Studies of Pre-Selma Cretaceous Core Samples From the Outcrop Area in Western Alabama

GEOLOGICAL SURVEY BULLETIN 1160

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A group of papers by W. H. Monroe, R. E. Bergenback, N. F. Sohl, E. R. Applin, E. B. Leopold, H. M. Pakiser, and L. C. Conant

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PREFACE

In 1954 four core holes were drilled in the pre-Selma Cretaceous strata of the Alabama Coastal Plain in order to get unweathered samples within a few miles of the outcrops. During the next few years several specialists studied the cores, and their reports are published as consecutive parts of this bulletin.

Watson H. Monroe, who spent many years studying the Coastal Plain strata in Alabama and Mississippi, conceived and supervised the drilling and planned the later studies. His earlier published report (W. H. Monroe, 1955, Cores of pre-Selma Cretaceous rocks in the outcrop area in western Alabama: Gulf Coast Geol. Societies Trans., v. 5, p. 11–37) contains a brief description of the stratigraphy, together with logs and other information regarding the core holes, and he has provided the introductory chapter to this bulletin. Richard E. Bergenback studied the petrology of the cores, which included finding the distribution of grain sizes, determining the mineralogy of the grains and the matrix of the sediments, and having X-Ray identifications made of the clay minerals. Norman F. Sohl studied the mollusks and other large fossils obtained from the cores and compared them with other faunal suites collected in Alabama and Texas. Esther R. Applin studied the sparse microfauna, comparing it with faunas obtained from deep wells downdip in Georgia, Alabama, and Mississippi and with outcrop samples from Texas, and has described a new species of Foraminifera. Estella B. Leopold and Helen M. Pakiser obtained a large pollen and spore assemblage by digesting carbonaceous layers of some of the cores in acid; this flora includes much new material, which is not described here.

The Bergenback, Sohl, and Applin reports discuss the probable environment in which the sediments accumulated. Louis C. Conant, who spent several years studying and mapping these sediments, has written a summary chapter integrating some of the surface and subsurface information.

Quarter-cuts of the cores belonging to the U.S. National Museum have been deposited on indefinite loan with the Alabama Geological Survey at University, Ala., and with the Shell Oil Co. at Jackson, Miss. They are available there for inspection and study.

LOUIS C. CONANT.

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STUDIES OF PRE-SELMA CRETACEOUS CORE SAMPLES FROM THE OUTCROP AREA IN WESTERN ALABAMA

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By WATSON H. MONROE

ABSTRACT

Four core holes were drilled by the U.S. Geological Survey in western Alabama near the outcrop of Upper Cretaceous rocks to obtain unweathered samples and accurate thicknesses of the pre-Selma formations. Data on these cores are compared with published outcrop information and will aid in correlating rocks of similar age penetrated in deep oil-test holes in southern Alabama and Mississippi.

The core holes penetrated the entire thickness of the Eutaw and McShan formations, part of the Gordo formation, all the Coker formation including the Eoline member, and the Vick formation. Plant and animal fossils, most of which are described in other chapters of this bulletin, were obtained from the Vick formation, from the Eoline member of the Coker formation, and from the Eutaw formation. Bright-colored sediments characteristic of the upper member of the Coker formation and of the Vick formation on the outcrop are similarly colored in the cores, at depths too great to be the result of Recent weathering. A core of the Vick formation contains veinlets of silty calcite; this calcite closely resembles the "pink lime" found in the pre-Upper Cretaceous Comanche rocks downdip.

INTRODUCTION

A study of the stratigraphy of the outcropping pre-Selma Upper Cretaceous rocks in Alabama and Mississippi was started in May 1944 as a part of the U.S. Geological Survey's war-time program of oil and gas investigations. The project resulted in publication of reports by L. C. Conant, D. H. Eargle, W. H. Monroe, J. H. Morris, and C. W. Drennen, which are listed with the references cited in this report. The geologic interpretations these authors made were based almost entirely on examination of weathered roadside outcrop samples and of cuttings from wells drilled by rotary methods. Thicknesses of units were determined by piecing together short sequences and by projection of dips for many miles. As the work progressed the authors recognized more and more the need for a few carefully drilled

core holes near the outcrop in order to obtain unweathered, undisturbed samples and to determine accurately the thicknesses of the units.

Four core holes were drilled by a contractor for the U.S. Geological Survey in the fall of 1954. The combined depth of the four holes was 1,686 feet, and 844 feet of core was recovered. All the holes were started a short distance above the top of an identifiable stratigraphic unit and were drilled through a lower horizon identifiable stratigraphically, though two of the holes were drilled into rocks of questionable Paleozoic age.

Much descriptive material on the cores was published by W. H. Monroe (1955), and the reader is referred to that paper for detailed megascopic descriptions of the four cores. Electric logs of these holes are also illustrated in Monroe's report (1955, figs. 2, 3). Lithologic logs of the holes are shown graphically on plate 1, which accompanies Bergenback's chapter in this bulletin. Minor discrepancies between the writer's and Bergenback's descriptions may be attributed to the fact that Bergenback's definitions are based on more careful laboratory studies.

The locations of the four test holes with relation to the outcrop of pre-Selma formations are shown on a generalized geologic map of western Alabama (fig. 1).

Many people contributed to the drilling project, especially L. C. Conant, who selected the drill sites and obtained permission of land owners to drill the holes; P. E. LaMoreaux, who provided electric logging equipment; C. W. Drennen, who supervised some of the drilling; and W. M. Edens of the Walters Drilling Co., who superintended the coring.

STRATIGRAPHIC RELATIONS

The outcropping pre-Selma Cretaceous rocks in western Alabama were mapped by Monroe, Conant, and Eargle (1946), who recognized six formations: Cottondale, Eoline, Coker, Gordo, McShan, and Eutaw. The Cottondale, Eoline, Coker, and Gordo formations were assigned to the Tuscaloosa group. The name McShan formation was applied to sand and clay formerly included in the lower part of the Eutaw formation in Alabama but included in the Tuscaloosa formation in Mississippi. In the same year Conant (1946) applied the name Vick formation to semiconsolidated pre-Tuscaloosa, post-Paleozoic sediments near Vick, Ala.

Subsequent studies (Drennen, 1953a, 1953b) farther north and farther east in Alabama showed that the Cottondale formation is a very local facies of the Eoline formation, and the name Cottondale was abandoned. Drennen also determined that the Eoline inter-

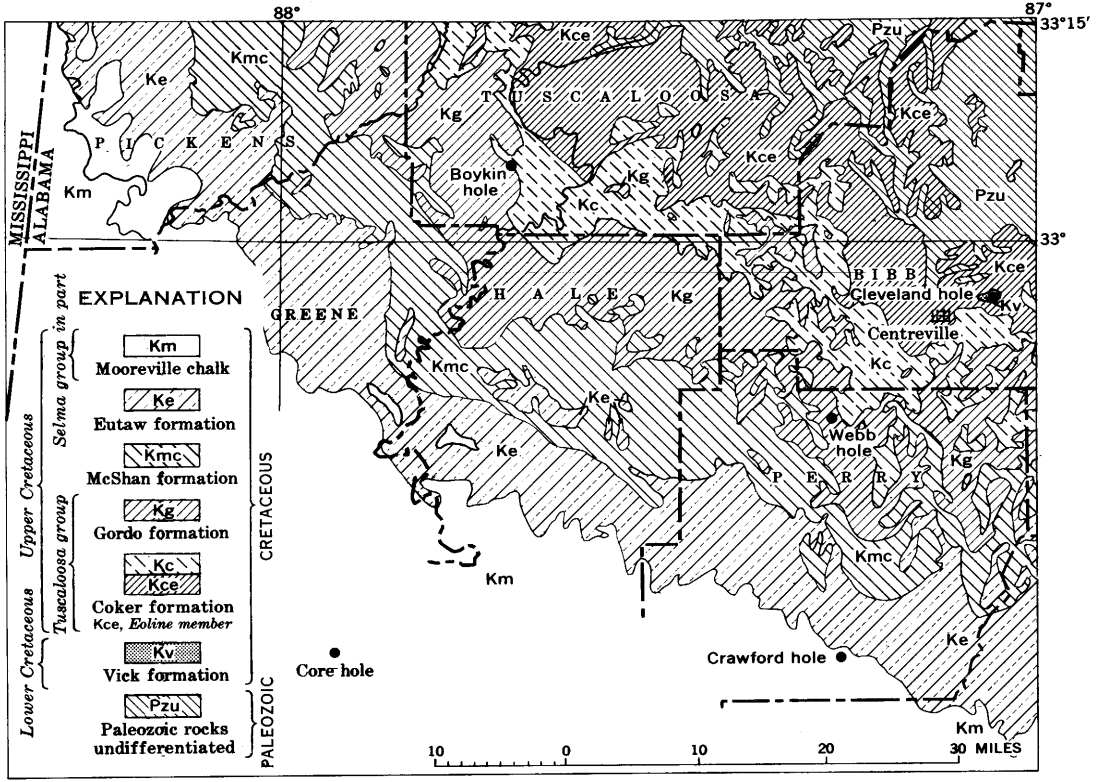

FIGURE 1.—Generalized geologic map of pre-Selma Cretaceous formations in western Alabama, showing location of drill holes.

tongues with the overlying Coker formation, and he therefore redefined the Coker to include the Eoline as a lower member.

The present classification of outcropping pre-Selma Cretaceous rocks includes five formations—in ascending order, the Vick formation; the Coker and Gordo formations, which constitute the Tuscaloosa group; the McShan formation; and the Eutaw formation. These formations, consisting mainly of sand, gravel, silt, and clay, and the lower part of the Mooreville chalk of the Selma group were cored in the four holes.

PRE-SELMA ROCKS

VICK FORMATION

The Vick formation crops out in road cuts and sink holes near Vick, about 4 miles east of Centreville in Bibb County, Ala., and consists of gray and reddish clay; brick-red, lavender, and gray sandy clay; and semiconsolidated clayey sandstone (Conant, 1946). These sediments are overlain unconformably by the basal beds of the Eoline member of the Coker formation and are more consolidated and have brighter colors than the overlying sediments. Conant considered the possibility of a Paleozoic age for the Vick, as the sediments somewhat resemble highly weathered Pennsylvanian rocks; however, because the nearest Paleozoic rocks along the strike of the Appalachian system are highly folded and faulted limestone and dolomite of Cambrian and Ordovician age, this possibility was discarded. The lithologic resemblance of the strata of the Vick formation to rocks of Comanche and Cotton Valley age in wells downdip in southern Alabama and Mississippi led Conant to suggest that the formation is of Early Cretaceous or Jurassic age. After publishing his paper, Conant found some poorly preserved leaves in one of the clay beds, which were identified as dicotyledons by Roland Brown. As dicotyledons were much more abundant in the Cretaceous than in the Jurassic, the Vick is now believed to be of Comanche age, probably a nearshore equivalent of some part of the Trinity group. The Vick was penetrated in the Cleveland and the Webb holes (pl. 1).

The Cleveland core hole which was drilled at the type locality of the Vick formation, crossed the contact between the Vick and the overlying Eoline member of the Coker formation at about 9.5 feet. The hole was drilled through 70.4 feet of Vick and penetrated 0.7 foot of dolomite of probable Cambrian or Ordovician age. The Vick formation in this hole consists principally of coarse-grained sandstone. The lower 10 feet of the Vick is very pebbly, and large cobbles are present in the basal 2 feet. A clayey silt 19.5 to 25.5 feet from the top contained impressions of leaves, identifiable only as dicotyledons (R. W. Brown, written communication, 1955).

The Webb hole, which entered the Vick formation at a depth of 554 feet, passed through 104 feet of Vick and into 2 feet of hard salmon-colored shale that the author believes to be of Paleozoic age. In this hole the Vick consists of alternating beds of highly micaceous, fine to coarse, red and greenish-gray sand, and red, brown, and gray clay; the lower 20 feet contained much coarse gravel and cobbles. Between 40 and 50 feet from the top of the formation is a 3-foot-thick unit of moderate-brown clayey, micaceous silt, cut by vermiculate veinlets of silty calcite, which is pink when washed. This calcite resembles the diagnostic "pink-lime" flakes commonly used to identify Comanche rocks in deep wells in southern Alabama and Mississippi. In general the rocks assigned to the Vick formation in the Webb hole contain much more mica and have colors brighter and stronger than any of the rocks in the overlying Tuscaloosa. The lower part of the Tuscaloosa contains abundant gravel and large cobbles, suggesting a sharp stratigraphic break. There seems little reason to doubt that the Vick in the Webb hole is of Comanche age, probably a nearshore equivalent of some formation in the Trinity group.

COKER FORMATION

The Coker formation consists of the Eoline member and an unnamed upper member. The Eoline member of the Coker formation, in the Tuscaloosa group, consists of a basal sand and gravel of locally varying coarseness and thickness, overlain by interbedded glauconitic sand and gray laminated clay. The presence of glauconite and locally of fossil marine shells indicates that this part of the Coker formation is a marine deposit. The upper member consists of highly crossbedded, generally nonglauconitic micaceous sand and varicolored clay. The clay characteristically contains spherules of siderite and of limonite or hematite. The Coker formation was penetrated in the drilling of both the Boykin and Webb holes (pl. 1).

EOLINE MEMBER

The Eoline member of the Coker formation differs considerably in the Boykin and Webb holes. In the Boykin hole it is 291 feet thick consisting of about 15 feet of sand and gravel at the base and grading upward into 30 feet of medium to coarse sand, which is overlain by about 246 feet of alternating beds of laminated gray clay and glauconitic sand. Lignite and lignitic clay beds are common, particularly in the upper half of the member, and the laminated clay and silt beds contain a large amount of fossil plant material. At the top of the Eoline member the Boykin hole penetrated 10 feet of waxy clay that is probably bentonitic. Very small Foraminifera of the family Saccamminidae were found by Mrs. Esther R. Applin in sand

and clay (core depth 404.3–437.6 feet, from which only 3.3 feet of core was recovered); Mrs. Applin's conclusions on the fauna and on the environment it suggests are published in her part of this bulletin.

In the Webb hole, the Eoline member is 334 feet thick and consists of fine-grained glauconitic sand and gray laminated clay, with a basal gravelly sand 85 feet thick. This thick basal sand more than accounts for the greater thickness of the member in the Webb as compared to the Boykin hole. As in the Boykin hole, the drill penetrated probable bentonite in the uppermost part of the Eoline member. The clay in the Webb hole contains a small amount of plant material and several zones of mollusks. Most of the mollusks are in clayey silt in the upper half of the member and are abundant in two layers of calcareous sandstone 93 to 103 feet below the top of the member. The mollusks have been studied by Norman F. Sohl, whose report is a separate part of this bulletin.

The upper contact of the Eoline member was not distinct in either the Boykin or the Webb hole but was determined by (1) a change in color from yellowish gray and olive in the Eoline to variegated red and orange above, (2) the glauconite in sand a short distance below the top of the Eoline, and (3) the top of the uppermost bentonitic clay in each hole, which accorded well with the other two criteria. The contact was thus placed in a sequence of clay and silt and apparently is conformable.

UPPER MEMBER

The unnamed upper member of the Coker is 185 feet thick in both the Webb and Boykin holes and consists of varicolored clay and sand. The colors are, in general, light red and reddish yellow, mottled with darker shades, such as dusky red and yellowish and reddish brown. Siderite spherules are abundant in several units and the clays characteristically contain abundant spherules of limonite or hematite.

GORDO FORMATION

The Gordo formation rests unconformably on the Coker formation. As mapped by Monroe, Conant, and Eargle (1946, p. 200–204), it is about 300 feet thick and consists of alternating thick beds of gravelly sand and of varicolored clay which locally contains abundant spherules of siderite.

In none of the core holes in pre-Selma rocks was the entire thickness of the Gordo penetrated, but the Boykin and Webb holes (pl. 1) were drilled through the basal part, and the upper 22 feet was penetrated in the Crawford hole (pl. 1). The basal part of the Gordo in the Webb hole contained much coarser gravel than in the Boykin hole; some of the cobbles from the Webb hole are as much as 70 mm long.

The upper part of the Gordo formation in the Crawford hole consists predominantly of light-gray clay, mottled with red.

McSHAN FORMATION

The McShan formation rests disconformably on the Gordo formation and generally consists of gray laminated clay interbedded with sand having variable amounts of glauconite. The glauconite in the McShan is predominantly pale green, in contrast with the predominantly dark-green glauconite in the overlying Eutaw formation.

In the Crawford hole (pl. 1) the full thickness of the McShan was penetrated, 215.5 feet, which compares reasonably well with the thickness of 240 feet as estimated by Monroe, Conant, and Eargle (1946, p. 205) for the McShan in the Warrior River valley, some 35 miles to the northwest. Though core recovery was poor, most of the McShan in the Crawford hole appears to be sand. The lower 75 feet of the formation consists mostly of medium to coarse sand, containing abundant pebbles in the bottom 30 feet. A few fossils from the McShan in the Crawford hole are listed in Mr. Sohl's report.

EUTAW FORMATION

The Eutaw formation rests on the McShan, but whether the contact is unconformable is uncertain. The two formations are much alike lithologically, but the Eutaw contains much coarser and darker glauconite and has abundant mollusks, especially in the upper part.

A complete section of 157 feet of the Eutaw formation was penetrated in the Crawford hole (pl. 1). Crustacean remains and shark teeth were found at many places throughout the formation, but molluscan fossils were found only in the upper 60 feet.

SELMA GROUP

MOOREVILLE CHALK

Drilling in the Crawford hole (pl. 1) penetrated the lower 26 feet of the Mooreville chalk of the Selma group. This lower part of the Mooreville is mainly a chalky marl that contains abundant coarse grains of glauconite and many fossil shells. The basal 3 feet of the formation is glauconitic, phosphatic, very fossiliferous sand and hard calcareous sandstone.

CONCLUSIONS

Information obtained by drilling of the test holes has made it possible to determine accurately the thicknesses of several of the pre-Selma formations; has indicated the correlation of the Vick formation of the outcrop area with the Comanche rocks of southern Alabama and Mississippi; has shown a definite change in facies in the Eoline member of the Coker formation, from sandy mollusk-bearing

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beds in the Cahaba River valley to carbonaceous, more clayey beds in the Warrior River valley; and has also proved that the strong, bright colors seen in many of the formations on the outcrop are present in the rocks at depths too great to be the result of Recent weathering.

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