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Digital Image Analysis of Selected Tchefuncte and Alexander Series Ceramics

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DIGITAL IMAGE ANALYSIS OF SELECTED TCHFUNCTE AND
ALEXANDER SERIES CERAMICS

A Thesis

Submitted to the Graduate Faculty of
the Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Arts

in

The Department of Geography and Anthropology

by
Peter A. Cropley
B.A., University of Massachusetts at Boston 2002
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Abstract

In this study, I used digital image analysis to quantitatively describe and detail the prehistoric pottery associated with the coastal Tchefuncte culture (ca. B.C. 800—100 A.D.). The first step was to select and procure samples of Tchefuncte Plain *var. Tchefuncte*, *var. Mandeville*, Baldwin Plain *var. O'Neal*, and two decorated Alexander series wares from the Tchefuncte site. Two samples of *var. Tchefuncte* from the Bayou Jasmine site (16SJB2) and two Alexander series samples from the Tennessee-Tombigbee area were included for comparison. The sites represented by the samples from the Tennessee-Tombigbee region are the Kellogg Village Site (22CL527) and the Sanders Site (22CL917). Sediment samples were procured from near the Tchefuncte site in St. Tammany Parish, the Bayou Jasmine site in St. John the Baptist Parish, and from Lowndes County, Mississippi, an area associated with the Alexander series wares included in this study. The sediment samples were prepared and fired in a kiln at low temperatures similar to the conditions suggested for firing in the production of Tchefuncte wares. All of these samples were thin sectioned and digitally scanned for analysis. Analysis of the thin sections included digital point counting (via JMicrovision software) and digital image analysis (via ImageJ

software). The results of digital image study identified wide variability in paste constituents, particularly for the Tchefuncte pottery. While a generalized profile of each of the plainwares in the sample was identified, some sherds in the sample appeared to be mistyped. While a relatively clear distinction could be made between the two Tchefuncte varieties, the sandy-paste Baldwin Plain *var. O'Neal* was difficult to differentiate from Tchefuncte Plain *var. Mandeville* and Alexander Incised *var. Incised*.

Chapter 1: Introduction

The goal for this study was to answer questions concerning the origin and appropriate type-variety designation of a set of ceramics from the Pontchartrain phase of the Tchula Period that have been identified variously as locally and non-locally made. I conducted digital image analysis (via ImageJ software) and digital point counting (with JMicrovision software) on a selected sample of 12 prehistoric sherds from the Tchefuncte site (16ST1), two samples from the Bayou Jasmine Site (16SBJ2), and two samples from sites along the Tombigbee River in Clay County, Mississippi (Kellogg Village site 22CL527 and Sanders site 22CL917). All of the samples in the set were analyzed with the aforementioned digital image analysis software; a subset ($n = 5$) was analyzed using the digital point counting method to facilitate a discussion of the efficacy of both methods. Samples of source sediments ($n = 3$) were extracted from locales near the Tchefuncte site, the Bayou Jasmine site, and the now-submerged Clay County, Mississippi sites were analyzed in conjunction with the sherds.

This study was conducted to determine the origin of the sandy-paste wares from the Tchefuncte Site, and included several examples of Tchefuncte plainwares, sandy-paste sherds, and untempered sherds, along with examples of sandy-paste sherds associated with the Alexander ceramic tradition from the Tennessee-Tombigbee region in northeastern Mississippi and northwestern Alabama. With the results of this analysis, I attempted to define the relationships between the local Tchefuncte Plain varieties and the presumably non-local Alexander wares.

Organization of the Thesis

In this thesis, I provide the reader with summary information on the prehistoric Coastal Louisiana cultural background, development of prehistoric ceramics in the Southeast, and the

methods and materials used in this study before stating the results and conclusions generated by the digital analysis. The regional cultural background is presented in Chapter 2, while a summary of the origin of ceramics in the southeastern United States, in particular coastal Louisiana, is discussed in Chapter 3. Chapter 4 provides a summary of the previous work conducted at the sites associated with this study, while Chapter 5 contains a brief review of similar research. Chapter 6 details the methods and materials used in this study; the results of the study are presented in Chapter 7. Finally, Chapter 8 is a discussion of the conclusions that can be made as a result of this study.

Chapter 2: Cultural Background

This cultural background for the region includes a discussion of the Late/Terminal Archaic to Tchula period transition, the relevant phases of the Tchula period, and the subsequent Marksville transition. Particular emphasis will be on the phases, ceramic series, and any potential stratigraphic and chronological considerations related to the questions pursued in this study.

The Late Archaic-Tchefuncte Transition

Recently listed as a World Heritage Site, the Poverty Point Site (16WC5) is located in West Carroll Parish, Louisiana. The site contains the largest and most complex Archaic earthworks in North America (Gibson 2010:77). Poverty Point inhabitants were fisher-hunter-gatherers and were involved in long-distance trade networks to procure exotic goods, particularly high-quality stone. Sites with identified Poverty Point components invariably contain the famous Poverty Point baked clay objects, along with figurines, stone vessels, microflint tools, greenstone celts and hoes, iron-oxide plummets, and jasper beads and pendants (Gibson 2010:77). Less diagnostic items found at these sites include galena, fiber-tempered pottery, grinding stones, and groundstone celts.

In addition to exotic items, Tchefuncte series ceramics were recovered during excavations at the Poverty Point site. Tchefuncte ceramics appear consistently in the stratigraphic record at Poverty Point, suggesting that the ware was present from early in the occupation of the site to the latest Late/Terminal Archaic occupation (Hays and Weinstein 2004:161). However, the origin of the Tchefuncte wares at Poverty Point remains obscure; whether or not the site was a center of ceramic innovation also remains unclear. Gibson (1995:70) suggested that Tchefuncte wares were produced at Poverty Point and further surmised

that the site was one of several centers of independent invention of the ware. Gibson (1995) referred to this pottery as 'Old Floyd' Tchefuncte and described the ware as containing a clay/grit temper with Tchefuncte-like surface decorations. Despite the location of Tchefuncte wares in the early stratigraphic record, there is some question as to whether Gibson's 'Old Floyd' Tchefuncte scenario is tenable. A recent petrographic analysis of three Tchefuncte sherds from the site indicated that the sherds were not manufactured from sediments local to Poverty Point, or at least not from the specific sediment samples collected for the study (Hays and Weinstein 2004:163; Stoltman 2004:217-219; however, see also Gibson and Melancon 2004:169-192). Stoltman (2004:219) suggested that the Tchefuncte wares present within the Poverty Point context at the site may be post-depositional intrusions, though this suggestion is not entirely plausible if Tchefuncte pottery was present throughout the stratigraphic profile.

Despite the presence of Tchefuncte pottery within Poverty Point contexts, the nature of the relationship between the two cultures remains unclear. The Tchefuncte assemblage from Poverty Point differs from Tchefuncte assemblages at other sites. For example, during the excavation at Bayou Jasmine (16SJB2), the complete range of Tchefuncte wares were recovered at the deepest levels of the site tested, whereas coeval deposits at the Poverty Point Site lack the diversity of Tchefuncte varieties (Hays and Weinstein 2004:163-164; Gagliano and Saucier 1963:320-327). However, we must keep in mind that the excavation at Bayou Jasmine was discontinued before reaching the Poverty Point context. Over at the Jaketown Site (22HU505), the Poverty Point and the Tchefuncte components are well stratified; the Tchefuncte component exhibits a full range of wares as well, suggesting that the series arrived at Jaketown fully developed (Hays and Weinstein 2004:163-164).

The chronological gap of several centuries between the abandonment of Poverty Point and the first well-dated Tchefuncte sites leaves an open question as to the fate of Poverty Point culture. Kidder (2006) implicated a climate change, which resulted in extensive flooding of the Lower Mississippi Valley. He postulated that the entire valley was abandoned, creating a temporal gap between the Poverty Point and Tchefuncte cultures at approximately 1000-500 B.C. (3000-2500 Cal B.P.) (see Kidder 2006). Some researchers speculate that the traditions of Poverty Point may have lived on further south with the Olmecs in Mesoamerica (see Gibson 2010:95-96).

The Louisiana/Mississippi Gulf Coastal Tchefuncte Phases

The Tchefuncte culture represents one of the most studied and well-known Eastern Woodland cultures in the Lower Mississippi Valley (Hays and Weinstein 2010:97-98). The Tchula period dates from approximately 800 B.C. to A.D. 1, though some studies suggest that it may have been somewhat earlier (Kidder 2002:69-72; see also Hays and Weinstein 2010:110). Coastal Tchefuncte sites located along the Gulf coast typically range from the Lower Mississippi River Delta east to western Mississippi and west to the eastern Gulf coast of Texas (Weinstein 1986:102). The main features that distinguish coastal Tchefuncte culture from Poverty Point culture—large coastal shell middens, large-scale use of pottery, along with the significant reduction of long-range trade networks, exotic lithic industries, and mound-building (mounds only appear near the end of the period)—stand in stark contrast to the earlier Poverty Point culture. Indeed, the only exotic artifacts recovered from Tchefuncte sites are small amounts of Alexander series pottery (Hays and Weinstein 2010:104; Weinstein and Rivet 1978:1). This is one reason to question the extra-local status of Alexander wares on Tchefuncte sites.

The phases related to this study are situated along the Louisiana and Mississippi Gulf Coasts, and include the Pontchartrain, Beau Mire, Lafayette, Grand Lake, and Apple Street phases (Figure 1) (Weinstein 1986:109-118; Blitz and Mann 2000:98). All of these phases occur within the borders of modern Louisiana with the exception of the Apple Street phase, which is located in the Mississippi Sound region, where there is an area of overlapping Tchefuncte, Alexander, and Bayou La Batre ceramic traditions (Blitz and Mann 2000:98).

The settlement pattern of Tchefuncte peoples was deduced from sites located within the Lower Mississippi Valley. Tchefuncte sites generally were isolated small hamlets or villages situated along slow-moving streams. Excavations have revealed that the Tchefuncte peoples were relatively sedentary and lived at sites nearly year-round, indicated by the seasonal range of faunal remains, large quantities of ceramic sherds, and burials present in the middens at many sites (Hays and Weinstein 2010:104). Two site types have been identified for coastal Tchefuncte settlements (Shenkel 1984). The first type was comprised of large shell middens associated with hunting and fishing activities, such as Bayou Jasmine. The second type was a village site, with large, dense earth midden deposits, such as the Oak Island sites. Structures have not been identified at most Tchefuncte sites; however, at the Lafayette Mounds Site, an arc of post-holes was recorded by Ford and Quimby (1945:21-22), while post-holes in the earth midden at the Little Oak Island site in Orleans Parish were suggested to represent a shed-like structure (Shenkel and Holley 1975:232-233).

As mentioned previously, mounds were typically not present at most Tchefuncte sites. However, evidence is accruing for the appearance of Tchefuncte mounds late in the Tchula period. The burial mound at the Lafayette Mounds Site (16SM17) and the mound at the St. Mary's Mound Site (16MA62) are two examples (Hays and Weinstein 2010:107-108). Artifact

assemblages recovered from stratified contexts or intrusive trash pits at these two sites are almost purely Tchefuncte in origin. In northwest Mississippi, Late Tchula period burial mounds are considered part of the Lake Cormorant culture. However, mounds to the south and west of the Lake Cormorant culture area are still regarded with some skepticism concerning their association with Tchefuncte contexts (Hays and Weinstein 2010:107).

Subsistence patterns at Tchefuncte sites indicate a strong reliance on riverine and coastal flora and fauna (Hays and Weinstein 2010:107). Shellfish are well represented in the coastal middens, in particular *Rangia cuneata*, a brackish water clam. The remains of mammals, such as deer, otter, wolf, bear, fox, cougar, and raccoon are also present at Tchefuncte sites. Other remains also present at Tchefuncte sites include duck, geese, turtles, alligators, frogs, snakes, and a variety of fish (Byrd 1974; Lewis 1997).

Tchefuncte artifact assemblages include pottery, stone, bone, and shell tools. Ceramics exhibit a wide variety of decorative styles on poorly prepared and untempered pastes (see Tchefuncte ceramics section for a larger discussion of ceramics). Lithic artifacts are present in substantially lesser quantities than ceramics at Tchefuncte sites and include debitage and a variety of dart point types (Hays and Weinstein 2010:104). Other stone artifacts present at Tchefuncte sites include groundstone items such as hammerstones, plummets, bar weights, and mortars (Ford and Quimby 1945:37-41). Decorated and undecorated ceramic pipes and bone implements, often fashioned into fishing hooks and socketed points, are common at many Tchefuncte sites (Hays and Weinstein 2010:102). Baked clay objects also have been recovered at Tchefuncte sites, though in small quantities.

Coastal Tchefuncte Phases of Louisiana and Mississippi

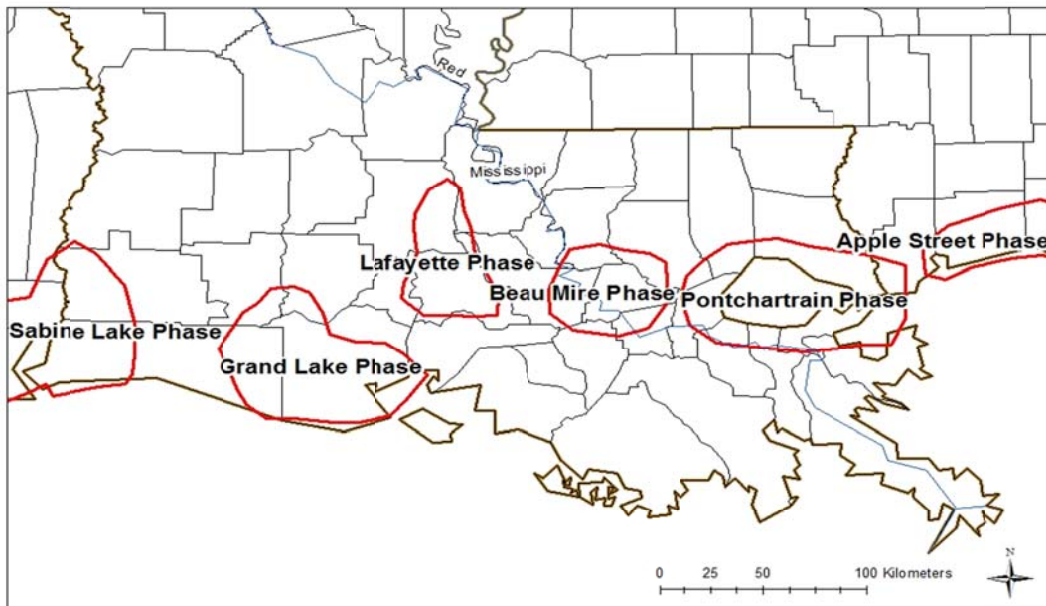


Figure 1. Coastal Tchefuncte Phases. Adapted by the author from Weinstein 1986:108.

Pontchartrain Phase

The Pontchartrain Phase takes its name from its location surrounding the Lake Pontchartrain Basin. Numerous excavations of Pontchartrain phase sites have been reported over several decades; these included excavations at the Little Woods sites (16OR1-5), the Big Oak Island site (16OR6), the Bayou Jasmine site (16SBJ82), and the Tchefuncte site (16ST1). This phase has received the greatest amount of research of the coastal period phases (Weinstein 1986:109).

Pontchartrain phase sites consisted of deeply stratified shell middens of varying sizes and shapes which are largely comprised of *Rangia cuneata* shells (Weinstein 1986:109).

Ceramics recovered from these sites are used to define the phase (Figure 2). In addition to the contorted and laminated pastes, shared by nearly all the Tchefuncte varieties, one of the most

significant attributes of Pontchartrain phase ceramic assemblages is the presence of sherds with sandy pastes. Now relegated to varieties of the Tchefuncte series, the Pontchartrain phase sandy-paste sherds were originally sorted into a Mandeville Series by Ford and Quimby (1945). These wares have since been reintegrated as varieties in the Tchefuncte series primarily due to the laminar and contorted appearance of the paste (Rivet 1973:71-72; Weinstein 1986:109; Weinstein and Rivet 1978:26-28). Pontchartrain phase sites typically contain numerous varieties of untempered and sandy paste types, including Tchefuncte Plain, Tchefuncte Incised, Tchefuncte Stamped, Tammany Punctated, Orleans Punctated, Lake Borgne Incised, Tchefuncte Red, Tchefuncte Cord Impressed, and Tchefuncte Bold Check Stamped (Weinstein 1986:109-112). Whether the sandy paste varieties are intentionally tempered or simply the result of naturally sandy raw clays remains an open question. It has long been recognized, however, that a few of these types and varieties share many attributes with ceramics of the Alexander series originating in the Tennessee and Tombigbee Valleys of interior Mississippi and Alabama (Blitz and Mann 2000:98; Weinstein 1986:109).

Beau Mire Phase

The Beau Mire phase is a collection of Tchefuncte components situated along the western margins of the Pontchartrain Basin. The Beau Mire type-site (16AN17) was originally located as the result of agricultural activities. Dr. Milton Newton of Louisiana State University made the first investigations at the site, which included a surface collection of artifacts (Weinstein and Rivet 1978:1). The surface-collected materials represented a Tchefuncte occupation with the inclusion of several Poverty Point-linked artifacts such as baked clay objects, microliths, and steatite sherds (Weinstein and Rivet 1978:1); however, the excavated material indicated only a

slight Poverty Point culture occupation prior to the Tchefuncte occupation. Beau Mire phase sites contain a distinct assemblage of ceramics, including high percentages of Orleans and Tammany Punctated, Lake Borgne Incised, along with diminished percentages of Tchefuncte Stamped sherds relative to sites associated with the Pontchartrain Phase (Weinstein 1986:115). In addition, a majority of Tchefuncte Plain var. *Tchefuncte* sherds at Beau Mire do not mirror the classic contorted and laminated pastes of Tchefuncte Plain from Pontchartrain Phase sites. Instead sherds are thin and well oxidized. Weinstein and Rivet (1978:31) speculated that this refined version of Tchefuncte Plain may represent a late Tchula version of the ware and that re-analysis and sorting of wares from the Tchefuncte and Oak Island Sites may reveal the ware in late stratigraphic contexts at the sites. Work by Fullen (2005) and Melançon (1999) has lent credence to this hypothesis. Fullen's hypothesis that the laminated and contorted appearance of Tchefuncte pottery diminished over time was confirmed in his comparison of sherds from the Sarah Peralta Site (16EBR67) and Bayou Jasmine sites. Fullen concluded that Tchefuncte potters refined their craft through time. Another indication that Beau Mire may be later than Pontchartrain is that surface decoration and other design elements, such as broad-line incising and cross-hatched rims (indications of Marksville influence) are present at Beau Mire (Weinstein 1986:115). Alexander series ceramics and Tchefuncte Plain var. *Mandeville* are not present at Beau Mire, marking another of the distinctions between the Pontchartrain Phase and this phase.



Lafayette Phase

The Lafayette Mounds Site (16SM17) in St. Martin Parish is the type-site for the Lafayette Phase of the late Tchula period and represents one of only a few mound sites excavated that indicate mound construction in the late Tchula Period (Hays and Weinstein 2010:107-109; Weinstein 1986:115). The site consists of three low, circular mounds located atop a natural levee within the floodplain of the Vermillion River. The Louisiana Archaeological Survey (LAS) made plans to excavate all three of the mounds in 1941, but the excavations were impeded by flooding and finally terminated by the withdrawal of funds by the WPA. Thus, only Mound 1 was excavated (Ford and Quimby 1945:21). This type of circular burial mound is a defining factor of the

Figure 2. Selected Decorated Ceramics from 16ST1. From top (L-R): a. Lake Borgne Incised *var. Unspecified*; b. Tchefuncte Incised *var. Unspecified*; c. Tchefuncte Stamped *var. Vermillion*; bottom row: d. Orleans Punctated *var. Unspecified*; e. Tammany Punctated *var. Tammany*. Photos Courtesy of R. Christopher Goodwin and Associates, Inc.

Lafayette Phase and they were likely communal burial locations for a dispersed population living in small villages or seasonal base camps (Weinstein 1986:117). This is a distinct feature of the Lafayette Phase, since other Tchula Period peoples typically buried their dead within shallow middens.

The original excavation at the Lafayette Mounds Site revealed a pre-mound surface prepared by removing the original natural soil and sediment to expose a desired surface of light-colored clay (Ford and Quimby 1945:22). Exposure of the pre-mound surface by archaeologists revealed post-molds, refuse pits, and artifacts, in particular Tchefuncte sherds (Ford and Quimby 1945:22). The post-molds did not reveal any recognizable shapes save for the appearance of one

arc that may represent the presence of a circular-shaped structure at the site (Ford and Quimby 1945:22). Thirty burials were located on top of the pre-mound floor of Mound 1 within an earthen mantle (Weinstein 1986:115). Twenty burials were flexed or bundled, the remaining ten could not be adequately interpreted. None of the burials in Mound 1 were associated with grave furniture, which is typical of Tchefuncte burials (Weinstein 1986:115). The primary mantle was 76 cm (29.9 in) at its thickest point and constructed of fill composed of silt and humus. The primary mantle was covered with a secondary mantle, which did not contain burials. The ceramics in the primary mantle fill were all identified as Tchefuncte types, while the overlying secondary mantle, which was as thick as the primary mantle, contained a mixture of Tchefuncte, Marksville, and Plaquemine period types (Ford and Quimby 1945:22; Weinstein 1986:117). The mixture of these pottery types in the secondary mantle is one of the major reasons that the concept of Tchula period mounds has remained so controversial (e.g., Neuman 1984:134-135).

Tchefuncte-Marksville Transition

The Marksville period follows the Early Woodland Tchefuncte period, and persisted from approximately A.D. 1 to 400 (McGimsey 2010:121). However, some of the traits of Marksville culture have been documented much earlier and later than this range of dates: grog-tempered Baytown Plain appears earlier, while some of the surface decoration attributed to the Marksville Period are present in contexts dated after A.D. 400. An association with the larger and more complex Hopewell culture of the Midwestern United States has been noted since Marksville was defined, due to a number of similarities in ceramic and other artifact styles, earthwork construction, mortuary practices, and raw material exchange networks (McGimsey 2010:120, 2000:11-12). These Hopewellian traits are found in sites located across the eastern United States

and several sites in Louisiana exhibit some of these attributes. However, work at Marksville sites in Louisiana suggests that these traits are rare. The largest site of the period, the Marksville Site (16AV1), is located in Avoyelles Parish and exhibited a complex and carefully planned ceremonial center (McGimsey 2010:121). The central area was enclosed within a C-shaped earthen embankment constructed of sediments from a borrow pit located adjacent to the exterior of the embankment. The apparent alignment of some of the structures with the sun, solstices, and some constellations suggests that the earthen embankment represented the enclosure of a sacred space and not a fortification (McGimsey 2010:122). Within the enclosure, six mounds of varying shapes and sizes were constructed. Only one of the mounds at the site contained burials.

Of particular interest at the Marksville Site was the presence of a series of low circular earthworks that contained a relatively deep basin within. One of these occurs within the main Marksville enclosure and seven occurred outside. The basin located within the embankment measured eight meters across and contained a deep, circular fire pit measuring 3 meters in diameter at the center. Excavation of the basins indicated fires that were “repeatedly ignited” and the ashes cleaned out after each use (McGimsey 2010:123). For instance, McGimsey’s (2001:52-64) excavation of a trench across Ring 2 in 2001 resulted in the exposure of the embankment, basin, and deep fire pit similar to the type previously mentioned. The exterior ditch associated with the ring appeared to contain a series of posts as well as refuse. The purpose of these earthen structures is not fully understood (McGimsey 2010:123).

Marksville sites are identified almost entirely by ceramics decorated with broad-incised geometric and zoned rocker-stamped designs. Motifs with possible significance to Hopewellian cosmology include the bird-raptor motifs identified on some mortuary vessels (McGimsey 2010:127). These decorative styles, along with the grog-tempered paste of Marksville pottery,

distinguished Marksville from Tchefuncte ceramics. Marksville pottery also generally lacks the contortions and laminated appearance of Tchefuncte wares. However, a number of Tchefuncte sites contain early Marksville components and there appear to be a small number of early-Marksville ceramics and Marksville-like decorative techniques appearing on late-period Tchefuncte ceramics at the Little Woods Sites, the Lafayette Mounds, the Tchefuncte site, Big Oak Island, and at Bayou Jasmine (Ford and Quimby 1945:5, 13-16, 23, 65-67; Hays and Weinstein 1996:52; Shenkel 1984:47; Weinstein and Rivet 1978:83-84). This indicates some level of continuity from Tchefuncte to Marksville cultural traditions.

Chapter 3: Prehistoric Ceramics in Southeastern Louisiana

Discussion of Ceramic Typology

Phillip Phillips (1970a; 1970b) formally introduced the type-variety concept to Southeastern ceramic typology to address issues surrounding the expression of cultural and historical relationships in archaeological ceramics. Put simply, the type-variety concept creates a taxonomic system of classification of ceramics. ‘Types’ are a combination of particular essential attributes and associations (decoration, pastes, modes, as well as areal, stratigraphic and temporal distribution, etc.) of a group of ceramics that distinguish it from other groups of ceramics (Phillips 1970a:23-31; Rice 1987:282-285). ‘Varieties’ are the smallest observable variations of these type attributes within the established type. For example, the type Coles Creek Incised

refers to those ceramics grouped together based on the aforementioned criteria, in this case rectilinear or curvilinear surface decoration on a grog-tempered paste (Phillips 1970a:69-76).

The Coles Creek Incised varieties express the distinctions made between the smallest observable variations in the associated attributes that comprise the type Coles Creek Incised; such as width, number, and distance between the incised lines.

The establishment of a type is based on several criteria (Phillips 1970a:33-36). These include background, sorting criteria, distribution, chronological position, and documentation.

The background information provided refers to any examples of the types and varieties located in the course of previous excavation and research. Sorting criteria are the basis for making the observable distinctions or associations in visible features of the variety, such as temper or decorative technique, among others. Distribution of varieties simply refers to the geographic position of the variety. Chronological position refers to the temporal association of the variety, whenever possible. Documentation refers to any literature, illustrations, or maps that are useful in describing the variety.

Development of Early Ceramic Traditions on the Gulf Coast

The Gulf Formational Stage (2500 to 100 B.C.) was developed by Walthall and Jenkins (1976) in order to consider the early invention and introduction of pottery into the cultural complexes within the Gulf Coastal Plain. The development of early ceramic complexes within the Gulf Formational Stage differed in substantial ways from the traditional sequences formulated for the East (Saunders and Hays 2004:1-3; Walthall and Jenkins 1976:43). Pottery became established throughout the eastern United States by 3000 rcybp (approximately 1000 B.C.) (Saunders and Hays 2004:2). However, along the South Atlantic Coast, and particularly

along the Savannah River, pottery occurred much earlier. The earliest pottery occurs at the Rabbit Mount Site (38AL15) at a corrected and calibrated date of around 3000 B.C. (Saunders and Hays 2004:2-3). From the lower Atlantic coast, pottery spread throughout most of Gulf and lower Atlantic coastal plains long before it appeared in the northeast.

The Gulf Formational Stage is separated into three periods; Early, Middle, and Late, and divided spatially into the Eastern and Western subregions. Each period represents a useful template for describing the specific suites of characteristics that define the local development as well as the external influences that occurred within the distinct cultural complexes across the Gulf Coastal Plain.

The Early Gulf Formational Period (3000-1200 B.C.)

The earliest ceramic wares to develop in the Southeastern United States were hand-modeled, fiber-tempered Stallings Island and Orange series wares (Jenkins et al. 1986:546). Stallings Island wares first appeared at the inland and coastal areas in the Savannah River region of Georgia-South Carolina, while the Orange series wares appeared first in St. Johns Valley in northeastern Florida (Jenkins et al. 1986: 546; Sassaman 1993:19; Walthall and Jenkins 1976: 43). Stallings Island wares are considered the oldest in North America, appearing around 3000 B.C. and disappearing by about 1000 B.C. (Jenkins et al. 1986:546; Sassaman 1993:16; Saunders and Hays 2004:6; Walthall and Jenkins 1976:44). Early complex Stallings Island ceramics exhibit mostly plain, undecorated wares, while simple linear or rectilinear punctations appear during the Middle complex. Late complex Stallings Island wares exhibit stab and drag decoration

with single punctations. The fiber-tempered Stallings Island complex shares decorative elements with the sandy paste Thoms Creek wares, the only exception being a finger-pinching treatment exclusive to coastal Thoms Creek wares (Sassaman 1993:20; Saunders and Hays 2004:7-8). The question of the temporal relationship between Stallings Island and Thoms Creek wares remains unresolved. Stalling was once considered unambiguously older than Thoms Creek, but recent radiocarbon dates places the two wares closer in time. Thoms Creek wares have been recovered from deposits along with Stallings Island pottery, and occasionally from discrete Thoms Creek contexts underlying these mixed Stallings Island-Thoms Creek assemblages (Saunders and Hays 2004:8). Adding to the difficulty is that there are also a number of sites with discrete Stallings Island assemblages recovered from beneath mixed assemblages. To date, no Thoms Creek assemblages have yielded dates older than Stallings Creek contexts. However, one difficulty in fine-tuning each wares' place in the chronological sequence is a lack of information on specific site function definitions at recovery locales (Saunders and Hays 2004:8).

The Orange ceramic complex appears to have developed slightly later than the Stallings Island complex, at around 2000 B.C. in the St. Johns Valley region of northeastern coastal Florida (Sassaman 1993:20-21; Saunders and Hays 2004:5-7; Walthall and Jenkins 1976:44). These fiber-tempered wares are typically recovered from large oyster shell middens along the St. Johns and Indian Rivers in coastal Florida. Traditional culture history descriptions have Orange series wares evolving from an undecorated, circular to rectangular pan-shaped vessel and later developing decorative elements such as narrow-lined, rectilinear incising and punctation (Jenkins et al. 1986:546-547; Walthall and Jenkins 1976:44). More recent work, however, suggests that decoration was part of the earliest assemblages (Sassaman 2003:11; Sassaman 2004:33). Around 1000 B.C., the St. Johns complex developed from the Orange complex. The St. Johns complex

was originally described as a chalky, temperless ware made of clays with naturally abundant sponge spicules. However, recent studies demonstrating the low frequency of sponge spicules in local clays indicate that St. Johns pottery with abundant spicules may indeed have been tempered (Rolland and Bond 2003). In any event, early St. Johns pottery bears incised designs similar to those on late Orange series wares, indicating some continuity.

The Middle Gulf Formational Period (1200-500 B.C.)

Sand, grit, and clay-tempered ceramics, along with a suite of untempered wares, dominate ceramic complexes in the Middle Gulf Formational Period along the Gulf Coastal Plain. Fiber-tempered wares make their first appearance in the western Gulf Coastal region during this period. In the Georgia-Carolina region, the coil-built, sand-tempered Refuge complex developed out of the Stallings Island complex, at least in the interior (Walthall and Jenkins 1976:44). Along the Georgia coast, some researchers (Guerrero and Thomas 2008:374; Thomas 2008:424) distinguish a St. Simons ceramic complex distinct from Stallings; others do not. The designation of a St. Simons complex as a coastal variant of Stallings Island remains controversial; many researchers suggest it is not sortable as a distinct type from Stallings Island (see discussion in Saunders and Hays 2004:9-10).

Decoration of Refuge wares included simple and dentate stamping, incision, and punctuation; while vessel shapes included open bowls and straight-sided cups with flat bases. Several other wares also developed out of previous ceramic traditions. As noted above, the Early Gulf Formational Orange series wares developed into the St. Johns ceramic complex along the Atlantic Coast, while a limestone-tempered ware appears in peninsular Florida exhibiting attributes that infer a relationship with late-Orange series wares and possibly with Thom's Creek

or late Stallings Island wares (Sassaman 1993:21; Walthall 1990:83-84; Walthall and Jenkins 1976:45). The final Middle Gulf Formational Period ware recovered from the eastern Gulf Coastal Plain was the disputed Norwood series, which purportedly developed along the western Florida panhandle. This fiber-tempered ware was distinguished by a sandy fiber-tempered paste, which is no longer considered a valid sorting criterion, because sandy pastes appear elsewhere at this time (Saunders and Hays 2004:14).

The Middle Gulf Formational Period in the Western Gulf Coastal Plain is also marked by the appearance of the Wheeler series in eastern Mississippi and northwestern Alabama and the Bayou La Batre series in the Mobile Bay and Delta regions (Walthall 1990:87-88; Walthall and Jenkins 1976:45). Evidence from this period indicates an increase in interaction among groups from across the Gulf Coastal Plain. Contributions of decorative styles and manufacturing techniques from earlier ceramic complexes and the presence of non-local ceramics and other trade goods recovered from contemporaneous sites across the Gulf Coastal Plain provide evidence for this interaction across the Southeast.

The fiber-tempered Wheeler series exhibits decorative elements derived from the Early Gulf Formational Stallings Island ceramic complex; decorative elements appearing later in the Wheeler complex may have been influenced by Bayou La Batre wares from the Mobile Bay region (Walthall 1990:87). Dominant vessel types are a flat-based beaker and a simple bowl shape decorated with a variety of punctate styles; later vessels exhibit simple and dentate stamping (Walthall and Jenkins 1976:46).

The Bayou La Batre ceramic series was produced within the Mobile Delta and Mobile Bay regions and is found in shell midden sites extending northward into the forested areas along the Tombigbee and Alabama River drainages (Walthall 1990:95-98; Walthall and Jenkins

1976:45). Tempering for Bayou La Batre wares shifted over time from crushed quartzite and coarse sand, with a refinement in texture of these materials until a fine sand temper was preferred (Jenkins et al. 1986:550). These wares appeared during the Middle Gulf Formational Period, yet were produced well into the succeeding Late Gulf Formational Period. The earliest appearance of Bayou La Batre wares may predate the development of Tchefuncte wares (Blitz and Mann 2000:22); however, many researchers consider the two wares to be closely related.

Some of the pottery recovered from the Poverty Point site was produced during this period. The origin, nature, and characteristics of the ceramics recovered from these contexts at Poverty Point was and continues to be a major point of discussion among Southeastern archaeologists. The extensive trade networks developed by the inhabitants of Poverty Point have led some researchers to conclude that the earliest ceramics at the site were the fiber-tempered Wheeler ceramics that were transported along with steatite from the Alabama/Georgia Piedmont, while the St. Johns wares present at Poverty Point likely originated from Florida (Jenkins et al. 1986:548). However, Sassaman (1993:35-39) countered that the production and trade networks for steatite may have negatively influenced the development and adoption of ceramic technologies at Poverty Point. Select individuals or groups with control over the steatite trade may have been effective, for a time at least, in suppressing ceramic innovation or relegating it to the production of special-purpose items (Sassaman 1993:40). However, more recent research suggests that fiber-tempered pottery predates the importation of steatite at Poverty Point (see Sassaman 2002:410).

The most contentious ware from the earliest contexts at Poverty Point are of the Tchefuncte series, which some argue was made on site (see Gibson and Melancon 2004; see discussion in Chapter II), while others contend the wares were of non-local manufacture (Hays

and Weinstein 2004:163). According to Gibson and Melancon (2004), Old Floyd Tchefuncte was early and locally made because it has a lower mean vertical position than fiber-tempered wares at the site.

St. Johns series wares were also recovered at Poverty Point. This spiculate-tempered pottery from eastern Florida was associated with the earliest occupations at Poverty Point. Radiocarbon dates associated with St. Johns sherds at the site yielded a date of 3250 B.P., which many consider to be the oldest pottery in the Lower Mississippi Valley (Hays and Weinstein 2004:167).

The Late Gulf Formational Period (500-100 B.C.)

Three major elements characterized the Late Gulf Formational period: 1) the disappearance of fiber-tempered wares 2) the development of the Tchefuncte and Alexander series wares in the Western Gulf Plain, and 3) the appearance of early-Woodland Deptford paddle-stamped wares in the Eastern Gulf Coastal Plain (Walthall and Jenkins 1976:47). Bayou La Batre wares continued to be produced in the Mobile Bay and Delta area of the Western Gulf Coastal Plain.

Alexander wares were originally identified and categorized from pottery collected in northern Alabama (Walthall and Jenkins 1976:47). A variety of the modes present in the Alexander series wares indicate influences from Wheeler, Tchefuncte, Bayou La Batre, and St. Johns complexes. Alexander assemblages recovered from areas spatially and temporally closer to one or the other parent complex tend to reflect more pronounced influence of that type (or types) (Walthall and Jenkins 1976:47) and this is reflected in the two defined Alexander phases, the

Hardin Phase and the Henson Springs Phase. Of particular interest is the Henson Springs Phase; two of the samples in this project are identified from Henson Springs Phase contexts in what is now the Tennessee-Tombigee Waterway.

Alexander wares are sand-tempered and typically exhibit decorative elements such as rectilinear and geometric incising, fingernail punctuating, and zoned dentate stamping (Jenkins et al. 1986:552). The internal chronology of the Alexander series, particularly in regards to its association with Tchefuncte and Wheeler series wares, is complicated by the purported early appearance of certain surface treatments at some sites and the absence or later appearance of different surface treatments at Alexander sites, such as at the Sanders and Kellogg Village Sites. Radiocarbon dates from the Henson Springs Phase Sakti-Chaha (40HR100) and Aralia (22IT563) sites indicated an early preference for pinched or fingernail-punctated surface decoration, with a marked increase in the use of incising in later Henson Springs Phase contexts. Conversely, radiocarbon data from the Sanders site yielded dates earlier than Sakti-Chaha and Aralia, despite the dominance of incised surface decoration (O’Hear 1990:98-103). Regardless, Alexander wares are often recovered from Tchefuncte and Wheeler contexts, indicating some relationship and/or influence with the two complexes, in particular the Wheeler complex (Jenkins et al. 1986:552; Saunders and Hays 2004:14-15; Walthall 1990:102-103).

Background of Tchefuncte Series Ceramics

Tchefuncte pottery has very distinctive ware characteristics; it is identifiable by laminated and contorted pastes, thought to be the result of poor wedging (or kneading) of raw clays during paste preparation (Ford and Quimby 1945: 67; Shenkel 1984:47). The contortion of Tchefuncte pastes refers to the ‘waves’ visible in cross-section (Fullen 2005:100). Laminations (or

separations) appear in pastes when organic materials are not thoroughly removed during preparation of the raw clay or due to improper kneading and forming of vessel coils prior to firing.

The paste of Tchefuncte ceramics is generally temperless; though incidental inclusions of grog (crushed sherds) or argillaceous clay pellets [ACP], small amounts of sand, grit, or vegetable fiber do occur (Ford and Quimby 1945:52-64; Hays and Weinstein 2010:98; Shenkel 1984:47). A recent petrographic analysis of Tchefuncte ceramics has confirmed that the grog identified in some sherds from the Tchefuncte components were naturally occurring clay pellets and not crushed sherds (Heller et al. 2013:327-328). All other grog-tempered plainwares from the Lower Mississippi Valley are identified as Baytown Plain (Phillips 1970); though Gibson, as noted, defined an 'Old Floyd' Tchefuncte at Poverty Point that is clay-grog tempered (Gibson and Melancon 2004:174). Sherds recovered from Tchefuncte sites typically range in color from dark or light gray to reddish buff (Ford and Quimby 1945:52-64).

Tchefuncte Plain vessels have surfaces that appear to have been 'floated', that is fine clay particles in the paste were brought to the surface of the vessel by rubbing it with a pebble or other hard implement while still damp (Ford and Quimby 1945:52). Most types of Tchefuncte pottery were poorly fired, resulting in poor tensile strength and a dark carbonized core (Ford and Quimby 1945:52-64). An exception to this from the Tchefuncte site is Chinchuba Brushed, which typically does not exhibit a carbonized core (Ford and Quimby 1945:64).

Vessel forms are typically bowls and jars with the 'tubby pot' (a small jar type) being the most frequently identified shape (Hays and Weinstein 2010:102). Bowl forms include round bowls with restricted mouths and wide shoulders (cazuelas), open bowls with no shoulder and wide mouths, and round bowls that widen just below the lip with slight restriction at the mouth.

Jar vessel forms include the aforementioned 'tubby pot,' as well as deep jars with slightly restricted necks and no flaring, a deep jar with unrestricted opening (beaker), a flared deep jar with slightly restricted neck, and a deep oval jar with restriction at the mouth and increased width at the shoulder (Ford and Quimby 1945:72; Heller 2012:21-22). Many jars and bowls exhibit basal supports in the form of wedge-shaped and teat-shaped legs (Ford and Quimby 1945:72). Other basal supports include multi-wedged and annular legs and bases.

Decorative motifs on Tchefuncte paste are diverse, and include simple and rocker stamping and geometric incising with deep, narrow, wide and/or shallow lines (Shenkel 1984:48). Also included are drag-and-jab incising, punctating with a variety of objects, pinching, and cord marking (Melancon 1996). These decorative techniques are used to define the types of ceramics of the Tchefuncte series, with each type then having its own distinct varieties. Ceramics exhibiting only incised lines are typed Tchefuncte Incised (Phillips 1970:162; Weinstein and Rivet 1978:36-40). Rocker and dentate-rocker stamped varieties are included under the type Tchefuncte Stamped (Ford and Quimby 1945:56-57; Phillips 1970:164-165) while thin-lined, drag-and-jab decorated ceramics are typed as Lake Borgne Incised (Ford and Quimby 1945:61-62; Rivet 1973:52-53; Weinstein and Rivet 1978:63-64). The type Tammany Pinched includes varieties that exhibit decorations made using fingers or fingernails (Weinstein and Rivet 1978:51-53). The type Orleans Punctated includes sherds with tool-made punctations set in zones of incised lines (Weinstein and Rivet 1978:71-72). Based on research at the Bayou Chene Blanc Site (16LV43), a new type has recently been added, Chene Blanc Plain, which is typically thinner and harder than Tchefuncte Plain. Chene Blanc Plain appears less laminated than Tchefuncte Plain though it still exhibits some contortion of paste and may contain incidental inclusions of hematite, bone, and grog (Hays and Weinstein 2000:66-69).

Discussion of Tchefuncte and Tchefuncte-related Plainwares

Tchefuncte plainwares represent the largest portions of assemblages recovered from Tchula period sites. Since the identification of Tchefuncte Plain by Ford and Quimby (1945), there have been several varieties added to the type (see Phillips 1970; Weinstein and Rivet 1978:26). This is the result of variation identified in the pastes of plainwares across the distinct Tchefuncte phases of the Tchula period. A discussion of the types relevant to my research and to the Tchefuncte site is presented below.

Tchefuncte Plain *var. Tchefuncte*

Tchefuncte Plain *var. Tchefuncte* appears in large quantities at the Tchefuncte site. Sherds of *var. Tchefuncte* recovered from Middens A and B totaled 31,735 and represent nearly 64% of the total ceramics recovered from the site (Ford and Quimby 1945:13-16). This plainware is identified by its laminated and contorted paste, the result of poor preparation of fine clay material prior to low temperature firing (Ford and Quimby 1945:52-54; Weinstein and Rivet 1978:29). Attempts to replicate Tchefuncte pottery only resulted in Tchefuncte-like pastes if clay was taken from the source and formed into a pot with absolutely no preparation at all (Gertjejansen et al. 1983). Gertjejansen et al. (1983) speculated that these factors also may account for the large amounts of Tchefuncte sherds at Tchula Period sites—most pots probably did not survive the firing process.

Inclusions of material in the paste of Tchefuncte Plain *var. Tchefuncte* appear to be incidental and include small amounts of hematite, shell, grog, sand, bone, and fiber (Hays and Weinstein 2010:98; Rivet 1973:69-70). Color ranges from reddish buff to dark gray and surface finishes are generally chalky and smoothed but bumpy. Toolmarks are sometimes visible on the interiors and exteriors of the ware (Rivet 1973:69-70). This description is directly related to sherds recovered from the Tchefuncte site; however, slight distinctions between the pastes, modes, and textures of Pontchartrain Phase plainware from other phases outside the Pontchartrain basin have been identified. For example, most of the Tchefuncte Plain *var. Tchefuncte* from the Beau Mire Site (16AN17) exhibit the laminated and contorted paste like the Pontchartrain Phase examples, but are thinner, buff to light orange in color, and do not have the dark carbonized interiors of the type-site sherds (Weinstein and Rivet 1978:30-31).

Chronology and Distribution of Tchefuncte Plain *var. Tchefuncte*

Tchefuncte Plain *var. Tchefuncte* occurs spatially at many Tchefuncte sites and is temporally distributed throughout the Tchula Period phases (Weinstein and Rivet 1978:33-35). As discussed for the Beau Mire and Bayou Chene Blanc sites above, differences in the paste, texture, and temper of *var. Tchefuncte* are identified at a number of sites across the spectrum of Tchefuncte phases. As noted above, the differences in Tchefuncte Plain *var. Tchefuncte* between these two phases may indicate a temporal distinction, with the *var. Tchefuncte* from the Pontchartrain Phase sites being an early Tchula marker, and the Beau Mire site sherds representative of a late (or later) Tchula manifestation (Weinstein and Rivet 1978:30-31). Further research into the chronological and stratigraphic position of Tchefuncte Plain may result in the designation of new varieties of with spatial or temporal relevance (Weinstein and Rivet 1978:30-35).

Tchefuncte Plain var. *Mandeville*

Over the years of research into Tchefuncte ceramics, var. *Mandeville* has been the subject of a large amount of discussion in relation to its origin and its type-variety designation (Hays and Weinstein 2010:98-99; Shenkel 1984:48-53; Weinstein and Rivet 1978:26-28). While Ford and Quimby (1945) and Shenkel (1980:74) described this sandy paste ware as a distinct type (Mandeville Plain), most archaeologists in the Lower Mississippi Valley consider the sandy-paste ware to be a variety of Tchefuncte Plain (Hays and Weinstein 2010: 98). The relegation of Mandeville Plain to variety status was initially proposed by Phillips (1970:109-110), then fully integrated as a variety by Rivet (1973:71-72). Decorated sherds of sandy paste Tchefuncte wares are relegated to varieties of each associated decorated type (Phillips 1970; Weinstein and Rivet 1978).

Tchefuncte Plain var. *Mandeville* represents the second most frequent type of ceramic recovered from 16ST1. A total of 8893 sherds of var. *Mandeville* were recovered from the middens at the site and represent nearly 18 per cent of the ceramic assemblage from both middens (Ford and Quimby 1945:13-16). This variety of Tchefuncte Plain exhibits a fine to coarse texture and contorted and a laminated sandy paste (Rivet 1973:71-72). Thus, despite the inclusion of sand and grit to the paste, this variety is similar in nearly every other attribute to var. *Tchefuncte*, except for the absence of carbonized interiors (Ford and Quimby 1945:62; Rivet 1973:71-72; Weinstein and Rivet 1978:26-35). The lack of dark cores is probably directly related to the abundant sand in the ware. Quartz grains would open up pore spaces in the clay fabric, allowing for better heat penetration during firing—hence the lack of dark cores.

Shenkel (1984:48-50) argued for the type status of Mandeville Plain, noting the distinctions in surface decoration (including rim profile and treatment, and vessel shape) between the sandy paste and non-sandy paste examples. Shenkel (1984:48-50) noted that the traditional sorting criteria of texture, color, and cross-section quality would indeed relegate Mandeville Plain to variety status, since the inclusion of sand to the paste of Mandeville Plain is regarded as unintentional. However, taking the surface treatments discussed earlier into consideration, Shenkel argued that since the traditional sorting criteria are essentially independent of one another within the Tchefuncte series wares, the surface decoration on the non-sandy and sandy paste wares would need to be similar enough to include Mandeville Plain as a variety of Tchefuncte Plain (Shenkel 1984:49). According to Shenkel, the Oak Island examples of both wares exhibit enough difference in surface treatments and basal supports to separate the two into different types. Shenkel further speculated about a connection between Mandeville Plain and the Alexander series wares found at the Oak Island and Tchefuncte sites (Shenkel 1984:50). He also suggested that future research may reveal that the introduction of sand-tempering may have come down the Pearl River into the eastern Pontchartrain Basin from the Alexander culture area (Shenkel 1984:62), while the temperless tradition may be rooted within the Lower Mississippi Valley.

Chronology and Distribution of Tchefuncte Plain *var.* Mandeville

Weinstein and Rivet (1978:28-29) suggested that Tchefuncte Plain *var.* Mandeville is somewhat difficult to place chronologically. While not present at Beau Mire, the upper stratigraphic position of *var.* Mandeville at the Oak Island and Tchefuncte sites appears to place it as a late Tchula period variety (Ford and Quimby 1945:74-84; Shenkel 1974:51). Since the

identification of Beau Mire as a late Tchula period site, it is surprising that *var. Mandeville* is lacking in the assemblage at the site (Weinstein and Rivet 1978:28-29). A plausible explanation for this is that *var. Mandeville* is unique to the Pontchartrain Basin (Weinstein and Rivet 1978:28). Additionally, a recent study analyzing the ceramics from the Tchefuncte Site assemblage (Heller 2013:328) confirmed that *var. Mandeville* likely is a Pontchartrain Phase marker as it does not have a significant presence in the assemblages of other Tchula phase sites.

The Alexander Series and Baldwin Plain *var. O'Neal* (aka O'Neal Plain)

Alexander series ceramics are present on a number of Tchefuncte period sites including 16ST1 (Ford and Quimby 1945:14-15). Decorated Alexander sherds at the site comprised 0.25 per cent (n = 86) of the total assemblage (n = 34,255). The decorative treatments associated with Alexander series ceramics are rectilinear or geometric incising, finger punctating, and zoned dentate incising on a coarse sandy paste (Saunders and Hays 2004:14-15). The plainware in this series, Baldwin Plain *var. O'Neal* (aka O'Neal Plain), is a coarse sand-tempered ware found at a number of Pontchartrain phase sites. Paste colors range from buff to gray in color and the sherds occasionally exhibit rim bosses or rim notching similar to Alexander Pinched and Alexander Incised (Ford and Quimby 1945:65; Jenkins 1981:123-127; Rivet 1973:54-56). The distinction between the *var. Mandeville* and the Baldwin Plain *var. O'Neal* sherds is made by the comparison between the typical laminated and contorted paste of Tchefuncte wares and the non-laminated and coarse sandy paste of the Alexander series ceramics (Weinstein and Rivet 1978:27).

A total of 671 sherds of Baldwin Plain *var. O'Neal* (about 2 per cent) were recovered from the middens at the Tchefuncte site. While this represents only a small fraction of the large

assemblage at the Tchefuncte type site, the presence of Alexander series wares at a number of other Tchefuncte occupations is important because it has been suggested as a marker for some variety of interaction, however minimal, between the Lower Mississippi Valley and the Tennessee-Tombigbee Valley in north-central Mississippi and western Alabama (Ford and Quimby 1945:65; Hays and Weinstein 2010:100). This ware is included in the currently proposed project due to its presence on several Pontchartrain phase sites and its possible connection to Tchefuncte Plain *var. Mandeville*.

Chronology and Distribution of the Alexander Series and Baldwin Plain *var. O'Neal* (aka O'Neal Plain)

Alexander series ceramics in the current sample set are associated with the Henson Springs Phase of the Late Gulf Formational Period in the Tennessee-Tombigbee region (Jenkins 1981:19). While there are some uncertainties associated with dating Alexander series wares, some (Saunders and Hays 2004:14-15) cite a range between 500 B.C. and 300 B.C., while others (Dye and Galm 1986:34) posit a longer range of 600 B.C. to 100 B.C. Jenkins and Walthall (1976:47; see also Jenkins 1981:19) speculate that surface decorative treatments exhibited in Alexander series ceramics may have developed as the result of interaction between regional Bayou La Batre, Wheeler, and Tchefuncte ceramic complexes.

Chapter 4: Previous Work at the Tchefuncte Site 16ST1 and Related Sites

The Tchefuncte site is located in Fontainebleau State Park, approximately four miles east of the city of Mandeville, in St. Tammany Parish, Louisiana (Figure 3). The Tchefuncte site is situated in a brackish marsh setting at the edge of dry land on the north shore of Lake Pontchartrain (Figure 4). Site 16ST1 consists of two *Rangia cuneata* shell middens; both are oval-elongated in shape (Ford and Quimby 1945:11). Midden A is approximately 76.2 m (250 ft) in length and



Figure 3. 16ST1 Locator Map. Source: Google Earth

30.5 m (100 ft) in width. Midden B is approximately 45.7 m (150 ft) in length and 30.5 m in length (Figure 4). Both middens are oriented in a northeast-southwest fashion parallel to the shoreline of Lake Pontchartrain. The site belongs to the Pontchartrain Phase of the Tchefuncte culture but also contains artifacts indicating occupations associated with Poverty Point, Marksville, and Coles Creek cultures (Ford and Quimby 1945:31-51).

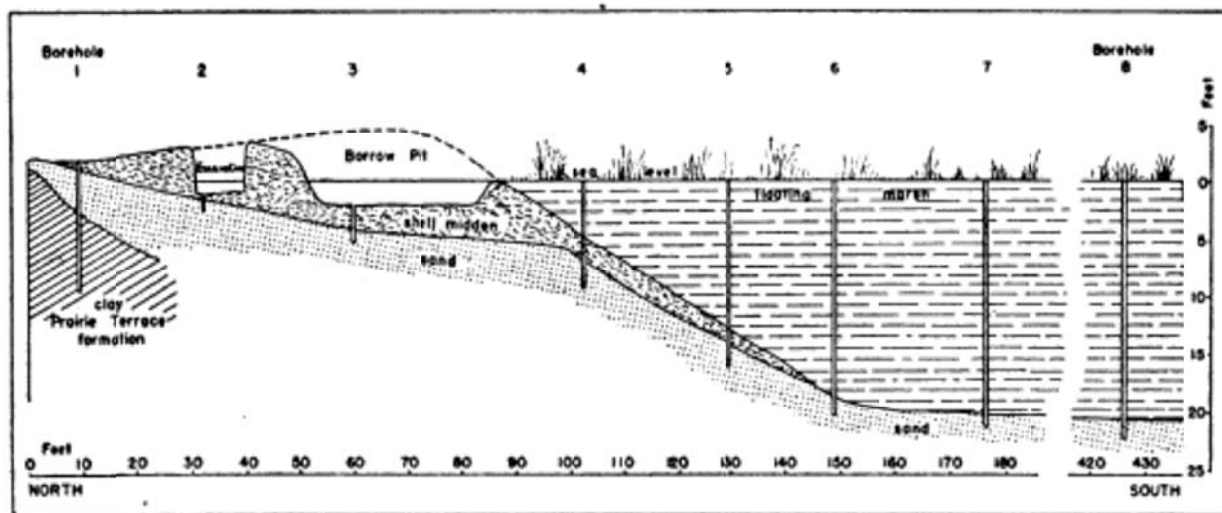


Figure 4. 16ST1 Midden B profile. Source: Ford and Quimby 1945:12.

Clarence L. Johnson of the Civilian Conservation Corps conducted initial work at the Tchefuncte site in the winter of 1938 (Ford and Quimby 1945:11). The work was initiated to mitigate damage that would be caused by shell dredging associated with road construction. (The *Rangia cuneata* shells that comprise the majority of the shell in the midden are often used in the manufacture of shell hash for road construction.) A few years before Johnson's work at the site, much of the top of Midden B was removed to produce shell hash (Ford and Quimby 1945:11). Subsequently, the southern portion of Midden B above the water level was mostly destroyed.

For Johnson's excavation, the Midden B area was gridded into five by five foot squares and 53 units were excavated (Ford and Quimby 1945:12). Thirty-six of these units were excavated to the water table, to an approximate depth of 75 cms (2.5 ft). Only two of the units were excavated using arbitrary levels of three inches to maintain provenience control; the remaining units were excavated with no vertical control. The base of the midden deposit was reached on the western portion of Midden B, but the remaining portion of the midden extended

to below the water table and excavation was terminated. The authors note that cultural material was still present. No features representing structural remains were identified during excavation, though several clean lenses of *Rangia cuneata* shells were recorded, possibly indicating shucking stations (Ford and Quimby 1945:12).

In January and February of 1941, archaeologists from the Louisiana Archaeological Survey began excavation the remaining portions of 16ST1 (Ford and Quimby 1945:12). The remaining unexcavated portion of the site was gridded into five by five foot squares and excavated in six-inch levels. The bases of both middens were encountered in most of the excavated units at depths sometimes below the water table. Trench profiles and borings conducted at the site indicated that both middens were deposited atop a sloping sandy beach, which in turn is underlain by clays representative of the Prairie Terrace formation (Ford and Quimby 1945:13).

Midden A artifacts consisted of 38,536 ceramic sherds, as well as faunal remains, smoking pipes, Poverty Point clay objects, chipped stone tools, and groundstone implements. The artifacts recovered from Midden B totaled 11,739 and consisted mostly of ceramics. The smoking pipes are constructed of a sandy paste material similar to the paste of Tchefuncte Plain *var. Mandeville* and represented, at the time, some of the earliest evidence for smoking in the eastern United States (Ford and Quimby 1945:29). Tubular ceramic pipes have since been recovered from earlier sites, such as Poverty Point (Gibson 2010:77). Both middens contained human remains scattered in the middens as well as in flexed and pit burials (Ford and Quimby 1945:13-16). A total of 43 burials were located during excavation, 22 in bundles and 21 in flexed positions. Of these burials, 16 were prone, and 11 of these were oriented with the skull to the east (Ford and Quimby 1945:26). The remaining burials were in a supine (extended, with the

face up) or indeterminate position. Associated grave goods were absent, typical of Tchefuncte burial contexts (Ford and Quimby 1945:26).

Related Site Descriptions

The Bayou Jasmine Site (16SJB2)

The Bayou Jasmine Site is situated between Lake Maurepas and Lake Pontchartrain on the swampy natural levee of Bayou Jasmine (Hays and Weinstein 1999:51). The site represents one of the most significant rangia shell middens in coastal Louisiana, and it is the earliest known Tchefuncte occupation excavated to date (Hays and Weinstein 1999:61). The excavation at Bayou Jasmine was conducted in 1975 by Robert Neuman and consisted of three test units totaling 9.9 m² (106.5 ft²) (Hays and Weinstein 1999:52-53). The Bayou Jasmine Site measured approximately 85 m (278.8 ft) by along its north-south axis and 50 m (164.0 ft) along its east-west axis. Auger tests conducted by Neuman (1975) revealed deposits extending to a maximum depth of 5.48 m (17.9 ft) below surface. Since the site was situated below sea-level, the units were encased in coffer dams and the units were pumped dry. Nevertheless, water pumps ran continuously to alleviate the influx of water into the units (Neuman 1975, 1977; Hays and Weinstein 1999:52-53). Despite these precautions, digging at these tests units was eventually terminated at approximately 2.8 m (9.2 ft) due to slumping of unit walls due to flooding as well as a lack of funds (Hays and Weinstein 1999:53).

In total, over 16,000 ceramic sherds, as well as other artifacts, were recovered from deeply stratified contexts. Tchefuncte ceramics dominate the assemblage recovered from the site, though Marksville, Coles Creek, and Plaquemines ceramics were recovered from the upper

levels of the excavated midden. Additionally, Poverty Point-related artifacts had been recovered from the spoil banks by collectors (Hays and Weinstein 1999:57).

A suite of radiocarbon assays from the site indicates that earliest date from the site was approximately 800 B.C. (Hays and Weinstein 1999:59). Calibrated dates from the Tchefuncte contexts at the site range from 1000 to 10 B.C (1 sigma). These assays predated earlier estimates of Tchefuncte occupations, which indicated that the culture began at around 500 B.C. The stratigraphic distribution of Tchefuncte ceramics at the site revealed the presence of nearly all the Tchefuncte types in the deepest, earliest levels of the site and a decrease in the diversity of varieties through time (Hays and Weinstein 1999:82). While Tchefuncte Plain *var. Tchefuncte* is present in large quantities (n= 13,973; 86.2 per cent) in the Tchula period contexts, the sandy paste *var. Mandeville* was recovered in relatively small quantities (n= 72; 0.4 per cent). Alexander series pottery from Bayou Jasmine were recovered in low quantities as well, represented only by several sherds of Alexander Incised *var. Green Point* and O'Neal Plain *var. Nott* (Hays and Weinstein 1999:63-64).

The Kellogg Village Site (22CL527)

The Kellogg Village Site is located in the Columbus Lock and Dam area of the Tennessee-Tombigbee Waterway in Clay County, Mississippi (Atkinson et. al 1980:1-3). The site was originally located by a collector and excavated in 1980 by James Atkinson of the Mississippi State University Department of Anthropology. The site measured approximately 80 m (262.5 ft) x 60 m (196.8 ft) in total extent. Two excavation blocks were set up within the site boundary; one a 4 x 4 m (13.1 x 13.1 ft) block and the other a 4 x 2 m (13.1 x 6.6 ft) block (Atkinson et al. 1980:31-33). A total of 24 1 x 1 m test units were excavated within these two blocks during this

investigation, which also included extensive mechanical stripping to locate additional features and burials (Atkinson et al. 1980:31-41). Soil and pollen samples were taken from feature and burial locations for specialized analyses.

The site exhibits a long-term Native American occupation, ranging from the Middle Archaic through the Mississippi periods; it also contains historic 19th century component. Multiple midden, pit, post mold, and irregular or circular features were uncovered during the excavations and these features were associated with most of the components recorded at the site (Atkinson et. al 1980: 173). A total of 42 burials were located, many of which were determined to be from the Mississippi period, though at least two appear to be related to the Archaic component of the site (Atkinson et al 1980:151-152). The site was destroyed by erosion and flooding resulting from the construction of Columbus Lake and the John C. Stennis Lock (O'Hear 1990:3).

Of specific interest to this study is the Henson Springs phase component (Late Gulf Formational period), which, according to a radiocarbon date collected from the site, is roughly coeval with the Tchefuncte period in coastal Louisiana (Atkinson et. al 1980:260; see also dates for the Bayou Jasmine site: Hays and Weinstein 1996:61). A radiocarbon date obtained from a burnt mussel shell recovered from Feature 136 at the Kellogg Village Site returned an uncorrected date of 760 ± 70 B.C. which was calibrated using dendrochronological calibration to 922 ± 86 B.C. (Sample #UGa-2767; Atkinson et al. 1980:233-234). The authors make no mention of other correction and calibration techniques used to obtain these dates. Regardless, this date from the Kellogg Village site was considered by many to be too early, potentially due to the absorption of older carbonates into the mussel shell fragment utilized for the analysis (O'Hear 1990:98). With the exception of one date from the Middle Archaic, the remaining

radiocarbon dates from the Kellogg Village site were from much later contexts. Alexander series ceramics were well represented in the total assemblage at Kellogg Village and they represented the earliest Woodland period occupation at the site (Atkinson et al. 1980:138). While the sample from the site used for this study is a general surface find, it is clearly identifiable as an Alexander Incised *var. Unspecified* (Sample 15). The site report indicates that the upper 25 centimeters of the area was subject to aboriginal and recent agricultural disturbances, which mixed the Woodland and Mississippian materials contained within the level (Atkinson et. al 1980:48).

The Sanders Site (22CL917)

The Sanders site (22CL917) is situated along a relict channel of the Tombigbee River and is currently on an island that resulted from the flooding of the area when completion of the John C. Stennis Lock created Columbus Lake (O’Hear 1990:3). The Sanders site is a small Henson Springs phase shell and earth midden that contains mostly Alexander series ceramics (O’Hear 1990:18). The very small remaining portion of the ceramic assemblage consists of fiber-tempered Wheeler series sherds. At the time of O’Hear’s publication, the Sanders site was the only known site that contained an unmixed Alexander series assemblage. The site is in close proximity to the Kellogg Village Site—only 100 meters separate them. Both sites contain Henson Springs Phase assemblages and the authors suggest that this indicates that it is possible that the Sanders site may be a dump location related to the nearby Kellogg Village site (O’Hear 1990:105).

Six radiocarbon dates were obtained from charred hickory nut shells (n = 2), mussel shell (n = 2), and wood charcoal (n = 2) (O’Hear 1990:97). Three of the samples (Beta 27812—nut shell, 27814—wood charcoal, and 27815—mussel shell) were calibrated and cluster with a

midpoint ranging from 800-850 B.C. (O'Hear 1990:100). A calculated average mean of the uncorrected dates was then calibrated and resulted in a date of 2780 ± 25 B.P. (806 B.C.).

A variety of Alexander Incised was recovered during the excavation; the relatively early radiocarbon dates suggests an early appearance of incising on Alexander pastes in the Tombigbee region (O'Hear 1990:99-103). Other artifacts recovered from the site include chipped stone artifacts (including 12 Flint Creek projectile points), worked bone tools, pecked and groundstone artifacts, and faunal and plant remains (O'Hear 1990:44, 50, 60-96). The Alexander Incised *var. Unspecified* sample for this project (Sample 16) was obtained from Midden B, Zone C, Level 1, (O'Hear 1990:14-15).

Chapter 5: Previous Studies and Problem Solving with Ceramic Petrographic and Digital Image Analysis

Previous digital image and petrographic analyses of ceramics from a variety of archaeological sites and regions have revealed the utility of this type of analysis in determining similarities and differences in the taxonomic, chronological, and spatial distribution of numerous ceramic complexes. While there are volumes of studies utilizing these techniques, I will highlight two studies that used petrographic techniques to study ceramic artifacts from Louisiana (Saunders and Stoltman 1999; Stoltman 2004). An additional study comparing the efficacy of digital image analysis with standard petrographic analysis is also included (Livingood and Cordell 2009).

A study of complicated stamped sherds from 34 Coles Creek sites in southern Louisiana was conducted to determine whether complicated stamped vessels were made locally (at each site where they occurred) or whether vessels and/or paddles were transported across the southern Louisiana Coles Creek region (Saunders and Stoltman 1999). The decorative motifs of these complicated stamped wares were transferred to paper and a paddle matching analysis was conducted. The paddle-matching analysis indicated two cases where specific paddles were used to decorate complicated stamped vessels at two sets of sites. The petrographic analysis, as outlined by Stoltman (1989, 1991), was comprised of the paddle matches from the sites, plainwares (assumed to be local), and local clays. The results of the analysis indicated strong associations between each site's complicated stamped wares and the local wares. The authors conclude that in most cases, the complicated stamped wares were manufactured at these specific site locales in the southern Louisiana and were not imported from another region; in other words, paddles rather than pots were moving. Further, the implications of transported paddles, potters,

decorative styles, and manufacturing techniques between these sites argues strongly for a high level of interaction between these Coles Creek loci (Saunders and Stoltman 1999).

A persistent question about the origin of wares from the Poverty Point site (16WC5) in West Carroll Parish, Louisiana, has led researchers to employ a variety of methods to determine their origin. The question concerns whether or not Poverty Point peoples made pottery on site, or whether it is of non-local origin. A petrographic analysis of three Poverty Point objects (PPOs), samples of Wheeler, Tchefuncte, and St. Johns wares from the site, and three sediment samples extracted from contexts beneath one of the Poverty Point mounds (Mound E) was conducted to determine whether the items were of local or non-local manufacture (Stoltman 2004). The point counting procedure described later in the methods section was used to quantitatively describe each sample. The results of the analysis indicated that the soil samples were a close match for the PPOs, as expected. Two fiber-tempered sherds were also made of material that appears similar to the sediment samples (Stoltman 2004:221-222). The remaining samples did not exhibit similar relative proportions of grain sizes (sand, silt, and clay constituents) as the sediment samples and appeared to be of non-local manufacture. Stoltman (2004) offered a caveat—despite the fact that the majority of sherd samples did not resemble the PPOs and the local sediment samples, more local samples should be analyzed before a strong conclusion of non-local manufacture can be made. However, the data from his petrographic analysis did lead Stoltman to suggest that, except for some fiber-tempered vessels, Poverty Point peoples did not produce pottery (Stoltman 2004:222; however, see Gibson and Melancon 2004; and Ortmann and Kidder:2004).

A side-by-side comparison of digital images and petrographic analysis on a small sample of 29 Mississippian ceramics from the Pevey Site (22LW510) in Mississippi provides an excellent example of the possibilities and drawbacks of both techniques in studies on prehistoric

ceramics (Livingood and Cordell 2009). The study reviewed some of the available software used in digital analyses of this type and provided a detailed account of the process of scanning thin sections and preparing them for analysis. The article provided details pertaining to the proper resolution settings for scanning, the types of polarizing filters used, and the levels of success the software had in recognizing inclusions present in each of the samples. For this particular study Livingood and Cordell (2009), the Image-Pro Premier software created by Media Cybernetics, Inc. was used.

Digital image software, such as ImageJ or Image-Pro Premier, offers the ability to isolate, classify, measure, and characterize objects captured in scanned images or microphotographs for use in the analysis of a wide variety materials and objects. Petrographic analysis is the classification and analysis of materials in thin section via a specialized microscope utilizing a variety of techniques, in particular point-counting.

The drawbacks of digital image analysis of ceramics was discussed as well. Shell temper voids and shell temper inclusions, while mapped correctly 75% of the time, had to be hand-edited to some extent to differentiate between the two (Livingood and Cordell 2009:868). Grog temper posed a considerable challenge for the software application and was mapped with only 25% accuracy. These samples required substantial hand editing. In all, digital imaging generated over 50 measurements on identified features in the samples, including color, location, nearest neighbor information, and measurements such as length, breadth, area, perimeter, aspect ratio, symmetry, and convexity (Livingood and Cordell 2009:868). The petrographic analysis consisted of a point-count to quantify the relative abundance of inclusions; in this case each point was assigned to one of several categories. These categories included clay-matrix, non-temper voids,

silt particles, grog-temper, shell-temper, and shell- and grog-temper voids. Aplastic inclusions, mainly quartzite sand, were counted and assigned to size and composition categories.

The results from the two different techniques were compared to determine comparability between the two techniques. The identification of shell temper largely fell within the margin of error ($\pm 3.5\%$) defined for both techniques, as did non-temper voids in the samples. Conversely, the digital image software underestimated the number of birefringent particles, particularly smaller-grained quartz inclusions. Ultimately, the authors suggested that increasing the resolution of the images imported into the digital imaging software would likely reduce the error in these specific counts to within an acceptable margin of error (Livingood and Cordell 2009:869).

The relative time, materials, and monetary investments involved with both of the techniques also were compared (Livingood and Cordell 2009:870). The wide range of digital image analysis and other software required for this type of study were discussed along with the necessary scanning and computer equipment. Necessary equipment and training for conducting petrographic point counting was also reviewed, including the hardware and software available for these types of studies. The authors also provided details on the time investment of each approach. The creation of macroinstructions for classifying the images and the scanning and editing of each sample required a considerable time investment. Additionally, the time involved in conducting the point count on each of the samples was discussed in conjunction with the training necessary to complete them with confidence.

The conclusion of the authors was that both techniques serve as valuable tools for the study of ceramics. Each of the techniques had distinct advantages, depending upon which aspects of the ceramics were of interest in a particular investigation. They conceded that while

petrographic point counting methods may have broader applicability, the digital image analysis may provide advantages in temper analysis, especially if the sample size is large and the process can be automated.

Chapter 6: Methods and Materials

Research Goals

Using digital image analysis and digital petrographic analysis, I have attempted to determine the distinctions, if any, between the sand-tempered ceramics on Tchefuncte sites. Plain ceramics in

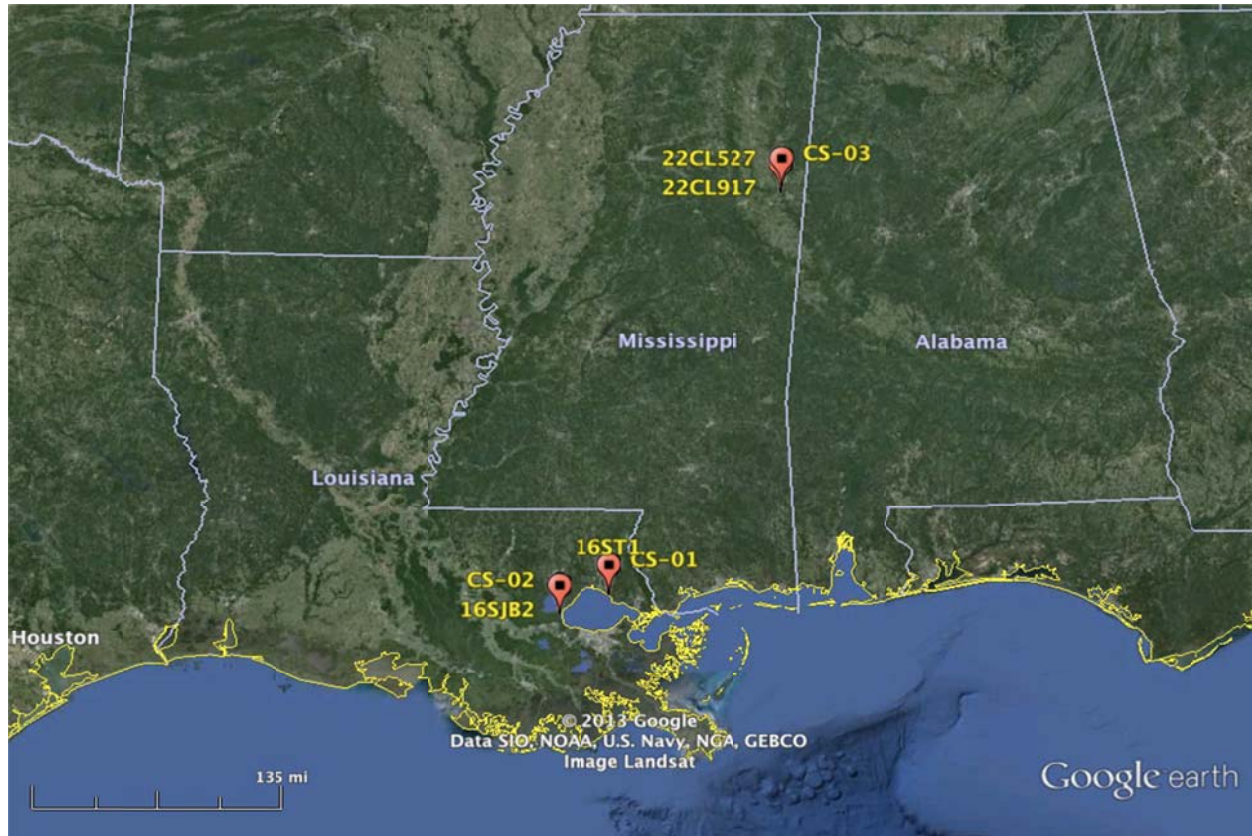


Figure 5. Related Sites and Clay Sample (CS-#) Locator. Map Source: Google Earth.

the sample have been identified as either the type Baldwin Plain *var. O'Neal* (n = 4) or as a local Pontchartrain Phase type Tchefuncte Plain *var. Mandeville* (n = 4). Alexander Incised *var. Unspecified* (n = 2) from the Alexander series of the Tennessee/Tombigbee Valley (MS/AL) were added as a control; one of these came from the Kellogg Village Site and one came from the Sanders Site (Figure 5; Table 1). As noted previously, the type Tchefuncte Plain *var. Mandeville* is typically distinguished from Tchefuncte Plain *var. Tchefuncte* by the unintentional inclusion of

fine sand in the paste of *var. Mandeville* (Rivet 1973:71-72; Weinstein and Rivet 1978:27-28). Both of these varieties (*var. Tchefuncte* and *var. Mandeville*) exhibit the contorted laminar paste typical of Tchefuncte wares. Two samples of Tchefuncte Plain *var. Tchefuncte* were selected from the Bayou Jasmine site along with four examples of the ware from the Tchefuncte Site; these were presumably locally made and will serve as additional controls. Alexander series ceramics from the Tchefuncte site were analyzed to determine how similar they were to the Alexander pottery from the ‘heartland’ of the ware. Additional digital image and digital petrographic analysis was done on clay samples collected from sediments near the Tchefuncte site in St. Tammany Parish and from the heartland of Alexander series ceramics in the Tennessee-Tombigbee region of central Mississippi-Alabama. National Petrographic, Inc. (www.nationalpetrographic.com) of Houston, Texas prepared the thin-section slides.

Table 1. Sherd and Raw Clay Sample Table by Site, Field Specimen # (FS), Type, Variety, and Provenience.

Specimen #	Site	FS#	Type	Variety	Midden	Unit	Stratigraphic Information ¹
1	Tchefuncte	14606	Tchefuncte Plain	<i>Tchefuncte</i>	A	40	D/9-12 inches (22.9-30.5 cm)
2	Tchefuncte	15289	Tchefuncte Plain	<i>Tchefuncte</i>	A	276	B/3-6 inches (7.6-15.2 cm)
3	Tchefuncte	17135	Tchefuncte Plain	<i>Tchefuncte</i>	B	835	D/9-12 inches (22.9-30.5 cm)
4	Tchefuncte	17349	Tchefuncte Plain	<i>Tchefuncte</i>	B	914	C/6-9 inches (15.2-22.9 cm)

¹Letters denote specific level system used by Ford and Quimby for excavation at the Tchefuncte site. Source: Ford and Quimby 1945:85.

Table 1, continued. Sherd and Raw Clay Sample Table by Site, Field Specimen (FS), Type, Variety, and Provenience.

Specimen #	Site	FS#	Type	Variety	Midden	Unit	Stratigraphic Information ¹
5	Tchefuncte	14784	Tchefuncte Plain	<i>Mandeville</i>	A	148	B/3-6 inches (7.6-15.2 cm)
6	Tchefuncte	15312	Tchefuncte Plain	<i>Mandeville</i>	A	293	E/12-15 inches (30.5-38.1 cm)
7	Tchefuncte	17135	Tchefuncte Plain	<i>Mandeville</i>	B	835	D/9-12 inches (22.9-30.5 cm)
8	Tchefuncte	17339	Tchefuncte Plain	<i>Mandeville</i>	B	911	C/6-9 inches (15.2-22.9 cm)
9	Tchefuncte	14739	Baldwin Plain	<i>O'Neal</i>	A	115	A/0-3 inches (0-7.6 cm)
10	Tchefuncte	15883	Baldwin Plain	<i>O'Neal</i>	A	483	E/12-15 inches (30.5-38.1 cm)
11	Tchefuncte	17276	Baldwin Plain	<i>O'Neal</i>	B	888	D/9-12 inches (22.9-30.5 cm)
12	Tchefuncte	15155	Baldwin Plain	<i>O'Neal</i>	A	442	B/3-6 inches (7.6-15.2 cm)
13	Bayou Jasmine	7221	Tchefuncte Plain	<i>Tchefuncte</i>	n/a	N5	140-150 cmbd
14	Bayou Jasmine	10686	Tchefuncte Plain	<i>Tchefuncte</i>	n/a	N5	210-220 cmbd
15	Kellogg Village	44	Alexander Incised	<i>unspecified</i>	n/a	general surface collection	surface
16	Sanders	21-9	Alexander Incised	<i>unspecified</i>	n/a	Unit 113R102 Zone C	Level 1 (0-10 cmbs)
17	Tchefuncte	CS-01	Clay Sample	n/a	n/a	n/a	50-70 cmbs
18	Bayou Jasmine	CS-02	Clay Sample	n/a	n/a	n/a	30-60 cmbs
19	Lowndes Co., MS	CS-03	Clay Sample	n/a	n/a	n/a	170-180 cmbs

¹Letters A through E denote level system used by Ford and Quimby for excavation at the Tchefuncte site. Source: Ford and Quimby 1945:85.

Methods: Basic Principles of Petrography and Analytical Techniques

Though ceramic petrography is considered somewhat outdated due to the availability of newer technologies, like Neutron Activation Analysis, to determine the composition of samples, the use of elemental composition is not without critics. Stoltman (2001:297-298) argued that petrographic analysis offers a unique and important opportunity to view the physical composition of ceramics in conjunction with newer techniques. While the usefulness of newer techniques of elemental composition is not in question, this project did not include elemental composition analysis.

Successful application of petrographic analysis of ceramics depends on three conditions. First, properly prepared thin sections must be available; second, a petrographic microscope must be available; and third, the analyst must have training in geology and the use of the petrographic microscope (Stoltman 2001:298). For this project, thin sections were prepared by an outside contractor (National Petrographic, Inc.). I have some very limited training in geology, and prepared for the analysis of the thin sections before working on the samples selected for this thesis by selecting readings and contacting individuals with experience in petrographic analysis to discuss the process. Additionally, I attended a petrographic workshop conducted by Dr. Chandra Reedy at the National Center for Preservation Technology and Training (NCPTT) in Natchitoches, Louisiana. In place of traditional petrographic analysis using a microscope, the freeware JMicrovison was utilized to examine a total of five of the samples from the entire set.

Simply put, petrography is the analysis of rocks and minerals in thin section (Stoltman 2001:299). Ceramic thin sections essentially contain two components—clay (plastic) and coarser-grained inclusions such as sand and silt. Other inclusions, intentional or otherwise, in the paste of ceramics can include grog, shell, bone, grit, hematite, and plant fibers, among other materials (Stoltman 2001:301).

In order to discuss paste composition, a distinction must be made between what Stoltman (2001:301) has described as the vessel paste and the vessel body. Paste refers to the natural clay material collected by potters before the addition of tempering material and includes any naturally occurring inclusions present in the material. The term body refers to all bulk constituents present in the material, natural or introduced by human hand. The main application of petrography to ceramics is to quantify the relative frequencies of sand, silt, and clay in the vessel paste (Stoltman 2001:301). The sizes and shapes of mineral and other inclusions in the vessel body are also identifiable during analysis.

Clay sources relied upon by prehistoric potters may contain naturally occurring or incidental inclusions of plant fibers, fossils, shell, bone, hematite, or grog. These are generally easily distinguishable as naturally occurring or as a purposeful additive using petrographic analysis and knowledge of clay resources. However, intentional sand or grit temper inclusions can be difficult to distinguish from naturally occurring sand inclusions (Rice 2005:411; Stoltman 2001:301; Stoltman 1991:111). Still, careful attention to texture, particle size, and angularity of sand grains can provide valuable information as to the nature of inclusions in sherds (Rice 2005:409-411). Determining the nature of sand or grit inclusions in clay material depends primarily on the characteristics of the source material, whether the clay is sedimentary or primary, and the angularity, size, and shape of the inclusions (Rice 2005:410-411). Identifying bimodal distributions of sand grain sizes in a sample can be an additional indicator that a sherd has been sand-tempered.

Stoltman (1991:111) also advocates procurement, firing, and preparation of thin-section slides of nearby clay source samples for comparison. This project included sediment samples from loci associated with the Tchefuncte site, the Bayou Jasmine Site, and the two sites in

Mississippi, in an attempt to address this issue. This is also the reason for the inclusion of Tchefuncte Plain var. *Tchefuncte*, as the ware does not typically have a sandy paste; determining whether any sand present is naturally occurring or purposefully added is of import. The sandy-paste Tchefuncte Plain var. *Mandeville* should appear quite different in thin section from its temperless compatriot, and comparison with the other selected sherds should prove to be an interesting exercise.

Quantitative analysis of thin sections can be applied to any inclusions in the body and paste of the sherd sample (Stoltman 2001:305). These analyses include measurement of mean grain sizes, percentages of grains of specific minerals, and percentage of artifact volume comprised by specific mineral content. There are two types of quantitative analyses that can be conducted with ceramic thin sections. The first is a visual comparison of thin-sectioned ceramic samples with test tiles representing measured amounts of mineral or other inclusions presented as percentages of minerals (or other materials) that may be present in the prepared samples (Stoltman 2001:305). The second technique is called point-counting which has two variants, the line method and the Glagolev-Chayes method; both require a special stage attachment to the microscope to move the thin section at specific intervals (Stoltman 2001:305). For this project, the digital image analysis software JMicrovision was used in lieu of a petrographic microscope. The line method involves recording any grains present along parallel, equally spaced lines along the thin section until reaching a preset number of observations, often 200-400 grains. This technique usually involves counting only sand-sized grains and often does not count other inclusions. Stoltman (2001:306) remarks that the limitations of the line method include the production of number frequencies that cannot be correlated to area, volume, weight, or

percentage. Additionally, the JMicrovision software does not offer a choice in methods, so the Glagolev-Chayes method was used.

The variety of tempered, untempered, and sandy paste wares involved required that a more robust analysis, such as the Glagolev-Chayes method, be made of each thin section. The analysis involves the counting of silt and sand-sized grains, and any inclusions present at specific intervals in a grid pattern along the thin section (Stoltman 2001:306). With the JMicrovision software, point counting utilizing scanned digital images was conducted using the same principals as the Glagolev-Chayes method outlined above.

The selection of an appropriate sampling interval is crucial to producing reliable results and it is important to choose an interval that is not smaller than the grains that are present. This can present a problem for ceramic analysts conducting petrographic analyses, since coarser inclusions in the body and paste of a sample can be larger than 1 mm (Stoltman 2001:306). However, a sampling interval of 1 mm is generally effective and reliable in the analysis of archaeological ceramics (see Stoltman 1989). Even for small sherds, the 1 mm sampling interval generally provides 100-300 counts per sample, which is reliable within a determined range of $\pm 3.5\%$ (Stoltman 1989:150-151). Results are presented in terms of a paste index; that is, only the characteristics of the parent material are counted and expressed as percentages of matrix (clay, which is not counted), sand, and silt according to standardized dimensions associated with each paste constituent (Figure 47). Clay particles are not measured because individual particles are not identifiable in thin section; they are recorded simply as 'matrix' (Stoltman 2004:211). Sand and silt particles are recorded and described in terms of size, and percentage of physical composition. Any temper included in the samples is described separately in terms of bulk composition of the vessel body (*sensu* Stoltman 2001). A standardized set of measurements for each constituent is

used to describe the material. Following the Wentworth scale (Rice 1987), silt is defined as material ranging from .002 mm to .0625 mm in size, while sand is anything larger than .0625 mm in maximum diameter (Stoltman 2004:211-212). These discrete size categories, along with matrix, are then expressed as percentages of paste.

In the following discussion, results are presented in three formats. First, the thin sections are described in qualitative terms regarding sand-silt-gravel composition of body and paste. A sand-size index is used to describe the average maximum diameter of sand grains in the sample along an ordinal scale. This ordinal scale is based on the Wentworth scale described earlier; (1) 0.0625 to 0.249 mm; (2) 0.25 to 0.499 mm; (3) 0.50 to 0.99 mm; (4) 1.00 to 1.99 mm; (5) greater than 2.00 mm (Stoltman 2001:314). These sand-size ranges were also used to create the bin ranges for the bimodal analysis. For that analysis, all data for sand grains for each sherd was tested for the presence of a bimodal distribution. If a bimodal distribution should be present, it may reveal the presence of two distinct sand size clusters which could indicate that a sample is sand-tempered (Rice 1987:410-411). These data are presented in tables or histograms, as appropriate. Finally, ternary diagrams are provided. Ternary diagrams are excellent visual representations of the relative percentages of the particle size classes; matrix (clay), sand (either as natural or intentional inclusion), and silt (Stoltman 2004).

Three postulates can be utilized for different scenarios concerning the production of ceramics—the provenience postulate, the local products-match postulate, and the spatial patterning postulate (Stoltman 2001:313-317). Each postulate is designed to answer specific questions regarding the physical characteristics, location, and association between wares, sites, and sediment samples. All of the aforementioned postulates can be utilized to determine the production locales and raw material sources of wares at a given site or set of sites.

The provenience postulate is designed to determine the location of manufacture for a ware recovered from a site by comparing it to local clay sources (Stoltman 2001:313-317). The local products-match postulate is designed to determine whether a ware was produced locally by comparing the pastes of sherds or vessels to the pastes of other wares already considered to be local products. The spatial patterning postulate involves comparing vessels of the same type across space to determine if the ware exhibits inter- and intra-site homogeneity. The implications of the results of these comparisons are discussed below.

First, the provenience postulate is used to confirm or negate whether a ware, or at least a particular sherd sample, was constructed of local clay material. Confirmation of the local origin of a sherd sample is positive if there is a match between the percentages of sand, silt, and clay-matrix present in the raw clay sample. It is negative if they do not match, or it can at least be ruled out that the sherd is not a match to the specific location where the raw clay sample was recovered. If this postulate is confirmed, the implication is that the ware is considered to be locally produced and its' presence at the site is not due to some form of exchange.

Secondly, the local-products match is confirmed if the percentages of sand, silt, and clay-matrix of a contentious ware matches those of a ware known to be of local manufacture. The characteristics of the ware in question should be consistent with the ware known to be of local manufacture in order to confirm this postulate. The implication of this postulate is that the two wares, provided they share the same or are derived from associated contexts, are likely from the same pottery tradition.

Thirdly, the spatial patterning postulate is used to evaluate the variability of characteristics of a single ware across a specific region or set of sites. Variability of these characteristics between sites may reflect exchange between sites, however, this can be confirmed

or negated by the analysis of the characteristics of a ware and an inter-site comparison of the results. Similarity within one site, along with dissimilarity with other centers of production of the same ware, may likely be indicative of local production of a wide-ranging ware, as opposed to indicating some form of exchange.

Clay Samples

A total of three raw material clay samples were procured from locations adjacent to each of the sites represented by sherd samples. Since all four of the sites, 16ST1, 16SJB2, 22CL527, and 22CL917 are submerged or eroded to varying extents, samples were collected from nearby locations with the same or similar soil associations (Figure 7 and 8; Table 2) as indicated by previous work conducted at the sites (i.e., O’Hear 1990) or by locating soil profile information, in particular clays, using the Web Soil Survey service provided by the United States Department of Agriculture (<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>). The samples were recovered from



Figure 6. Army Corps of Engineers Property in Lowndes County, Mississippi near locations of Sites 22CL527 and 22CL917

as close to the currently defined site boundaries as possible and from depths below surface where

Table 2. Clay Sample Provenience and Descriptive Information

Sample	Site	Northing	Easting	Zone	Munsell Color	Depth of Sample	Soil	Associated Drainage	Parish/County
CS-01	Tchefuncte	3358958	787152	15N	10YR 4/2 Dark Grayish Brown	50-70 cmbs (19.7-27.6 inbs)	Silty Clay	Cane Bayou	St. Tammany, LA
CS-02	Bayou Jasmine	3339541	746065	15N	10YR 3/2 Very Dark Grayish Brown	30-60 cmbs (11.8-23.6 inbs)	Sandy Clay	Bayou Jasmine	St. John the Baptist, LA
CS-03	Kellogg Village and Sanders	3716627	362653	16N	7.5 YR 3/3 Dark Brown	170-180 cmbs (66.9-70.9 inbs)	Sandy Clay	Tennessee-Tombigbee	Lowndes Co., MS

clays were first encountered. All samples were recovered using a split spoon auger that can sample to a maximum depth of two meters below surface. All sample locations were recorded using a Trimble GeoXT set to the appropriate UTM Zone and using a datum of NAD 83 (Table 2).

The color and texture of each sample was recorded, and then each sample was bagged separately in 4 mil plastic bags. In order to prepare them for thin sectioning, a portion of each sample was pressed into a small plastic dish to maintain uniformity of size and similar weight. The three samples weighed approximately 175-190 grams each and measured 3 cm by 3 cm in size. All three samples were left out to dry in a cool, dark place for 14 days in preparation for

firing. After drying thoroughly, the samples were transferred to a foil roasting pan and fired in an electric kiln. The kiln reached a temperature of 600° C, considered a baseline temperature to



Figure 7. Bayou Jasmine Site 16SJB2- Clay Source Sample Area

achieve the tan or buff colors of Tchefuncte ceramics (Gertjeansen et al. 1983:45), but below the temperature required for thorough firing through the core, thus replicating the dark, carbonized cores exhibited by many examples of Tchefuncte ceramics from the

Pontchartrain Basin. Careful

attention was paid to maintaining

the maximum temperature in the electric kiln. Once the proper temperature was maintained for 90 minutes, the heat was reduced at 10 minute intervals to slowly cool the samples in an effort to prevent or reduce cracking and shattering of the clay due to thermal shock (Rice 1987:105).

After removal from the kiln, the samples were set out in conditions similar to the initial drying conditions to cool. Surprisingly, very little fracturing of the samples had occurred. At this point, the control sample preparation was complete and the test blocks were ready to be thin sectioned. The ceramic sherds used in this study were a grab sample from the collections available from the Louisiana State University Museum of Natural Science and the Cobb Institute of Archaeology at Mississippi State University.

A total of 19 samples were sent for thin sectioning (Table 2). Sherd samples were selected from the Tchefuncte site, and with the addition of the *var. Tchefuncte* sherds from

Bayou Jasmine and the two non-local Alexander series sherds from the Clay County, Mississippi sites, these samples round out the set of prehistoric ceramics. Additionally, the three prepared clay samples were sent along with the sherd samples.

The sample set was sent National Petrographic Service, Inc. of Houston, Texas, for thin sectioning. Each sample was impregnated with a blue epoxy for clearer indication of voids in the samples and then cut and mounted on a 27 x 46 mm slide. After mounting, each sample was ground to a standard thickness (0.03 mm). During the grinding, an oil solution was used to protect the ceramic material from damage or loss of inclusions. Once the sample was ground, cover slips were applied to each of the slides.

Scanning

Digital images of each thin section are an essential part of this project. Special care was taken to select the proper hardware and imaging resolution settings for each of the samples (Figures 26-44). Several different light sources were used for this study: reflected light, and plane- and cross-polarized light. For the reflected light scans, a Plustek OpticFilm 8100 35mm film scanner with homemade slide adapter was used to scan the images. The plane- and cross-polarized images were scanned using an Epson Perfection 4180 Photo flatbed scanner with a transparency adapter. The horizontal and vertical resolution was set to 4800 dpi for each sample with a color bit depth of 24 on both of the scanners used. These polarized light scans were created to enhance the visibility of inclusions present in the samples not clearly visible in the reflected light scans. A homemade slide holder with polarizing film was constructed of cardboard. Dr. Patrick Livingood of Oklahoma State University provided some useful tips on how to construct the slide holder and place the polarizing film within the scanner. Each slide was

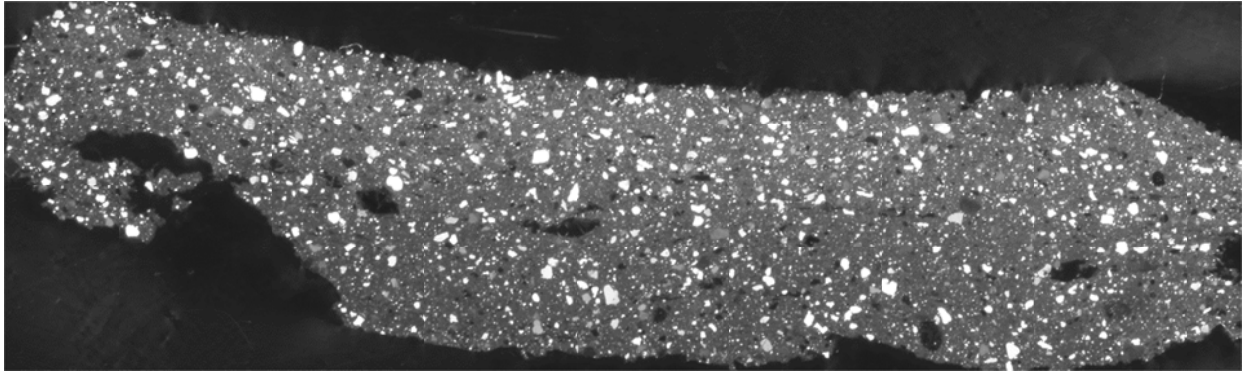
placed in the slide holder on a single square of polarizing film to create the plane-polarized images (also see Arpin et al. 2002). Once the plane-polarized scan was complete, a second square of polarizing film was placed perpendicular to the square already in place, creating a cross-polarized image when scanned. In total, scanning each of the 19 images three times with different filters took over 10 hours. The cross-polarized images took the longest amount of time, about 15 minutes each, while the reflected (non-polarized) images took about 8-10 minutes each. Researchers doing studies with large sample sets would certainly want to consider the time involved with scanning these types of images. However, once scanned, the samples become much easier to share and this could be of great utility given the collaborative aspects of many archaeological projects and the fragile nature of thin section slides.

Digital Image Analysis Software

ImageJ Software

The digital image analysis software ImageJ is a public domain software originally developed beginning in 1987 by Wayne Rasband of the National Institute of Health (USA) (Mateos-Perez and Pascau 2013:7-8). The software was originally intended for use in the medical sciences for the analysis and classification of pathologies in medical images; however, over the years its application has expanded into many disciplines for numerous purposes including X-ray analysis, crime scene investigations, ultrasound diagnosis, tomographic image reconstruction, and remote sensing imagery, as well as the analysis of archaeological materials (Mateos-Perez and Pascau 2013:7-8). ImageJ does not include a point-count function; however, the functions available in ImageJ make it widely applicable to other particle- and grain size- analyses such as the one conducted for this study.

The ImageJ software provides the ability to define the shape, size, and quantity of objects in an image. This is accomplished by first acquiring an image in .tiff format and importing it into



the ImageJ platform. In this study, the images were acquired with a flatbed scanner. Once the

Figure 8. ImageJ Grayscale Image of Sample 4

image is open, it is oriented and converted to a grayscale image (Figure 8). At this point, the image was calibrated and the scale set in order to acquire grain size measurements in millimeters. A scale bar is added and the image is then thresholded, that is it is transformed into a binary image (Figure 9). A binary image is an image that contains only two possible values for each pixel, generally black or white (Russ 2011a; Russ 2011b). A region of interest is then delineated on the image; the region of interest in these images is the outline of the sherd in the scanned polarized images imported into ImageJ. Once this is completed, the analyze function in ImageJ can measure and count the particles in the image and tabulate all relevant data in the form of Excel spreadsheets (Figure 9). From these spreadsheets, the resulting tables and figures can be constructed for analysis (see also Reedy 2006; Reedy and Kamboj 2004; Reedy and Vallamsetra 2004).

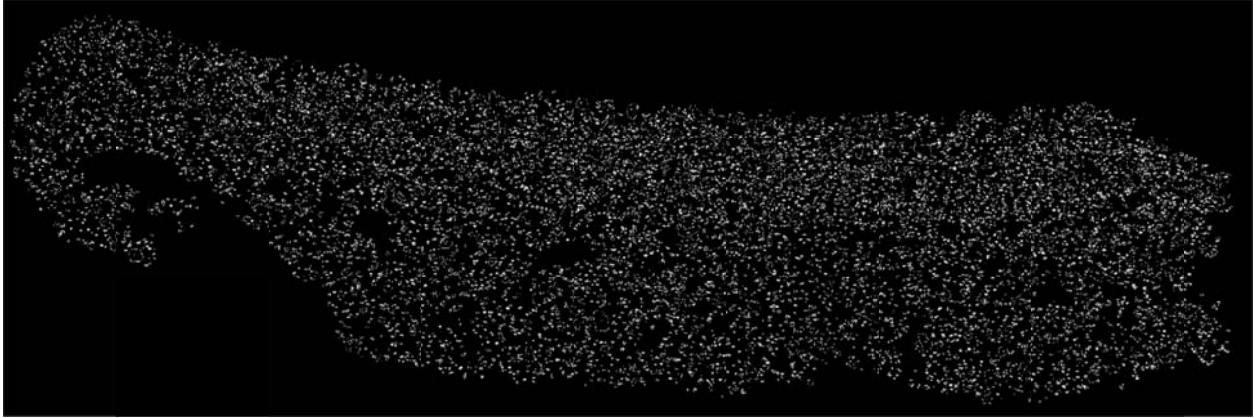


Figure 9. ImageJ Thresholded and Measured Image of Sample 4

JMicrovision Software

The JMicrovision software was developed by Nicolas Roduit of the University of Geneva, Switzerland. The software is intended for application in many aspects of geological research, and has a number of valuable functions for those studying archaeological materials. Of interest here is the digital point counting function, which in this study replaces the traditional use of a petrographic microscope. However, the JMicrovision software does not offer the same types of functions pertaining to particle- and grain size-analysis that are included with the ImageJ software, such the ability to convert images to greyscale and threshold objects for counting and measuring.

Images imported into JMicrovision are converted to a tiled .tiff format prior to any analysis. Once imported, the spatial calibration function is used to set the scale of the image and a scale bar is added. At this point, the point counting function is activated and the classes of objects to identify are generated. For this study, the classes included clay, silt, and sand were specified. Once a region of interest containing the sherd in thin section is created, the point counting is ready to start. A total of 300 points were counted for each of the five samples

included in this portion of the study. Evolution plots generated by JMicrovision indicate when enough points have been collected to ensure statistical relevancy. The results are exported as Excel spreadsheets and a graph of the results can be generated once the point counting is complete.

Chapter 7: Results and Discussion

Visual Descriptions of Thin Section Slides

At this point, it seems necessary to compare and describe each of the thin section slides in terms of their visual appearance (Samples 1-19; Figures 10-47; Table 3). Each of the slides will be described in terms how they compare to the others in its ware group as well as any other visual aspects of the thin section slides pertinent to the analysis of the sample set. After the visual descriptions, figures of each of the sherds, clay samples, and thin sections are presented side-by-side.

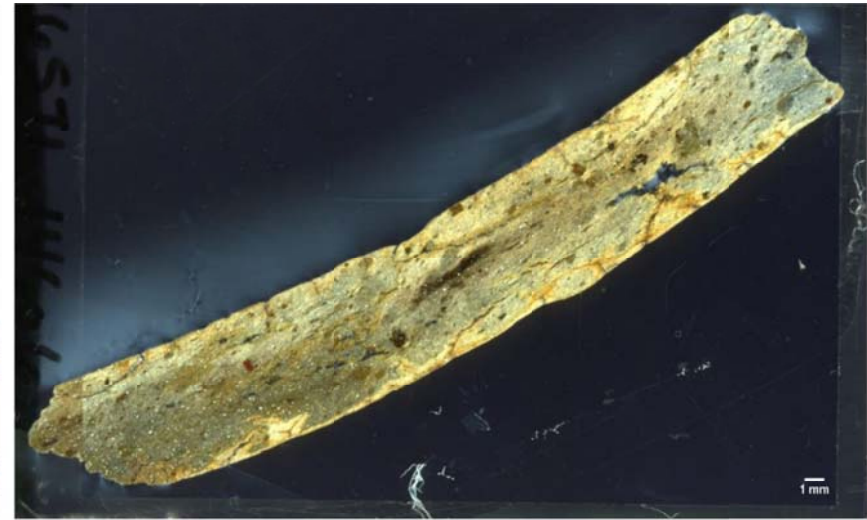
Samples 1 through 3 (Figures 10-15) of Tchefuncte Plain *var. Tchefuncte* from the Tchefuncte site all exhibit a similar appearance in terms of the inclusions visible in the paste of each sherd. All three of these sherds appear to have the typical contorted and laminated paste associated with Tchefuncte pottery. However, Sample 4 (Figures 16 and 17) does not resemble the other three sherds. The sherd appears to have a much higher fraction of sand compared to the other three samples, and it lacks the laminations and contortions evident in the scanned images of the other three samples. It is likely that this sherd was mistyped as *var. Tchefuncte* and is either a *var. Mandeville* sherd, or even a Baldwin Plain *var. O'Neal* sherd. In fact, strictly based on a visual comparison, Sample 4 appears most similar to Sample 15 (Figures 38 and 39), which is an Alexander Incised *var. Unspecified* sherd.

The Tchefuncte Plain *var. Mandeville* sherds (Samples 5 through 8; Figures 18-25) all appear to be somewhat similar in terms of inclusions and overall appearance. Three of the Baldwin Plain *var. O'Neal* samples (Samples 9, 10, and 12; Figures 26 through 29, 32 and 33) also appear to be relatively similar. However, Sample 11 (Figures 30 and 31) contains larger grains of sand than the other three of the same ware. The two sherds of Tchefuncte Plain *var.*

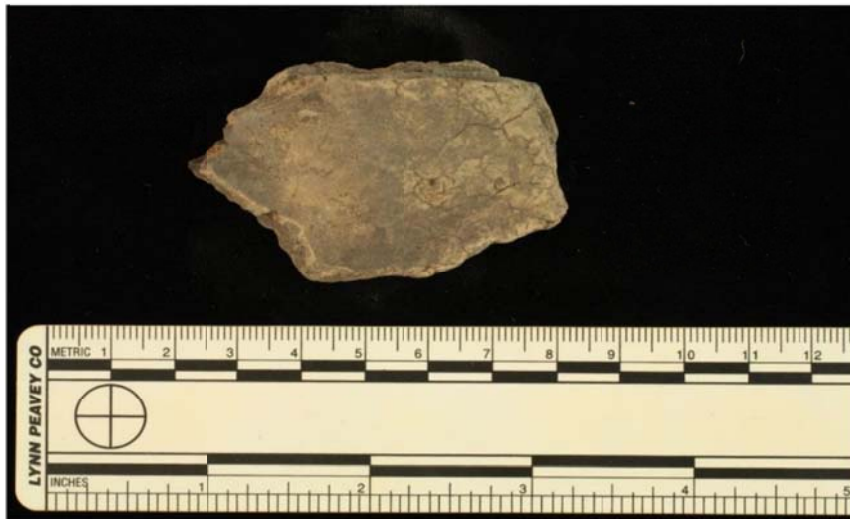
Tchefuncte from Bayou Jasmine (Samples 13 and 14; Figures 34 through 37) look relatively similar in terms of inclusions, although Sample 13 looks as though it may have been fired at a lower temperature or for a shorter time, as the interior of the sherd retains unoxidized material. Finally, of the three fired clay samples, Samples 17 and 19 (Figures 42-43, and 46-47) look to contain similar-sized sand inclusions, which are relatively lacking in the sample from Bayou Jasmine (Sample 18; Figures 44 and 45). Given the lack of inclusions, it is not surprising that Sample 18 exhibits an unoxidized core, while the two other fired clay samples (Samples 17 and 19) do not.

Sherd and Fired Clay Samples Analysis via ImageJ Software

Each of the 19 samples in the set were subjected to particle/grain analysis utilizing the ImageJ software and the data produced were used to construct tables and ternary diagrams (Figures 48 and 49; Table 3). Table 3 contains each of the individual sample results of the digital image analysis in terms of the percentages of clay, sand, and silt, as well as the sand-size index for each sherd or clay sample. The ternary diagrams visually present the total percentages of clay-matrix, sand-, and silt-sized particles in each thin section in the sample set. A full-size ternary diagram of all the individual sherds is presented before using a reduced diagram to present the results in a more pleasing graphic style (Figure 48 vs. 49). The sand-size data were analyzed for bimodal distributions that may indicate whether added temper was present in any of the samples (Figure 60). The results of each of the samples is presented below, first according to type and variety and then by clusters based solely on the data, regardless of type. These clusters are comprised of samples that share similar percentages of the three categories—clay-matrix, sand, and silt. Sand-size index values will also be used to compare samples within cluster.



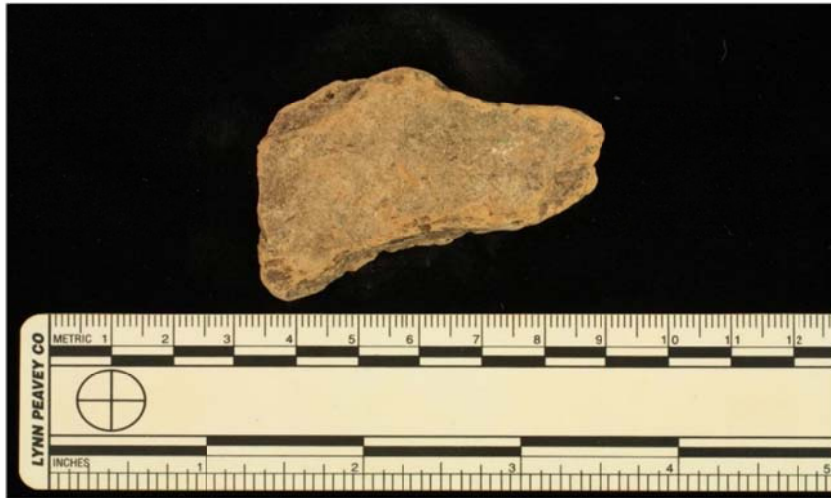
Figures 10 and 11 (L-R). Sample 1- Tchefuncte Plain var. Tchefuncte from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 12 and 13 (L-R). Sample 2- Tchefuncte Plain var. Tchefuncte from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 14 and 15 (L-R). Sample 3- Tchefuncte Plain var. Tchefuncte from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 16 and 17 (L-R). Sample 4- Tchefuncte Plain var. Tchefuncte from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 18 and 19 (L-R). Sample 5- Tchefuncte Plain var. *Mandeville* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 20 and 21 (L-R). Sample 6- Tchefuncte Plain var. *Mandeville* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



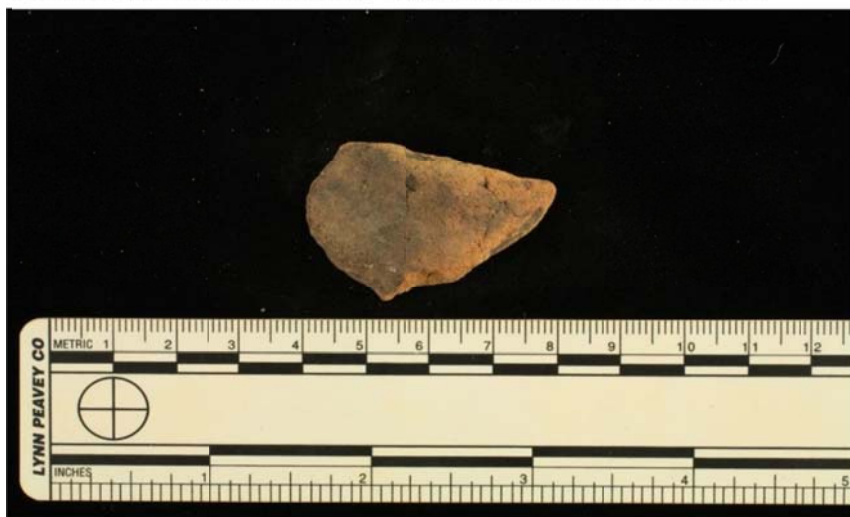
Figures 22 and 23 (L-R). Sample 7- Tchefuncte Plain var. *Mandeville* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



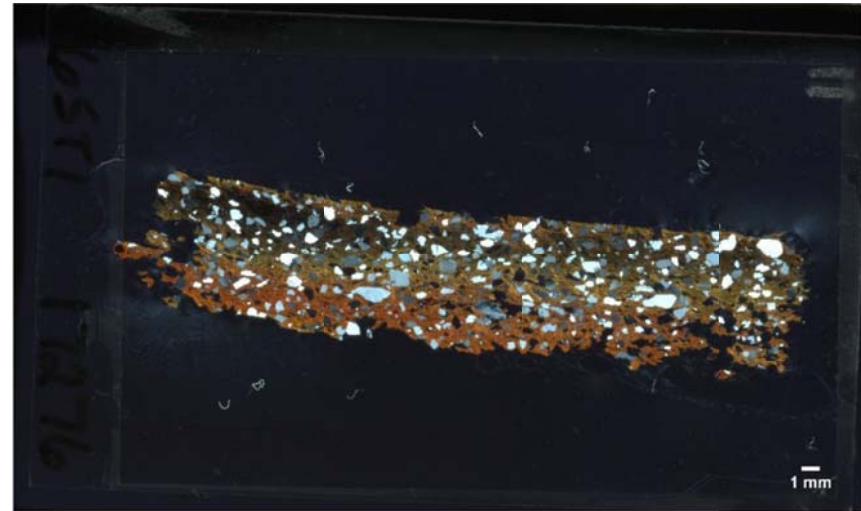
Figures 24 and 25 (L-R). Sample 8- Tchefuncte Plain var. *Mandeville* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



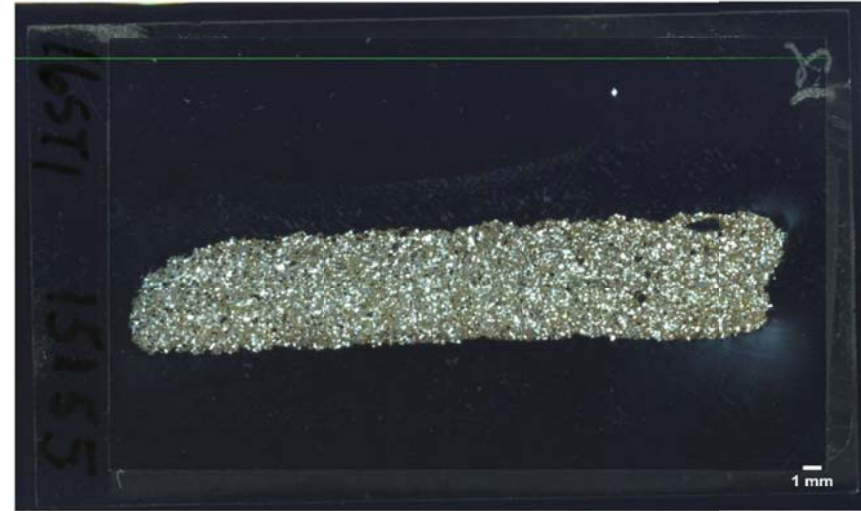
Figures 26 and 27 (L-R). Sample 9- Baldwin Plain var. *O'Neal* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 28 and 29 (L-R). Sample 10- Baldwin Plain var. *O'Neal* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



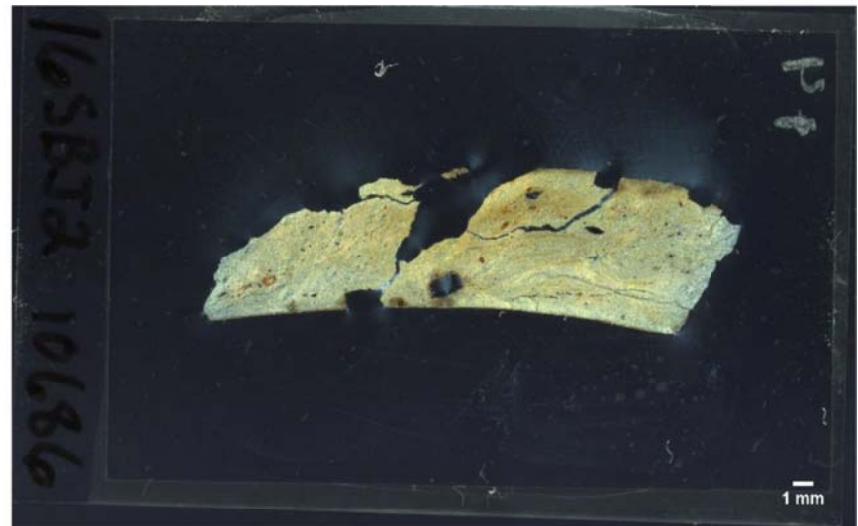
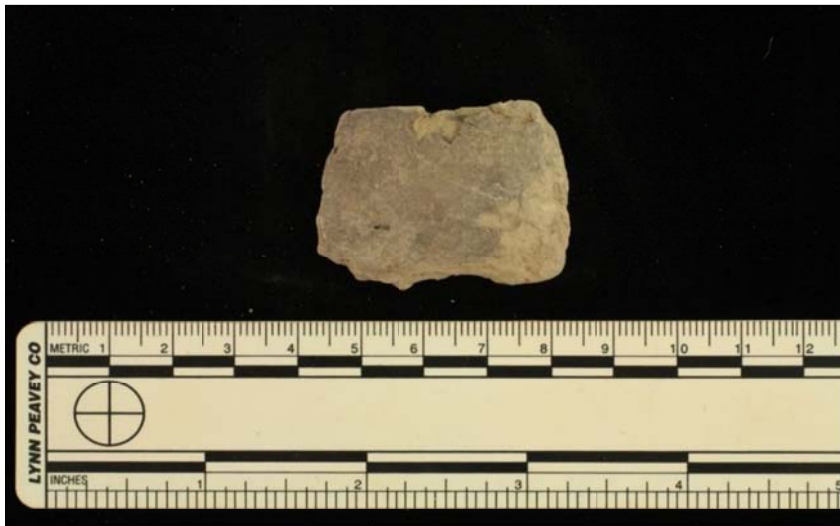
Figures 30 and 31 (L-R). Sample 11- Baldwin Plain var. *O'Neal* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 32 and 33 (L-R). Sample 12- Baldwin Plain var. *O'Neal* from 16ST1. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



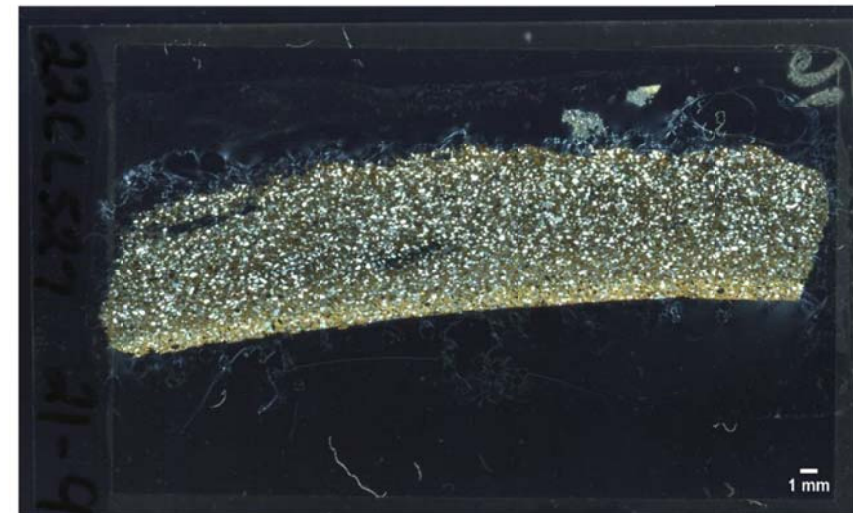
Figures 34 and 35 (L-R). Sample 13- Tchefuncte Plain var. *Tchefuncte* from 16SJB2. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



Figures 36 and 37 (L-R). Sample 14- Tchefuncte Plain var. *Tchefuncte* from 16SJB2. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the LSU Museum of Natural Science.



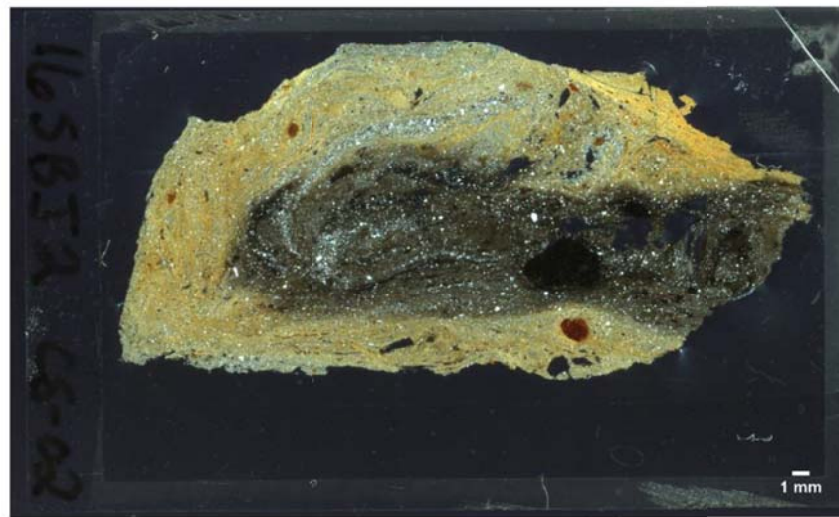
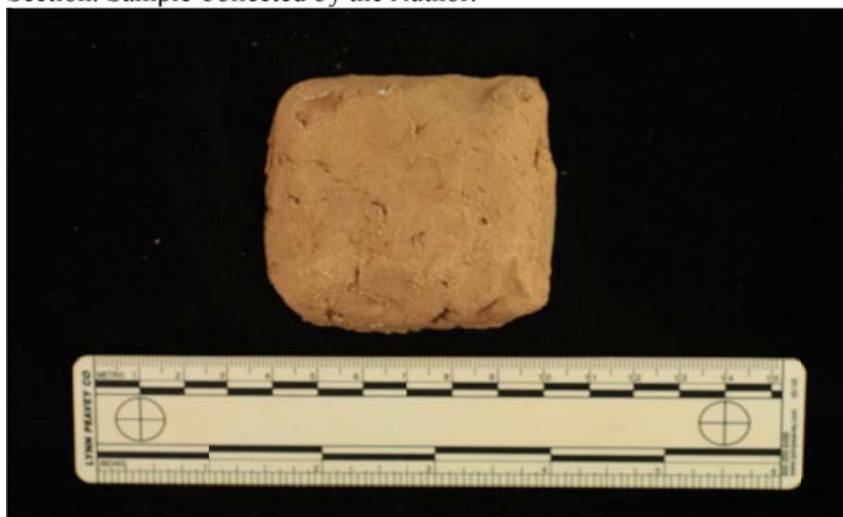
Figures 38 and 39 (L-R). Sample 15- Alexander Incised var. *Unspecified* from 22CL527. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the Cobb Institute of Archaeology at Mississippi State University.



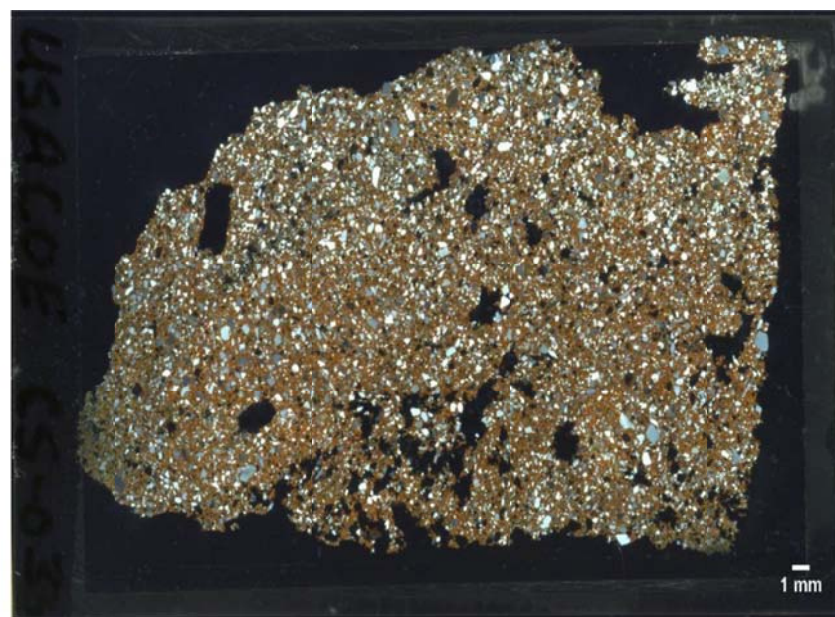
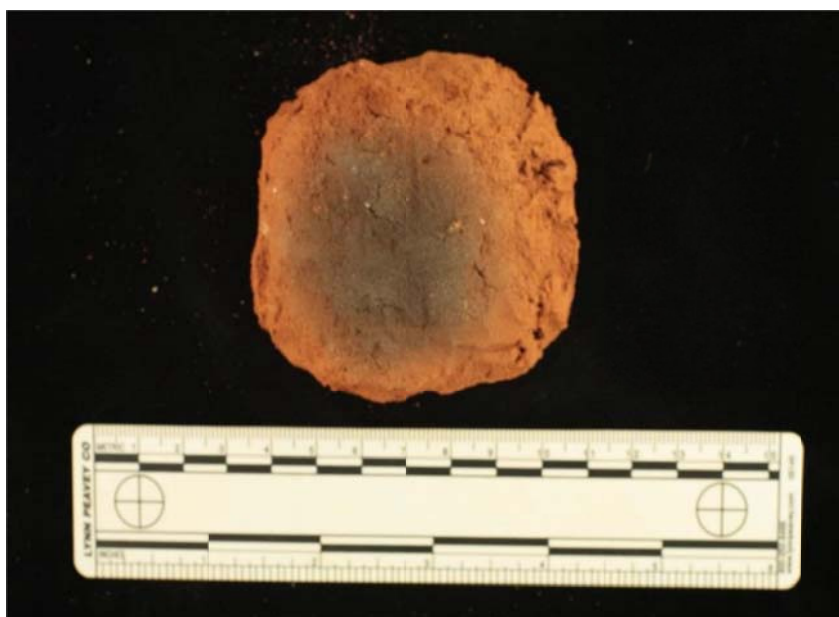
Figures 40 and 41 (L-R). Sample 16- Alexander Incised var. *Unspecified* from 22CL917. Left: Sherd Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Courtesy of the Cobb Institute of Archaeology at Mississippi State University.



Figures 42 and 43 (L-R). Sample 17- Fired Clay Sample from near 16ST1. Left: Fired Clay Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Collected by the Author.



Figures 44 and 45 (L-R). Sample 18- Fired Clay Sample from near 16SJB2. Left: Fired Clay Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Collected by the Author.



Figures 46 and 47 (L-R). Sample 19- Fired Clay Sample from near 22CL527 and 22CL917. Left: Fired Clay Sample. Right: Cross-Polarized Scanned Image of Thin Section. Sample Collected by the Author with Permission of the Army Corps of Engineers- Mobile District.

Based on these two ways of looking at the results, a discussion of the implications of the results of the analysis of Tchefuncte and Alexander pottery and the fired-clay samples will be made in the final chapter.

Because the sample size is small ($n = 19$) and many varieties/site samples are represented by only a few examples (some with widely varying frequencies of paste constituents), comparing the results of this study in terms of means and ranges, as is often done in these types of studies, is not necessarily worthwhile. However, the results of this study do present the opportunity to discuss any potential relationships between the sherds and the fired-clay samples based upon the percentages of clay-matrix, sand, and silt particles identified in the analysis, along with sand-size index values; and what these data can reveal about these types.

Tchefuncte Plain var. *Tchefuncte* from the Tchefuncte and Bayou Jasmine sites

A total six of Tchefuncte Plain var. *Tchefuncte* were analyzed during this project. Analyzed individually, the results reveal that four of the six samples cluster together (Samples 1, 2, 3, and 13; Table 3) and are largely comprised of clay-matrix, with small amounts of sand and silt inclusions (Figure 50; Table 3). The remaining two samples also cluster (Samples 4 and 14), and have lower percentages of clay matrix, and significantly higher amounts of sand and silt inclusions.

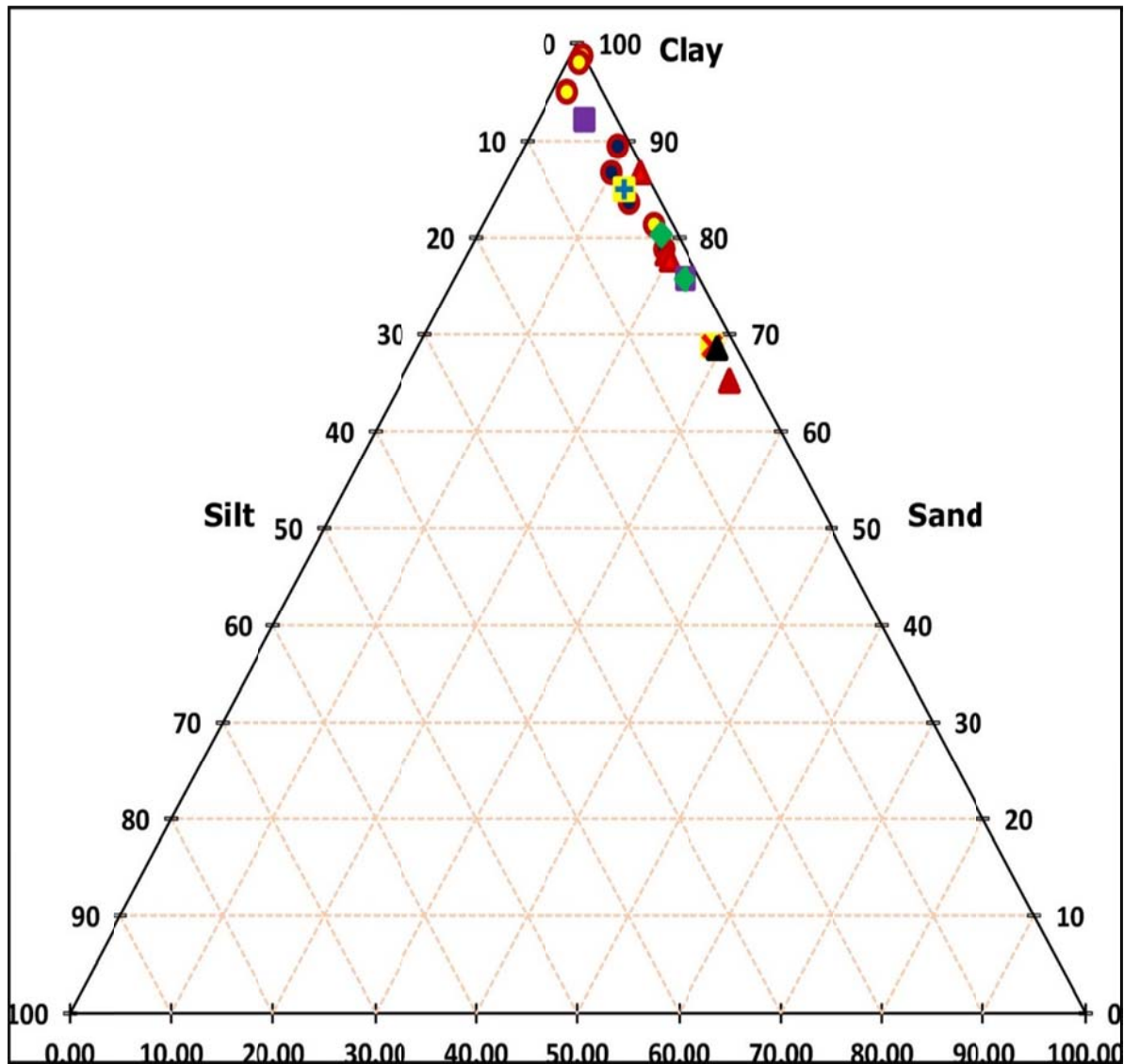


Figure 48. Full-size Ternary Diagram of All Samples in the Study (1-19). Legend- Yellow Circles (●): 16ST1 Tchefuncte Plain var. *Tchefuncte* (1-4). Blue Dots (●): 16ST1 Tchefuncte Plain var. *Mandeville* (5-8). Red Triangles (▲): 16ST1 Baldwin Plain var. *O'Neal* (9-12). Purple Squares (■): 16SJB2 Tchefuncte Plain var. *Tchefuncte* (13-14). Green Diamonds (◆): 22CL527 and 22CL917 Alexander Incised var. *Unspecified* (15 and 16). Yellow Square with Red X (⊠): 16ST1 Clay Source Sample (17). Yellow Square with Blue Plus Sign (⊕): 16SJB2 Clay Source Sample (18). Black Triangle (▲): Mississippi Clay Source Sample (19).

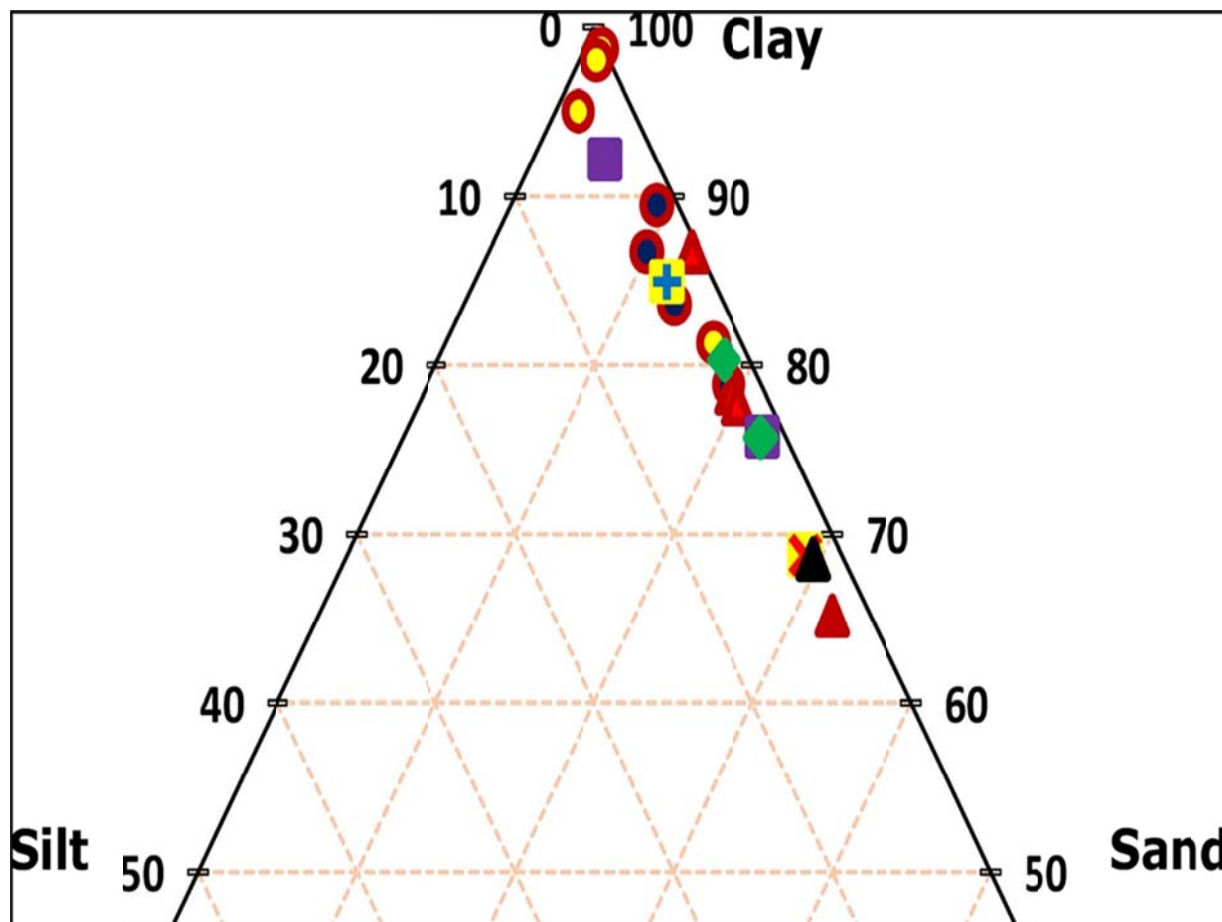


Figure 49. Ternary Diagram of All Samples in the Study (1-19). Legend- Yellow Circles (●): 16ST1 Tchefuncte Plain var. *Tchefuncte* (1-4). Blue Dots (●): 16ST1 Tchefuncte Plain var. *Mandeville* (5-8). Red Triangles (▲): 16ST1 Baldwin Plain var. *O'Neal* (9-12). Purple Squares (■): 16SJB2 Tchefuncte Plain var. *Tchefuncte* (13-14). Green Diamonds (◆): 22CL527 and 22CL917 Alexander Incised var. *Unspecified* (15 and 16). Yellow Square with Red X (☒): 16ST1 Clay Source Sample (17). Yellow Square with Blue Plus Sign (☒): 16SJB2 Clay Source Sample (18). Black Triangle (▲): Mississippi Clay Source Sample (19).

Table 3. Individual Sample Results of the Digital Image Analysis of Sherds

Sample #	Site #	Type	Variety	Clay (%)	Sand (%)	Silt (%)	Sand-Size Index
1	Tchefuncte site	Tchefuncte Plain	<i>Tchefuncte</i>	98.72	1.16	0.12	1.02
2	Tchefuncte site	Tchefuncte Plain	<i>Tchefuncte</i>	98.05	1.15	0.80	1.04
3	Tchefuncte site	Tchefuncte Plain	<i>Tchefuncte</i>	95.03	1.47	2.37	1.01
4	Tchefuncte site	Tchefuncte Plain	<i>Tchefuncte</i>	81.32	16.87	1.81	1.08
5	Tchefuncte site	Tchefuncte Plain	<i>Mandeville</i>	89.49	9.21	1.30	1.08
6	Tchefuncte site	Tchefuncte Plain	<i>Mandeville</i>	78.87	19.07	2.06	1.14
7	Tchefuncte site	Tchefuncte Plain	<i>Mandeville</i>	86.74	9.98	3.28	1.05
8	Tchefuncte site	Tchefuncte Plain	<i>Mandeville</i>	83.63	13.23	3.14	1.08
9	Tchefuncte site	Baldwin Plain	<i>O'Neal</i>	78.39	19.45	2.16	1.15
10	Tchefuncte site	Baldwin Plain	<i>O'Neal</i>	65.18	32.42	2.40	1.2
11	Tchefuncte site	Baldwin Plain	<i>O'Neal</i>	86.73	12.79	0.48	1.34
12	Tchefuncte site	Baldwin Plain	<i>O'Neal</i>	77.75	20.18	2.07	1.16
13	Bayou Jasmine site	Tchefuncte Plain	<i>Tchefuncte</i>	92.18	4.64	3.18	1.01
14	Bayou Jasmine site	Tchefuncte Plain	<i>Tchefuncte</i>	75.79	22.78	1.43	1.14
15	Kellogg Village site	Alexander Incised	<i>unspecified</i>	80.32	18.05	1.63	1.14
16	Sanders site	Alexander Incised	<i>unspecified</i>	75.75	22.67	1.58	1.2
17	Tchefuncte site	Fired Clay Sample	<i>n/a</i>	68.79	28.92	2.29	1.22
18	Bayou Jasmine	Fired Clay Sample	<i>n/a</i>	85.00	12.08	2.92	1.08
19	Lowndes Co., MS	Fired Clay Sample	<i>n/a</i>	68.56	29.53	1.91	1.24

Of the four Tchefuncte Plain *var. Tchefuncte* sherds that cluster together, three are from Tchefuncte and one is from Bayou Jasmine. The results of the analysis do not reveal a direct association between the paste constituents of the Tchefuncte Plain *var. Tchefuncte* at the two sites, and the variability across this subset is substantial.

Of the four samples of Tchefuncte Plain *var. Tchefuncte* from Tchefuncte, three exhibit similar percentages of clay-matrix (95.03-98.72 per cent), sand (1.15-1.47 per cent), and silt (0.12-2.37 per cent) (Samples 1,2, and 3; Table 3; Figure 51). Sample 4, however, contains a considerably lower amount of clay-matrix (81.32 per cent) and higher percentage of sand (16.87 per cent), along with slightly higher amounts of silt (1.81 per cent). Samples 1 through 3 show the laminated and contorted appearance typical of Tchefuncte pottery; however, Sample 4 does not exhibit these characteristics. The visual comparison of the Sample 4 thin section (Figures 14 and 15) with the other Tchefuncte Plain *var. Tchefuncte* sherds also clearly shows a marked difference in the amounts of sand present in Sample 4. Sand-size index values for the set are generally low, indicating that on average the sherds contain finer grains of sand. The sand-size index values for Samples 1 through 3 range from 1.01 to 1.04; while Sample 4 has a higher sand-size index of 1.08.

The two samples of Tchefuncte Plain *var. Tchefuncte* from Bayou Jasmine also exhibit wide variability in constituents (Samples 13 and 14; Table 3; Figure 50). The results of Sample 13 indicates the clay-matrix comprising 92.18 per cent of the sherd, while clay-matrix constitutes only 75.79 per cent in Sample 14. Sand comprises 22.78 per cent of Sample 14; only 4.64 per cent of Sample 13 is sand. The percentage of silt in the two samples is 3.18 for Sample 13 and 1.43 for Sample 14. The sand-size index values for the samples are quite different; Sample 13

has a value of 1.01, while Sample 14 has a value of 1.14. The two sherds do not appear similar based on the results of the analysis and of a visual inspection of the thin sections.

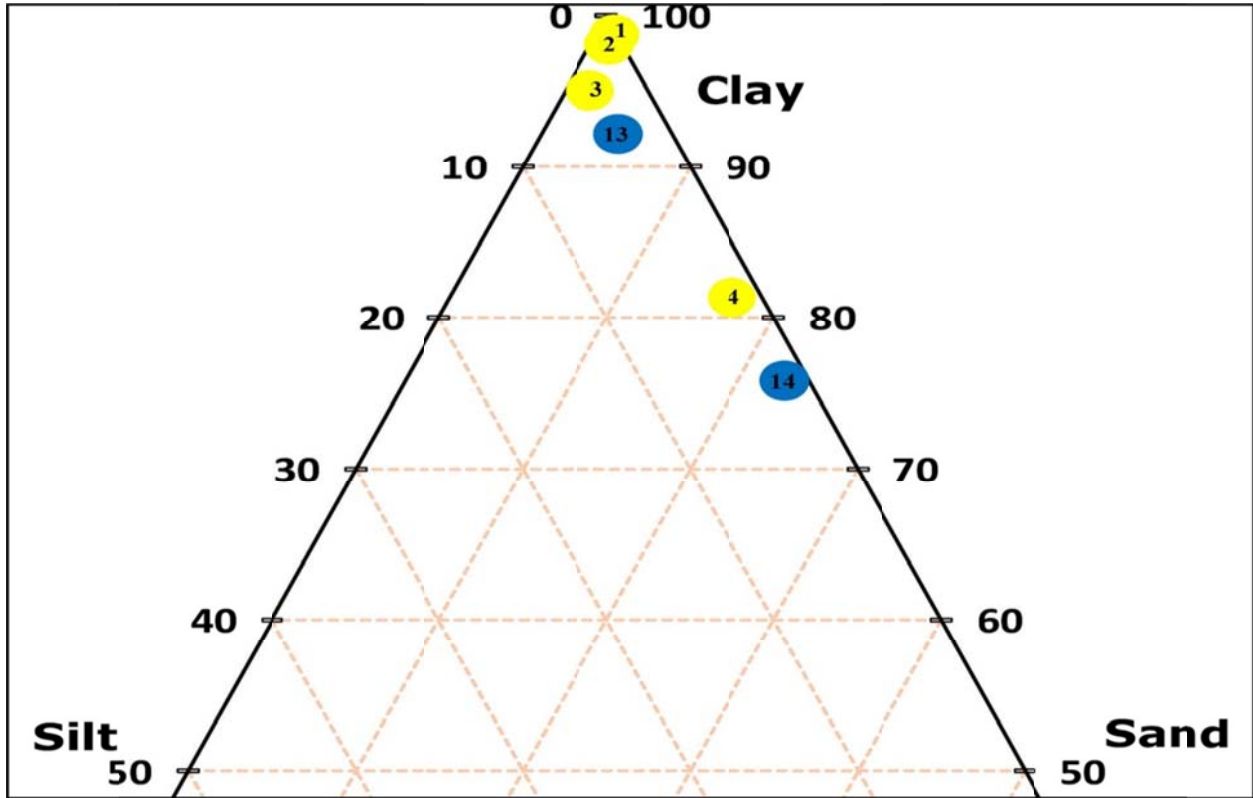


Figure 50. Tchefuncte Plain var. *Tchefuncte*. Legend- Yellow Dots: 16ST1 Sherds, Samples 1-4. Blue Dots: 16SJB2 Sherds, Samples 13 and 14.

Tchefuncte Plain var. *Mandeville*

Four examples (Samples 5, 6, 7, and 8) of Tchefuncte Plain var. *Mandeville* from Tchefuncte were analyzed for this project (Figure 51; Table 3). This sandy-paste ware was recovered at both

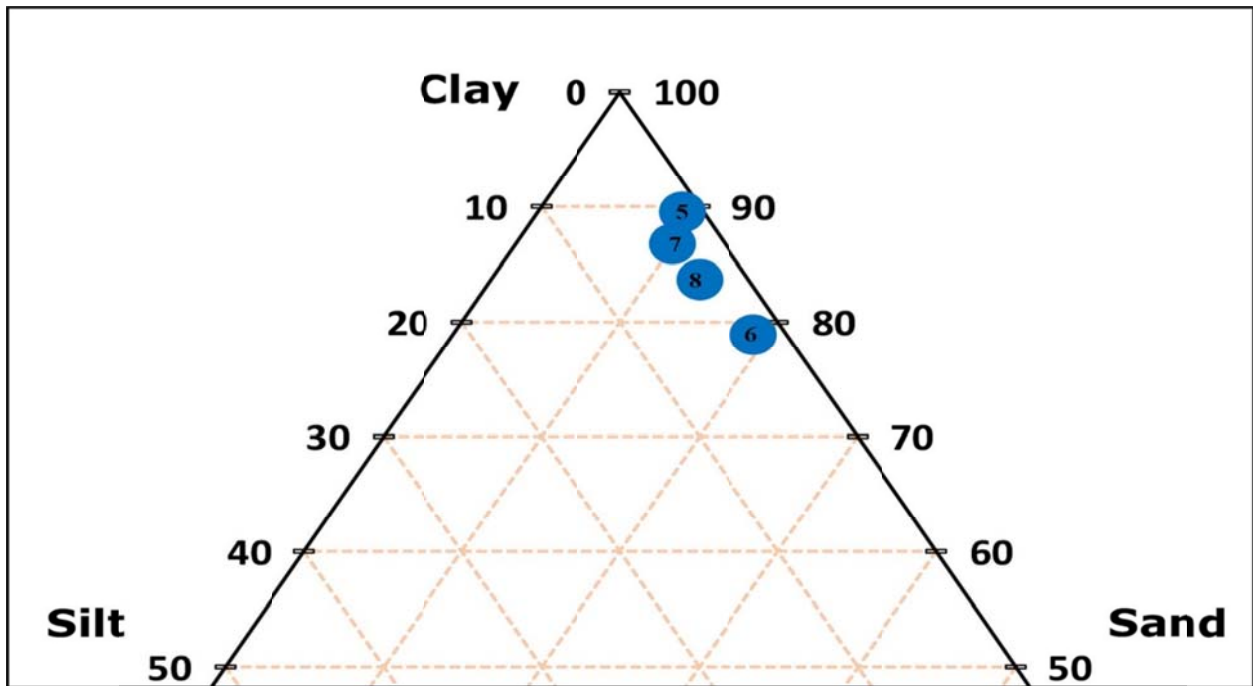


Figure 51. Tchefuncte Plain *var. Mandeville* from Site 16ST1. Blue dots: Tchefuncte Plain *var. Mandeville*.

the Tchefuncte and Bayou Jasmine sites and is considered to be a marker for late-Tchula Period sites (Ford and Quimby 1945: 74-84; Shenkel 1974: 51). Three of the four samples (Samples 5, 7, and 8) are similar in terms of clay, sand, and silt percentages (Clay= 83.63-89.49 per cent; Sand= 9.21-13.23 per cent; Silt= 1.30-3.28 per cent), while Sample 6 exhibited higher amounts of sand (19.07 per cent). Additionally, the sand-size index values for Samples 5, 7, and 8 (1.08, 1.05, and 1.08; Table 3) indicate that on average, sand grains are somewhat finer than in Sample 6 (1.14).

Baldwin Plain *var. O'Neal*

The four Baldwin Plain *var. O'Neal* sherds (Samples 9 to 12; Table 3; Figures 24-31; 52) from Tchefuncte ranged widely in the clay-matrix fraction, from 65.18 to 86.73 per cent. The

amount of sand present in these sherds was quite variable and constituted from 12.79 to 32.42 per cent of the paste. Silt was relatively low in all of the sherds, ranging from 0.48 to 2.10 per cent. A visual inspection of the thin section slides and the results indicate uniformity between Samples 9 and 12; however Samples 10 and 11 each look markedly different than the other two Baldwin Plain *var. O'Neal* sherds in the sample set (Figure 52). Sample 10 ranks the highest in percentage of sand in the entire sample set at 32.42 per cent. Sample 11 has the highest sand-size index value of the set at 1.34, indicating that on average, it contains larger grains of sand than any of the other samples in the study.

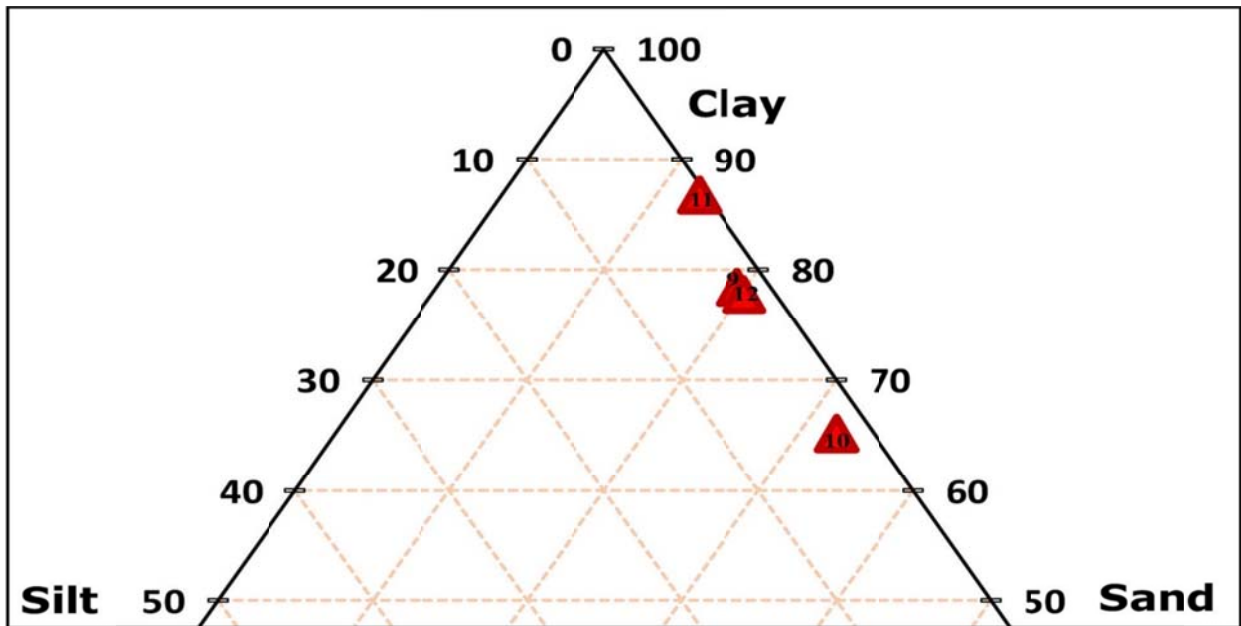


Figure 52. Ternary Diagram of Baldwin Plain *var. O'Neal* Samples from 16ST1 (9-12). Red Triangles: Baldwin Plain *var. O'Neal* samples.

Alexander Incised *var. Unspecified*

The two sherds of Alexander Incised *var. Unspecified* in the set (Samples 15 and 16; Figures 36-39; 53) exhibit relatively similar results across all four of the categories in the study (Table 3).

The results of Sample 15—clay-matrix 80.32 per cent, sand 18.05 per cent, and silt 1.63 per cent, compare rather nicely with the results of Sample 16—clay-matrix 75.75 percent, sand 22.67 per

cent, and silt 1.58 per cent. The sand-size index values for the two differ by only 0.06, this indicates that the average size of sand grains in the two samples are relatively similar.

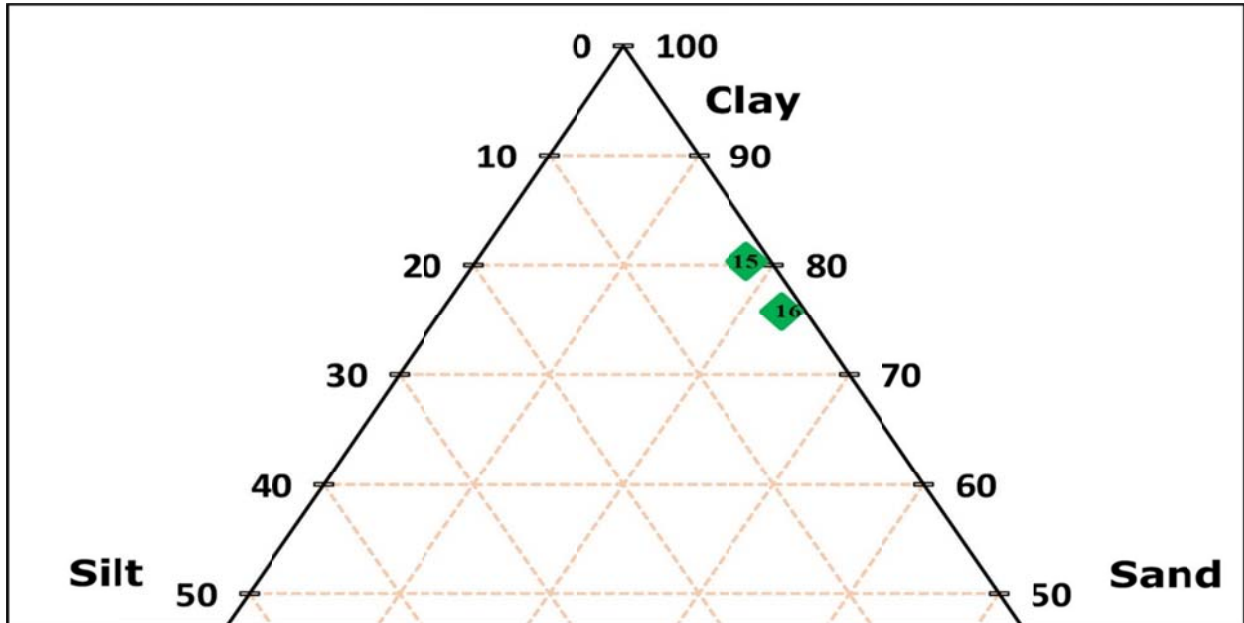


Figure 53. Ternary Diagram of Alexander Incised *var. Unspecified* Sherds from 22CL527 and 22CL917. Green Triangles: Samples 15 and 16.

Clay Source Samples from the Study Areas

The three clay source samples were extracted from locations near each of the sites (Figure 54; Table 3). The fired-clay sample from Lowndes Co., Mississippi (Sample 19) has a paste with clay-matrix (68.56 per cent), sand (29.53 per cent), and silt (1.91 per cent), while the sample from Tchefuncte (Sample 17) contains 68.79 per cent clay-matrix, sand at 28.92 per cent, and silt at 2.29 per cent. The Mississippi clay sample has a nearly identical sand-size index value as the 16ST1 clay sample (1.22 versus 1.24). Finally, the clay sample from Bayou Jasmine exhibits 85.0 per cent clay-matrix, 12.08 per cent sand, and 2.92 per cent silt. The sand-size index value for the Bayou Jasmine sample is 1.08, indicating that, on average, sand sizes in the sherd are relatively finer than the other two fired clay samples in this study.

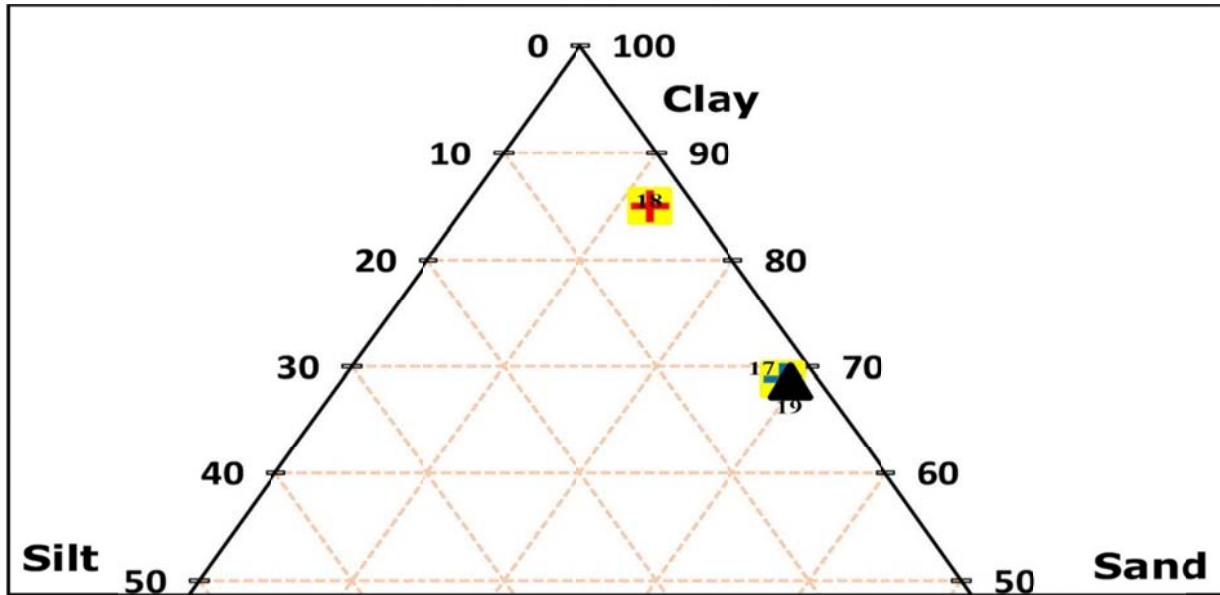


Figure 54. Ternary Diagram of Clay Source Samples from Sites 16ST1, 16SJB2, and from near Sites 22CL527 and 22CL917. Yellow Square with Red Cross: 16ST1 Sample 17. Yellow Square with Blue Cross: 16SJB2 Sample 18. Black Triangle: Mississippi Sites Sample 19.

Clusters of Samples Identified in the Results

Five clusters were identified in the results of the digital image analysis. The clusters were identified regardless of type or variety, and solely based on the nearness of values of clay-matrix, sand, and silt percentages in the sherd and fired-clay samples. Typically, the constituent percentages are considered 'near' to one another when there are within approximately ± 3.5 per cent of the other values in the cluster. The ± 3.5 per cent range used to group the clusters is consistent with acceptable concurrence levels used in other studies of this type (see Stoltman 1989: 150-153). The only exception to this criterion were the Alexander Incised *var. Unspecified* sherds from the Kellogg Village and Sanders sites. The origin of these sherds is not in question, and the higher sand-size index values precluded them from inclusion within the other clusters.

Cluster 1

The first cluster of samples is wholly comprised of examples of Tchefuncte Plain *var.*

Tchefuncte, though three of the sherds are from the Tchefuncte site and one is from Bayou Jasmine (Samples 1,2,3, and 13; Figure 55; Table 4). These samples range in clay-matrix values from 92.18 to 98.72 per cent, from 1.15 to 4.64 per cent in sand, and from 0.80 to 3.18 per cent in silt. Though some variability in the relative percentages of constituents is evident, all of these sherds exhibit the laminated and contorted appearance associated with Tchefuncte pottery. Also, the sand-size index values for these sherds are very similar, ranging from 1.01 to 1.04, indicating that the average sand grains present are smaller and finer those of Tchefuncte Plain *var.*

Mandeville and for any other subset in the study.

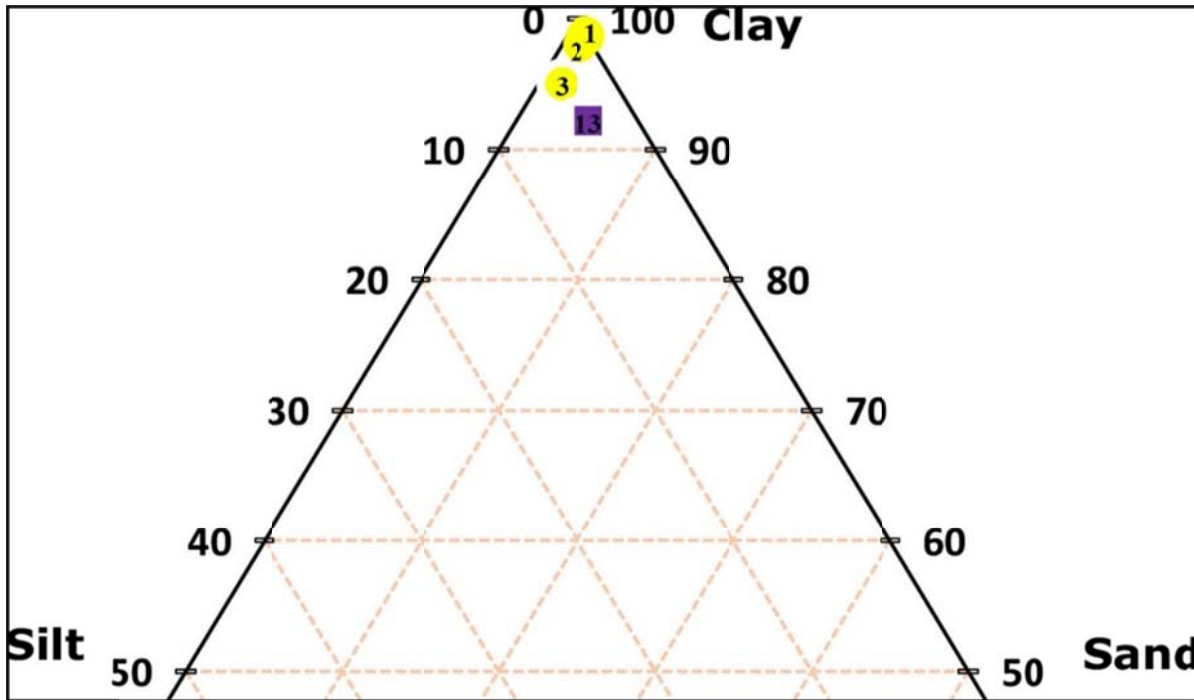


Figure 55. Cluster 1: All Tchefuncte Plain *var.* *Tchefuncte*. Samples 1, 2, and 3 from 16ST1; Sample 13 from 16SJB2.

Table 4. Cluster 1 Results.

Sample	Site	Type	Variety	Clay (%)	Sand (%)	Silt (%)	Sand-Size Index
1	Tchefuncte	Tchefuncte Plain	<i>Tchefuncte</i>	98.72	1.16	0.12	1.02
2	Tchefuncte	Tchefuncte Plain	<i>Tchefuncte</i>	98.05	1.15	0.80	1.04
3	Tchefuncte	Tchefuncte Plain	<i>Tchefuncte</i>	95.03	1.47	2.37	1.01
13	Bayou Jasmine	Tchefuncte Plain	<i>Tchefuncte</i>	92.18	4.64	3.18	1.01

Cluster 2

Cluster 2 is comprised of Samples 5, 7, 8, 11, and 18 (Figure 56; Table 5). Samples 5, 7, and 8 are all Tchefuncte Plain *var. Mandeville* from 16ST1, while Sample 11 is a Baldwin Plain *var. O'Neal* sherd from 16ST1, and Sample 18 is the fired clay sample from 16SJB2. These samples range in percentages of clay-matrix from 83.63 to 89.49 per cent, sand from 9.21 to 13.23 per cent, and silt from 0.48 to 3.28 per cent. Sand-size index values range from 1.05 to 1.34.

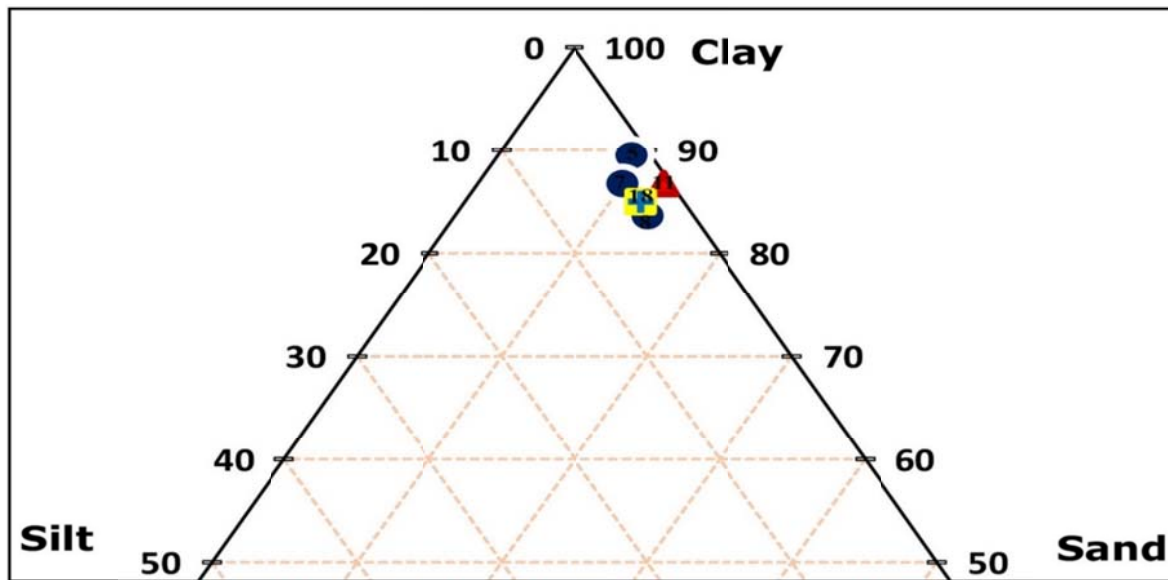


Figure 56. Cluster 2. Includes Samples 5, 7, and 8--Tchefuncte Plain *var. Mandeville* from 16ST1; Sample 11—Baldwin Plain *var. O'Neal* from 16ST1; and Sample 18—the fired-clay sample from 16SJB2.

Table 5. Cluster 2 Results.

Sample	Site	Type	Variety	Clay (%)	Sand (%)	Silt (%)	Sand-Size Index
5	Tchefuncte	Tchefuncte Plain	<i>Mandeville</i>	89.49	9.21	1.30	1.08
7	Tchefuncte	Tchefuncte Plain	<i>Mandeville</i>	86.74	9.98	3.28	1.05
8	Tchefuncte	Tchefuncte Plain	<i>Mandeville</i>	83.63	13.23	3.14	1.08
11	Tchefuncte	Baldwin Plain	<i>O'Neal</i>	86.73	12.79	0.48	1.34
18	Bayou Jasmine	Clay Sample	<i>n/a</i>	85.00	12.08	2.92	1.08

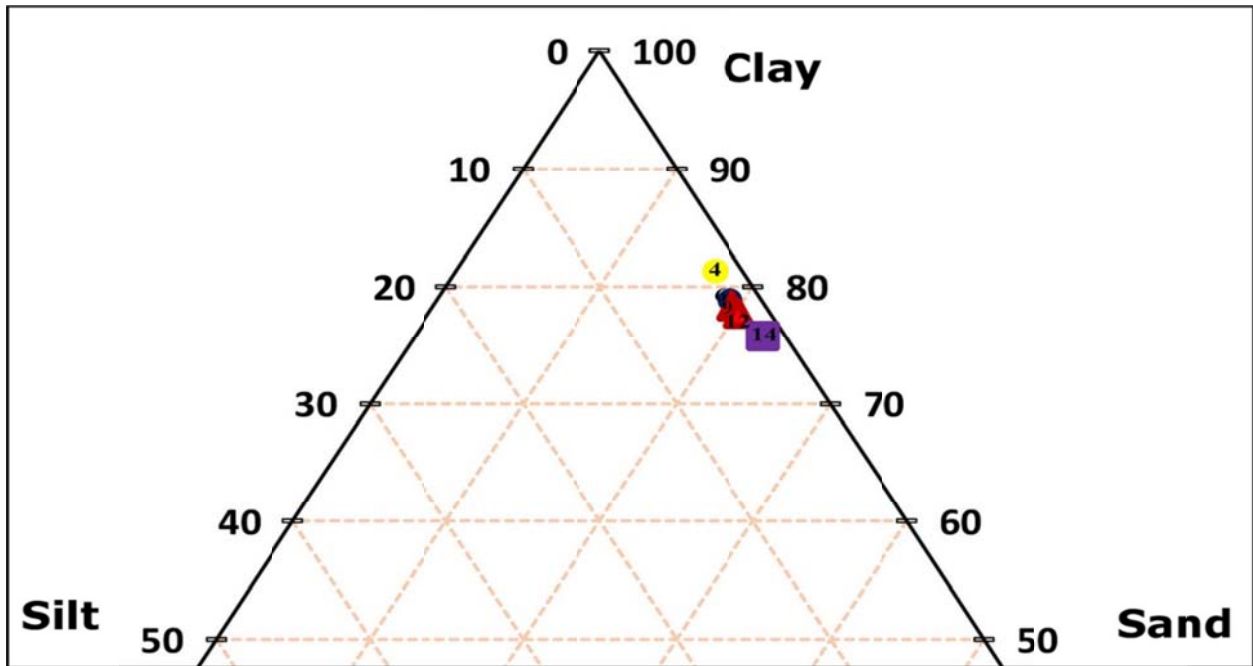


Figure 57. Cluster 3. From 16ST1- Samples 4, 6, 9, and 12, Sample 14 is from 16SJB2.

Cluster 3

Samples 4, 6, 9, 12, and 14 make up the third and most diverse cluster in the sample set, which includes three varieties of sherds (Figure 57; Table 6). From the Tchefuncte site, Sample 4 is Tchefuncte Plain *var. Tchefuncte* sherd and Sample 6 is a Tchefuncte Plain *var. Mandeville* sherd. Samples 9 and 12 are examples of Baldwin Plain *var. O'Neal* from Tchefuncte, and

rounding out the cluster is Sample 14, a Tchefuncte Plain var. *Tchefuncte* sherd from Bayou Jasmine. Percentages of clay-matrix range from 75.79 to 81.32 per cent, sand from 16.87 to 22.78 per cent, and silt from 1.43 to 2.16 per cent. Sand-size index values range from 1.08 to 1.16, indicating that these sherds tend to have slightly coarser sand grains than most of the other clusters.

Table 6. Cluster 3 Results.

Sample	Site	Type	Variety	Clay (%)	Sand (%)	Silt (%)	Sand-Size Index
4	Tchefuncte	Tchefuncte Plain	<i>Tchefuncte</i>	81.32	16.87	1.81	1.08
6	Tchefuncte	Tchefuncte Plain	<i>Mandeville</i>	78.87	19.07	2.06	1.14
9	Tchefuncte	Baldwin Plain	<i>O'Neal</i>	78.39	19.45	2.16	1.15
12	Tchefuncte	Baldwin Plain	<i>O'Neal</i>	77.75	20.18	2.07	1.16
14	Bayou Jasmine	Tchefuncte Plain	<i>Tchefuncte</i>	75.79	22.78	1.43	1.14

Cluster 4

Cluster 4 is comprised of two of the fired-clay samples and a Baldwin Plain var. *O'Neal* sherd from the Tchefuncte site (Samples 10, 17, and 19; Figure 58; Table 7). These samples range in clay-matrix from 65.18 to 68.79 per cent, sand from 28.92 to 32.42 per cent, and silt from 1.91 to 2.40 per cent. Sand-size index values for all three samples are nearly identical, ranging from 1.20 to 1.24.

Table 7. Cluster 4 Results.

Sample	Site	Type	Variety	Clay (%)	Sand (%)	Silt (%)	Sand Size Index
10	Tchefuncte	Baldwin Plain	<i>O'Neal</i>	65.18	32.42	2.40	1.2
17	Tchefuncte	Clay Sample	<i>n/a</i>	68.79	28.92	2.29	1.22
19	Lowndes Co., MS	Clay Sample	<i>n/a</i>	68.56	29.53	1.91	1.24

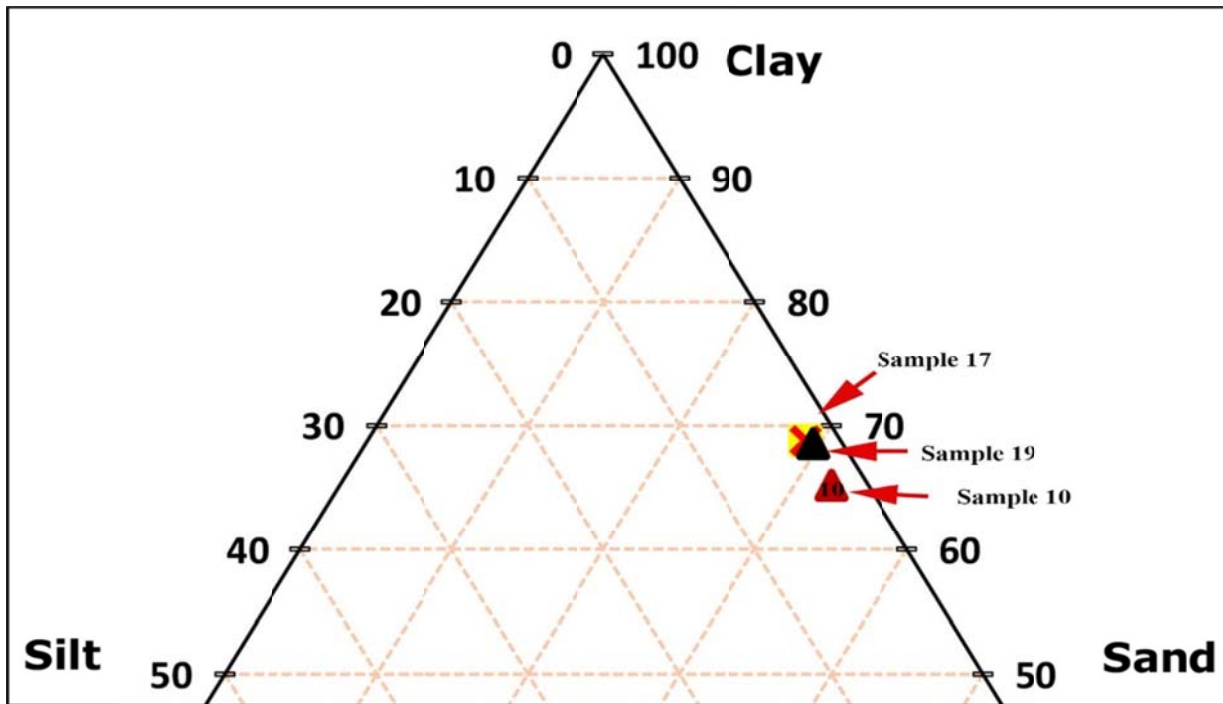


Figure 58. Cluster 4. Samples 10, 17, and 19. Sample 10, Baldwin Plain var. *O'Neal* sherd from 16ST1; Sample 17, fired-clay sample from Tchefuncte; Sample 19, fired-clay sample from Mississippi.

Cluster 5

Cluster 5 includes the two Alexander Incised var. *Unspecified* sherds from Mississippi (Samples 15 and 16; Figure 59; Table 8). Because these two sherds were recovered from two different (but adjacent) Henson Springs phase sites in Mississippi, they are relegated to their own cluster.

However, these two sherds are most similar to those in Cluster 3, the Tchefuncte Plain var.

Mandeville and Baldwin Plain cluster (Figure 57; Table 6), with clay-matrix ranging from 75.75 to 80.32 per cent, sand from 18.05 to 22.67 per cent, and silt from 1.58 to 1.63 per cent. There is a slight difference between Cluster 3 and Cluster 5 in the sand-size index values. Cluster 3 ranges from 1.08 to 1.16, while the Cluster 5 sand-size index values are 1.14 and 1.20. While this difference is small, it does indicate that the sand sizes in the Alexander Incised *var. Unspecified* sherds are slightly coarser than those in Cluster 3.

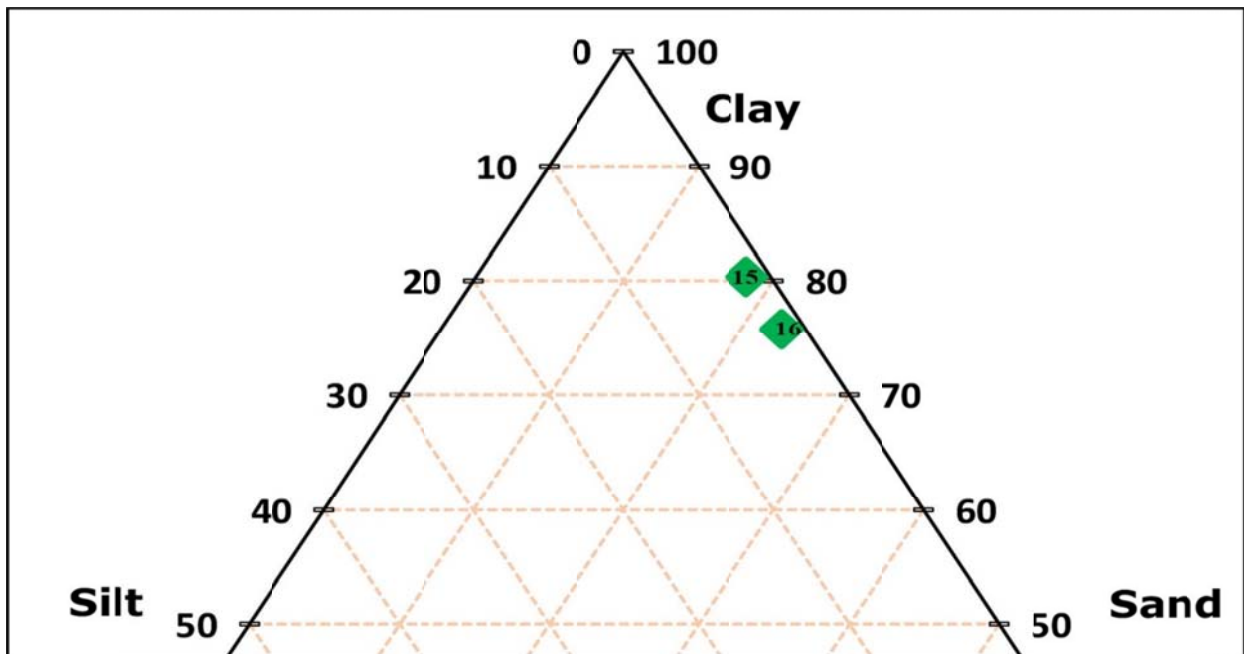


Figure 59. Cluster 5. Samples 15 and 16- Alexander Incised *var. Unspecified* from the Kellogg Village and Sanders sites in Mississippi.

Table 8. Cluster 5 Results.

Sample	Site	Type	Variety	Clay (%)	Sand (%)	Silt (%)	Sand-Size Index
15	Kellogg Village	Alexander Incised	<i>unspecified</i>	80.32	18.05	1.63	1.14
16	Sanders	Alexander Incised	<i>unspecified</i>	75.75	22.67	1.58	1.2

Are any of these Wares Tempered?

The results of the grain size analysis for the 16 sherds in the set were subjected to a modal analysis. This simple modal test was utilized to determine whether or not a bimodal distribution was present in any of the samples, a possible indicator of the purposeful inclusion of temper in the samples (Rice 1987:410-411). None of the modal tests of the sherds indicated a bimodal distribution in the sand size category. While the lack of any evident mode in the sand fractions of the Baldwin Plain *var. O'Neal* and Alexander Incised *var. Unspecified* sherds does not necessarily mean that they were not tempered, it is interesting to note that the clay source sample from Mississippi contains a variety of sand sizes as well. A sample of the results of this analysis for a Baldwin Plain *var. O'Neal* sherd (Sample 11) is presented in the form of a histogram below (Figure 60). Note that the bin range (i.e., sand size categories) used in creating the histogram represents the sand-size classes as defined by the Wentworth Scale and also are used for the sand-size index values. While it remains possible that some of these wares may be tempered, the sand inclusions in many of the sherds are likely the natural result of the parent materials included in the source location of primary clays or the result of materials incorporated during transportation and bedding of local sediments.

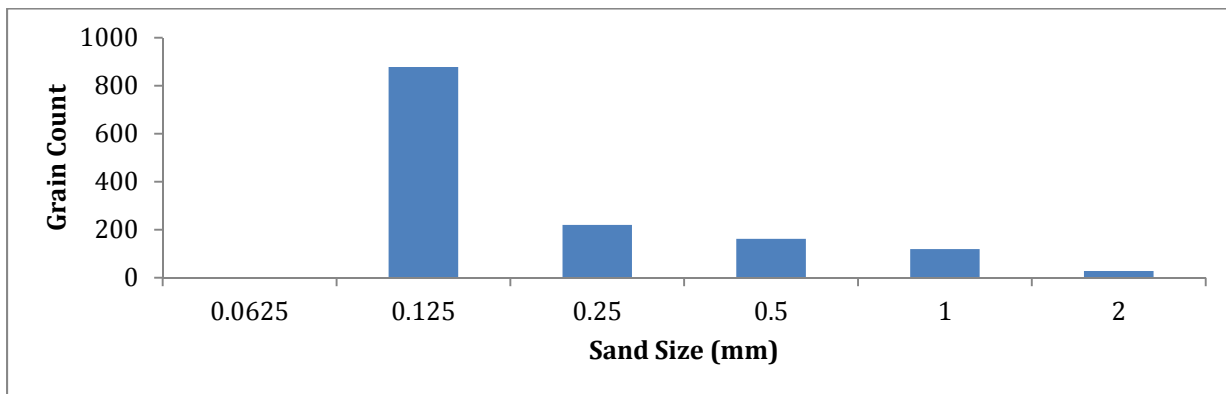


Figure 60. Example Histogram of Sand Sizes in Sample 11- Baldwin Plain *var. O'Neal* from 16ST1.

Results of the Point Count Using JMicrovision

As previously discussed, five of the samples from the entire set were randomly selected for point counting using the point count feature in the freeware JMicrovision (See Table 9). The subset selected for this procedure consisted of Samples 3, 7, and 12 from the Tchefuncte site, Sample 15 from the Kellogg Village site, and the fired-clay sample from Lowndes Co., Mississippi (Sample 19). A total of 300 points were counted for each sample according the procedures outlined earlier in this document. Evolution plots indicate that sufficient points had been collected for each sample (e.g.; Figure 61). The results from the point count will be compared to those from the previous image analysis exercise.

Sample #	Site #	Type	Variety	Clay (%)	Sand (%)	Silt (%)
3/Point Count	Tchefuncte	Tchefuncte Plain	<i>Tchefuncte</i>	94.00	5.00	1.00
3/Image Analysis	Tchefuncte	Tchefuncte Plain	<i>Tchefuncte</i>	95.03	1.47	2.37
7/Point Count	Tchefuncte	Tchefuncte Plain	<i>Mandeville</i>	90.00	7.67	2.33
7/Image Analysis	Tchefuncte	Tchefuncte Plain	<i>Mandeville</i>	86.74	9.98	3.28
12/Point Count	Tchefuncte	Baldwin Plain	<i>O'Neal</i>	75.00	23.67	1.33
12/Image Analysis	Tchefuncte	Baldwin Plain	<i>O'Neal</i>	77.75	20.18	2.07
15/Point Count	Kellogg Village	Alexander Incised	<i>Unspecified</i>	74.00	25.00	1.00
15/Image Analysis	Kellogg Village	Alexander Incised	<i>Unspecified</i>	80.32	18.05	1.63
19/Point Count	Lowndes Co., MS	Clay Sample	<i>n/a</i>	70.00	27.33	2.67
19/Image Analysis	Lowndes Co., MS	Clay Sample	<i>n/a</i>	68.56	29.53	1.24

Table 9. Results of the Point Count over

of Digital Image Analysis of Five Samples.

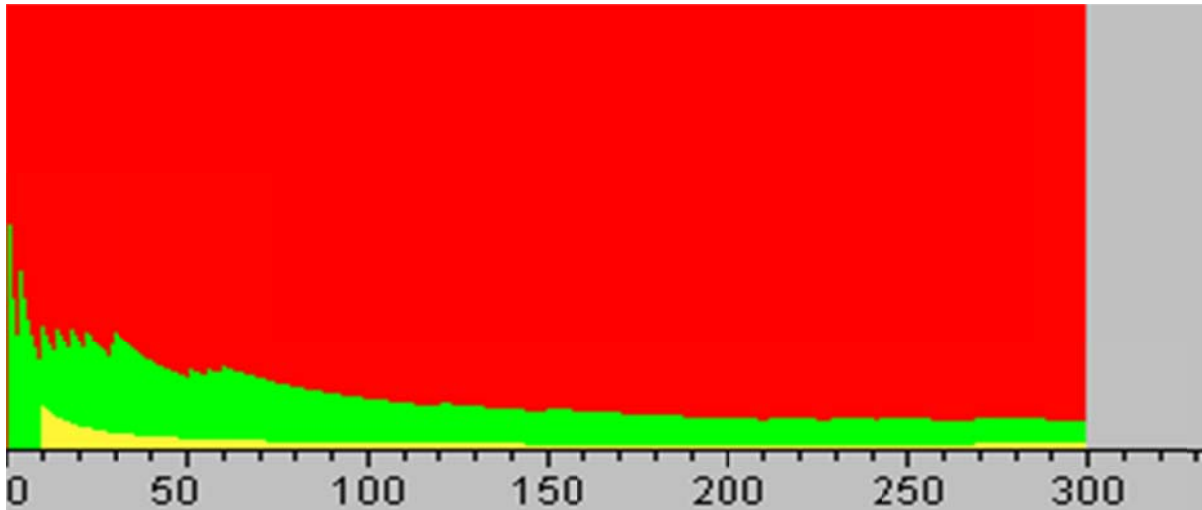


Figure 61. Evolution Plot Example from Point Count of Sample 3. Red: Clay-matrix fraction. Green: Sand fraction. Yellow: Silt fraction. Generated by JMicrovision.

Sample 3 Tchefuncte Plain var. Tchefuncte from the Tchefuncte Site

The point counting results for this Tchefuncte Plain var. Tchefuncte sherd were relatively within the results from the digital image analysis of the sample discussed in the previous section (Table 9; Figure 62). The analysis was run twice with near identical results. The percentages for clay-matrix (94.0 per cent), sand (5.0 per cent), and silt (1.0 per cent) from the point count are relatively close to the results for the digital image analysis for the sample (Table 4; Figure 55). The largest difference was in the sand fraction, 5.0 per cent for the point count versus 1.47 per cent for the image analysis.

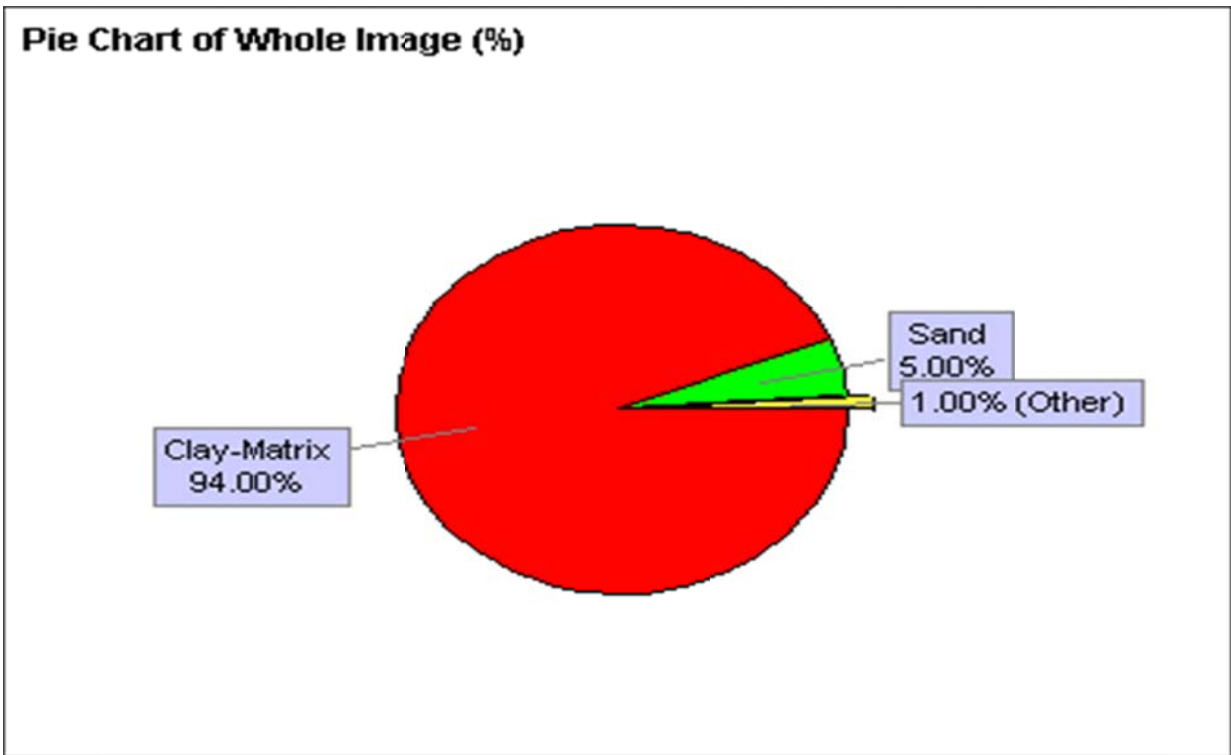


Figure 62. Point Counting Results of Sample 3. Other: Silt Percentage. Generated by JMicrovision.

Sample 7 Tchefuncte Plain *var. Mandeville* the Tchefuncte Site

This *var. Mandeville* sherd exhibits slightly higher results in the clay-matrix category (90 per cent) than the results of the digital image analysis of the sample. Additionally, it was also similar in the sand (7.67 per cent) and silt (2.33 per cent) categories to (Tables 5 and 9; Figure 63). The point count results for this sherd show relative consistency with the digital image analysis results for Sample 7.

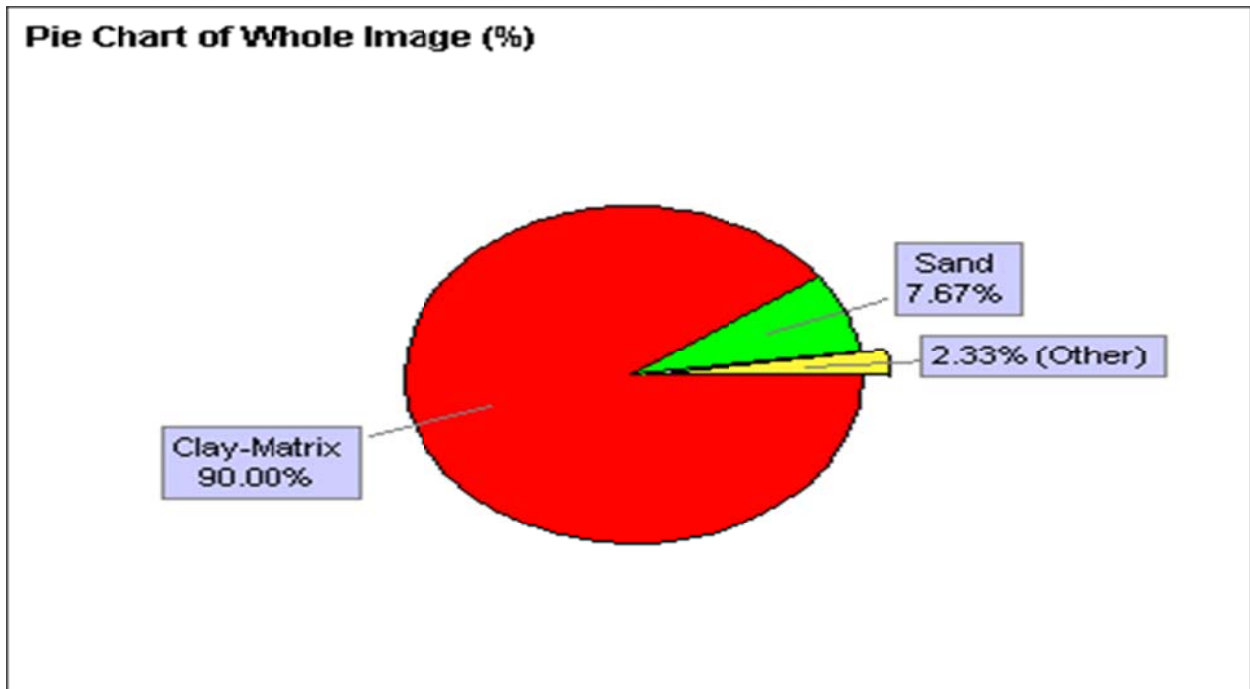


Figure 63. Results of the Point Count of Sample 7. Generated by JMicrovision.

Sample 12 Baldwin Plain *var. O'Neal* the Tchefuncte Site

The results of the point count for this Baldwin Plain sherd shows considerable consistency with the results of the digital image analysis for the sherd (clay-matrix= 75.0 per cent; sand= 23.67 per cent; Silt= 1.33 per cent) (Table 9; Figure 64). The silt percentage counted for the sample was slightly lower, while the percentage of sand fraction of the sample showed the largest difference between the two analyses; 20.18 per cent for the digital image analysis versus 23.67 per cent for the point count. The results of this point count were completed twice, with similar results each attempt. However, these results are generally comparable for those of the other Baldwin Plain *var. O'Neal* sherds from the digital image analysis conducted via the ImageJ software.

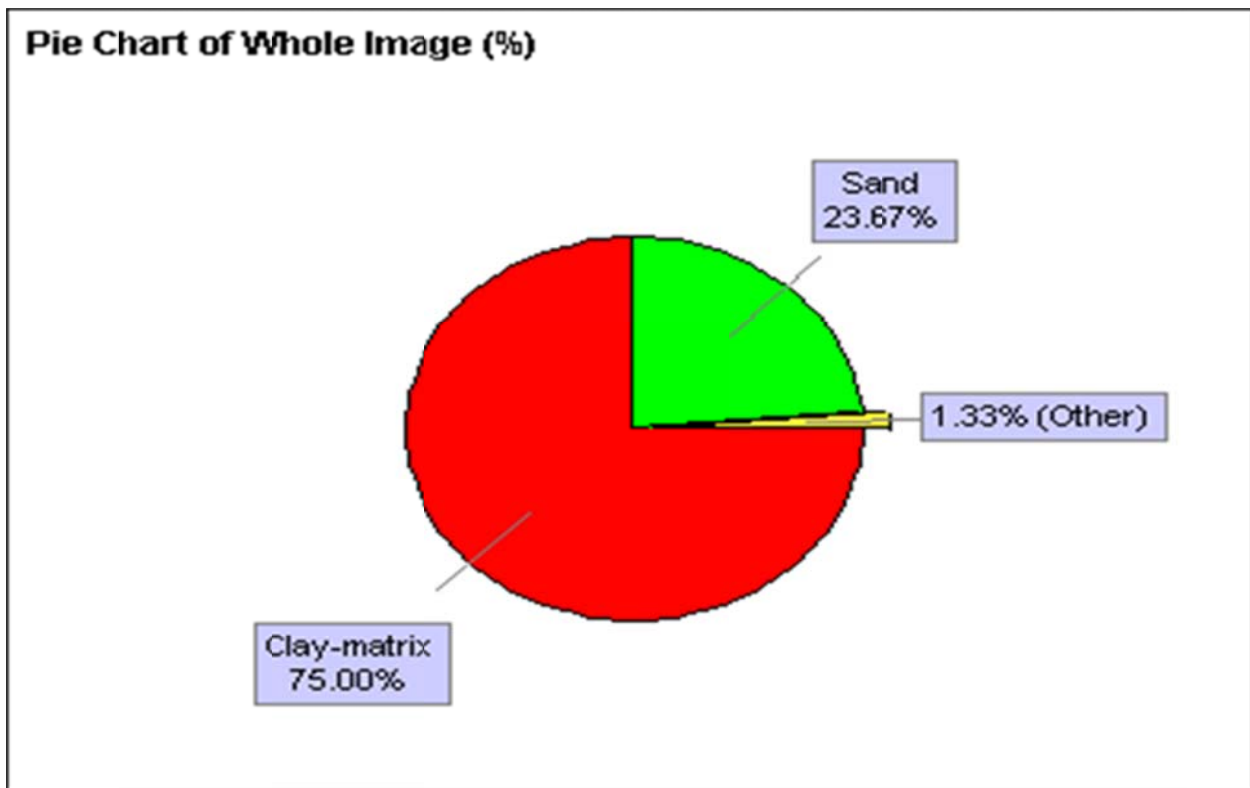


Figure 64. Results of the Point Count of Sample 12. Generated by JMicrovision.

Sample 15 Alexander Incised *var. Unspecified* (22CL527)

The Sample 15 results are the most inconsistent between the two different analyses (Table 9; Figure 65). The results of the point count of this Alexander Incised sherd indicated a slightly lower fraction of clay-matrix (75.0 per cent) than the digital image analysis. However, it is interesting to note that these point count results are very close to those recorded for Sample 16, the other sample of Alexander Incised *var. Unspecified* sherd from Mississippi.

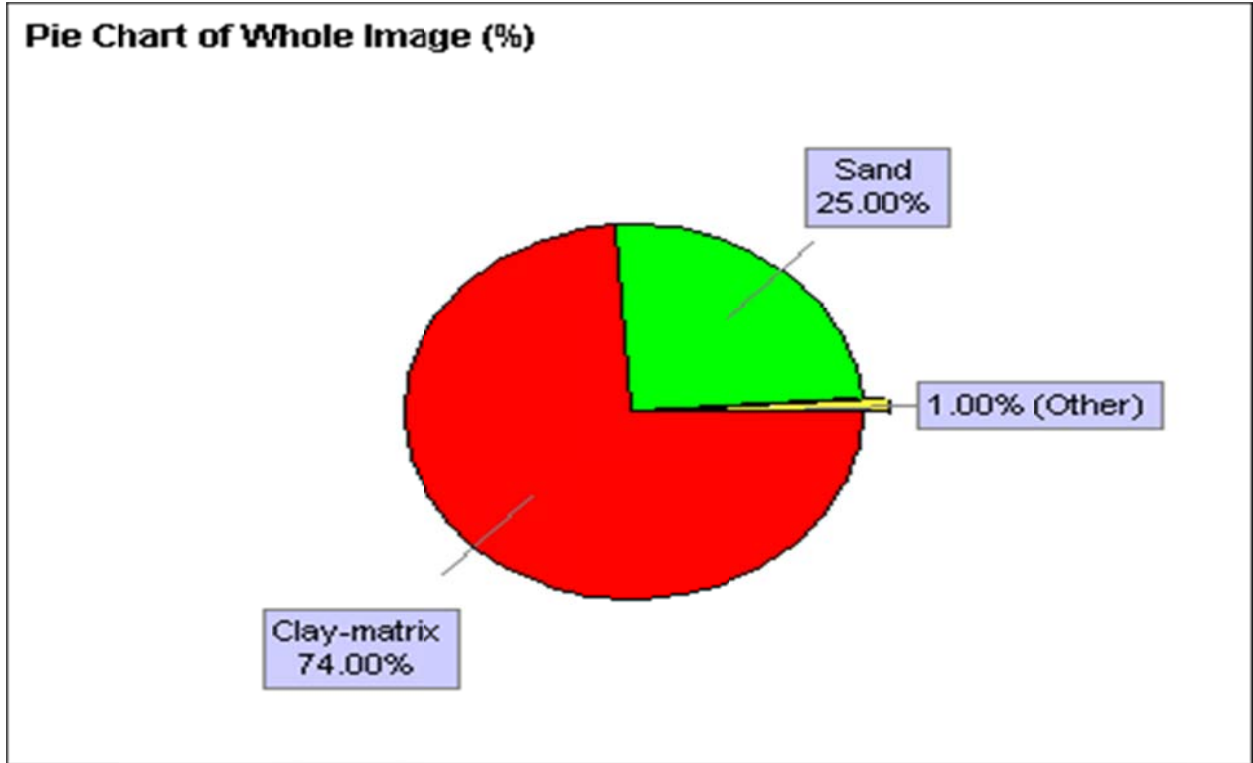


Figure 65. Results of the Point Count of Sample 15. Other: Silt fraction. Generated by JMicrovision.

Sample 19 Clay Source Sample/Lowndes County, Mississippi

Again, the results collected during the point count resulted in fractions that fall near the fractions of clay-matrix, sand, or silt for the results collected during the digital image analysis of this fired-clay sample from Mississippi (Table 9; Figure 66). The point count results for the clay-matrix (70.0 per cent), sand (27.33 per cent), and silt (2.67 per cent) fractions show considerable similarity to the results for the sample (Table 7; Figure 58).

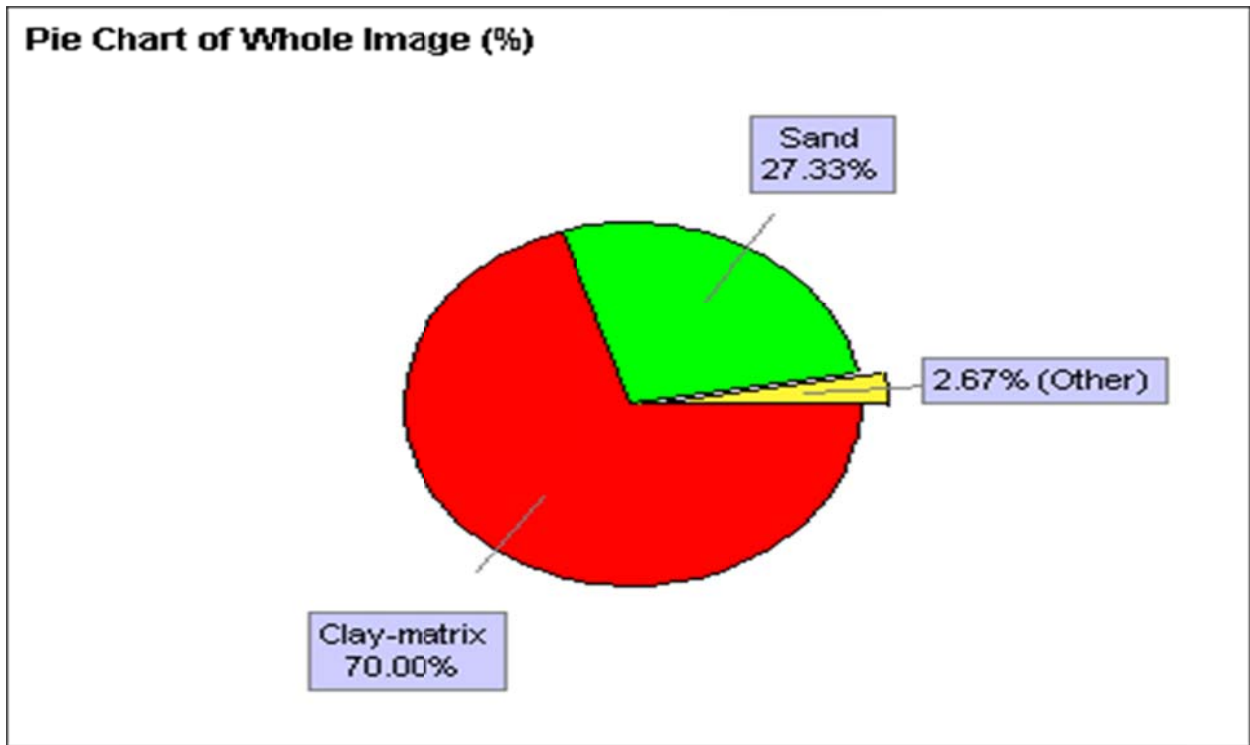


Figure 66. Results of the Point Count of Sample 19. Other: Silt fraction. Generated by JMicrovision.

Discussion of the Digital Image Analysis/ImageJ Results

The digital image analysis of the 19 samples in this set indicates a wide range of variability in paste constituents in the sample. In some cases, the results generally adhered to the accepted conventions on the relationships between the wares/types and their associated archaeological cultures. Each ware type/variety had some samples that clustered in distinctive groups based on clay-matrix, sand, and silt fractions identified during the analysis. However, there were a number of outliers (Figures 48 and 49; Tables 2 and 3). Thus, using a deviation factor of ± 3.5 per cent, I created ware clusters, independent of type, with the exception of the Alexander Incised sherds from Mississippi. This approach highlighted three factors could influence the conclusions. First, it is possible that some of the sherd samples may simply have been mistyped. Second, the wide

ranges in constituent percentages, especially in the Tchefuncte wares, make it difficult to differentiate individual sherds of these plainwares into the conventional ‘types’; a refinement of the parameters used to sort plainwares is necessary. Finally, the sand-size index values for each sample may provide a ‘tie-breaker’ of sorts, in the sense that differences in the average sizes of sand grains within each of the samples can be an indicator of similarity or distinction and thereby influence inclusion or exclusion with a cluster. With this in mind, the conclusions are presented below based upon these aforementioned criteria and in terms of the three postulates mentioned earlier.

Tchefuncte Plain *var. Tchefuncte* from the Tchefuncte and Bayou Jasmine Sites

These four examples of Tchefuncte Plain *var. Tchefuncte* from Site 16ST1 and 16SJB2 clustered in a group that is distinguished from all of the other samples in the set (Samples 1, 2, 3, and 13; Figure 55; Table 4). These examples of Tchefuncte Plain *var. Tchefuncte* all exhibit relatively uniform percentages of constituents and sand-size index values that conform to the Tchefuncte Plain *var. Tchefuncte* characteristics at both the Tchefuncte and Bayou Jasmine sites. An additional visual comparison of the sherds shows the typical laminated and contorted appearance so commonly associated with Tchefuncte pottery as well.

While the raw clay sample did not conform to the sherds, it does appear that the spatial patterning postulate is supported by the relative homogeneity of these samples within the Tchefuncte site and possibly between the Tchefuncte and Bayou Jasmine sites.

Tchefuncte Plain *var. Mandeville* from the Tchefuncte Site

Cluster 2 is comprised predominantly of Tchefuncte Plain *var. Mandeville* from 16ST1 (Table 5; Figure 56). Also included is the fired-clay sample from Bayou Jasmine and an example of Baldwin Plain *var. O'Neal*, also from the Tchefuncte site. There is some variability within this cluster in terms of paste constituents, and by using the sand-size index values, Sample 11 (Baldwin Plain *var. O'Neal*) is eliminated from the cluster for containing, on average, coarser sand grains. That leaves only the samples of Tchefuncte Plain *var. Mandeville* from the Tchefuncte site and the fired-clay sample from Bayou Jasmine, and changes the range of sand-size index values to 1.05 to 1.08, indicating smaller and finer sizes of sand grains in the samples.

These results would seem to indicate that, of the aforementioned three postulates for determining location of production, this subset satisfies the local-products match and the spatial patterning postulates. The relative homogeneity of the Tchefuncte Plain *var. Mandeville* sherds in this cluster, along with their distinctiveness from the Tchefuncte Plain *var. Tchefuncte* from the Tchefuncte site from Cluster 1, show that these two wares can be differentiated in terms of paste constituents. With the fired-clay sample from Bayou Jasmine included in Cluster 2, which appears to affirm the local-products match postulate, potentially raises the issue of inter-site interaction between the Tchefuncte and Bayou Jasmine sites. However, this small study does not contain a large enough sample size to say this with any confidence. The similarities between the Tchefuncte Plain *var. Mandeville* from the Tchefuncte site and the fired-clay sample from Bayou Jasmine may really only reflect similarities in the history of sediment transport and deposition within the Pontchartrain Basin.

Tchefuncte Plain var. Tchefuncte and Tchefuncte Plain var. Mandeville from the Tchefuncte Site

While the differences between the Clusters 1 and 2 in terms of paste constituents is relatively clear, the reasons for this are not. It may be that the selection of raw materials for ceramic production at the two sites may have varied based on the type and function of the vessel(s) being prepared, possibly accounting for the similar percentages of inclusions within the two different clusters. It may also be possible that the differences between the two clusters were due to changes in selection criteria for raw material procurement locales or technological adaptations that occurred over time. Finally, the variability of the pastes may simply be the result of the limited mixing and poor preparation of the raw clays evident in Tchefuncte ceramics.

Tchefuncte Plain var. Tchefuncte, Tchefuncte Plain var. Mandeville, Baldwin Plain var. O'Neal from the Tchefuncte and Bayou Jasmine Sites

In Cluster 3, it becomes more apparent that the wide variability in paste constituents for plainwares from the Tchefuncte and Bayou Jasmine sites is problematic (Table 6; Figure 57). However, a close review of the results and a visual inspection of the samples brings to light one of the issues presented earlier. Samples 4 and 14, both typed as Tchefuncte Plain var. *Tchefuncte*, appear to have been mistyped. The Sample 4 sherd exhibits percentages of clay-matrix, sand, and silt, as well as a sand-size index value, that resembles those of the Baldwin Plain var. *O'Neal* from the same cluster. A visual comparison of the thin section also appears to confirm this, as the sample does not exhibit any laminations or contortions in thin section. Sample 14, a sherd of Tchefuncte Plain var. *Tchefuncte* from Bayou Jasmine, appears to have been mistyped as well and exhibits attributes closer to those of the var. *Mandeville* sherds. It is

worth noting that *var. Mandeville* pottery was a minority constituents in the Tchefuncte assemblage at the Bayou Jasmine site. It is possible that mis-typing of *var. Mandeville* wares as *var. Tchefuncte* may be an issue. Samples 9 and 12, both Baldwin Plain *var. O'Neal*, share similar paste constituent percentages with the remainder of this subset. However, a visual inspection of the sherds, along with an examination of Sample 4, did not identify the laminated and contorted appearance typically associated with Tchefuncte wares.

Clusters 3 and 4 exemplify the problems with identifying and typing these plainwares. In the absence of surface and other decorative treatments, sorting criteria for these wares is usually limited to descriptions of the relative 'sandiness' of a sherd and the presence/absence of the laminations and contortions visible in cross-section. It is easy to see why it can be difficult to macroscopically sort some of these types/varieties, as the apparent wide-ranging variability in paste characteristics of each accepted type and/or variety makes sorting a difficult task.

The four samples of Baldwin Plain *var. O'Neal* from the Tchefuncte site in this sample set are distributed across three of the identified clusters (Clusters 2, 3, and 4; Figures 56, 57, and 58). The sand-size index value for Sample 11 was sufficiently high to differentiate it from the remainder of the samples in Cluster 2, which consisted almost entirely of Tchefuncte Plain *var. Mandeville* sherds. The differences between the two wares in terms of clay-matrix and sand percentages indicates that that Tchefuncte Plain *var. Mandeville* sherds tend to contain a higher amount of clay-matrix than the 'sandier' Baldwin Plain sherds. However, the results do not identify any clear markers of distinction between the two wares, with the exception of slightly elevated sand-size index values. A larger sample size and more robust sampling of source clays may aid in refining the distinctions between these two wares.

Cluster 4 also included two of the fired-clay samples from the study, one from the Tchefuncte site and one of the Mississippi samples. It is interesting to note the Baldwin Plain *var. O'Neal* sherd also included within Cluster 4 exhibited similar results in all four of the values used in this study with both fired-clay samples— Sample 17 from the Tchefuncte site and Sample 19 from Mississippi. This result is puzzling and adds further confusion to the location of production for the Baldwin Plain *var. O'Neal* pottery; it certainly negates the provenience postulate. Thus, the question of the local products-match postulate, i.e., location of production, of Baldwin Plain at the Tchefuncte site is still an open question.

Cluster 5—Alexander Incised *var. Unspecified*

The two non-local Alexander Incised sherds from Sites Kellogg Village and the Sanders site were only marginally distinguished from all the other samples in the set. The closest matches were the Baldwin Plain wares from the Tchefuncte site; the two types compared somewhat closely in all four categories (clay-matrix, sand, silt, and sand-size index) and the sand-size index values were nearly identical. Although a larger sample size could potentially provide results that may reveal distinctive ranges of paste constituents for each of the two types, at present no conclusive statements about the relationship between Alexander wares and Baldwin Plain are possible.

Point Count Discussion

The percentages of clay-matrix, sand, and silt of the point count subset exhibited general consistency with the results of the digital image analysis conducted with the **ImageJ** software. A total of 300 points were collected for each sample, well within the range deemed appropriate for

this kind of exercise (see Stoltman 1989; Livingood and Cordell 2009). The evolution plots generated for each point count indicate that enough points have been recorded for the data to be considered sufficient. Since the results of the point counting exercise represent a sample of the areal extent of the sherd in thin section, it stands to reason that there will be some variability between these data and the results of the digital image analysis. The digital image analysis measures all particles in the sherd sample, while the point count only samples the sherd at a fixed number of points along predetermined intervals. However, it is possible that with a larger point count sample subset, even more reliable results could be achieved.

Chapter 8: Conclusions

In this study, I have attempted to refine the taxonomy of plainwares recovered from the Tchefuncte site and from the Pontchartrain Phase of the Tchula period. Since the application of the type-variety system into Southeastern ceramics studies (Phillips 1970), the varieties Tchefuncte Plain *var. Mandeville* (aka Mandeville Plain) and Baldwin Plain *var. O'Neal* (aka O'Neal Plain) have been lumped together or differentiated from one another by various researchers (see Shenkel 1981 and 1984; Weinstein and Rivet 1978). Digital petrographic and digital image analysis of these two varieties, along with analysis of selected samples of Tchefuncte Plain *var. Tchefuncte*, two examples of Alexander series varieties from the Tchefuncte and Bayou Jasmine sites, and two samples from the Tennessee-Tombigbee region provided the sample set to determine any associations between and among these ceramics. Sediment samples from contexts associated with the Tchefuncte Site, the Bayou Jasmine Site and the Alexander series wares from Mississippi were fired and analyzed along with the ceramic set. The data produced as a result of these analyses was expressed in terms of bulk composition and percentages of constituents and used to make these potential associations and distinctions. The results were discussed in terms of association across all four of the sites, within clusters of specific types/varieties, and within clusters that appear to be related according to the results of the digital image analysis and/or digital point counting procedures.

Point Count Conclusions

With two attempts at point counting for each of the five samples selected, the results of the point count exercise consistently conformed to the results of the digital image analysis portion of this

study (Table 9). The slight differences between the results of the image analysis and point count are difficult to resolve. However, considering the consistency in the results between the two analyses, I believe that both analyses resulted in reasonably reliable data. The point count analysis of the samples consisted of 300 points, well within the range recommended by Stoltman (1989) and other petrographers (Livingood and Cordell 2009). Considering these results, I would suggest that digital point counting is a viable and cost-effective means of analyzing archaeological ceramics. However, larger sets of sherds and raw clay resource samples, in conjunction with some type of complimentary analyses (i.e., chemical analysis) would probably produce better interpretations.

Summary of Digital Image Analysis Conclusions

In this study, I used digital image and point counting software to attempt to identify the potential relationships between sandy-paste plainwares recovered from Tchefuncte contexts in southeastern Louisiana and contemporaneous wares of the Alexander series of Alabama and Mississippi. Taken as a whole, the results generally conformed to current convention concerning the relationships, with a few exceptions.

The results of this study appear to indicate that the Tchefuncte Plain *var. Tchefuncte* and *var. Mandeville* from both the Tchefuncte and Bayou Jasmine sites are of local manufacture; the local products-match and spatial patterning postulates for the two wares is confirmed. Additionally, these two wares can reasonably be sorted from one another based on relative percentages of paste constituents and by visual examination of sherds in cross section. Differentiating between Tchefuncte Plain *var. Mandeville* and Baldwin Plain *var. O'Neal* proved to be a more difficult enterprise. The two wares share very similar results in all four analytical

categories; however the two types could be distinguished by a visual examination of the sherds that identified laminations and contortions consistent with Tchefuncte pottery. Additionally, the fired-clay sample (Sample 18) from near the Bayou Jasmine Site exhibited characteristics similar to those of the Tchefuncte Plain *var. Mandeville* from the Tchefuncte site. While this raises some interesting possibilities concerning inter-site interaction, it is possible that these similarities may really only reflect the history of the transport and deposition of similar clays around the Pontchartrain Basin.

The average percentages of the constituent clay-matrix, sand, and silt in each of the wares in the set was such that a series of clusters could be generated. Most of the Tchefuncte Plain *var. Tchefuncte*, Tchefuncte Plain *var. Mandeville*, and two of the Baldwin Plain *var. O'Neal* from the Tchefuncte and Bayou Jasmine sites were separated into individual clusters with their own suite of characteristics. As for the Alexander Incised *var. Unspecified* sherds from Mississippi, the sherds showed some similarity to the Baldwin Plain *var. O'Neal* in the sample set. However, these results do not provide any clarification on the relationship between the two wares because the results of both the digital image and point count analysis were inconclusive. Adding to the confusion are the results of Cluster 4. A Baldwin Plain sherd clustered with the fired clay samples from both the Tchefuncte site and the sample from Mississippi. Also, problematic was the fact that a few of the samples were likely mistyped, and it is easy to see how this can create problems in identifying a generalized profile for each of these plainwares. However, as can be seen from the final results, digital image analysis and point counting can provide a set of useful results that may aid in refining the distinctions that can be made with these types of wares, as well as aid in typing more difficult specimens. In the absence of surface treatments and decorations, I contend that creation of a generalized profile that includes quantification of paste

constituents, as well as qualitative descriptions, can be helpful in defining these slight differences in plainwares. Additionally, it may even be possible to prepare test tiles that could be used as comparative guides in the macroscopic analysis to distinguish some of these wares.

Final Thoughts

The application of digital image analysis to archaeological ceramics has produced numerous studies and facilitated the sharing of digital images and results among researchers for wider analysis and consideration (e.g., Ortmann and Kidder 2004; Reedy and Kamboj 2004a and 2004b; Reedy and Vallamsetla 2004a and 2004b; Livingood 2003). This study provided an excellent introduction to the uses of digital image analysis in the evaluation of archaeological materials. While the learning curve involved with the software and analytical techniques involved is quite steep, I consider these valuable tools for any archaeologist interested in ceramic ecology or artifact analysis.

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Appendix 1.1 LSU Museum Loan Agreement

LSU Museum of Natural Science, Anthropology Division Invoice of Loaned Materials

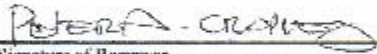
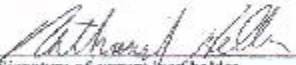
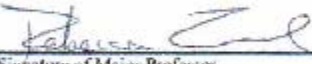

Invoice: 11214

Date of Loan: 1/24/13
Original date of return: 5/31/13 (renewable)
Renewed date of return: 5/31/14

To: Peter Cropley
Contact information: 5226 Camp St, Apt B,
New Orleans, LA 70115
Telephone: 504-250-5782

Items: 2 sherds and one clay sample from the Bayou Jasmine (16SJB2) site and 12 sherds and one clay sample from the Tchefuncte State Park (16ST1) site (see attached inventory list).

Destructive testing has been approved but the LSU Museum of Natural Science requires the return of the thin sections and sherds.

	6/6/2013
Signature of Borrower	Date
	6/6/13
Signature of current loan holder	Date
	6/4/2013
Signature of Major Professor	Date
	6/4/2013
Signature of Curator	Date

All items described above were returned in good condition except as noted

Signature of Curator _____ Date _____

Appendix 1.2 Cobb Institute Loan Agreement

MISSISSIPPI STATE UNIVERSITY
COBB INSTITUTE OF ARCHAEOLOGY
LOAN AGREEMENT

No.: _____

BORROWER

Name: Peter A. Cropley

Institution: Louisiana State University at Baton Rouge

Address: Department of Geography and Anthropology Louisiana State
University 227 Howe-Russell Geoscience Complex Baton Rouge, LA
70803

Telephone: 504-250-5782 E-mail: petecropley@gmail.com

DATE OF LOAN: March 15, 2013 DURATION: December 31, 2013

PURPOSE OF LOAN: Two Alexander series ceramics for petrographic analysis for Master's thesis.

LOCATION OF MATERIALS DURING LOAN: LSU-Baton Rouge

<u>Catalog or Box Number</u>	<u>Description</u>	<u>Provenience</u>	<u>Notes</u>
22CL917-21-9	1 sherd of Alexander Incised var. unspecified/	Unit 113R102 Zone C, Level 1/	
	Bag 21 Item 9		
22CL527-44	1 sherd of Alexander Incised var. unspecified/	general surface collection	

Receipt of the materials listed above and on n/a continuation sheets is acknowledged and the conditions of the Cobb Institute Collections Loan Conditions are accepted.

BORROWER: Peter A. Cropley DATE: March 15, 2013

LENDER: DATE: _____

DATE RETURNED: _____ RECEIVED BY: _____

CONDITION: _____

(Feb. 2013)

CONDITIONS OF LOAN

1. Written permission must be obtained from the U.S. Army Corps of Engineers, Mobile District prior to the use of its collections for research, interpretive displays, education, or other purposes.
2. Loaned materials will be maintained in the condition received. Materials will not be cleaned, retouched, repaired or altered in any way without prior written consent from the lender. No accession numbers or any other markings will be removed from or added to the specimens without prior written consent of the lender.
3. Any damages occurring during shipment or any other time will be immediately reported to the lender.
4. None of the material may be transferred to any other party without prior written permission of the lender.
5. Photographs of the loaned materials may be made and used for scientific and documentation purposes. Such photographs may be published, with acknowledgment given to: U.S. Army Corps of Engineers, Mobile District and the Cobb Institute of Archaeology, Mississippi State University.
6. No casting or any other replication of any loaned materials will be performed without prior written consent of the U.S. Army Corps of Engineers, Mobile District.
7. No destructive analysis will be performed on loaned materials without prior written agreement from the U.S. Army Corps of Engineers, Mobile District. If destructive analysis is agreed, each artifact to be affected will be documented by the borrower prior to analysis by digital or film photographs of at least two views, usually obverse and reverse unless otherwise specified in the agreement. Each photograph will be accompanied by full provenience information (site number, with bag number and catalog number or grid and zone/level designation) for the artifact shown. A copy of each photograph will be provided to the Cobb Institute of Archaeology collections manager.
8. This agreement may be terminated by either party with thirty days written notice or may be amended by mutual written consent.
9. One copy of any thesis, dissertation, publication, unpublished paper, or presentation material that includes data from research performed on loaned collections will be

deposited with the Cobb Institute collections manager, and with the District Archaeologist of the U.S. Army Corps of Engineers, Mobile District. The copy may be in paper or electronic format (PDF preferred). Any products of research should acknowledge the loan of materials from the Cobb Institute of Archaeology, Mississippi State University; in addition, the U.S. Army Corps of Engineers must be acknowledged in the products of research relating to its collections.

10. All U.S. Army Corps of Engineers-Mobile District collection materials must have a detailed descriptive and photographic record prepared, including their condition, at the cost of the borrower.

(Feb. 2013)

Appendix 1.3 ARPA Permit for Mississippi Clay Source Sample

OMB No. 1024-0037
Expires 30 June 1989

DEPARTMENT OF THE ARMY

**APPLICATION for a FEDERAL PERMIT under
THE ARCHAEOLOGICAL RESOURCES PROTECTION ACT**
approved October 31, 1979
(P.L. 96-85; 93 Stat. 721; 16 U.S.C. 470aa-mm; 32 CFR 229)

NAME OF PROJECT OR INSTALLATION:

Peter Croyley, Master's Thesis on Ceramic Petrography of Tchoufuncté and Alexander Plainwares

All information requested must be completed before application will be considered. Use separate sheets of paper if more space is needed to complete a section.

1. Name of Institution: Louisiana State University, Museum of Natural Science

2. Date of Application: April 29, 2013

3. Address (include Zip Code)

Museum of Natural Science, 119 Foster Hall, Louisiana State University, Baton Rouge, LA, 70803

4. Type of permit requested: (check appropriate box)

a. Surveys, limited testing and/or limited collections on lands identified in No. 5

b. Excavation, collection and intensive study of specific sites described below in No. 5

5. Lands of the United States for which a permit is requested:

- a. Description: Specify military installation or civil works project. If on surveyed lands, descriptions must be by subdivisions of the Public Land Surveys. If on unsurveyed lands, description must be by metes and bounds with ties to some topographic feature.

U.S. Army Corps Property in Lowndes County, MS. Located on east side of Tennessee-Tombigbee Waterway and south of State Highway 50. UTM coordinates $\text{e } 362569.60 \text{ n } 3716690.12 \text{ Z } 16\text{S}$

- b. Attach a readable copy of a map or plan showing specific sites or areas for which permit is desired (see attached map).
See attached

6. Nature and extent of the work proposed, including how and why it is proposed to be conducted:

Single soil sample collection for clay source sample for Master's Thesis on ceramic petrography

Vita

Peter A. Cropley, a native of Nashua, New Hampshire, graduated *cum laude* with his bachelor's degree in Anthropology from the University of Massachusetts at Boston in 2002. Prior to graduating, he worked for the Massachusetts Historical Commission's Technical Services Division for two years. Since 2003, Mr. Cropley has been employed as a Cultural Resources Management Archaeologist in New Orleans, Louisiana, and has worked on archaeological projects across the United States. As his interest in archaeology expanded, he decided to pursue graduate studies at Louisiana State University where he will receive his Master of Arts degree in December of 2014. Upon receiving his degree, he will continue to advance in his career in Cultural Resources Management.