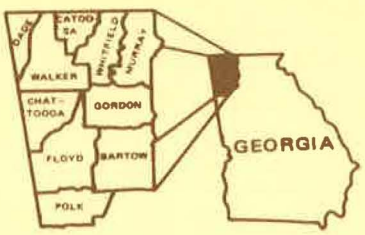
CERAMIC AND STRUCTURAL CLAYS, AND SHALES OF WALKER COUNTY, GEORGIA

BRUCE J. O'CONNOR



DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY

INFORMATION CIRCULAR 72

Cover Photo:

Shale pit (Mississippian Pennington Shale?) of the Chattanooga Sewer Pipe and Fire Brick Company near Flintstone (northern Walker County near Ga. Hwy. 193 west of Fort Oglethorpe). Photo by S.W. McCallie, 1913, courtesy of the Georgia Department of Archives and History.

CERAMIC AND STRUCTURAL CLAYS AND SHALES OF WALKER COUNTY, GEORGIA

By

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Information Circular 72

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INTRODUCTION

This report presents a compilation of all available published and unpublished ceramic firing tests and related analytical data on samples from Walker County, Georgia. It provides information on mined and/or undeveloped clays, shales and related materials; and is intended for use by geologists, engineers and members of the general public. The report should aid in the exploration for deposits of ceramic raw material with economic potential for future development. This information may also be of use to those who wish to obtain information on the potential use of particular deposits at specific locations.

Tests by the U.S. Bureau of Mines, subsequently referred to as USBM, were performed by the Norris Metallurgy Research Laboratory, Norris, Tennessee and the Tuscaloosa Research Center, Tuscaloosa, Alabama under cooperative agreements with the Georgia Geologic Survey and its predecessors (i.e., the Earth and Water Division of the Ga. Department of Natural Resources; the Department of Mines, Mining and Geology; and the Geological Survey of Georgia). Many of the firing tests were performed on samples collected by former staff members of the Georgia Geologic Survey (and its predecessors) during several uncompleted and unpublished studies. These include work by Bentley (1964), Smith (1968?) and Tadkod (1980). Additional unpublished data presented in this compilation include work by TVA (see Butts and Gildersleeve, 1948, p. 124 and 125). Published data include studies by the following authors: Spencer (1893, p. 217 to 287; chemical analyses only), Veatch (1909, p. 279 to 402), Smith (1931, p. 136 to 172), and Hollenbeck and Tyrrell (1969, p. 6 to 13).

Regardless of the source, all of the ceramic firing testing data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. They do not preclude the use of the materials in mixes (Liles and Heystek, 1977, p. 5).

ACKNOWLEDGEMENTS

The author gratefully acknowledges the help of many individuals during the preparation of this report and the work of many who contributed to the earlier, unpublished studies included here. The cooperative work of the U.S. Bureau of Mines forms the main data base of this study. During the last several years Robert D. Thomson, Chief of the Eastern Field Operations Center, Pittsburgh, Pennsylvania, was responsible for administering the funding of costs incurred by the USBM. Others in that office who helped coordinate the program were Charles T. Chislaghi and Bradford B. Williams. Since 1966 M.E. Tyrrell, H. Heystek, and A.V. Petty, Ceramic Engineers, and Kenneth J. Liles, Research Chemist, planned and supervised the test work done at the USBM Tuscaloosa Research Center in Tuscaloosa, Alabama. Prior to 1966 this test work was supervised by ceramists H. Wilson, G.S. Skinner, T.A. Klinefelter, H.P. Hamlin and M.V. Denny at the former Norris Metallurgy Research Laboratory in Norris, Tennessee. Tests by the Tennessee Valley Authority were conducted under the supervision of H.S. Rankin and M.K. Banks at the Mineral Research Laboratory on the campus of North Carolina State College, Asheville, North Carolina, using samples collected by S.D. Broadhurst. Additional tests were conducted by professors W.C. Hansard, L. Mitchell, and J.F. Benzel at the Department of Ceramic Engineering, Georgia Institute of Technology, Atlanta, Georgia. The majority of the unpublished tests were performed on samples collected by former staff geologists of the Georgia Geologic Survey, predominantly by J.W. Smith, A.S. Furcron, R.D. Bentley, N.K. Olsen, D. Ray, M.A. Tadkod, and G. Peyton, assisted by C.W. Cressler of the U.S. Geological Survey. N.K. Olsen and C.W. Cressler also have

provided the author with valuable advice and suggestions regarding sample locations and past studies. The advice and encouragement of my colleagues on the staff of the Georgia Geologic Survey are greatly appreciated. However, the contents of this report and any errors of omission or commission therein are the sole responsibility of the author.

LOCATION OF STUDY AREA

Walker County is located near the northwestern corner of the Valley and Ridge province of northwest Georgia (Fig. 1). One company is currently mining slate in the county, and several operations have been active here in the past (Tables 1 and 2). The most abundant ceramic raw materials in the county are the shales and residual clays derived from the Red Mountain Formation and the Conasauga Group; however, other units such as the Floyd Shale and the Rome, Red Mountain, Pennington and Gizzard Formations, as well as residual clays of the Knox Group, are locally well developed. The general nature of these and other geologic units which occur in the county are summarized on Table 3.

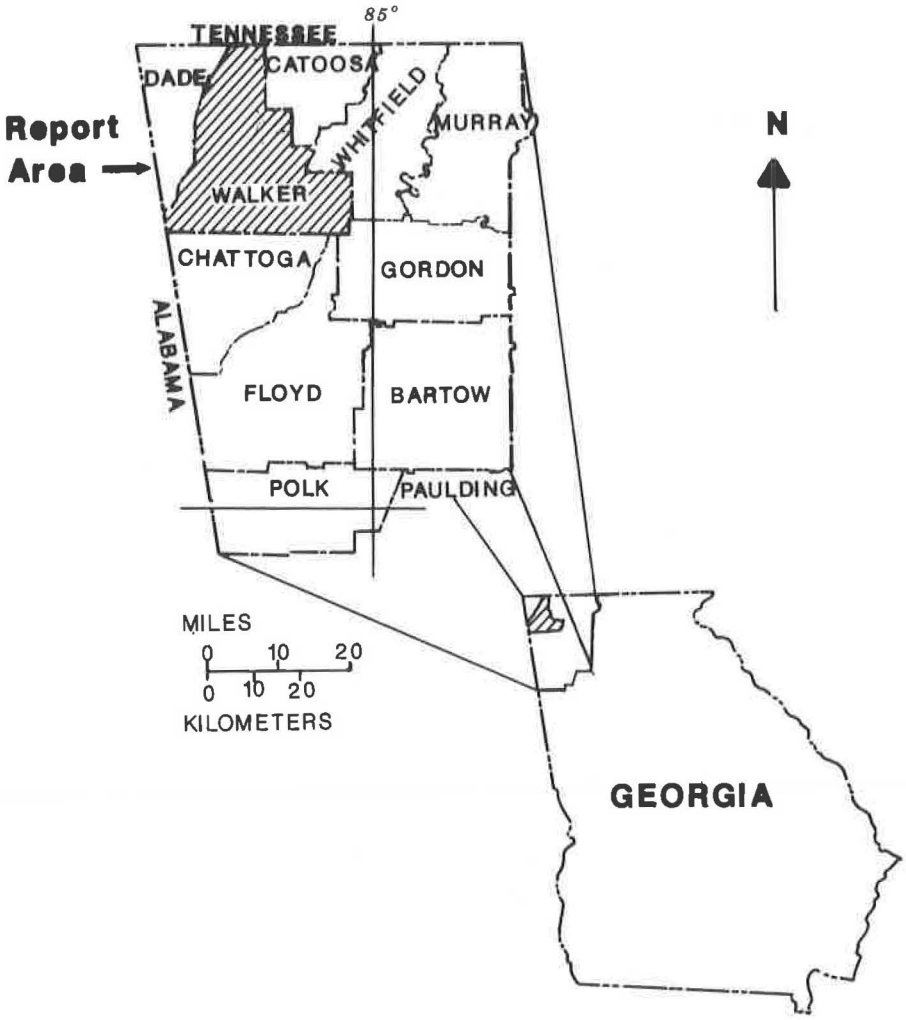


FIGURE 1

LOCATION OF WALKER COUNTY REPORT AREA

(after Cressler, and others, 1976)

TABLE 1

Active Clay and Shale Mines and Pits in Walker County, Georgia*

COMPANY CONTACT	LOCATION OF MINE, PIT OR QUARRY	USE(S) GEOLOGIC AGE-FORMATION
General Shale Products Corp. P. O. Box 3547 Johnson City, TN 37602 Walter Banyas Vice President, Real Estate (615) 282-4661 Bill Cantrell Mining Superintendent (404) 799-0491	Turner mine: 1/2 mile west of Rossville between Burnt & Salem Rds., near Ga.-Tenn. Stateline, 3/4 mile east of Ga. Hwy. 193. (Permit #138)	Brick. (Silurian-Red Mountain Formation-shale)

* After Kline and O'Connor, 1981, p. 11.

TABLE 2

Summary of 20th Century Clay and Shale Mines and Companies in Walker County, Georgia

American Sewerpipe Co. (c. 1905), Blowing Springs plant and pits: Sewer pipe, drain tile, and wall coping from alluvial clay and from Red Mountain Formation shale. Acquired by the W.S. Dickey Clay Mfg. Co., c. 1915 (Veatch, 1909, p. 374; Smith 1931, p. 164; Butts and Gildersleeve, 1948, p.97).

W.S Dickey Clay Manufacturing Co. (c. 1915): Sewer pipe from hauled-in clays and shales. Acquired from American Sewerpipe Co., c. 1915 (Smith, 1931, p. 164; Butts and Gildersleeve, 1948, p. 97).

*General Shale Products Corp. (Key-James Divn., Tn.), Rossville plant and pits: Brick from Red Mountain Formation shale. Acquired from Key-James Brick Co., c. 1970 (?) 35 acres permitted.

Key-James Brick Co. (Tn.), LaFayette & Rossville plant and pits: Brick. Acquired by General Shale Products Co., c. 1970 (?)

Miller-Burns Fire Brick Co. (1902), Rossville (?): Fire brick from Knox Group colluvial chert and clay (Smith, 1931, No. 34, p. 167). See Mission Ridge Brick Co. below.

J. Milligan (1908?): Colluvial clay (for ceramic products?) pits near Cedar Grove, in McLemore Cove. Ceramic test: Wkr. 09V-4 (Veatch, 1909, p. 375; Butts and Gildersleeve, 1948, p. 97).

Mission Ridge Brick Co., (1908?), Mission Ridge plant and pits: Face brick from Red Mountain shale. Acquired (from Miller-Burns Fire Brick Co.?) prior to 1909. Abandoned c. 1946(?). Ceramic test: Wkr. 09V-1; (&09V-5?) and Wkr. 31S-34 (Veatch, 1909. p. 280; Smith, 1931, No. 34, p. 167; Butts and Gildersleeve, 1948, p. 96).

S.N. Worthen (1908?), LaFayette; Pottery and stoneware from Conasauga Group residual clay. Ceramic test: Wkr.09V-3. (Veatch, 1909, p. 374; Butts and Gildersleeve, 1948, p. 96).

NOTE:

The majority of the information for the companies listed above was taken from the Mining Directories (Circular 2, 1st to 18th editions) published by the Georgia Geologic Survey and its predecessors at irregular intervals since 1937. Some additional information came from the "Georgia Surface Mining and Land Reclamation Activities" published annually since 1969 by the Georgia Surface Mined Land Reclamation Program (Environmental Protection Division, Ga. Dept. of Natural Resources). Additional sources of information were found in the references cited at the end of each entry. Uncertainty in the dates is due to incomplete records in the Survey's files.

* Active pit.

TABLE 3

Generalized Summary of Stratigraphic Units in Walker County, Northwest Georgia

CHRONOSTRATIGRAPHIC UNIT	STRATIGRAPHIC UNITS - THICKNESS AND ROCK TYPES 1/
Quaternary (and Tertiary?)	* Various unnamed bodies of alluvial, colluvial and residual material. Largely clay and sand, but also, locally gravel and breccia.
Pennsylvanian	Pottsville Formation * Crab Orchard Mts. Formation (or Group) or Walden Sandstone - Sandstone, shale, coal, conglomerate and limestone. Includes: Rockcastle Member (or Sandstone or Conglomerate) - Approx. 50 ft., predominantly sandstone with dark shale; Vandever Member (or Formation or Shale) - Approx. 400 ft., light to dark shale with interbedded siltstone, fine-grained sandstone, and coal; Newton Member (or Sandstone or Bonair Sandstone) - Approx. 100 ft., cross-bedded sandstone; Whitwell Member (or Shale) - Approx. 200 ft., light-gray to black shale with some siltstone, sandstone and coal; and Sewanee Member (or Conglomerate) - Approx. 250 ft., conglomeratic sandstone with minor coal. * Gizzard Formation (or Group or Member) or Lookout Sandstone (or Formation) or Pottsville Formation - gray to tan shale, with interbedded siltstone, sandstone, coal and fire clay. Includes: Signal Point Member (or Shale) - Approx. 360 ft., shale with some coal; Warren Point Member (or Sandstone) - Approx. 140 ft., conglomeratic sandstone with minor coal; and Raccoon Mtn. Member (or Formation) - Approx. 175 ft., shale with coal.
Mississippian	* Pennington Formation (or Shale) - Approx. 100-300 ft., gray, green and red shale. Sandstone present in middle. Bangor Limestone - Approx. 300-480 ft., fine- to coarse-grained gray limestone with interbedded shale at top. Floyd Shale - Approx. 100-2000 ft., silt and clay with some sandstone and limestone. Approximate age-equivalent to Tuscambia Limestone and Monteagle Limestone. Hartselle Formation (or Member or Sandstone) - Approx. 50-300 ft., thin- to thick-bedded sandstone.

TABLE 3

Generalized Summary of Stratigraphic Units in Walker County, Northwest Georgia (continued)

CHRONOSTRATIGRAPHIC UNIT	STRATIGRAPHIC UNITS - THICKNESS AND ROCK TYPES 1/
Mississippian, cont'd.	Monteagle Limestone - Approx. 250 ft. Includes: Golconda Formation (or Limestone) - Approx. 15-20 ft., green fissile shale containing some thin limestone; Gasper Limestone - Approx. 150 ft., gray, non-cherty limestone; and Ste. Genevieve Limestone - Approx. 245 ft., gray, limestone. Tuscumbia Limestone - Approx. 125 ft. Includes: St. Louis Limestone - Approx. 125 ft., gray, very cherty limestone. Fort Payne Formation (or Chert) - Approx. 10-125 ft., thin- to thick-bedded chert and cherty limestone. Locally includes: *Lavender Shale Member - Approx. 0-100 ft., shale, massive mudstone and impure limestone.
Devonian	Chattanooga Shale - Approx. 5-10 ft., carbonaceous, fissile black shale. Armuchee Chert - Approx. 50-150 ft., thin- to thick-bedded chert.
Silurian	**Red Mountain Formation (formerly Rockwood Formation) - Approx. 600-1200 ft., sandstone, red and green shale, with conglomerate, limestone and local hematitic iron ore.
Ordovician	Sequatchie Formation - Approx. 75-250 ft., sandstone, siltstone, shale, calcareous shale and limestone. (*)Chickamauga Group (or Limestone) - Approx. 400 ft., dominantly limestones with some dolostone and lesser shale, claystone, siltstone, sandstone, anmd bentonite clay horizons. Equivalent, in part, to the Moccasin Limestone and Bays Formation and to the Rockmart Slate and Lenoir Limestone. Includes: Maysville Formation and Trenton Limestone; Lowville-Moccasin Limestone; Lebanon Limestone; and Murfreesboro Limestone. Lenoir Limestone - Approx. 0-100+ ft. Includes: Mosheim Limestone Member - 35 ft.; and Deaton Member - 0-100+ ft.

TABLE 3

Generalized Summary of Stratigraphic Units in Walker County, Northwest Georgia (continued)

CHRONOSTRATIGRAPHIC UNIT	STRATIGRAPHIC UNITS - THICKNESS AND ROCK TYPES 1/
Cambrian-Ordovician	(*)Knox Group - Approx. 2000-4000 ft., dominantly cherty dolostone, minor limestone. Includes: Newala Limestone - Approx. 300 ft., limestone and dolostone; Longview Limestone - Approx. 350 ft.; Chepultepec Dolomite - Approx. 800 ft.; and Copper Ridge Dolomite - Approx. 2500 ft.
Cambrian	* Conasauga Group (or Formation) - Approx. 1500-2000 ft., predominantly shale and limestone with minor sandstone. Includes: "Upper Unit" = Nolichucky Shale - and Maryville Limestone? - Approx. 400-1600 ft.; "Middle Unit" = Rutledge Limestone and Rogersville Shale? - Approx. 200-400 ft.; and "Lower Unit" = Pumpkin Valley Shale and Honaker Dolomite? - Approx. 300-500 ft. Rome Formation - Approx. 500-1000 ft., shale, and interbedded sandstone, siltstone and quartzite.

NOTES:

* = Some ceramic firing tests have been made on slate, shales and clays of this unit.
(*) = Same as the above, but for residual clays only.
** = Numerous firing tests have been made on this unit.
1/ Descriptions based on data in Bergenback and others, 1980; Butts and Gildersleeve, 1948; Chowns, 1972, 1977; Chowns and McKinney, 1980; Crawford, 1983; Cressler 1963, 1964a and b, 1970, 1974; Cressler and others, 1979; Croft, 1964; Georgia Geologic Survey, 1976; Gillespie and Crawford, in press; Thomas and Cramer, 1979.

EXPLANATION OF KEY TERMS ON THE CERAMIC TEST AND ANALYSES FORMS

The test data and analyses which are presented here were compiled on a set of standardized forms (Ceramic Tests and Analyses) in the most concise manner consistent with the various laboratories represented. These forms are modified in large part after those used by the Pennsylvania Geological Survey (e.g., O'Neill and Barnes, 1979, 1981).

It should be noted that, although the great majority of these tests were performed by the USBM, it was decided not to reproduce their data forms directly for several reasons. First, the USBM forms contain several entries which are not essential to this project (e.g., Date received) or do not make the most efficient use of space. Second, the USBM forms have been changed several times over the span of decades covered by the present compilation. Finally, investigators from other laboratories have reported parameters which were not measured by the USBM.

The paragraphs which follow briefly describe, in alphabetical order, the more critical entries on the forms, the nature of the information included and, where possible, the various factors and implications to be considered in their interpretation. Many of the particular comments here are based on descriptive information published in the following sources. Tests by Georgia Geologic Survey authors are described in Veatch (1909, p. 50 to 64) and in Smith (1931, p. 19 to 25), while the particulars of the USBM studies are given in Klinefelter and Hamlin (1957, especially p. 5 to 41) and in Liles and Heystek (1977, especially p. 2 to 16). The discussions which follow are not intended to be exhaustive but are merely meant to remind the reader,

and potential user, of the key aspects of the information presented. Various technical texts and reports should be consulted for more detailed information (e.g., Clews, 1969; Grimshaw, 1972; Jones and Beard, 1972; Norton, 1942; Patterson and Murray, 1983). The abbreviations used on these test forms are defined in Table 4.

1. Absorption (%)

The absorption is a measure of the amount of water absorbed by open pores in the fired specimen and is given as a percentage of the specimen's dry weight. For slow firing tests, it is measured on fired specimens which have been boiled in water for 2 to 5 hours and then kept immersed in the water for up to 24 hours while cooling (Smith, 1931, p. 22; Klinefelter and Hamlin, 1957, p. 27-28; Liles and Heystek, 1977, p. 3). For the quick firing tests, however, the specimens are not boiled but only cooled and then immersed in water for 24 hours (Liles and Heystek, 1977, p. 4).

The absorption gives an indication of the amount of moisture which may be absorbed and subject to destructive freezing in outdoor structures. Less than 22% absorption is considered promising for slow-fired materials.

2. Appr. Por. (%) - Apparent Porosity, Percent

The apparent porosity is a measure of the amount of open pore space in the fired sample, relative to its bulk volume, and is expressed as a percent. As in the case of absorption values, it is based on the weight and volume of the specimen which has been boiled in water for 2 to 5 hours and then kept immersed in water for several hours as it cools (Klinefelter and Hamlin, 1957, p. 27 to 28; Liles and Heystek,

TABLE 4

Abbreviations for Terms on the Ceramic Firing Test Forms

ABBREVIATIONS

Appr. Por. = Apparent Porosity
App. Sp. Gr. = Apparent Specific Gravity

Btw. = Bartow County

°C = Degrees Celsius
Ct. = Catoosa County
Cht. = Chattooga County

Dd. = Dade County
Dist. = District
DTA = Differential Thermal Analysis

E. = East

°F = Degrees Fahrenheit
Fl. = Floyd County

g/cm^3 = Grams per cubic centimeter
Gdn. = Gordon County

Lab. & No. = Laboratory (name) and number (assigned in laboratory)
Lat. = Latitude
LOI = Loss on Ignition
Long. = Longitude
lb/in^2 = Pounds per square inch
lb/ft^3 = Pounds per cubic foot

Mry. = Murray County

N. = North
NE. = Northeast
NW. = Northwest

org. = Organic

Plk. = Polk County

S. = South
SE. = Southeast
SW. = Southwest
Sec. = Section

Table 4. Abbreviations for Terms on the Ceramic Firing Test Forms (continued)

7 1/2' topo. quad. = 7 and 1/2 minute topographic quadrangle

Temp. = Temperature
TVA = Tennessee Valley Authority

USBM = U.S. Bureau of Mines
USGS = U.S. Geological Survey

W. = West
Wkr. = Walker County
Wf. = Whitfield County

XRD = X-ray diffraction

1977, p. 3). The apparent porosity is an indication of the relative resistance to damage during freezing and thawing. Less than 20% apparent porosity is considered promising for slow-fired materials (O'Neill and Barnes, 1979, p. 14, Fig. 4).

3. App. Sp. Gr. - Apparent Specific Gravity

As reported in earlier USBM studies, the apparent specific gravity is a measure of the specific gravity of that portion of the test specimen that is impervious to water. This is determined by boiling the sample in water for 2 hours and soaking it in water overnight or 24 hours (Klinefelter and Hamlin, 1957, p. 27 to 28). These data were replaced by bulk density and apparent porosity measurements after the USBM moved its laboratories from Norris, Tennessee to Tuscaloosa, Alabama in 1965.

4. Bloating

Bloating is the term given to the process in which clay or shale fragments expand (commonly two or more times their original volume) during rapid firing. It results from the entrapment of gases which are released from the minerals during firing but which do not escape from the body of the host fragment due to the viscosity of the host at that temperature. Bloating is a desirable and essential property for the production of expanded lightweight aggregate where an artificial pumice or scoria is produced. Expanded lightweight aggregate has the advantages of light weight and high strength compared to conventional crushed stone aggregate. Bloating is not desirable, however, in making other structural clay products such as brick, tile and sewer pipe where the dimensional characteristics must be carefully controlled. In these cases bloating is extremely deleterious since it leads to variable and uncontrollable warping, expansion and general disruption of the fired clay body (Klinefelter and Hamlin, 1957, p. 39-41).

5. Bloating Test (or Quick Firing Test)

The Bloating Test refers to the process of rapidly firing (or "burning") the raw sample in a pre-heated furnace or kiln to determine its bloating characteristics for possible use as a lightweight aggregate. Although specific details of the different laboratory methods vary, all use several fragments of the dried clay or shale placed in a refractory plaque (or "boat") which in turn is placed in the pre-heated furnace for 15 minutes (Klinefelter and Hamlin, 1957, p. 41; Liles and Heystek, 1977, p. 4).

6. Bulk Density (or Bulk Dens.)

The bulk density is a measure of the overall density of the fired specimen based on its dry weight divided by its volume (including pores). Determinations are the same for slow firing and quick firing test samples, although for the latter the results are given in pounds per cubic inch as well as grams per cubic centimeter units (Klinefelter and Hamlin, 1957, p. 27 to 28 and 41; Liles and Heystek, 1977, p. 3 and 4). If quick-fired material yields a bulk density of less than 62.4 lb/ft^3 (or if the material floats in water), it is considered promising for lightweight aggregate (K. Liles, oral communication, 1984).

7. Color

The color of the unfired material, unless otherwise stated, represents the crushed and ground clay or shale. In most cases this is given for descriptive purposes only since it is generally of no practical importance for ceramic applications (only the fired color is significant). Here only broad descriptive terms such as light-brown, cream, gray, tan, etc. are used. Fired colors are more critical and therefore more specific descriptive terms and phrases are used (Klinefelter and Hamlin, 1957, p. 18 and 19). In many cases the Munsell color is given for a precise description (see discussion below).

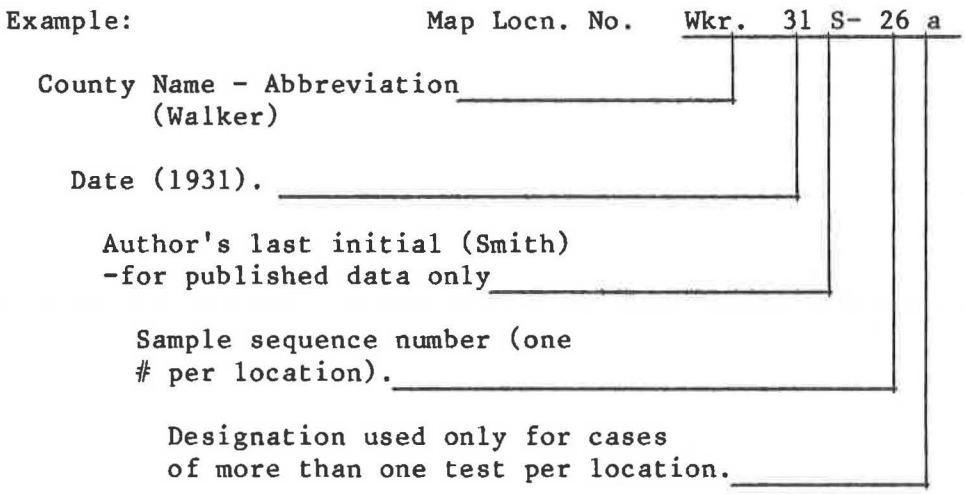
8. Color (Munsell)

This is a system of color classification based on hue, value (or brightness) and chroma (or purity) as applied to the fired samples in this compilation. It was used by Smith (1931, p. 23-25) and by the

USBM since the early 1970's (Liles and Heystek, 1977, p. 3; Liles, oral communication, 1982). In all other cases the fired color was estimated visually.

9. Compilation Map Location No.

This number or code was assigned by the author to provide a systematic designation to be used in plotting sample locations on the base maps as shown by the typical example below.



The map location number Wkr. 31S-26a is derived from the county name (e.g., Wkr. for Walker County), the year the tests were performed (e.g., 31 for 1931) plus the last initial of the author for major published sources (e.g., S for Smith), followed by a sequence number assigned in chronological order or sequential order for published data. (The only exceptions to this are the tests reported in Smith, 1931, wherein the sequence number of the present report is the same as the "Map location No." of Smith.) Each map location number represents a

specific location, or area, sampled at a particular time. In cases where several separate samples were collected from a relatively restricted area, such as an individual property, such samples are designated a, b, c, etc. Different map location numbers have been assigned to samples which were collected from the same general locality, such as a pit or quarry, but which were collected by different investigators at different times.

10. Cone

Standard pyrometric cones, or cones, are a pyrometric measure of firing temperature and time in the kiln. They are small, three-sided pyramids made of ceramic materials compounded in a series, so as to soften or deform in progression with increasing temperature and/or time of heating. Thus, they do not measure a specific temperature, but rather the combined effect of temperature, time, and other conditions of the firing treatment. The entire series of cones ranges from about 1112°F (600°C) to about 3632°F (2000°C) with an average interval of about 20°C between cones for a constant, slow rate of heating (Klinefelter and Hamlin, 1957, p. 29). For the past several decades the use of these cones has been limited to the Pyrometric Cone Equivalent (PCE) test (Liles and Heystek, 1977, p. 16). However, all of the ceramic firing tests reported by Veatch (1909) and Smith (1931) as well as some of the earliest USBM tests report firing conditions in terms of the standard cone numbers.

11. Drying Shrinkage

The drying shrinkage is a measure of the relative amount of shrinkage (in percent) which the tempered and molded material undergoes

upon drying. Although there are a variety of ways by which this can be measured, in this report the shrinkage values represent the percent linear shrinkage based on the linear distance measured between two reference marks or lines imprinted on the plastic specimen before drying. Even though the methods have varied in detail, the drying is usually accomplished in two stages: first, by air drying at room temperature (usually for 24 hours) and second, by drying in an oven followed by cooling to room temperature in a desiccator (Klinefelter and Hamlin, 1957, p. 30-31; Liles and Heystek, 1977, p. 3). In most cases the heating was at 212°F (100°C) for 24 hours; however, studies by Smith (1931, p. 20 and 21) employed 167°F (75°C) for 5 hours followed by 230°F (110°C) for 3 hours.

12. Dry Strength

The dry strength (or green strength) is a measure of the apparent strength of the clay or shale after it has been molded and dried. Unless otherwise indicated, it represents the tranverse, or crossbreaking, strength as opposed to either tensile strength or compressive strength. For the great majority of cases only the approximate dry strength is indicated as determined by visual inspection, using such terms as low, fair, good, or high (Klinefelter and Hamlin, 1957, p. 32-33; Liles and Heystek, 1977, p. 2). Smith (1931, p. 12-13) reports a quantitative measurement of this strength using the modulus of rupture (MOR) expressed in units of pounds per square inch (psi).

13. Extrusion Test

More extensive tests are sometimes made on clays and shales which

show good plasticity and long firing range in the preliminary test. In the Extrusion Test several bars are formed using a de-airing extrusion machine (i.e., one which operates with a vacuum to remove all possible air pockets). These bars are fired and tested for shrinkage, strength (modulus of rupture) and water saturation coefficient (Liles and Heystek, 1977, p. 8).

14. Firing Range

The term firing range indicates the temperature interval over which the material shows favorable firing characteristics. For slow-fired materials such desirable qualities include: a) good strength or hardness; b) good color; c) low shrinkage; d) low absorption; and e) low porosity. For quick-fired materials these include: a) good pore structure; b) low absorption; and c) low bulk density. For slow-firing and quick-firing tests the firing range should be at least 100°F (55°C) to be considered promising (O'Neill and Barnes, 1979, p. 15-18).

15. Hardness

The hardness, as measured on fired materials, indicates the resistance to abrasion or scratching. It is designated either in verbal, descriptive terms or in numerical terms using Mohs' hardness (Liles and Heystek, 1977, p. 3). It is used as an indication of the strength of the fired materials. Smith (1931), however, measured the fired strength with the modulus of rupture.

16. Hardness (Mohs')

The hardness of fired specimens using the Mohs' scale of hardness

is currently used by the USBM as a numerical measure of the fired bodies' strength (Liles and Heystek, 1977, p. 3). The values correspond to the hardness of the following reference minerals:

Mohs' Hardness No.	Reference Minerals
1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Orthoclase
7	Quartz
8	Topaz
9	Corundum
10	Diamond

A Mohs' hardness greater than 3 is considered promising for slow-fired materials.

17. HCl Effervescence

The effervescence in HCl is visually determined as none, slight or high based on the reaction of 10 ml of concentrated hydrochloric acid added to a slurry of 10 grams powdered clay or shale (minus 20 mesh) in 100 ml of water (Klinefelter and Hamlin, 1957, p. 17; Liles and Heystek, 1977, p. 4). This test gives a general indication of the amount of calcium carbonate present in the sample. An appreciable effervescence could be an indication of potential problems with lime pops and/or frothing of slow-fired ceramic products.

18. Linear Shrinkage, (%)

The term linear shrinkage represents the relative shrinkage of the clay body after firing. In most cases it represents the percent total linear shrinkage from the plastic state and is based on measurements

between a pair of standard reference marks imprinted just after molding (Klinefelter and Hamlin, 1957, p. 30-32; Liles and Heystek, 1977, p. 3). (Also see the discussion under Drying Shrinkage.) Smith (1931, p. 22) gives the shrinkage relative to both the dry, or green, state (under the column headed Dry) as well as the plastic state (under the column headed Plastic). A total shrinkage of 10% or less is considered promising for slow-fired materials.

19. Modulus of Rupture (MOR)

The modulus of rupture is a measure of the strength of materials (for crossbreaking or transverse strength in this compilation) based on the breakage force, the distance over which the force was applied and the width and thickness of the sample. The MOR is expressed in psi units (pounds per square inch) for the limited MOR data reported here (determined by Smith, 1931, p. 21 and 23).

20. Mohs'

See Hardness (Mohs').

21. Molding Behavior

See Working Properties.

22. Munsell

See Color (Munsell).

23. "MW" face brick

"MW" stands for moderate weather conditions. This is a grade of brick suitable for use under conditions where a moderate, non-uniform

degree of frost action is probable (Klinefelter and Hamlin, 1957, p. 36 and 37; ASTM Annual Book of Standards, 1974). (Also see "SW" face brick.)

24. PCE - Pyrometric Cone Equivalent

The PCE test measures the relative refractoriness, or temperature resistance, of the clay or shale; it is indicated in terms of standard pyrometric cones. The value given is the number of the standard pyrometric cone which softens and sags (or falls) at the same temperature as a cone made from the clay or shale being studied. These tests are usually only made on refractory materials which show favorable potential in the preliminary slow firing tests (i.e., high absorption, low shrinkage, and light fired color). The results are usually given for the upper temperature range Cone 12 (1337°C; 2439°F) to Cone 42 (2015°C; 3659°F) where the temperature equivalents are based on a heating rate of 150°C (270°F) per hour. With increasing temperature resistance the sample is designated as either a low-duty, medium-duty, high-duty, or super-duty fire clay (Klinefelter and Hamlin, 1957, p. 29-30 and 57-58; Liles and Heystek, 1977, p. 16).

25. pH

The pH is a measure of the relative acidity or alkalinity with values ranging from 0 to 14. (A pH of 7 is neutral. Values greater than this are alkaline whereas those which are less than 7 are acid.) Most of the ceramic tests by the USBM presented here show pH values as determined on the crushed and powdered raw material (in a water slurry) prior to firing (Klinefelter and Hamlin, 1957, p. 28; Liles and Heystek, 1977, p. 4).

Strongly acid or alkaline pH values may give some indication of potential problems with efflorescence and scum due to water-soluble salts in the clay. Unfortunately, no simple and direct interpretation is possible from the pH data alone. The best method for determining these salts is through direct chemical analysis as described under Soluble Salts. (Also see Solu-Br.)

26. Plasticity

See Working Properties.

27. Porosity, Apparent

See App. Por.

28. Quick Firing

See Bloating Test.

29. Saturation Coefficient

The saturation coefficient is determined only for specimens which have undergone the more extensive Extrusion Test. It is determined by submerging the fired specimen in cool water for 24 hours, followed by submerging the specimen in boiling water for 5 hours. The saturation coefficient is found by dividing the percent of water absorbed after boiling into the percent of water absorbed after the 24-hour submergence (Liles and Heystek, 1977, p. 8).

30. Shrinkage

See Drying Shrinkage and Linear Shrinkage.

31. Slaking

See Working Properties.

32. Slow Firing Test

Slow Firing Test refers to the process of firing ("burning") the dried specimen in a laboratory furnace or kiln. Although specific details of the different laboratory methods vary, all specimens are started at room temperature and are slowly heated to the desired temperature over a specific interval of time.

The majority of the slow firing tests by the USBM reported here were made using 15-minute draw trials. In this method a set of molded and dried test specimens are slowly fired in the kiln or furnace. The temperature is gradually raised to 1800°F (982°C) over a period of 3 to 4 hours (to avoid disintegration of the specimen as the chemically combined water is released) and the temperature is held constant for about 15 minutes. One specimen is removed from the kiln (a draw trial) and the temperature is raised to the next level (usually in intervals of 100°F). At each interval the temperature is again held constant for a 15-minute soak and then one specimen is withdrawn. This process is repeated until the final temperature is achieved (usually 2300 or 2400°F; 1260 or 1316°C) - see Klinefelter and Hamlin (1957, p. 19 and 30). The disadvantage of this draw trial method is that it tends to underfire the specimens, compared to the industrial process, since they are soaked for a relatively short time and quickly cooled by removal from the kiln.

Since the early 1970's the USBM has abandoned the draw trials and has adopted a method which more closely resembles the conditions of

commercial manufacture. As described by Liles and Heystek (1977, p. 2 and 3), one of the test specimens is slowly fired, over 24 hours, to 1832°F (1000°C), where it is held for a one-hour soak. The kiln is then turned off, but the specimen remains in the kiln as it slowly cools. (This gives a much closer approximation of most commercial firing processes.) This is subsequently repeated, one specimen at a time, for successive 50°C intervals usually up to 2282°F (1250°C). Unfortunately, only a relatively small part of the current data set is represented by USBM tests using this newer method.

The firing test methods used by Smith (1931, p. 21 and 22) are somewhat intermediate to the two methods described above. First, the specimens were slowly fired from 200 to 1200°F (93 to 649°C) over a period of 11 hours. The temperature was subsequently increased at a rate of 200°F per hour for approximately 4 hours followed by 100°F per hour until final temperature conditions were reached. At these later stages firing conditions were monitored using standard pyrometric cones in the kiln. The maximum firing temperature was determined from observed pyrometric cone behavior. This temperature was based on the temperature equivalent to 2 cones below the desired final cone. The kiln temperature was then held constant until the desired cone soaked down. Test specimens were then removed from the kiln and allowed to cool. Smith's firings averaged about 17 hours in the kiln and all specimens were fired to cones 06, 04, 02, 1, 3 and 5 wherever possible. No specific information is available on the methods employed by Veatch (1909) or the unpublished data from TVA or Georgia Tech.

33. Solu-Br. (Solu-Bridge)

Solu-Bridge measurements were used in the 1950's and 60's by the

USBM as a measure of the soluble salts (e.g., calcium sulfate) in the unfired raw material which might cause scum and efflorescence on fired products. "The solubridge and pH readings show the higher alkali samples. Solubridge determinations give the water soluble part of the alkalis and readings above 1.5 indicate fairly high soluble salt content. Clays containing high alkalies have rather short maturing temperatures and require closer firing control. The alkalis also influence the color and lower the vitrification temperature." (H.P. Hamlin, written communication, 1957). In this method the pulverized clay or shale is boiled in water, left to stand overnight, and filtered. The content of soluble salts in the solution is then measured using the Solu-Bridge instrument readings applied to suitable calibration tables (Klinefelter and Hamlin, 1957, p. 28-29). These data are no longer collected because consistent and meaningful results are difficult to achieve.

34. Soluble Salts

Excessive water-soluble salts can cause problems with efflorescence or scum on fired clay products. (More than 3 to 4% calcium sulfate, and 1/2% magnesium or alkali sulfates are considered excessive.)

The most accurate determinative method is to boil the finely powdered sample in distilled water for 1/2 to 1 hour and let it soak overnight. The decanted solution is then analyzed for the soluble salts using standard chemical methods. The Solu-Bridge readings may also be used as a general measure of the soluble salts (Klinefelter and Hamlin, 1957, p. 28).

35. Strength

See Dry Strength and Modulus of Rupture.

36. "SW" face brick

"SW" stands for severe weather conditions. This is a grade of brick suitable for use under conditions where a high degree of frost action is probable (Klinefelter and Hamlin, 1957, p. 36 and 37, and theASTM Annual Book of Standards, 1974). (Also see "MW" face brick.)

37. Temp. °F (°C)

The temperature at which the material was fired (both slow and quick firing tests) is given in Fahrenheit (°F) followed by the Celsius (°C) conversion in parentheses. In cases where only pyrometric cone values are available, the approximate temperature is given on the form and is based on the table of temperature equivalents in Norton (1942, p. 756, Table 128) or in Veatch (1909, p. 57).

38. Water of Plasticity (%)

This is a measure of the amount of water (as weight percent relative to the dry material) required to temper the pulverized raw clay or shale into a plastic, workable consistency. This is not a precise measurement, being dependent upon the experience of the technician, the type of equipment used and the plasticity criteria. In most cases it represents the amount of water necessary for the material to be extruded into briquettes from a laboratory hydraulic ram press. In general, high water of plasticity values tends to correlate with a greater degree of workability, higher plasticity and finer grain size. Unfortunately, high values also correlate with a greater degree of shrinkage,

warping and cracking of the material upon drying. (See Klinefelter and Hamlin, 1957, p. 20-22; Liles and Heystek, 1977, p. 2.)

39. Working Properties (or Workability)

This area of working properties includes comments on the slaking, plasticity, and molding, or extruding behavior of the tempered material (Klinefelter and Hamlin, 1957, p. 5, 19-22 and 33-34). The term slaking refers to the disintegration of the dry material when immersed in water. It may range in time from less than a minute to weeks, but generally in the present report it is given only a relative designation such as rapid, slow, or with difficulty. Plasticity likewise is designated in a comparative manner in order of decreasing plasticity: plastic, fat (or sticky), semiplastic, short (or lean), semiflint and flint. Molding behavior is referred to as good, fair, or poor and is a general designation for the ease with which the material can be molded into test bars or briquettes.

These working properties are very imprecise and strongly dependent upon the judgement and experience of the operator. They do, however, give a general indication of how the material might respond to handling in the industrial process.

Ceramic Tests and Analyses of Clays and Shales
in Walker County, Georgia *

* The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design.

CERAMIC TESTS AND ANALYSES

Material Clay (residual). Compilation Map Location No. Wkr.09V-1

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Survey, #105.

Date Reported 1909. Ceramist O. Veatch. Ga. Survey.

Water of Plasticity - % Working Properties Very poor plasticity.

Color White (?). Drying Shrinkage 2.6 % Dry Strength (tensile) not exceed 15 psi.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Remarks
2210 (1210) (Cone 4)	-	-	1	-	Quite porous	-
2498 (1370) (Cone 12)	-	Good	5.5	-	-	-
3146 (1730) (Cone 30)	-	-	-	-	-	Melted to a glass

(The clay does not crack or warp on firing at any of the above cones.)

Remarks / Other Tests The clay was blended with about 1/3 residual plastic clay and fired at Cone 2 to manufacture a soft and friable fire brick at the Mission Ridge Fire Brick Company; however, they used the above fire clay in its original state with coarse chert particles and not finely ground as in the above (Veatch, 1909, p. 281).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size -40 mesh. Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	85.00
TiO_2	0.28
Al_2O_3	9.72
Fe_2O_3(total)	1.35
FeO	-
MnO	trace
MgO	0.00
CaO	trace
Na_2O	trace
K_2O	0.44
P_2O_5	0.00
S (total)	0.00
C (org.)	-
CO_2	-
H_2O^-	0.34
H_2O^+	-
Ignition loss	3.16
Total	100.30

Mineralogy:

Mineral	volume %
Quartz (chert)	80-90
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others (clays ?)	10-20
Total	100

Analyst E. Everhart, Ga. Survey (in Veatch, 1909, p. 281 and App. B, #105, p.416-417).

O. Veatch, Ga. Survey.

Date c. 1909.

c.1909.

Method Standard "wet".

Visually estimated.

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Ft. Oglethorpe (Cntr.). Lat. _____, Long. _____.

Field No. - , Collected by O. Veatch. Date c. 1909.

Sample Method Grab (?). Weathering/alteration Residual clay from chert.

Structural Attitude No visible stratification.

Stratigraphic Assignment Recent (to Eocene ?) residual clay from Knox Group (Cambrian - Ordovician) chert and dolostone.

Sample Description & Comments Sample from a 30 foot deep pit about 1/4 mile west of the brick plant of the Mission Ridge Fire Brick Company which is located on the Central of Ga. Railroad, 8 miles south of Chattanooga, Tenn. The "clay" shows a heterogeneous mass of white, drab, yellow and purplish fine clay and coarse chert. The clay is locally concentrated in pockets. The chert particles range from minute to angular boulders up to 2 feet long (Veatch, 1909, p. 280 and 281).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Clay (underclay). Compilation Map Location No. Wkr.09V-2

County Walker. Sample Number -

Raw Properties: Lab & No. Ga.Survey, #108

Date Reported 1909. Ceramist O. Veatch, Ga. Survey.

Water of Plasticity - % Working Properties -

Color - Drying Shrinkage - % Dry Strength -

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Remarks
2822 (1550) (Cone 21)	-	-	-	-	-	Completely fused

Remarks / Other Tests The sample is not sufficiently refractory to be used as a fire clay although it is in the appropriate stratigraphic position where fire clays have been mined in adjacent states (Veatch, 1909, p. 107 and 282). It may be used for making other less refractory heavy clay products like brick.

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	69.61
TiO_2	1.38
Al_2O_3	16.72
Fe_2O_3(total)	3.38
FeO	-
MnO	0.08
MgO	trace
CaO	trace
Na_2O	0.28
K_2O	1.81
P_2O_5	-
S (total)	0.02
C (org.)	-
CO_2	-
H_2O^-	1.74
H_2O^+	-
Ignition loss	5.35
Total	100.37

Mineralogy Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst E. Everhart, Ga. Survey (in Veatch, 1909, App. B, #108, p. 416-417).

Date c.1909

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 10, 298, 314, and 315, Sec. Dist.

7 1/2' topo quad. Durham (N. edge). Lat., Long.

Field No. -, Collected by O. Veatch. Date c. 1909.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude (Probably very nearly flat-lying.)

Stratigraphic Assignment Underclay (Walden Sandstone?) late Pennsylvanian.

Sample Description & Comments Sample is from clay underlying the coal at the mines of the Durham Coal & Coke Company on Lookout Mountain. The clays here are indurated to semi-indurated and about 2 feet thick (Veatch, 1909, p. 107 and 282). The coal mines at this locality are described by McCallie (1904, p. 34-40).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Clay, residual (Conasauga). Compilation Map Location No. Wkr.09V-3

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Survey.

Date Reported 1909. Ceramist O. Veatch, Ga. Survey.

Water of Plasticity - %Working Properties Very plastic; good molding qualities.

Color Almost white (Cream colored when wet). Drying Shrinkage 8 % Dry Strength (tensile) 81 psi.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Remarks
2174 (1190) (Cone 3)	Gray	-	2.7	-	-	Very dense
2318 (1270) (Cone 7)	Darker gray	Vitrified	4.1	-	-	-

(Clay does not warp or crack when fired to the above conditions.)

Remarks / Other Tests If properly fired this clay is suitable for a good grade of stoneware. It was used at a nearby stoneware pottery at the time these tests were run (Veatch, 1909, p. 374 and 375).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org.)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. LaFayette (formerly Estelle). Lat. _____, Long. _____,

Field No. -, Collected by O. Veatch. Date c. 1909.

Sample Method Grab (?). Weathering/alteration Residual clay (from shale).

Structural Attitude -

Stratigraphic Assignment Recent (to Eocene?) residual clay derived from Conasauga Group shale (Cambrian)-and partly colluvial?

Sample Description & Comments Sample is from a yellowish to bluish white plastic clay that occurs along a small branch or creek. It is an alteration product of the Conasauga shale (possibly also partly colluvial in origin) and has been used by Mr. S. N. Worthen for his stoneware pottery operation. About 5 to 6 feet of clay is exposed and the overall extent of the deposit "is not great, but is sufficient for the needs of a pottery." (Veatch, 1909, p. 374 and 375). The locality is simply listed as "LaFayette".

Compiled by B. J. O'Connor Date 12-10--81

CERAMIC TESTS AND ANALYSES

Material Clay, colluvial. Compilation Map Location No. Wkr.09V-4

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Survey #106.

Date Reported 1909. Ceramist O. Veatch, Ga. Survey.,

Water of Plasticity - % Working Properties Very plastic.

Color Gray. Drying Shrinkage 6.8 % Dry Strength (tensile) 225 psi. (maximum).

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Remarks
2318 (1270 (Cone 7)	Light gray	Vitrified	1	-	-	Slight swelling

Remarks / Other Tests The clay is not refractory and is definitely not a fire clay however, it could be used in stoneware and terra cotta mixtures particularly if it were located near a cheap source of transportation such as a railroad line (Veatch, 1909, p. 375).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	69.33
TiO_2	-
Al_2O_3	19.01
Fe_2O_3 (total)	2.02
FeO	-
MnO	-
MgO	0.87
CaO	trace
Na_2O	0.18
K_2O	2.10
P_2O_5	-
S (total)	-
C (org.)	-
CO_2	-
H_2O^-	0.26
H_2O^+	-
Ignition loss	6.88
Total	100.65

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst (in Veatch, 1909, p. 375 and Appendix B, No. 106, p. 426 and 417; from Spencer, 1893, p. 286).

Date c. 1893.

Method Standard "wet"

Sample Location Data:

County Walker. Land Lot 138(?), Sec. , Dist. .

7 1/2' topo quad. Cedar Grove (NE.1/4). Lat. , Long. .

Field No. -, Collected by O. Veatch and J. W. Spencer. Date c. 1909 and c. 1893.

Sample Method Grab (?). Weathering/alteration Weathered colluvial clay.

Structural Attitude -

Stratigraphic Assignment Recent (?) colluvial clay (a residual clay "transported but a short distance").

Sample Description & Comments A bluish-white plastic clay from the Mulligan property near Cedar Grove in "McLamore" (now McLemore) Cove. "This clay has been mined and shipped in small quantities, but its distance from a railway line renders it of little value." The analysis given by Spencer (cited above) is probably from this or similar clays in the vicinity (Veatch, 1909, p. 375).

Compiled by B. J. O'Connor Date 12-11-81

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.09V-5

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Survey, #104.

Date Reported 1909. Ceramist O. Veatch, Ga. Survey.

Water of Plasticity 26 % Working Properties Fair plasticity; poor slaking; fine-grained texture.

Color Yellow or yellow-brown. Drying Shrinkage 5 % Dry Strength (tensile) 25 prs.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Remarks
1850 (1010) (Cone 07)	Red	Good brick hardness	0.4	-	-	-
1922 (1050) (Cone 05)	Red	-	0.7	-	-	-
2102 (1150) (Cone 1)	Dark red	Vitrified	-	-	-	Showed warping
2174 (1190) (Cone 3)	-	-	-	-	-	Burned to a cinder

Remarks / Other Tests This shale should be good for making common building brick and it was used to a small extent by the Mission Ridge Fire Brick Company according to Veatch (1909, p. 399).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	61.64
TiO_2	1.24
Al_2O_3	15.66
Fe_2O_3 (total)	8.50
FeO	-
MnO	trace
MgO	1.18
CaO	trace
Na_2O	1.80
K_2O	3.93
P_2O_5	-
S (total)	0.00
C (org.)	-
CO_2	-
H_2O^-	1.33
H_2O^+	-
Ignition loss	4.80
Total	100.09

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst E. Everhart, Ga. Survey. (in Veatch, 1909, p. 400 and Appendix B, No. 104, p. 416 and 417.)

Date c. 1909.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot , Sec. , Dist. .

7 1/2' topo quad. Ft. Oglethorpe (NE. 1/4). Lat. , Long. .

Field No. -, Collected by O. Veatch. Date c. 1909.

Sample Method Grab (?). Weathering/alteration Weathered (?).

Structural Attitude -

Stratigraphic Assignment Rockwood Formation (now designated Red Mountain Formation) of Silurian age.

Sample Description & Comments Sample of yellow or yellow-brown, fine-grained shale from exposures on the Central of Georgia Railroad at Mission Ridge (Veatch, 1909, p. 399 and 400; also see Wkr.31S-33 from Smith, 1931, p. 167-169).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.09V-6

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Survey, #103.

Date Reported 1909. Ceramist O. Veatch, Ga. Survey.

Water of Plasticity - % Working Properties Rather lean; slakes only very slowly (low plasticity).

Color Yellow or brown. Drying Shrinkage 3.7 % Dry Strength (tensile) 25 psi.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
1922 (1050) (Cone 05)	Red	Steel hard	3.0	-	-	-
1994 (1090) (Cone 03)	Red	Semi-vitrified	4.6	-	-	-
2102 (1150) (Cone 1)	Dark red	Vitrified	6.6	-	-	-
2210 (1210) (Cone 4)	Very dark	Completely vitrified	8.4	-	-	-
2282 (1250) (Cone 6)	-	Fused	-	-	-	-

(Fires without warping or cracking at each of the above temperatures)

Remarks / Other Tests The shale might be suitable for making vitrified brick although its low plasticity and strength (dry) would present difficulties. Veatch suggests that the partly decomposed (weathered) shale would probably be superior to the unweathered shale (1909, p. 400).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis			Mineralogy: Not determined.	
Oxide		Weight %	Mineral	volume %
SiO_2		54.48		
TiO_2		0.92	Quartz	
Al_2O_3		22.89	Feldspar	
Fe_2O_3	(total)	7.48	Carbonate	
FeO		-	Mica	
MnO		0.41	Chlorite-vermiculite	
MgO		1.40	Montmorillonite	
CaO		0.22	Others	
Na_2O		0.43		
K_2O		4.76		
P_2O_5		0.04		
S	(total)	0.03	Total	
C	(org.)	*		
CO_2		-		
H_2O^-		1.62		
H_2O^+		-		
Ignition loss		5.36		
Total		100.04		

* shale is free of carbonaceous matter (Veatch, 1909, p. 400).

Analyst E. Everhart, Ga. Survey (in Veatch, 1909, p. 400-401 and Appendix B, No. 103, p. 416 and 417.)

Date c. 1909.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. LaFayette (Estelle) (SW.1/4) . Lat. _____, Long. _____.

Field No. - , Collected by O. Veatch. Date c. 1909.

Sample Method Grab (?). Weathering/alteration Unweathered (?).

Structural Attitude -

Stratigraphic Assignment Shale from the "Rockwood" (now Red Mountain) Formation (Silurian).

Sample Description & Comments Sample of fine-grained, yellow or brown shale from a cut on the "Chattanooga Southern" (now the Tenn., Ala., Ga.) Railroad near Bronco Veatch, 1909, p. 400-401).

Compiled by B. J. O'Connor Date 12-12-81

CERAMIC TESTS AND ANALYSES

Material Shale (Conasauga). Compilation Map Location No. Wkr.09V-7

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Survey, #102.

Date Reported 1909. Ceramist O. Veatch, Ga. Survey.

Water of Plasticity - % Working Properties Fair plasticity.

Color - Drying Shrinkage 5.8 % Dry Strength (tensile) 65 psi.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Remarks
1922 (1050) (Cone 05)	Red	Good hardness	3.8	-	-	Good density
2102 (1150) (Cone 1)	Dark red	Vitrified	10.1	-	-	-
2210 (1210) (Cone 4)	Dark red	Complete	9.5	-	-	-
2282 (1250) (Cone 6)	-	Partly fused	-	-	-	-

Remarks / Other Tests This shale could be used for making bricks (Veatch, 1909, p. 401).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	54.31
TiO_2	0.90
Al_2O_3	23.04
Fe_2O_3 (total)	6.63
FeO	-
MnO	0.12
MgO	1.40
CaO	0.28
Na_2O	0.08
K_2O	4.32
P_2O_5	0.04
S (total)	0.06
C (org.)	-
CO_2	-
H_2O^-	2.00
H_2O^+	-
Ignition loss	6.59
Total	99.77

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst E. Everhart, Ga. Survey (in Veatch, 1909, p. 401-402, and Appendix B, No. 102, p. 416 and 417).

Date c. 1909.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. LaFayette (Estelle) NE. 1/4. Lat._____, Long. _____.

Field No. -, Collected by O. Veatch. Date c. 1909.

Sample Method Grab (?). Weathering/alteration Partly decomposed.

Structural Attitude Folded and metamorphosed throughout this region.

Stratigraphic Assignment Conasauga Group (Cambrian) shale.

Sample Description & Comments Sample of partly decomposed (ie., weathered) shale from 1/2 mile N. of LaFayette. The shale underlies the Chattooga Valley but is extensively weathered and is rarely exposed at the surface. "It contains thin beds of limestone and sandstone; and is folded and metamorphosed" (Veatch, 1909, p. 401-402).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale, soft to semi-hard (Red Mountain). Compilation Map Location No. Wkr.31S-25

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #25.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 22.0 % Working Properties Plasticity-- grainy (better on aging overnight); slaking-- a little slow; molding-- fairly good (clay column edges tear slightly).

Color Light brown. Drying Shrinkage 2.8 % Dry Strength (MOR) 95.6 psi. (green)

Remarks Drying behavior: Test bars all slightly warped.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color** (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Salmon (2YR-6/7)	954	3.4 (5.9)	14.8	-	Slight
1920 (1050)	Dark salmon (10R-5/7)	1175	4.0 (6.9)	12.9	-	Slight
2000 (1095)	Fair red (10R-5/5)	1548	5.6 (8.5)	10.1	-	Some
2060 (1125)	Good red (10R-5/4)	2200	6.7 (10.2)	7 7	-	Slight
2090 (1145)	Good red (10R-4/5)	2327	7.7 (10.1)	4.6	-	Some
2160 (1180)	Deep red (10R-4/3)	2664	8.1 (10.2)	4.8	-	Some*

*: Beginnings of a glassy structure on broken ends.

Remarks / Other Tests Firing Range = Cone 02 to 5 (commercial kiln = Cone 03 to 3). This shale is suitable for making building brick and possibly structural tile, but it is not possible to tell without prospecting whether or not this sample is representative of any sizable deposit (Smith, 1931, p. 139).

Preliminary Bloating (Quick Firing) Tests: Not determined.

**Note: Munsell Color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	63.72
TiO_2	0.55
Al_2O_3	22.45
Fe_2O_3 (total)	7.01
FeO	-
MnO	-
MgO	0.00
CaO	0.00
Na_2O	0.67
K_2O	0.97
P_2O_5	0.00
S (total)	0.00
C (org.)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	5.61
Total	100.98*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 138.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard"wet".

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. LaFayette (Estelle) (SW. 1/4). Lat. _____, Long. _____.

Field No. - , Collected by R. W.Smith. Date c. 1930.

Sample Method Grab samples. Weathering/alteration Weathered.

Structural Attitude Beds strike N.20°E., and dip about 70°W.

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Samples of soft to semi-hard, greenish-drab colored shale (probably above the iron ore seam) taken from several places along the "Bronco to Campbell Gulf road" on Shinbone Ridge, 1/8 mile W. of the Bronco Station on the Tenn., Ala. & Ga. railroad. At this place the road makes a small angle to the strike of the beds; therefore, no more than 10 stratigraphic feet of shale are exposed for sampling. Property owned by Misses C. and J. McWhorter (Smith, 1931, p. 138 to 139).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale, semi-hard (Red Mountain). Compilation Map Location No. Wkr.31S-26a

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #26.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 18.9 % Working Properties Plasticity - poor (somewhat better on aging 5 days), slaking - slow; and molding - fair (clay column edges tend to tear slightly).

Color Brown. Drying Shrinkage 2.6 % Dry Strength (MOR) 87.5 psi. (green)

Remarks Drying Behavior: Test bars all somewhat warped.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color* (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Dark salmon (1YR-5/7)	1150	3.6 (6.2)	11.4	-	Some
1920 (1050)	Dark salmon (10R-5/6)	1235	3.3 (5.8)	9.9	-	Some to considerable
2000 (1095)	Fair red (10R-5/5)	1764	4.9 (7.5)	8.2	-	Some
2060 (1125)	Good red (10R-4/5)	2134	6.4 (8.7)	6.4	-	Slight
2090 (1145)	Brownish-red(10R-4/5)	2006	4.6 (7.2)	5.7	-	Considerable*
2160 (1180)	Deep brownish red (10R-4/3)	2365	5.8 (8.3)	3.9	-	Considerable**

*: Slightly pimply surface.
**: Pimply surface and somewhat glassy fracture.

Remarks / Other Tests Firing Range = Cone 03 to 2 (best at Cone 01 to 2). All test bars show slight traces of a bluish-white scum, but probably not enough to effect their use in making heavy clay products (Smith, 1931, p. 144). This shale should be satisfactory for making building brick and structural tile (if properly handled). The worst aspects are the slow slaking, poor green strength and structure of the test bars. This can probably be largely eliminated by grinding, long pugging, and using hot water with electrolytes (Smith, 1931, p. 145).

Preliminary Bloating (Quick Firing) Tests: Not determined.

*Note: Munsell Color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Brittle, fairly easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	61.29
TiO_2	0.73
Al_2O_3	23.36
Fe_2O_3 (total)	7.16
FeO	-
MnO	-
MgO	0.42
CaO	0.00
Na_2O	1.06
K_2O	0.81
P_2O_5	trace
S (total)	trace
C (org)	-
CO_2	
H_2O^-	*
H_2O^+	-
Ignition loss	5.26
Total	100.09*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- free basis by Smith, 1931, p. 143.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot 252, 254-256 and 285, Sec. 4, Dist. 8.

7 1/2' topo quad. LaFayette (Estelle) (NW. top). Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method 2 groove samples of 5 and 8 ft. Weathering/alteration Some weathering.

Structural Attitude Beds strike about N.40°E. and dip "gently" (5 to 15°) SE.

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Soft to semi-hard greenish-drab colored shale (harder and more compact near the top) with occasional thin streaks of brown sandstone sampled as 5 and 8 ft. grooves from the W. and E. sides of the middle trestle respectively, of the Tenn., Ala., & Ga. railroad cuts on the property of the Southern States Coal and Iron Co. (This corresponds to unit 17, 45+ feet thick in Smith's measured section. The sampled intervals represent only the base and top of this unit respectively, since the middle is poorly exposed.) The section is E. of Estelle station, N. of Dug Gap and Ga. Hwy. 193 (Smith, 1931, p. 141-145).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale, hard (Red Mtn. Formation). Compilation Map Location No. Wkr.31S-26b

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #26b.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 18.0 % Working Properties Plasticity - poor at first, but fair on aging 2 days; slaking - rather slow; molding - fair, column edges tear slightly.

Color Brownish-drab. Drying Shrinkage 2.8 % Dry Strength (MOR) 103.5 psi. (green).

Remarks Drying Behavior: Test bars all slightly warped.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color* (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Dark salmon (1YR-6/6)	1505	3.1 (5.9)	10.6	-	Slight
1920 (1050)	Dark salmon (10R-5/5)	1754	3.5 (6.4)	8.8	-	Little or none
2000 (1095)	Good red (10R-5/5)	2169	4.0 (6.7)	6.5	-	Slight black core
2060 (1125)	Deep red (10R-4/5)	2622	6.6 (9.3)	4.6	-	Some
2090 (1145)	Brownish-red (10R-3/6)	2012	2.3 (5.1)	3.2	-	Bad**
2160 (1180)	Deep brownish red (10R-3/4)	2202	2.3 (4.8)	2.2	-	Bad**

**: Vitreous and pimply surface, glassy fracture.

Remarks / Other Tests Firing Range = Cone 04 to 2 (commercial kiln = Cone 04 to 1). If properly handled, this shale should be suitable for making building brick and structural tile. The poor working properties and low green strength could probably be improved by fine grinding, long pugging and the use of hot tempering water with certain electrolytes (Smith, 1931, p. 145).

Preliminary Bloating (Quick Firing) Tests: Not determined.

*Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931)

Crushing Characteristics (unfired material) Brittle, fairly easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	63.69
TiO_2	0.73
Al_2O_3	18.40
Fe_2O_3 (total)	8.08
FeO	-
MnO	-
MgO	0.60
CaO	0.00
Na_2O	1.31
K_2O	1.64
P_2O_5	0.12
S (total)	trace
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	5.42
Total	99.99*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 144.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot 252, 254-256 and 285, Sec. 4, Dist. 8.

7 1/2' topo quad. LaFayette (Estelle) (NW. edge). Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method Partial groove of 14 ft. bed. Weathering/alteration None.

Structural Attitude Beds strike about N.40°E. and dip "gently" (5 to 15°)SE.

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Sample from a 14 ft. bed of hard, greenish-drab shale E. of the middle trestle of the Tenn., Ala., & Ga. RR. from railroad cuts on the property of the Southern States Coal & Iron Co. (This corresponds to unit 19, 14 ft. thick in Smith's measured section.) Shale has small hackly fracture, almost flaky, with a few 1/2 inch beds of brown sandstone, and lies E. and stratigraphically above the other sample tested (Wkr.31S-26a). The section is E. of Estelle and N. of Dug Gap and Ga. Hwy. 193 (Smith, 1931, p. 141-145).

Compiled by B. J. O'Connor Date 10-25-81

CERAMIC TESTS AND ANALYSES

Material Shale, hard (Red Mountain). Compilation Map Location No. Wkr.31S-27

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #27.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity - % Working Properties Plasticity - very poor (even on aging 1 week): Slaking - very slow. Molding Behavior - very poor (unable to form roll-press test bars).

Color Brownish-drab. Drying Shrinkage - % Dry Strength -

Remarks

Slow Firing Tests: Not determined due to very poor working properties.

Temp. °F (°C)	Color (Munsell)	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:

Remarks / Other Tests Sample was discarded without further firing tests (Smith, 1931, p. 149).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) A little difficult to grind. (Shale is tough rather than brittle.)

Particle Size -16 mesh. Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	71.50
TiO_2	0.90
Al_2O_3	17.07
Fe_2O_3 (total)	5.68
FeO	-
MnO	-
MgO	trace
CaO	0.00
Na_2O	0.47
K_2O	1.00
P_2O_5	0.08
SO_3 (total)	0.96
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	2.35
Total	100.01*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 149.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot 211, Sec. 4, Dist. 8.

7 1/2' topo quad. Kensington (SE. 1/4). Lat. _____, Long. _____.

Field No. _____, Collected by R. W.Smith. Date c. 1930.

Sample Method 5 ft. groove. Weathering/alteration None apparent.

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Groove sample of hard, gray to drab colored shale with a hackley fracture. (A few layers contain traces of calcite?) Samples from a 10 ft. outcrop at a bluff above the stream in a small hollow on the N. side of the road (Ga. Hwy. 136 [formerly Hwy. 143]) in Cattlett Gap. 3 miles W. of Warren Station on the Central of Georgia railroad, on the Glenn and Warthen properties (Smith, 1931, p. 148 and 149).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale, hard to semi-hard (Red Mtn. Formation). Compilation Map Location No. Wkr.31S-28

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #28.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 18.0 % Working Properties Plasticity - very poor and grainy, but fair on aging 2 days, slaking - very slow; molding behavior - poor, column edges tend to tear and crack.

Color Brownish-gray. Drying Shrinkage 3.1 % Dry Strength (MOR) 179.5 psi. (green).

Slow Firing Tests:

Approx. Temp. °F (°C)	Color* (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Salmon (2YR-6/8)	985	2.5 (6.1)	12.3	-	Slight
1920 (1050)	Dark salmon (1YR-6/7)	1495	3.9 (7.1)	9.8	-	Slight
2000 (1095)	Light red (2YR-6/7)	1990	4.6 (7.3)	7.6	-	Little or none
2060 (1125)	Good red (10R-5/4)	2317	5.8 (8.5)	5.7	-	Slight
2090 (1145)	Good red (10R-4/4)	2522	5.5 (8.0)	4.9	-	Some
2160 (1180)	Brownish-red (10R-3/4)	3348	6.1 (8.6)	2.3	-	Some to considerable (vitrified, pimply surface).

Remarks / Other Tests Firing Range = Cone 02 to 4 (commercial kiln = Cone 02 to 3). Should be suitable, if handled properly, for making building brick and structural tile. The slow slaking, poor plasticity, and low green strength could probably be overcome by fine grinding, long pugging, hot tempering water and certain electrolytes in the tempering water (Smith, 1931, p. 152).

Preliminary Bloating (Quick Firing) Tests: Not determined.

*Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931)

Crushing Characteristics (unfired material) Brittle, fairly easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	65.89
TiO_2	1.09
Al_2O_3	21.63
Fe_2O_3 (total)	5.76
FeO	-
MnO	-
MgO	0.06
CaO	0.00
Na_2O	0.80
K_2O	1.11
P_2O_5	trace
S (total)	trace
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	3.84
Total	100.18*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 151.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 157 and 158, Sec. 4, Dist. 11.

7 1/2' topo quad. Durham (SE. 1/4). Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method Grab samples at 2 foot intervals. Weathering/alteration -

Structural Attitude Beds strike N.20°E., and dip 35°W.

Stratigraphic Assignment Red Mountain Formation (Silurian) shales, 55+ feet below the Chattanooga Shale.

Sample Description & Comments 153 feet (stratigraphic) of hard to semi-hard, olive-green to greenish-drab shale, variably fissile, with several layers of sandstone 1 to 2 inches thick. Taken from road cuts ("Terrapin Trail") through the ridge 1 mile NW. of Cassandra (on the Shaw property) 5/8 mile W. of the Tenn., Ala., Ga. RR. The iron ore horizon is probably near the base of unit (1) (which is alternating layers of sandstone and shale at least 120 feet thick) and underlying the shale tested here (Smith, 1931, p. 150).

Compiled by B. J. O'Connor Date 10-26-81

CERAMIC TESTS AND ANALYSES

Material Shale, hard (Red Mountain). Compilation Map Location No. Wkr.31S-29

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #29.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 16.5 % Working Properties Plasticity - very poor and grainy, but fair after aging 4 days; slaking - very slow; molding - fair (column tends to crack and tear edges slightly).

Color Gray. Drying Shrinkage 2.5 % Dry Strength (MOR) 116.8 psi. (green).

Remarks Drying Behavior: Test bars somewhat warped.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color++ (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Light salmon (3YR-6/7)	799	1.9 (4.3)	11.9	-	Some**
1920 (1050)	Dark salmon (1YR-6/6)	1283	2.4 (4.8)	10.6	-	Some**
2000 (1095)	Light red (10R-5/5)	*	2.8 (5.3)	10.1	-	Some**
2060 (1125)	Good red (10R-4/5)	1708	4.6 (6.8)	7.3	-	Some**
2090 (1134)	Deep red (10R-4/4)	2100	2.6 (5.0)	4.0	-	Some+
2160 (1180)	Brownish-Red(1YR-4/4)	2515	4.1 (6.5)	5.2	-	Considerable+

*: Modulus of Rupture not determined due to breakage of all test bars in handling.
**: Test bars show slight traces of scum, but not enough to give serious trouble in making heavy clay products.
+: Test bars have pimply surface and broken ends show traces of glassy structure.

Remarks / Other Tests Firing Range = Cone 02 to 2 (commercial kiln = Cone 03 to 1). This shale is suitable for making building brick and possibly structural tile although the firing range is only 3 cones. The poor working properties could probably be overcome by fine grinding, long pugging and/or the use of hot tempering water with or without certain electrolytes (Smith, 1931, p. 154-155).

Preliminary Bloating (Quick Firing) Tests: Not determined.

++Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931)

Crushing Characteristics (unfired material) Brittle, fairly easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	60.84
TiO_2	1.09
Al_2O_3	25.62
Fe_2O_3 (total)	4.27
FeO	-
MnO	-
MgO	0.55
CaO	0.00
Na_2O	0.97
K_2O	1.83
P_2O_5	trace
S (total)	0.00
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	4.84
Total	100.01

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 154.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot 271, Sec. 4, Dist. 10.

7 1/2' topo quad. Fort Oglethorpe (SW. Cor.). Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method Grab sample. Weathering/alteration Weathered.

Structural Attitude Shale layers "dipping 15° to 20° to the east" (on the west limb of a shallow syncline).

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Taken from 30 ft. of hard, olive-green shale, with 1 or 2 thin sandstone layers, exposed in a bluff in a hollow near the W. edge of the Mallicoat property and just E. of the Southern States Coal & Iron Company property. The Mallicoat property lies west of the Chattanooga Valley Road, 3/4 mi. north of the High Point Station of the Tenn., Ala., & Ga. Railroad (Smith, 1931, p. 153 to 155).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale and clay (Red Mtn. Formation). Compilation Map Location No. Wkr.31S-30

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #30.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 33.9 % Working Properties Plasticity - fair, a little "short"; slaking - rapid; molding behavior - good.

Color Light brown. Drying Shrinkage 7.9 % Dry Strength (MOR) 168.7 psi. (green).

Remarks Drying Behavior: Good, little or no warpage.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color** (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Light red (1YR-6/7)	2072	7.0 (14.3)	13.9	-	Little or none
1920 (1050)	Fair red (10R-5/5)	2731	9.5 (16.6)	8.7	-	Slight
2000 (1095)	Good red (10R-4/5)	2259	9.1 (16.5)	7.0	-	Some
2060 (1125)	Good red (10R-4/4)	3713	13.7 (20.6)	2.6	-	Slight
2090 (1145)	Dark red (10R-3/6)	2615	12.8 (19.6)	2.1	-	Some*
2160 (1180)	Dark red (10R-3/5)	3975	13.7 (20.2)	0.9	-	Some*

*: Vitreous appearance, fractures show glassy structure.

Remarks / Other Tests Firing Range = Cone 04 to 5 (commercial kiln = Cone 04 to 3). This material shows too much shrinkage to be used by itself in making heavy clay products; however, if mixed with a slow-slaking shale (like those of the Red Mtn. Formation described earlier) this mixture would probably process better than either the clay or the shale by itself (Smith, 1931, p. 157).

Preliminary Bloating (Quick Firing) Tests: Not determined.

**Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis Oxide	Weight %
SiO_2	56.75
TiO_2	0.73
Al_2O_3	24.54
Fe_2O_3 (total)	8.65
FeO	-
MnO	-
MgO	trace
CaO	0.00
Na_2O	1.24
K_2O	1.69
P_2O_5	0.10
S (total)	0.00
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	6.25
Total	99.95*

Mineralogy: Not determined. Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 156.)

Analyst E. Everhart, Ga. Survey.,

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot 217 and 252, Sec. 4, Dist. 9.

7 1/2' topo quad. Fort Oglethorpe (SW. 1/4). Lat. _____, Long. _____.

Field No. _____, Collected by Mrs. W. W. Scott. Date c. 1930.

Sample Method Prospect pits 3 ft. deep. Weathering/alteration Weathered shale and residual clay.

Structural Attitude Nearby Shale strikes N.20°E., dips about 30°W.

Stratigraphic Assignment Red Mountain Formation (Silurian) weathered shale (below Fe ore and Recent (?) clay residuum derived from Red Mountain shale.

Sample Description & Comments Soft brown sandy shale and residual clay from two prospect pits (3 ft. deep) on the Scott property west of the Tenn., Ala., & Ga. Railroad crossing with the Chattanooga Valley Rd., 1 1/2 mi. N. of the High Point station and 1 1/2 mi. S. of Cenchat (Smith,. 1931, p. 155 to 157). (Several rail cars of residual clay were mined from a pit c. 400 yards W. of the RR. and shipped to the W. S. Dickey Clay Mfg. Co. plant near Flintstone to the N. to make sewer pipe several years prior to 1930.)

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale, hard (Red Mountain). Compilation Map Location No. Wkr.31S-31

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #31.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 18.4 % Working Properties Plasticity - poor and grainy, but fair after aging for 2 days; slaking - slow; molding behavior - fair (column tends to tear at edges slightly).

Color Grayish-drab. Drying Shrinkage 3.3 % Dry Strength (MOR) 114.5 psi. (green).

Remarks Drying Behavior: Good with little or no warpage.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color* (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Fair red (1YR-5/7)	1165	4.2 (7.1)	10.5	-	Very slight
1920 (1050)	Fair red (10R-5/7)	1482	4.6 (7.6)	9.2	-	Slight
2000 (1095)	Good red (10R-5/5)	1573	3.5 (6.8)	8.3	-	Some
2060 (1125)	Good red (10R-4/5)	2086	7.1 (10.1)	5.4	-	Slight
2090 (1145)	Good red (10R-4/5)	2165	4.9 (8.4)	5.0	-	Some
2160 (1180)	Dark red (10R-3/5)	2717	6.2 (9.2)	2.6	-	Considerable (fractures look

Remarks / Other Tests Firing Range = Cone 04 to 5 (commercial kiln = Cone 04 to 3). This shale is suitable for making building brick, structural and roofing tile, and possibly sewer pipe. The slow slaking and low green (dry) strength probably could be overcome by fine grinding, long pugging, using hot tempering water, and/or with certain electrolytes in the water (Smith, 1931, p. 160). Adding a small amount of plastic clay such as the residual clay described under Wkr.31S-30) would also make the shale easier to process.

Preliminary Bloating (Quick Firing) Tests: Not determined.

*Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Brittle, fairly easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	59.96
TiO_2	0.85
Al_2O_3	23.80
Fe_2O_3 (total)	7.90
FeO	-
MnO	-
MgO	trace
CaO	0.00
Na_2O	0.69
K_2O	1.81
P_2O_5	0.15
S (total)	trace
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	5.12
Total	100.28*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 158.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 199 and 234, 216, Sec. 3, 3, Dist. 10, and 9

7 1/2' topo quad. Fort Oglethorpe (SW. 1/4). Lat _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method 5 ft. grooves (2). Weathering/alteration Some weathering?

Structural Attitude Strike about N.5°E. and dip 15° to 20°W.

Stratigraphic Assignment Red Mountain Formation (Silurian) just above the iron ore horizon.

Sample Description & Comments Hard, fissile, olive-green shale (about 20-50 ft. thick) collected as 5 ft. groove samples from 2 nearby abondoned iron mine pits which had partly slumped in since the ore was mined (c. 1900 - 1904). Located on the Long property 1/2 to 1 mi. SW of Cenchat (the crossing of the Tenn., Ala., & Ga. RR and the Durham branch, dismantled, of the Central of Ga. RR lines) W. of the TAG railroad and the Chattanooga Valley Rd. and adjacent to the Durham branch, east of McCallie Lake (Smith, 1931, p. 157-161).

Compiled by B. J. O'Connor Date 10-29-81

CERAMIC TESTS AND ANALYSES

Material Shale, hard (Red Mtn. Formation). Compilation Map Location No. Wkr.31S-32

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #32.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 19.6 % Working Properties Plasticity - poor and grainy at first, fair after aging 2 days; slaking - slow; molding behavior - good.

Color Grayish-drab. Drying Shrinkage 2.6 % Dry Strength (MOR) 111.9 psi. (green).

Remarks Drying Behavior: Test bars all slightly warped.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color* (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Dark salmon (2YR-6/8)	1157	2.9 (5.3)	11.8	-	Slight
1920 (1050)	Fair red (10R-8/7)	1205	2.9 (5.7)	11.7	-	Slight
2000 (1095)	Good red (10R-5/6)	1522	3.6 (6.0)	10.6	-	Some
2060 (1125)	Good red (10R-5/5)	1912	5.2 (7.5)	7.7	-	Some
2090 (1145)	Good red (10R-4/4)	2413	4.6 (7.2)	5.1	-	Considerable
2160 (1180)	Dark red (10R-3/4)	3147	7.1 (9.4)	3.1	-	Considerable

Remarks / Other Tests Firing Range = Cone 04 to 5 (commercial kiln = Cone 04 to 3). This shale is suitable for making building brick, structural and roofing tile, and possibly sewer pipe. The tendency for slow slaking and low green strength could probably be overcome by fine grinding, long pugging, using hot tempering water (with or without electrolytes; Smith, 1931, p. 163).

Preliminary Bloating (Quick Firing) Tests: Not determined.

*Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Fairly easy grinding (slightly tough rather than brittle).

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	62.80
TiO_2	1.01
Al_2O_3	22.22
Fe_2O_3 (total)	7.00
FeO	-
MnO	-
MgO	trace
CaO	0.00
Na_2O	0.51
K_2O	1.72
P_2O_5	trace
S (total)	0.00
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	4.85
Total	100.11*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 162.)

Analyst E. Everhart, Ga. Survey.

Date 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 199 and 234 (+ parts of 200, 233, 235, and 236.) Sec. 4, Dist. 10.

7 1/2' topo quad. Ft. Oglethorpe (SW. side). Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method Several grab samples. Weathering/alteration More or less weathered.

Structural Attitude Beds strike N.20°E., dip c. 30°W. (with a few minor variations).

Stratigraphic Assignment Red Mountain Formation (Silurian) about 200 ft. thick above and below the iron ore horizon.

Sample Description & Comments Hard, fissile, olive-green shale with a few thin sandstone partings (and some local, heavy sandstone beds in the middle of the exposure). Samples taken from the McCallie property along the old Durham branch now dismantled) of the Central of Georgia RR. where it makes a horseshoe bend around the S. side of McCallie Lake (formerly Cenchat Lake) 1 mi. W. of Cenchat and the TAG RR., adjoining the W. side of the Long property (Wkr.31S-31 above). Taken from about 1,000 ft. cuts along the RR E. of the lake and from outcrops W. and SW. of the lake within the horseshoe bend (Smith, 1931, p. 161 - 163).

Compiled by B. J. O'Connor Date 1-29-81

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mtn.) and residual clay. Compilation Map Location No. Wkr.31S-33

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #33.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 28.0 % Working Properties Plasticity - good; slaking - fairly rapid; molding behavior - good.

Color Light brown. Drying Shrinkage 3.7 % Dry Strength (MOR) 106.0 psi. (green).

Remarks Drying Behavior: slight warpage.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color** (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Deep salmon (2YR-5/5)	1375	5.3 (8.7)	14.2	-	Slight
1920 (1050)	Medium red (10R-5/4)	1528	5.7 (9.0)	14.1	-	Slight
2000 (1095)	Medium red (1YR-5/5)	1886	6.3 (9.5)	11.8	-	Some
2060 (1125)	Good red (10R-4/4)	2682	10.7 (14.0)	5.5	-	Some
2090 (1145)	Deep red (10R-3/5)	2896	12.0 (15.5)	3.5	-	Considerable
2160 (1180)	Deep brownish red (10R-3/4)	3539	12.3 (15.8)	1.5	-	Considerable*

*: Bars kiln-marked with vitreous looking surface and glassy fractures.

Remarks / Other Tests Firing Range = Cone 02 to 4 (commercial kiln = Cone 02 to 3). This material satisfactory for making building brick, tile (structural, roofing, and quarry) and possibly sewer pipe. The slightly high shrinkage could probably be reduced if a more sandy clay or slower-slaking shale were added to the material tested (Smith, 1931, p. 167).

Preliminary Bloating (Quick Firing) Tests: Not determined.

**Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	57.71
TiO_2	0.73
Al_2O_3	23.64
Fe_2O_3 (total)	8.00
FeO	-
MnO	-
MgO	trace
CaO	0.00
Na_2O	1.32
K_2O	1.80
P_2O_5	0.44
S (total)	0.00
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	6.46
Total	100.10

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 166.)

Analyst E. Everhart, Ga. Survey.

Date c. 1931.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot 80, Sec. 4, Dist. 9.

7 1/2' topo quad. Fort Oglethorpe (NE. 1/4). Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c, 1930.

Sample Method Grab samples. Weathering/alteration More or less weathered. shale and clay.

Structural Attitude Beds strike NNE., dip 23° to 75°E.; cut by 2 thrust faults striking N.20°E. and dipping 20-25° and 75°E.

Stratigraphic Assignment Red Mountain Formation (Silurian) overthrust by the Knox Group (Cambrian-Ordovician) chert and cherty clay.

Sample Description & Comments Grab samples of sandy, brown, weathered shale with thin interbedded layers of sandy, brown clay and some brown, sandy clay with thin shale partings from 2 cuts on the Central of Ga. RR up to several hundred feet N. of the RR bridge over the road (McFarland Gap Road) in McFarland Gap through Missionary Ridge. Located on the McFarland property 2 miles S. of Rossville just E. of McFarland Ave. and 3/4 mile N. of Mission Ridge RR station. Sampled interval represents about 150 feet (stratigraphic) of Red Mountain Formation (Smith, 1931, p. 165-167). Also see Wkr. 09V-5.

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale, semi-hard to hard (Red Mtn. Formation). Compilation Map Location No. Wkr.31S-34

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #34.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 21.0 % Working Properties Plasticity - poor and grainy (fair on aging 3 days); slaking - a little slow; molding behavior - fair (clay tends to tear at column edges).

Color Brownish-gray. Drying Shrinkage 3.3 Dry Strength (MOR) 105.0 psi. green).

Remarks Drying Behavior: Test bars somewhat warped.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color** (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Dark salmon (2YR-5/5)	1052	3.2 (6.2)	13.1	-	Some
1920 (1050)	Fair red (10R-4/5)	1542	3.9 (6.9)	10.7	-	Some
2000 (1095)	Good red (1YR-4/3)	2250	4.8 (7.8)	7.0	-	Some
2060 (1125)	Deep red (10R-4/3)	2606	7.7 (10.7)	6.0	-	Some
2090 (1145)	Brownish-red (10R-4/4)	2477	4.3 (7.6)	5.3	-	Considerable*
2160 (1180)	Deep brownish red (10R-3/3)	2694	5.8 (8.7)	2.7	-	Considerable*

*: Vitreous appearing surface and somewhat glassy fractures.

Remarks / Other Tests Firing Range = Cone 04 to 2 (commercial kiln = Cone 04 to 1). Suitable for making building brick and structural tile and possibly for roofing tile, quarry tile and sewer pipe. The poor working properties and low green strength probably could be improved by fine grinding, long pugging, or hot tempering water (or with electrolytes; Smith, 1931, p. 169). Shale used by the Mission Ridge Brick Company for making face (building) brick, although plant was not operated since c. 1925 (Smith, 1931, p. 167 and 169).

Preliminary Bloating (Quick Firing) Tests: Not determined.

**Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Brittle, fairly easy grinding.

Particle Size -16 mesh. Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	61.83
TiO_2	0.92
Al_2O_3	16.81
Fe_2O_3	5.67
FeO	1.43
MnO	-
MgO	0.92
CaO	0.00
Na_2O	2.73
K_2O	2.78
P_2O_5	trace
$S O_3$	0.85
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	
Ignition loss	5.14
Total	99.08*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 168.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 101, 102, and 115. Sec. 4, Dist. 9.

7 1/2' topo quad. Fort Oglethorpe (cntr.), Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method Grab samples. Weathering/alteration Somewhat weathered.

Structural Attitude Shale strikes N.22°E. and dips c. 25°E.

Stratigraphic Assignment Red Mountain Formation (Silurian) above and below the iron ore horizon.

Sample Description & Comments Semi-hard to hard, greenish-drab shale which breaks into smooth, flat or hackly-fractured pieces (some weathers flaky) and interbedded with fairly abundant, thin, blocky-weathering, hard sandstone layers. The latter are especially abundant near the ridge-top where the interbedded clay is sandy, soft and "short". Samples from several levels in the shale pit which exposes 75 to 80 ft. (vertical) of shale about 150 ft. below the top of Missionary Ridge (W. slope). Taken from the Mission Ridge Brick Co. property (old Miller-Burns Fire Brick Co.), about 1/4 mi. W. of face brick plant and the Central of Ga. RR., Mission Ridge station, about 3 mi. S. of Rossville (Smith, 1931, p. 167-169).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale, soft to semi-hard (Red Mountain). Compilation Map Location No. Wkr.31S-35

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Tech., #35.

Date Reported 1931. Ceramist R. W. Smith, Ga. Survey.

Water of Plasticity 23.9 % Working Properties Plasticity - poor and "short" fair on aging overnight); slaking - a little slow; molding behavior - fair (clay tends to tear on column edges slightly).

Color Brown. Drying Shrinkage 2.7 % Dry Strength (MOR) 102.6 psi. (green).

Remarks Drying Behavior: Test bars all slightly warped.

Slow Firing Tests:

Approx. Temp. °F (°C)	Color* (Munsell)	Hardness (MOR, psi.)	Linear Shrinkage, % dry (plastic)	Absorption %	Appr. Por. %	Other data: Warpage
1840 (1005)	Dark salmon (2YR-6/8)	889	3.3 (6.2)	15.9	-	Slight
1920 (1050)	Fair red (1YR-5/7)	1382	4.8 (7.5)	12.5	-	Slight
2000 (1095)	Good red (10R-5/5)	1985	6.1 (8.6)	10.8	-	Some
2060 (1125)	Good red (10R-4/5)	2533	8.4 (10.7)	6.7	-	Some
2090 (1145)	Good red (10R-4/4)	2611	8.4 (10.8)	5.3	-	Considerable
2160 (1180)	Dark red (10R-4/3)	2785	9.1 (11.5)	4.7	-	Considerable

Remarks / Other Tests Firing Range = Cone 02 to 5 (commercial kiln = Cone 02 to 4). Shale is suitable for making building brick, structural tile and possibly roofing tile and sewer pipe. The slow slaking could probably be overcome by fine grinding, long pugging, hot water or electrolytes in the water (Smith, 1931, p. 172).

Preliminary Bloating (Quick Firing) Tests: Not determined.

*Note: Munsell color notation "10R" corresponds to the original notation "R-YR" reported in Smith (1931).

Crushing Characteristics (unfired material) Easy grinding.

Particle Size -16 mesh. Retention Time Approx. 17 hours.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	59.98
TiO_2	0.91
Al_2O_3	23.25
Fe_2O_3 (total)	6.56
FeO	-
MnO	-
MgO	0.12
CaO	0.00
Na_2O	1.63
K_2O	1.98
P_2O_5	0.07
S (total)	0.00
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	5.34
Total	99.84*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 170.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 114, 115 138 and 139. Sec. 4, Dist. 9.

7 1/2' topo quad. Fort Oglethorpe (cntr.). Lat. _____, Long. _____.

Field No. _____, Collected by R. W. Smith. Date c. 1930.

Sample Method Several Grab samples. Weathering/alteration More or less weathered.

Structural Attitude Strike about N.25°E., dip about 25°E.

Stratigraphic Assignment Red Mountain Formation (Silurian) shale.

Sample Description & Comments Taken from the Brown property, 1/4 to 1 1/4 miles south of Mission Ridge station (Central of Ga. RR.) on the W. side of Missionary Ridge and adjacent to the Mission Ridge Brick Co. property on the north. Samples were taken at intervals along a private road (west from the house at the ridge top) from 100 to 230 ft. below the crest. They range from soft, brownish-drab to semi-hard, greenish-drab shale locally containing a few thin partings of sandstone. A few seams of soft, locally argillaceous, red iron ore up to a few feet thick occur near the top of the section (Smith, 1931, p. 169-172).

Compiled by B. J. O'Connor Date 06-13-88

CERAMIC TESTS AND ANALYSES

Material Clay, bentonite (Chickamauga). Compilation Map Location No. Wkr.31S-A

County Walker. Sample Number -

Raw Properties: Lab & No. -

Date Reported 1931. Ceramist -

Water of Plasticity - % Working Properties Soft, plastic.

Color Olive-green to greenish-cream. Drying Shrinkage - % Dry Strength -

Slow Firing Tests: Not determined.

Temp. °F (°C)	Color (Munsell)	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:

Remarks / Other Tests Measured section and chemical analysis only reported by Smith (1931, p. 337-338).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	61.52
TiO_2	0.74
Al_2O_3	21.80
Fe_2O_3 (total)	7.04
FeO	-
MnO	-
MgO	0.27
CaO	0.14
Na_2O	0.82
K_2O	1.94
P_2O_5	trace
S (total)	0.00
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	5.80
Total	100.07*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 338).

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 251 and 252. Sec. 4, Dist. 9.

7 1/2' topo quad. Fort Oglethorpe (SW. 1/4). Lat. _____, Long. _____.

Field No. -, Collected by R. W. Smith. Date c. 1930.

Sample Method Grab samples. Weathering/alteration Some weathering.

Structural Attitude Beds strike about N.10°E., dip about 35°W.

Stratigraphic Assignment 23 ft. of clay and limestone from Chickamauga limestone (Ordovician).

Sample Description & Comments Sample combined from units 1 and 3 (base and middle) of measured section in a gulley on the Parrish property just W. of the Chattanooga Valley Rd. (and the TAG RR.) and 1 1/2 miles N. of the High Point station. Adjacent to the S. side of the Scott property (see Wkr.31S-30). 1) = 10 ft. greenish-cream, soft, waxy clay resembling fuller's earth. 3) = 7 ft. of soft, waxy olive-green colored clay. Other portions of section contain limestone, sandy clay, golden mica flakes or are reddish-brown colored (Smith, 1931, p. 337-338).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Clay, bentonite (Chickamauga). Compilation Map Location No. Wkr.31S-B

County Walker. Sample Number -

Raw Properties: Lab & No. -

Date Reported 1931. Ceramist -

Water of Plasticity ____% Working Properties Not determined.

Color Greenish-drab. Drying Shrinkage - % Dry Strength -

Slow Firing Tests: Not determined.

Temp. °F (°C)	Color (Munsell)	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:

Remarks / Other Tests Description and chemical analysis only reported by Smith (1931, p. 338).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	70.57
TiO_2	0.73
Al_2O_3	14.84
Fe_2O_3 (total)	4.98
FeO	-
MnO	-
MgO	0.26
CaO	0.16
Na_2O	0.91
K_2O	1.68
P_2O_5	1.04
S (total)	0.00
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	4.70
Total	99.87*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 338.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lot 94, Sec. 4, Dist. 11.

7 1/2' topo quad. Durham (SE. 1/4). Lat. , Long. .

Field No. -, Collected by R. W. Smith. Date c. 1930.

Sample Method Grab sample. Weathering/alteration Somewhat weathered?

Structural Attitude -

Stratigraphic Assignment In Chickamauga limestone (Ordovician).

Sample Description & Comments Taken from an outcrop on the Coopers Gap road (now Ga. Hwy. 136 [formerly Hwy. 143]) on the Strickland property, 1/2 mile W. of the Cooper Heights station (Tenn., Ala., and Ga. RR.). Analyzed clay is from a 2-3 ft. bed of soft, greenish-drab, "cheesy" clay and is overlain by 18 in. to 2 ft. of speckled white or light green, mealy clay full of golden mica flakes. This latter clay (not sampled) is similar to that near the top of the measured section (bed 6) on the Parrish property (see Wkr.31S-A) according to Smith (1931, p. 338).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Clay, bentonite (Chickamauga). Compilation Map Location No. Wkr.31S-C

County Walker. Sample Number -

Raw Properties: Lab & No. -

Date Reported 1931. Ceramist -

Water of Plasticity - % Working Properties Soft, mealy.

Color Greenish-drab. Drying Shrinkage - % Dry Strength -

Slow Firing Tests: Not determined.

Temp. °F (°C)	Color (Munsell)	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:

Remarks / Other Tests Description and chemical analysis only reported by Smith (1931, p. 338 and 339).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	54.69
TiO_2	0.74
Al_2O_3	27.93
Fe_2O_3 (total)	4.97
FeO	-
MnO	-
MgO	0.04
CaO	0.37
Na_2O	3.09
K_2O	1.96
P_2O_5	0.14
S (total)	trace
C (org)	-
CO_2	-
H_2O^-	*
H_2O^+	-
Ignition loss	6.06
Total	99.99*

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

(* = analysis recalculated on an H_2O^- -free basis by Smith, 1931, p. 339.)

Analyst E. Everhart, Ga. Survey.

Date c. 1930.

Method Standard "wet".

Sample Location Data:

County Walker. Land Lots 131 and 158, Sec. 4, Dist. 11.

7 1/2' topo quad. Durham (SE. 1/4). Lat. , Long. .

Field No. -, Collected by R. W. Smith. Date c. 1930.

Sample Method Grab samples. Weathering/alteration Somewhat weathered.

Structural Attitude Beds strike N.25°E., dip 35°W.

Stratigraphic Assignment In Chickamauga limestone (Ordovician).

Sample Description & Comments Composite of two samples from the Baker property: One is from road cut just W. of the Chattanooga Valley Rd. (Ga. Hwy. 193), 1/2 mi. N. of Cassandra, from 5 ft. of soft, mealy, greenish-drab clay full of mica which overlies chert and dark gray to drab limestone. The second sample is from somewhat more weathered bentonite outcrops 1/4 mi. to the north of the first (Smith, 1931, p. 338-339).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Clay. Compilation Map Location No. Wkr.41-1

County Walker. Sample Number -

Raw Properties: Lab & No. Ga. Survey.

Date Reported 5-31-41. Ceramist G. Massengale.

Water of Plasticity 32.8 % Working Properties Good plasticity; very little grit; and easily workable.

Color - Drying Shrinkage 6.2 % Dry Strength (MOR) 501 psi.

Slow Firing Tests: Not determined/unavailable.

Temp. °F (°C)	Color (Munsell)	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:

Remarks / Other Tests This clay is expected to be red-firing and should be suitable for making brick, hollow tile, tile and possibly sewer pipe (if it fires satisfactorily).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. LaFayette (Estelle) . Lat. _____, Long. _____.

Field No. - , Collected by Charlie Cook. Date c. May 1941.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment -

Sample Description & Comments Clay sample from Mr. Charlie Cook, Route 3, LaFayette, Ga. (Exact location unspecified, but probably is from Cook's property in Walker Co.)

Compiled by B. J. O'Connor Date 1-25-82

CERAMIC TESTS AND ANALYSES

Material Clay. Compilation Map Location No. Wkr.45-1

County Walker. Sample Number -

Raw Properties: Lab & No. Not available.

Date Reported June 1945. Ceramist Unknown.

Water of Plasticity - % Working Properties -

Color Light (?). Drying Shrinkage - % Dry Strength -

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
unknown* (various)	Buff* (various shades)	*	*	*	*	*

*:More specific data not available.

Remarks / Other Tests This clay said to possess the properties of both ball clay and fire clay.

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot 220, Sec. 4, Dist. 9.

7 1/2' topo quad. Fort Oglethorpe (SW. 1/4). Lat. _____, Long. _____.

Field No. -, Collected by T. A. Murray(?). Date 1945.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Recent (?) clay probably derived from the Knox Group (Cambrian-Ordovician) dolomite residuum.

Sample Description & Comments Test results of undetermined origin reported by Mr. A. G. Skates, Chattanooga, Tn. (on 6-8-45) regarding clay from Mr. T. A. Murray, Rossville, Ga. (from unpublished files of the Ga. Survey). Location probably near dismantled RR grade through Missionary Ridge about 1 mile SW. of Wallaceville as determined from the Land Lot designation.

Compiled by B. J. O'Connor Date 06-13-88

CERAMIC TESTS AND ANALYSES

Material Clay. Compilation Map Location No. Wkr. 46-1

County Walker. Sample Number -

Raw Properties: Lab & No. USBM, Norris, Tn.; No. Ga. 19.

Date Reported 6-6-46. Ceramist H. Wilson, USBM.

Water of Plasticity - % Working Properties -

Color - Drying Shrinkage - % Dry Strength -

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
2075 (1135) (Cone 2)	Reddish buff	Fairly hard	-	-	Porous	-

Remarks / Other Tests Possible use in making common red brick. (Insufficient material submitted for complete testing.)

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO			
CaO		Montmorillonite	
Na_2O		Others	
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot 299, Sec. _____, Dist. 10.

7 1/2' topo quad. Durham (N. Center). Lat. _____, Long. _____.

Field No. 2., Collected by L. T. Gillen. Date 5-9-46.

Sample Method Grab (?). Weathering/alteration Weathered (?).

Structural Attitude -

Stratigraphic Assignment Pennsylvanian (+ Recent weathering ?).

Sample Description & Comments A "residual clay" from a coal mine strip pit (L. T. Gillen, Progressive Industries). Location is about 1/4 mile NE of Durham near (probably north of) Ga. Hwy. 170.

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Clay (residual). Compilation Map Location No. Wkr.46-2

County Walker. Sample Number -

Raw Properties: Lab & No. USBM, Norris, Tn.; #Ga. 20.

Date Reported 6-6-46. Ceramist H. Wilson, USBM.

Water of Plasticity - % Working Properties Plasticity - good.

Color Light buff. Drying Shrinkage - % Dry Strength -

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
2075 (1135) (Cone 2)	Brownish buff	Hard	-	-	Somewhat porous	-

Remarks / Other Tests Promising for brick, hollow tile, etc. and merits further testing. (Insufficient material submitted for complete testing.)

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot 299, Sec. _____, Dist. 10.

7 1/2' topo quad. Durham (N. center). Lat. _____, Long. _____.

Field No. 3., Collected by L.T. Gillen. Date 5-9-46.

Sample Method Grab (?). Weathering/alteration Residual clay.

Structural Attitude -

Stratigraphic Assignment Recent (?) residual clay.

Sample Description & Comments Clay described as a residual clay ("fire clay-blue") from coal mine strip pit submitted by L. T. Gillen, Progressive Industries. Located about 1/4 mile NE. of Durham near (probably N. of) Ga. Hwy. 170.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Clay. Compilation Map Location No. Wkr.46-3

County Walker. Sample Number -

Raw Properties: Lab & No. USBM, Norris, Tn.; #Ga. 21.

Date Reported 6-6-46. Ceramist H. Wilson, USBM.

Water of Plasticity - % Working Properties Plasticity - good.

Color Grayish-buff. Drying Shrinkage - % Dry Strength -

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
2075 (1135) (Cone 2)	Light buff with spots of red.	Hard	-	-	Somewhat porous	-

Remarks / Other Tests This clay merits further testing for brick, hollow tile and low grade fire brick. (Insufficient material submitted for complete testing.)

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO			
CaO		Montmorillonite	
Na_2O		Others	
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot 63, Sec. _____, Dist. 11.

7 1/2' topo quad. Durham (N. center). Lat. _____, Long. _____.

Field No. 4, Collected by L.T. Gillen Date 5-9-46.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Clay from coal strip pit (Pennsylvanian).

Sample Description & Comments Clay sample described as a "fire clay-blue" from coal mine strip pits submitted for L. T. Gillen, Progressive Industries. Located near Price Branch, about 1/4 mile E. of Ga. Hwy. 157 and about 1/2 mile SW. of Ascalon.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Pennsylvanian). Compilation Map Location No. Wkr.46-4

County Walker. Sample Number 1.

Raw Properties: Lab & No. N.C. State College Research Lab
Asheville, North Carolina; TVA #97.

Date Reported 10-8-46. Ceramist M. K. Banks, TVA.

Water of Plasticity - % Working Properties -

Color - Drying Shrinkage - % Dry Strength -

Slow Firing Tests: Not determined.

Temp. °F (°C)	Color (Munsell)	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:

Preliminary Bloating (Quick Firing) Tests: Negative.

Temp. °F (°C)	Absorption %	Bulk Density g/cm^3 lb/ft^3	Pore Structure
2350 (1288)	-	-	-
2400 (1316)	-	-	Dirty gray color; not vitrified (too refractory).
2450 (1343)	-	-	-

Remarks Not usable, by itself, for expanded light weight aggregate manufacture.

Crushing Characteristics (unfired material) _____ -

Particle Size -8 mesh. Retention Time 30 min. (in muffle furnace).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	_____
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total	_____		

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Durham (N. edge). Lat. _____, Long. _____.

Field No. 1. , Collected by S. D. Broadhurst (TVA). Date 1946?

Sample Method Grab (?). Weathering/alteration _____

Structural Attitude Nearly horizontal.

Stratigraphic Assignment Pennsylvanian.

Sample Description & Comments Interim report on tests from N.C. Research Lab via. H. S. Rankin (TVA, 10-22-46). Sample taken from top of "A" coal seam at the V. P. Serodino Co. strip mine. The shale is hard, black, very fissile, and weathers rapidly. It ranges from 20 to 40 feet thick, is nearly flat-lying, and has little overburden. This area is near the terminus of the Durham Branch (dismantled) of Central of Ga. Railroad (east of map location No. 100, Butts and Gildersleeve, 1948, p. 105).

Compiled by B. J. O'Connor Date 2-26-82

CERAMIC TESTS AND ANALYSES

Material Shale (Conasauga). Compilation Map Location No. Wkr.46-5

County Walker. Sample Number 2.

Raw Properties: Lab & No. N.C. State College Research Lab
Asheville, North Carolina; TVA #98.

Date Reported 10-8-46. Ceramist M. K. Banks, TVA.

Water of Plasticity - % Working Properties -

Color Gray-green. Drying Shrinkage - % Dry Strength -

Slow Firing Tests: Not determined.

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:

Preliminary Bloating (Quick Firing) Tests: Negative.

Temp. °F (°C)	Absorption %	Bulk Density g/cm^3 lb/ft^3	Pore Structure
2350 (1288)	-	-	-
2400 (1316)	-	-	Vitrified only (too refractory).
2450 (1343)	-	-	-

Remarks Not usable, by itself, for expanded light weight aggregate manufacture.

Crushing Characteristics (unfired material) -

Particle Size -8 mesh. Retention Time 30 min. (in muffle furnace).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Nickajack Gap (W. side.) Lat _____, Long. _____.

Field No. 2., Collected by S. D. Broadhurst (TVA). Date 1946?

Sample Method Grab (?). Weathering/alteration _____

Structural Attitude -

Stratigraphic Assignment Conasauga Group (Cambrian).

Sample Description & Comments Interim report on tests from N.C. Research Lab via H. S. Rankin (TVA, 10-2-46). Sample of gray-green, fairly soft shale with thin beds of sandstone which occur locally. Sample was taken from a fairly fresh road cut and is typical of the Conasauga in the LaFayette area. Location is 7 miles N. of LaFayette and 1/4 mile east of U.S. Hwy. 27.

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Clay (high silica). Compilation Map Location No. Wkr.63-1

County Walker. Sample Number -

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1516

Date Reported 4-17-63 Ceramist H.P. Hamlin, USBM.

Water of Plasticity 21.0 % Working Properties Short working, fairly plastic, fine grit. pH =6.4

Color Light gray. Drying Shrinkage 5.0 % Dry Strength Low.

Remarks Drying Characteristics: Good, no drying defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs)*	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Appr. Sp. Gr.
1800 (982)	Buff-orange	(2) Soft, crumbly	5.0	15.9	-	2.59
1900 (1038)	Buff-orange	(2) Soft, crumbly	5.0	16.2	-	2.63
2000 (1093)	Buff-orange	(3) Fair hard	6.0	15.1	-	2.59
2100 (1149)	Tan	(5) Very hard	7.5	14.0	-	2.56
2200 (1204)	Red-gray	(6) Steel hard	7.5	9.1	-	2.47
2300 (1260)	Gray-red	(6) Steel hard	7.3	10.2	-	2.42

Remarks/Other Tests The working properties and fired shrinkage suggest high silica. Potential use: chimney flue tile (?), decorative brick.

Preliminary Bloating (Quick Firing) Tests: Negative.

*Based on comparison of Tyrrell's 1967 revisions of Denny's 1967 data sheets.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C)

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy:	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
SO		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method - _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. -, Collected by L. E. Whaley. Date c. March, 1963.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment -

Sample Description & Comments From the Lynne E. Whaley farm Rock Springs area. No further data available.

Compiled by B. J. O'Connor Date 7-25-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-1

County Walker. Sample Number 1.

Raw Properties: Lab & No. USBM, Norris Tenn.; No. 1553-A.

Date Reported 4-8-64 (revised 1967) Ceramist M.V.Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.).

Water of Plasticity 22.6 % Working Properties Low plasticity. pH=5.3. Not effervescent with HCl.

Color Light gray. Drying Shrinkage 0.0 % Dry Strength Low.

Remarks Drying Characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Bulk Dens. gm/cc
1800 (982)	Tan	2	4.0	17.7	32.2	1.82
1900 (1038)	Tan	3	5.0	14.5	27.7	1.91
2000 (1093)	Tan	4	10.0	6.2	13.8	2.23
2100 (1149)	Red-brown	4	10.0	5.1	11.6	2.27
2200 (1204)	Red-brown	6	12.0	2.1	5.0	2.37
2300 (1260	Dark brown	6	12.0	1.2	2.8	2.34

Remarks / Other Tests Should fire to "SW" face brick specifications at about 1950°F (1066°C). Abrupt vitrification. Potential Use: Face brick; quarry tile.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	61.70
TiO_2	0.90
Al_2O_3	21.12
Fe_2O_3	6.12
FeO	1.49
MnO	0.05
MgO	1.08
CaO	0.08
Na_2O	0.26
K_2O	2.21
P_2O_5	0.06
SO_2	0.16
C (org)	-
CO_2	-
H_2O^-	3.81
H_2O^+	1.10
Ignition loss	-
Total	100.14

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst L. H. Turner, Ga. Survey.

Date January 1964.

Method -

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 1., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Shale from the upper portion of the Red Mountain Formation which is largely shale with a few minor 1-8 in. siltstone beds ("Zone A", in Bentley, 1964, p. 8 and 13).

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-2

County Walker. Sample Number 2.

Raw Properties: Lab & No. Ga. Tech., #2.

Date Reported 1964. Ceramist L. Mitchell, Ga. Tech.

Water of Plasticity - % Working Properties Fair plasticity.

Color Light salmon. Drying Shrinkage - % Dry Strength -

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
2120 (1160) (Cone 1+)	Dark brick red	-	Slight	-	-	Vitrified

Remarks / Other Tests Fired texture is very gritty (Bentley, 1964, p. 19).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO			
CaO		Montmorillonite	
Na_2O		Others	
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 2., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Shale from the upper portion of the Red Mountain Formation which is largely shale with a few minor 1-8 in. siltstone beds ("Zone A" in Bentley, 1964, p. 13).

Compiled by B. J. O'Connor Date 1-22-82

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-3

County Walker. Sample Number 3.

Raw Properties: Lab & No. Ga. Tech., #3.

Date Reported 1964. Ceramist L. Mitchell, Ga. Tech.

Water of Plasticity - % Working Properties Poor plasticity.

Color Beige. Drying Shrinkage - % Dry Strength -

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
2120 (1160) (Cone 1+)	Very dark brick red	-	Slight	-	-	Vitrified

Remarks / Other Tests Fired texture is slightly gritty (Bentley, 1964, p.19).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 3., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Shale from the upper portion of the Red Mountain Formation which is largely shale with a few minor 1-8 in. siltstone beds ("Zone A" in Bentley, 1964, p. 13).

Compiled by B. J. O'Connor Date 1-22-82

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-4

County Walker. Sample Number 4.

Raw Properties: Lab & No. USBM, Norris Tenn.; No. 1553-B.

Date Reported 4-8-64 (revised 1967) Ceramist M.V.Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.).

Water of Plasticity 16.0 % Working Properties Low plasticity. pH=6.5. Not effervescent with HCl.

Color Gray. Drying Shrinkage 0.0 % Dry Strength Low.

Remarks Drying Characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Bulk Dens. gm/cc
1800 (982)	Light brown	2	5.0	11.9	23.3	1.96
1900 (1038)	Light brown	3	5.0	9.5	19.5	2.05
2000 (1093)	Brown	4	5.0	8.2	17.1	2.08
2100 (1149)	Red-brown	5	9.0	2.9	6.7	2.30
2200 (1204)	-	-	Expanded	-	-	-
2300 (1260	-	-	Melted	-	-	-

Remarks / Other Tests Should fire to "SW" face brick specifications at about 2000°F (1093°C). Low plastic strength. Potential Use: Face brick.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO			
CaO		Montmorillonite	
Na_2O		Others	
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 4., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Shale from the upper portion of the Red Mountain Formation which is largely shale with a few minor 1-8 in. siltstone beds ("Zone A" in Bentley, 1964, p. 13).

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Conasauga). Compilation Map Location No. Wkr.64-5

County Walker. Sample Number 10.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-H.

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM. (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 22.1 % Working Properties Long working, smooth, plastic, fatty. (Moderate plasticity) pH=5.10 (Not effervescent with HCl.)

Color Yellow. Drying Shrinkage 5.0 % Dry Strength Fair.

Remarks Drying Chracteristics: Fair, slightly rough. (No defects.)

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other Data: Bulk Dens. gm/cc
1800 (982)	Tan	(3) Fair hard	7.0	19.9	35.6	1.79
1900 (1038)	Tan	(3) Fair hard	7.0	18.3	33.7	1.84
2000 (1093)	Light brown	(4) Hard	10.0	15.2	29.5	1.94
2100 (1149)	Brown	(4) Hard	10.5(10.0)	17.0	15.3	2.19
2200 (1204)	Chocolate	(5) Very hard	10.5(10.0)	7.0	15.1	2.15
2300 (1260)	Blackish brown	(5) Very hard	13.5(12.5)	5.0	11.0	2.20

Remarks/Other Tests Fair color; rough surface; some cracking; shrinkage and absorption slightly high. (Should fire to "MW" face brick specifications at about 2050°F (1121°C). Abrupt vitrification). Potential use: None. (Face brick, sewer pipe.)

Preliminary Bloating (Quick Firing) Tests: Negative.

Note: Appr. Por. and Bulk Dens. plus data and remarks in parentheses are from 1967 revised data sheets by Tyrrell.

Crushing Characteristics (unfired material) -

Particle Size - 20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 10., Collected by J.W. Smith (?). Date c. 1963.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Canasauga Group (Cambrian).

Sample Description & Comments No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Clay (Chickamauga residuum). Compilation Map Location No. Wkr.64-6

County Walker. Sample Number 11.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-I

Date Reported 4-8-64. (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 23.8 % Working Properties Moderate plasticity
pH = 5.2. Not effervescent with HcL.

Color Red-brown. Drying Shrinkage 5.0 % Dry Strength Fair.

Remarks Drying Characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs!)	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Bulk Dens. gm/cc
1800 (982)	Light brown	2	5.0	18.0	32.4	1.80
1900 (1038)	Light brown	3	5.0	17.0	30.9	1.82
2000 (1093)	Brown	4	9.0	13.1	25.5	1.95
2100 (1149)	Brown	5	10.0	11.0	22.3	2.03
2200 (1204)	Dark brown	6	10.0	7.9	19.8	2.51
2300 (1260)	-	-	Expanded	-	-	-

Remarks / Other Tests Should fire to "MW" face brick specifications at about 2050°F (1121°C). Potential use: Face brick.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size - 20 mesh. Retention Time 15 min. drawtrials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	64.30
TiO_2	1.00
Al_2O_3	17.14
Fe_2O_3	7.32
FeO	0.72
MnO	0.18
MgO	0.92
CaO	0.24
Na_2O	0.50
K_2O	1.47
P_2O_5	0.14
SO_2	0.15
C (org)	-
CO_2	-
H_2O^-	4.53
H_2O^+	1.28
Ignition loss	-
Total	99.89

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst L. H. Turner, Ga. Survey.

Date January 1964.

Method -

Sample Location Data:

County Walker. Land Lot , Sec. , Dist. .

7 1/2' topo quad. Kensington (SW. base). Lat. , Long. .

Field No. 11., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration Residual clay.

Structural Attitude -

Stratigraphic Assignment Chickamauga Group (Ordovician) clay residuum (Tertiary?).

Sample Description & Comments Sample taken from between Ga. Hwy. 193 and the TAG Railroad, about 0.15 mi. W. of Wkr.64-7 and about 1 mi. ESE. of Davis Crossroads (Bentley, 1964, p. 5 and 8).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-7

County Walker. Sample Number 12.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-J

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 21.8 % Working Properties Low plasticity. pH=5.2. Not effervescent with HCl.

Color Gray. Drying Shrinkage 5.0 % Dry Strength Fair.

Remarks Drying characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Bulk Dens. gm/cc
1800 (982)	Light brown	3	5.0	13.9	27.2	1.96
1900 (1038)	Light brown	3	5.0	12.9	25.8	2.00
2000 (1093)	Brown	4	10.0	8.7	18.8	2.16
2100 (1149)	Brown	5	10.0	6.6	14.9	2.25
2200 (1204)	Dark brown	6	10.0	2.6	6.3	2.41
2300 (1260)	-	-	Melted	-	-	-

Remarks / Other Tests Should fire to "SW" face brick specifications at 2050°F (1121°C). Potential Use: Face brick; sewer pipe.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	68.58
TiO_2	0.80
Al_2O_3	15.70
Fe_2O_3	6.94
FeO	-
MnO	-
MgO	1.00
CaO	0.24
Na_2O	0.05
K_2O	1.52
P_2O_5	0.05
SO_2	0.14
C (org)	-
CO_2	-
H_2O^-	4.29
H_2O^+	1.06
Ignition loss	-
Total	100.37

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst L. H. Turner, Ga. Survey.

Date January 1964.

Method -

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Kensington (SW. base). Lat. _____, Long. _____.

Field No. 12., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Sample of soft, drab and reddish brown shale from the lower portion of the Red Mountain Formation which is dominantly shale with minor siltstone ("Zone C" of Bentley after Smith, 1931, p. 141) taken from cuts on the N. side of the TAG Railroad near Estelle cemetery, 2 mi. SE. of Kensington (Bentley, 1964, p. 6, 8, and 9).

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-8

County Walker. Sample Number 13.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-K

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 24.6 % Working Properties Low plasticity. pH=6.1. Not effervescent with HCl.

Color Red-brown. Drying Shrinkage 0.0 % Dry Strength Low.

Remarks Drying characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Bulk Dens. gm/cc
1800 (982)	Light brown	3	5.0	18.8	32.7	1.74
1900 (1038)	Light brown	3	5.0	16.7	30.1	1.80
2000 (1093)	Brown	4	7.5	12.2	23.8	1.95
2100 (1149)	Brown	5	8.0	9.5	19.5	2.05
2200 (1204)	Brown	6	8.0	7.4	15.7	2.12
2300 (1260)	Dark brown	6	10.0	3.5	7.9	2.27

Remarks / Other Tests Should fire to "SW" face brick specifications at 2150°F (1177°C). Potential Use: Face brick.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy:	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
SO_2		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Kensington (S. base). Lat. _____, Long. _____.

Field No. 13., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Sample from the middle portion ("Zone B") of the Red Mountain Formation on the S. side of Ga. Hwy. 136 (formerly Hwy. 143) about 1/2 mile SE. of Catlett Gap and about 2 miles NW. of junction with U.S. 27 (Bentley, 1964, p. 5 and 10).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale (Pennington). Compilation Map Location No. Wkr.64-9

County Walker. Sample Number 14

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-L

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 21.85 % Working Properties Long working, smooth, plastic, fatty. (Low plasticity.) pH=6.50

Color Tan. Drying Shrinkage 1.0(0.0) % Dry Strength Good (Low).

Remarks Drying Characteristics: Good. (No defects.)

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Tan	(3) Fair hard	3.5(3.0)	18.4	32.8	1.78
1900 (1038)	Tan	(4) Hard	5.0	15.4	28.6	1.86
2000 (1093)	Light brown	(5) Very hard	9.5(9.0)	9.9	20.3	2.05
2100 (1149)	Brown	(5) Very hard	10.0	7.3	15.6	2.14
2200 (1204)	Chocolate	(5) Very hard	10.0	5.35	12.1	2.24
2300 (1260)	Dark brown	(6) Steel hard	10.0	2.30	5.3	2.31

Remarks / Other Tests Fair color. (Should fire to "SW" face brick specifications at about 2050°F, 1121°C.) Poetntial use: Brick and tile, if color ok; 2100-2100°F common pottery. (Face brick sewer pipe.)

Preliminary Bloating (Quick Firing) Tests: Negative.

Note: Appr. Por. and Bulk Dens. plus data and remarks in parentheses are from 1967 revised data sheets by Tyrrell.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. - . Lat. _____, Long. _____.

Field No. 14, Collected by J.W. Smith (?). Date c. 1963.

Sample Method Grab(?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Pennnington Shale (Mississippian).

Sample Description & Comments No further data available.

Compiled by B.J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Gizzard). Compilation Map Location No. Wkr.64-10

County Walker. Sample Number 15

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-M

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 26.5 % Working Properties Long working, smooth, plastic, fatty. (Low plasticity.) pH=5.69 (Not effervescent with HCl.)

Color Yellow-brown. Drying Shrinkage 2.5. % Dry Strength Good. (Low.)

Remarks Drying Characteristics: Good. (No defects).

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Tan	(3) Fair hard	4.5(4.0)	21.3	35.6	1.67
1900 (1038)	Tan	(4) Hard	5.5(5.0)	19.6	33.7	1.72
2000 (1093)	Light brown	(5) Very hard	7.5	13.8	26.2	1.90
2100 (1149)	Brown	(5) Very hard	7.5	10.9	21.7	1.99
2200 (1204)	Brown	(6) Steel hard	9.0	9.2	19.0	2.07
2300 (1260)	Dark brown	(6) Steel hard	10.0	5.7	12.5	2.20

Remarks / Other Tests Fair color. (Should fire to "MW" face brick specifications at about 2050°F, 1121°C.) Potential use: Brick and tile, common pottery. (Face brick.)

Preliminary Bloating (Quick Firing) Tests: Negative.

Note: Appr. Por. and Bulk Dens. plus data and remarks in parentheses are from 1967 revised data sheets by Tyrrell.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. -. Lat. _____, Long. _____.

Field No. 15, Collected by J.W. Smith (?). Date c. 1963.

Sample Method Grab(?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Gizzard Formation (Pennsylvanian).

Sample Description & Comments No further data available.

Compiled by B.J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Vandever). Compilation Map Location No. Wkr. 64-11

County Walker. Sample Number 17

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-O

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 22.4. % Working Properties Long working, smooth, plastic, fatty.* (Low plasticity.) pH=6.80. (Not effervescent with HCl.)

Color Gray. Drying Shrinkage 0.5(0.0) % Dry Strength Good. (Low.)

Remarks Drying Characteristics: Good. (No defects).

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800		(3)				
(982)	Tan	Fair hard	4.5(4.0)	17.5	31.3	1.79
1900	Light	(4)				
(1038)	brown	Hard	4.5(4.0)	14.7	27.6	1.88
2000		(5)				
(1093)	Brown	Very hard	9.0	8.0	17.0	2.13
2100		(5)				
(1149)	Chocolate	Very hard	10.0	4.0	9.2	2.30
2200	Dark	(6)				
(1204)	brown	Steel hard	10.5(10.0)	1.7	4.0	2.38
2300			Glassy			
(1260)	Black	Melted	(Expanded)	-	-	-

Remarks / Other Tests Fair color. Apparently mixed material - may be weathered and unweathered. (Should fire to "SW" face brick specifications at about 2000°F, 1093°C Abrupt vitrification.) Potential Use: Brick and tile if color not objectionable; stoneware and pottery. (Face brick, sewer pipe, lightweight aggregate.)

Preliminary Bloating (Quick Firing) Tests: Negative and positive. (Positive.)

Temp. °F(°C)	Absorption %	Bulk density gm/cc	Bulk density Lb/ft^3	Remarks
1800 (982)	-	-	-	Apparently mixed material.
2000 (1093)	3.5	1.57	97.8	Very little expansion. (Slight expansion.)
2100 (1149)	2.6	1.18	73.5	Split open cracks. (Slight expansion.)
2200 (1204)	5.3	0.72	44.9	Good lightweight aggregate. (Good pore structure.)

Remarks: Probably make good lightweight aggregate in rotary kiln at about 2100°F (1149°C). (Possible raw material for lightweight aggregate.)

Note: Appr. Por. and Bulk Dens. plus data and remarks in parentheses are from 1967 revised data sheets by Tyrrell.

*Revised by K. J. Liles (written communication, 1987)

Crushing Characteristics (unfired material) Good.

Particle Size -20 mesh. (also 1/2" + 1/4") Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. -. Lat. _____, Long. _____.

Field No. 17, Collected by J.W. Smith (?). Date c. 1963.

Sample Method Grab(?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Vandever Shale (Pennsylvanian).

Sample Description & Comments No further data available.

Compiled by B.J. O'Connor Date 7-28-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-12

County Walker. Sample Number 18

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-P

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 22.2 % Working Properties Low plasticity. pH=5.9 Not effervescent with HCl.

Color Yellow. Drying Shrinkage 1.0 % Dry Strength Low.

Remarks Drying Characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Light brown	2	3.0	16.8	30.2	1.80
1900 (1038)	Light brown	4	5.0	13.6	26.0	1.91
2000 (1093)	Brown	4	5.0	10.6	21.3	2.01
2100 (1149)	Dark brown	5	10.0	7.3	15.6	2.14
2200 (1204)	Dark brown	6	10.0	2.1	4.9	2.35
2300 (1260)	Dark brown	6	10.0	1.3	3.1	2.35

Remarks / Other Tests Should fire to "SW" face brick specifications at about 2050°F (1121°C). Potential use: Face brick.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 18., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Reported in Bentley (1964, p. 19). No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Residuum). Compilation Map Location No. Wkr.64-13

County Walker. Sample Number 19

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1553-Q

Date Reported 4-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 24.1 % Working Properties Long working, smooth, plastic, fatty.* (Low plasticity.) pH=6.40 (Not effervescent with HCl.)

Color Red-brown. Drying Shrinkage 1.0(0.0) % Dry Strength Good (Low).

Remarks Drying Characteristics: Good. (No defects.)

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Tan	(3) Fair hard	5.0	16.2	30.0	1.83
1900 (1038)	Light brown	(4) Hard	9.0	11.0	22.2	2.02
2000 (1093)	Brown	(4) Hard	10.0	6.6	14.6	2.21
2100 (1149)	Chocolate	(5) Very hard	11.5	3.0	7.1	2.35
2200 (1204)	Dark brown	(6) Steel hard	12.5	1.5	3.6	2.40
2300 (1260)	Dark brown	(6) Steel hard	14.0	0.9	2.1	2.38

Remarks / Other Tests Good color; shrinkage and absorption good. (Should fire to "SW" face brick specifications at about 1950°F, 1066°C.) Potential use: Brick, tile, decorative potery. (Face brick, sewer pipe, quarry tile.)

Preliminary Bloating (Quick Firing) Tests: Negative.

Note: Appr. Por. and Bulk Dens. plus data and remarks in parentheses are from 1967 revised data sheets by Tyrrell.

*Revised by K.J. Liles (written communication, 1987).

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. -. Lat. _____, Long. _____.

Field No. 19, Collected by J.W. Smith (?). Date c. 1963.

Sample Method Grab(?). Weathering/alteration Residuum.

Structural Attitude -

Stratigraphic Assignment Upper Ordovician.

Sample Description & Comments No further data available.

Compiled by B.J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-14

County Walker. Sample Number 42.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1554-N.

Date Reported 5-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 23.2 % Working Properties Low plasticity. pH=5.8. Not effervescent with HCl.

Color Buff. Drying Shrinkage 2.5 % Dry Strength Low.

Remarks Drying characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	-	2	4.0	17.5	32.0	1.83
1900 (1038)	-	3	5.0	13.3	25.4	1.91
2000 (1093)	-	5	7.5	9.1	18.8	2.07
2100 (1149)	-	6	10.0	3.3	8.5	2.57
2200 (1204)	-	-	Expanded	-	-	-

Remarks / Other Tests Should fire to "MW" face brick specifictions at about 1950°F (1066°C). Potential use: Face brick.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	57.82
TiO_2	0.90
Al_2O_3	22.38
Fe_2O_3	9.12
FeO	-
MnO	-
MgO	1.09
CaO	0.26
Na_2O	0.35
K_2O	2.01
P_2O_5	0.02
SO_2	0.15
C (org)	-
CO_2	-
H_2O^-	5.06
H_2O^+	1.15
Ignition loss	-
Total	100.31

Mineralogy Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst L. H. Turner, Ga. Survey.

Date January 1964.

Method -

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 42., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Sample from middle of the Red Mountain Formation ("Zone B" of Bentley, 1964, p. 5 and 10). No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-15

County Walker. Sample Number 43.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1554-O.

Date Reported 5-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 24.4 % Working Properties Moderate plasticity. pH=5.9. Not effervescent with HCl.

Color Yellow. Drying Shrinkage 4.0 % Dry Strength Fair.

Remarks Drying characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	-	2	5.0	18.8	34.0	1.81
1900 (1038)	-	3	7.5	13.8	26.4	1.91
2000 (1093)	-	4	10.0	11.3	22.6	2.00
2100 (1149)	-	6	11.0	6.6	14.2	2.15
2200 (1204)	-	6	14.0	3.4	7.7	2.27
2300 (1260)	-	-	Expanded	-	-	-

Remarks / Other Tests Should fire to "SW" face brick specifictions at about 2050°F (1121°C). Potential use: Face brick; sewer pipe.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	59.86
TiO_2	1.00
Al_2O_3	18.54
Fe_2O_3	8.42
FeO	1.06
MnO	0.30
MgO	0.80
CaO	0.38
Na_2O	0.36
K_2O	2.77
P_2O_5	0.07
SO_2	0.25
C (org)	-
CO_2	-
H_2O^-	4.74
H_2O^+	1.70
Ignition loss	-
Total	100.30

Mineralogy Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst L. H. Turner, Ga. Survey.

Date January 1964.

Method -

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 43., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Reported in Bentley (1964, p. 19); no further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Pennington). Compilation Map Location No. Wkr.64-16

County Walker. Sample Number 44.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1554-P.

Date Reported 5-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell1, Tuscaloosa, Ala.)

Water of Plasticity 25.3 % Working Properties Sh rt working, smooth, mealy.* (Low plasticity.) pH=5.7 (Not effervescent with HCl.)

Color Yellow. Drying Shrinkage 2.1(2.0) % Dry Strength Good. (Low).

Remarks Drying characteristics: Good, slight warping. (No defects.)

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Tan	(2) Soft	1.0(2.0)	23.4	37.7	1.61
1900 (1038)	Tan	(3) Fair hard	1.0(2.0)	21.9	36.4	1.66
2000 (1093)	Light brown	(3) Fair hard	1.0(2.0)	21.4	36.2	1.69
2100 (1149)	Brown	(4) Hard	4.0	19.8	34.3	1.73
2200 (1204)	Chocolate	(4) Hard	4.0	18.4	32.4	1.76
2300 (1260)	Chocolate	(4) Very hard	5.0	16.9	30.9	1.83

Remarks / Other Tests Slight scum-probably sulfate - too high absorption, rather soft, fair color. Could be combined with clay of high shrinkage and low absorption. (High absorptions at all firing temperatures.) Potential use: None without mixing. (Not suitable for use as the principal component in vitreous clay products.)

Preliminary Bloating (Quick Firing) Tests: Negative.

*Revised by K.J. Liles (written communication, 1987).

Note: Appr. Por. and Bulk Dens. plus data and remarks in parentheses are from 1967 revised data sheets by Tyrrell.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy Not determined.	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
SO_2		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method - _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 44., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Pennington Formation (Mississippian).

Sample Description & Comments Reported as Red Mountain Shale in Bentley (1964, p. 19). No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Gizzard). Compilation Map Location No. Wkr.64-17

County Walker. Sample Number 45.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1554-Q.

Date Reported 5-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 20.6 % Working Properties Low plasticity. pH=6.7. Not effervescent with HCl.

Color Tan. Drying Shrinkage 1.0 % Dry Strength Low.

Remarks Drying characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	-	2	5.0	17.2	30.8	1.79
1900 (1038)	-	3	5.0	14.2	26.7	1.88
2000 (1093)	-	5	10.0	8.6	17.7	2.06
2100 (1149)	-	6	12.5	1.9	4.3	2.27
2200 (1204)	-	-	Expanded	-	-	-

Remarks / Other Tests Should fire to "SW" face brick specifictions at about 2000°F (1093°C). Potential use: Face brick.

Preliminary Bloating (Quick Firing) Tests: Positive.

Temp. °F(°C)	% Absorption	Bulk density gm/cc	Bulk density Lb/ft^3	Remarks
2000 (1093)	34.7	1.78	111.1	-
2100 (1149)	37.5	1.48	92.4	-
2200 (1204)	6.1	1.32	82.4	-

Comments Not suitable for lightweight aggregate (heavy).

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. (and -3/4"+1/2") Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy Not determined.	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
SO_2		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method - _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 45., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Gizzard Formation (Pennsylvanian).

Sample Description & Comments Reported as Red Mountain Shale in Bentley (1964, p. 19). No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr.64-18

County Walker. Sample Number 46.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1554-R.

Date Reported 5-8-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 21.4 % Working Properties Low plasticity. pH=5.9. Not effervescent with HCl.

Color Gray. Drying Shrinkage 4.0 % Dry Strength Fair.

Remarks Drying characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Moh's')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	-	2	5.0	18.5	31.1	1.68
1900 (1038)	-	2	5.0	18.0	31.7	1.76
2000 (1093)	-	3	7.5	11.0	21.1	1.92
2100 (1149)	-	5	10.0	6.4	13.4	2.09
2200 (1204)	-	5	10.0	4.6	10.0	2.17
2300 (1260)	-	6	10.0	1.3	2.9	2.22

Remarks / Other Tests Should fire to "SW" face brick specifictions at about 2050°F (1121°C). Potential use: Face brick; sewer pipe.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	64.86
TiO_2	1.20
Al_2O_3	19.54
Fe_2O_3	5.40
FeO	-
MnO	-
MgO	0.77
CaO	0.40
Na_2O	0.26
K_2O	2.07
P_2O_5	0.00
SO_2	0.15
C	-
CO_2	-
H_2O^-	4.23
H_2O^+	1.25
Other volatiles	-
Total	100.13

Mineralogy Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst L.H. Turner, Ga. Survey.

Date January, 1964.

Method -

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 46, Collected by R.D. Bentley. Date c. 1964.

Sample Method Grab(?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Sample of shale from middle of the Red Mountain Formation ("Zone B" of Bentley, 1964, p. 5, 8 and 10). No further data available.

Compiled by B.J. O'Connor Date 11-4-87

CERAMIC TESTS AND ANALYSES

Material Shale (Gizzard). Compilation Map Location No. Wkr.64-19

County Walker. Sample Number 69.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1555-N

Date Reported 5-28-64 (revised 1967) Ceramist M.V. Denny, USBM. (revised by M.E. Tyrrell, Tuscaloosa, Ala.)

Water of Plasticity 19.6 % Working Properties Short working. smooth, plastic. (Low plasticity.) pH=6.20. (Not effervescent with HCl.)

Color Gray. Drying Shrinkage 0.0 % Dry Strength Good. (Low.)

Remarks Drying Characteristics: Linear cracking, uneven surface. (No defects.)

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data: Bulk Dens.
1800		(2)				
(982)	Flesh	Soft	2.0	20.5	34.0	1.66
1900	Light	(3)				
(1038)	brown	Fair hard	2.0	16.7	29.4	1.76
2000	Light	(4)				
(1093)	brown	Hard	5.0	13.7	25.2	1.34
2100		(5)				
(1149)	Brown	Very hard	10.0	9.9	19.6	1.93
2200	Dark	(6)				
(1204)	brown	Steel hard	10.0	3.3	7.3	2.22
2300	Dark	(6)				
(1260)	brown	Steel hard	10.0	3.1	6.9	2.22

Remarks / Other Tests Surface cracks, fair color. (Should fire to "SW" face brick specifications at about 2100°F(1149°C). Low plastic strength.) Potential use: Brick if color not objectionable. (Face brick.)

Preliminary Bloating (Quick Firing) Tests: Negative.

Note: Appr. Por. and Bulk Dens. plus data and remarks in parentheses are from 1967 revised data sheets by Tyrrell.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO			
CaO		Montmorillonite	
Na_2O		Others	
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Other volatiles			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. -. Lat. _____, Long. _____.

Field No. 69, Collected by J.W. Smith(?). Date c. 1963.

Sample Method Grab(?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Gizzard Formation (Pennsylvanian).

Sample Description & Comments No further data available.

Compiled by B.J. O'Connor Date 7-28-87

CERAMIC TESTS AND ANALYSES

Material Clay (Knox Group residuum). Compilation Map Location No. Wkr.64-20

County Walker. Sample Number 90.

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1556-I.

Date Reported 6-26-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, ala.)

Water of Plasticity 16.8 % Working Properties Low plasticity.

Color White. Drying Shrinkage 1.0 % Dry Strength Low.

Remarks Drying characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Ivory	4	1.0	14.8	26.8	1.81
2000 (1038)	Ivory	4	2.5	14.8	27.1	1.83
2100 (1093)	Pink	4	2.5	14.8	27.1	1.83
2200 (1149)	Pink	4	2.5	14.8	27.1	1.83
2300 (1204)	Pink	5	2.5	14.9	27.1	1.82

Remarks / Other Tests Not suitable for use as a single component body. High absorption at all temperatures. Potential use: Face brick, glazed tile, stoneware mixtures.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	Weight %
SiO_2	90.30
TiO_2	1.00
Al_2O_3	5.63
Fe_2O_3	0.43
FeO	1.06
MnO	0.00
MgO	0.16
CaO	0.41
Na_2O	trace
K_2O	0.10
P_2O_5	trace
SO_2	trace
C (org)	-
CO_2	-
H_2O^-	2.07
H_2O^+	1.03
Ignition loss	-
Total	100.13

Mineralogy: Not determined.

Mineral	volume %
Quartz	
Feldspar	
Carbonate	
Mica	
Chlorite-vermiculite	
Montmorillonite	
Others	
Total	

Analyst L. H. Turner, Ga. Survey.

Date January 1964.

Method

Sample Location Data:

County Walker. Land Lot , Sec. , Dist. .

7 1/2' topo quad. Durham (E. edge). Lat. , Long. .

Field No. 90., Collected by R. D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Knox Group (Cambrian-Ordovician) clay residuum (Tertiary?).

Sample Description & Comments Tripoli sample from several small pits in the Knox about 4 mi. NW. of Kensington. This material is not recommended for blending with Red Mountain shales (to lighten the color) because it increases the absorption of the tiles (L. Mitchell in Bentley, 1964, p. 8 and 17).

Compiled by B. J.O'Connor Date 7-28-87

CERAMIC TESTS AND ANALYSES

Material Shale (Gizzard). Compilation Map Location No. Wkr. 64-21

County Walker. Sample Number 91

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1556-J

Date Reported 6-26-64 (revised 12967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.).

Water of Plasticity 20.6. % Working Properties Low plasticity. pH=7.5. Not effervescent with HCl.

Color Gray. Drying Shrinkage 4.0 % Dry Strength Low.

Remarks Drying Characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Tan	3	5.0	14.9	27.6	1.85
1900 (1038)	Light brown	4	5.0	9.9	20.0	2.02
2000 (1093)	Light brown	5	10.0	7.1	15.2	2.14
2100 (1149)	Brown	5	10.0	5.8	12.7	2.19
2200 (1204)	Chocolate	6	10.0	1.4	3.3	2.37
2300 (1260)	Dark brown	6	14.0	0.1	0.2	2.37

Remarks / Other Tests Should fire to "SW" face brick specifications at about 1950°F (1066°C). Potential Use: Face brick, sewer pipe.

Preliminary Bloating (Quick Firing) Tests: Positive.

Temp. °F(°C)	Absorption %	Bulk density gm/cc	Bulk density Lb/ft^3	Remarks
2000 (1093)	4.3	1.62	101.1	Slight expansion.
2100 (1149)	6.3	1.10	68.6	Fair expansion.
2200 (1204)	5.9	1.05	65.5	Fair expansion.
2300 (1260)	7.1	0.71	44.3	Good expansion.

Remarks: Promising raw material for lightweight agregate.

Crushing Characteristics (unfired material) Good.

Particle Size - 20 mesh. (also -3/4" + 1/2") Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy:	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO			
CaO		Montmorillonite	
Na_2O		Others	
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. _____. Lat. _____, Long. _____.

Field No. 91., Collected by J.W. Smith (?). Date c. 1963.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Gizzard Formation (Pennsylvanian).

Sample Description & Comments No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Pennington). Compilation Map Location No. Wkr. 64-22

County Walker. Sample Number 92

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1556-K

Date Reported 6-26-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.).

Water of Plasticity 21.6 % Working Properties Moderate plasticity. pH=6.4. Not effervescent with HCl.

Color Gray. Drying Shrinkage 5.0 % Dry Strength Fair.

Remarks Drying Characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Light brown	3	5.0	15.4	28.5	1.85
1900 (1038)	Light brown	4	10.0	10.8	21.5	1.99
2000 (1093)	Light brown	4	10.0	5.6	12.6	2.25
2100 (1149)	Red-brown	5	10.0	0.8	2.0	2.50
2200 (1204)	-	-	Expanded	-	-	-

Remarks / Other Tests Should fire to "SW" face brick specifications at about 1950°F (1066°C). Potential Use: Face brick, quarry tile.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size - 20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy:	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. - . Lat. _____, Long. _____.

Field No. 92., Collected by J.W. Smith (?). Date c. 1963.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Pennington Shale (Mississippian).

Sample Description & Comments No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mountain). Compilation Map Location No. Wkr. 64-23

County Walker. Sample Number 93

Raw Properties: Lab & No. USBM, Norris, Tenn.; No. 1556-L

Date Reported 6-26-64 (revised 1967) Ceramist M.V. Denny, USBM (revised by M.E. Tyrrell, Tuscaloosa, Ala.).

Water of Plasticity 21.6 % Working Properties Low plasticity. pH=6.2. Not effervescent with HCl.

Color Gray. Drying Shrinkage 1.0 % Dry Strength Low.

Remarks Drying Characteristics: No defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	-	2	4.0	15.9	28.3	1.78
1900 (1038)	-	3	5.0	10.5	20.8	1.98
2000 (1093)	-	4	9.0	8.0	16.6	2.07
2100 (1149)	-	5	10.0	6.9	14.7	2.13
2200 (1204)	-	6	10.0	1.4	3.3	2.37
2300 (1260)	-	-	Expanded	-	-	-

Remarks / Other Tests Should fire to "SW" face brick specifications at about 2000°F (1093°C). Potential Use: Face brick.

Preliminary Bloating (Quick Firing) Tests: Negative.

Crushing Characteristics (unfired material) -

Particle Size - 20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy:	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO			
CaO		Montmorillonite	
Na_2O		Others	
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. - . Lat. _____, Long. _____.

Field No. 93., Collected by R.D. Bentley. Date c. 1964.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Reported in Bentley (1964, p. 19). No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Clay. Compilation Map Location No. Wkr. 67-1

County Walker. Sample Number 143

Raw Properties: Lab & No. USBM, Tuscaloosa, AL; G-9-6.

Date Reported 1-11-67 Ceramist M.E. Tyrrell, USBM.

Water of Plasticity 21.8 % Working Properties Low plasticity.
pH=4.8. Not effervescent with HCl.

Color Brown. Drying Shrinkage 2.5 % Dry Strength Low.

Remarks Drying Characteristics: No drying defects.

Slow Firing Tests:

Temp. °F (°C)	Color	Hardness (Mohs')	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data Bulk Dens. gm/cc
1800 (982)	Tan	3	2.5	25.4	39.6	1.56
1900 (1038)	Tan	3	2.5	23.8	38.1	1.60
2000 (1093)	Tan	4	5.0	20.1	34.2	1.70
2100 (1149)	Light brown	5	10.0	16.3	29.3	1.80
2200 (1204)	Red-brown	6	10.0	13.7	25.8	1.88
2300 (1260)	Dark brown	7	15.0	4.9	10.7	2.18

Remarks / Other Tests Should fire to "SW" face brick specifications at about 2250°F (1232°C). Good color. Potential use: Building brick. (Also see extrusion test.)

Preliminary Bloating (Quick Firing) Tests: Negative.

TUSCALOOSA METALLURGY RESEARCH LABORATORY

Clay Evaluation: Extrusion Tests

Sender's identification: No. 143 (Walker Co.) Date 1/12/68

Tuscaloosa number: G-9-6

Body composition: Raw clay through 6-mesh: 100%.

Tempering water: 21.5% of dry batch weight.

Vacuum on machine: 28 inches of mercury.

Drying: 24 hours in air; 24 hours at 140°F (60°C).

Drying shrinkage: 3.1%

Modulus of rupture, dry unfired: 250 psi.

Firing:

Time- 24 hours

Temperature- 2230°F (1221°C)

Cone- 8

Total shrinkage: 10.4%

Absorption, 5-hour boiled: 2.3%

Absorption, 24-hour soaked: 2.0%

Saturation coefficient: 0.87

Apparent porosity: 5.4%

Bulk density: 144.1 lb/cu. ft.

Fired modulus of rupture: 4350 psi.

Mohs' hardness: 6

Color: Dark red

Comments: Should be satisfactory for face brick or quarry tile. Good color.

Crushing Characteristics (unfired material) -

Particle Size -20 mesh. Retention Time 15 min. draw trials (following 3-4 hr. to 1800°F, 982°C).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy:	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. - . Lat. _____, Long. _____.

Field No. -, Collected by J.W. Smith (?). Date c. 1966.

Sample Method Grab (?). Weathering/alteration -

Structural Attitude -

Stratigraphic Assignment -

Sample Description & Comments No further data available.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Pennsylvanian). Compilation Map Location No. Wkr.69-1

County Walker. Sample Number G-14-1.

Raw Properties: Lab & No. USBM, Tuscaloosa, AL.; #G-14-1.

Date Reported March 1969. Ceramist M. E. Tyrrell, USBM.

Water of Plasticity - % Working Properties -

Color Medium gray. Drying Shrinkage - % Dry Strength -

Slow Firing Tests: Not determined.

Preliminary Bloating (Quick Firing) Tests: Positive.

Temp. °F (°C)	Absorption %	Bulk Density g/cm3	Bulk Density lb/ft3	Remarks
1800 (982)	3.5	2.46	153	No expansion.
1900 (1038)	6.8	2.17	135	No expansion.
2000 (1093)	5.8	1.46	91	Slight expansion.
2100 (1149)	7.4	0.81	51	Good pore structure.
2200 (1204)	9.1	0.71	44	Fair pore structure.
2300 (1260)	7.8	0.81	50	Melting.

Remarks Data from Hollenbeck and Tyrrell, (1969, p. 10). Also see Rotary kiln and concrete test data.

TUSCALOOSA METALLURGY RESEARCH LABORATORY

Clay Evaluation: Rotary Kiln Test

Date 1968+

Sender's identification: Pottsville Fm. Tuscaloosa No.: G-14-1

RAW MATERIAL

Screen Analysis: (Crushed to pass 3/4" screen)

Through	Retained on	Weight, percent	Cummulative, percent
3/4"	1/2"	-	-
1/2"	3/8"	-	-
3/8"	4 mesh	-	-
4 mesh	pan	(100.0)++	(100.0)++

Fragment shape: R (= 1 in. x 1 in. round rods - extruded).++

Crushing loss (minus 4-mesh): - (Entire sample crushed to pass 4 mesh for for extrusion due to excessive fine flakes on normal crushing.)++

Firing Data:

Size range of feed: R. Pour weight of feed, lb/ft^3: 72.0

Bloating temperature: 2070°F (1132°C)
Logging Temperature: 2100°F (1149°C)
(nodules sticking together)

FIRED MATERIAL

(All fired material crushed through roll crusher)

*Screen Analysis: (Percentages by weight passing sieves)

Size designation:	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 50	No. 100
Fine: (not determined)	-	-	-	-	-	-	-	-
Coarse:	100.0	94.7	68.3	15.8	5.3	-	-	-

**Loose pour weights, lb/ft3: Fine - Coarse 51.0

Comments: Absorption: 8.4%. Although this is a suitable raw material for lightweight aggregate, it probably would have to be pelletized because of its crushing characteristics.

The data presented in this report are based on laboratory tests that are preliminary in nature and will not suffice for plant or process design. The data should be compared to appropriate ASTM specifications.

* ASTM Designation C 136-71 ** ASTM Designation C 29-71
\+ Hollenbeck and Tyrrell, 1969, p. 11 and 13.
++ Fine ground and extruded due to unfavorable crushing characteristics during initial crushing.

Crushing Characteristics (unfired material) Excessive fines.

Particle Size 1/2 - 3/4 in. Retention Time 15 minutes (Quick Firing Tests).

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Dougherty Gap (NW. 1/4). Lat. _____, Long. _____.

Field No. G-14-1. , Collected by R. P. Hollenbeck. Date 1967 and 1968.

Sample Method Channel (?). Weathering/alteration Slightly weathered.

Structural Attitude -

Stratigraphic Assignment Pennsylvanian Pottsville Formation or possibly Gizzard?

Sample Description & Comments Hard, medium gray shale, slightly weathered (about 8 feet exposed) overlain by alternate beds of sandstone and shale from road cut on S. side of unpaved road, 0.6 mi. E. of intersection with Ga. Hwy.157 (formerly Hwy.239) which is 1.5 mi. N. of Chattooga County line (Hollenbeck and Tyrrell, 1969, p. 6).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale (Conasauga). Compilation Map Location No. Wkr.80-1

County Walker. Sample Number Clay No. 6.

Raw Properties: Lab & No. Marazzi Ceramiche, #M.P. 1795.

Date Reported March 1980. Ceramist L. Lorici.

Water of Plasticity - % Working Properties Compact.

Color Yellowish-brown. Drying Shrinkage Good. % Dry Strength -
Pressing Good. Fluidizing Good.

Slow Firing Tests: (50 x 100 x 8 mm. pressed tiles.)

Temp. °F (°C)	Color	Hardness	Linear Shrinkage, %	Absorption %	Appr. Por. %	Other data:
1976 (1080) (= cycle 1)	-	-	-	-	-	-
2030 (1110) (= cycle 2)	-	-	5.0	-	7.3	-
1994 (1090) (= cycle 3)	-	-	7.1	-	4.4	-

(DTA & Dilatometric Analyses on file. - unpubl. report.)

Remarks / Other Tests Illitic shale with low percentages of kaolinite and montmorillonite and a high mica content. ("Bl": too refractory for making tile.).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size <40 microns Retention Time Cycle 1: 40-45 min.
Cycle 2: 70-75 min. in roller kiln.
Cycle 3: 200-230 min.

Chemical & Mineralogical Data:

Chemical Analysis

Oxide	(A)	Weight % (B)
SiO_2	62.58	62.8
TiO_2	0.5	0.8
Al_2O_3	18.84	19.8
Fe_2O_3	7.06	10.0
FeO	-	-
MnO	0.00	-
MgO	1.30	1.2
CaO	0.22	-
Na_2O	0.05	0.2
K_2O	2.90	3.7
P_2O_5	-	-
S (total)	-	-
C (org)	-	-
CO_2	-	-
H_2O^-	-	-
H_2O^+	-	-
Ignition loss	6.38	(6.6)
Total	99.88	98.5 w/o LOI

Mineralogy

Mineral	volume % (A)	(B)
Quartz		x
Feldspar		
Carbonate		
Mica (Muscovite)		
Chlorite-(+ kaolinite) vermiculite	(23)	
Montmorillonite		low
Illite	(77)	X
Kaolinite		low
Total	-	-

x = present.
(A) = clays and micasd only.

Analyst A) R. Landrum, GA Survey. B) Marazzi Ceramiche.
M. A. Tadkod, GA Survey. M. Ceramiche.

Date Aug. & Sept. 1979.
Aug. & Sept. 1979.

Method A) Atomic Absorption B) XRF & Spectrophotometry.
X-ray diffraction.

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. LaFayette (Estelle) (NE. cor.). Lat. _____, Long. _____.

Field No. 8., Collected by M. A. Tadkod. Date July 1979.

Sample Method Grab. Weathering/alteration Weathered.

Structural Attitude -

Stratigraphic Assignment Conasauga Group (Cambrian).

Sample Description & Comments Sample from roadcut E. of Town Creek, about 1 3/4 mi. NE. of LaFayette city limits and about 1 mi. E. of junction of U.S. Hwy. 27 and Ga. Hwy. 136-formerly Hwy. 143 (Tadkod, 1979 and 1980, unpubl. data notes).

Compiled by B. J. O'Connor Date 06-09-88

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mtn.). Compilation Map Location No. Wkr.80-2a

County Walker. Sample Number C shale.

Raw Properties: Lab & No. Georgia Tech., #CS.

Date Reported 12-10-80. Ceramist J. F. Benzel, Georgia Tech.

Water of Plasticity - % Working Properties -

Color - Drying Shrinkage 2.04 % Dry Strength (MOR) 162 psi.
Drying Wt. loss 16.28 %

Slow Firing Tests:

Approx. Temp. °F (°C)	Color	Hardness (MOR, psi.)	Linear Shrinkage, % (total)	Absorption %	Appr. Por. %	Other data: LOI%
2120 (1160) (Cone 1)	- (3 samples fired)	1946	6.63 (8.67)	2.05	-	4.66

Remarks / Other Tests Exploration test firing for possible substitute in 8" sewer pipe blend 1(see Wkr.80-2b). Low water absorption is very good; but dry strength is very poor.

Preliminary Bloating (Quick Firing) Tests: Not determined.

CERAMIC TESTS AND ANALYSES

Material Shale (blend). Compilation Map Location No. Wkr.80-2b

County Walker (+Floyd and Hancock). Sample Number C shale-blend.

Raw Properties: Lab & No. Georgia Tech., # 3C.

Date Reported 12-10-80. Ceramist J. F. Benzel, Georgia Tech.

Water of Plasticity - % Working Properties -

Color - Drying Shrinkage 3.73 % Dry Strength (MOR) 292 psi.
Drying Wt. loss 21.47 %

Slow Firing Tests: (1x1x=9 in. bars.)

Approx. Temp. °F (°C)	Color	Hardness (MOR, psi.)	Linear Shrinkage, % (total)	Absorption %	Appr. Por. %	Other data: LOI %
2120 (1160) (Cone 1)	-	2475	5.20 (8.93)	5.94	-	5.20
	(3 sample bars fired)					

Remarks / Other Tests Experimental blend: 30% C shale (=Wkr. 80-2a) + 35% Floyd Top 1(=Fl.80-4a) + 35% Linton shale (Hancock Co., Ga.) +8% grog. May be suitable for 8" sewer pipe blend (good absorption); however, dry strength is low - not as good as x5 blend (=Fl.80-4d).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Cedar Grove (E. cntr.). Lat. _____, Long. _____.

Field No. C shale., Collected by O'Connor and Benzel. Date Aug. 1980.

Sample Method Random grab samples. Weathering/alteration Weathered.

Structural Attitude Bedding dips about 30°SE.

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Sample from E. side of dirt road (S-1763) about 0.2 mi. N. of junction of Hogjowl Creek and Long Hollow Creek and 0.2 mi. NW. of location Wkr.80-3.

Compiled by B. J. O'Connor Date 10-20-87

CERAMIC TESTS AND ANALYSES

Material Shale (Red Mtn.). Compilation Map Location No. Wkr.80-3a

County Walker. Sample Number D shale.

Raw Properties: Lab & No. Georgia Tech., # DS.

Date Reported 12-10-80. Ceramist J. F. Benzel, Georgia Tech.

Water of Plasticity - % Working Properties -

Color - Drying Shrinkage 2.62 % Dry Strength (MOR) 92 psi.
Drying Wt. loss 19.05 %

Slow Firing Tests: (1x1x=9 in. bars.)

Approx. Temp. °F (°C)	Color	Hardness (MOR, psi.)	Linear Shrinkage, % (total)	Absorption %	Appr. Por. %	Other data: LOI %
2120 (1160) (Cone 1)	-	1055 (3 sample bars fired)	5.73 (8.35)	8.30	-	3.91

Remarks / Other Tests Experimental test firing for possible substitute in 8" sewer pipe blend (see Wkr.80-3b).

Preliminary Bloating (Quick Firing) Tests: Not determined.

CERAMIC TESTS AND ANALYSES

Material Shale (blend). Compilation Map Location No. Wkr.80-3b

County Walker (+Floyd and Hancock). Sample Number D shale-blend.

Raw Properties: Lab & No. Georgia Tech., #3D.

Date Reported 12-10-80. Ceramist J. F. Benzel, Georgia Tech.

Water of Plasticity - % Working Properties -

Color - Drying Shrinkage 3.88 % Dry Strength (MOR) 340 psi.
Drying Wt. loss 21.46 %

Slow Firing Tests: (1x1x=9 in. bars.)

Approx. Temp. °F (°C)	Color	Hardness (MOR, psi.)	Linear Shrinkage, % (total)	Absorption %	Appr. Por. %	Other data: LOI %
2120 (1160) (Cone 1)	-	2738 (3 sample bars fired)	5.11 (8.99)	6.64	-	5.08

Remarks / Other Tests Experimental 8" sewer pipe blend: 30% D shale (=Wkr.80-3a) +35% Floyd Top (Fl.80-4a) +35% Linton shale (Hancock Co., Ga.) + 8% grog. Not as good as x5 blend (= Fl.80-4d).

Preliminary Bloating (Quick Firing) Tests: Not determined.

Crushing Characteristics (unfired material) -

Particle Size - Retention Time -

Chemical & Mineralogical Data: Not determined.

Chemical Analysis		Mineralogy	
Oxide	Weight %	Mineral	volume %
SiO_2			
TiO_2		Quartz	
Al_2O_3		Feldspar	
Fe_2O_3		Carbonate	
FeO		Mica	
MnO		Chlorite-vermiculite	
MgO		Montmorillonite	
CaO		Others	
Na_2O			
K_2O			
P_2O_5			
S (total)		Total	
C (org)			
CO_2			
H_2O^-			
H_2O^+			
Ignition loss			
Total			

Analyst _____ _____

Date _____ _____

Method _____ _____

Sample Location Data:

County Walker. Land Lot _____, Sec. _____, Dist. _____.

7 1/2' topo quad. Cedar Grove (E. cntr.). Lat. _____, Long. _____.

Field No. D shale., Collected by O'Connor and Benzel Date Aug. 1980.

Sample Method Random grab samples. Weathering/alteration Weathered.

Structural Attitude Bedding dips SE.

Stratigraphic Assignment Red Mountain Formation (Silurian).

Sample Description & Comments Sample from E. side of dirt road (S-1763) about 0.1 mi. NE. of Long Hollow Creek and 0.2 mi. SE. of location Wkr.80-2.

Compiled by B. J. O'Connor Date 10-20-87

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- C24-72 Pyrometric cone equivalent (PCE) of refractory materials, Part 17, p. 9-14.
- C27-70 Classification of fireclay and high-alumina refractory brick, Part 17, p. 15-17.
- C43-70 Standard definitions of terms relating to structural clay products, Part 16, p. 33-35.
- C62-69 Standard specification for building brick (solid masonry units made from clay or shale), Part 16, p. 121-125.
- C216-71 Standard specification for facing brick (solid masonry units made from clay or shale), Part 16, p. 121-125.
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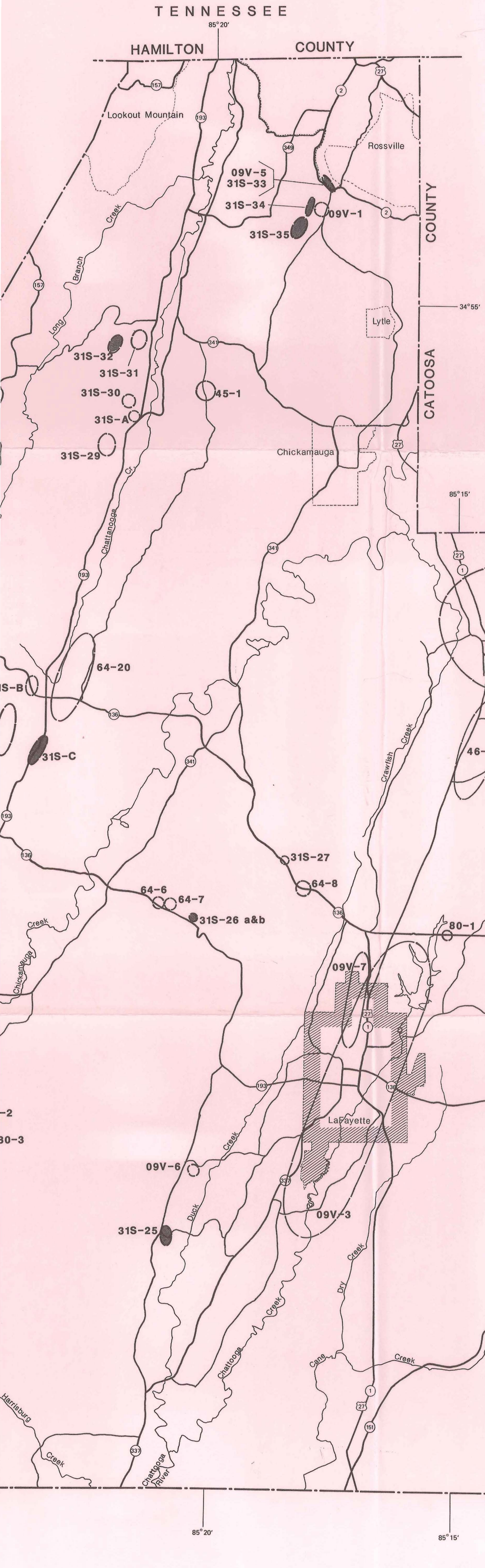
Plate 1

CLAY AND SHALE TEST LOCATIONS IN WALKER COUNTY



EXPLANATION

09V-1 Numbers correspond to the "Map Location No." in text.

Exact sample location.

Approximate sample location.

Several samples collected over the enclosed area. Boundary dashed where approximate.

Major roads

Streams and lakes

Location numbers:

Wkr. 09V-1 to Wkr. 09V-7
Wkr. 31S-25 to Wkr. 31S-35
Wkr. 31S-A to Wkr. 31S-C
Wkr. 45-1
Wkr. 46-1 to Wkr. 46-5
Wkr. 63-1
Wkr. 64-6 to Wkr. 64-8
Wkr. 64-20
Wkr. 69-1
Wkr. 80-1 to Wkr. 80-3

Not shown (location unknown):

Wkr. 64-1 to Wkr. 64-5
Wkr. 64-9 to Wkr. 64-19
Wkr. 64-21 to Wkr. 64-23