Article 130

SURFACE AND SUBSURFACE STRATIGRAPHIC SEQUENCE IN SOUTHEASTERN MISSISSIPPI

By D. HOYE EARGLE, Austin, Tex.

Work done on behalf of the Atomic Energy Commission

Abstract.—The stratigraphic sequence in southeastern Mississippi includes outcropping units of Miocene to Recent age; many subsurface units of Tertiary, Cretaceous, and Jurassic age down to the Jurassic(?) salt; and possibly older sedimentary rocks that are underlain by the basement crystalline rocks. Two newly named units are described—the Tatum Limestone Member, a basal unit of the Catahoula Sandstone of Miocene and Oligocene(?) age; and the Andrew Formation of Early Cretaceous age.

A detailed knowledge of the stratigraphic section of southeastern Mississippi was required for use in geologic and geophysical studies of the Tatum salt dome, Lamar County, Miss., for the U.S. Atomic Energy Commission. The deepest well in the southeastern Mississippi region penetrated only a few feet of bedded salt believed to be the Louann; consequently, the rocks below the salt are not known. Because detonations at the site, however, are expected to give geophysical data on rocks beneath the salt, the units that are found below the salt in adjoining areas are shown in the accompanying table.

Subsurface sections were constructed radiating outward from the salt dome at least 25 miles in all directions in which velocity surveys of wells were available. Study of the continuous-velocity logs of wells shows, as expected, a close correlation between lithology and zones of relatively uniform velocity characteristics. The zones compare closely with named stratigraphic units. The stratigraphic nomenclature is here brought up to date and, for several units, names that more nearly conform to the rules of stratigraphic nomenclature are herein introduced. Some names in common usage have been adopted, and some lithologic names have been changed to indicate more specifically the lithology of the subsurface units. Type sections in wells are designated and briefly described. The accompanying table shows the names and stratigraphic relations of the units.[1]

As described by Matson (1916) the Citronelle Formation (Pliocene) (1, in table) is the sequence of sediments, chiefly nonmarine, above the Pascagoula Formation (Miocene) and below stream-terrace deposits. Its type locality at the town of Citronelle (Mobile County) in nearby southwestern Alabama includes (a) sand and gravel, considered to be Pleistocene in age (Roy, 1939; Carlston, 1951), that caps the uplands and lies unconformably on the deposits below, and (b) littoral, estuarine, and shallow marine deposits considered to be Pliocene in age (Berry, 1916; Stringfield and LaMoreaux, 1957). In Mississippi, only the sand and gravel deposits have been mapped as Citronelle, and they are considered by some geologists to be Pleistocene in age (Brown and others, 1944; Fisk, 1938; Doering, 1956). More recently Brown is of the opinion that the Citronelle is Pliocene in age (written communication to G. V. Cohee, June 23, 1959). The Citronelle is several hundred feet thick along the coast of southeastern Mississippi and contains important aquifers. Inland it is thinner than along the coast and forms extensive upland plains and caps interstream divides. Remnants are found as far north as 140 miles from the Gulf of Mexico.

[1] Formal use of these names was considered at a conference in Jackson, Miss., on September 17, 1962, arranged by Esther R. Applin, of the U.S. Geological Survey, and attended by representatives of the U.S. Geological Survey, the Mississippi Geological Survey, the Mississippi Geological Society, and the Trowbridge Sample Service. Thicknesses given in the accompanying table were obtained from well logs of southeastern Mississippi and from data from Andrews (1960), Nunnally and Fowler (1954), Rainwater (1960, 1961), and Scott and others (1961). The author thanks his colleagues of the U.S. Geological Survey and Jules Braunstein, Shell Oil Co.; E. H. Rainwater, Shell Development Co.; and Eleanor Caldwell, Humble Oil and Refining Co.; for discussions and advice as to the use of these names.

ART. 130 *IN* U.S. GEOL. SURVEY PROF. PAPER 475-D, PAGES D43-D48. 1964.

The Pascagoula and Hattiesburg Formations (2) together form an indivisible stratigraphic unit. The Pascagoula Formation was described near the coast, along the Pascagoula River, where the beds are chiefly marine, and the Hattiesburg was described about 50 miles or more inland at Hattiesburg, Miss., where the beds are less marine and consist in large part of sands that are important fresh-water aquifers.

The Catahoula Sandstone is divided into an upper part, chiefly nonmarine sand and clay, and a lower part termed the Tatum Limestone Member (3), a new name introduced to replace "Limestone of the *Heterostegina*

Surface and subsurface units in southeastern Mississippi and adjoining areas

[Numbers in parentheses keyed to text discussion]

System	Series	Group	Unit	Approximate thickness (feet)	Lithologic character
Quaternary	Pliocene to Recent		Coastal terrace deposits	300±	Silt, sand, gravel.
			(1) Citronelle Formation	150±	Gray to mottled red and orange silty clay, sand, gravel.
Tertiary	Miocene		(2) Pascagoula and Hattiesburg Formations, undifferentiated.	350–2, 300+	Greenish-gray silty clay, sand, and gravelly sand.
			Catahoula Sandstone: Upper part	250–700	Gray to olive sand, silt, and silty clay.
	Miocene(?) and Oligocene(?)		Catahoula Sandstone: (3) Tatum Limestone Member.	90–300	White to gray sandy limestone and marl; glauconitic calcarenite.
	Oligocene		(4) Chickasawhay(?) Limestone	60–470	Gray to white sandy limestone and fossiliferous sandstone and clay.
		Vicksburg	Bacatunna Clay Member of Byram Formation.	50–215	Calcareous clay.
			Glendon Limestone Member of Byram Formation and Marianna Limestone, undifferentiated.		White to gray sandy limestone and marl.
			Red Bluff Clay	30±	Gray, fine sand and clay interbedded, and soft fossiliferous limestone.
	Eocene	Jackson	Yazoo Clay	0–253	Olive to gray calcareous clay.
			(5) Moodys Branch Limestone (Ocala Limestone to south).	30–300	White sandy limestone, fossiliferous glauconite, and fossiliferous calcarenite.
		Claiborne	Cockfield Formation	25–215	Lignitic clay and fine sand.
			(6) Cook Mountain Limestone	115–235	Hard to soft white calcarenite (lime sand) and glauconitic, bentonitic clay.
			(7) Sparta Sand and Zilpha Clay.	90–625	Gray shale and thin siltstone, interbedded.
			(8) Winona Marl	90–200	Glauconite, marl, green sand, and shale.
			(9) Tallahatta Siltstone		Hard gray siltstone, glauconite.
	—?— Paleocene	(10) Wilcox	Undivided (Salt Mountain Limestone equivalent near base).	2, 250–3, 200	Gray fine-grained sandstone and green to gray shale, interbedded. Chalky white fossiliferous limestone.
		Midway	Porters Creek Clay	650–1, 050	Gray shale.
			(11) Clayton Limestone	10–25	Limestone.

Surface and subsurface units in southeastern Mississippi and adjoining areas—Continued

[Numbers in parentheses keyed to text discussion]

System	Series	Group	Unit	Approximate thickness (feet)	Lithologic character
Cretaceous	Upper Cretaceous	(12) Selma Group and Eutaw Formation, undifferentiated.		925–1, 500	White chalk to gray marl, shale, and calcareous sandstone at base.
Cretaceous	Upper Cretaceous	Tuscaloosa	Gordo Formation (upper Tuscaloosa of oil geologists).	300–900	Sandstone and gray shale.
Cretaceous	Upper Cretaceous	Tuscaloosa	(13) Coker Formation (includes marine Tuscaloosa and lower Tuscaloosa of oil geologists with "massive sand" at base).	620–1, 160	Shale and some sandstone, mostly marine (includes thick sand, containing few shale lenses at base, and some gravel).
Cretaceous	Lower Cretaceous		(14) Dantzler Formation	575–1, 150	Red to gray mottled shale, buff, red, and green sandstone and siltstone.
Cretaceous	Lower Cretaceous		(15) Andrew Formation	1, 000–1, 880	Limestone, sandstone, and gray to green shale.
Cretaceous	Lower Cretaceous		Paluxy Formation	1, 000–1, 450	Sandstone and shale, buff, pink, white, micaceous.
Cretaceous	Lower Cretaceous		Mooringsport Formation	200–1, 000	Marine shale, some sandstone.
Cretaceous	Lower Cretaceous		Ferry Lake Anhydrite	160–240	Anhydrite, shale, limestone.
Cretaceous	Lower Cretaceous		Rodessa Formation, James Limestone, and Pine Island Shale, undifferentiated.	750±	Limestone, shale, sandstone, anhydrite (hard calcareous sandstone, gray to red limy micaceous shale, oolitic to finely crystalline limestone.)
Cretaceous	Coahuila of Mexico		Sligo Formation	300	Sandstone, shale, mudstone, reddish to greenish gray.
Cretaceous	Coahuila of Mexico		Hosston Formation	1, 800–2, 650±	Sandstone, red shale, conglomerate.
Jurassic	Upper Jurassic		(16) Cotton Valley Formation	2, 000–2, 900±	Sandstone, shale, mudstone, red to purple, and green.
Jurassic	Upper Jurassic		(17) Haynesville Formation (includes Buckner Member)	1, 500–3, 450±	Sandstone and red beds (Buckner Member contains salt in Alabama).
Jurassic	Upper Jurassic		Smackover Formation		Oolitic limestone.
Jurassic	Upper Jurassic		Norphlet Formation		Sand and shale in Mississippi and Alabama, red shale and conglomerate in Arkansas and Louisiana.
Jurassic(?)			(18) Louann Salt	0–5, 000±	White coarsely crystalline halite.
Jurassic(?)			Werner Formation	200±	Anhydrite, red shale, sandstone.
Permian(?)			(19) Eagle Mills Formation (restricted).	7, 000±	Red beds, alluvial, continental flood-plain; some gray and green beds, gray to white siltstones and sandstones, in association with diabase.
Pennsylvanian(?)			(20) Morehouse Formation	1, 200±	Dark-gray shale.
Pennsylvanian and older				Unknown.	Sedimentary and metasedimentary rocks.
Precambrian			Basement rocks	Unknown	Crystalline igneous and metamorphic rocks.

zone" or "*Heterostegina* limestone." The following is a description of the Tatum Limestone Member.

Type section.—U.S. Atomic Energy Commission hydrologic test well 1, Tatum dome area, Lamar County, Miss., is the type section. Well 1 is in the NE¼SW¼ sec. 12, T. 2 N., R. 16 W., and the datum is 321 feet above sea level. Hydrologic test well 2 in the SW¼SW¼ sec. 14, T. 2 N., R. 16 W., for which the datum is 302 feet, is a reference section.

Areal extent.—Southern Mississippi to northern Florida and the northern part of the Florida parishes of Louisiana.

Thickness.—In well 1, 163 feet, from a depth of 1,373–1,536 feet; in well 2, 170 feet, from 1,470–1,640 feet. The Tatum thins to about 90 feet in the southeastern part of the area and thickens to 300 feet toward the west.

Lithology.—Sandy limestone, marl, glauconitic calcarenite, and calcirudite (made up chiefly of fossil and limestone fragments).

Electrical-log characteristics.—High resistivity; generally very low self-potential, which is characteristic of a fresh-water aquifer.

Sonic-log characteristics.—High in sonic velocity. It is the first zone of high velocity found in drilling and in geophysical exploration of southern Mississippi.

Paleontology.—Larger foraminifers are chiefly *Heterostegina* sp., *Miogypsina* sp., and *Sorites* sp. Many species of smaller Foraminifera have been identified from cores from well 1 by Ruth Todd and Doris Low.

Age.—Miocene(?) and Oligocene(?). Larger foraminifers are said to be definitely Oligocene in age (Cole and Applin, 1961); smaller foraminifers suggest Miocene age (Ruth Todd and Doris Low, personal communication, 1962), although an Oligocene age is not necessarily precluded. The Tatum is tentatively correlated with fossiliferous limestones and marls of the Paynes Hammock Sand (Miocene) and the upper bed of the Chickasawhay Limestone (Oligocene) as described by MacNeil (1944).

Chickasawhay Limestone (4) has been defined from surface outcrops only, and use of the name for a unit of the subsurface is questioned because exact correlation with surface outcrops is uncertain.

Moodys Branch Limestone (5) is used in southeastern Mississippi instead of Moodys Branch Formation to indicate the characteristic subsurface lithology of the unit. The Ocala Limestone, in the southern part of the report area, as in western Florida and southern Alabama, is equivalent to the Moodys Branch Limestone and the Yazoo Clay farther updip.

Cook Mountain Limestone (6) is used instead of Cook Mountain Formation to indicate the characteristic subsurface lithology of the unit. It has been called the *Camerina* limestone by some geologists, but this genus is also present in other formations.

The terms Sparta Sand and Zilpha Clay (7) are used collectively in this article for the unit that underlies the Cook Mountain Limestone. "Upper part of Cane River equivalent" (of Louisiana) has been used for this unit in southwestern Mississippi. Some sandy beds in the middle of the chiefly clayey and silty unit are the downdip equivalents of the Sparta Sand.

Winona Marl (8) is used for the green sand and shale and glauconitic marl whose equivalent is the Winona Sand of the outcrop. The term "Cane River Marl" (or, as used by some geologists, "Lower part of Cane River equivalent") is commonly used by oil geologists for this subsurface unit in southwestern Mississippi.

Tallahatta Siltstone (9) is used in the report area instead of Tallahatta Formation to indicate more definitely the characteristic subsurface lithology of the unit.

Recent studies in Mississippi show that the different units in the Wilcox section (10) are closely correlative with the various formations of the Wilcox Group in Alabama. However, in this subsurface study, the Wilcox Group has not been subdivided.

Clayton Limestone (11) is used instead of Clayton Formation of the outcrop to indicate the characteristic subsurface lithology of the unit.

Some geologists consider that the shale and sandstone section below the chalk of the Selma Group and Eutaw Formation, undifferentiated (12), correlates with the basal part of outcropping Eutaw Formation equivalents in Arkansas.

"Massive sand" (13) for the basal beds of the Upper Cretaceous is used informally (a formal name is not recommended) since the beds are not of uniform lithologic character and they vary in stratigraphic position.

The Dantzler Formation (14) was originally described by Hazzard, Blanpied, and Spooner (1947). The following is a description of the formation.

Type section.—Humble Oil and Refining Co. No. B–1 Dantzler Lumber Co. well, Jackson County, Miss. The well is in sec. 30, T. 5 S., R. 8 W., and the derrick floor elevation is 108 feet above sea level (datum, 1 foot above rotary, or about 110 feet). Depth 8,905–9,910 feet (Nunnally and Fowler, 1954, p. 25).

Areal extent and thickness.—Southeastern Mississippi, extending into the southwest corner of Alabama; 1,200 feet thick (Nunnally and Fowler, 1954, p. 28) but thins rapidly to the west. Western limit, Franklin and Amite Counties; northern limit, from northern boundaries of Lincoln and Covington Counties southeast to Greene County. Beyond these limits the formation cannot be distinguished from the underlying Andrew Formation.

Lithology.—Nonmarine sands, fine- to medium-grained, white to dull-red, and green; shales, dark-purplish-red, generally mottled with white, yellow, ochre, and gray; some shales are dark gray; some are micaceous, slightly chloritic, silty. Some beds are carbonaceous and lignitic, others are calcareous and contain gray, red, or white limestone nodules

Electrical-log characteristics.—Generally lower resistivity and self-potential than beds above and below.

Sonic-log characteristics.—Generally lower sonic velocity than beds above and below.

Paleontology.—F. W. Rolshausen, of the Humble Oil and Refining Co., has found oyster shells, ostracods, and *Chara* in some cores from the type well, and one specimen of *Haplophragmoides* in one core from a depth of 9,779–9,789 feet.

Age.—May include beds of Cenomanian age at top, as originally correlated by Hazzard, Blanpied, and Spooner, but is unconformably overlain by beds of known Cenomanian age, the Tuscaloosa Group.

The Andrew Formation (15) is here named and described as generally marine rocks previously called "Pre-Dantzler rocks of Washita and Fredericksburg Groups, undifferentiated" (Nunnally and Fowler, 1954,

p. 22–25). The following is a description of the Andrew Formation.

Type section.—Gulf Oil Co. No. 25 J. M. Andrew well, sec. 6, T. 1 N., R. 16 W., Baxterville oil field, Lamar County, Miss. Elevation of the derrick floor is 233 feet above sea level (datum is 1 foot above rotary, about 2 feet above derrick floor, or about 235 feet). Cuttings and cores were examined by Esther R. Applin (written communication, October 1962), who found that the formation extends in depth from 9,800 feet (electrical-log point, or the 9,810–9,820-foot sample) to 11,360 feet (electrical-log point, or the 11,380–11,390-foot sample).

Areal extent and thickness.—Across southern Mississippi and into adjoining States. Northern limit is defined by a change in facies to nonmarine sands and shales whose lithology is similar to overlying and underlying formations. Northern limit of recognizable Andrew Formation extends from Claiborne County on the northwest to southeastern Greene County on the southeast (Nunnally and Fowler, 1954).

Lithology.—According to Mrs. Applin's sample and core descriptions the Andrew Formation consists, toward the top, of dull- to dark-red, gray, and olive-gray shale containing beds of brownish-gray finely sandy limestone, some shell fragments, and some beds of olive-gray dolomite and light-cream limestone. This grades down into gray and greenish-gray to dull-red micaceous shale alternating with limestone, minor beds of fine-grained sandstone containing some carbonaceous matter, and grayish-green siltstone. Much of the lower part is dark-gray shale.

Electrical-log characteristics.—Generally low self-potential and alternating zones of moderately high and low resistivity.

Sonic-log characteristics.—Generally high sonic velocity, but thin zones of strongly contrasting velocities.

Paleontology.—According to Mrs. Applin, the upper part of the Andrew Formation contains abundant bivalves and ostracods. A few specimens of *Lituola inflata* were found in samples from depths of 10,280–10,300 and 10,360–10,370 feet. *Ostrea* fragments were common throughout the section; ostracods were abundant and scattered throughout. *Quinqueloculina* and other Miliolids were found at 10,596–10,601 and at 10,626–10,628½ feet. *Plicatula*- and Pecten-like pelycypods were found at 10,611–10,616 feet.

Age.—The formation has been correlated with the lower part of the Washita and Fredericksburg Groups of Texas. Exact correlations on the basis of diagnostic faunas, however, are unknown to the author.

Cotton Valley Formation (16) is used instead of Cotton Valley Group because the formations making up the group in other States have not been differentiated in southeastern Mississippi.

Haynesville Formation (17) includes the Buckner Member in the subsurface of southestern Mississippi. The Buckner is believed to include some salt beds in Alabama.

The Louann Salt (18) (greatly contorted) has been intruded as diapirs into overlying sediments. One well in the report area is reported to have penetrated the bedded Louann Salt. Applin and Applin (1953) state that a core composed of 1 foot of anhydrite and 1 foot of rock salt was recovered in a basket core barrel from the lowermost 9-foot interval of George Vasen fee well No. 1, Stone County, Miss., drilled to a depth of 20,450 feet. The units listed here as occurring below the Louann have not been drilled in southeastern Mississippi and are, therefore, not known to be present there. They have been found, however, in one or more States adjoining Mississippi, where the salt occurs at shallower depths.

The Eagle Mills (19) was originally described (Imlay, 1940) to include beds now included in the Norphlet, Louann, Werner, and the Eagle Mills, restricted. The exact age of this sequence is unknown, but has been considered by various authors as Permian(?), Triassic(?), or Jurassic(?). Scott, Hayes, and Fietz (1961) tentatively include the Eagle Mills in the Triassic, partly on the basis of identification by Erling Dorf of a plant fossil that is similar to one of the Chinle Formation of Arizona and the Newark Group of Virginia, and partly on lithologic similarities to the Newark Group.

The structural and stratigraphic relations of the Morehouse Formation (20) to the Eagle Mills Formation, restricted, are not known.

REFERENCES

Andrews, D. I., 1960, The Louann salt and its relationship to Gulf Coast salt domes: Gulf Coast Assoc. Geol. Societies Trans., v. 10, p. 215–240.

Applin, P. L., and Applin, E. R., 1953, The cored section in George Vasen's fee well 1, Stone County, Mississippi: U.S. Geol. Survey Circ. 298, 29 p.

Berry, E. W., 1916, The flora of the Citronelle Formation: U.S. Geol. Survey Prof. Paper 98–L, p. 193–208.

Brown, G. F., and others, 1944, Geology and ground-water resources of the coastal area in Mississippi: Mississippi Geol. Survey Bull. 60, 232 p.

Carlston, C. W., 1951, Profile sections in Citronelle Formation in southwestern Alabama: Am. Assoc. Petroleum Geologists Bull., v. 35, no. 8, p. 1888–1892.

Cole, W. S., and Applin, E. R., 1961, Stratigraphic and geographic distribution of larger Foraminifera occurring in a well in Coffee County, Georgia, *in* Contributions from the Cushman Foundation for Foraminiferal Research, v. 12, pt. 4: p. 127–135.

Doering, J. A., 1956, Review of Quaternary surface formations of Gulf Coast region: Am. Assoc. Petroleum Geologists Bull., v. 40, no. 8, p. 1816–1862

Fisk, H. N., 1938, Geology of Grant and LaSalle Parishes: Louisiana Dept. Conserv., Geol. Bull. 10, 246 p.

Hazzard, R. T., Blanpied, B. W., and Spooner, W. C., 1947, Notes on correlation of the Cretaceous of east Texas, south Arkansas, north Louisiana, Mississippi, and Alabama: Shreveport Geol. Soc. 1945 Reference Rept., v. 2, p. 472–481.

Imlay, R. W., 1940, Lower Cretaceous and Jurassic Formations of southern Arkansas and their oil and gas possibilities: Arkansas Geol. Survey Inf. Circ. 12.

MacNeil, F. S., 1944, Oligocene stratigraphy of southeastern United States: Am. Assoc. Petroleum Geologists Bull., v. 28, no. 9, p. 1313–1354.

Matson, G. C., 1916, The Pliocene Citronelle Formation of the Gulf Coastal Plain: U.S. Geol. Survey Prof. Paper 98, p. 167–192.

Nunnally, J. D., and Fowler, H D., 1954, Lower Cretaceous stratigraphy of Mississippi: Mississippi Geol. Survey Bull. 79, 45 p.

Rainwater, E. H., 1960, Stratigraphy and its role in the future exploration for oil and gas in the Gulf Coast: Gulf Coast Assoc. Geol. Societies Trans., v. 10, p. 33–75.

Rainwater, E. H., 1961, Outline of geological history of Mississippi: Gulf Coast Assoc. Geol. Societies Trans., v. 11, p. 43–45.

Roy, C. J., 1939, Type locality of Citronelle Formation, Citronelle, Alabama: Am. Assoc. Petroleum Geologists Bull., v. 23, no. 10, p. 1553–1559.

Scott, K. R., Hayes, W. E. and Fietz, R. P., 1961, Geology of the Eagle Mills Formation: Gulf Coast Assoc. Geol. Societies Trans., v. 11, p. 1–14.

Stringfield, V. T., and LaMoreaux, P. E., 1957, Age of Citronelle Formation in Gulf Coastal Plain: Am. Assoc. Petroleum Geologists Bull., v. 41, no. 4, p. 742–746.