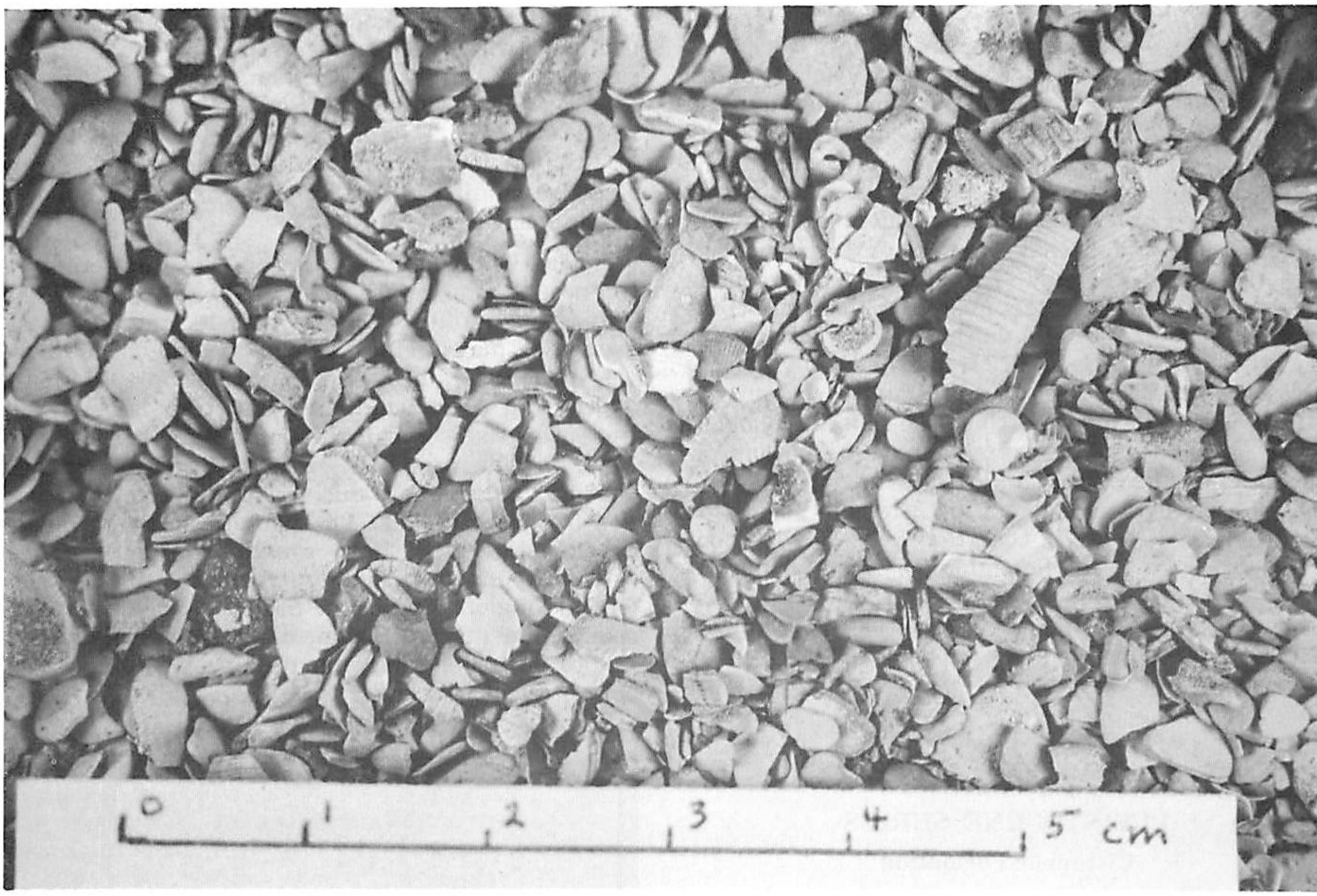


Figure 45 — Subsurface sample of the Moodys Branch Formation from Test Hole A0-7. Location: NW/4, SE/4, NW/4, Sec. 24, T.5N., R.10E.

fossiliferous, sandy clays at Pachuta, Clarke County, Mississippi. This highly calcareous and fossiliferous member is very distinct in outcrop. The Pachuta Marl is usually light gray to white in outcrop, and is composed of glauconitic, calcareous, highly fossiliferous, clayey, silty sand with a marine fauna. The most abundant and obvious fossils in outcrop are the oyster *Pycnodonte* (*Pycnodonte*) *trigonalis* (Conrad) and the scallop *Chlamys spillmani* (Gabb). A dark brown, clayey soil develops upon weathering of the member, and often fossils are reduced to calcareous nodules in the soil. Figure 46 illustrates the appearance of the Pachuta Marl in outcrop. A good exposure occurs at a roadcut in NW/4, NE/4, NE/4, Sec. 11, T.5N., R.10E..

Shubuta Clay Member (Equivalent)

The Shubuta Clay Member was introduced into the literature by Murray (1947) in reference to its type locality near Shubuta, Clarke County, Mississippi.

The Shubuta Clay equivalent stratigraphic

Figure 46 — Close-up of calcareous, fossiliferous Pachuta Marl in outcrop. Location: NW/4, NE/4, NE/4, Sec. 11, T.5N., R.10E.

interval occupies the extreme southwestern corner of Newton County, and becomes increasingly calcareous to the northwest as it grades into Pachuta Marl equivalent strata discussed above. The Shubuta Clay is usually medium light-gray to medium bluish-gray when fresh. No fossils are obvious, although to the southeast in Clarke County, where the units are well defined, the Shubuta Clay is fossiliferous (Gilliland, 1980). It is probable that the calcium carbonate has weathered from the clay. The unit is exposed along roadside ditches and creekbanks as a nonfossiliferous clay, and can best be seen in the NE/4 of Section 33, and the SW/4 of Section 34, T.5N., R.10E. An interesting aspect of the Shubuta equivalent outcrop belt in Newton County is that well-rounded pebbles, and some well-rounded cobbles, have become incorporated into the upper 1 to 2 feet of the clay as a result of downslope movement of Citronelle Formation high terrace deposits in the area. Large (over 1 foot diameter) samples of ferruginous cemented quartz-chert conglomerate, characteristic of lowermost Citronelle Formation, occur frequently overlying the Yazoo Formation along its outcrop belt in Newton County.

QUATERNARY SYSTEM

PLEISTOCENE SERIES

Citronelle Formation

The Citronelle Formation was introduced into the literature by Matson (1916), in reference to graveliferous sands and clays at its type locality at Citronelle, northern Mobile County, Alabama. Berry (1916) determined the age of the Citronelle Formation as Pliocene, based on flora collected near the type locality. Roy (1939) contended that these fossil plants are not representative of the Citronelle Formation, and assigned a Pleistocene age to the Citronelle based on his assignment of flora studied by Berry (1916) to strata which underlie the Citronelle Formation. Further, Roy (1939) suggested that the term Citronelle be dropped as a formation name. Subsequently, Isphording and Lamb (1971) established a mid-Pliocene through early Pleistocene age for the Citronelle Formation in northern Mobile County, Alabama, based on vertebrate fossils collected from the lowermost Citronelle Formation. Presently, the Mississippi Bureau of Geology recognizes the Citronelle as a formation, and recognizes the age as late Pliocene-early Pleistocene.

Citronelle Formation deposits occupy high elevations in Newton County, ranging from 480 to 600 feet at the lower contact. The lower contact of the Citronelle Formation is erosional, and channeling into underlying strata is apparent in many instances. Well cemented quartz-chert pebble conglomerate usually occurs at the lower contact, and aids in preventing confusion with other coarse-grained sand units at the surface, as well as in the subsurface, in Newton County. Thickness of the Citronelle varies from 90 feet at Nance Hill 3.5 miles southwest of Newton, to less than 1 foot where the lowermost conglomerate forms resistant caprock on some hilltops occupying highest elevations.

The Citronelle Formation, in Newton County, is composed of moderate reddish-brown to very light-gray, medium- to very large-scale, tabular cross-bedded to planar cross-bedded, pebbly, medium- to very coarse-grained, subangular to subrounded quartz and chert sand. Silt and clay laminae and lenses separate some of the truncated cross-bed sets. Figure 47 illustrates the well-cemented quartz-chert pebble conglomerate which occurs in the lower portion of the Citronelle. The pebbles occurring in the conglomerate are usually rounded to well rounded, with subrounded to subangular matrix sand. Except for the conglomerate in the basal portions, the Citronelle sediments are unconsolidated and highly subject to downslope movement; however, steep walls hold up well in gravel pits (Figure 48). Very large tabular cross-beds with steep foresets, occurring in the lower portions of the Citronelle in Newton County, are indicative of large migrating sand dunes in a fluvial environment of high flow regime with a large sediment input. High flow regime is also indicated by large (medium sand to cobble) sediment size. Horizontally bedded, medium to large scale planar and trough cross-bedded, very coarse sand and

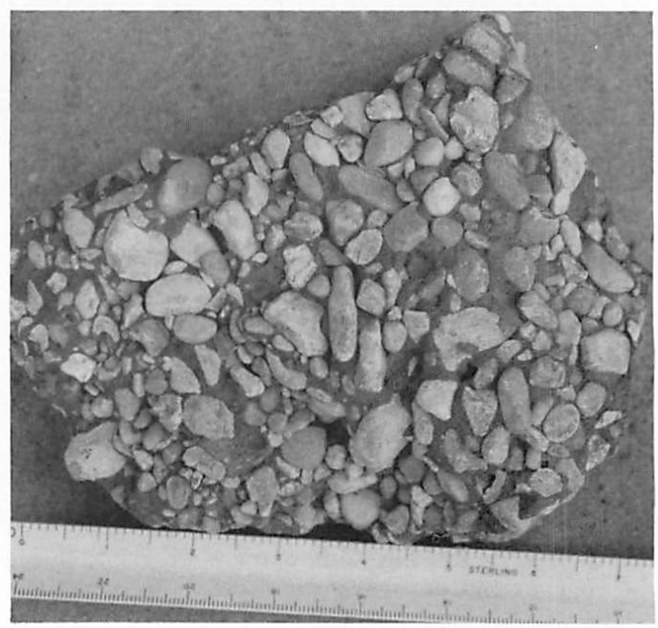


Figure 47 — Conglomerate from lowermost Citronelle Formation. Location: NE/4, SW/4, Sec. 24, T.5N., R.10E.

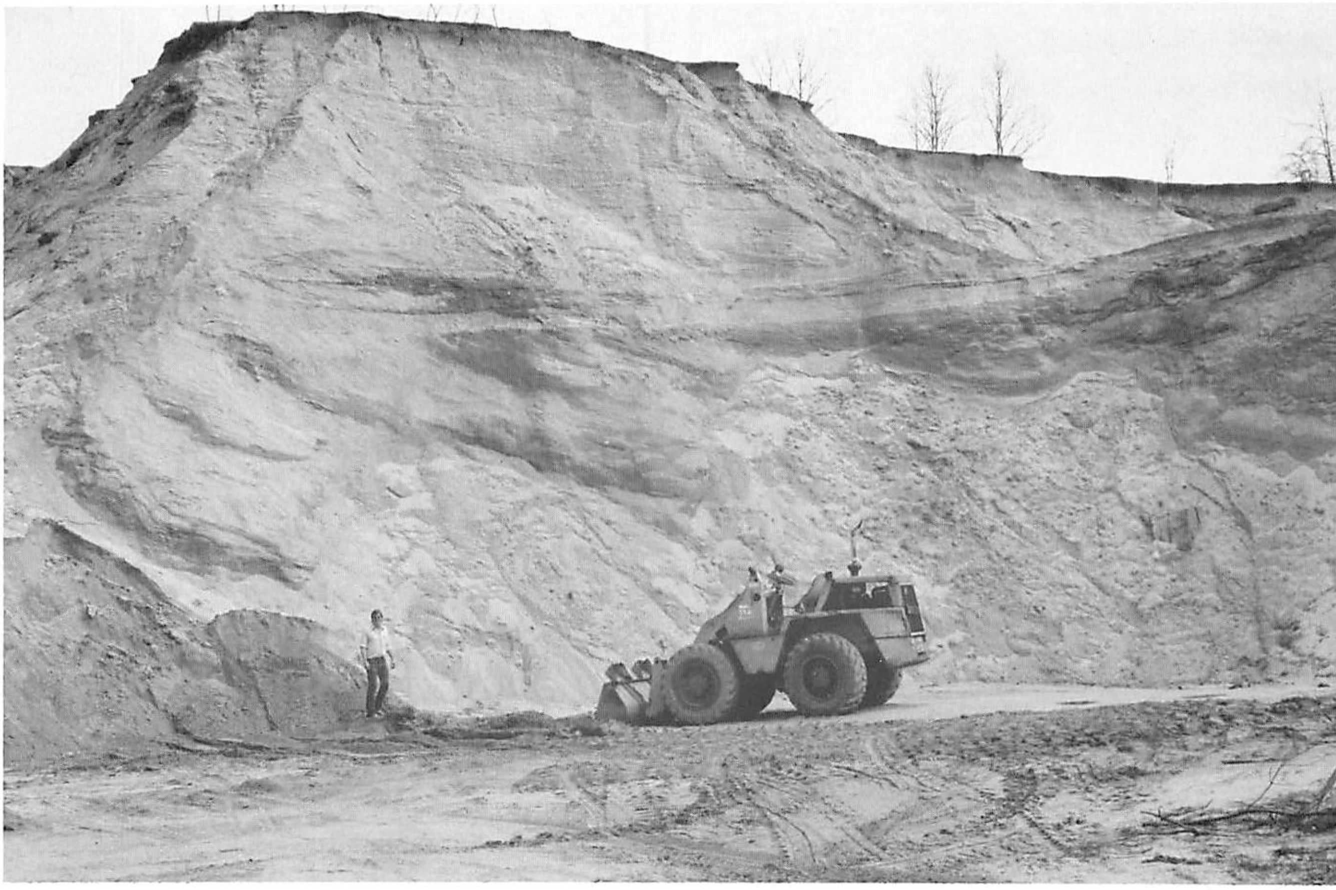


Figure 48 — Citronelle Formation at Nance Hill. Location: NE/4, SW/4, Sec. 24, T.5N., R.10E.

pebbles in the upper portions of the Citronelle in Newton County indicate a lower flow regime than in the lower portions. Figure 49 illustrates the altitude relationship of the Citronelle Formation with surrounding terrain.

Terrace Deposits

Lower elevation post-Citronelle age terrace deposits cover a substantial portion of the land in Newton County. These sediments are usually finer grained than Citronelle material, and blend easily with other formations characterized by similar sediments. Terrace deposits in Newton County are differentiated on the basis of thin, discontinuous, and rare pebble laminae, as well as root structures (Figure 50). Low terrace deposits unconformably overlie several formations in Newton County. Source material for these deposits was derived from the Citronelle Formation, as well as older units exposed at the surface. Figure 51 illustrates the thin pebble layers and the disconformable contact with underlying formations. Low terrace deposits are differentiated from the Citronelle Formation on the basis of their position at a lower elevation. The thin pebble layers, mottled appearance of the soil, and root-fill structures serve to differentiate this unit lithologically. The color, as mentioned above, is usually mottled, and ranges from pale yellowish-brown to very pale orange and various light shades of gray. The sediments are poorly sorted, and are composed of very fine to very coarse, clayey, silty sand, with occasional pebbles.

There is no apparent bedding in most instances, although occasional cross-bedding is evident where the unit is well preserved. Low terrace deposits are indicated on the Newton County geologic map as post-Citronelle in age.

RECENT SERIES

Alluvium

Alluvial deposits are well developed in and adjacent to streams in Newton County, except at the upstream limit of tributaries and intermittent streams. These deposits cover a substantial area, and are

Figure 49 — View from the Citronelle terrace showing its elevation with respect to the surrounding terrain. Location: NE/4, SW/4, Sec. 24, T.5N., R.10E.

Figure 50 — Low elevation terrace material in outcrop. Note root structures and mottled appearance of massively bedded sand. Location: SE/4, SE/4, SW/4, Sec. 17, T.6N., R.10E.

Figure 51 — Low elevation terrace material disconformably overlying the Yazoo Formation. Location: SE/4, SE/4, SW/4, Sec. 17, T.6N., R.10E.

manifested at the surface as wide flood plains produced in the natural course of flooding, which occurs frequently in Newton County. This process yields organic-rich, gray and brown, mottled clays and sands, as well as large areas of flat, smooth terrain. These flood plains are used extensively for cropland and grazing areas in Newton County. In general, flood plains are wide in comparison to the sizes of the streams, suggesting frequent flooding of larger streams in the recent past. The Chunky River, for example, rises onto the flood plain at least annually, and during exceptionally high water, roads crossing its flood plain are flooded and washed out. Figure 52 illustrates annual flooding of the Chunky River flood plain. Similar major streams, such as Potterchitto Creek, are contained within broad flood plains. The town of Hickory, except the northwest corner of the town limit boundaries, is entirely contained upon reworked Kosciusko material on a very flat surface produced by the Potterchitto Creek fluvial system in the recent past.

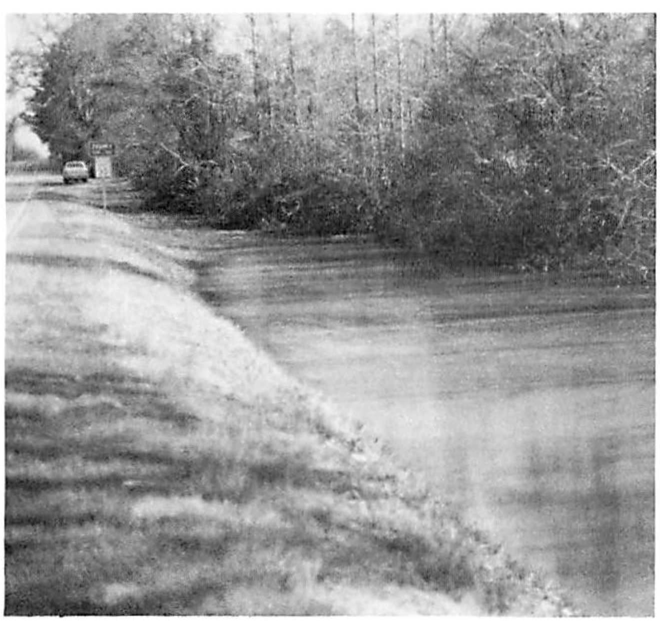


Figure 52 — The Chunky River flood plain during flood stage. Unusually high water sometimes covers Highway 80 (in picture) in this area. Location: NW/4, NE/4, Sec. 35, T.6N., R.13E.

The materials of formations traversed by a particular stream determine, to a large extent, the character and composition of associated fluvial deposits. Near the water table, and directly adjacent to streams, sand is the dominant lithology, while back swamp areas contain frequent sandy carbonaceous silt and clay beds. Test Hole A0-11 penetrated 16 feet of alluvium in the form of medium- to coarse-grained sand with wood fragments and lenses of clay and silt, adjacent to the Chunky River at Chunky, Mississippi. The color of alluvial sediments is largely determined by oxidation-reduction potential controlled by the water table. Reduction of the soil, which occurs mainly at and below the upper limit of saturation, imparts gray color to the soil. Higher elevation flood-plain areas, less frequently saturated, characteristically reveal oxidized sediments that are various hues of brown in color. In this manner it is possible to discriminate, to a large extent, between the present and ancient flood-plain deposits associated with a particular stream. Older flood-plain sediments at Hickory are brown to tan, mottled sands, while sediments adjacent to Potterchitto Creek to the south of Hickory are characteristically gray in color, due to frequent saturation of flood-plain material. This principle can be applied throughout Newton County, as higher, older flood-plain alluvium grades into younger, lower flood-plain alluvium.

STRUCTURE

The structural characteristics of strata exposed in Newton County are due primarily to its location with respect to several major structural features (Figure 53). The county is located on the eastern flank of the Mississippi Embayment and the northern flank of the Gulf Coast Geosyncline. The axis of the Mississippi Embayment generally trends north-south, and that of the Gulf Coast Geosyncline trends generally east-west. The northwest-southeast trend in strike of strata exposed at the surface in Newton County is due to the influence of these two components. The strike of strata exposed to the north in Mississippi trends in a more north-south general direction, parallel to the axis of the Mississippi Embayment. To the east, in Alabama, strike trends in an east-west direction, generally parallel to the axis of the Gulf Coast Geosyncline. The dip of near-surface strata in Newton County is about 30 feet per mile toward the southwest (Dip Section, Plate 2). The northern boundary of the Mississippi Salt Basin extends to the southwest edge of Newton County (Figure 53).

The Pickens-Gilbertown Fault Zone lies near the southwest corner of Newton County (Figure 53). No faults were detected at the surface or indicated in shallow subsurface strata in Newton County.

Electrical logs utilized in the construction of Dip Section A-A' on Plate 2 are: 1 - Mississippi Bureau of Geology Test Hole A0-7; 2 - Griner Drilling Company, City of Newton, Well #3; 3 - Terry Drilling Company, Esko Company, Water Well; 4 - Mississippi Bureau of Geology Test Hole A0-21; 5 - Decatur Development Association, Water Well; 6 - Beulah-Hubbard Water Association, Test Hole #1; 7 - Mississippi Bureau of Geology Test Hole A0-3.

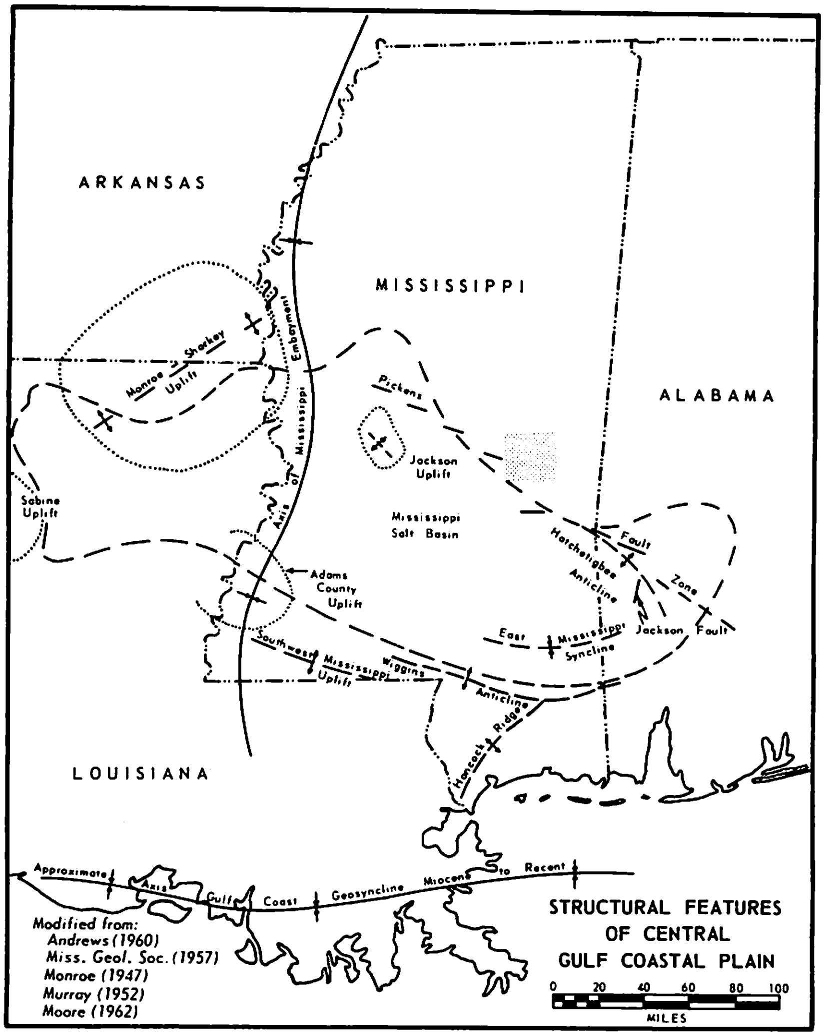


Figure 53 — The location of Newton County with respect to major structural features of the central Gulf Coastal Plain

Electrical logs utilized in the construction of Strike Section B-B' on Plate 2 are: 1 - Mississippi Bureau of Geology Test Hole A0-4; 2 - Mississippi Bureau of Geology Test Hole A0-1; 3 - Town of Decatur, Singer-Layne, Water Well; 4 - Decatur Development Association, Water Well; 5 - Griner Drilling Service, Town of Hickory, Test Well #3; 6 - Mississippi Bureau of Geology Test Hole A0-15.

The Central Mississippi Ridge is present in the subsurface of Newton County wherein Paleozoic strata were uplifted and overlying organic rich Pennsylvanian shale was eroded from uplifted areas (Morgan, 1970). Oil and gas migration within overlying organic poor Cotton Valley and Lower Cretaceous strata could have occurred in the absence of structural traps. Cretaceous units which are organic rich in other areas of Mississippi are present in the subsurface of Newton County (Devery, 1982, page 16). The sequence of Cretaceous strata is relatively thin in comparison to areas south and west of Newton County which lie well within the Mississippi Salt Basin (Nunnally and Fowler, 1954, Plate 15). Several exploration wells have penetrated Jurassic and Cretaceous strata in Newton County; however, all known test wells drilled in Newton County were abandoned.

ECONOMIC GEOLOGY

Sand and Gravel

Fluvial-deltaic paleoenvironments deposited large quantities of terrigenous sand as delta systems prograded and aggraded between marine transgressions. Most of these sands are fine- to coarse-grained with minor amounts of gravel. The Citronelle Formation contains the largest amount of gravel; however, as Plate 1 illustrates, the areal distribution of this formation is limited. The main occurrence of the

Citronelle Formation is at Nance Hill in SW/4, Sec. 24, T.5N., R.10E., where the sandy gravel has been extensively quarried for local road construction and other construction uses. The main occurrences of sand are within the Meridian, Kosciusko, and Cockfield formations. The Cockfield Formation contains minor amounts of pea-size gravel in the vicinity of Newton. Many abandoned sandpits mark earlier quarrying activities in each of these sandy formations.

Clay

Clays and natural clay mixtures which occur in Newton County were examined in order to determine their mineralogy and physical properties. The results of these examinations are given in the Clay Mineralogy and Clay Tests Sections of this report. Samples from the Yazoo, Cook Mountain, and Zilpha formations contain varying amounts of montmorillonite and kaolinite. Cristobalite, clinoptilolite, and montmorillonite comprise the major clay constituents of the Tallahatta Formation. Lesser amounts of clinoptilolite were detected in the clays of the Cook Mountain and Yazoo formations. The Tallahatta Formation has been recognized for its zeolite bearing strata in Alabama and eastern Mississippi (Reynolds, 1970, 1984); however, the zeolite bearing strata are not as thick or continuous in Newton County, and economic potential is less favorable. Clays of the Basic City Shale Member in Alabama and eastern Mississippi give way westward to sandstones and siltstones which are prevalent in Newton County. This reflects the contrast between the quiet marine shelf depositional environments of Alabama and the energetic nearshore depositional environments present in Newton County at that time. Transportation and reworking of sediments in this more energetic nearshore environment, as well as dilution by terrigenous sediment input, would have destroyed the in situ conditions necessary in the formation of zeolite minerals from the volcanic parent material. The mineralogy and X-ray characteristics of Newton County clays are given in detail by Gann (Clay Section, this report). Results of structural evaluation of clay samples selected from Newton County, given by Liles and Heystek in the Clay Section of this report, indicate that some of the clays prevalent in the Yazoo and Cook Mountain formations are potentially useful in the manufacture of brick and lightweight aggregate. Clay from the Shubuta Clay Member of the Yazoo Formation has potential use in the manufacture of structural clay products. Tests on clay samples from the Zilpha Formation indicate that these clays have potential use in brick and lightweight aggregate production. Detailed local studies on any particular clay unit would necessarily precede its economic development.

Lignite

Carbonaceous shale intervals occur in delta plain sediments comprising upper portions of the Hatchetigbee, Kosciusko, and Cockfield formations. Intervals of carbonaceous sediments encountered in subsurface strata of Newton County in the course of this study contained thin beds and laminae of impure, argillaceous lignite, interbedded and interlaminated with sand. The main occurrences of lignitic sediments were observed in Test Hole A0-7, which penetrated 119 feet of Upper Cockfield strata containing occasional laminae and beds, less than 1 foot thick, of impure, argillaceous lignite. The thin and impure nature of these occasional lignite occurrences will probably not encourage their production as a commercial fuel in the near future. The Mississippi Mineral Resources Institute is presently continuing a statewide study of lignite occurrences. A test hole completed during that study, 1 mile northwest of Test Hole A0-7, penetrated 4 feet of thinly bedded lignite, with interbedded sand, silt, and clay.

Glauconite

The Winona Formation contains glauconite in concentrations frequently exceeding 60 percent. Unweathered exposures of Winona sediments are green in color due to high glauconite concentrations. Oxidation imparts a very dark red to maroon color to weathered outcrops. The maximum thickness of the Winona Formation encountered in the subsurface during the course of this study was 72 feet in Test Hole A0-1, and a minimum of 35 feet in Test Hole A0-14. Glauconite is common in other marine intervals of Eocene strata in Newton County, as low percentages (15 percent or less) occur in the Hatchetigbee, Tallahatta, Zilpha, Kosciusko, Cook Mountain, and Moodys Branch formations. Glauconite occurs as elongate rounded grains up to 2 millimeters in diameter, and upon weathering, produces ironstone layers characteristic of the Winona Formation in Newton County. These Winona ironstones comprised the first iron ore mined in the state. The ore was mined in neighboring Clarke County and smelted in Birmingham, Alabama (Bicker, 1970). Ironstone occurrences in the Winona Formation of Newton County are not of economic value as an ore. However, the glauconite enhances the fertility of soil as it weathers.

Oil and Gas

No oil or gas wells have been produced commercially in Newton County. A possible explanation for this is given in the Structural Geology Section of this report. All test wells drilled in Newton County to date were abandoned due to little or no hydrocarbon potential.

TEST HOLE RECORDS

The following are descriptions of cuttings and cores from test holes drilled during the geologic and mineralogic study of Newton County. These test holes are preceded by the prefix A0, as a code designation reserved for samples from Newton County. All the following described samples are catalogued and stored in the Bureau's sample library, where they are available for public observation.

A0-1

Location: Adjacent to pond behind house west of dirt road in NW/4, SE/4, SW/4, NW/4, Sec. 3, T.7N., R.11E.

Elevation: 485 feet (Topographic map)
Date: September 13, 1982

Purpose: Drilled 310 feet for stratigraphic information. Electrical log from 40 to 309 feet.

Depth	Thickness	Description
		Kosciusko Formation
40	40	Sand, grayish-brown, fine- to medium-grained, subangular quartz, silty, trace lignite.
90	50	Sand, grayish-orange, fine- to coarse-grained, subangular quartz, silty, clayey, trace dark minerals.
130	40	Sand, dark-gray to grayish-black, fine- to coarse-grained, subangular quartz, clayey, silty, micaceous, lignitic.
144	14	Sand, pale yellowish-brown, fine- to very coarse-grained, subangular quartz, clayey, silty, glauconitic, micaceous.
		Zilpha Formation
184	40	Silt, medium-gray to dark yellowish-brown, carbonaceous, clayey, glauconitic, micaceous, sandy.
		Winona Formation
256	72	Sand, light olive-gray to pale yellowish-brown, fine- to coarse-grained, subangular quartz, glauconitic, fossiliferous, silty, clayey; frequent indurated layers.
		Tallahatta Formation - Neshoba Sand Member
265	9	Sand, yellowish-gray, fine- to coarse-grained, subangular quartz, silty, micaceous.
		Tallahatta Formation - Basic City Shale Member
310	45	Sand, pale yellowish-brown, very fine- to very coarse-grained, subangular quartz, clayey, glauconitic.

A0-2

Location: Field adjacent to pond north of paved road in NW/4, SE/4, NE/4, NE/4, Sec. 22, T.7N., R.11E.

Elevation: 535 feet (Topographic map)
Date: September 22, 1982

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

Depth	Thickness	Description
		Cockfield Formation
49	49	Sand, dark yellowish-orange to dark yellowish-brown, very fine- to coarse-grained, subangular quartz, silty, clayey, trace lignite.
		Cook Mountain Formation - Gordon Creek Shale Member
61	12	Silt, dark yellowish-brown, carbonaceous, clayey, glauconitic, micaceous, sandy.
		Cook Mountain Formation - Potterchitto Member
96	35	Sand, pale yellowish-brown, very fine- to coarse-grained, subangular quartz, fossiliferous, silty, clayey, glauconitic.
		Kosciusko Formation
148	52	Silt, grayish-brown, clayey, sandy, carbonaceous, trace lignite.
256	108	Sand, pale- to dark yellowish-brown, fine- to coarse-grained, subangular to subrounded quartz, carbona-

Depth	Thickness	Description
		ceous, silty, clayey, micaceous, trace lignite; glauconitic at base.
		Zilpha Formation
296	40	Silt, dark yellowish-brown, carbonaceous, clayey, micaceous.
		Winona Formation
310	14	Sand, pale yellowish-brown, fine- to medium-grained, subangular quartz, glauconitic, fossiliferous, silty, clayey, micaceous.

A0-3

Location: West of dirt road in NW/4, SW/4, NE/4, NW/4, Sec. 12, T.8N., R.13E.

Elevation: 600 feet (Topographic map)
Date: September 24, 1982

Purpose: Drilled 270 feet for stratigraphic information. Electrical log from 10 to 270 feet.

Depth	Thickness	Description
		Tallahatta Formation - Basic City Shale Member
48	48	Silt, light- to very-light gray, clayey, glauconitic, sandy, micaceous; frequent thin indurated layers.
		Meridian Sand
76	28	Sand, very light-gray, fine- to coarse-grained, subangular quartz, silty, micaceous.
		Hatchetigbee Formation
100	24	Silt, pale yellowish-brown, clayey, sandy, micaceous, carbonaceous.
110	10	Sand, light-gray, very fine- to medium-grained, subangular quartz, silty; thin indurated layers.
130	20	Silt, light-gray, clayey, sandy, lignitic, micaceous.
250	120	Silt, medium-gray, sandy, clayey, lignitic, micaceous, glauconitic; thin indurated layers.
270	20	Sand, medium-gray, very fine- to medium-grained, subangular quartz, silty, carbonaceous.

A0-4

Location: Behind barn on west side of dirt road in SE/4, SE/4, Sec. 4. T.8N., R.10E.

Elevation: 490 feet (Topographic map)
Date: October 12, 1982

Purpose: Drilled 110 feet for stratigraphic information.

Depth	Thickness	Description
		Kosciusko Formation
40	40	Sand, pinkish-gray, fine-grained, well-sorted, subangular quartz, micaceous, trace dark minerals.
110	70	Sand, pinkish-gray, fine- to medium-grained, subangular quartz, trace dark minerals.

A0-5

Location: Southeast of pond on south side of paved road in NE/4, SE/4, SW/4, NE/4, Sec. 5, T.8N., R.12E.

Elevation: 525 feet (Topographic map)
Date: October 20, 1982

Purpose: Drilled 270 feet for stratigraphic information. Electrical log from 20 to 270 feet.

Depth	Thickness	Description
		Zilpha Formation
8	8	Clay, greenish-red, silty, glauconitic, micaceous, sandy; ironstone layer at base.
		Winona Formation
63	55	Sand, light-brown to pale yellowish-orange, medium- to coarse-grained, subrounded quartz, glauconitic, micaceous, sparsely fossiliferous; frequent thin, well-lithified layers.
		Tallahatta Formation - Neshoba Sand Member
75	12	Sand, pale yellowish-brown, fine- to medium-grained, subrounded quartz, micaceous, trace dark minerals.

Depth	Thickness	Description
		Tallahatta Formation - Basic City Shale Member
90	15	Silt, pale yellowish-brown, clayey, sandy, glauconitic, micaceous.
110	20	Clay, pale yellowish-brown, shaly, sandy, silty, glauconitic, thinly interbedded with sand.
158	48	Silt, pale yellowish-brown, sandy, clayey, glauconitic, micaceous.
		Meridian Sand
169	11	Sand, pale yellowish-brown, fine- to medium-grained, subangular quartz, micaceous.
		Hatchetigbee Formation
190	21	Sand, dark yellowish-brown, very fine- to medium-grained, subangular quartz, silty, carbonaceous, micaceous.
270	80	Sand, pale yellowish-brown, very fine- to fine-grained, clayey, silty, micaceous, carbonaceous, trace lignite.

A0-6

Location: Gravel pit on Nance Hill, in NW/4, SE/4, NE/4, SW/4, Sec. 24, T.5N., R.10E.

Elevation: 540 feet (Topographic map)
Date: October 21, 1982

Purpose: Drilled 60 feet for stratigraphic information. No electrical log.

Depth	Thickness	Description
		Citronelle Formation
60	60	Gravel, moderate orange-pink, very well-rounded, sandy, quartzitic, cherty, trace opal and agate; lithified bed at base.

A0-7

Location: Adjacent to pond in NW/4, SE/4, NW/4, Sec. 24, T.5N., R.10E.

Elevation: 475 feet (Topographic map)
Date: November 9, 1982

Purpose: Drilled 370 feet for stratigraphic information. Electrical log from 16 to 368 feet.

Depth	Thickness	Description
		Yazoo Formation - North Twistwood Creek Clay Member
38	38	Clay, very light-gray, silty, sandy, calcareous, sparingly fossiliferous.
		Moodys Branch Formation
53	15	Sand, light-gray, very coarse-grained, fossiliferous, glauconitic; sample recovered comprised of fossil shells with traces of quartz sand and glauconite.
		Cockfield Formation
172	119	Silt, dark- to medium-gray, shaly, sandy, lignitic, micaceous.
226	54	Sand, medium light-gray, very fine- to medium-grained, subrounded quartz, silty, micaceous, carbonaceous.
		Cook Mountain Formation - Gordon Creek Shale Member
264	38	Silt, medium light-gray, sandy, clayey, glauconitic, micaceous, carbonaceous, sparingly fossiliferous.
		Cook Mountain Formation - Potterchitto Member
336	72	Sand, light-gray, very fine- to medium-grained, subangular quartz, clayey, calcareous, fossiliferous, glauconitic.
		Kosciusko Formation
370	34	Sand, light-gray, very fine- to medium-grained, subangular quartz, silty, clayey, trace lignite and sulfides.

A0-8

Location: West side of dirt road in SE/4, NW/4, NW/4, Sec. 2, T.7N., R.13E.

Elevation: 510 feet (Topographic map)
Date: November 16, 1982

Purpose: Drilled 150 feet for stratigraphic information. Electrical log from 16 to 148 feet.

Depth	Thickness	Description
		Tallahatta Formation - Basic City Shale Member
10	10	Claystone, very light-gray, silty, sandy, glauconitic, micaceous; thinly interbedded with nonlithified layers.
63	53	Siltstone, light-gray, sandy, clayey, micaceous, glauconitic, thinly interbedded with nonlithified layers
		Meridian Sand
72	9	Sand, grayish-orange, coarse-grained, very well-sorted, subrounded quartz, micaceous, trace dark minerals.
		Hatchetigbee Formation
90	18	Sand, medium dark-gray, very fine- to coarse-grained, subrounded quartz, silty, clayey, carbonaceous, micaceous.
150	60	Sand, medium- to dark-gray, very fine- to medium-grained, subrounded quartz, silty, clayey, micaceous, glauconitic, trace lignite.

A0-9

Location: West side of dirt road in SW/4, NW/4, SE/4, Sec. 21, T.7N., R.13E.

Elevation: 440 feet (Topographic map)
Date: June 17, 1983

Purpose: Drilled 160 feet for stratigraphic information. Electrical log from 15 to 157 feet.

Depth	Thickness	Description
		Tallahatta Formation - Neshoba Sand Member
15	15	Sand, dark yellowish-orange, medium-grained, very well-sorted, subangular quartz, trace dark minerals.
		Tallahatta Formation - Basic City Shale Member
30	15	Sand, dark-gray, very fine- to medium-grained, subangular to subrounded quartz, silty, micaceous, glauconitic, carbonaceous.
100	70	Silt, medium light-gray, clayey, sandy, micaceous.
118	18	Sand, medium light-gray, very fine- to medium-grained, subangular quartz, clayey, glauconitic, micaceous.
		Meridian Sand
148	30	Sand, medium-gray, very fine- to medium-grained, silty, clayey, micaceous, trace glauconite.
		Hatchetigbee Formation
160	12	Silt, medium light-gray, sandy, clayey, subangular quartz, micaceous, carbonaceous, trace lignite.

A0-10

Location: East side of dirt road in NE/4, SE/4, SW/4, Sec. 33, T.7N., R.13E.

Elevation: 460 feet (Topographic map)
Date: June 8, 1983

Purpose: Drilled 320 feet for stratigraphic information. Electrical log from 30 to 320 feet.

Depth	Thickness	Description
		Kosciusko Formation
20	20	Sand, light-brown, medium-grained, very well-sorted, subangular quartz, trace dark minerals.
34	14	Sand, dark-gray, fine- to medium-grained, subangular quartz, clayey, silty, glauconitic, micaceous.
		Zilpha Formation
48	14	Silt, grayish-brown, clayey, carbonaceous.
		Winona Formation
80	32	Sand, light olive-gray, very fine- to medium-grained, subrounded quartz, glauconitic, calcareous, fossiliferous, silty, clayey.
92	12	Sand, dark greenish-yellow, medium- to coarse-grained, subrounded quartz, glauconitic, calcareous, sparingly fossiliferous.

Depth	Thickness	Description
		Tallahatta Formation - Neshoba Sand Member
105	13	Sand, medium-gray, very fine- to medium-grained, subrounded quartz, micaceous.
		Tallahatta Formation - Basic City Shale Member
130	25	Silt, medium-gray, sandy, clayey, glauconitic, micaceous.
202	72	Sand, light- to very light-gray, very fine- to medium-grained, subrounded quartz, silty, clayey, micaceous; frequent thin lithified layers.
		Meridian Sand
220	18	Sand, medium light-gray, very fine- to fine-grained, subrounded to subangular quartz, silty, micaceous.
239	19	Sand, medium dark-gray, very fine- to medium-grained, subrounded quartz, silty, micaceous.
		Hatchetigbee Formation
250	11	Silt, dark-gray, clayey, sandy, glauconitic, micaceous, trace lignite.
290	40	Sand, light-gray, very fine- to medium-grained, subrounded quartz, silty, clayey, glauconitic, micaceous.
320	30	Sand, medium light-gray, very fine- to very coarse-grained, subrounded quartz, silty, clayey, micaceous.

A0-11

Location: Immediately south of Highway 80 Chunky River bridge, on Chunky River flood plain, east side of river, in SE/4, SW/4, SE/4, Sec. 25, T.6N., R.13E.

Elevation: 295 feet (Topographic map)
Date: June 9, 1983

Purpose: Drilled 170 feet for stratigraphic information. Electrical log from 10 to 170 feet.

Depth	Thickness	Description
		Alluvium
16	16	Sand, yellowish-gray, medium- to coarse-grained, subangular quartz, silty, trace dark minerals.
		Tallahatta Formation - Basic City Shale Member
40	24	Silt, light-gray, sandy, clayey, micaceous, glauconitic; frequent thin, well-lithified layers.
65	25	Sand, light-gray, very fine- to coarse-grained, subrounded quartz, silty, clayey, glauconitic, micaceous.
		Meridian Sand
96	31	Sand, light- to medium light-gray, fine- to coarse-grained, subangular to subrounded quartz, micaceous, glauconitic, carbonaceous.
		Hatchetigbee Formation
110	14	Sand, light-gray, very fine- to coarse-grained, subangular quartz, silty, micaceous, carbonaceous.
120	10	Silt, light-gray, clayey, sandy, micaceous.
170	50	Sand, light-gray, very fine- to coarse-grained, subangular quartz, silty, micaceous, glauconitic, trace dark minerals.

A0-12

Location: West side of dirt road in SW/4, NE/4, SE/4, Sec. 18, T.5N., R.13E.

Elevation: 480 feet (Topographic map)
Date: June 14, 1983

Purpose: Drilled 310 feet for stratigraphic information. No electrical log.

Depth	Thickness	Description
		Cockfield Formation
35	35	Sand, moderate reddish-brown, very fine- to medium-grained, subangular quartz, silty, limonitic toward base.
		Cook Mountain Formation - Gordon Creek Shale Member
50	15	Sand, medium light-gray, very fine- to fine-grained, subangular quartz, clayey, silty, glauconitic.

		Cook Mountain Formation - Potterchitto Member
70	20	Sand, light-gray, medium- to coarse-grained, subangular quartz, silty, calcareous, fossiliferous, glauconitic, micaceous.
118	48	Sand, light-gray, very fine- to medium-grained, subangular to subrounded quartz, silty, calcareous, fossiliferous, glauconitic, micaceous.
		Kosciusko Formation
180	62	Sand, brownish-gray, very fine- to fine-grained, subangular quartz, silty, clayey, small amounts of lignite.
275	95	Sand, light brownish-gray to light-gray, fine- to very coarse-grained, subangular to subrounded quartz, micaceous, glauconitic at base.
		Zilpha Formation
290	15	Silt, brownish-gray, clayey, carbonaceous, micaceous.
		Winona Formation
310	20	Sand, light olive-gray, very fine- to coarse-grained, subangular quartz, silty, glauconitic, calcareous, fossiliferous, thin lithified layers.

A0-13

Location: North side of dirt road in SE/4, NW/4, NE/4, Sec. 10, T.5N., R.13E.

Elevation: 360 feet (Topographic map)
Date: June 16, 1983

Purpose: Drilled 160 feet for stratigraphic information. Electrical log from 40 to 160 feet.

Depth	Thickness	Description
		Kosciusko Formation
60	60	Sand, pale yellowish-brown to medium light-gray, fine- to medium-grained, subangular quartz, silty, glauconitic, micaceous, trace dark minerals.
76	16	Sand, light olive-gray, fine- to very coarse-grained, subrounded to subangular quartz, glauconitic, micaceous; highly glauconitic toward base.
		Zilpha Formation
88	12	Silt, medium light-gray, sandy, clayey, carbonaceous, micaceous, glauconitic.
		Winona Formation
120	32	Sand, light olive-gray, fine- to medium-grained, subangular to subrounded quartz, silty, fossiliferous, glauconitic, frequent lithified layers.
145	25	Sand, greenish-gray, very fine- to medium-grained, subrounded quartz, silty, fossiliferous, glauconitic, micaceous.
		Tallahatta Formation - Neshoba Sand Member
154	9	Sand, medium light-gray, very fine- to coarse-grained, subrounded quartz, micaceous.
		Tallahatta Formation - Basic City Shale Member
160	6	Sand, light-gray, very fine- to medium-grained, subrounded quartz, silty, clayey, glauconitic, micaceous.

A0-14

Location: East side of dirt road in NE/4, NW/4, SE/4, Sec. 22, T.5N., R.13E.

Elevation: 440 feet (Topographic map)
Date: June 30, 1983

Purpose: Drilled 340 feet for stratigraphic information. Electrical log from 0 to 336 feet.

Depth	Thickness	Description
		Cook Mountain Formation - Potterchitto Member
34	34	Sand, moderate- to pale reddish-brown, fine- to medium-grained, subangular quartz, silty, fossiliferous, glauconitic, micaceous.
		Kosciusko Formation
120	86	Sand, grayish-brown, very fine- to medium-grained, subangular quartz, silty, clayey,

		carbonaceous, micaceous, trace lignite.
170	50	Sand, moderate- to dusky yellowish-brown, very fine- to coarse-grained, subangular quartz, silty, clayey, carbonaceous, micaceous.
194	24	Sand, olive-gray, very fine- to coarse-grained, subrounded quartz, silty, clayey, glauconitic, micaceous, carbonaceous.
		Zilpha Formation
215	21	Sand, dark yellowish-brown, very fine- to fine-grained, subangular quartz, silty, clayey, carbonaceous, micaceous, glauconitic.
		Winona Formation
250	35	Sand, pale- to dark yellowish-brown, very fine- to coarse-grained, subangular quartz, silty, glauconitic, fossiliferous, micaceous; frequent thin lithified layers.
		Tallahatta Formation - Neshoba Sand Member
259	9	Sand, pale yellowish-brown, very fine- to coarse-grained, subangular to subrounded quartz, micaceous.
		Tallahatta Formation - Basic City Shale Member
290	31	Sand, pale-brown, very fine- to coarse-grained, subrounded quartz, fossiliferous, glauconitic, micaceous, carbonaceous; frequent thin lithified layers.
340	50	Sand, pale yellowish-brown, very fine- to medium-grained, subrounded quartz, silty, clayey, glauconitic, carbonaceous, fossiliferous.

A0-15

Location: West side of dirt road in NE/4, NE/4, SW/4, Sec. 35, T.5N., R.13E.

Elevation: 410 feet (Topographic map)
Date: July 6, 1983

Purpose: Drilled 300 feet for stratigraphic information. Electrical log from 18 to 300 feet.

Depth	Thickness	Description
		Cook Mountain Formation - Potterchitto Member
30	30	Sand, moderate yellowish-brown, very fine- to medium-grained, subangular quartz, silty, clayey, fossiliferous, glauconitic, micaceous.
78	48	Sand, medium- to very light-gray, very fine- to medium-grained, subangular quartz, silty, fossiliferous, glauconitic, carbonaceous, micaceous.
		Kosciusko Formation
156	78	Silt, pale-brown, clayey, sandy, carbonaceous, micaceous, trace lignite.
182	26	Sand, pale-brown, very fine- to medium-grained, subangular quartz, silty, clayey, carbonaceous, micaceous, trace lignite.
214	32	Sand, light olive-gray, very fine- to very coarse-grained, subangular quartz, silty, clayey, glauconitic, carbonaceous, micaceous; glauconite content increases toward bottom.
		Zilpha Formation
230	16	Silt, pale-brown, sandy, clayey, carbonaceous, micaceous, glauconitic.
		Winona Formation
268	38	Sand, medium light-gray, very fine- to very coarse-grained, subrounded quartz, silty, glauconitic, fossiliferous; occasional thin lithified layers.
		Tallahatta Formation - Neshoba Sand Member
276	8	Sand, light-gray, very fine- to coarse-grained, subangular to subrounded quartz, silty, micaceous.
		Tallahatta Formation - Basic City Shale Member
300	24	Sand, light-gray, very fine- to coarse-grained, subangular quartz, silty, clayey, glauconitic, carbonaceous, micaceous; occasional thin lithified layers.

A0-16

Location: West side of dirt road in SE/4, SE/4, NW/4, Sec. 30, T.5N., R.13E.

Elevation: 410 feet (Topographic map)
Date: July 8, 1983

Purpose: Drilled 150 feet for stratigraphic information. Electrical log from 0 to 150.

Depth	Thickness	Description
		Cockfield Formation
18	18	Sand, light-brown, very fine- to coarse-grained, subangular quartz, silty, clayey.
		Cook Mountain Formation - Gordon Creek Shale Member
43	25	Sand, pale- to moderate yellowish-brown, very fine- to fine-grained, subangular quartz, clayey, silty, glauconitic, carbonaceous, micaceous.
		Cook Mountain Formation - Potterchitto Member
60	17	Sand, pale yellowish-brown, very fine- to medium-grained, subangular quartz, silty, fossiliferous, glauconitic, micaceous.
121	61	Sand, grayish-brown, very fine- to medium-grained, subangular quartz, silty, clayey, fossiliferous, glauconitic, micaceous, carbonaceous.
		Kosciusko Formation
150	29	Silt, dark-gray, clayey, sandy, glauconitic, carbonaceous, micaceous.

A0-17

Location: Eastern edge of pasture in SW/4, SW/4, SW/4, Sec. 32, T.8N., R.12E.

Elevation: 490 feet (Topographic map)
Date: July 26, 1983

Purpose: Drilled 270 feet for stratigraphic information. Electrical log from 0 to 265 feet.

Depth	Thickness	Description
		Kosciusko Formation
78	78	Sand, dark- to pale yellowish-orange, fine- to medium-grained, subrounded quartz, micaceous; trace amounts of lignite and dark minerals.
		Zilpha Formation
98	20	Silt, dusky yellowish-brown, clayey, shaly, glauconitic, carbonaceous.
		Winona Formation
130	32	Sand, pale yellowish-brown, very fine- to medium-grained, subangular quartz, silty, clayey, calcareous, fossiliferous, micaceous; frequent thin indurated layers.
150	20	Sand, light olive-gray, fine- to medium-grained, subangular quartz, glauconitic, fossiliferous, micaceous.
		Tallahatta Formation - Neshoba Sand Member
162	12	Sand, light-gray, medium- to coarse-grained, well-sorted, subangular quartz, micaceous, glauconitic.
		Tallahatta Formation - Basic City Shale Member
180	18	Sand, light-gray, very fine- to coarse-grained, subangular quartz, silty, glauconitic, carbonaceous, micaceous.
210	30	Silt, light-gray, clayey, sandy, glauconitic, micaceous; occasional thin indurated layers.
270	60	Sand, light-gray, very fine- to coarse-grained, subangular quartz, glauconitic, micaceous, carbonaceous.

A0-18

Location: West side of dirt road in NE/4, SE/4, SW/4, Sec. 18, T.8N., R.13E.

Elevation: 520 feet (Topographic map)
Date: July 28, 1983

Purpose: Drilled 210 feet for stratigraphic information. Electrical log from 0 to 206 feet.

Depth	Thickness	Description
		Winona Formation
18	18	Sand, moderate reddish-brown, very fine- to very

Depth	Thickness	Description
		coarse-grained, subangular quartz, silty, glauconitic.
		Tallahatta Formation - Neshoba Sand Member
32	14	Sand, grayish-orange, fine- to very coarse-grained, subangular quartz, silty, glauconitic; thin ironstone layer at base.
		Tallahatta Formation - Basic City Shale Member
70	38	Sand, light-gray, very fine- to medium-grained, subangular quartz, silty, clayey, glauconitic, micaceous.
140	70	Silt, light- to medium dark-gray, subangular quartz, sandy, clayey, glauconitic, micaceous; occasional thin lithified layers.
		Meridian Sand
154	14	Sand, light brownish-gray, fine- to medium-grained, subangular quartz, silty, clayey, micaceous; thin lithified layer at base.
		Hatchetigbee Formation
210	56	Sand, medium light-gray, very fine- to fine-grained, subangular quartz, silty, clayey, micaceous, carbonaceous, glauconitic; occasional thin lithified layers.

A0-19

Location: West side of logging road in NE/4, SW/4, NE/4, Sec. 3, T.8N., R.13E.

Elevation: 610 feet (Topographic map)
Date: August 4, 1983

Purpose: Drilled 160 feet for stratigraphic information. Electrical log from 0 to 149 feet.

Depth	Thickness	Description
		Citronelle Formation
32	32	Sand, dark yellowish-orange, fine- to very coarse-grained, subangular quartz; well lithified quartz-chert pebble conglomerate at base.
		Tallahatta Formation - Basic City Shale Member
104	72	Sand, light-gray, very fine- to fine-grained, subangular quartz, silty, clayey, glauconitic, micaceous, carbonaceous; occasional thin lithified layers.
		Meridian Sand
138	34	Sand, light brownish- to light-gray, very fine- to coarse-grained, subangular quartz, micaceous.
		Hatchetigbee Formation
160	22	Sand, medium- to dark-gray, very fine- to medium-grained, subangular quartz, silty, clayey, carbonaceous, micaceous, glauconitic; occasional thin lithified layers.

A0-20

Location: West side of dirt road in NW/4, NW/4, SW/4, Sec. 22, T.8N., R.13E.

Elevation: 450 feet (Topographic map)
Date: November 29, 1983

Purpose: Drilled 100 feet for stratigraphic information. Electrical log from 0 to 99 feet.

Depth	Thickness	Description
		Meridian Sand
18	18	Sand, light-brown, fine- to medium-grained, subangular quartz, trace dark minerals.
		Hatchetigbee Formation
30	12	Sand, moderate orange-pink, very fine- to coarse-grained, subangular quartz, silty, clayey, micaceous.
100	70	Silt, medium dark-gray, clayey, sandy, micaceous, carbonaceous.

A0-21

Location: North side of logging road in NE/4, SW/4, SW/4, Sec. 6, T.6N., R.12E.

Elevation: 435 feet (Topographic map)
Date: December 15, 1983

Purpose: Drilled 190 feet for stratigraphic information. Electrical log from 0 to 182 feet.

Depth	Thickness	Description
		Cook Mountain Formation - Potterchitto Member
24	24	Sand, pale yellowish-brown, subangular quartz, silty, glauconitic, micaceous, fossiliferous; lithified layer at base.
		Kosciusko Formation
50	26	Silt, dusky-brown, clayey, sandy, carbonaceous, micaceous, glauconitic.
190	140	Sand, very pale-orange, medium- to coarse-grained, subrounded to subangular quartz, silty, micaceous.

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THE BUREAU OF MINES TEST PROGRAM FOR CLAY AND CERAMIC RAW MATERIALS

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INTRODUCTION

Since 1938, the Federal Bureau of Mines has carried on a test program for ceramic raw materials. The program was initiated at the Bureau's former Norris, Tennessee, Laboratory and, since 1966, has been continued at the Tuscaloosa Research Center in Tuscaloosa, Alabama. As a result of this program, many thousands of samples of raw materials have been evaluated. The bulk of these samples has been received through cooperative agreements with approximately 30 states.

The objective of the Bureau program is to evaluate domestic clays, shales, and other ceramic raw materials to improve the utilization and conservation of the Nation's mineral raw materials. Further objectives include developing and improving the test methods used to evaluate ceramic raw materials.

TESTING AND EVALUATION

The program at the Tuscaloosa Research Center is divided into three distinct phases: (1) preliminary ceramic testing, wherein each sample is evaluated for general properties; (2) extended ceramic testing, which is conducted on those samples that show promise in preliminary tests; and (3) miscellaneous tests, which are special tests specifically requested by the submitting agency.

PRELIMINARY CERAMIC TESTING

About 20 lb (9 kg) of each clay is needed for testing. A smaller quantity, about 2 lb (1 kg), can be tested; however, if the preliminary tests are promising, additional material would be required for extended testing. All incoming samples are recorded in an individual state log with the sender's identification code, the date received, and a series number assigned by the Tuscaloosa Research Center.

If necessary, the sample is dried at 105° C, then crushed by roll crusher to pass 3/4-inch (2-cm) mesh. Pieces of 3/4-inch (2-cm) material are then picked at random for quick-firing. The remaining material is then split by riffling to obtain a representative 2-lb (1-kg) sample, which is crushed to pass 20 mesh. About 1 lb (0.5 kg) of the crushed material is blended with incremental additions of water. From the mixed material, six individual 1- by 2- by 3/8-inch (2.5- by 5- by 1-cm) briquets are extruded in a laboratory-size hydraulic ram press. The amount of water required to form the samples is recorded as the "water of plasticity." Shrinkage marks (always a standard distance apart) are applied to the briquets, which are then air-dried for 24 hours, and oven dried at 110° C for an additional 24 hours. Linear shrinkage is determined by measuring the reduction in the space between the shrinkage marks, and dry strength is determined by visual inspection as "good," "fair," or "poor." One of the six briquets is then fired, using a 24-hour cycle, to a temperature of 1,000° C, which is maintained for 1 hour. The briquet is allowed to cool in the kiln. The procedure is repeated for the five remaining briquets, each at one of the following temperatures: 1,050°, 1,100°, 1,150°, 1,200°, or 1,250° C. After cooling, the linear shrinkages are determined for each firing temperature. The briquets are weighed, then covered with water and boiled for 5 hours. The soaked briquets are reweighed, first in air, and then immersed in water. From the three weights obtained on each briquet, the percent absorption, percent apparent porosity, and bulk density are calculated.

Each briquet is redried at 105° C. and Moh's hardness is determined. Next, the color of each briquet is classified using the Munsell System (Kollomorgan Corporation, 1973; ASTM specification D1535-68, American Society for Testing and Materials, 1975). Finally, the briquets are mounted on a display card and given to the submitting agency.

During the preliminary testing, an additional sample of the minus 20-mesh material is processed to determine pH and degree of effervescence. In this test 10 g of the sample are mixed with 100 ml of distilled water and the pH of the slurry is determined. Subsequently, 10 ml of concentrated reagent-grade hydrochloric acid is added to the slurry to visually assess the degree of effervescence as "none," "slight," or "high."

All data are recorded on a standard report form. Recommendations and comments that are made on the preliminary evaluation form are based on American Society for Testing and Materials (ASTM) specifications (American Society for Testing Materials, 1976). The evaluation of a sample is made solely on its own properties and does not preclude the use of the material in mixes.

A quick-fire test to determine the bloating characteristics of each sample for its possible use as lightweight aggregate is generally conducted concurrently with the briquet-testing procedure. The small, 3/4-inch (2-cm) pieces of the sample initially picked at random from the total sample are dried at 110° C, then placed in a small refractory boat, which in turn is placed in a kiln preheated to 1,100° C. If the sample shows any degree of expansion, additional tests are made over a complete range of temperatures (usually 1,000° to 1,250° C) to determine the optimum expansion temperature. After firing, the expanded samples are cooled, weighed, and allowed to soak in water for 24 hours. The weight of the sample while suspended in water is determined. The sample is also weighed in air after being patted dry to remove excess surface water. From this data, the percent absorption and bulk density are calculated. On the preliminary evaluation form, a notation is made as to whether the sample has positive or negative bloating characteristics. When positive (expansion occurs), the data are included on the preliminary ceramic test report form.

EXTENDED CERAMIC TESTING

A sample is generally subjected to extended testing only if it displays superior qualities in the preliminary tests or if it is specifically requested by the submitting agency. Extended evaluation encompasses one of the following tests:

1. Extrusion of plastic clays - This test is made on those samples that are plastic in nature and have a long firing range, as determined in preliminary tests.

2. Dry-pressing - Dry-pressing is only performed on those samples that have low plasticity, but have a long firing range.

Extrusion

When a sample exhibits plasticity and a long firing range in the preliminary tests, approximately 15 lb (7 kg) of the original material is crushed to pass an 8-mesh screen, mixed with enough water to reach the plastic state, and extruded in a Fate-Root-Heath Type PX-3 de-airing extrusion machine. (Reference to a specific brand or trade name is made for identification only and endorsement by the Bureau of Mines is not implied). Generally, twenty 1- by 1- by 6-inch (2.5- by 2.5- by 15-cm) test bars are extruded and fired to the best temperature as established during the preliminary firing tests. Usually only 10 of the bars are used for testing, with the remainder provided to the agency submitting the sample for its evaluation or use. Data such as dry and fired shrinkage, dry and fired modulus of rupture, and the saturation coefficient (24-hour absorption of water divided by 5-hour absorption) are determined and recorded on a standard form.

Dry-Pressing

Many clays show potential for use in making structural clay products but are somewhat nonplastic and cannot be extruded. For extended testing, such samples are dry-pressed rather than extruded. In dry-pressing, the sample is crushed to pass an 8-mesh screen and about 5 to 6 pct water is added to moisten the clay particles. A weighed amount of the moistened sample is then placed in a die and pressed at approximately 1,250 psi. Normally, 20 brick having the dimensions 1-3/4 by 3-1/2 by approximately 1 inch (4.5 by 9 by 2.5 cm) are pressed; about 10 are used for testing. Tests are then made to determine properties such as fired compressive strength and the saturation coefficient.

MISCELLANEOUS TESTS

Tests included in this category further identify potential uses of the sample submitted. These tests are usually specifically requested by the submitting agency. Data from these tests are recorded on a standard form or reported directly to the submitting agency by letter or memorandum report.

Pyrometric Cone Equivalent (PCE)

A PCE test is normally made on samples that show potential as a refactory material. Generally samples that show low shrinkage, high absorption, and a light color at the highest firing temperature in the preliminary tests are further tested for their refractory properties. Test cones are made from the sample and are compared with standard cones in accordance with ASTM test method C24-72 (American Society for Testing and Materials, 1974). A sample is generally classified as a low-duty fire clay if it has a PCE of 15 to 28; as medium duty when its PCE varies between 29 and 31; and high duty if it has a PCE of 31-1/2 to 32. With a PCE of 33 or higher, a clay is rated as a super-duty fire clay. The data are reported on the standard preliminary ceramic data form under "Other Tests."

Absorbency Test

Clays that are submitted for determining their potential as oil and water absorbents are tested according to Federal Specification P-A-1056B, Absorbent Materials, Oil and Water (for floors and decks), dated February 24, 1976. The test is comprised of three parts wherein the absorption of lubricating oil, absorption of distilled water, and solubility of the clay in distilled water are determined. Absorption is reported on a standard form, as milliliters of oil or water per gram of sample. Minimums of 0.6 and 0.7 ml/g are required to meet Federal oil and water absorbency specifications, respectively.

Foundry Bond Test

To evaluate or characterize a clay for potential use as binder for molding sands for foundries, green-compression and dry-compression strengths of clay-bonded sand samples are determined. There are no specific reported strength specifications because the desired industrial properties vary with the metal being cast, the size of the castings, and the actual practice in each individual foundry. Consequently, evaluation is based on comparing values obtained on two commercially acceptable foundry clays (a Wyoming bentonite and a Southern bentonite) to that of the clays being tested.

Drilling Mud Test

The American Petroleum Institute (API) Specification 13A (American Petroleum Institute, 1974) is used to evaluate a clay exhibiting swelling or gelling properties. Two tests, namely viscosity and grit content (sections 3.4 and 3.5, respectively) are generally used to determine the potential of a clay sample for use as a drilling mud.

Pelletizing Test (Plate Water Absorption Test)

A major and growing application for clays and bonding characteristics is the pelletizing or agglomeration of fine ores such as taconite iron ore. In most cases, fine iron ores are processed in a blast furnace only after they are pelletized. The samples are first tested by a Marsh funnel. It is preferred that the clay slurry take 20 seconds to pass through the funnel before proceeding with the pelletizing test. Clays currently used in industry take from 20.5 to 33 seconds to pass through the funnel. To evaluate pelletizing potential, the absorption characteristics of the samples are compared to that of a clay that is currently in use in industry. Using those samples that take longer than 20 seconds in the Marsh funnel, the amount of water absorbed over an 18 hour period by a 2 g sample is determined gravimetrically. The test relates to the effectiveness of the clay sample on the quality of moist iron ore balls prepared for heat-hardening into pellets.

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Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-1

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 1 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 53.5 Working Properties Plastic

Color Brown Drying shrinkage, percent 12.5 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	5 YR 7/8	5	15.0	16.0	29.0	1.81
1,050	5 YR 6/10	5	17.5	13.9	26.1	1.88
1,100	5 YR 6/8	5	20.0	7.2	15.5	2.14
1,150	5 YR 5/6	5	20.0	5.4	12.0	2.21
1,200	5 YR 4/6	5	20.0	3.6	8.2	2.26
1,250	5 YR 4/4	5	20.0	3.4	7.6	2.26

pH 5.4 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft³)	Remarks

Potential Use Not suitable for structural products. High shrinkage.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-2

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 2 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 64.9 Working Properties Plastic

Color Brown Drying shrinkage, percent 10.0 Dry Strength Good

Slow firing test:

Temp. °C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	7.5 YR 8/4	3	12.5	37.0	48.4	1.31
1,050	7.5 YR 7/6	3	15.0	28.7	42.1	1.47
1,100	5 YR 6/8	4	22.5	12.8	24.0	1.87
1,150	5 YR 5/8	5	22.5	10.5	20.3	1.94
1,200	5 YR 4/4	5	25.0	3.6	7.8	2.13
1,250	-	-	Melted	-	-	-

pH 5.3 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. °C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Not suitable for structural products. High shrinkage.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-3

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 3 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 52.5 Working Properties Plastic

Color Brown Drying shrinkage, percent 15.0 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	10 YR 8/6	3	15.0	17.7	30.6	1.73
1,050	10 YR 8/6	4	15.0	15.9	28.4	1.79
1,100	7.5 YR 7/6	4	20.0	10.1	20.2	2.01
1,150	7.5 YR 6/6	4	20.0	9.0	18.5	2.06
1,200	7.5 YR 6/4	6	20.0	6.8	14.5	2.13
1,250	7.5 YR 6/2	6	20.0	4.7	10.3	2.19

pH 5.0 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Not suitable for structural products. High shrinkage.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-4

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 4 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 62.5 Working Properties Plastic

Color Brown Drying shrinkage, percent 17.5 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	5 YR 7/6	4	20.0	12.0	22.4	1.87
1,050	5 YR 6/8	4	22.5	9.9	19.7	1.99
1,100	5 YR 5/8	5	25.0	5.9	13.0	2.20
1,150	5 YR 5/6	5	25.0	4.7	10.6	2.23
1,200	5 YR 4/6	5	25.0	4.5	10.0	2.24
1,250	5 YR 4/4	5	25.0	2.8	6.3	2.27

pH 4.6 HCL Effervescence None Other tests --

Preliminary Bloating Test: Positive

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks
1,100	12.0	1.49 (93.0)	Slight expansion
1,150	15.9	1.40 (87.4)	Slight expansion
1,200	12.0	1.29 (80.5)	Partial expansion
1,250	11.7	.97 (60.5)	Good pore structure

Potential Use Not suitable for structural products. High shrinkage. Marginal for lightweight aggregate (1,250° C). Short firing range.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-5

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 5 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 50.6 Working Properties Plastic

Color Tan Drying shrinkage, percent 2.5 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	7.5 YR 8/6	3	5.0	44.1	51.1	1.16
1,050	7.5 YR 8/6	3	5.0	42.9	50.5	1.18
1,100	7.5 YR 8/6	3	5.0	41.5	49.6	1.19
1,150	5 YR 7/8	3	7.5	40.3	48.8	1.21
1,200	2.5 YR 6/8	3	7.5	38.9	48.3	1.24
1,250	2.5 YR 6/6	3	10.0	37.6	47.3	1.26

pH 4.5 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Not suitable for structural products. Too soft.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-6

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 6 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 53.5 Working Properties Plastic

Color Tan Drying shrinkage, percent 2.5 Dry Strength Good

Slow firing test:

Temp. °C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	5 YR 8/4	3	2.5	48.6	53.7	1.10
1,050	5 YR 8/4	3	2.5	47.5	53.0	1.12
1,100	5 YR 8/4	3	2.5	47.4	52.9	1.12
1,150	5 YR 8/4	3	5.0	45.5	51.7	1.14
1,200	5 YR 8/4	3	5.0	44.4	51.5	1.16
1,250	5 YR 8/4	3	5.0	44.2	51.3	1.17

pH 4.6 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. °C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Not suitable for structural products. Too soft.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-7

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 7 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 54.6 Working Properties Plastic

Color Tan Drying shrinkage, percent 12.5 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	7.5 YR 8/6	4	10.0	20.7	33.6	1.62
1,050	7.5 YR 7/8	4	15.0	19.9	33.1	1.67
1,100	7.5 YR 6/8	4	17.5	13.6	26.0	1.91
1,150	5 YR 5/8	5	17.5	10.9	21.2	1.95
1,200	5 YR 4/6	6	20.0	9.2	18.6	2.03
1,250	5 YR 4/4	6	22.5	6.7	14.4	2.13

pH 4.6 HCL Effervescence None Other tests --

Preliminary Bloating Test: Positive

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks
1,100	18.8	1.49 (93.0)	Slight expansion
1,150	16.1	1.38 (86.1)	Slight expansion
1,200	18.6	1.04 (64.9)	Good pore structure
1,250	6.9	.70 (43.7)	Good pore structure

Potential Use Marginal for structural clay products (e.g., building brick at 1,000° C). High shrinkage above 1,000° C. Lightweight aggregate at 1,200°-1,250° C.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-8

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 8 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 43.7 Working Properties Plastic

Color Tan Drying shrinkage, percent 12.5 Dry Strength Good

Slow firing test:

Temp. °C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	5 YR 6/10	5	15.0	12.3	23.5	1.92
1,050	5 YR 6/8	6	17.5	7.4	15.4	2.08
1,100	5 YR 5/8	6	17.5	4.2	9.1	2.16
1,150	5 YR 5/6	6	17.5	3.4	7.4	2.17
1,200	2.5 YR 4/6	6	17.5	2.7	6.0	2.20
1,250	2.5 YR 4/6	6	17.5	2.5	5.5	2.20

pH 4.6 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. °C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Not suitable for structural products. High shrinkage.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-9

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 9 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 35.1 Working Properties Plastic

Color Tan Drying shrinkage, percent 10.0 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	2.5 YR 6/6	4	10.0	27.7	43.0	1.49
1,050	5 YR 6/6	4	12.5	27.2	42.8	1.54
1,100	10 YR 7/4	4	12.5	26.9	41.4	1.55
1,150	2.5 Y 7/6	4	12.5	26.9	40.0	1.58
1,200	-	-	Melted	-	-	-
1,250	-	-	-	-	-	-

pH 4.9 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Not suitable for structural products. High absorption.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-10

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 10 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 45.2 Working Properties Plastic

Color Black Drying shrinkage, percent 10.0 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	5 YR 7/6	5	12.5	21.8	35.2	1.61
1,050	5 YR 6/8	5	15.0	17.5	30.2	1.72
1,100	5 YR 6/6	5	15.0	13.5	25.7	1.88
1,150	2.5 YR 5/6	5	15.0	13.5	25.4	1.91
1,200	-	-	-	-	-	-
1,250	-	-	-	-	-	-

pH 6.4 HCL Effervescence None Other tests --

Preliminary Bloating Test: Positive

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks
1,050	34.8	1.09 (68.0)	Partial expansion
1,100	41.2	1.05 (65.5)	Partial expansion
1,150	31.6	.95 (59.3)	Good pore structure
1,200	34.5	.61 (38.1)	Some large pores

Potential Use Not suitable for structural products. High shrinkage. Lightweight aggregate at 1,150°-1,200° C.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-11

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 11 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 56.4 Working Properties Plastic

Color Tan Drying shrinkage, percent 7.5 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	10 YR 8/4	3	12.5	30.8	43.1	1.40
1,050	10 YR 8/4	3	12.5	24.6	37.8	1.54
1,100	7.5 YR 6/6	4	20.0	11.7	22.2	1.89
1,150	10 YR 6/4	4	20.0	9.4	18.4	1.92
1,200	5 Y 6/2	5	20.0	7.7	14.9	1.96
1,250	-	-	Melted	-	-	-

pH 5.9 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Not suitable for structural products. High shrinkage.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

Tuscaloosa Research Center
Preliminary Ceramic Evaluation

Tuscaloosa Number MS-11-12

Date received 02-07-84 Date reported 03-28-84

Sender's Name Mississippi Bureau of Geology

Sender's Identification Newton County - 12 Type Material Clay

Raw Properties:

Water of Plasticity, Percent 39.1 Working Properties Plastic

Color Tan Drying shrinkage, percent 10.0 Dry Strength Good

Slow firing test:

Temp. ° C	Munsell Color	Moh's Hardness	Percent Linear Shk	Percent Abs.	Percent Appr. Por.	Bulk density gm/cc
1,000	5 YR 6/10	4	10.0	11.7	22.1	1.84
1,050	5 YR 6/8	4	12.5	9.8	19.5	1.88
1,100	5 YR 6/6	4	12.5	9.8	18.0	1.89
1,150	5 YR 5/6	4	12.5	9.0	16.9	1.93
1,200	2.5 YR 4/6	4	12.5	8.5	16.8	1.96
1,250	2.5 YR 3/4	4	12.5	7.9	15.2	1.98

pH 5.8 HCL Effervescence None Other tests --

Preliminary Bloating Test: Negative

Temp. ° C	Percent absorption	Bulk Density gm/cc (lb/ft^3)	Remarks

Potential Use Structural clay products (e.g., building brick at 1,000°-1,250° C).
Slightly high shrinkage at 1,050°-1,250° C.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. It does not preclude the use of the material in mixes.

MINERALOGY OF SELECTED NEWTON COUNTY FORMATIONS

by
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INTRODUCTION

Twelve grab and channel samples and two test hole cores were collected by the Mississippi Bureau of Geology in Newton County, Mississippi. These samples were subsequently delivered to the Geology Department of Millsaps College for investigation. The sample examinations were completed by Dr. Delbert E. Gann, Associate Professor, Department of Geology.

The investigation included the X-ray diffraction analysis of the samples submitted to determine the mineralogy of each (Table 1). Each sample was prepared as a bulk random mount and as oriented clay mounts. The latter were heated to 600° C for one hour, and organically treated with ethylene glycol to determine expansion and contraction characteristics of the clay minerals present.

All of the grab and channel samples were collected from Eocene formations including: three from the Yazoo Formation, three from the Cook Mountain Formation, three from the Zilpha Formation, and three from the Basic City Shale Member of the Tallahatta Formation. Two test hole cores collected are from the subsurface Basic City Shale. The sample collection localities are illustrated in Figure 1. X-ray diffractograms for selected samples are given in Figures 2, 3, and 4.

The determined mineralogy included varying amounts of quartz, clinoptilolite, calcite, potash feldspar, glauconite (and other similar phyllosilicates), cristobalite, kaolinite, montmorillonite, questionable mixed-layer clays, and amorphous material (probably glass).

The economic possibilities of these minerals are questionable. The mechanical and physical properties of the samples are discussed elsewhere in the Bulletin.

SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Each sample received from the Bureau of Geology was completely air-dried for two weeks. After drying each sample was split into representative fractions. One fraction was ground by hand in a mortar and pestle until the sample would pass through a 325 mesh (less than 44 μm) sieving screen. The material passing through the screen was randomly packed in a standard aluminum holder used in X-ray diffraction procedures. Each sample was then scanned with a General Electric XRD-6 diffractometer through 20-60° 2θ using a nickel filter, 1° entrance slit, 3° exit slit, and CuKα radiation. The X-rays were generated at 35 KV and 20 Ma. The recorder was operated at 2° 2θ per inch, 500 cps and a time constant of 2.

A second sample fraction was immersed in distilled water and subsequently disaggregated by means of an ultrasonic generator. After an appropriate settling time, the clay fraction (less than 2 μm) was removed by pipet. Part of the solution from each sample was deposited onto two glass slides and air-dried for 24 hours. The remaining solution was pulled by vacuum through a Millipore filter apparatus using 47 mm diameter cellulose filters with a 0.45 μm pore size. The samples prepared on glass slides were used for clay mineral heating and glycolation experiments, while the oriented filtered material was used as untreated control samples. All of the oriented samples, untreated, heated, and glycolated, were scanned with the X-ray diffractometer through 2°-20° under the same instrumental conditions described above.

The semi-quantitative amount of each mineral identified was determined by measurement of peak intensities of the maximum reflection, if not interfered with by another mineral. If the latter occurred, a secondary peak was selected. In the case of the clay minerals, primarily montmorillonite, the area under the 15Å reflection was measured. The intensities were compared to known standard mixtures of the minerals identified.

MINERALOGY

Quartz, montmorillonite, and amorphous material (with respect to X-ray diffraction) were ubiquitous in all samples. Quartz is equally abundant in the clay sized fraction (less than 2 μm) as well as coarser grained fractions (Table 1). Its abundance is lowest in the Basic City Shale samples and highest in the Yazoo Formation samples. Montmorillonite, a member of the smectite group of clay minerals, is most abundant in the Zilpha Formation clays. As the abundance of montmorillonite decreases in the re-

TABLE 1

Bulk XRD Mineralogy Of Selected Samples From The Eocene Formations Of Newton County, Mississippi

Mineralogy and Amount (%)

Sample Number	Formation-Location	Quartz SiO_2	Cristobalite SiO_2	Clinoptilolite $(Na,K,Ca)_6(Si,Al)_{36}O_{72} \cdot 20H_{20}$	Calcite $CaCO_3$	Feldspar $KAlSi_3O_8$	Kaolinite $Al_2Si_2O_5(OH)_4$	Mica-illite (pyllosilicate)	Montmorillonite $Na_{0.3}(Al,Mg)_2Si_4O_{10}(OH)_2.nH_2O$	mixed-layer clays (phyllosilicate)	Amorphous (SiO_2(?))
1	Cook Mountain Formation- SE/4, SW/4, NE/4, Sec. 8, T. 7 N., R. 11 E.	31	N.D.	N.D.	N.D.	N.D.	6	2	49	trace	12
2	Cook Mountain Formation- NW/4, NE/4, NE/4, Sec. 26, T. 6 N., R. 11 E.	23	trace	10	N.D.	trace	8	1	49	trace	9
3	Zilpha Formation- SW/4, SE/4, NE/4, Sec. 5, T. 8 N., R. 12 E.	59	trace	N.D.	N.D.	7	1	1	28	N.D.	4
4	Zilpha Formation- SE/4, NW/4, NE/4, Sec. 16, T. 8 N., R. 12 E.	21	trace	N.D.	N.D.	trace	N.D.	N.D.	74	N.D.	5
5	Tallahatta Formation- NW/4, NW/4, NE/4, Sec. 26, T. 7 N., R. 13 E.	23	47	2	N.D.	trace	N.D.	3	18	N.D.	7
6	Tallahatta Formation- SE/4, SE/4, NE/4, Sec. 35, T. 7 N., R. 13 E.	19	50	N.D.	N.D.	N.D.	N.D.	1	21	N.D.	9
7	Zilpha Formation- SW/4, SW/4, SW/4, Sec. 14, T. 7 N., R. 12 E.	20	trace	N.D.	N.D.	trace	N.D.	2	75	trace	3
8	Yazoo Formation- NE/4, SE/4, NW/4, Sec. 16, T. 5 N., R. 10 E.	52	2	1	N.D.[2]	trace[3]	2	N.D.	37	N.D.	6
9	Yazoo Formation- SE/4, SW/4, NE/4, Sec. 5, T. 5 N., R. 10 E.	42	3	3	18	trace	2	N.D.	26	trace	6
10	Cook Mountain Formation- SE/4, NW/4, NW/4, Sec. 19, T. 7 N., R. 10 E.	24	2	trace	N.D.	trace	7	trace	59	trace	8
11	Tallahatta Formation- SW/4, SW/4, NE/4, Sec. 6, T. 8 N., R. 13 E.	8	2	6	trace	N.D.	N.D.	trace	77	trace	7
12	Yazoo Formation- NW/4, NW/4, SW/4, Sec. 36, T. 6 N., R. 10 E.	57	3	N.D.	N.D.	trace	3	N.D.	32	trace	5

Basic City Test Hole Cores

Sample Number	Location	Quartz SiO_2	Cristobalite SiO_2	Clinoptilolite	Calcite $CaCO_3$	Feldspar $KAlSi_3O_8$	Kaolinite	Mica-illite	Montmorillonite	mixed-layer clays	Amorphous
AO-11	(25'-31') SE/4, SW/4, SE/4, Sec. 25, T. 6 N., R. 13 E.	17	60	12	N.D.	N.D.	N.D.	N.D.	4	N.D.	7
AO-19	(32'-34') NE/4, SW/4, NE/4, Sec. 3, T. 8 N., R. 13 E.	44	46	N.D.	N.D.	trace	N.D.	3	2	N.D.	5

[1] Amounts are semi-quantitative weight measurement percentages determined by peak intensities and/or peak areas. These values are probably correct within a measurement error of ± 10%.

[2] N.D. = Not Detectable

[3] probably less than 1% by weight

spective samples, there is a marked increase in cristobalite and a somewhat larger abundance of clinoptilolite. Cristobalite abundance is greatest in the Basic City Shale samples. Sample number 11 (Basic City Shale) has a very low cristobalite content, but contains a correspondingly high percentage of montmorillonite (Table 1). Clinoptilolite is not an abundant constituent of the samples. It could be identified with certainty in six of the fourteen samples investigated. The Basic City Shale material tends to be richer in this zeolite. It is worthy of note that in the Basic City Shale test hole cores, core A0-11 was relatively high in zeolite to a depth of about 27 feet, and below this horizon the zeolite disappeared with a corresponding increase in cristobalite. Test hole core A0-19 did not contain any identifiable zeolite, but was rich in quartz and cristobalite.

The presence of montmorillonite in each of the fourteen samples was confirmed by examination of the (001) reflection occurring in the vicinity of 5^{o}-6^{o} 2θ (approximately 15Å d-spacing) under varying conditions. After heating a sample to about 300^{o}C for one hour the smectite structure collapsed to about 8^{o}-10^{o} 2θ (approximately 9Å d-spacing). Each of the samples was also treated with an ethylene glycol mixture for 24 hours, which caused the smectite layers to expand to 17-18Å. These changes were confirmed by X-ray diffraction.

In a similar manner, suspected kaolinite-bearing samples were heated to 500-600^{o} C for one hour. X-ray diffraction data suggest that the kaolinite became amorphous under these conditions. Chlorite, which has similar d-spacing values, is stable to about 800^{o}C.

Glauconite and muscovite were identified in hand specimens megascopically in many of the samples. The structures of these phyllosilicates (including illite) are nearly identical, and for the purpose of this report are not distinguished by means of X-ray diffraction.

Clinoptilolite, a zeolite of the heulandite subgroup, is virtually indistinguishable from heulandite, by normal X-ray diffraction examination procedures, especially due to the fact that only small amounts of the mineral are present in some samples. Thermal treatment of these zeolites, however, has been helpful in separating clinoptilolite from heulandite (Reynolds, 1970, and Mumpton, 1960). Heulandite was shown to be unstable above 350^{o}C while clinoptilolite was stable to nearly 800^{o}C (Mumpton, 1960). In the present investigation samples 2 (Cook Mountain), 11 (Basic City), and A0-11 (Basic City) were heated to 350^{o} C for about 2 hours and re-examined by means of X-ray diffraction. No detectable change was observed in the 9Å reflection characteristic of zeolites in the heulandite subgroup, suggesting that the zeolite described here is very much like clinoptilolite.

ORIGIN OF MINERALS

The mineral assemblage described herein, specifically that of quartz, montmorillonite, cristobalite and/or clinoptilolite, is suggestive of being derived from pyroclastic or similar material. With the possible exception of quartz, the bulk of the minerals present in the samples is assumed to be diagenetic. Clinoptilolite may form from devitrification of rhyolitic volcanic ash constituents, while montmorillonite is formed from subsequent alteration of clinoptilolite by leaching of silica (Reynolds, 1970). The cristobalite probably represents secondary precipitation of, in part, the silica leached from zeolites and other constituents in the original ash material. This is particularly applicable to Basic City Shale samples 5 and 6, which contain approximately 50 percent cristobalite, minimal to non-detectable zeolite and non-detectable montmorillonite. Reynolds (1970) suggested that the liberated silica circulating above the diagenetically altering volcanic ash would ultimately precipitate as pH conditions dropped, and would probably crystallize as cristobalite.

The small amounts of kaolinite present, primarily in the Yazoo and Cook Mountain formations, suggest alteration of pre-existing feldspars that likely were also present in the original volcanic ash material. Feldspar is moderately abundant in only one sample, that being the Zilpha Formation number 3. The presence of a small amount of kaolinite is indicated in the same sample. Calcite, almost certainly diagenetic, is important in only one sample, number 9 of the Yazoo Formation.

Representative diffractograms of the samples from the Yazoo Formation, Cook Mountain Formation, Zilpha Formation, and Basic City Shale (including test hole cores) are illustrated in Figures 2-4. Each diffractogram set includes a bulk random scan and a scan of a glycolated sample where applicable. The diffraction patterns have not been artificially enhanced or smoothed over. The broad reflections occurring in the vicinity of 5^{o}-6^{o} 2θ and 20^{o} 2θ are montmorillonite. Clinoptilolite has distinctive reflections at about 9.9^{o}, 11.2^{o}. 13.1^{o}, 16.9^{o}, 17.4^{o}, 22.4^{o}, and 22.7^{o}. A comparison between the d-spacing of a clinoptilolite standard from Maricopa County, Arizona, and the zeolite found in the samples of this investigation is shown in Table 2. The comparison is favorable and is also consistent with JCPDS diffraction data for clinoptilolite (file number 25-1349) from San Bernardino County, California. As shown in Figure 2, thermal treatment of the clinoptilolite had no recognizable effect, suggesting the presence of the more temperature stable phase as compared to heulandite which becomes less stable after heating.

Kaolinite yields distinctive peaks at 12.4° and 25.1° 2θ. Two important quartz reflections occur at 20.9° and 26.7° 2θ, while calcite has a major peak at 29.4° 2θ. Amorphous material, although non-crystalline with respect to X-ray diffraction, often produces a very broad, low hump with a maximum height centering around 24°-26° 2θ. Cristobalite was identified on the basis of two major reflections located at 21.9° and 36.0° 2θ.

TABLE 2

Comparison Of Clinoptilolite From Maricopa County, Arizona, and Newton County, Mississippi

d-spacing Å Maricopa County	Intensity (%)	d-spacing Å Newton County	Intensity (%)
8.93	65	8.96	90
7.84	25	7.91	25
6.65	15	6.7	15
5.24	15	5.24	15
5.09	20	5.09	20
4.64	15	4.66	5
4.33	5	4.3	5
3.95	100	3.97	100
3.91		3.93	
3.70	5	3.71	15
3.54	10	3.56	20
3.40	30	3.42	15
3.31	15	3.31	10
3.15	30	3.18	20
3.07	10	3.12	15
		3.07	10
2.97	55	2.97	40
2.79	15	2.79	25
2.73	10	2.74	10
2.67	5	2.66	5

ECONOMIC CONSIDERATIONS

Economic utilization of the Newton County clays is questionable at best. Although zeolites have been utilized in the past as selective sorbents, catalysts, and desiccants, the potential use of Newton County, Mississippi, zeolites is unknown. The zeolites here occur in small inconsistent quantities, disseminated through silty shales, claystones, and sands. Reserves have not been estimated due to a lack of sample control and the corresponding delineation of the ore body or bodies. Abundances of zeolites vary dramatically from site to site, formation to formation, and within single core holes. The most promising formation is the Basic City Shale, but a more detailed investigation of the contained units is needed before a final evaluation can be made with respect to economic potential. This is also true for cristobalite, which has been demonstrated to be the most abundant constituent of the Basic City Shale, ranging from 2 to 60 percent by weight.

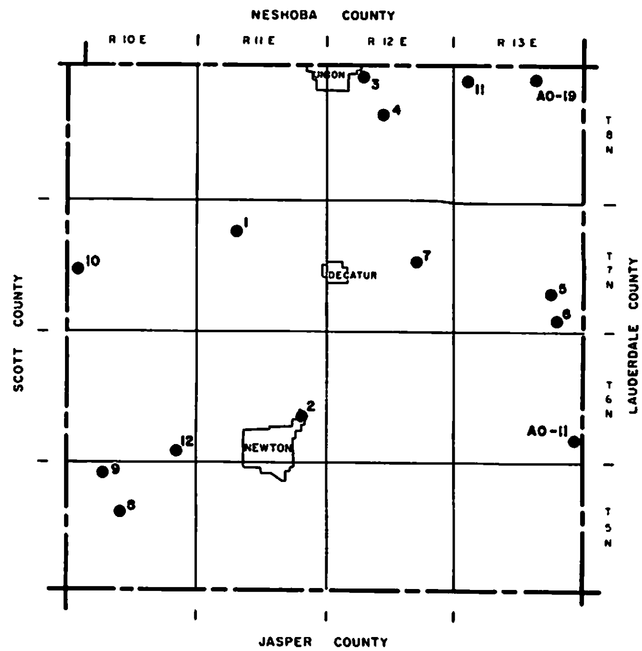

Figure 1 — Clay sample localities.

CONCLUSIONS

At least nine minerals and one amorphous phase (probably glass) were identified in the fourteen samples collected by the Bureau of Geology from formations in Newton County, Mississippi, including the Yazoo, Cook Mountain, and Zilpha Formations and the Basic City Shale. Quartz and montmorillonite are ubiquitous to all samples. Clinoptilolite, a zeolite from the heulandite subgroup, is also present in small amounts in all but the Zilpha Formation. The Basic City Shale contains the most consistently high values of this zeolite. Cristobalite comprises about one-half or more of most of the Basic City Shale samples. Smaller quantities of calcite, potash feldspar, kaolinite, mica-illite (muscovite and glauconite primarily), and possible mixed-layer clays are generally present in small to non-detectable amounts in each of the samples examined. The amorphous phase is ubiquitous but averages about 5 percent in each of the samples. The economic potential of these minerals is questionable.

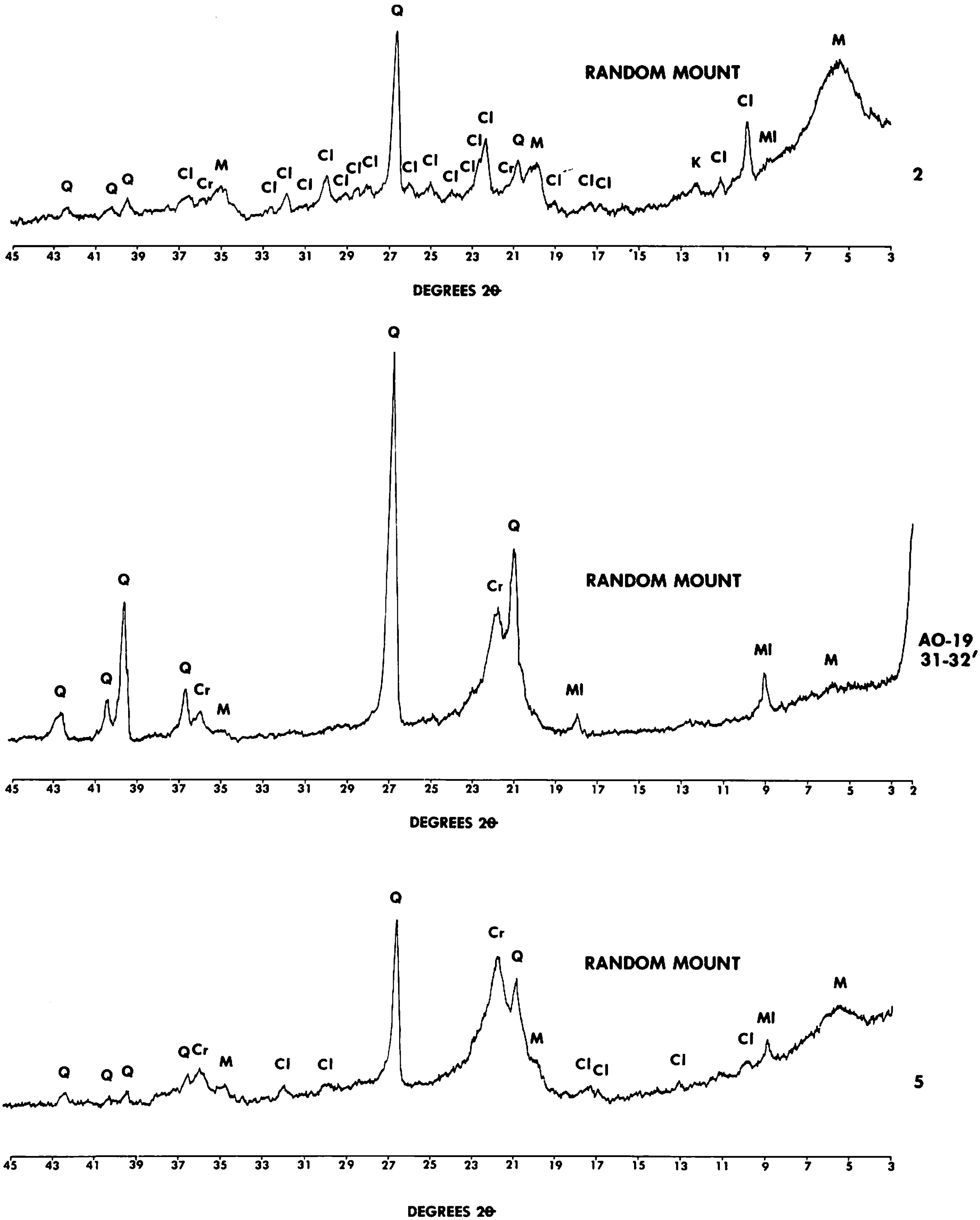

Figure 2 — X-ray diffractograms of selected samples from the Cook Mountain (2) and Tallahatta formations (A0-19 and 5), illustrating occurrences of: Montmorillonite (M), Mica-Illite (MI), Clinoptilolite (Cl), Cristobalite (Cr), and Quartz (Q).

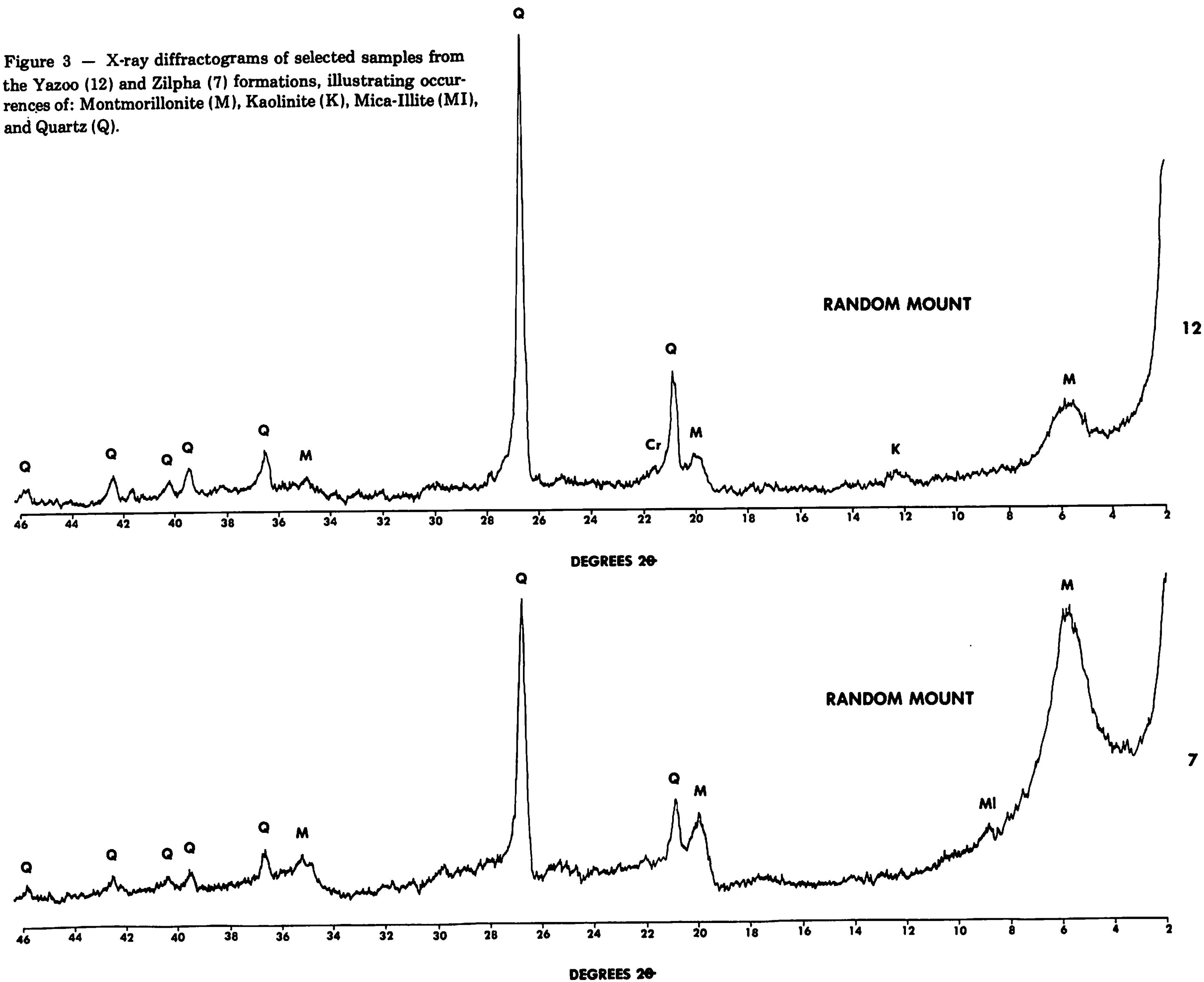

Figure 3 — X-ray diffractograms of selected samples from the Yazoo (12) and Zilpha (7) formations, illustrating occurrences of: Montmorillonite (M), Kaolinite (K), Mica-Illite (MI), and Quartz (Q).

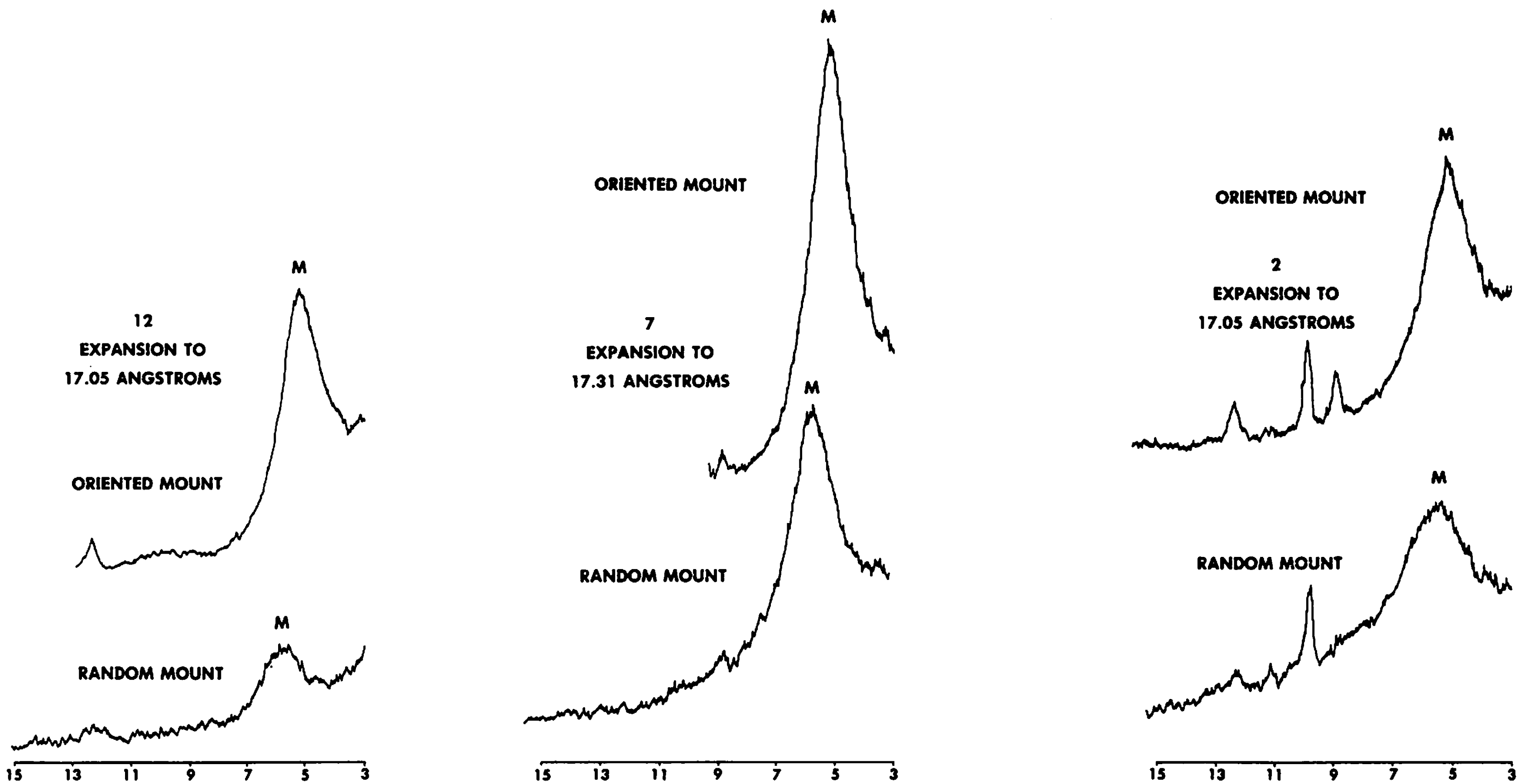

Figure 4 — X-ray diffractograms illustrating the expansibility of selected montmorillonitic clay samples from the Yazoo (12), Zilpha (7), and Cook Mountain (2) formations. Horizontal scale in degrees 2θ.

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WATER RESOURCES OF NEWTON COUNTY, MISSISSIPPI

by
James J. Sims, Jr.

ABSTRACT

Newton County is underlain by aquifers containing an abundance of ground water that requires little or no treatment for most uses. Sufficient quantities of fresh ground water are available for present domestic, industrial, and municipal demand in most areas of the county. In some localities, limited quantities of water needing no treatment are available. The primary aquifers underlying the county include sand intervals within the Wilcox Group, Meridian Sand, Tallahatta Formation, Winona Formation, Kosciusko (Sparta) Formation, and Cockfield Formation. Other, minor aquifers include terrace deposits and alluvium. Because of restricted occurrence and very limited potential, neither terrace deposits nor alluvium will be developed as major ground water sources in Newton County.

The larger municipal and industrial wells in the county yield moderate to large quantities of water from the lower Wilcox, Meridian - upper Wilcox, and Kosciusko aquifers. Small to moderate yields to rural self-supplied wells are generally produced from the Tallahatta, Winona - Neshoba Sand, and Cockfield aquifers. Wells completed in these aquifers range in depth from 38 feet in eastern Newton County to 1880 feet in southwestern Newton County. Most of the wells are less than 400 feet deep. Recorded transmissibilities for the aquifers in Newton County range from 9,000 to 44,000 gallons per day per foot (g.p.d./ft) and yields may exceed 500 gallons per minute (g.p.m.) (Table 5). Quality problems include excessive color in some areas, excessive iron concentrations in other areas, and a pH below 7.0. Most of the water is a soft, sodium bicarbonate type with moderate mineralization. Treatment for iron removal is generally all that is required for most ground water produced in the county.

Surface water of quality suitable for most industrial uses is available from the Chunky River and Potterchitto and Tallahatta creeks. The variability of streamflow from these streams is such that large water needs can be supplied only with storage. The quality of the surface water is generally good; it can be used for most purposes with only minor treatment. The water has low dissolved solids, low hardness, and pH ranging from 5.5 to 6.5. Minor flooding occurs along the flood plains of most of the streams after heavy rains, which usually occur in late winter and early spring. Low flows are generally experienced in late summer and fall.

Cooperation and Acknowledgments

The writer wishes to express appreciation for the assistance and cooperation of various water well contractors, state and local officials, and well owners for providing information contained in this report. Previously gathered information on well completions by the Mississippi Bureau of Land and Water Resources has been very helpful. Chemical analyses made by the Water Resources Division of the U.S. Geological Survey and the Mississippi State Department of Health have also been very helpful. Results of pumping tests conducted by the U.S. Geological Survey were most helpful. Special acknowledgment is made to Howard Johnson, a former employee of the Bureau of Geology, who assisted in well locations and surface water sampling.

GROUND WATER

Introduction

The vital importance of having an adequate and suitable supply of fresh water cannot be taken for granted. It is one of the prime natural resources of any area, and for that reason this section is included as an essential part of this report. The data summarized in this report will supplement information known and published about the water resources of Newton County. Information concerning quantity, quality, and availability of the water resources is contained herein, and an attempt is made to present it in such a manner as to aid those interested in developing water supplies at various locations throughout the county.

Fresh water (containing less than 1000 mg/1 in dissolved solids) aquifers are available in Newton County to depths of 2100 feet below sea level. The base of fresh water ranges from less than 600 feet to slightly more than 2100 feet below sea level. Fresh water can be obtained from one or more aquifers everywhere in the county. Often these aquifers differ considerably in hydraulic characteristics and contain water of different chemical quality and physical properties. Selection of a suitable aquifer in any locality may be done on the basis of any of these considerations.

The major aquifers in Newton County are sand intervals within the Wilcox Group, Meridian Sand, and Kosciusko Formation. The trend in recent years has been to construct large capacity wells in the Meridian - upper Wilcox rather than the Kosciusko. The Meridian - upper Wilcox generally contains water of better chemical quality than the Kosciusko. The lower Wilcox aquifer has the best potential of any ground water or surface water source in the county. Water from this aquifer usually contains excessive iron concentrations and a low pH; therefore, treatment is generally necessary for public supply.

Other aquifers of local importance are sands in the Tallahatta Formation, Winona Formation, and Cockfield Formation. The Winona - Tallahatta aquifer system is one of the principal sources of water for domestic use in central and northwestern Mississippi. This aquifer system is tapped significantly throughout the county and generally produces enough good quality water for rural self-supplied uses. The Cockfield aquifer is the shallowest, most dependable source of ground water for small domestic wells in the southwestern third of the county.

The Pleistocene and Holocene aquifers have very little potential in Newton County due to very restricted occurrences. The Holocene aquifers can produce small amounts of poor quality water. These aquifers are poorly developed and are restricted to the flood plains of streams in Newton County. Only a trace of the total ground water produced in the county is from the Pleistocene or Holocene aquifers.

Methods of Investigation

Included in this report is information on the availability and quality of ground water from each aquifer in Newton County (Figure 1). A determination of water levels, aquifer thickness, physical and chemical characteristics of the water from each aquifer was made and is also included as a part of this report.

Data used in this report were obtained by collection of information on location, ownership, elevation, screened interval, screen length, casing diameter, static water level, method of lift, water bearing unit, yield and use. One hundred twenty seven wells were located "in the field" in Newton County to verify correct locations and determine elevations. These accumulated data are summarized in the "Records of Selected Wells" (Table 1).

A Hach colorimeter was used to determine the chemical quality of the ground water in Newton County. One hundred four water samples were collected "in the field" and analyzed for silica, iron, calcium, magnesium, sodium, potassium, sulfate, chloride, flouride, total dissolved solids, specific conductance, pH, temperature, hardness, and color. Complete laboratory analyses of some ground water samples conducted by the Mississippi State Department of Health and the U.S. Geological Survey are summarized along with the field analyses under the "Chemical Analyses of Water from Selected Wells" (Table 2).

Present Ground Water Use

All of the present municipal, industrial and domestic water supplies in Newton County are from ground water sources. Callahan (1976) stated that nine municipal and rural water associations in the county withdraw a total of 0.981 million gallons per day of ground water. Areas that are presently supplied by municipal water systems include Union, Decatur, Newton, and Hickory. There were five rural water associations and three private industrial systems operating in the county in 1985, serving areas outside the municipalities.

The municipal and rural water associations utilize three aquifers to provide ground water to well over 10,000 individuals in the county. The large capacity public supply wells in the Newton area are completed in the Kosciusko aquifer. This is the most heavily pumped area in the county. The Meridian - upper Wilcox aquifer is used for large capacity wells at Union, Decatur, and Chunky. The lower Wilcox aquifers supply two rural water associations in the northeastern part of the county.

More than half the total withdrawal of ground water in the county is from rural self-supplied wells. All of Newton County is underlain by at least one aquifer capable of yielding enough ground water for self-supplied use. Callahan (1976) stated that total rural self-supplied ground water withdrawal in Newton County exceeds 0.890 million gallons per day. These rural water wells vary in depth from 38 feet for a Kosciusko well in northern Newton County (Section 2, T.7N., R.11E.) to a 680 foot Winona - Neshoba well in southwestern Newton County (Section 36, T.6N., R.10E.) (Table 1).

Ground Water Availability

Ground water is available in Newton County from several important aquifers (Table 1). These aquifers are sand intervals within the Wilcox Group, Meridian Sand, Tallahatta Formation, Winona Formation, Kosciusko Formation, and Cockfield Formation. Some of the water-bearing sands pinch out locally, but most of them are widely distributed

SYSTEM	SERIES	GROUP	STRATIGRAPHIC UNIT	WATER RESOURCES DATA	Thickness (feet)
QUATERNARY	HOLOCENE		ALLUVIUM	Generally not an Aquifer. Occurrence is restricted to flood plains of streams. Can supply small yields of poor quality water to shallow wells.	0 to 25'+
	PLEISTOCENE		TERRACE DEPOSITS	Generally not an Aquifer. Can supply small yields to shallow wells. Water quality would be poor.	0 to 20'+
			CITRONELLE FORMATION	Generally not an Aquifer.	0 to 90'
TERTIARY	EOCENE	JACKSON	YAZOO FORMATION	Not an Aquifer.	80'+
			MOODYS BRANCH FORMATION	Not an Aquifer.	12' to 15'
		CLAIBORNE	COCKFIELD FORMATION	An important Aquifer for domestic wells in the southwestern third of the county. Water tends to be colored with iron concentrations in excess of 0.3 mg/l. This Aquifer is not developed to its maximum potential in Newton County.	166' to 194'
			COOK-MOUNTAIN: UNDIFFERENTIATED	Not an Aquifer.	47' to 110'
			KOSCIUSKO FORMATION	An important Aquifer in the southwestern two-thirds of the county, capable of yielding 500 to 1000 gpm in some localities. Water quality is fair. Iron concentrations and color are normally high in the outcrop area.	136' to 228'
			ZILPHA FORMATION	Not an Aquifer.	12' to 68'
			WINONA FORMATION	Irregularly connected to the Neshoba Sand. Supplies small yields to a great number of domestic wells in the northwestern third of the county. Water quality is generally good.	35' to 72'
			TALLAHATTA FORMATION: NESHOBA SAND	An extensively tapped source of water for small domestic wells in the northern part of the county. Water quality is generally good.	8' to 15'
			TALLAHATTA FORMATION: BASIC CITY SHALE	Generally not an Aquifer.	83' to 130'
			MERIDIAN SAND	Hydraulically connected to the upper Wilcox. Generally the most utilized source of water for industrial, municipal, and domestic wells. Except for high iron concentrations, water quality is good.	9' to 40'
		WILCOX	UNDIFFERENTIATED	Most important Aquifer in Newton County but cost due to depth has limited its use. This Aquifer underlies the entire county and can yield 500 gpm of good quality water.	0 to 190'+

Figure 1 — Stratigraphic column and water resources data of Newton County.

TABLE 1

Records Of Selected Wells In Newton County, Mississippi

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

Majority of wells are rotary drilled.

Water Level: M, Measured; R, Reported; O, Observed; Est., Estimated.

Method of Lift: A, Airlift; C, Cylinder; F, Natural Flow; J, Jet; N, None; P, Piston; 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; IS, Institutional; N, None; O, Observation; P, Public Supply; S, Stock; T, Test; A, Abandoned; U, Unused.

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

Well No.	Owner	Year Drilled	Altitude of land surface datum (feet)	Depth (feet)		Casing diameter (inches)	Water level		Method of lift	Water bearing unit	Use	Yield		Remarks
				Well	Top of screen		Above (+) or below LSD (feet)	Date of measurement				Gallons per min.	Date	
A1	Sonny Mills	1973	518	420	328	4	180 (R)	1973	J	TLLT	D	7	1973	C, X
A2	Pete Mowdy	1969	500	250	181	4	88 (R)	1969	J	WNON	U	10	1969	X
A3	William Brown	1968	500	260	189	4	90 (R)	1969	J	WNON	D			C
A4	Lee Kendrick	1978	504	280	225	4	110 (R)	1978	J	WNON	D	6	1978	C, X
A5	Lucern Congregational Methodist Church	1980	500	285	220	2			J	WNON	D			C, X
A6	Kenny Bankston	1979	483	280	194	4			J	WNON	D			C, X
A7	C. Williams	1969	525	310	210	4	100 (Est.)	1982	J	WNON	D			C, X
A8	Larry French	1975	525	305	233	4	90 (R)	1975	J	WNON	D	10	1975	C, X
A9	Houston Leach	1976	478	360	280	4	150 (R)	1976	S	TLLT	D	5	1976	C, X
A10	N. J. Mowdy	1967	488	50	45	2			J	KOSC	D			C
B1	Victor Ezell	1960	483	69	63	2	14 (R)	1960	J	KOSC	D			C, X
B2	Dewayne Burton	1980	502	325	200	4			S	WNSB	S			C, X
B3	Cooper Saxon	1966	550	240	235	2	40 (R)	1966	J	MUWX	U			C
B4	M. R. Russell	1978	478	47	42	4	10 (R)	1978	J	KOSC	D	10	1978	C
B5	M. R. Russell	1978	478	180	120	4	80 (R)	1978	N	KOSC	A	6	1978	X
B6	Town of Union	1924	476	270	220	12	100 (Est.)	1982	T	MUWX	A			C
B7	Town of Union	1941	476	233	173	10	102 (R)	1941	T	MUWX	U	80	1941	C
B8	Town of Union	1963	476	242	192	16	93 (R)	1967	T	MUWX	P	369	1980	C
B9	Town of Union	1966	476	323	273	12	107 (R)	1967	T	MUWX	P	520	1967	C, P
C1	Beulah-Hubbard Water Association	1968	525	974	921	8	205 (R)	1968	T	LWCX	P	150	1968	C, E, P
C2	Lee Smith	1964	463	110	105	2	68 (R)	1964	J	WNSB	U			C
C3	Denver Bracken	1974	463	60	35	4	20 (R)	1974	J	WNSB	D	10	1974	C
C4	Bob Terrell	1976	532	400		2			J	MUWX	D	10	1976	C, X
C5	Buck Terrell	1970	500	250	126	4	92 (R)	1970	J	MUWX	D	10	1970	C
C6	Orange Ethridge	1973	536	300	290	4	150 (R)	1973	S	MUWX	D	10	1973	
C7	Beulah-Hubbard Water Association	1980	500	1,050		8			T	LWCX	P			C, E
D1	Duffee Water Association	1970	460	995	875	8	152 (R)	1970	T	LWCX	P	150	1970	C, E, P
D2	Duffee Water Association	1979	420	885	804	8	110 (R)	1979	T	LWCX	P	150	1979	C, E, P
D3	Edward Threat		475						B	WLCX	U			C
D4	James R. Gressett	1971	475	144		4	53 (R)	1971	S	MUWX	D	9	1971	C, X
D5	J. T. Chesney		484							LWCX	D			
D6	Tony Dean	1964	420	233	160	2	120 (R)	1964	J	MUWX	D			C, X
E1	Conehatta Indian School	1969	522	955	618	8	200 (R)	1969	T	MUWX	IS	138	1969	C, E
E2	Conehatta Indian School	1978	518	713	595	8	212 (R)	1978	T	MUWX	IS	218	1978	C, E
E3	Conehatta Indian School	1959	515	351	307	10	163 (R)	1959	S	KOSC	U			C
E4	Wilmer Morgan	1980	465	300	220	4			J	KOSC	D			C, X
E5	Lewis McDonald	1978	440	400	320	4	125 (R)	1978	J	WNSB	D	6	1978	C, X
E6	H. C. Blackburn	1978	495	440	365	4	168 (R)	1978	J	WNSB	D	6	1978	C, X
F1	B. L. Meador	1980	452	38	33	2			J	KOSC	D			C, X
F2	Beat Line Baptist Church	1980	508	390	300	4			S	WNSB	D			X
F3	Pine Ridge M. B. Church		500						J	KOSC	D			
F4	Homer Burton	1978	412	150	120	4			S	KOSC	D			C, X
F5	Homer Pierce	1974	435	180	100	4	70 (R)	1974	J	WNSB	D	10	1974	
F6	Ernest Byran	1979	430	150	90	4	32 (R)	1979	J	WNSB	D	10	1979	X
F7	Vernon Reeves	1971	400	46	40	2	32 (R)	1971	J	KOSC	U	10	1971	
F8	Dave Ethridge	1973	525	260	190	4	130 (R)	1973	J	KOSC	U	10	1973	
G1	Decatur Development Association	1967	432	362	313	12			S	MUWX	D			C, E
G2	Town of Decatur	1974	455	1,546	313	12	116 (R)	1974	T	MUWX	P	350	1974	C, E
G3	Cleveland Smith	1962	470	81	75	2	45 (R)	1962	J	KOSC	A			C
G4	Jack Russell	1966	395	110	105	2			A	WNON	D	40	1966	C
G5	Travis Ledlow	1970	485	280	230	4	115 (R)	1970	J	MUWX	D	10	1970	
G6	Paul Wansley	1977	430	260	127	4	95 (R)	1977	J	WNSB	D	4	1977	C, X
G7	Ray Knowlan	1960	400	150	105	2	56 (R)	1960	J	WNSB	D			C
G8	Cecil Ivy	1973	393	195		4	64 (R)	1973	J	WNSB	D	6	1973	C
G9	Auburn Majure	1976	450	200	130	4	82 (R)	1976	S	WNSB	D	5	1976	C, X
G10	Lain Spears	1977	425	300	98	4	86 (R)	1977	S	WNSB	D	6	1977	C, X
G11	E. L. Thorne	1968	380	295	145	2	75 (R)	1968	J	WNSB	D	6	1968	C
G12	John Sandifer	1980	460	200	95	4	100 (R)	1980	S	WNSB	D	6	1980	C, X
G13	Gene Loper	1971	490	160	55	4	105 (R)	1971	J	KOSC	D	10	1971	
G14	Avery Addy	1980	490	260	62	4	65 (R)	1980	J	KOSC	D	8	1980	C, X
G15	Jessie Savell	1979	463	145	82	4	60 (R)	1979	J	KOSC	D	6	1979	X
G16	B. T. Rigdon	1962	450	117	82	2	46 (R)	1962	S	KOSC	D	7	1962	C
G17	Town of Decatur	1929	430	310	290	4	80 (R)	1959	T	MUWX	A	226	1959	C
G18	Town of Decatur	1951	430	320	290	10	80 (R)	1951	T	MUWX	A			C
G19	Town of Decatur	1966	415	323	303	12	82 (R)	1966	T	MUWX	P	212	1966	C, P
G20	Newton Academy	1973	410	320	125	4	90 (R)	1973	J	WNSB	U	15	1973	
G21	Spring in Section 1		440				+ (O)	1982	N, F	WNON	N	.5	1982	C
G22	Spring in Section 4		440				+ (O)	1982	N, F	KOSC	N	.5	1982	C

TABLE 1
Continued

RECORDS OF SELECTED WELLS IN NEWTON COUNTY

Well No.	Owner	Year Drilled	Altitude of land surface datum (feet)	Depth (feet)		Casing diameter (inches)	Water level		Method of lift	Water bearing unit	Use	Yield		Remarks
				Well	Top of screen		Above (+) or below LSD (feet)	Date of measurement				Gallons per min.	Date	
H1	Earnest O. Mabry	1978	400	165	61	4	5 (M)	1981	S	MUWX	D	20	1978	C, X
H2	Center Ridge Community Center	1975	500	90	85	2	65 (R)	1975	S	TLLT	U	8	1975	
H3	Roger Culpepper	1975	500	280	175	4	175 (R)	1975	S	MUWX	D	8	1975	C, X
H4	William J. Culpepper	1975	500	87	82	2	70 (Est.)	1982	S	TLLT	D	8	1975	C, X
H5	Spring in Section 9		400				+ (O)	1982	N, F	TLLT	N	5	1982	C
H6	Spring in Section 28		400				+ (O)	1982	N, F	TLLT	N	1	1982	C
H7	Spring in Section 28		360				+ (O)	1982	N, F	TLLT	N	5	1982	C
J1	Lawrence Water Association	1968	493	498	456	8	175 (R)	1978	T	KOSC	P	168	1978	C, E, P
J2	Lawrence Water Association Test Well	1966	493	1,012	418	2	163 (R)	1966	N	KOSC	T			C, E
J3	Pine Ridge Church	1973	488	182	177	2	48 (R)	1973	J	CCKF	D			X
J4	B & W Feed Services	1977	432	182	172	4	14 (R)	1977	S	CCKF	D	30	1977	C
J5	Sam Bounds, Jr.	1980	448	680	612	4	145 (R)	1980	S	WNSB	D	20	1980	C, X
J6	Otto Robinson	1979	436	500	407	4	130 (R)	1979	J	KOSC	D	20	1979	X
J7	David Gibbs	1979	478	115	100	4	50 (R)	1979	J	CCKF	S	35	1979	
K1	ESCO Corporation	1970	364	477	437	6	42 (R)	1980	S	MUWX	I	175	1980	C, E
K2	Herman Evans	1980	510	125	120	2			J	CCKF	D			C
K3	Amos Bounds	1961	442	98	88	2	27 (R)	1961	J	CCKF	U			C
K4	Sarah Greenwood	1980	400	330	265	4	85 (R)	1980	J	WNSB	D	10	1980	C, X
K5	E. S. Williamson	1980	405	135	130	2	40 (R)	1980	J	KOSC	D	4	1980	C
K6	Don Baker	1978	390	320	260	4	80 (R)	1978	N	WNSB	A	10	1978	X
K7	City of Newton	1938	405	310	250	8	108 (R)	1966	T	KOSC	A	432	1966	C
K8	City of Newton	1951	405	312	252	12	102 (R)	1966	T	KOSC	P			C
K9	City of Newton Test Well	1974	486	1,880	1,860	5	154 (R)	1974	T	LWCX	T	55	1974	C, E
K10	City of Newton	1974	486	325	274	16	154 (R)	1974	T	KOSC	P	450	1974	E
K11	City of Newton	1968	405	311	271	18	100 (R)	1968	T	KOSC	P	548	1968	C, P
L1	Lebanon Primitive Baptist Church	1979	430	40	35	2	26 (R)	1979	J	KOSC	D	4	1979	C, X
L2	Mississippi State Experiment Station	1977	360	240	230	4	80 (R)	1977	S	WNSB	IS	30	1977	C
L3	Mississippi State Experiment Station	1954	355	420	391	6	23 (R)	1954	S	MUWX	U			
L4	Mississippi State Experiment Station	1947	360	440		6	28 (R)	1947	T	MUWX	U	160	1947	C
L5	Town of Hickory	1939	325	88	78	8	15 (R)	1941	T	KOSC	A			C
L6	Town of Hickory	1956	325	56	11	10	10 (R)	1958	T	KOSC	P	90	1958	C
L7	Town of Hickory	1972	324	424	374	8	10 (R)	1972	T	MUWX	P	230	1972	E
M1	Chunky Water Association	1970	323	139	109	8	14 (R)	1970	T	MUWX	P	80	1970	C, E
M2	Mt. Pleasant Church	1975	420	250	170	4	135 (R)	1975	J	MUWX	D	6	1975	C
M3	Chunky Baptist Church	1966	323	145	43	4	20 (R)	1966	S	MUWX	D			C
M4	T. J. Archie	1977	482	263	220	4	160 (R)	1977	J	MUWX	S	8	1977	C, X
M5	T. J. Archie	1977	460	260	200	4	170 (R)	1977	J	MUWX	D	8	1977	C, X
M6	L. E. Booge	1979	368	200	103	4	70 (R)	1979	J	MUWX	S	6	1979	C, X
M7	Lindsey Booge	1979	362	180	80	4	50 (R)	1979	J	MUWX	D	6	1979	C, X
M8	H. Scheuneman	1963	440	180	175	4	92 (R)	1963	S	MUWX	D			C, X
N1	Bilbo Whatley	1973	448	180	174	2	61 (R)	1973	J	CCKF	D			C
N2	E. H. Everett	1972	402	200	194	2	47 (R)	1972	J	CCKF	D	13	1972	C
N3	Lilly Gordy	1975	408	205	200	2	80 (R)	1975	J	CCKF	D			
N4	V. C. Weed	1963	412	242	231	2	42 (R)	1963	J	CCKF	D			C
N5	George Logan	1967	432	195	189	2	58 (R)	1967	J	CCKF	D	7	1967	C
N6	Roberts Deer Club	1976	424	206	201	2	36 (R)	1976	J	CCKF	D	16	1976	C
N7	L. M. Bounds	1980	463	250	240	2	50 (R)	1980	A	CCKF	D	5	1980	C
N8	Floyd Nelson	1977	442	175	170	2	45 (R)	1977	J	CCKF	D	4	1977	C
O1	South Newton Water Association	1970	442	434	367	10	125 (R)	1970	T	KOSC	P	200	1970	C, E
O2	Henry M. Lay		443	105	94	4			J	CCKF	D			C
O3	Hughes and Hughes	1981	430	625						KOSC	A			E
P1	Poplar Springs Baptist Church	1975	460	245		2	133 (R)	1975	P	KOSC	D	4	1975	C
P2	Charles Little	1976	460	380	303	4	105 (R)	1976	S	WNSB	D			C, X
P3	Bernard Baucum	1977	390	340	267	4	80 (R)	1977	J	WNSB	D	5	1977	C, X
P4	W. A. Brock	1978	368	300	240	4	60 (R)	1978	J	WNSB	D	6	1978	C, X
P5	Jerry Williamson	1972	410	270	260	2	94 (R)	1972	J	KOSC	D	5	1972	C
P6	Ross Holmes	1961	441	110	100	2	40 (R)	1961	J	CCKF	D			C
Q1	Joe Williams	1970	356	430	178	4	57 (R)	1970	S	WNSB?	D	12	1970	C, X
Q2	Leo Williams	1970	420	430	188	4	135 (R)	1970	J	WNSB?	D	12	1970	C, X
Q3	Sam Everett	1974	322	305	80	4	15 (R)	1974	J	WNSB?	D	12	1974	C, X
Q4	George Ratliff	1976	420	300	90	4	108 (R)	1976	S	WNSB?	D	10	1976	C, X
Q5	Langdon Barber	1977	344	240	30	4	58 (R)	1977	J	WNSB?	D	10	1977	C, X
Q6	W. H. Griffis	1962	400	340	270	4	78 (R)	1962	J	MUWX	D			C, X
Q7	Claude Little	1964	405	330	122	4	60 (R)	1964	J	WNSB?	D			X

TABLE 2
Chemical Analyses Of Water From Selected Wells In Newton County, Mississippi

*Analysis by U.S.G.S.
**Analysis by M.S.B.H.
B.O.G.

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				
						Dissolved constituents and hardness given in milligrams per liter																
A1	420	TLLT	4-6-82	28.0	0.1							27	2	1		292	203		450	6.7	56	0
A3	250	WNON	4-12-82	25.6	2.4							17	2	.52		201	165		310	7.2	65	50
A4	280	WNON	4-7-82	24.8	0.1							31	1	.17		325	120		500	7.2	61	0
A5	285	WNON	4-28-82	14.4	1.4							15	.5	.5		221	111		340	7.1	68	25
A6	280	WNON	4-7-82	2.6	0.2							5	7			49	45		74	5.3	57	0
A7	310	WNON	4-7-82	28.8	0.4							20	8	.11		266	140		410	7.4	64	30
A8	305	WNON	4-12-82	27.2	0.1							15	5	.51		292	143		450	7.8	78	0
A9	360	TLLT	4-28-82	19.2	0.1							25	5	.19		279	81		430	7.6	72	10
A10	50	KOSC	11-16-82	12.0	0.1							10	4	.42		209	13		320	7.6	57	0
*A10	50	KOSC	9-12-68	15.0	4.5	2.0	.5	1.6	.6	10	0	.2	3	0	0	17	7		26	5.8	66	10
B1	69	KOSC	4-28-82	14.4	0.18							13	3	.27		195	96		300	7.2	75	5
B2	325	WNSB	4-28-82	3.5	6.4							8	5.5	.23		79	88		120	6.2	70	475
B3	240	MUWX	5-27-82	12.0	0.12							0	7.5	.25		52	55		80	4.8	77	10
B4	47	KOSC	5-27-82	16.5	4.0							12	8.5	.25		227	335		350	6.7	78	300
*B6	270	MUWX	12-2-60	5.2	4.0	12.0	3.7					20.5	5.0	.2						5.7	67	
**B6	270	MUWX	9-28-47	28.4	2.5	12.5	6.9					20	5.0	0	0	98.5	65			6.1		
*B7	233	MUWX	2-14-67	42.0	3.2	7.1	4.3	9.8	3.6	44	0	20	3.7	.1	.1	97	35		134	6.1	66	
**B7	233	MUWX	12-20-60	4.8	4.0	12.0	3.7					20.4	5	.2		77.1	45.2			5.7	66	
**B8	242	MUWX	2-11-63	7.2	2.0	11.9	2.9					19.7	5			77	42			5.9	66	0
*B9	323	MUWX	11-28-68	43	2.9	12	4.9	4.0	2.6	47	0	15	3.2	.2	.1	108	50		131	5.9	66	0
**B9	323	MUWX	6-9-66		4.0								3.0							6.0		0
C1	965	LWCX	8-6-81	11.2	.9							7	2	.13		156	29		240	7.2	75	
*C1	965	LWCX	5-22-69	18.0	1.5	12	2.9	38	3.8	142	0	6.6	3.1	.1	.1	159	42		245	7.7	73	15
**C1	965	LWCX	3-4-70	3.2	1.0	12	1.9	38.8	2.7			6.6	5	.1		132	38			7.3	73	5
C2	110	WNSB	5-3-82	24.0	11.2							57	2	.4		199	137		290	7.2	70	140
*C2	110	WNSB	9-12-68	48.0	21	32	13	80	4.9	36	0	120	5.5	.1	0	250	134		342	6.4	66	5
C3	60	WNSB	5-3-82	28	1.8							12	1.5	.5		192	134		280	6.6	72	90
C4	400	MUWX	4-29-82	28	.3							18	4.5	.3		214	172		330	7.2	72	0
C5	250	MUWX	4-29-82	28	.3							17	7	.4		110	90		170	6.9	68	0
C7	1,050	LWCX	3-2-83	17	2.8							10	11	.23		104	28		160	6.7	75	250
D1	925	LWCX	8-6-81	9.0	6.0							3	5	.12		79	23		120	6.1	73	
**D1	925	LWCX	1-22-71	2.4	6.0	3.6	1.5	29.1	0			26	5	0		106	15			6.1		5
D2	844	LWCX	8-6-81	7.5	3.0							5	4	.125		79	20		120	5.8	78	
D3		LWCX	8-6-81	1.2	7.0							4	4	.1		32	8		50	7.3	66	
D4	144	MUWX	3-2-83	13	0.8							7	3.5	.26		97	22		150	7.4	58	10
*D6	233	MUWX	9-12-68	50	11	21	9.1	11	3.9	44	0	5.4	2.2	0.1	0.1	100	57		142	6.4	68	5
*E1	639	MUWX	4-21-69	26	0.1	3.3	0.2	75	2.5	186	0	18	1.7	0.1	0.3	219	9		322	7.5	70	5
**E1	639	MUWX	8-27-71		0.3	0	2.4	78	3.2			20.7	6	0	0	193	100		154	7.3		0
E2	625	MUWX	5-11-82	29	0.32							18	1	0.1		192	40		280	7.7	78	0
*E3	351	KOSC	2-15-67	28	5.8	16	4.1	5.5	2.6	74	0	5.4	2.2	0.1	0.1	101	0		142	6.4	70	5
E4	300	KOSC	5-27-82	30	0.32							17.0	2	0.26		195	80		300	7.8	76	50
E5	400	WNSB	5-25-82	27	0.09							14	2	0.37		195	32		300	7.8	77	50
E6	440	WNSB	5-27-82	25	0.1							7	1.5	0.42		260	40		400	7.6	76	0
F1	38	KOSC	5-6-82	10.4	0.2							6	4.5	0.27		26	50		40	5.8	72	40
F4	150	WNSB	5-6-82	28	0.4							26	1.5	0.12		201	215		310	7.2	71	0
G1	362	MUWX	5-6-82	13.6	0.3							23	2	0.13		169	270		260	7.4	72	0
*G1	362	MUWX	11-28-67	53	1.1	14	2.4	7.6	2.7	54	0	9.8	3.5	0.2	0.1	120	45		138	6.1	66	
G2	373	MUWX	5-6-82	13.2	2.2							12	5	0.14		79	78		120	6.2	71	0
*G3	81	KOSC	9-12-68	7.9	4.5	1.2	0.5	3	0.4	10	0	0.2	2.9	0	0.4	22	5		25	6.7	66	5
*G4	110	WNON	5-15-69	32	0.2	50	11	12	5.8	228	0	12	3.1	0.1	1.5	240	170		386	7.7	66	5
G6	260	WNSB	8-10-82	20	0.35							14	0.5	0.5		195	280		300	7.2	79	40
G7	150	WNSB	8-10-82	7.5	0.5							13	4	0.3		227	149		350	7.4	80	0
G8	195	WNSB	8-10-82	12	0.1							18	3	0.4		234	90		360	7.5	78	0
G9	200	WNSB	8-10-82	22	0.05							18	1	0.5		234	168		360	7.4	75	10
G10	300	WNSB	8-10-82	24	0.1							14	3	0.4		211	125		325	7.6	78	0
G11	295	WNSB	8-10-82	22	0.4							17	1	0.5		170	65		262	7.2	81	100
G12	200	WNSB	8-10-82	25	0.1							23	3.5	0.4		247	149		380	7.3	76	0
G14	260	KOSC	8-10-82	26	0.1							27	2.5	0.3		209	155		320	7.5	82	0
G16	260	KOSC	8-10-82	31	0.8							12	4.5	0.4		234	170		360	7.3	79	0
*G17	310	MUWX	2-15-67	28	3.9	12	2.4	9.5	4.2	59	0	10	3.6	0.1	0.2	99	40		133	6.3	70	10
**G18	320	MUWX	12-2-60	8.8	1.0	15	2.5					19.1	7	0.2			48			5.9	70	
**G19	323	MUWX	2-20-67	1.6	1.0	8	5.4	15.4				18.6	9	0		86.8	42			5.9	66	5
G21	Spring	WNON	3-2-83	8.0	0.35							2.0	2.5	0.12		21	8		32	8.2	62	200
G22	Spring	KOSC	3-2-83	7.0	0.75							8.0	3.5	0.125		30	13		45	8.0	62	150
H1	165	MUWX	8-6-81	8.8	3.0							2.5	4	0.1		71	30		110	6.2	72	
H3	280	MUWX	8-6-81	10	0.8							24	3	0.2		195	105		300	6.4	72	
H4	87	TLLT	5-3-82	10.4	0.2							8	1.5	0.3		26	48		41	5.8	72	0
H5	Spring	TLLT	11-15-82	17.0	0.09							4	3	0.5		52	10		80	6.6	54	80
H6	Spring	TLLT	1-25-83	11.0	0.3							9	4	0.1		8	12		12	8.2	55	50
H7	Spring	TLLT	1-25-83	12.5	0.7							6	3	0.2		21	14		32	8.2	60	170

TABLE 2
Continued

Dissolved constituents and hardness given in milligrams per liter

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
J1	496	KOSC	5-14-82	29.5	1.4							20	1	0.35		195	122		300	6.8	76	20
**J1	496	KOSC	12-5-66		3.0								9				120			6.4	68	
**J2	496	KOSC	3-4-70	4.8	2.0	38.4	5.8	1.8			8.07	4	0			168	120			6.4	67	5
J4	182	CCKF	5-25-82	17.5	0.3							9	1	0.2		26	30		42	5.4	78	10
J5	680	WNSB	5-25-82	19.5	0.13							8	0.5	0.7		326	22		500	7.8	74	10
K1	477	MUWX	5-19-82	29.5	0.5							11	5	0.25		97	80		150	6.9	78	50
K2	125	CCKF	5-11-82	7.5	0.05							10	0.5	0.26		9	90		13	5.2	72	0
*K3	98	CCKF	9-12-68	22	14	4	0.7	2.2	1.0	22	0	0.2	3	0	0	44	13		46	6.6	68	10
*K4	330	WNSB	5-19-82	24.5	0.12							6	3	0.25		169	50		260	7.8	76	40
K5	135	KOSC	5-19-82	25	11.2							13	6	0.23		104	82		160	6.6	70	0
**K7	310	KOSC	12-2-60	6	0.5	28	2.6					6.4	6				81			6.2	68	
*K8	312	KOSC	2-14-67	36	0.49	32	3.4	8.6	2.5	115	0	9.8	4.6	0.1	0.1	154	94		220	6.1	68	10
**K9	1,880	LYCX	10-17-74		2.6	3.0	2.2	47	3.8			20.4	13	0.2		161.5	16.6			6.9		
**K11	311	KOSC	10-7-70	4.4	0.3	28	3.9	12.5	2.25			9.8	7	0		125.6	86			6.2		5
L1	40	KOSC	5-3-82	7.6	2.7							3	2.5	0.27		59	55		90	6.7	70	140
L2	240	WNSB	5-11-82	27.0	0.4							6.5	1.2	0.3		179	60		275	7.8	78	0
**L3	422	MUWX	2-2-67		1.6								40				39			7.3		
*L4	440	MUWX	11-15-66	39	1.6	6.2	1.7	42	3.8	118	0	14	3.6	0	1.2	170	22		215	7.1		5
*L5	88	KOSC	2-15-67	17	0.07	5.4	2.1	20	1.8	8	0	20	25	0.1	6.0	101	22		162	5.1	68	10
**L6	50	KOSC	12-2-60	3.6	0.2	5.4	1.8					16.3	18	0.2		64				5.2		
M1	130	MUWX	8-7-81	2.6	0.1							17	3	0.25		214	55		330	7.5	66	20
**M1	130	MUWX	8-20-70	3.2	0.2	15.6	4.6	50.1	5.5			40.6	4	0		199	58			7.6		5
M2	250	MUWX	8-7-81	10.8	0.15							20	2	0.15		240	105		370	6.8	72	20
M3	145	MUWX	11-15-82	22.8	0.1							20	2.5	0.5		159	60		260	6.3	60	0
M4	263	MUWX	8-7-81	10.8	0.2							14	3	0.17		162	75		250	6.2	68	20
M5	260	MUWX	8-7-81	10.8	0.15							10	2	0.3		199	98		290	6.6	68	10
M6	200	MUWX	8-7-81	15.6	0.05							7	2	0.2		221	92		340	6.2	68	20
M7	180	MUWX	8-7-81	14.4	0.1							7	1	0.25		214	90		330	7.0	68	20
*M8	180	MUWX	9-12-68	49	5.6	22	5.6	11	2.8	98	0	22	3.3	0.1	0.1	164	78		214	6.8	66	15
N1	180	CCKF	11-15-82	18	0.12							16	2.5	0.13		104	85		160	6.2	55	10
N2	200	CCKF	5-19-82	25.5	0.28							80	2.5	0.25		370	310		570	7.5	72	50
N4	242	CCKF	11-15-82	17	0.12							33	1.5	0.12		20	260		32	5.8	55	0
*N4	242	CCKF	9-12-68	37	0.8	29	3.8	8.5	3.2	110	0	15	4.8	0.1	0.2	156	88		233	7.2	64	5
N5	195	CCKF	11-15-82	19	0.5							24	7.5	0.12		110	81		170	7.1	52	280
N6	206	CCKF	11-15-82	24	0.5							18	5.0	0.5		14	55		22	5.8	55	30
N7	250	CCKF	5-19-82	22	1.2							5	2.5	0.13		44	81		68	7.3	76	60
N8	175	CCKF	5-19-82	24.5	0.33							23	3.5	0.25		94	74		130	7.3	76	0
O1	434	KOSC	6-1-82	23	0.7							15	0.5	0.12		143	85		220	6.5	74	20
O2	105	CCKF	6-1-82	25	0.8							10	1	0.12		143	106		220	7.0	80	0
P1	245	KOSC	6-1-82	30	0.56							12	1.5	0.13		102	90		158	6.0	80	20
P2	380	WNSB	6-1-82	27	0.05							4	3.5	0.2		224	89		345	7.6	76	0
P3	340	WNSB	6-1-82	19.5	0.13							7	0.5	0.25		199	46		305	7.8	77	0
P4	300	WNSB	6-1-82	27.5	0.12							5	3	0.25		209	60		320	7.8	74	0
P5	270	KOSC	6-1-82	26	0.36							14	0.5	0.2		126	100		185	7.5	80	10
P6	110	CCKF	11-15-82	32	0.09							9	2.5	0.3		136	70		210	6.2	60	30
*P6	110	CCKF	9-12-68	19	0.4	3.9	0.5	1.5	0.8	14	0	0.6	2.8	0	0.4	36	12		39	7.1	66	5
Q1	430	WNSB?	11-15-82	28	0.08							14	2	0.32		162	87		250	6.1	55	10
Q2	430	WNSB?	11-15-82	32	0.08							10	1	0.33		143	72		220	6.2	57	0
Q3	322	WNSB?	3-9-83	38	0.09							18	1	0.25		157	80		235	6.5	53	10
Q4	420	WNSB?	3-9-83	15	0.06							19	1.5	0.12		201	20		294	6.9	54	10
Q5	349	WNSB?	3-9-83	22	0.11							16	1.0	0.125		192	29		280	7.4	55	0
*Q6	340	MUWX	9-12-68	13	0.09	6.1	0.4	56	1.5	147	0	14	2.2	0.1	2.3	168	17		273	7.9	66	5

and have a relatively predictable occurrence. Considerable differences in the water-bearing characteristics of the sands are common due to variations in thickness and grain size. These and other factors such as shape and sorting of the sand grains and the presence of clay or silt result in a variable permeability among the aquifers from place to place. In some areas located at lower elevations, ground water may seep out onto the surface through springs. Flow from these springs is minimal and ultimately dependent on precipitation.

The principal source of ground water recharge of the aquifers in the county is precipitation on the outcrops of permeable strata. From the outcrops, subsurface water movement is generally in a southwestward direction.

Fresh water in Newton County is available to a maximum depth of more than 2500 feet. The base of the Wilcox Group generally marks the base of fresh water (Figure 3). The lower Wilcox aquifer is the only relatively undeveloped aquifer in the county. This aquifer has the best potential of any ground water source in Newton County because of the excellent quantity of water available from it. Rural self-supplied wells in the county average 200 to 300 feet in depth, and therefore do not tap the lower Wilcox. Large capacity municipal and public supply wells are generally deeper and usually yield water of superior quality and quantity in relation to the shallower aquifers.

The Meridian - upper Wilcox aquifer is a water-bearing sand which includes the Meridian Sand and underlying hydraulically connected sands in the upper part of the Wilcox Group. This aquifer is extremely irregular in both thickness and lithology. The Meridian Sand crops out in the northeastern corner of Newton County and has an average thickness of about 25 feet throughout the county. In some areas where sand occurs in the upper part of the Wilcox Group, the aquifer system can reach a thickness of 100 feet or more. The Meridian - upper Wilcox is the most utilized aquifer in Newton County. It is the principal source of water for Union, Decatur, and Chunky. It is also extensively tapped for domestic supplies throughout the northeastern two-thirds of the county.

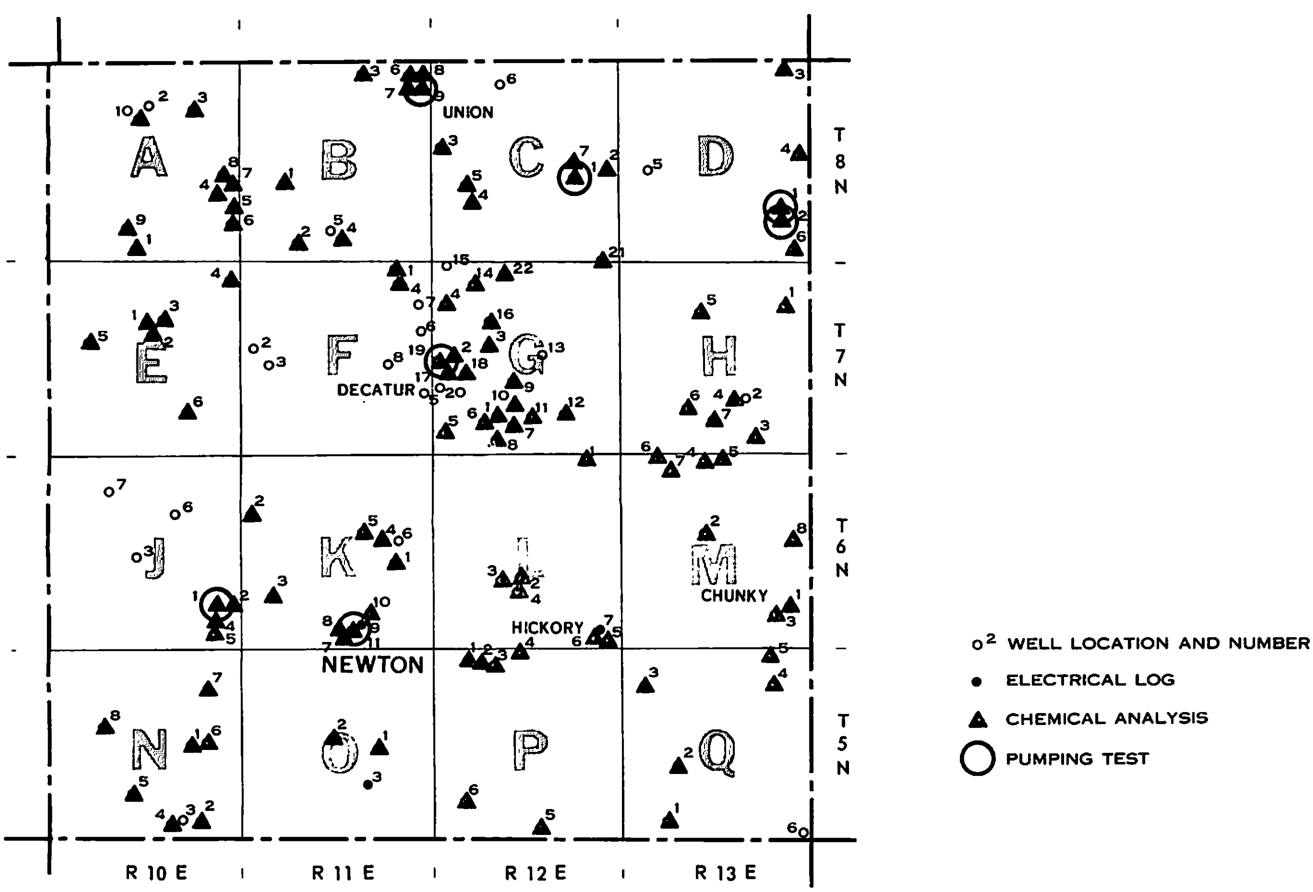

Figure 2 — Location of selected wells in Newton County, Mississippi.

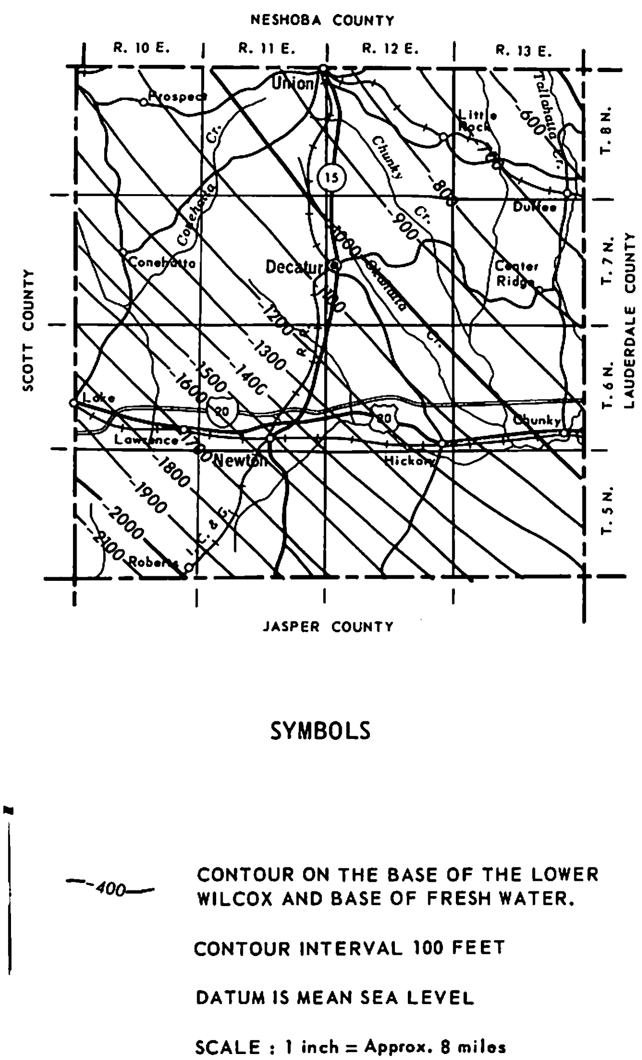

Figure 3 — Configuration of the base of the lower Wilcox aquifer in Newton County, Mississippi.

The Winona - Tallahatta aquifer is a water-bearing zone which includes the Winona Formation and the Basic City Shale and Neshoba Sand members of the Tallahatta Formation. The Winona Formation is composed of medium- to coarse-grained, very glauconitic sand and averages about 15 feet in thickness. It is commonly referred to as the "greensand" by well drillers in the Newton County area. The Basic City Shale Member of the Tallahatta Formation is generally an aquiclude, being composed primarily of glauconitic clay and claystone. The Neshoba Sand Member of the Tallahatta Formation is a fairly coarse, glauconitic sand that is irregularly connected to the Winona Formation in some areas. In these areas, these two units are combined and referred to as the Winona - Neshoba aquifer. The Winona - Tallahatta aquifer system is an important source of ground water for small domestic wells in northern Newton County. Although the aquifer is generally not capable of yielding large quantities of water, it is extensively tapped because the water is usually suitable for most uses without treatment.

The Kosciusko (Sparta) Formation crops out in central Newton County as a wide diagonal band running northwest to southeast. Boswell et al. (1970) stated that the Kosciusko is 100 feet thick near the Alabama - Mississippi state line in Clarke County. The thickness near the outcrop increases northwestward to about 200 feet in northern Newton County. Luper and Baughman (1972) indicated the Kosciusko is 200 feet thick in Smith County. The Kosciusko is an excellent aquifer, generally capable of yielding large quantities of water. However, high iron concentrations make treatment necessary for public supply.

The Cockfield Formation crops out in a wide band across southwestern Newton County. Boswell et al. (1970) stated that the Cockfield is slightly less than 100 feet thick at the Alabama - Mississippi state line in Clarke County. It thickens southwestward to about 350 feet in Scott County. The Cockfield is the primary source of water for domestic wells in southwestern Newton County. High iron concentrations are common in most places, making treatment necessary for public supply. Large quantities of ground water at shallow depths in this area make the Cockfield an excellent source of water for rural uses.

Ground Water Quality

The variation of chemical quality of ground water may be the result of either the minerals in the sand in which it is found or contamination by man-made pollutants. The quality of water is the most important property when considering uses for it. Good quality water is essential for most municipal and domestic uses, and it is not unusual for the quality of the water to vary within a small geographic region. Table 2 shows selected available chemical analyses of water from wells in Newton County.

Most of the ground water produced in Newton County is a soft, sodium - magnesium bicarbonate type, with the exception of water produced from the Cockfield and Meridian - upper Wilcox aquifers. Water from these aquifers is of the calcium - bicarbonate type. The calcium and magnesium are the chief minerals in water causing hardness. Hard water leaves a scale in water pipes and hot water heaters. The most common demonstration of hard water is the amount of soap needed to produce suds. All of the calcium and magnesium minerals causing the hardness must be removed before sudsing can be achieved. Water with a hardness of less than 50 mg/l

TABLE 3
Rural And Municipal Water Association Wells In Newton County, Mississippi

WELL NO.	OWNER	ELEVATION (FT.)	WELL DEPTH (FT.)	CASING (IN.)	SCREEN LENGTH (FT.)	AQUIFER	STATIC WATER LEVEL (FT.)	YIELD (GPM)	ANALYSIS NO.
B8	Town of Union Well #3	476	242	16	50	MUWX	93	369	B8
B9	Town of Union Well #4	471	323	12	50	MUWX	107	520	B9
C1	Beulah-Hubbard Water Association	525	974	8	44	LWCX	205	105	C1
D1	Duffee Water Association Well #1	460	925	8	50	LWCX	152	150	D1
D2	Duffee Water Association Well #2	420	760	8	40	LWCX	110	150	D2
G2	Town of Decatur Well #4	455	414	12	60	MUWX	116	350	G2
G19	Town of Decatur Well #3	415	323	12	20	MUWX	82	212	G19
J1	Lawrence Water Assoc.	493	496	8	50	KOSC	175	---	J1
K8	City of Newton Well #2	405	312	12	60	KOSC	102	---	K8
K9	City of Newton Well #4	486	325	16	50	KOSC	154	450	K9
K11	City of Newton Well #3	405	311	18	40	KOSC	100	548	K11
L6	Town of Hickory Well #2	325	56	10	45	KOSC	10	90	L6
L7	Town of Hickory Well #3	324	424	8	50	MUWX	10	230	
M1	Chunky Water Association	323	139	8	30	MUWX	14	80	M1
O1	South Newton Water Association	442	407	10	40	KOSC	125	200	O1

is considered soft and water with a hardness of 50 to 150 mg/l is considered hard. A hardness of more than 200 mg/l would require treatment by the lime - soda ash or iron exchange method to remove excessive hardness before it could be considered satisfactory for use.

High total dissolved solids in ground water prohibits its use for a variety of industrial purposes such as air conditioning, baking, canning, laundering, raw water ice, and tanning (Table 4). High total dissolved solids is generally not a common problem in ground water produced in Newton County. All of the one hundred four wells sampled contained total dissolved solids less than 500 mg/l (Table 2). Total dissolved solids in the 500 to 1000 mg/l range contain minerals which give the water a disagreeable taste and is generally considered unsatisfactory for most uses without treatment. High total dissolved solids content of water is potentially corrosive to metal pipes and fixtures.

The pH of ground water in Newton County ranges from acidic to slightly alkaline (4.8 to 7.8). Low pH (acid) water is generally the result of excessive carbon dioxide in the water and is usually associated with shallow wells located at or near the outcrop area. Acid water corrodes metal and is detrimental to casing and plumbing systems.

Water with an iron concentration above 0.3 mg/l is the most persistent complaint among water well owners in the county. High iron concentration is the most common problem in water from every aquifer tapped in Newton County, causing rust deposits in sinks and tubs and eventual clogging of pipes and pumps. Concentrations as high as 2.0 mg/l are found in water produced from Kosciusko, Meridian - upper Wilcox and lower Wilcox aquifers. Aeration is the usual treatment for water containing high iron concentrations (> 0.3 mg/l) and is commonly used by municipal, industrial, and rural water systems throughout the county.

Test Drilling

The Bureau of Geology drilled a total of 21 test holes in Newton County which were beneficial in identifying aquifers. All of these test holes were logged with either a "single point" or "multi-point" electrical logger, and samples of cuttings were col-

TABLE 4
Water Quality Tolerances For Industrial Applications

(American Water Works Association, 1950, Water quality and treatment, p. 67, table 3-4, Remarks: A, no corrosiveness; B, no slime formation; C, conformance to Federal drinking-water standards; D, Al_2O_3 less than 8 ppm, SiO_2 less than 25 ppm, Cu less than 5 ppm. Chemical constituents in parts per million.)

Industrial Use	Turbidity	Color	Fe	Mn	Fe +Mn	Hardness	Alkalinity	pH	Total solids	Remarks
Air Conditioning1/	...	...	.5	.5	.5	...	...	...	...	A,B
Baking	10	10	.2	.2	.2	2/	...	...	...	C
Boiler feed:										
0-150 psi	20	80	...	...	...	75	....	8.0+	3000-1000	
150-250 psi	10	40	...	...	...	40	...	8.5+	2500-500	
250 psi and up	5	5	...	...	...	8	...	9.0+	1500-100	
Canning:										
Legumes	10	...	.2	.2	.2	25-75	...	...	...	C
General	10	...	.2	.2	.2	...	...	...	...	C
Carbonated beverages3/	2	10	.2	.2	.3	250	50	...	850	C
Confectionary	...	...	.2	.2	.2	...	...	4/	100	...
Cooling5/	50	...	.5	.5	.5	50	...	...	...	A,B
Ice (raw water6/)	1-5	5	.2	.2	.2	...	30-50	...	300	C
Laundering	...	...	.2	.2	.2	50	...	...	...	
Plastics, clear, uncolored	2	2	.02	.02	.02	...	...	...	200	
Paper and pulp7/										
Groundwood	50	20	1.0	.5	1.0	180	...	...	...	A
Kraft pulp	25	15	.2	.1	.2	100	...	...	300	
Soda and sulfite	15	10	.1	.05	.1	100	...	...	200	
Light paper, HL-grade	5	5	.1	.05	.1	50	...	...	200	B
Rayon (viscose) pulp:										
Production	5	5	.05	.03	.05	8	50	...	100	D
Manufacture	0.3	...	.0	.0	.0	55	...	7.8-8.3	...	
Tanning8/	20	10-100	.2	.2	.2	50-135	135	8.0	...	
Textiles:										
General9/	5	20	.25	.25	...	20	...	...	...	
Dyeing	5	5-20	.25	.25	.25	20	...	...	...	
Wool scouring10/	...	70	1.0	1.0	1.0	20	..	...	...	
Cotton bandage	5	5	.2	.2	.2	20	...	...	...	

1/ Waters with algae and hydrogen sulfide ordors are most unsuitable for air conditioning.
2/ Some hardness desirable.
3/ Clear, ordorless, sterile water for syrup and carbonation. Water consistent in character. Most high-quality filtered municipal water not satisfactory for beverages.
4/ Hard candy requires pH of 7.0 or greater, as low value favors inversion of sucrose, causing sticky product.
5/ Control of corrosion is necessary as is also control of organisms, such as sulfer and iron bacteria, which tend to form slimes.
6/ $Ca(HCO_3)_2$ particularly troublesome. $Mg(HCO_3)_2$ tends to greenish color. CO_2 assists to prevent cracking. Sulfates and chlorides of Ca, Mg, Na should each be less than 300 ppm (white butts).
7/ Uniformity of composition and temperature desirable. Iron objectionable since cellulose absorbs iron from dilute solutions. Manganese very objectionable, clogs pipelines and is oxidized to permanganates by chlorine, causing reddish color.
8/ Excessive iron, manganese, or turbidity creates spots and discoloration in tanning of hides and leather goods.
9/ Constant composition; residual alumina less than 0.5 ppm.
10/ Calcium, magnesium, iron, manganese, suspended matter and soluble organic matter may be objectionable.

lected at 10-foot intervals. Identification of aquifers and their stratigraphic position and thickness was aided by the information obtained from the drilling of these test holes.

Aquifer Tests

Aquifer tests are valuable in an area because they provide the only sound basis for the selection and purchase of a well pump. Properly planned and accurately measured pumping tests reveal important information about the aquifer itself. Such information cannot be gained otherwise and correct application of this information is essential in properly developing ground water for domestic, industrial, municipal, and rural water association supplies.

Some of the terms used in aquifer tests are as follows:

Well yield is the volume of water per unit of time discharged from a well, either by pumping or by free flow. Units are usually in gallons per minute (g.p.m.).

Specific capacity is the number of gallons per minute a well produces for each foot of drawdown, or lowering of the water level. It is usually expressed as gallons per minute per foot of drawdown (g.p.m./ft.).

Transmissibility is the rate of flow of water through a vertical section of an aquifer one foot wide under a hydraulic gradient of 1 foot per foot. Transmissibility is the index of an aquifer's ability to transmit water. Units are in gallons per day per foot (g.p.d./ft.).

Permeability is the rate of flow of water through a one-foot-square section of an aquifer under the unit hydraulic gradient of 1 foot per foot. It is commonly obtained by dividing the transmissibility by the aquifer thickness in feet. Its units are gallons per day per square foot (g.p.d./ft.^{2}).

Table 5 shows a summary of pumping test results on public supply wells in Newton County. Figure 2 shows the locations of the wells from which the results were obtained.

AQUIFERS

Lower Wilcox

The lower part of the Wilcox group is generally considered to be the deepest and most extensive aquifer system in Newton County. Cost due to drilling depth along with the availability of water from shallow aquifers has limited its development in this area. The aquifer is capable of adequately supporting additional municipal, public, rural, and industrial supplies and should prove to be a valuable source of ground water in the future.

Sediments composing the Wilcox Group are exposed in a broad arc that extends from Lauderdale to Tippah County in Mississippi. In the subsurface, the beds generally dip to the southwest at slightly more than 50 feet per mile in Newton County. Average thickness of the beds ranges from 200 to 400 feet. The Wilcox Group of Eocene age in Mississippi includes, in ascending order, the Nanafalia, Tuscahoma, Bashi, and Hatchetigbee formations. The lower formations of the Wilcox Group are well developed beds usually composed of coarse sand and fine gravel. The lower Wilcox aquifer is formed by these interconnected sand beds at the base of the lower Wilcox.

Presently the lower Wilcox aquifer in Newton County supplies two rural water associations with over 100,000 gallons of water per day. Transmissibilities for the lower Wilcox usually average about 25,000 gallons per day per foot (Table 5). Static water levels range from less than 275 feet to more than 325

TABLE 5
Summary Of Pumping Tests In Newton County, Mississippi
After Newcome, R., JR., 1971

WELL NO.	OWNER	DEPTH (FEET)	AQUIFER	AQUIFER THICKNESS (FEET)	SCREEN LENGTH (FEET)	PUMP. PERIOD (HOURS)	TEST YIELD (GPM)	SPECIFIC CAPACITY GPM/FEET 1-DAY	TRANSMISSI-BILITY GPD/FOOT	PERMEA-BILITY GPD/FT^2	TRANS-MISSIVITY FT2/D	HYDR. CONDUCTIVITY FT/D
B9	Town of Union	323	MUWX	105	50	1	520	20	40,000	380	5300	50
C1	Beulah-Hubbard Water Assoc.	965	LWCX	55	44	1	150	--	25,000	450	3300	60
D1	Duffee Water Association	965	LWCX	200+	50	2	174	19	270,000	---	36,000	250
D2	Duffee Water Association	860	LWCX	200+	40	1	150	37	------	---	----	--
G19	Town of Decatur	323	MUWX	36	20	1	280	4.6	9,000	250	1200	33
J1	Lawrence Water Association	496	KOSC	110	40	1	168	8.2	44,000	400	5800	53
K11	City of Newton	311	KOSC	40	40	1	360	6.9	30,000	750	4000	100

feet above sea level. Large volumes of water are available from properly constructed wells in the lower Wilcox. Yields as high as 1000 gallons per minute or more are possible from the lower Wilcox aquifer.

The lower Wilcox aquifer contains a soft sodium bicarbonate type water which can be used for most municipal, domestic, and public supplies without major treatment. Total dissolved solids are generally less than 150 mg/1. Water from the lower Wilcox has a pH between 5.8 and 7.7, with higher pH values expected downdip from the outcrop area. The concentration of iron in water produced from the lower Wilcox is high. All of the wells sampled in Newton County contained iron concentrations exceeding 0.3 mg/1. Farther downdip, however, the iron concentrations are expected to decrease to less than 0.3 mg/1.

Meridian - upper Wilcox

The Meridian - upper Wilcox aquifer system comprises the Meridian Sand and the discontinuous, hydraulically connected sand beds in the upper part of the Wilcox Group. The aquifer is extremely irregular in thickness and lithology. Boswell et al. (1970) stated that the Meridian Sand crops out in Newton, Clarke and Lauderdale counties and attains a maximum thickness of about 100 feet in Lauderdale County. The Meridian is generally thinner in the subsurface in Newton County, reaching a maximum thickness of about 40 feet; however, where sand occurs in the upper part of the Wilcox, the aquifer system may be as thick as 100 feet or more.

Boswell (1976b) indicated that the Meridian - upper Wilcox aquifer supplies over 350,000 gallons of ground water per day to several municipal and rural water systems in Newton County. Wells completed in the Meridian - upper Wilcox are from less than 150 feet deep in northeastern Newton County to more than 950 feet deep near the Conehatta community in west-central Newton County. Transmissibilities for the Meridian - upper Wilcox aquifer range from 9000 to 40,000 gallons per day/foot (Table 5). Static water levels are from less than 325 feet to more than 400 feet above mean sea level. Yields of more than 500 gallons per minute are common from properly constructed wells, but most wells produce less than 100 gallons per minute. The Meridian - upper Wilcox is the most utilized aquifer in the county. It is the principal source of water at Union, Decatur, and Chunky.

Water produced from the Meridian - upper Wilcox in Newton County is soft and of the calcium - magnesium bicarbonate type. In most areas the water is of good quality. Total dissolved solids in water produced from the Meridian - upper Wilcox are as low as 52 mg/1 and as high as 985 mg/1.

Water produced from the Meridian - upper Wilcox has a pH between 4.8 and 7.9. The low pH values are common in water produced from shallow wells near the outcrop area; farther downdip, the pH values increase to a maximum of 7.9. The concentration of iron in the Meridian - upper Wilcox is high. About 90 percent of the wells sampled in Newton County contained iron concentrations exceeding 0.3 mg/1.

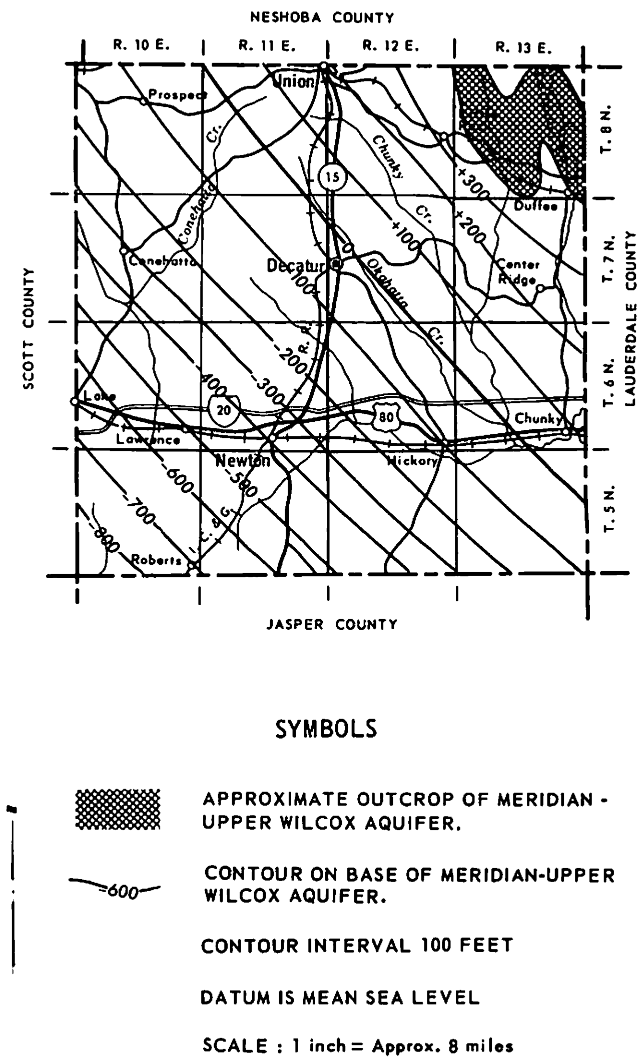

Figure 4 — Configuration of the base of the Meridian-Upper Wilcox Aquifer in Newton County, Mississippi.

Winona - Tallahatta

The Winona - Tallahatta aquifer system comprises the Winona Formation and the Basic City

Shale and Neshoba Sand members of the Tallahatta Formation. The Basic Shale Member is generally considered an aquiclude; however, irregular sand beds occur in the unit and a few wells produce very small quantities of water from these intervals in northwestern Newton County. The Neshoba Sand and the overlying Winona Formation are irregularly connected to form the Winona - Tallahatta aquifer system (Hosman et al., 1968). The Winona - Tallahatta aquifer is generally less than 50 feet thick and dips to the southwest at about 50 feet per mile in Newton County. This aquifer supplies numerous small self-supplied wells in the county. Yields are generally 5 to 10 gallons per minute. Boswell et al. (1970) stated that the maximum yield for the Winona - Tallahatta aquifer is probably not more than 100 gallons per minute.

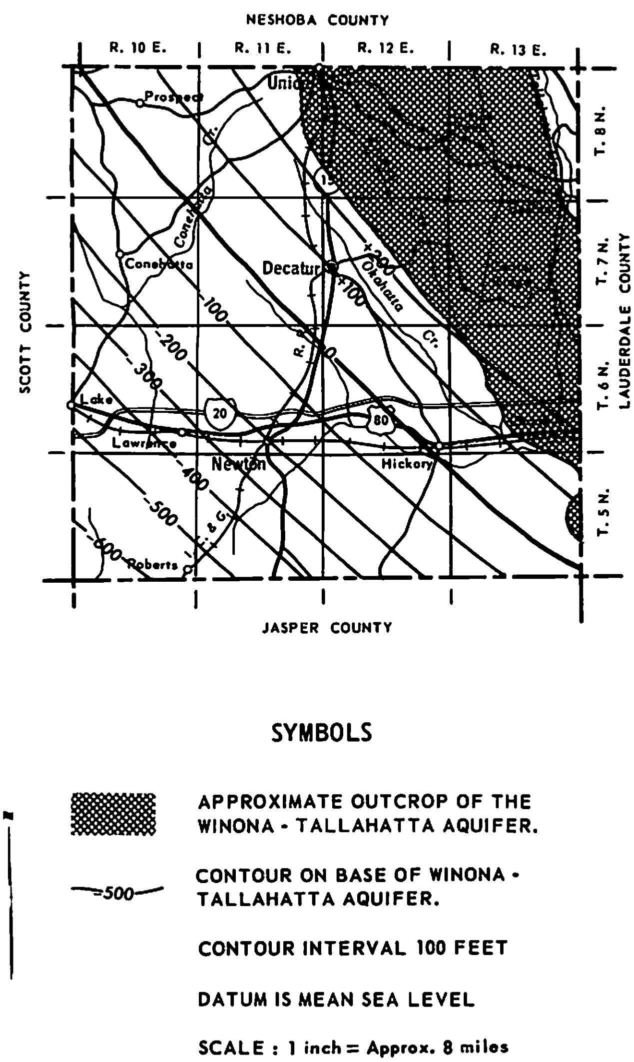

Figure 5 — Configuration of the base of the Winona-Tallahatta Aquifer in Newton County, Mississippi.

The Winona - Tallahatta aquifer contains a soft-sodium bicarbonate type water. It is extensively tapped in the northern half of the county because the water is usually suitable for general use without treatment. Total dissolved solids range from 49 mg/l to over 300 mg/l in Newton County. Water produced from the Winona - Tallahatta is generally noncorrosive (pH values range from 5.3 to 7.8). Excessive color is a common characteristic of the water in some locations. The water is highly mineralized in some areas but commonly does not contain iron. Over 60 percent of the wells sampled contained iron concentrations less than 0.3 mg/l.

Kosciusko (Sparta) Formation

The Kosciusko Formation crops out in a wide band across the central part of Newton County. It is underlain by the Zilpha Formation and overlain by the Cook Mountain Formation. The Zilpha and the Cook Mountain are both aquicludes and are easily identified in well cuttings. The Kosciusko Formation is composed principally of rounded, fine- to coarse-grained quartz sand. The sand grains are well sorted, providing a high permeability in the aquifer. Boswell et al. (1970) indicated that the Kosciusko is about 100 feet thick downdip from the outcrop area at the Mississippi - Alabama state line. The thickness increases westward to about 200 feet near the outcrop in northern Newton County. The formation thickens southwestward in the subsurface to about 500 feet in Smith County.

The Kosciusko Formation is an important aquifer in Newton County, supplying a large portion of the ground water needs across the southwestern half of the county. Wells completed in the Kosciusko are from 38 feet deep in north-central Newton County (Section 2, T.7N., R.11 E.) to 496 feet deep in southern Newton County (Section 25, T.6N., R.10E.). Static water levels for the Kosciusko wells range from less than 300 feet above sea level to more than 450 feet above sea level. Wells completed in the Kosciusko in Newton County have enough hydrostatic head to cause the static water level to rise within a few feet of the ground surface. Yields from these wells are as high as 500 gallons per minute, but most of the wells yield 10 to 50 gallons per minute. Transmissibilities for the Kosciusko aquifer in Newton County range from 30,000 to 44,000 gallons per day/foot (Table 5).

Wells completed in the Kosciusko aquifers in Newton County produce water of the sodium - bicarbonate type. The water is generally of good quality and is suitable for most uses after some minor treatment. Total dissolved solids are commonly low, averaging between 17 mg/l and 227 mg/l. Water produced from the Kosciusko in Newton County is acidic to slightly basic, ranging from 5.1 to 7.8 in pH.

The lower pH values are common at or near the outcrop area. Excessive color and high iron concentrations are the most common problems associated with water from the Kosciusko aquifers. Most of the wells sampled in the county averaged over 50 units of color. Iron concentrations as high as 4.0 mg/l can be expected from the Kosciusko at some locations. Over 80 percent of the wells sampled in Newton County contained iron concentrations exceeding 0.3 mg/l. These high iron concentrations and excessive color make treatment necessary for public supply and for some industrial uses.

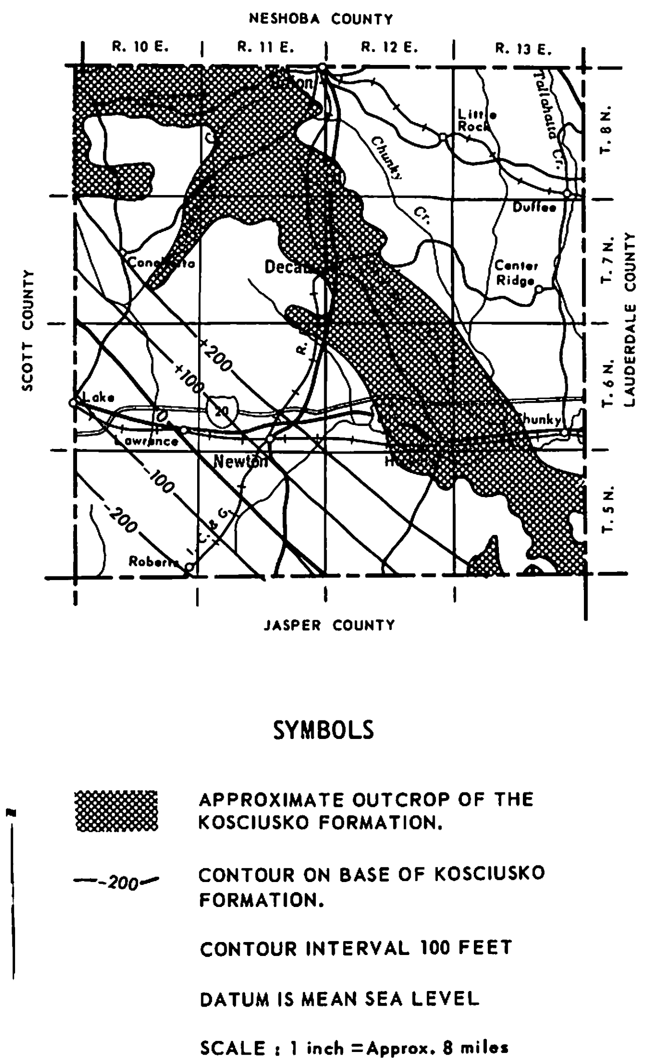

Figure 6 — Configuration of the base of the Kosciusko Formation in Newton County, Mississippi.

Cockfield Formation

The Cockfield Formation is exposed at the surface in southwestern Newton County and is commonly composed of fine- to medium-grained sand, sandy clay, and clay. It is underlain by the Cook Mountain Formation and overlain by the Moodys Branch and Yazoo Formations of the Jackson Group. Deposits of the Jackson Group and the Cook Mountain Formation act as excellent confining beds for water in the Cockfield Formation. Boswell et al. (1970) stated that the Cockfield is slightly less than 100 feet thick at the Alabama - Mississippi state line. It thickens northwestward to about 350 feet in Scott County. The average thickness in Newton County is about 175 feet.

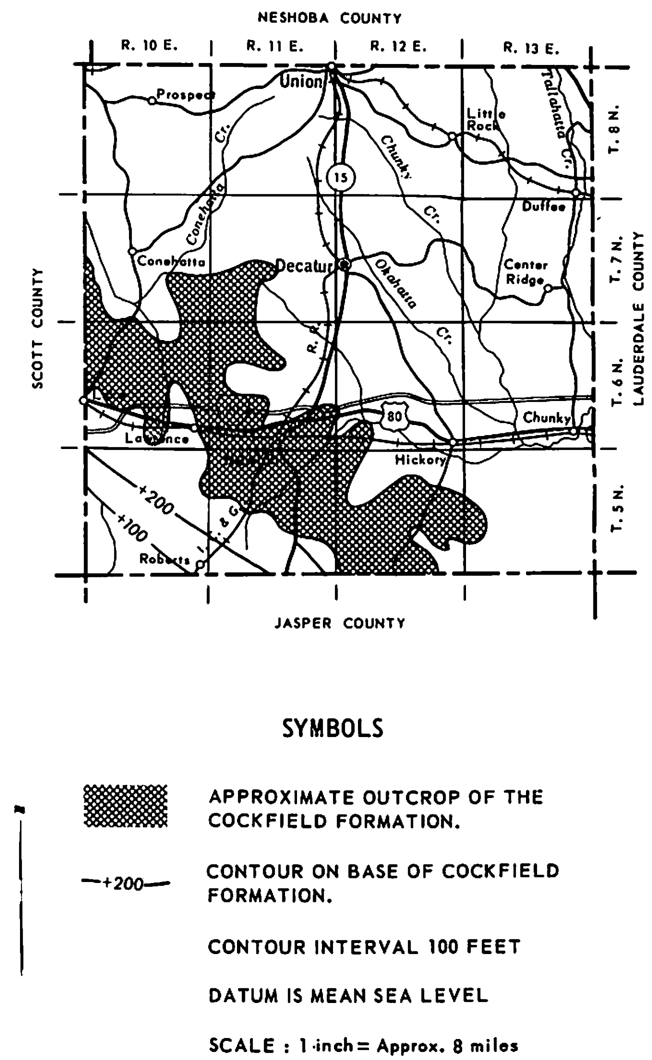

Figure 7 — Configuration of the base of the Cockfield Formation in Newton County, Mississippi.

The Cockfield aquifers are an important source of water for small domestic wells in southwestern Newton County. These aquifers are the shallowest dependable sources of ground water in the southwestern half of the county. Wells completed in the Cockfield supply numerous rural individuals water in the area. Wells completed in the Cockfield range from 98 feet deep (Section 30, T.6N., R.11E.) to 250 feet deep (Section 11, T.5N., R.10E.). Static water levels for the Cockfield range from less than 350 feet above sea level to more than 400 feet above sea level. Yields are generally less than 100 gallons per minute even though the aquifers are capable of producing much more water.

Water produced from the Cockfield in Newton County is of the calcium - magnesium bicarbonate type. Hardness ranges from 13 mg/1 to 310 mg/1, indicating a variable hardness in water produced from the Cockfield. Total dissolved solids are moderately low, ranging from 9 mg/1 to 370 mg/1. The pH of Cockfield water is between 5.2 and 7.5. Most of the pH values are expected to be less than 7.0 since water from the Cockfield is only available at or near the outcrop area in Newton County. Excessive color in the Cockfield is a problem locally. One Cockfield well in southwestern Newton County (Section 28, T.5N., R.10E.) produces water with a color index of 280 units. However, most of the Cockfield wells sampled in the county averaged less than 30 units of color. Iron concentrations in the Cockfield are also highest near the outcrop area, but the concentrations tend to decrease downdip to less than 0.3 mg/1.

Citronelle Formation

The Citronelle is generally not used as a source of ground water in Newton County. A few small, shallow, domestic wells are perhaps completed in the Citronelle, but none have been reported. The wells would be located at high elevations in areas where sand intervals in the formation are of sufficient thickness. These sand intervals are extremely erratic in thickness and lithology. The formation reaches a maximum thickness of about 90 feet in extreme southwestern Newton County. Recharge and water levels of the Citronelle vary due to seasonal climatic conditions.

Water quality from the Citronelle is expected to be poor, probably hard and acidic with high iron concentrations. Few deposits of Citronelle sand and gravel are present in Newton County; therefore, it is not considered an important source of ground water.

Terrace Deposits and Alluvium

A few bored or dug wells may be completed in terrace sands. These deposits consist of up to 20 feet of poorly sorted, fine- to coarse-grained sand and pebble-sized gravels. Alluvial deposits consist mainly of silt, sand, and gravel and are as much as 25 feet thick in the county. These deposits overlie the bedrock formations in flood plains of streams in most of the county. Neither the terrace nor alluvial deposits are continuous enough for extensive development as sources of ground water. Both deposits are water table aquifers and static water levels are dependent on precipitation. Few wells are made in these deposits due to poor water quality and low water levels during the dry season, but both can be utilized in areas where deposits are thick enough and suitable aquifer material is present.

Ground Water Conclusions

Newton County is endowed with great quantities of available ground water and the potential for ground water development is excellent. Present usage of ground water in the county accounts for only a small percentage of the total amount of ground water available. Minor treatment is required at some locations for some of the ground water produced from the aquifers presently used for water supply in the county. Ground water is the source of all water for municipal, industrial, and domestic supplies in Newton County. Newton, Decatur, Hickory, and Union are served by municipal water systems. Five rural water associations were serving areas of the county in 1985. Private water systems supply several industries in the county.

Ground water is available from sand intervals within the Wilcox Group, Meridian Sand, Tallahatta Formation, Kosciusko (Sparta) Formation, Cockfield Formation, Citronelle Formation, terrace deposits, and alluvium. Wells completed in these aquifers range from 38 feet to 1880 feet in depth, and yields over 500 gallons per minute were recorded. The majority of the ground water pumpage is from the Meridian - upper Wilcox and Winona - Tallahatta aquifers. The Meridian - upper Wilcox is the most utilized aquifer in the county. The lower Wilcox is the only underdeveloped aquifer in the county. Availability of shallow aquifers has limited its development as it is practically unused in central and southern Newton County. The Meridian - upper Wilcox and Kosciusko aquifers are the major aquifers in the central and southern parts of the county, while the Winona - Tallahatta and Cockfield aquifers are widely used for small to moderate yields in these areas. Both terrace deposits and alluvial deposits are discontinuous materials comprising water-table aquifers. These aquifers produce small amounts of poor quality water and are generally not considered as ground water sources.

Ground water quality in Newton County is generally good and acceptable for most uses. Water quality problems include excessive color, excessive iron concentrations, total dissolved solids greater than 300 mg/1, hardness approaching 300 mg/1, and

TABLE 6
Stream Gaging Station Locations In Newton County, Mississippi

REFERENCE NO.	STATION NO.	STATION NAME AND LOCATION	DRAINAGE AREA (Square Miles)	PERIOD OF RECORD (years)	MINIMUM FLOW IN C.F.S. (7-DAY AVERAGE)	MAXIMUM FLOW IN C.F.S. (7-DAY AVERAGE)
1	2-4752.9	Potterchitto Creek near Newton SW¼ sec. 28, T.6 N., R.11 E.	6		.52	
2	2-4753.5	Tarlow Creek near Newton W½ sec. 11 T.5 N., R.11 E.	15.9	1952-1968	0	4300
3	2-4753.9	Bethel Creek near Hickory sec. 26 T.6 N., R.12 E.	2.2	1943-1968	.1	
4	2-4752.2	Little Rock Creek at Little Rock sec. 30 T.8 N., R.13 E.	.22	1965-1980		40

low pH. Water quality is generally better downdip and at greater depths. Excessive iron content, low pH, and a high color index are the most common problems with ground water quality. The ground water problems can almost invariably be solved with minor treatment or selection of another aquifer. In most areas, water quality is good and treatment is not necessary.

SURFACE WATER

Introduction

Surface water is an important natural resource which can be used to meet large demands where ground water of sufficient quantity and quality is inadequate. Ample quantities of good quality surface water are not available in Newton County without storage facilities. Reservoir facilities on Tallahatta and Potterchitto creeks as well as the Chunky River would establish large supplies of water for industrial and recreational purposes, provided the quality requirements would be low enough to not require major treatment.

Most of the rivers and streams in Newton County experience low flows during dry weather periods. The primary reason for this is that these streams are located in the headwaters of major river basins and their drainage areas are small. As the flow of these streams approaches zero, the streamflow consists mainly of ground-water discharge. Runoff directly into the streams from the drainage area is responsible for high streamflows in times of heavy rainfall.

The chemical quality of the surface water in Newton County is variable within a small area due to factors such as high or low flow, the amount and content of the sediments transported by the stream, and man-made pollutants. Pollution is generally not known to be a problem except in areas where pesticides and herbicides have been used on a large-scale basis. Surface water quality tends to be best during times of high streamflow. Dissolved solids constituents tend to be higher when the streamflow is low, resulting in poor water quality.

Drainage

Newton County is located in the Pascagoula and Pearl River drainage basins (Figure 8). All of the county, with the exception of the northwest corner, lies within the Pascagoula River drainage basin. Conehatta and Tuscolameta creeks and their tributaries drain the northwest corner of the county and eventually empty into the Pearl River drainage basin. The Chunky River and its major tributaries, Potterchitto Creek, Little Rock Creek, Okahatta Creek, and Tallahatta Creek, drain the entire eastern two-thirds of the county. Chunky River is the largest stream in the county, draining over 360 square miles; it is formed by the junction of these tributaries two miles west of Chunky. Chunky River eventually combines with Okatibbee River to form the Chickasawhay River in Clarke County. Major drainages in the county include upstream tributaries of Potterchitto, Suinlovey, and Algood creeks in the south and upstream tributaries of West Tallahala Creek in the southwest corner.

Surface Water Availability

Utilization of surface water in Newton County is

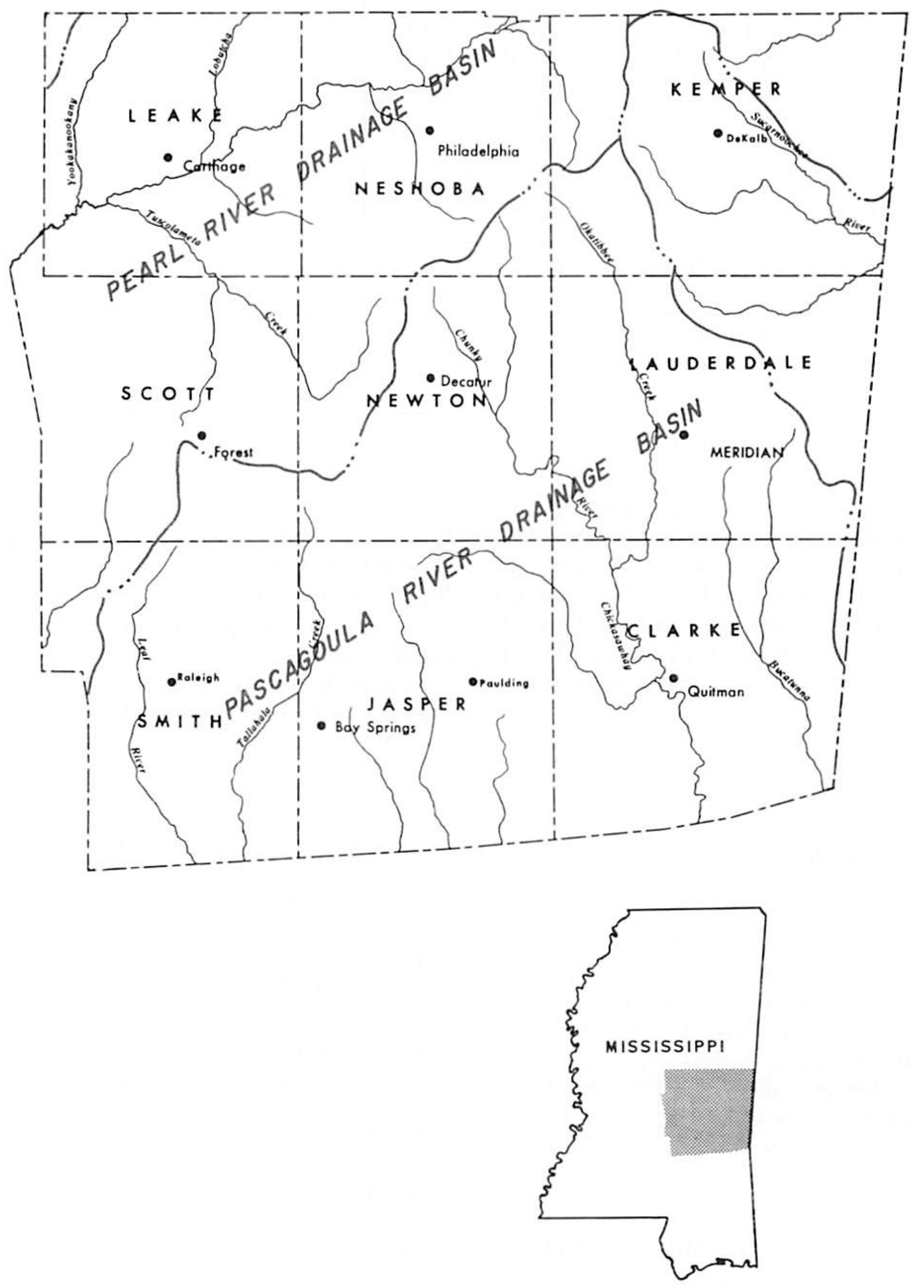

Figure 8 — Pearl River and Pascagoula River drainage basins and Newton County's location in the basins.

dependent on the construction of reservoirs as storage facilities in times of low stream flow. Chunky River in the eastern part of the county is the largest source of surface water in the county and could be used as a surface water source without impoundment provided the maximum demand during the dry season does not exceed the minimum streamflow. The minimum low flow reported on the Chunky River is 1.6 cubic feet per second, which was recorded on the Highway 80 stream gage in Lauderdale County. Most of the other streams in the county have little or no dry-weather flow.

The next largest sources of surface water in Newton County are the Tallahatta and Conehatta creeks. These are relatively small streams with small drainage areas and flow depends on the amount of precipitation in the immediate drainage basin. Annual low flow is generally less than 10 cubic feet per second (c.f.s.) for these streams, indicating that impoundment would be necessary to serve a large user. Other streams potentially capable of small surface water supply include Tuscolameta Creek, Tarlow Creek, and Potterchitto Creek, providing reservoirs are constructed to impound the water. Numerous smaller streams are present and provide for an intricate drainage system. Most of these small streams have low flows of zero or very near zero during the dry season.

Lakes in Newton County include Osborn Lake, Spring Lake, and County Pond. These lakes are relatively small, generally less than 5 acres in surface area. They are used for recreational purposes and thus have limited water supply potential.

Figure 9 shows the locations of thirty five surface-water samples collected for this investigation in Newton County. The water samples were analyzed "in the field" with a Hach colorimeter to determine physical and chemical properties such as temperature, specific conductance, total dissolved solids, pH, total hardness, and turbidity (Table 7). An analysis of high and low flow was chosen to represent varying conditions of streamflow.

The streams of Newton County contain water that is generally soft. Most of the samples ranged from 10 to 50 mg/1 in total hardness. The pH of the surface water varies with the season and stream-flow, but it is generally between 5.5 and 6.5 (Table 7).

Flood Hazard

Most of the streams in Newton County are subject to minor flooding during periods of excessive rainfall. Floods are most likely to occur in late winter and spring; however, record floods can and have occurred in practically every month of the year. Flood history should be considered before constructing any type of structure in the flood plain or near any stream. Information including flood records, flood maps, flood frequency curves, and flood profiles are available at the United States Geological Survey, Water Resources Division, Jackson, Mississippi. Listed in Table 6 is information recorded by the four stream gaging stations in Newton County. These stream gaging stations provide partial and continuous records of the maximum and minimum seven-day streamflow.

Unusual floods along Chunky River in recent years occurred in April 1900, in February and December 1961, and in April 1964. These floods along with other floods in the past have caused relatively light damage to crops, livestock, and communities located in areas adjacent to the river. Care should be exercised in building any type of structure in the flood plain of any of the streams, particularly that of the Chunky River.

Surface Water Conclusions

The major problems concerning surface water in Newton County include volume and occurrence. Surface water stored in reservoirs in any part of the county will be suitable for most uses after minor treatment provided man-made pollution is held to a minimum. The Chunky River is a potential source of large quantities of surface water. Smaller streams such as Tallahatta, Tuscolameta, and Potterchitto creeks could serve as reliable sources of surface water provided geologic conditions are suitable for impoundment.

Chemical quality of the surface water is good. The water is soft with low total dissolved solids and pH ranging from 5.5 to 6.5. The quality usually varies within a small area due to factors such as high and low flow, and man-made pollutants. Quality is usually best during times of high stream flow.

Presently, floods are not a major hazard as there is little industrial development along the streams. Much of the inconvenience of flooding can be avoided by careful selection of industrial sites. Construction of multi-purpose reservoirs in the county could reduce the potential for floods in the future.

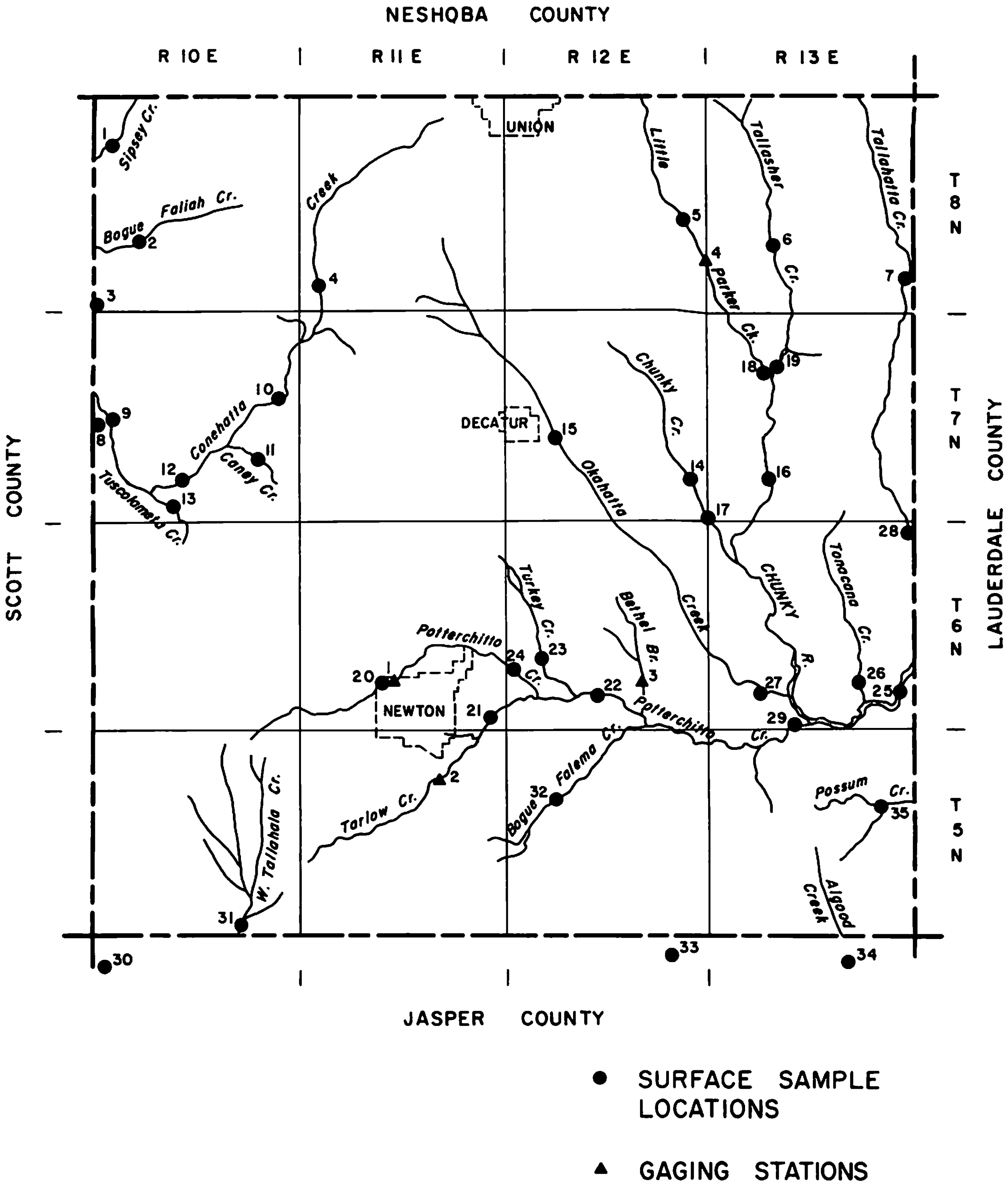

Figure 9 — Location of surface sample locations and gaging stations in Newton County, Mississippi.

TABLE 7
Surface Water Sample Analyses In Newton County, Mississippi

FILE NO.	DATE	NAME	TURBIDITY (FTU)	TOTAL HARDNESS	pH	TEMPERATURE °F	°C	SPECIFIC CONDUCTANCE	TOTAL DISSOLVED SOLIDS
1	5/14/81	Sipsey Creek	70	9	5.7	70	21	35	22
	9/16/82		42	46	6.4	78	25	42	26
2	5/14/81	Bogue Falich Creek	90	52	7.8	76	24	150	94
	9/16/82		55	48	6.2	78	25	100	63
3	5/14/81	Bollyhusha Creek	40	62	6.6	70	21	150	90
	9/16/82		18	85	6.9	79	26	190	119
4	5/25/81	Conehatta Creek	55	20	6.2	71	22	64	40
	9/21/82		142	43	5.9	75	24	120	75
5	5/25/81	Little Rock Creek	55	20	6.2	71	22	64	40
	9/21/82		20	33	6.6	73	23	90	56
6	5/25/81	Talleshue Creek	50	20	5.9	70	21	44	28
	9/21/82		30	27	6.7	74	23	56	35
7	5/25/81	Tallahatta Creek	50	12	5.6	72	22	41	26
	9/21/82		25	19	6.3	74	23	42	27
8	5/14/81	Tuscolomete Creek	55	22	7.7	68	20	66	41
	9/16/82		38	41	6.7	83	28	110	69
9	5/14/81	Tuscolomete Creek(Warrior Canal)	85	30	6.5	68	20	98	61
	9/16/82		65	39	6.4	80	27	110	69
10	5/15/81	Conehatta Creek	60	42	6.5	77	25	95	59
	9/16/82		65	50	6.3	78	26	105	65
11	5/14/81	Caney Creek	70	16	5.9	68	20	55	34
	9/16/82		55	20	6.6	87	31	60	37
12	5/14/81	Conehatta Creek	55	28	6.1	72	22	79	49
	9/16/82		40	47	6.3	83	28	105	65
13	5/14/81	Tuscolomete Creek	55	22	5.8	68	20	63	39
	9/16/82		40	55	6.5	80	27	140	87
14	5/15/81	Chunky Creek	25	36	6.6	70	21	100	62
	10/1/82		18	21	6.8	68	20	66	41
15	5/15/81	Okahatta Creek	40	12	5.9	68	20	43	27
	10/17/82		23	27	5.3	57		54	36
16	5/15/81	Talleshue Creek	35	14	5.3	65	18	48	30
	10/11/82		85	15	6.1	73	23	49	31
17	5/15/81	Chunky Creek	20	32	6.2	66	19	100	62
	10/11/82		80	22	5.5	72	22	62	39
18	5/15/81	Little Rock Creek	45	19	6.0	64	18	55	34
	10/1/82		30	20	7.2	68	20	75	47
19	5/15/81	Talleshue Creek	40	14	5.4	66	19	45	28
	10/1/82		10	10	6.8	70	21	75	47
20	5/15/81	Potterchitto Creek	30	20	5.4	66	19	66	41
	9/21/82		38	24	6.0	72	22	90	56
21	5/15/81	Tarlow Creek	45	26	6.0	71	22	94	59
	10/17/82		50	40	6.9	54	12	150	94
22	5/15/81	Potterchitto Creek	45	21	5.9	68	20	82	51
	10/17/82		30	28	6.7	57	14	100	63
23	5/15/81	Turkey Creek	45	37	6.1	70	21	90	56
	10/17/82		30	40	6.8	58	14	90	56
24	5/15/81	Potterchitto Creek	60	20	5.9	71	22	79	49
	10/17/82		33	30	6.8	57	14	90	56
25	5/15/81	Chunky River	30	22	5.8	60	16	62	39
	10/11/82		80	20	6.6	73	23	65	41
26	5/15/81	Tonecane Creek	25	22	6.0	64	18	63	39
	10/11/82		62	22	6.6	73	23	66	41
27	5/15/81	Okahatta Creek	30	10	5.7	65	19	45	28
	10/11/82		63	12	6.3	73	23	58	36
28	5/15/81	Tallahatta Creek	80	19	5.5	65	19	52	32
	10/11/82		60	14	5.2	75	24	48	30
29	5/15/81	Potterchitto Creek	85	20	6.0	68	20	77	48
	10/11/82		48	22	6.3	74	23	89	56
30	5/25/81	Tallahala Creek	55	118	6.8	71	22	300	188
	10/11/82		60	50	7.2	72	22	125	78
31	5/25/81	Quaterliah Creek	30	316	7.7	70	21	700	438
	10/11/82		42	20	6.2	76	24	142	89
32	5/15/81	Bogue Falema Creek	82	19	5.5	65	18	53	33
	10/17/82		62	23	6.5	57	14	63	39
33	5/25/81	Scotchen Flipper Creek	42	18	5.7	65	19	53	33
	10/17/82		28	23	5.9	74	23	60	38
34	5/25/81	Algood Creek	60	40	6.0	70	21	100	63
	10/17/82		50	57	6.2	60	16	130	81
35	5/25/81	Possum Creek	80	15	5.8	70	21	40	25
	10/11/82		40	17	5.3	68	20	40	25

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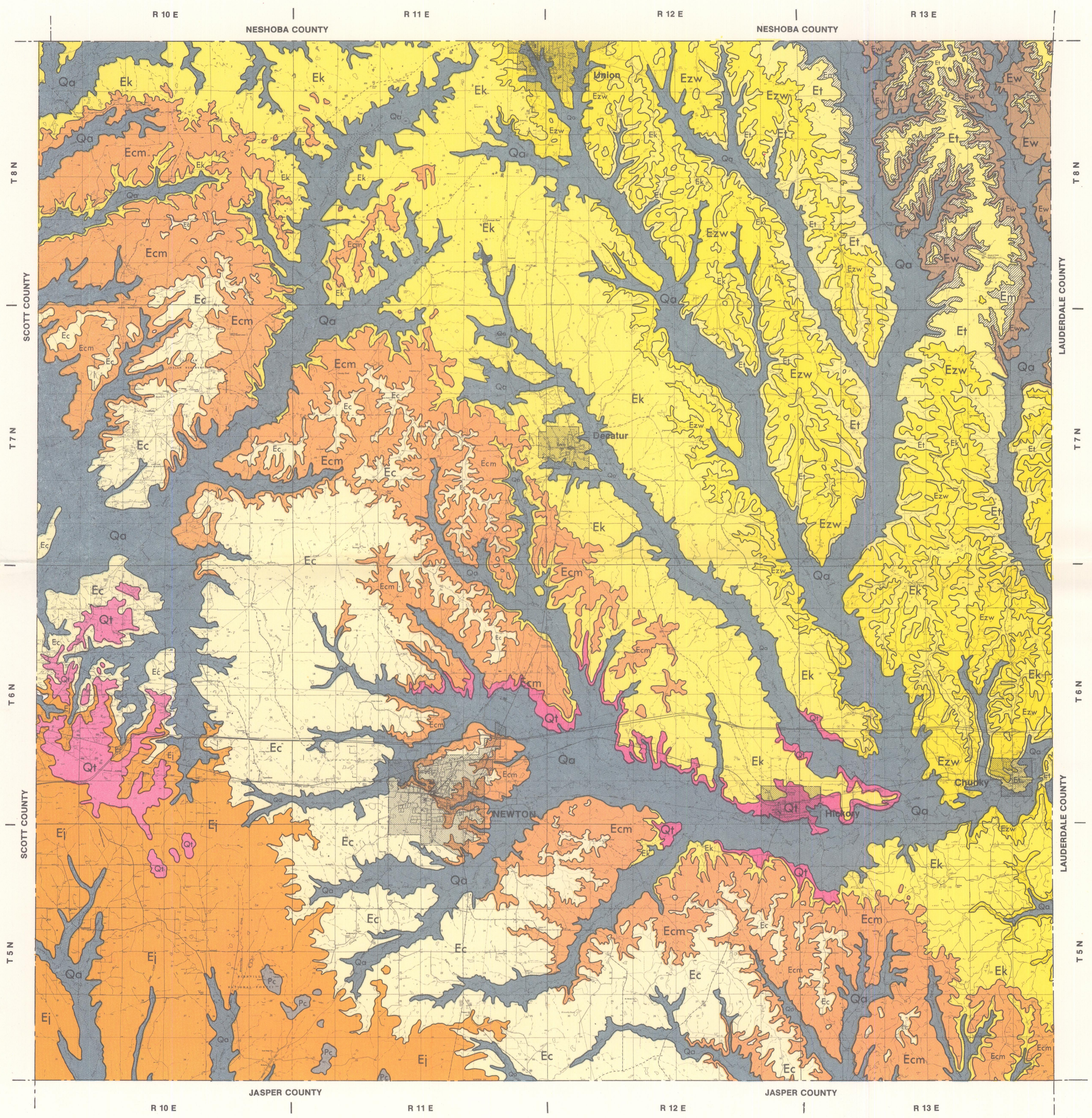

NEWTON COUNTY, MISSISSIPPI
GEOLOGIC MAP

GEOLOGY BY ROBERT MERRILL
MISSISSIPPI BUREAU OF GEOLOGY

SCALE

1 0 1 2 3 4 MILES

THIS MAP IS BASED ON DATA AVAILABLE TO THE DATE MARCH 20, 1984.

LEGEND

Recent

Qa — Alluvium—sand, light- to yellowish-gray, very fine- to very coarse-grained, subangular to subrounded quartz, silty, traces of dark minerals; contains some organic matter and small pebbles.

Pleistocene

Qt — Terrace deposits—sand, light gray to pale yellowish-brown, mottled, very fine- to very coarse-grained, subangular to subrounded quartz, silty; frequent thin layers and lenses of well-rounded quartz and chert pebbles; occasional thin ironstone beds.

Pc — Citronelle Formation—sand, moderate reddish-brown to very light-gray, medium- to very coarse-grained, subangular to subrounded quartz; frequent well-rounded quartz and chert pebbles; cross bedded; well-cemented quartz-chert pebble conglomerate at base.

Eocene

Jackson Group

Ej — Yazoo Formation—includes in descending order:
Shubuta Clay—clay, very light- to yellowish-gray, silty, sandy, sparingly fossiliferous.
Pachuta Marl—clay, very light-gray to white, silty, sandy, fossiliferous, calcareous, glauconitic.
North Twistwood Creek Clay—clay, light- to greenish-gray, slightly sandy, calcareous, micaceous.
Moodys Branch Formation—sand, light-gray, fine- to medium-grained, silty, clayey, highly fossiliferous, glauconitic.

Claiborne Group

Ec — Cockfield Formation—sand, dark yellowish-orange to dark yellowish-brown, very fine- to coarse-grained, subangular quartz, silty, clayey, carbonaceous; shaly in upper portions.

Ecm — Cook Mountain Formation—includes in descending order:
Gordon Creek Shale—silt, dark yellowish—brown, carbonaceous, clayey, glauconitic, micaceous, sandy.
Potterchitto—sand, light-gray to pale yellowish-brown, very fine- to coarse-grained, subangular quartz, fossiliferous, silty, clayey, glauconitic.

Ek — Kosciusko Formation—sand, light-gray to grayish—brown, fine- to coarse-grained, subangular to subrounded quartz, silty, clayey, micaceous, carbonaceous; shaly in upper portions, cross bedded in lower portions.

Ezw — Zilpha Formation—silt, medium-gray to dark yellowish-brown, clayey, sandy, carbonaceous, micaceous.
Winona Formation—sand, light olive-gray to pale yellowish-brown,fine- to coarse-grained, subangular quartz, silty, clayey, glauconitic, fossiliferous, micaceous; frequent thin indurated layers.

Et — Tallahatta Formation—includes in descending order:
Neshoba Sand—sand, medium light- to yellowish-gray, fine- to coarse-grained, subangular to subrounded quartz, silty, micaceous.
Basic City Shale—silt, light- to medium-gray, sandy, clayey, glauconitic, micaceous.
Sand, fine- to medium-grained, silty, glauconitic, micaceous, sandstone and siltstone in weathered zone near the surface.

Wilcox Group

Em — Meridian Sand—sand, medium- to very light-gray, fine- to coarse-grained, subangular to subrounded quartz, cross bedded, micaceous, glauconitic.

Ew — Hatchetigbee Formation—sand, light- to medium-gray, very fine- to coarse-grained, subangular quartz, silty, micaceous, carbonaceous, glauconitic, interbedded or interlaminated with clayey silt.

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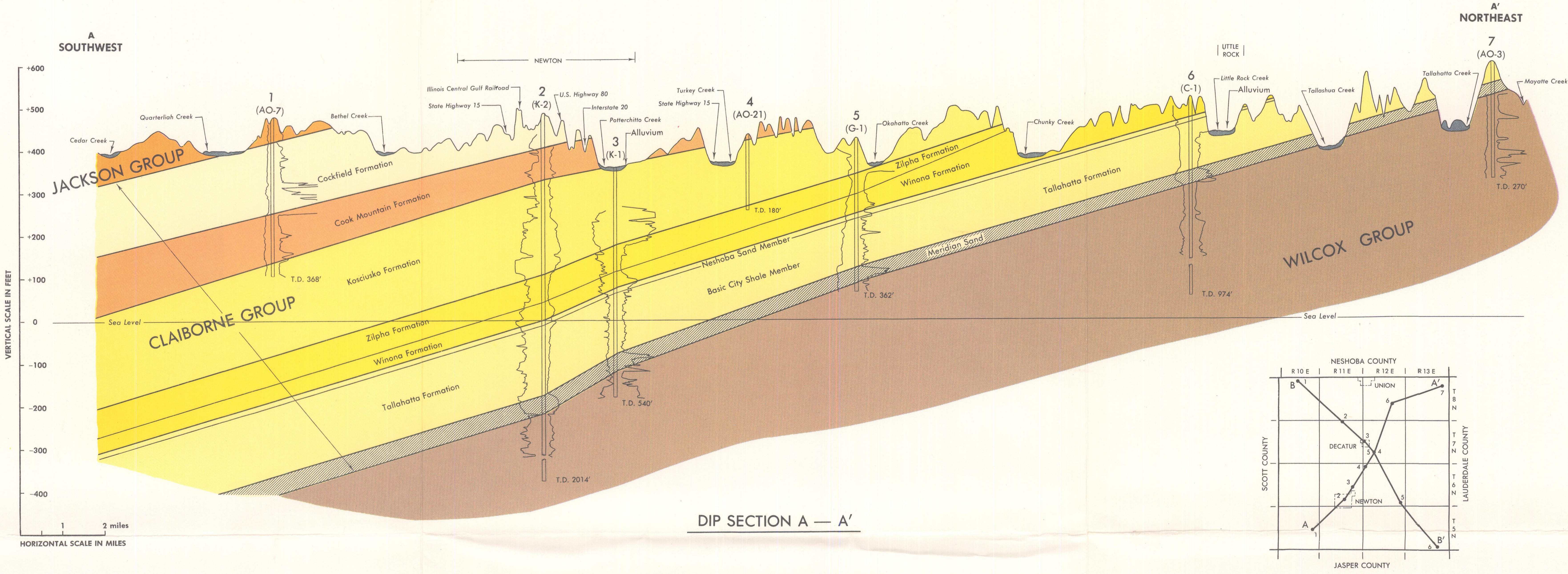
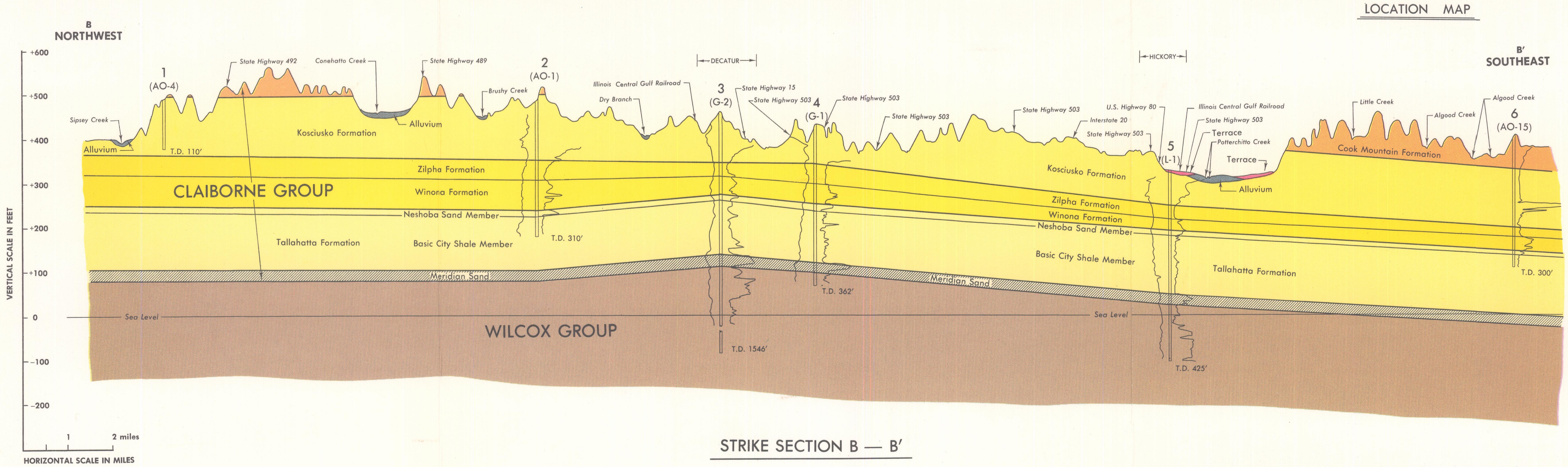


DIP SECTION A — A'

LOCATION MAP



STRIKE SECTION B — B'

STRATIGRAPHIC-STRUCTURAL CROSS SECTIONS

NEWTON COUNTY, MISSISSIPPI

MISSISSIPPI BUREAU OF GEOLOGY

Robert K. Merrill, Geologist

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