Bauxite Deposits of the Springvale District Georgia

GEOLOGICAL SURVEY BULLETIN 1199-F

Bauxite Deposits of the Springvale District Georgia

By LORIN D. CLARK

BAUXITE DEPOSITS OF THE SOUTHEASTERN UNITED STATES

GEOLOGICAL SURVEY BULLETIN 1199-F

Distribution and occurrence of bauxite deposits

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1965

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402

CONTENTS

ILLUSTRATIONS

BAUXITE DEPOSITS OF THE SOUTHEASTERN UNITED STATES

BAUXITE DEPOSITS OF THE SPRINGVALE DISTRICT, GEORGIA

By Lorin D. Clark

ABSTRACT

The Springvale bauxite district is in Randolph and Quitman Counties in the Coastal Plain province of Georgia. Rocks exposed in the district are the Ripley Formation and the Providence Sand of Late Cretaceous age; the Midway Group of Paleocene age; the Wilcox Group of Eocene age; weathered sands, presumably of the Claiborne Group of Eocene age; and a residuum derived from limestones of the Jackson Group of Eocene age and from the limestones of Oligocene age.

The bauxite occurs as cores in koalin lenses in nonmarine beds which occupy the same stratigraphic position as the marine Nanafalia Formation (basal Wilcox Group) at Fort Gaines, 20 miles southwest of the district. Extensive subterranean solution of underlying limestone of the Midway Group has allowed the Eocene beds to slump in a very irregular manner and has caused faulting and distortion of the bauxite bodies.

None of the deposits in the Springvale district has been mined since 1922. Total production from 1916, when bauxite was discovered in the district, until 1922 was about 16,000 long tons. Reserves of all grades of bauxite in which the overburden is not too great to permit profitable mining are estimated to be between 50,000 and 150,000 long tons.

A joint drilling program by the U.S. Bureau of Mines and the U.S. Geological Survey resulted in the discovery of three ore bodies that contain a small tonnage of commercial grade bauxite. Suggestions are given for further prospecting.

INTRODUCTION

The Springvale bauxite district is in parts of Randolph and Quitman Counties, Ga., about 15 miles east of the Chattahoochee River and 75 miles north of the south boundary of the State. The village of Springvale is near the west-central part of the district, and the city of Cuthbert is about 5 miles southeast of it. Geologically, the district can be regarded as an eastward continuation of the Eufaula bauxite district, Alabama, from which it is separated by the Chattahoochee River valley.

The district was mapped by the U.S. Geological Survey during August and part of September 1942 and all of 1943 as part of the search for stratigraphic and critical minerals by the U.S. Department of the Interior. The geology was mapped on aerial photographs, and the final map was compiled by the radial-line method with horizontal control from plane-table traverses and bench marks of the Georgia Geodetic Survey. Altitudes for determining the regional structure were obtained with a surveying aneroid barometer.

A joint drilling program by the U.S. Bureau of Mines and the U.S. Geological Survey lasted for about 10 weeks from September to November 1943. A total of 388 holes aggregating 21,285 feet were put down. Three bauxite deposits containing a small tonnage of commercial grade ore were discovered. The overburden on two of the deposits is thin enough that they could be profitably mined.

The mapping was under the supervision of W. H. Monroe, who did much of the planimetric control work used in compiling the final map. Many concepts developed by W. G. Warren and the author (Warren and Clark, 1965) in the Eufaula district, Alabama, apply equally well to the Springvale district and have been incorporated in this text. The regional stratigraphic studies of F. S. MacNeil were valuable in determining the age relations of various beds in the district. R. L. Heller and J. H. Morris located and logged Bureau of Mines drill holes and aided in the study of the relations of the bauxite. William A. Beck, project engineer for the Bureau of Mines, cooperated with Survey geologists to the fullest possible extent.

HISTORY

Bauxite deposits in the Springvale district were discovered in 1916. The first mine was opened the same year on the Garner property on the east edge of Springvale (Smith, 1929, p. 420). Four other pits were opened later, but when mining stopped in 1922, the total production of the district had been only about 16,000 tons. Since 1922, bauxite outcrops have been examined several times by various operators, but no mining has been done. All the old pits are now slumped and partly filled with water. Smith (1929, p. 410–430) made a brief examination of the bauxite and kaolin exposures of the district in 1927.

Other mineral production in the district includes 3 carloads of yellow ochre, mined near Springvale in 1922, and limestone from quarries 8 miles north of Cuthbert. This limestone was used at various times for ornamental building stone, road metal, and agricultural purposes.

PHYSIOGRAPHY

The Springvale bauxite district is in the Coastal Plain province. It is drained by Pataula Creek, which also forms northwest boundary of the main part of the district. Seven miles southwest of the district, Pataula Creek empties into the Chattahoochee River.

The area mapped can be separated into two physiographic divisions: the lowland area underlain by the Nanafalia Formation on the northwest, and the infacing scarp and high plain to the southeast. The first is a gently rolling terrain, into which Pataula Creek and its tributary, Hodchodkee Creek, have cut valleys 150 to 200 feet deep. Southeast of Pataula Creek the hills of this terrain reach a fairly uniform altitude of about 390 feet above sea level, but northwest of Pataula Creek the land surface rises gradually. Development of the topography seems to have been controlled by the lithology of the Nanafalia Formation rather than by a temporary base level of the Chattahoochee River drainage.

The gently rolling terrain is bounded on the southeast by a steep serrated scarp, in most places 100 feet high, which rises to the plain that forms the east border of the area mapped. The scarp is a continuation of the Baker Hill cuesta in Barbour and Henry Counties, Ala. It becomes less distinctive in the northeast corner of the district. The high plain is here much less dissected then the seaward-dipping slope of the cuesta in Alabama and, in general, is characterized by broad, nearly flat areas, broken by relatively narrow stream valleys.

The streams that head near the crest of the scrap are perennial and are fed by springs which emerge at the top of the Tuscahoma Formation of Eocene age; in the area underlain by the Nanafalia Formation of Eocene age, some of the streams are spring fed, whereas others are mere wet-weather rills. The courses of the smaller streams ars short and their gradients high; deep vertical-walled gullies are common. The major streams of the region meander across broad swampy bottomlands.

Shallow sinkholes, formed by solution of limestone in the Midway Group, occur throughout the area and are even found where the Midway is overlain by 150 to 200 feet of younger beds. One of the largest, a sink 25 feet deep and more than 200 yards in diameter, is occupied by the pond 5 miles N. 10° E. of Cuthbert. However, the dendritic pattern of the drainage indicates that the role played by solution of the limestone in the formation of the present topography was small.

The lowest point in the district is on Pataula Creek at an altitude of 220 feet above sea level; the highest point, on the plain northeast of Cuthbert, is about 540 feet above sea level. Total relief is thus about 320 feet over a distance of about 10 miles.

STRATIGRAPHY

Rocks exposed in the district are limestone and unconsolidated clay, sand, and shale, ranging in age from Late Cretaceous to Oligocene. The geologic units mapped (pl. 1) are: the Providence Sand and Ripley Formation of Late Cretaceous age; the Clayton Formation of the Midway Group of Paleocene age; the Nanafalia and Clayton Formations, undivided, of Paleocene and Eocene age; the Nanafalia and Tuscahoma Formations of the Wilcox Group of Eocene age; and sand of the Claiborne Group of Eocene age. Remnants of a residuum from the Jackson Group of Eocene age and Oligocene limestones with included bodies of overlying Miocene beds and terrace gravels are found on the plain at the east edge of the district. The residuum was mapped with the Claiborne, as none of these sediments have a bearing on the location of bauxite deposits. The Bashi Marl Member of the Hatchetigbee Formation of Wilcox age has not been recognized within the district, with the possible exception of one doubtful exposure. Quaternary alluvium, representing remnants of terraces along Pataula and Holanna Creeks, was not mapped.

UPPER CRETACEOUS

RIPLEY FORMATION AND PROVIDENCE SAND

The oldest formation recognized in outcrop in the district during the field mapping was the Providence Sand of Late Cretaceous age. However, subsequent mapping of Cretaceous rocks of Georgia by Eargle (1955, p. 59, and pl. 1) showed that the underlying Ripley Formation crops out in the northwest extremity of the mapped area in the valley of Hodchodkee Creek. This location is the only place in the district that the Ripley is exposed, and it is not differentiated on the map from the Providence Sand.

The Providence Sand is composed of micaceous sands, clays, and shales, largely marine within this district. In general, the sediments are fine-grained in the southern part of the district and become coarser to the north, where the formation is composed of coarse light-colored sands together with lenses of kaolin and in appearance closely resembles the sands and kaolins of the Nanafalia Formation. However, some of the kaolins of the Providence Sand are stained light purple, a color not found in kaolin of the Nanafalia. *Halymenites* burrows are abundant throughout both the coarse- and fine-grained parts of the formation, except in the kaolin lenses and in carbonaceous shale. Large grains of fairly fresh appearing feldspar are common in some of the coarse sands.

The black carbonaceous, micaceous, sandy shale, which along the Chattahoochee River is directly overlain by the Midway Group, crops out at the base of the highway cut half a mile south of the mouth of Hodchodkee Creek. (See fig. 1.) Here it is overlain by more than 50 feet of fine clayey sand of still higher beds in the Providence Sand.

The following measured sections show the variation in the units of the formation.

Section measured on the south side of Pataula Creek in the roadcut 1 mile east of the mouth of Hodchodkee Creek

	Thickness (feet)
6. Soil	
Midway Group(?):	
5. Sand, coarse, red, somewhat clayey. No burrows	3+
Providence Sand:	
4. Clay, sandy, and micaceous sand, containing abundant *Halymenites* burrows. Top marked by zone of broken and apparently weathered purple and white mottled fine sand, 1 ft thick	3
3. Sand, fine, red, micaceous, containing scattered feldspar grains. *Halymenites* burrows rare at base, more common at top	10
2. Sand, fine, gray, clayey, micaceous, fossiliferous. Scattered *Halymenites* burrows	19
1. Sand, coarse, gray, gritty, micaceous. Contains scattered shale fragments and fossils. Base obscured	16+

Section measured in the roadcut a quarter of a mile south of the mouth of Holanna Creek

	Thickness (feet)
4. Soil	
Providence Sand:	
3. Sand, fine, micaceous, gray to pink color. Scattered *Halymenites* burrows, clay fragments	15+
2. Sand, fine, micaceous, calcareous, black. Contains large fossils	5
1. Clay, sandy, coarse-grained, containing small fossils. Base obscured	6+

Where the basal sand of the Midway Group rests on coarse Providence Sands, the contact is indistinct, but where kaolin is present in the upper part of the Providence, the contact is fairly sharp. At many places cracks in this kaolin as much as a foot deep are filled by sand of the overlying Midway. The surface of the Providence Sand, however, shows no noticeable relief within the area mapped.

PALEOCENE

MIDWAY GROUP

The Midway Group, of Paleocene age, rests unconformably on the Providence Sand. The most complete section of the unweathered Midway Group is that exposed in the headwaters of Pumkin Creek, 7 to 8 miles north of Cuthbert (pl. 1). Here it is composed of a thick bed of fossiliferous limestone overlain by fuller's earth. Altitudes measured by barometer at the top of the fuller's earth in a highway cut half a mile east of Grier's Cave and at a limestone spring south of the cave indicate a total thickness of the Midway in this vicinity of more than 100 feet. Altitudes at this spring and at the top of the mine face in Wade quarry, north of the cave, indicate that the limestone alone is more than 75 feet thick.

Southwest of the Springvale district on the Chattahoochee River the Midway Group is composed largely of limestone with minor amounts of quartzite and sand. The thickness was estimated to be 218 or 298 feet by Langdon (1894, p. 369, 418, and 743), who based his estimates on the observed width of outcrop and an assumed rate of dip. A later figure, based on estimates of W. C. Warren, F. S. MacNeil, and L. D. Toulmin, Jr., places the thickness at 135 feet, ±20 feet.

The entire section of limestone of the Midway Group on the Chattahoochee River has been included in the Clayton Formation which has been divided into two members by MacNeil (1946, p. 6) on the basis of regional studies. In Alabama, the two members are separated by a fuller's earth zone, represented along the river by a bed of argillaceous sand. No subdivision of the Clayton has been made in most of the area shown in plate 1 because of extensive solution. Inasmuch as fuller's earth occurs at the top of the limestone section in the vicinity of Pumkin Creek, however, this limestone probably represents the lower member.

The thickest continuously exposed section of rocks of the Clayton Formation in the area studied is in Williamson quarry, half a mile east of the highway and 7 to 8 miles north of Cuthbert. Following is a partial section measured in the quarry.

Clayton Formation:	*Thickness (feet)*
8. Soil.	
7. Fuller's earth	4+
6. Limestone, spongy. Contains abundant corals, bryozoa, and echinoid fragments	13
5. Fuller's earth, sandy, micaceous, dark brown. Contains fragments of weathered limestone	1
4. Limestone, hard, oyster shells abundant	8
3. Sand, very fine, micaceous, white. Contains oyster shells. Probably decalcified limestone	½
2. Limestone, soft, very fossiliferous. No break with unit below	13
1. Limestone, hard, dense. Contains *Turritella*, *Ostrea crenulimarginate*, cephalopods. Base obscured	12+
Total	51½+

Limestone float, of uncertain age, occurs in a field above the quarry face in which this section was measured.

Over the rest of the district, however, the Clayton Formation has been decalcified near the surface, so that the Midway group is represented in exposures only by a residuum of coarse red basal sand, 4 to 8 feet thick, in which *Halymenites* burrows are locally present. This sand is overlain by 10 to 25 feet of highly contorted residual clays and fine sand. Hollow concretions of limonite are abundant in most of these outcrops. Fields underlain by residuum of the Clayton Formation are characterized by dark-red, sandy soil, littered with irregular fragments of limonite. Limetone is scarce in outcrop, but its presence under cover is attested by the structure of overlying beds, and it was found in a drill hole northeast of Springvale. Fuller's earth is found only in the northeast corner of the district, but whether its absence elsewhere is due to lack of deposition or to pre-Nanafalia erosion was not ascertained.

Exposed contacts between the Clayton and Nanafalia are very irregular. Curved domes and horns of decalcified Midway material extend upward into the Nanafalia Formation 10 feet or more above the general surface of the Midway Group (fig. 1). Because of this irregularity and the fact that the Midway is generally thin at outcrops, the Midway has been mapped separately only in the vicinity of Pumkin Creek.

FIGURE 1.—Irregular contact between decalcified beds of the Midway Group and the Nanafalia Formation. Surface of contact is at top of hard ledge of banded limonite on which the hammer rests. Roadcut on southeast side of Pataula Creek, 1½ miles northwest of Springvale.

EOCENE

WILCOX GROUP

NANAFALIA FORMATION

The nonmarine beds referred to the Nanafalia Formation in this report were included in the Midway Group by Veatch and Stephenson (1911, p. 218, 219). However, they occupy the same stratigraphic position as the marine Nanafalia beds at Fort Gaines, 12 miles to the southwest. Similar bauxite-bearing beds, occupying the same stratigraphic interval in Henry County, Ala., can be traced to within 3 miles of Fort Gaines. For this reason these nonmarine beds are considered to be of Nanafalia age and therefore to be the basal part of the Wilcox Group.

In the Springvale district the beds included in the Nanafalia Formation consist of sands, kaolinitic sands, and kaolins, which, with one possible exception (p. 9), show no evidence of marine deposition. The sands are unconsolidated, generally micaceous, and range in color from light red or brown to white. They are crossbedded, coarse to fine, and commonly contain clay balls. Lenses of quartz-pebble conglomerate are common. The kaolin is in the form of lenses, reaching a maximum thickness of more than 50 feet and a diameter of more than 700 feet. Some of the kaolin lenses have cores of bauxite or bauxitic clay. Some of the kaolins are silty and micaceous, and some are also carbonaceous. All gradations from clean sand through kaolinitic sand to clean kaolin can be observed.

Because of an insufficient number of exposed sections, any subdivisions in the Nanafalia Formation within the district cannot be made. Certainly, the "upper barren beds" of the Eufaula district, Alabama (Warren and Clark, 1965, p. E8), are not universally present in the Springvale district. However, beds closely resembling them can be seen below the basal sand of the Tuscahoma in the roadcuts about 5 miles northwest of Cuthbert, near the T-intersection on the Cuthbert-Springvale road, and in a gully about 3 miles southeast of Springvale and half a mile northeast of Georgia Highway 50, on the south side of Holanna Creek.

The thickness of the Nanafalia Formation varies greatly within the district, and measurements are made difficult by the slumping attendant on solution of limestone of the Midway Group. The thickest section in the district was penetrated by drill holes east of Springvale where the total thickness is nearly 80 feet. In the vicinity of the bauxite pits and outcrops the probable average thickness is about 70 feet. Northeastward, the formation thins over a short distance, and northeast of Pumkin Creek it is present only in depressions on the Midway surface. In the northeast corner of the area mapped, the overlying Tuscahoma rests directly on limestone of the Clayton Formation. In a roadcut 200 feet long on State Highway 1, half a mile south of Pataula Creek and just north of the map boundary, the basal sand in the Tuscahoma can be seen in some places in contact with the Midway residuum and in others separated from it by 3 to 5 feet of Nanafalia Formation (fig. 2). Large gullies southwest of here show the Tuscahoma resting directly on the Midway in most places. The Nanafalia beds are also locally very thin farther southwest of Springvale; in a roadcut half a mile south of the mouth of Holanna Creek, the Tuscahoma Formation is apparently in contact with beds of the Midway Group.

The variation in thickness of the Nanafalia Formation is in part attributable to pre-Tuscahoma erosion and in part to deformation of the Nanafalia as a result of slumping due to solution of the underlying limestone. Also, in some places the Nanafalia may have been deposited upon an uneven surface, perhaps a karst topography. If so, some of the variation in thickness would result from accumulation of greater stratigraphic thicknesses in the depressions than over elevated parts of the surface.

A possible exception to the general continental origin of the Nanafalia Formation in the district is an outcrop near Morris, on the north

FIGURE 2.—The Nanafalia Formation (N), represented by a 3-foot bed of white friable sand on which the hammer rests. The formation is underlain by laminated fuller's earth of the Clayton Formation (C) and overlain by coarse clayey basal sand of the Tuscahoma Formation (T) containing *Halymenites* burrows. Roadcut on U.S. Highway 27, half a mile south of Pataula Creek.

763–749 O—65——2

side of Holanna Creek. Here the Midway is overlain by a red coarse-grained nonglauconitic sandy clay that is perforated with borings. This deposit does not resemble the Tuscahoma in appearance and is taken to be Nanafalia. A narrow estuary may have extended this far north during early Nanafalia time.

The bluff on the east side of the Chattahoochee River at Fort Gaines affords an excellent exposure of the top of the Midway Group, the Nanafalia Formation, and the lower part of the Tuscahoma Formation. Sections have been measured here by Loughridge (1884, p. 280 and 398); Spencer (1891, p. 46); Langdon (1894, p. 406); Veatch (1909, p. 80); Stephenson (Veatch and Stephenson, 1911, p. 231–232); Cooke (1943, p. 49); and Warren (Warren and Clark, 1965, p. E11 and E12).

TUSCAHOMA FORMATION

In this district the Tuscahoma Formation of Eocene age consists of three members: the basal member is a coarse, glauconitic sand; the middle member, a laminated clay; and the upper member, a fine sand. All can be traced from the Chattahoochee River to the northeast corner of the district, where some of the upper beds have been removed by pre-Claiborne erosion. Throughout most of the outcrop area the total thickness of the Tuscahoma Formation is from 70 to 80 feet.

The basal sand member rests unconformably on the nonmarine beds of the Nanafalia Formation and commonly contains clay balls derived from these beds. In general, the sand is coarse, strongly glauconitic, and fossiliferous. Quartz pebbles as much as 1 inch in diameter are common. The amount of clay varies, and in some places the bed is a sandy clay. The pecten *Chlamys greggi* Harris is nearly everywhere present and is an excellent guide fossil, as it is not known to occur in beds stratigraphically higher or lower than beds 12 and 13 of the Fort Gaines section. (See Warren and Clark, 1965, p. E10–E12, fig. 1.) Venericardias, Ostreas, Turritellas, corals, and other fossils are abundant locally. *Halymenites* burrows are abundant in the member throughout the district and in many places have penetrated as much as 5 feet into the underlying continental sands of the Nanafalia Formation (fig. 3). The basal sand bed, where it is fresh, is a dull green owing to the glauconite, but it weathers to a deep red or drab color. It ranges from 5 to 10 feet in thickness.

Below the basal sand member just described is a bed about 3 feet thick of coarse glauconitic sand with abundant Halymenites burrows. This bed may be the equivalent of bed 11 (basal part of Tuscahoma) of the Fort Gaines section (fig. 4). (See Warren and Clark, 1965, p. E27–E31.) It was included with the Tuscahoma Formation in mapping.

FIGURE 3.—Basal sand of the Tuscahoma Formation resting on clay of the Nanafalia Formation which has been perforated by *Halymenites* borings. The borings are filled with glauconitic sand of the Tuscahoma. Gully at base of scarp 2 miles east of Springvale.

The character of the basal member changes somewhat north of Pumkin Creek. Here, *Halymenites* was the only fossil found, no glauconite was seen, and the color is purplish red. The glauconite may have been present at one time but was since leached out.

FIGURE 4.—Glauconitic basal sand of the Tuscahoma Formation resting on white sand of the Nanafalia Formation. *Chlamys greggi* Harris is found in the sand bed above the upper of the two clay-ball zones appearing in picture, but not in the sand bed below. Gully 3 miles southwest of Springvale.

The basal sand grades upward into the laminated light-gray or green clay middle member of the Tuscahoma Formation (bed 14 of the Fort Gaines section). In some places the clay is micaceous and very sandy. In a few outcrops the lower 10 to 15 feet of the member is carbonaceous, glauconitic, and fossiliferous. The thickness ranges from 30 to 60 feet.

The upper member, as exposed in most places, is a very fine orange or yellow sand, having the appearance of a weathered arkose, although examination with a hand lens failed to reveal feldspar grains. The sand is in part crossbedded and contains thin broken beds of laminated clay. *Halymenites* burrows are found in some places in the top part of the unit.

Fresh exposures of the upper member are found where the small streams northwest of Cuthbert have cut into a thick section of fine sand containing the typical thin, broken beds of laminated clay. Here the sand is dark gray, weathering to rust color, and resistant enough to form potholes, low waterfalls, and small gorges. Glauconite grains are common in the sand, and scattered plant fragments have been found. Large *Halymenites* burrows occur at the top of the section.

An excellent section of the Tuscahoma Formation is exposed in the highway cut on the south side of Holanna Creek, 4 miles due west of the corporate limits of Cuthbert near the south boundary of the map. The section is as follows:

	Thickness (feet)
Sand unit of the Claiborne Group:	
5. Sand, red, fine, micaceous, massive. Very even texture throughout. Top grades into soil	30+
Tuscahoma Formation:	
4. Sand, orange. Contains thin broken beds of laminated clay. Looks like weathered arkose	15
3. Clay, gray, laminated. Bottom portion very sandy	55
2. Sand, coarse, glauconitic, fossiliferous. Contains *Turritella* sp. and *Chlamys greggi* Harris	6½
Nanafalia Formation:	
1. Clay, light-gray, silty, micaceous. Upper 2 ft is yellow and ferruginous	6½

The lower 10 feet of the section was measured by boring with a hand auger. The Tuscahoma-Claiborne contact in the above section dips steeply, but whether it dips from pre-Claiborne channeling or from slumping is uncertain. An almost identical section was measured here by Veatch and Stephenson (1911, p. 234) along the old public road.

The combination of low relief in most of the area and uneven settling of beds overlying the Midway Group has made it very difficult to map the boundary of the Tuscahoma Formation accurately. Many isolated patches of Tuscahoma material, a few acres in extent, have not been mapped.

BASHI MARL MEMBER OF THE HATCHETIGBEE FORMATION

The Bashi Marl Member may be present in the area between Springvale and Cuthbert, but it has not been definitely identified and apparently does not occur elsewhere in the district. The remainder of the Hatchetigbee Formation is not present in the district. However, the Tuscahoma-Claiborne contact was not studied carefully, and some exposures of the Bashi may have been overlooked.

CLAIBORNE GROUP

Resting unconformably on the Tuscahoma Formation is a section of clean unconsolidated sand about 50 feet thick. On the basis of its regional stratigraphic relations, the sand was considered by MacNeil (1947) to belong to the Claiborne Group of middle Eocene age. How much of the Claiborne it represents is not known, owing to its deeply weathered condition. It will be referred to as the sand unit of the Claiborne Group.

In places, the sands of the Claiborne closely resemble some of the material in the Nanafalia. Where the sand is fresh, it is white to light yellow in color, but it oxidizes to a deep red. In the east-central part of the district, the sand unit contains lenses of kaolin. The sand is in part massive and in part crossbedded and, within the district, shows no evidence of marine deposition. In the northeast corner of the district, and possibly elsewhere, the Claiborne fills channels in the top of the Tuscahoma Formation (fig. 5).

The sand unit forms the top of the cuesta that bounds the bauxite district on the southeast, and it seems to have played the role of a resistant bed in the formation of the ridge. When the ground surface was protected by forests and sod, drainage from areas underlain by the sand was largely in the subsurface, as rainwater could easily seep through the loose, porous sands. Under these conditions, erosion would be negligible in areas underlain by the sand. That infiltration is considerable at the present time, even after extensive cultivation, is indicated by the many springs which emerge at the base of this sand at the top of the less permeable Tuscahoma sediments.

UPPER EOCENE AND OLIGOCENE

Remnants of a residuum derived from limestones of the Jackson Group of late Eocene and Oligocene age occur in small patches in the eastern part of the district. The residuum consists largely of contorted clays and sand with residual chert blocks which contain Eocene fossils in some localities and Oligocene fossils at others. In places it may include undifferentiated weathered Miocene beds or terrace gravels (MacNeil, F. S., written commun., 1959). The residuum has not been separated from the Claiborne Group in mapping.

FIGURE 5.—Sand unit of the Claiborne Group (dark) filling channels in truncated upper beds of the Tuscahoma Formation (white). Roadcut on U.S. Highway 27, about half a mile south of Little Pumkin Creek.

STRUCTURE

The contact between the Providence Sand of Late Cretaceous age and the Clayton Formation of Paleocene age is the only surface on which contours can be drawn to show regional structure because extensive solution of the limestone of the Clayton Formation has allowed overlying beds to slump in a very irregular manner.

The strike of this surface in the west half of the mapped area is N. 75° E., but in the east half it swings to N. 50° E. The dip is southeastward at about 20 feet per mile.

Because solution of the limestone of the Midway Group has been most complete near the stream valleys, overlying beds are generally found at lower altitudes near streams rather than on the divides and on the scarp. However, deep sinks are found throughout the area, and there is little regularity in the structure of beds overlying the Midway Group. Small faults having displacements of as much as 20 feet are common, and in many places the basal sand of the Tuscahoma Formation is seen to be draped over the crests of the low hills. The Bureau of Mines drilling has shown vertical dislocations of the Tuscahoma-Nanafalia contact amounting to 40 feet within a horizontal distance of 100 feet.

DRILLING PROGRAM

A joint drilling program was begun by the Bureau of Mines and the Geological Survey in September 1943 in an attempt to expand the known reserves of the district. Drilling was terminated 10 weeks later after a small part of a favorable area had been prospected.

The power-auger drill, which was used, proved well suited to rapid reconnaissance prospecting, but it is not adapted to accurate blocking out of ore bodies because samples are contaminated as they are brought to the surface and because the time lag in getting these samples up renders depth and thickness determinations uncertain. Bauxite brought up to the surface through overlying beds of sand is contaminated and is invariably of much lower grade than are clean samples of the same material.

Drilling in known bauxite deposits was avoided, and all holes were located without surface indication of bauxite. A first set of holes was located in a grid pattern at intervals of 300 feet to locate the large kaolin lenses which contain the bauxite. Holes that penetrated bauxite or kaolin were offset with other holes at distances of 50 or 100 feet to outline the bauxite roughly or, if kaolin was found, to determine whether or not it graded laterally into bauxite. Holes were drilled to a depth of 50 feet or to such depth as was necessary to reach the bottom of bauxite or kaolin deposits.

In all, 388 holes, totaling 21,285 feet, were drilled. Three small bauxite bodies were found. Two of these are shallow and are probably minable, but the third is too low in grade to be of commercial interest.

SUGGESTIONS FOR FUTURE PROSPECTING

Prospecting for bauxite should be limited to the areas underlain by the Nanafalia Formation, as shown on the geologic map (pl. 1). At lower altitudes favorable prospecting areas are limited by belts where erosion has carried away the bauxite-bearing beds of the Nanafalia Formation and exposed the barren beds of the Midway Group and the Providence Sand. Prospecting is further limited to areas where bauxite can be expected under less than 50 feet of overburden because of the small size of the bauxite deposits and the relatively high cost of mining deep ore bodies. Overburden will generally exceed 50 feet where the Nanafalia Formation is overlain by the Tuscahoma and younger formations. The possibilities of finding bauxite are greater in those parts of the district where nearly the entire original thickness of the Nanafalia Formation is present. The difficulty of prospecting has been increased by extensive solution of limestone of the Clayton Formation. Slumping attendant on this solution has faulted and tilted the bauxite and kaolin bodies and has caused a variation of more than 30 feet in the altitudes of the bauxite.

Northeast of Springvale, the favorable prospecting area is clearly indicated by bauxite outcrops, but scattered occurrences of bauxite float in the vicinity of Union Church show that an area of about 2 square miles is favorable for prospecting.

BAUXITE

The bauxite bodies are associated with lenses of kaolin that occur in the Nanafalia Formation. No bauxite has been found associated with kaolin in other formations in the district nor with kaolin containing more than a very small percentage of silt, mica, or sand. Extensive drilling and mining in the Eufaula bauxite district, Alabama, have shown the bauxite there to be completely surrounded by kaolin, except where cut by erosion, and this situation can be assumed to hold true also for the less adequately explored Springvale district. All three unexposed bauxite bodies in the district are enveloped in kaolin. The bauxite-kaolin contact is gradational on all sides.

The bauxite bodies are irregular in shape but in general have the form of thick lenses, which may have the rough proportions of 150 feet in length, 75 feet in width, and 20 feet in thickness. The deposits dip at various angles. A fault in the low-grade bauxite that forms one wall of the southernmost of the Garner mines indicates that some of the irregularity in shape and attitude of the bauxite is due to slumping after formation of the bauxite but a part may be due to slumping and breaking of the kaolin lenses before formation of the bauxite. The size of known ore bodies ranges from a few tons to more than 6,000 tons, the latter being the amount of ore produced from the largest mine of the district (Smith, 1929, p. 427). Larger ore bodies may exist beneath the surface.

The regional trend of bauxite deposits from the Eufaula district, Alabama, to the Andersonville district, Georgia, follows the belt of nonmarine Nanafalia sediments. In the Springvale district (pl. 1), however, bauxite in kaolin in the Nanafalia is restricted to a zone 2 or 3 miles wide which trends west-northwestward across the strike and extends across the whole width of outcrop of the Nanafalia Formation. The northwest end of the zone is cut off by the Hodchodkee Creek valley, and the southeast end passes under the post-Nanafalia beds that form the cuesta. The zone is divided into two unequal parts by the valley of Pataula Creek, and only a small remnant is left northwest of the creek, in the vicinity of Union Church. The reason for the localized occurrence of bauxite is not apparent, for many outcrops of nonsandy kaolin on both sides of this zone testify to the presence of kaolin lenses in the Nanafalia Formation throughout the district.

Altitude of the bauxite deposits northeast of Springvale ranges from 350 to 380 feet above sea level.

PHYSICAL APPEARANCE

The bauxite of the Springvale district is a light-colored, generally soft material, some varieties of which closely resemble the kaolin with which it is associated. In general, kaolin is dense, sticky, and nonpisolitic, whereas bauxite is porous, mealy, and pisolitic; but a variety of kaolin not uncommon in the district is porous, somewhat mealy, and contains soft pisolites. Most of the bauxite contains a greater or lesser concentration of pisolites ranging from small simple structures 0.1 cm in diameter to compound structures 3 cm in diameter. No relation has been established between the grade of the bauxite and the type, size, or relative abundance of the pisolites. Most of the bauxite is fairly soft, but a rare variety of high-grade bauxite (sample 1 in section on chemistry) occurs as groups of boulders (fig. 6) or as scattered float on the surface. It is hard, pisolitic, and light colored, the whole mass resembling the material that forms the hard pisolites of the soft variety of bauxite. It may be the result of secondary enrichment of long-exposed bauxite. A small part of the Springvale bauxite has been noticeably stained and indurated by iron oxide, but the hard red high-iron bauxite common in the Eufaula district, Alabama, is absent.

FIGURE 6.—Residual boulders of high-grade bauxite 1½ miles north of Springvale. This type of occurrence is known locally as a "bust-up."

Two types of pisolites are found in the district—one hard and dense except for small angular cavities and the other soft and spongy. The hard pisolites are concretionary structures of gibbsite and are found only in bauxite, where the soft pisolites are composed of clay and are more common in kaolin.

In the field bauxite can be distinguished from kaolin by chewing a small piece of the material. Kaolin, even the varieties that appear mealy, adheres to the teeth, whereas bauxite does not. This test is applicable only to the bauxites of this region.

CHEMISTRY

Microscopic and X-ray studies indicate that the bauxite is composed largely of a mixture of gibbsite ($Al_2O_3 \cdot 3H_2O$) and kaolinite ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$). The grade of the bauxite rises with the relative amount of gibbsite. The bauxite is invariably contaminated with minor amounts of iron and titanium. When more than a small percentage of iron is present, it is probably the result of deposition of iron oxide by ground water. Free silica is rare in bauxite or kaolin in the Springvale district.

Partial analyses of three representative samples of Springvale bauxite and one sample of kaolin are as follows:

Partial analyses of representative samples of Springvale bauxite and kaolin

[Chemical analyses made in Bureau of Mines field office, Tuscaloosa, Ala.]

Sample	SiO_2	Fe_2O_3	TiO_2	Al_2O_3	Ignition loss	Total
1	5. 51	1. 41	2. 29	60. 35	30. 93	100. 49
2	16. 40	8. 03	2. 37	47. 85	24. 77	99. 42
3	9. 5	1. 4	2. 5	57. 4	29. 4	100. 2
4	44. 85	1. 14	1. 24	38. 72	14. 13	100. 08

1. Hard float on surface of shallow bauxite body 1½ miles N. 15° E. of Springvale. Boulders shown in figure 6 are of similar material.
2. Light-red, high-iron bauxite from outcrop north of road half a mile west of T-intersection on upper Cuthbert-Springvale road.
3. From a test pit adjacent to small mine at head of McCallop Creek.
4. Mealy, porous, structureless kaolin, closely resembling bauxite in appearance. Sample was collected in a gully 100 yd west of Fussell mine, but the same type of kaolin is found in several other localities in the district.

ORE BODIES

All the bauxite discovered in the Springvale district during the investigation by the Geological Survey and the Bureau of Mines was in small deposits, generally of low grade. The deposits are fairly thick in proportion to their areal extent and roughly elliptical or long, narrow, and curving in plan. The enclosing kaolin bodies are also somewhat elliptical. Ore bodies A and C (fig. 7) are elongate and appear to extend down a slope which probably was the side of a shallow sinkhole. Ore body B seems to lie in the bottom of a wide shallow sinkhole and is overlain by a thin cover of kaolin which exhibits the same fragmental texture as the bauxite.

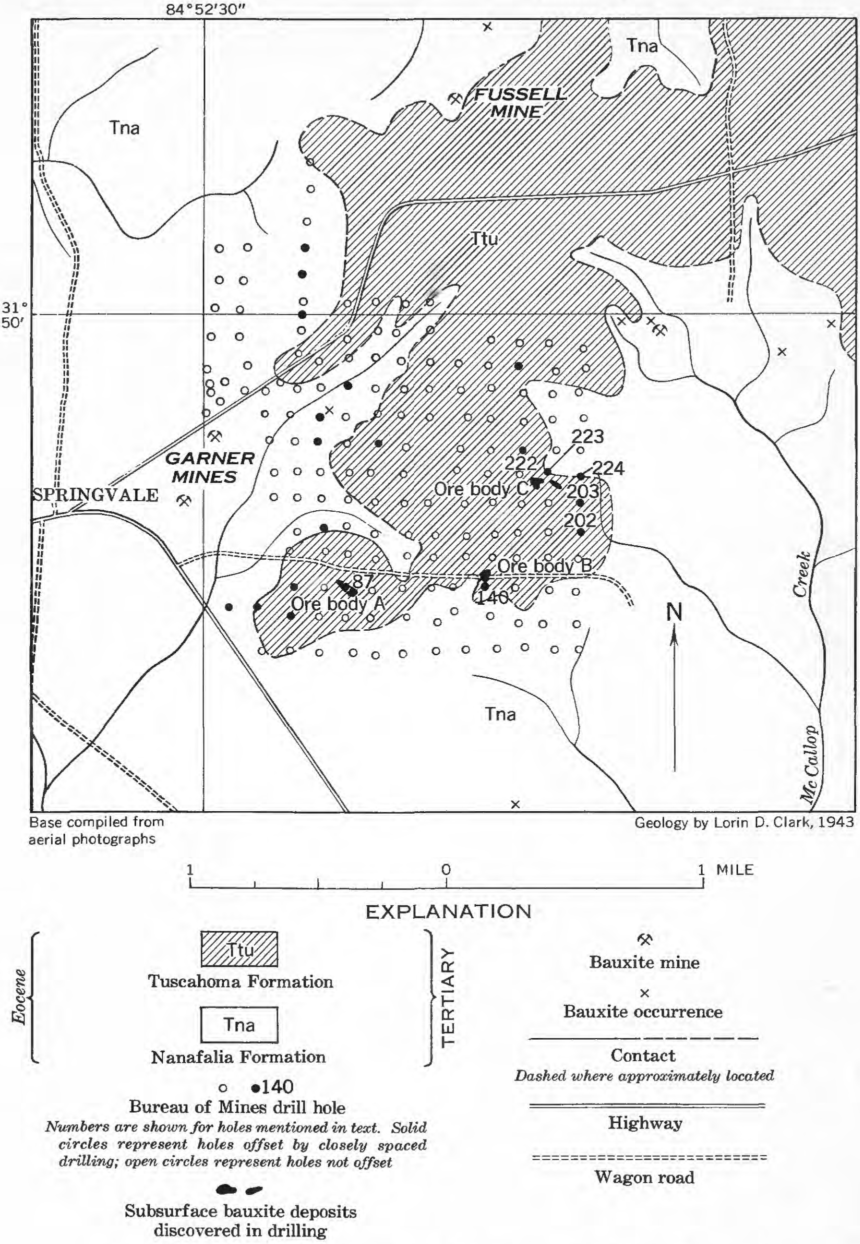

FIGURE 7.—Locations of drill holes in the Springvale district, Georgia.

Ore body A is in the NW¼ Georgia Land Lot 70. The greatest thickness of bauxitic clay and bauxite was about 49 feet, penetrated in the discovery hole, drill hole 87 (Beck, 1949, figs. 3, 4). Additional holes were offset on 50-foot centers. The log of hole 87 and chemical analyses (Beck, 1949, p. 7) of the bauxitic clay and bauxite interval follow.

Log of hole 87

Depth (feet) From	To	Description
0	3	Soil, sandy, light-brown to rust.
3	8	Clay, sandy, light-brown to gray.
8	13	Clay, bauxitic, cream to light-gray.
13	20	Bauxite, nonplastic, cream to light-gray, with small hard oolites and pisolites.
20	30	Bauxite, pisolitic and structureless, some hard oolites and pisolites, cream to gray.
30	53	Bauxite, soft, abundant pisolites, pinkish cream in color.
53	57	Clay, bauxitic, fragmental, pink with white fragments.
57	60	Sand, clayey, medium, micaceous, light-pink.

Chemical analyses of bauxitic clay and bauxite interval from hole 87

[Beck, 1949]

Depth (feet)		Analyses (percent)				
From	To	Al_2O_3	SiO_2 (insoluble)	Fe_2O_3	TiO_2	Ignition loss
10	13	50. 3	21. 3	1. 8	1. 8	24. 2
13	17	51. 7	20. 3	1. 3	1. 9	24. 5
17	20	51. 1	21. 1	1. 4	2. 0	24. 2
20	23	52. 8	17. 5	1. 2	2. 1	25. 9
23	27	52. 4	17. 6	1. 3	2. 3	25. 9
27	30	50. 7	19. 1	1. 6	2. 2	25. 4
30	43	54. 0	15. 4	1. 3	2. 2	26. 6
43	50	52. 4	18. 2	1. 1	2. 3	25. 3
50	53	47. 1	28. 2	1. 3	2. 1	21. 1
53	60	40. 6	39. 7	1. 4	1. 8	16. 0

Beck (1949, p. 4) pointed out that the samples obtained in power-auger drilling were somewhat contaminated by sand and, to eliminate the effect of the sand, approximately 5 percent should be added to the percentage of alumina and the same amount subtracted from the silica content.

The deposit is about 200 feet long and ranges from 50 to 90 feet in width. The average thickness of bauxitic clay and bauxite together is about 20 feet. The overburden ranges in thickness from 7 to 20 feet.

Ore body B is in the SE¼ Georgia Land Lot 71. Discovery hole 140 is south of the bauxite but penetrated fragmental kaolin, and thus indicated the possibility of an ore body. Offset holes were drilled on 100-foot centers to delimit the body. The offset holes are not shown on figure 7 because of the scale. The greatest known thickness of bauxite plus bauxitic clay is 27 feet in offset hole 148, about 160 feet north of hole 140. The log of hole 148 and chemical analyses of part of the bauxite from hole 148 (Beck, 1949, p. 10) are as follows:

Log of offset hole 148

Depth (feet)		Description
From	*To*	
0	3	Soil, light- to dark-brown.
3	8	Sand, reddish-brown, clayey, medium to coarse, slightly micaceous.
8	13	Clay, light-brown to ocher-colored, kaolinitic, fragmental.
13	27	Clay, ocher-colored, bauxitic, pisolitic and fragmental, nonplastic.
27	40	Bauxite and bauxitic clay, light tan to cream in color, pisolitic and fragmental.
40	43	Clay, light-gray, kaolinitic and bauxitic, micaceous(?).

Chemical analyses of samples from offset hole 148

[Beck, 1949]

Depth (feet)		Analyses (percent)				
From	To	Al_2O_3	SiO_2 (insoluble)	Fe_2O_3	TiO_2	Ignition loss
10	13	35.5	39.7	6.9	1.5	15.3
27	30	45.8	24.0	4.8	2.1	22.6
30	37	44.8	36.3	3.9	2.3	21.5
37	40	41.2	34.1	3.1	2.1	18.1
40	43	41.3	34.2	3.0	2.1	18.0

NOTE.—Samples from 13 to 27 ft were broken and lost.

The roughly elliptical deposit is entirely surrounded by kaolin and is about 100 feet in diameter. The overburden ranges in thickness from 13 to 25 feet. This ore body is very incompletely delimited, but because of its small size and low grade, no further drilling was done.

Ore body C, in the SE¼ Land Lot 71, consists of two small deposits (fig. 7), one on the edge and the other on the slopes and bottom of an irregularly shaped sinkhole. The discovery hole, drill hole 223, is on the northeast edge of the sink structure and penetrated only clay. Offset holes were drilled on 50- and 100-foot centers to partly delimit the bodies. These holes are not shown on figure 7. The smaller of the two deposits is probably elongate northwest. The only hole in it, offset hole 243, showed 17 feet of bauxitic clay and bauxite overlain by 10 feet of overburden. The larger of the two deposits is shaped like a spearhead. About 10 feet of bauxitic clay and bauxite were discovered in offset drill holes 244 and 261. The overburden on the deposit ranges from 17 to 60 feet in thickness. The description and chemical analyses of hole 261 follow:

Log of hole offset hole 261

Depth (feet) From	To	Description
0	3	Soil, tan, sandy.
3	17	Sand, red-brown to olive-drab, clayey, fine, glauconitic; Tuscahoma Formation.
17	27	Clay, light-gray, plastic, sandy and silty.
27	33	Clay, very light gray, kaolinitic, only slightly plastic.
33	60	Bauxite and bauxitic clay, light cream-tan, pisolitic.
70	83	Clay, pink, kaolinitic, plastic.
83	86	Clay, pink, plastic, silty.

Chemical analyses of samples from offset hole 261

[Beck, 1949]

Depth (feet)		Analyses (percent)				
From	To	Al_2O_3	SiO_2 (insoluble)	Fe_2O_3	TiO_2	Ignition loss
43	[1] 47	30.4	51.5	4.1	1.6	11.8
47	[1] 50	30.6	50.7	4.0	1.6	12.3
50	[1] 53	31.7	49.1	4.2	1.6	13.1
53	[1] 57	26.2	54.4	5.8	1.4	11.1
57	[1] 60	21.5	59.0	6.5	1.2	9.5
60	[1] 70	45.0	30.7	2.7	2.1	19.7
70	[1] 73	39.1	38.3	4.0	1.8	16.9
73	77	37.4	39.5	4.2	1.8	16.5
77	80	35.7	43.7	4.1	1.7	14.5
80	83	34.1	45.0	4.5	1.7	14.0
83	86	30.2	49.5	5.4	1.5	12.7

[1] Samples much contaminated with sand.

RESERVES

Because of the complex stratigraphy of the nonmarine Nanafalia Formation and the faulted condition of the kaolin and bauxite bodies, only a rough estimate of indicated and inferred reserves of bauxite can be made, but there probably are between 50,000 and 150,000 long tons of all grades of bauxite.

REFERENCES CITED

Beck, W. A., 1949, Investigation of the Springvale bauxite district, Randolph County, Georgia: U.S. Bur. Mines Rept. Inv. 4555, 20 p.

Cooke, Wythe, 1943, Geology of the Coastal Plain of Georgia: U.S. Geol. Survey Bull. 941, 121 p.

Eargle, D. H., 1955, Stratigraphy of the outcropping Cretaceous rocks of Georgia: U.S. Geol. Survey Bull. 1014, 101 p.

Langdon, D. W., 1894, The Tertiary and Cretaceous formations east of the Alabama River, *in* Smith, E. A., and others, Report on the geology of the Coastal Plain of Alabama: Alabama Geol. Survey, p. 368–445 and p. 737–745.

Loughridge, R. H., 1884, Part I. Physico-geographical and agricultural features of the State of Georgia; *and* Part II. Agricultural descriptions of the Counties of Georgia: U.S. 10th Census, v. 6, p. 275–424.

MacNeil, F. S., 1946, Summary of the Midway and Wilcox stratigraphy of Alabama and Mississippi: U.S. Geol. Survey Strategic Minerals Inv. Prelim. Rept. (3–195), 29 p.

——— 1947, Geologic map of the Tertiary and Quaternary formations of Georgia: U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 72.

Smith, R. W., 1929, Sedimentary kaolins of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 44, 482 p.

Spencer, J. W., 1891, A general or preliminary geological report on southwest Georgia and report on Polk County: Georgia Geol. Survey, First Rept. Progress, 1890–91, p. 11–128.

Veatch, Otto, 1909, Second report on the clay deposits of Georgia: Georgia Geol. Survey Bull. 18, 453 p.

Veatch, Otto, and Stephenson, L. W., 1911, Preliminary report on the geology of the Coastal Plain of Georgia: Georgia Geol. Survey Bull. 26, 466 p.

Warren, W. C., and Clark, L. D., 1965, Bauxite deposits of the Eufaula district, Alabama: U.S. Geol. Survey Bull. 1199–E. 31 p.

U.S. GOVERNMENT PRINTING OFFICE: 1965 O—763-749