Bauxite Deposits of the Warm Springs District Meriwether County Georgia

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White—BAUXITE DEPOSITS, WARM SPRINGS DISTRICT, MERIWETHER COUNTY, GEORGIA—Geological Survey Bulletin 1199-I

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By WALTER S. WHITE

BAUXITE DEPOSITS OF THE SOUTHEASTERN UNITED STATES

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Distribution and occurrence of veinlike bauxite deposits

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By Walter S. White

ABSTRACT

Deposits of bauxite in an unusual geologic setting were discovered 3 miles west of Warm Springs, Ga., in 1915. One ore body, mined from 1916 to 1919, produced 4,000 long tons, and in about 1923 two carloads were taken from another deposit. These deposits were investigated by the U.S. Geological Survey in January 1943.

The predominant rocks of the Warm Springs region are the crystalline schists, gneisses, and quartzites of the Piedmont province. Overlying them are a few isolated deposits of sand and clay that are very similar to the Upper Cretaceous sands and clays of the Coastal Plain province farther south. The largest deposit, which contains all the known bauxite, seems to lie in a trough that has been faulted down against crystalline rocks along its south boundary.

The bauxite occurs in veinlike ore bodies that strike nearly east-west and dip steeply north or south. Commercial deposits occur in a clay unit 100 feet or more thick that forms the upper part of the sequence of unconsolidated sediments overlying the crystalline rocks. Veins of white bauxite 6 to 12 feet thick are found on a line 100 to 200 feet north of and parallel to the south boundary fault. The total length of each of the deposits and the possibility that all are more or less continuous with one another have not been adequately tested. Bauxite is known to extend downward along the veins to depths greater than 50 feet and may possibly extend to the base of the clay unit that contains it. A vein of hard red bauxite crops out 500 feet north of the fault. The typical white bauxite contains 50 to 54 percent alumina, 1 to 2 percent ferric oxide, 1.5 to 2.5 percent titania, and 16 to 19 percent silica. The red bauxite contains about 52 percent alumina, 7 to 8 percent ferric oxide, 2.5 percent titania, and 6 to 8 percent silica.

Proved reserves of bauxite in the Warm Springs district are almost negligible, but the area is very incompletely tested. Further exploration, particularly east from the Republic mine, is recommended.

INTRODUCTION

Deposits of bauxite are found in an unusual geologic setting 3 miles west of Warm Springs, Meriwether County, Ga. The location of the known deposits is shown in figures 1 and 2.

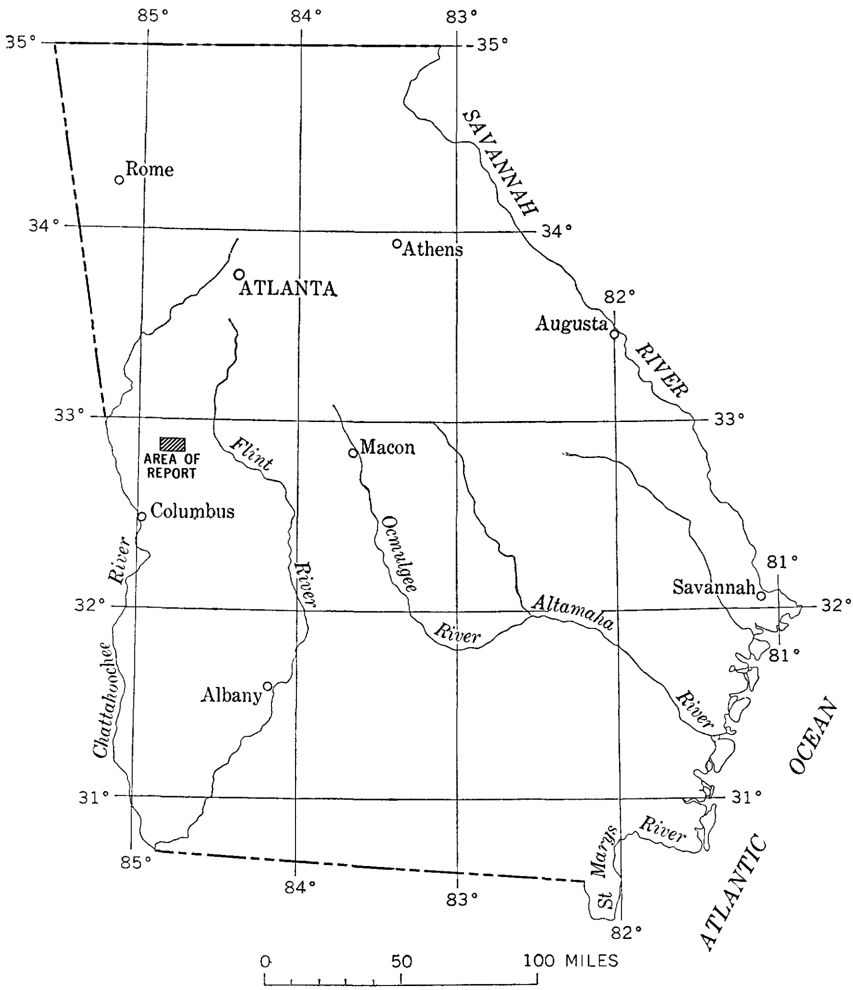

FIGURE 1.—Map of Georgia showing area of this report.

Bauxite was discovered in the district in 1915 by J. T. Wynne of Warm Springs and was identified by State Geologist S. W. McCallie. In 1916 the Republic Mining and Manufacturing Co. began mining one of the bauxite outcrops on the Wynne property, but operations were suspended shortly after the close of World War I. In all, about 4,000 long tons of bauxite was mined (Smith, 1929, p. 452). About 1923 Jack Turner mined two carloads of bauxite from a shaft about 1,000 feet east of the Republic mine. Many test holes have been dug in the area at various times, but no further mining has been done.

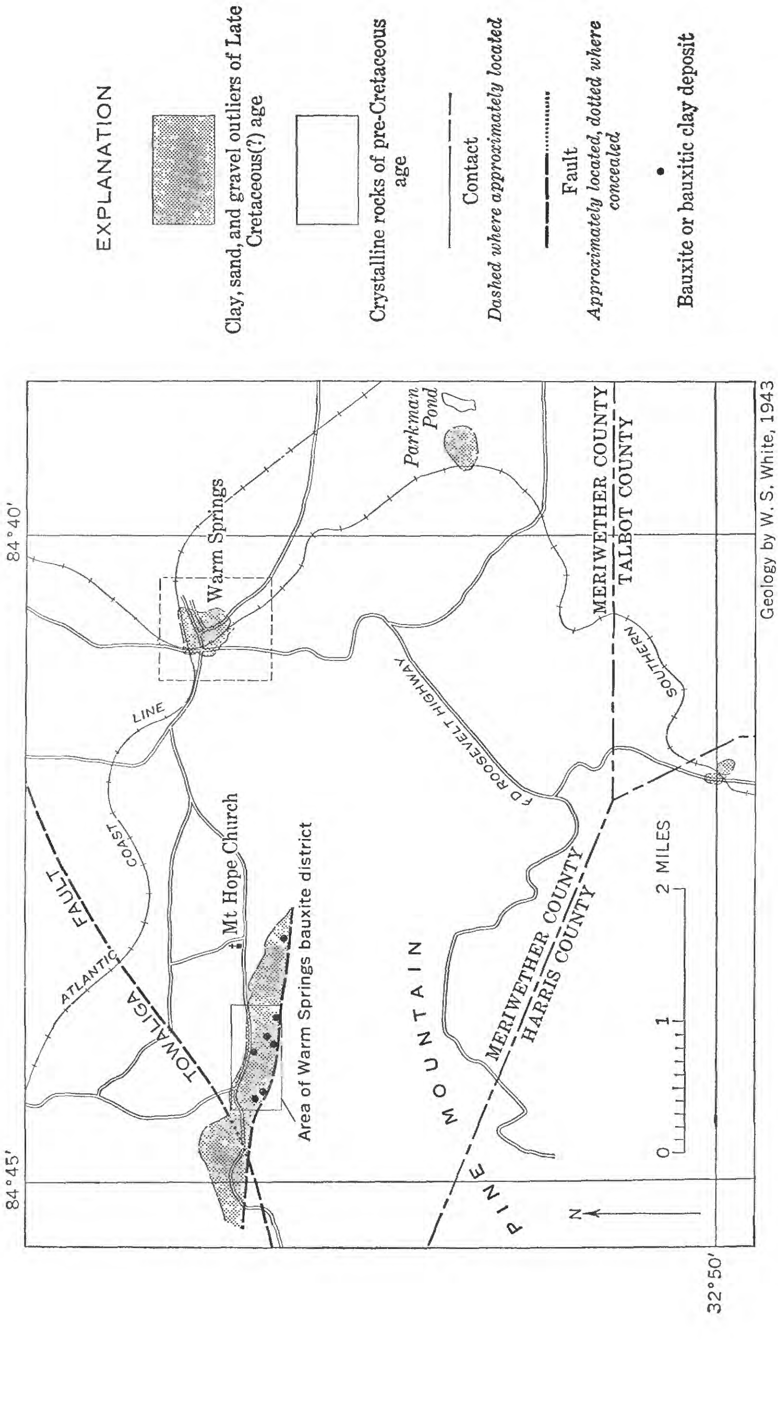

FIGURE 2.—General geology of Warm Springs, Ga., and vicinity.

Assistant State Geologist Shearer (1917, p. 319–324), published an account of the deposits and described the first mining operations as an appendix to his study of the bauxite and clay deposits of the Coastal Plain. The deposits were later described by Smith (1929, p. 451–459) and Munyan (1938, p. 38–39). The bauxite is briefly mentioned by Hewett and Crickmay (1937, p. 31) in their description of the geology of the Warm Springs quadrangle.

The writer spent about 2½ weeks in the district during January 1943 and prepared a detailed geologic and topographic map of the area that contains the bauxite. He also examined other nearby areas where bauxite might be expected on the basis of the local geology.

The writer wishes to acknowledge the generous cooperation of State Geologist Garland Peyton, who permitted the use of data in the files of the Geological Survey of Georgia. The writer is particularly grateful to J. T. Wynne of Warm Springs for his interest in the investigations and for information on the history of exploration in the district.

GENERAL GEOLOGY

The rocks exposed in the Warm Springs bauxite district are of Precambrian(?), Cretaceous(?), and Tertiary age. The investigation described here was largely confined to the Cretaceous(?) rocks.

PRECAMBRIAN(?) ROCKS

The crystalline rocks of the Piedmont province that underlie the region around Warm Springs have been described by Hewett and Crickmay (1937, p. 25–30). Most of the rock units are also present in the Thomaston quadrangle to the east, described by Clarke (1952). A large fault, striking about N. 65° E., separates two belts of crystalline rocks whose structural and stratigraphic relations to one another are not known in detail. The trace of this fault, called the Towaliga fault, is shown in figure 2. The age of the crystalline rocks is not known; they have been called Precambrian(?) mainly for lack of evidence to the contrary. The sequence and lithology of the different crystalline rock units are summarized in the following stratigraphic table:

North of Towaliga fault

Snelson Granite	Foliated granite, intrusive into Carolina Gneiss.
Carolina Gneiss of former usage	Biotite gneiss and mica schist containing considerable injected granitic material.

South of Towaliga fault

Cunningham Granite	Dark quartz monzonite containing biotite and pyroxene.
Manchester Schist	Mica schist and biotite gneiss, quartzite member 850 ft above base.
Hollis Quartzite	Quartzite, thick- and thin-bedded.
Woodland Gneiss	Biotite augen gneiss, intruding Sparks Schist.
Sparks Schist	Mica schist, biotite gneiss, and quartzite.

The Hollis Quartzite forms a persistent ridge 200 to 300 feet high that stands out above the surrounding areas, which are underlain by schists and gneisses. Near Warm Springs this ridge is known as Pine Mountain.

CRETACEOUS(?) SYSTEM

The bauxite deposits occur in the largest of several scattered deposits of unconsolidated gravel, sand, and clay that overlie the crystalline rocks (pl. 1). These unconsolidated deposits are probably all about the same age, but inasmuch as no fossils have been found in them, their place in the time scale is not known. Although they are now correlated as Upper Cretaceous (Cooke, 1926, p. 137–139), according to Shearer (1917, p. 323) these rocks are lithologically "identical with the Lower Cretaceous sediments of the Coastal Plain, which approach most closely at Geneva, Talbot County, 23 miles south." Because the base of the Cretaceous at Geneva would project to a point several hundred feet above the deposits at Warm Springs, either the unconformity beneath the rocks of the Coastal Plain has been deformed since the Cretaceous or the unconsolidated deposits of the Warm Springs area accumulated in deep erosion valleys in the Piedmont. The evidence for faulting, described in the paragraphs on structure, suggests that the unconformity has been deformed.

The poor exposures do not yield enough information for compilation of a detailed columnar section of the Cretaceous(?) rocks. In the area studied in greatest detail, 3 to 4½ miles west of Warm Springs, on the lower north slope of Pine Mountain, two units were recognized.

Lower unit.—At least 75 feet thick, the lower unit is composed of pink and white sandy clay and clayey sand, locally gravelly. Bedding can be seen in a few favorable exposures, but the rocks in general are massive. Secondary cementation of sandier beds by iron oxide has locally formed a more resistant rock that is found as abundant fragments on the surface. In general, these ferruginous layers crop out near the base of slopes where springs would be expected, and this fact, together with the sporadic distribution, suggests that the cementation is relatively recent and not necessarily restricted to a single stratigraphic horizon. An excellent exposure of the lower unit can be seen in roadcuts 1.3 to 1.4 miles west of Mount Hope Church (fig. 2). Ferruginous sandstone here underlies pink and white sands and clays. On the road which turns north just east of these exposures, 360 feet from the intersection, pink and white sandy clay can be seen directly overlying the Manchester Schist. The absence of sandstone may indicate an overlap of the sandy clays.

Upper unit.—Above the sandy clay and clayey sands is the upper unit, which is composed almost entirely of pink and white kaolinitic clay and little or no silt. A specimen of this clay collected from a deep test hole just north of the Republic mine contained 38 percent alumina, according to J. T. Wynne. If this analysis is representative, the clay must be nearly pure kaolinite. In a few places, the clay is red and contains tabular or nodular pieces of soft to hard red iron oxide. This ferruginous clay seems to be restricted in distribution, and the iron oxide may be of secondary origin.

The total thickness of the upper unit is estimated to be as much as 100 feet, although there may have been some thickening by folding at the places where the maximum figure was obtained. The thickness of the two Cretaceous(?) units was determined by using dips calculated from the outcrop pattern. In making the calculations, however, the minimum dip, which also gives the minimum thickness, was used; therefore, unless errors due to stratigraphic complication are involved, the thicknesses given are either nearly correct or too small. The kaolinitic clay unit is well exposed in and near the Republic mine and in gullies 400 to 500 feet east-northeast of it (fig. 2).

Other outliers.—Deposits of sand and clay similar to those of the bauxite district occur at several other places on the lower parts of the north, east, and south slopes of Pine Mountain (fig. 2). Hewett and Crickmay (1937, p. 31) mapped these deposits but considered them to be of Tertiary(?) age.

The city of Warm Springs is largely underlain by pink and white clayey sand. An excellent exposure of the base of the sands, showing a bed of gravel 2 feet thick overlying schist, can be seen in a cut along the Southern Railway Co. tracks 1,300 feet southeast of the Warm Springs depot. White silt-free clay crops out in a ditch beside the tracks of the Atlantic Coast Line Railroad Co. about 300 feet east of the underpass beneath the Southern Railway Co. tracks. A small patch of white clayey sand was observed in a railroad cut 0.78 mile due north of Mount Hope Church.

Between Parkman Pond and the Southern Railway Co. tracks, about 2 miles south-southeast of Warm Springs, is a deposit of clayey sand and gravel which is at least 50 feet thick. The gravel is well exposed in a large railroad cut, and clayey sand was noted in two gullies a quarter of a mile east of the tracks. No clay beds were seen.

About 20 or 30 feet of clayey sand and gravel overlie schist just north of the F. D. Roosevelt Highway bridge over the Southern Railway Co. tracks at the base of the south slope of Pine Mountain. There are no clay beds within the sand and gravel.

TERTIARY AND QUATERNARY DEPOSITS

Overlying all the rock units in the region are thick deposits of gravel, sand, and residual clay of Tertiary and Quaternary age. Near Pine Mountain, the gravels consist predominantly of fragments of Hollis Quartzite. The gravel and sand deposits can locally be shown to belong to at least three distinct stages, but no detailed work has been done on them. Only terrace gravels have been shown on the geologic map (pl. 1). The valley bottoms are covered by 4 to 10 feet of gravel, and most slopes are veneered with similar material.

STRUCTURE

The structure of the crystalline rocks has been described by Hewett and Crickmay (1937, p. 31–32), but it has little direct bearing on the extent of the bauxite deposits.

The shape and internal structure of the patch of sand and clay of Cretaceous(?) age that contains the bauxite provides evidence of folding and faulting (pl. 1). The sand and clay members crop out in an elongate strip that strikes slightly north of west along the north base of Pine Mountain. The most easterly exposure observed was about half a mile south-southeast of Mount Hope Church (fig. 2), but a thick cover of gravels may conceal these unconsolidated rocks for a considerable distance farther east. The most westerly exposures were seen just west of a right-angle bend in the east-west road, 2 miles due west of Mount Hope Church. The beds probably continue west of this point, but if present they are buried beneath a cover of alluvium in the bottom of a broad valley. The average width of the belt is a little more than a quarter of a mile.

Along the north boundary of the bauxite district (pl. 1), the outcrop pattern and a few scattered exposures indicate that the sands and clays overlie the crystalline schists unconformably and dip southward at angles of 12°–30°. They are inferred to be faulted down against the Manchester Schist near the south boundary of the district. The chief evidence that this contact is a fault is the outcrop pattern. The relation of this fault to the Towaliga fault is shown on figure 2. Over much of its length in the bauxite area, the fault contact can be located fairly closely, and, as can be seen from the map (pl. 1), it is relatively straight and shows none of the irregularity that a gently dipping sedimentary contact would show. Nowhere along its trace were the clays and sands found higher than and south of a schist outcrop, but several schist outcrops were found higher than and only a short distance south of clay outcrops. The contact, therefore, must be steeply dipping, and the presence of the upper kaolinitic clay member close to the trace of the fault suggests that some beds have been cut out (for example, sections *B–B′* and *C–C′*, pl. 1). The dip of the fault is not known, but the fault is assumed to be normal and to dip steeply northward.

At most places along the fault, the unconsolidated rocks adjacent to the schist are sandy clays and clayey sands. In drawing the structure sections (pl. 1), the writer has interpreted these sandy rocks as the lower unit of the Cretaceous(?) brought to the surface on the south side of a syncline by drag along the fault. An alternate explanation of these sandy rocks—that they represent a third unit overlying the kaolinitic clays in a homoclinal sequence dipping south—requires considerable variation in the thickness of the clayey unit. There is one place in the south wall of the Republic mine where sandy clay can be seen apparently dipping steeply south, but this dip is considered to be anomalous and is perhaps due to overturning along the fault or to initial dip.

About 300 feet north of the Republic mine, the distribution of outcrops suggests an anticlinal roll in the bedding. This gentle flexure, together with the complementary syncline just north of it, apparently extends for several hundred yards to the east and west. The structural terrace so formed (section *D–D′*, pl. 1) may be caused by a small fault in the underlying crystalline rocks, but in the absence of more definite information, no such fault is shown in the structure sections.

BAUXITE DEPOSITS

Bauxite is known to occur at seven localities within the area shown in plate 1. Except for three small pieces that J. T. Wynne picked up 1,800 feet south of Mount Hope Church, none has been observed elsewhere in the region. All the important deposits are found within the limits of the upper kaolinitic clay member. The ore bodies are veinlike, have thicknesses ranging from 6 to 17 feet, and extend to an unknown depth. All strike nearly east, and the large ore bodies dip steeply north, with one exception; the deposit of red bauxite 400 feet north of the Republic mine apparently dips steeply south and lies on the north limb of the syncline postulated from the outcrop pattern.

These veinlike deposits may represent bauxitic material along one or more fissure zones or steeply dipping bauxitic beds in the upper clay member. No conclusive evidence was found in support of either possibility. The small occurrences of bauxite 100 feet northeast and 750 feet east-southeast of the Republic mine seem to be parallel to a rude stratification in the clay and sand which include them. The large vein exposed in the east end of the Republic mine, however, dips steeply north in contrast to the sandy clay a few feet to the south, which dips 60° SE.; the vein here seems to be crosscutting. If the larger bauxite veins are interpreted as beds, the dips must be steeper and the folding more intense than is shown in plate 1.

As shown on the geologic map, the Turner prospect, the Republic mine, and the southeast Smith prospect seem to lie on a single line striking N. 80° W., nearly parallel to and a short distance north of the boundary fault. Exploration of this line is far from complete, but the exposures, particularly west of the Republic mine, suggest that there is no single continuous vein or bed of bauxite. The northwest Smith prospect lies north of the projection of the line through the other deposits, and the Turner deposit strikes more nearly east than the line. These relations suggest that the deposits are a series of en echelon veins, rather than a single vein or bed. The east end of one such vein would lie a short distance, probably less than 100 feet, north of the west end of another.

REPUBLIC MINE

The largest known bauxite deposit in the district is that which the Republic Mining and Manufacturing Co., now Aluminum Co. of America (Alcoa), worked from 1916 to 1919 under lease from J. T. Wynne and E. K. Large. The shape and size of the pit that was excavated are shown on the map and in the sections (pl. 1). The workings below water level are shown diagrammatically in accordance with the oral descriptions of Mr. Wynne. The walls of the opening have slumped considerably, and little could be seen at the time of the fieldwork. Shearer's report (1917, p. 320) and Mr. Wynne's oral descriptions indicate that the bauxite occurred in the form of a single vein as much as 12 feet wide, striking N. 80° W. and dipping as much as 80° N. That part of the vein which is now exposed at the east end of the open cut is about 8 feet wide. From the reported amount of bauxite produced and the estimated area of the workings in the plane of the vein, the average width was calculated to be about 10 feet. All the working faces were in ore at the time mining ceased. Shearer (1917, p. 320) states that the vein pinched in all directions and was almost entirely worked out in 1916. This statement can be disregarded, however, inasmuch as only 1,000 long tons of the total production of 4,000 long tons had been removed at the time. Operations were finally suspended because of a lessened demand for low-grade bauxite and trouble with support of the overhanging north wall.

According to Mr. Wynne, a test pit now covered by the dump, 100 feet west of the main opening, showed bauxite, and the extension of the bauxite body west of the pit, as shown on the map, is based entirely on this information. Nothing is known about the extent of the bauxite west of this pit or east of the east end of the main pit. The bauxite vein is bounded on the south by several feet of hard white bauxitic clay, beyond which is clay and sandy clay. On the north side the bauxite is in contact with the typical pink and white clay of the upper unit of the Cretaceous(?) sediments.

The ore now exposed in the pit is a moderately soft massive white pisolitic bauxite, from which the pisolites crumble readily to leave a vesicular mass. The pisolites are as large as half an inch in diameter, and some of the ore mined is said to have contained pisolites as much as 1 inch across. Fragments lying on the dump suggest that some of the ore was rather hard. Two analyses of the bauxite, made by the Geological Survey of Georgia (Shearer, 1917, p. 322), show the following composition of the ore (in percent):

Al_2O_3	Fe_2O_3	TiO_2	SiO_2	*Ignition loss*
51.28	0.48	1.71	19.05	26.71
54.76	.93	1.66	16.06	26.75

TURNER PROSPECT

In the Turner prospect, from 725 to 950 feet east-southeast of the Republic mine, seven test holes in a line expose a continuous veinlike deposit of bauxite. The deposit here strikes east and dips 60° to 65° N. It has been explored to a depth of 30 feet in two of the holes. The best exposure of the vein is in the bottom of the shaft on the 1,000-foot contour (pl. 1), 900 feet east of the Republic mine and 200 feet due west of a private road. Examination of all the other openings indicates that the vein is fairly uniform in lithology and width, and the exposure in this shaft may be taken as typical. The central part of the deposit, 5 to 7 feet wide, has been explored by two short drifts, east and west, in which both working faces show ore very similar in appearance and texture to that exposed in the Republic mine. A short crosscut to the north exposes 4 feet of soft bauxitic clay containing many small red and white pisolites and bounded at the end of the opening by soft pink clay. A 6-foot crosscut to the south reveals white bauxitic clay containing scattered pink pisolites; the clay grades southward into streaky pink and white bauxite clay.

In addition to the seven holes just mentioned, test holes and trenches as much as 10 feet deep have been dug for distances of 100 feet farther east and 200 feet farther west along the strike and also on both sides of the vein and its projected strike, but none of these holes seems to have penetrated the overburden of red terrace gravel and sand of Tertiary or Quaternary age.

SMITH PROSPECTS

The Smith prospects, Nos. 1 and 2 (pl. 1), lie approximately 1,900 and 2,300 feet, respectively, west-northwest of the Republic mine. Prospect No. 1, beside a small creek, consists of three openings which show bauxite; 12 others in the vicinity failed to penetrate the overburden. The three pits that show bauxite are alined N. 80° W. over a distance of 35 feet; the middle pit is cut into the bank of the creek on the discovery outcrop. As partly exposed in the gully, the bauxite body is at least 10 feet wide, measured north to south, but this includes some bauxitic clay containing scattered pisolites. According to F. C. Suggs (oral commun., 1943), the westernmost pit, which was dug by him, is 18 feet deep; just below the overburden, the hole is entirely in bauxite, but at the bottom, the southern part of the hole is in clay. This pit exposed the depth of bauxite shown in section *F–F′*, plate 1. Mr. Suggs also stated that a 10-foot pit 10 feet southwest of this opening was mostly in clay, some of it bauxitic. Several 20-foot auger holes put down by the General Ore Co. in 1942 showed pink and white clay both north and south of the line of pits exposing bauxite. No permanent record of this augering was kept, but the cuttings were still visible beside the holes in 1943. All the available data suggest that here, too, a veinlike deposit dips steeply north. It is probably about 10 feet wide. Other old test holes to the east and west seem to lie on the strike of the vein but do not seem to have penetrated the overburden.

The bauxite lying on the surface is hard, white, and vesicular. The crumbly pisolites are as much as half an inch in diameter. An analysis of this ore made for Mr. Suggs by the Geological Survey of Georgia gave the following results: 46.94 percent Al_2O_3, 0.08 percent Fe_2O_3, 1.80 percent TiO_2, 28.12 percent SiO_2, and 22.03 percent loss on ignition.

Prospect No. 2, approximately 375 feet northwest of No. 1, consists of a single test pit 7 feet deep in bauxite. Shallow auger holes a few feet east and west of the opening penetrated bauxite; holes 10 feet north and south entered clay. Other test holes immediately to the west of prospect No. 2 apparently were too shallow to penetrate the overburden. This deposit may lie en echelon with that in prospect No. 1.

The ore is cream colored and contains crumbly pisolites as large as a half inch in diameter. Two analyses of this ore made for Mr. Suggs by the Georgia Geological Survey gave the following results, in percent:

Al_2O_3	Fe_2O_3	TiO_2	SiO_2	*Ignition loss*
54. 53	1. 30	2. 50	18. 06	23. 49
54. 98	1. 20	1. 90	16. 04	25. 09

RED BAUXITE OUTCROP

Hard red bauxite crops out 300 to 400 feet northeast of the Republic mine. This outcrop first attracted attention to the presence of bauxite in the Warm Springs district and led to the discovery of the white bauxite. The outcrop, consisting of huge boulders and ledges, is more than 200 feet long and seems to be about 17 feet wide. It strikes east. Test pits to the north and south show red clay. A test hole, 8 or 10 feet deep, that followed a soft layer in the outcrop dipped steeply south, and an auger hole put down in clay a few feet south of the outcrop entered bauxite at depth, according to J. T. Wynne (oral commun., 1943). These facts suggest that the body dips steeply south. Abundant boulders to the west indicate that the deposit probably continues for at least 100 feet in that direction. Absence of indications of bauxite beyond the known limits of the deposit to the east and west might be due either to pinching out of the vein or to a transition from the hard red bauxite into a softer, less resistant bauxite, possibly white.

The exposed bauxite is hard, and is largely made up of a brick-red matrix containing light-buff and dark-red pisolites ¼ to 1 inch in diameter. Some of the fragments lying around the outcrop are a light-buff color and contain light and dark pisolites. Locally, the bauxite consists almost entirely of pisolites with hollow spaces between them. Two analyses of this ore made by the Geological Survey of Georgia (Shearer, 1917, p. 322) gave the following results, in percent:

Al_2O_3	Fe_2O_3	TiO_2	SiO_2	*Ignition loss*
52. 36	7. 06	2. 83	5. 50	28. 80
51. 95	8. 26	2. 23	8. 40	27. 46

MINOR DEPOSITS

About 150 feet north of the east end of the Republic mine, a steep bank is littered with cobbles of hard red bauxite. In three test holes, the bauxite occurs as cobbles in a thin layer of rather sandy clay a foot or two thick. According to Mr. Wynne, an auger hole put down on top of the ridge 40 feet northeast penetrated bauxite at 20 feet, a fact suggesting that the bauxite forms a bed that dips gently north. The bauxite contains abundant small red pisolites in a hard gray matrix. Some of the bauxite is softer and contains abundant coarse sand grains.

Small amounts of bauxite crop out near the base of a high bluff 750 feet N. 15° W. of the west end of the Republic mine. A 6-foot hole here shows that the bauxite is confined to a zone about 1 foot thick in ferruginous sandy clay, overlying at least 3 feet of yellow sand. The bauxite is soft and buff colored and contains scattered small pisolites. It grades upward and downward into sandy bauxitic clay of the same color.

ORIGIN OF THE BAUXITE

The bauxite of this district probably formed in place as an alteration of the sedimentary kaolin. Under proper climatic conditions, such as prevailed between Midway and Wilcox time, ground water is capable of leaching silica from kaolinitic clays and of leaving a residual deposit high in alumina. In the Warm Springs bauxite, this leaching must have taken place after the folding and faulting of the beds. If folding and faulting had followed the formation of bauxite, the relatively delicate pisolitic structure should be appreciably disturbed by the crushing and shearing.

The tabular deposits of bauxite might be either subconcordant veins or replacements of individual beds. In other words, the bodies may be tabular because the formation of bauxite was guided by zones of shearing in the clay or because the process selectively followed individual beds. If the body of bauxite of the Republic mine connects at depth with the red bauxite zone shown on the geologic map and in sections *C–C′* and *D–D′* of plate 1, the bauxite has almost certainly replaced one or more beds. The steep dip of the tabular bodies of bauxite, however, particularly that of the main body of red bauxite, seems to slightly favor the hypothesis that the deposits are veins. If these dips represent attitudes of bedding, the folding is much tighter than might be expected where a thin veneer of unconsolidated material overlying a crystalline floor is deformed, as in this district. Also favoring the vein hypothesis is the apparent crosscutting relationship of bauxite to bedding in the Republic mine, although this evidence is not unequivocal.

Shearer (1917, p. 324) and W. B. Lang (written commun., 1942) have suggested that the deposits may have been formed by thermal waters ascending from depth, and the proximity of the deposits to modern thermal springs is cited. Hewett and Crickmay (1937, p. 32–34) have shown that the Warm Springs are due to a circulation of water within the Hollis Quartzite. If the bauxite deposits were formed by thermal waters originating in this manner, none could form north of the Towaliga fault, where the Hollis Quartzite is absent. As Lang points out, all the known deposits of bauxite lie south of the fault, although clays are found north as well as south of it (fig. 2).

Because no evidence exists that thermal waters have played any part in the formation of the bauxite deposits of either the Appalachian Valley and Ridge or the Coastal Plain provinces, thermal waters are certainly not essential for bauxite formation. The proximity of the deposits to modern warm springs is probably a coincidence.

POTENTIALITIES OF THE AREA

The bauxite of commercial grade, along the line from the Turner prospect to the Smith prospects, is almost certainly restricted to the upper kaolinitic clay unit of the Cretaceous(?) sediments. The base of this unit at any point, therefore, in general represents the lower limit of expectable bauxite occurrence. The lowermost bauxite may actually lie somewhat higher. The probable dip of the unit is shown in sections *B–B′* to *F–F′*; its depth along a line through the Turner prospect, the Republic mine, and the Smith prospect No. 1 is shown in section *A–A′* (pl. 1).

Exploration in the Warm Springs district has been inadequate to determine the longitudinal extent of the bauxite ore bodies. Until more work is done, the veinlike ore bodies in the Republic mine and Turner prospect may be assumed to be almost continuous with one another, perhaps with slight offset or en echelon arrangement. The ore body in the Turner prospect may continue eastward for several hundred feet but does not persist indefinitely; on a slope with fairly good exposures about 1,000 feet east of the prospect, only the lower clayey sand unit of the Cretaceous(?) is present, and the upper unit has been eroded if, indeed, it was ever deposited here. Bauxite has been found 100 feet west of the Republic mine, and Smith (1929, p. 453) states that a test hole 600 feet west of the mine was in hard white bauxitic clay. Most of the holes west of the mine (pl. 1) apparently failed to locate bauxite. The vein might lie between pits, or an en echelon vein may lie farther north and continue west toward the Smith prospect. The intervening ground is covered by sand and gravel at least 3 or 4 feet thick. The possible occurrence of a continuous ore body or a series of discontinuous bodies between the Republic mine and the Smith prospects should be more fully tested, but is less promising than the possibility of eastward continuation. West of the Smith prospect exposures are too poor to indicate the extent, if any, of the upper clay unit of the Cretaceous(?).

The grade of the white bauxite from the Warm Springs area seems to be fairly uniform; the content of alumina ranges from 50 to 55 percent. J. T. Wynne states that some ore containing more than 60 percent alumina was shipped from the Republic mine, but such ore is probably exceptional.

In addition to the white bauxite, there is probably a small tonnage of red bauxite in and below the exposures northeast of the Republic mine (see section *C–C′*, pl. 1). The red bauxite contains about 52 percent alumina, 6 to 8 percent silica, and 7 to 8 percent iron oxide. The possibility that white bauxite might be found east or west of the red bauxite has already been suggested.

Only one place outside the area shown in plate 1 seems worthy of exploration. Roadcuts on the lower north and west slopes of the round hill 1¾ miles due west of Mount Hope Church reveal abundant pink and white sandy clay. The thickness of the sands and clays under and north of this hill suggests that the top and south side of the hill might be underlain in part by the upper unit of the Cretaceous(?), even though it does not crop out. One deep auger hole on the upper south slope of the hill would determine whether the clay is present or not; if it is present, there is a reasonable chance that it contains some bauxite.

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