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## The Petrographic Analysis of Sherds from the Musgano Site (41RK19), Rusk County, Texas

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# The Petrographic Analysis of Sherds from the Musgano Site (41RK19), Rusk County, Texas

*Steve A. Tomka, Lori Barkwill Love, and Timothy K. Perttula*

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## INTRODUCTION

Characterizing the mineralogical composition of ceramic vessels and sherds from Caddo sites in East Texas by means of petrographic analysis provides a unique opportunity to gather and investigate empirical evidence from ceramic vessels on : (1) technological and manufacturing practices, and (2) their trade and exchange at varying scales conducted by ancestral Caddo people with their neighbors, both near and far (i.e., other ancestral Caddo groups as well as non-Caddo communities). This evidence in turn can be used to explore changes in the nature of social and economic relationships between particular Caddo groups and other prehistoric populations. Identified compositional and paste differences that have been recognized between the different wares made by Caddo groups (i.e., plain wares, utility wares, and fine wares, see Perttula 2013) can also be employed to explore functional and technological differences in vessel function and form.

It is important to build on existing petrographic studies of Caddo vessels and vessel sherds (see Perttula and Selden 2013) by examining unstudied assemblages to (1) better clarify the compositional nature of these ceramic wares across the Caddo temporal and geographic landscape; (2) to help pinpoint other ceramic manufacturing locales and mineralogical compositional groups, but also to assess their apparent technological complexity; and (3) lead to better evaluations of the regional character of prehistoric and historic Caddo trade and interaction networks that existed, and more definitively establish whether there were changes through time in the direction and intensity of local and long distance trade and interaction. The disparate pieces of information contained within the sherds and vessel fragments of Caddo ceramics found on many prehistoric and early historic sites throughout the region have the potential to address these questions and research issues, and can contribute unique information concerning those relationships that existed in the distant (and not-so-distant) past between Caddo farmers.

Twenty decorated sherds from the Musgano ceramic assemblage curated at the Texas Archeological Research Laboratory at The University of Texas at Austin (TARL) were selected for petrographic analysis. The sherds were split and one of the remaining fragments of each pair was used for the production of thin sections. Originally, the other half of each sherd was to be submitted for instrumental neutron activation analysis, but such analyses were not done; the remaining sherd fragment was returned for continued curation at TARL. Upon the receipt of the thin sections, they underwent petrographic analysis as reported on herein.

The 20 sherds include sherds from engraved fine wares (n=8, 40 percent)—bottles and carinated bowls—as well as sherds from utility wares (n=12, 60 percent) (Table 1). The utility wares have brushed-applied, incised, incised-punctated (from Maydelle Incised, Weches Fingernail Impressed, and Washington Square Paneled vessels), and punctated decorative elements. Ten percent of the sherds are from bone-tempered vessels, based on macroscopic examination, while the others are from grog-tempered vessels.

## PETROGRAPHIC ANALYSIS METHODS

The thin sections were examined with a Leica DM750P Petrographic microscope with an attached mechanical stage. A two-step process was used to examine the thin sections. The first step involved recording their general characteristics and taking photomicrographs of representative portions of each thin section.

**Table 1. Sherds selected for petrographic analysis from the Musgano site.**

Sample No./ Lot No.	TARL No.	Sherd type	Description
RK19-1/118	UT00865	rim	cross-hatched engraved zone; grog-tempered
RK19-2/54	UT00866	body, Bt	horizontal and curvilinear engraved lines and circle element; grog-tempered; Perttula 2015:Figure 15a
RK19-3/128	UT00867	body	parallel brushed and straight applied fillet; grog-tempered
RK19-4/128	UT00868	rim, Bt	horizontal engraved lines; Hickory Engraved; grog-tempered
RK19-5/72	UT00869	body	diagonal opposed incised lines; bone-tempered; Maydelle Incised; Perttula 2015:Figure 8a
RK19-6/104	UT00870	body	horizontal incised lines and a single row of tool punctates; grog tempered
RK19-7/123A	UT00871	body	horizontal incised bands filled with crescent-shaped fingernail impressions; Weches Fingernail Impressed; grog-tempered; Perttula 2015:Figure 10f
RK19-8/149	UT00872	body, Bt	curvilinear engraved lines and hatched narrow panels; grog-tempered; Perttula 2015:Figure 15e
RK19-9/69	UT00873	body	parallel and narrow hatched engraved lines and zones; grog-tempered
RK19-10/128	UT00874	body, CB	horizontal incised line and row of tool punctates; Washington Square Paneled; bone-tempered; Perttula 2015:Figure 11b
RK19-11/148	UT00875	body	tool punctated panels filled with diagonal incised lines pitched in opposite directions; grog-tempered; Perttula 2015:Figure 10h
RK19-12/99	UT00876	body	incised triangles filled with tool punctates; Maydelle Incised; grog-tempered
RK19-13/65	UT00877	body, CB	rectilinear and curvilinear engraved elements; grog-tempered; Perttula 2015:Figure 14f
RK19-14/87	UT00878	body	diagonal and triangular incised elements, the latter filled with tool punctates; Maydelle Incised; grog-tempered; Perttula 2015:Figure 10j
RK19-15/74	UT00879	body	parallel rows of tool punctates; grog-tempered
RK19-16/74	UT00880	body	panels with concentric semi-circular engraved elements; grog-tempered; Perttula 2015:Figure 14g
RK19-17/67	UT00881	rim, CB	narrow horizontal incised panels filled with tool punctates; Washington Square Paneled; grog-tempered; Perttula 2015:Figure 11d
RK19-18/67	UT00882	rim	diagonal opposed incised lines; tool punctated rows under lip and at rim-body juncture; grog-tempered; Perttula 2015:Figure 9e
RK19-19/136	UT00883	body	curvilinear hatched zone; red pigment; grog-tempered; Perttula 2015:Figure 14j
RK19-20/94	UT00884	body	incised triangle filled with rows of tool punctates; grog-tempered; Maydelle Incised; Perttula 2015:Figure 10n

Bt=bottle; CB=carinated bowl

The general characteristics recorded were paste matrix descriptions, paste color, b-fabric (Stoops 2003:95), and description of edges. Two photomicrographs, one in plane light and another in cross-polar light, were taken of each thin section at 4x magnification. Digital images were captured using a Leica DFC 295 Digital Camera attached to a Dell computer.

The second step involved point counting using the Glagolev-Chayes method. The Glagolev-Chayes method involves using the mechanical stage, which allows one to move the thin section at a given interval beneath the crosshairs in the ocular, and identifying and recording each point encountered in the crosshairs (Galehouse 1971:389-390). For the point count sampling, the microscope was set at 10x magnification, and the stage was set so that the vertical and horizontal increments were both 0.4 mm. Each point encountered was identified as either paste matrix, void, or a given type of non-plastic inclusion. Paste matrix was recorded by tally; however, for all voids and non-plastic inclusions, estimated size and shape were recorded. Non-plastic inclusions and voids were only counted once even if the same void or inclusion was encountered more than once in the crosshairs. Once the point counting was completed, non-plastic inclusions that were noted during the scanning of the slide but not included in the point counting were recorded using a general estimate of their frequency.

The thin sections were point counted until 200 paste points were reached. Stoltman (1989:151-152, 2012:H-1) suggests that a minimum of 100 points (exclusive of voids) are needed to ensure reliable results and that point counting in excess of 200 points yields redundancy. To reach the minimum of 200 paste points counted for each slide, the minimum number of points recorded was 231, and the maximum number of points recorded was 315 (see below). The counts, measurements, and paste, voids, and non-plastic inclusion type recorded during point counting for each thin section were input into a JMP Pro 10 data table.

The maximum diameter of the inclusion/void was measured with the ocular scale to the nearest whole number. At 10x magnification, each tick mark on the ocular scale represents 0.02 mm. The raw tick mark count was recorded for each inclusion, input into JMP and converted to an actual size. Within each temper category, the distribution of sand was noted by size category based on the Wentworth Grain Size scale (Table 2).

**Table 2. Wentworth grain size scale used for distribution of sand size.**

Size Category	Recorded Size
Silt	0.02-0.06 mm
Very Fine Sand	0.07-0.12 mm
Fine Sand	0.13-0.25 mm
Medium Sand	0.26-0.50 mm
Coarse Sand	0.51-1.0 mm
Very Coarse Sand	1.01-2.0 mm

### **Temper Categories**

To assign temper categories to the thin-sections in the study, the recorded paste/inclusions were combined into the following simplified categories:

<b>Recorded Paste/Inclusion</b>	<b>Simplified Inclusion Category</b>
Paste	Paste
Bone	Bone
Sherd	Grog
Quartz	Sand
Polycrystalline quartz	Sand
Alkali feldspar	Sand
Microcline	Sand
Chert	Sand
Muscovite	Mica
Mica Schist	Mica
Biotite	Mica
Calcium carbonate	Other
Clay pellet	Other
Hematite	Other
Opaque	Other
Organic	Other
Unknown	Other
Calcite	Other
Other	Not included
Voids	Not included
Secondary Calcite	Not included

### ***Sherd ID***

The ID number etched on the thin sections.

### ***Simplified Inclusion Categories (paste percent, sand percent, bone percent, grog percent, hematite, and mica percent)***

This lists the percentage of each category found during point counting. Note that the “other” inclusion category was omitted from this table.

### ***Median Sand Size***

This represents the median size for the sand inclusions in the thin section.

### ***Median Inclusion Size***

The median inclusion size represents the median size for all inclusions excluding sand and voids.

*Platy Bone Inclusions*

Platy bone inclusions list whether or not platy bone inclusions were common in the thin section. Y=platy-shaped bone was common, N=bone was generally not platy-shaped.

*Common Inclusions (feldspar, mica, and hematite)*

This lists whether or not these inclusions were rare (R), uncommon (U), common (C), and abundant (A).

*Temper of Grog (sand, bone)*

The temper identifies what kind of aplastic additive is present in the grog piece employed as temper.

*Results of Petrographic Analysis*

As indicated earlier, there was a broad range in the point counts of the 20 thin sections from the Musgano site. Table 3 presents the number of aplastic inclusions and voids per thin section. The lower the total number of points counted (i.e., 200 paste plus voids and aplastic inclusions), the less frequent the number of aplastic inclusions, while the higher the number of points counted, the more frequent the number of aplastic inclusions in the ceramic fabric.

**Table 3. Breakdown of aplastic inclusions by count group from the Musgano site.**

Aplastic Point Count Group	Sample number/ Thin section sherd ID
30-40 points	n=1; 5
41-50 points	n=7; 3, 4, 6, 12, 14, 16, 20
51-60 points	n=2; 11, 17
61-70 points	n=2; 1, 18
71-80 points	n=2; 10, 15
81-90 points	n=3; 2, 8, 9
91+ points	n=3; 7, 8, 19

Table 3 indicates a peak in point counts at 41-50 inclusions and voids (35 percent of the slides). The majority of the slides (n=12; 60 percent) have higher counts of inclusions. It is worth noting, however, that the bulk of the inclusions are quartz, and other sand constituents that are part of the parent clay.

To define the temper groupings within this collection of thin sections, a frequency distribution was created for each specimen based on the simplified inclusion category (voids and secondary calcite excluded). The "other" category was not used in temper assignments given that this category made up a small fraction of the inclusion categories. Using this approach, four temper categories were defined within these thin-sections (Table 4): Temper Group I: bone-tempered grog-tempered sandy paste (n=9, 45 percent); Temper Group II: grog-tempered (n=7, 35 percent); Temper Group III: sandy paste (n=2, 10 percent), and Temper Group IV: bone-tempered sandy paste (n=2, 10 percent) thin sections. Overall, grog-tempered thin sections were the most common category represented, followed by thin sections tempered with bone. All of the ceramic vessels were made of sandy paste clays. Table 4 lists the thin sections by temper group.

**Table 4. List of thin-sections by temper group defined in the sample analyzed from the Musgano site.**

Temper Group	Thin Section
I: Grog-tempered (with bone) Sandy paste	4, 5, 7, 8, 10, 12, 15, 18, 20
Sub-group 1	4, 5, 8, 12, 15, 18, 20
Sub-group 2	7, 10
II: Grog-tempered (no bone) Sandy paste	1, 2, 6, 9, 14, 16, 17
III: Sandy paste no temper	3, 19
IV: Bone-tempered Sandy paste	11, 13

**Temper Group I: Grog Temper Sandy Paste  
(grog contains bone temper, n=9: 4, 5, 7, 8, 10, 12, 15, 18, 20)**

These nine thin sections represent clay fabrics tempered with grog. The grog temper seen in these thin sections is itself tempered with bone. Therefore, the bone occurs only occasionally in the clay fabric of the thin sections, but it is consistently noted in the pieces of grog that are used as the aplastic additive to the clay.

Two subgroups may be defined on the basis of the percentage of bone in the clay fabric. In sub-group 1, consisting of seven sherd specimens (4, 5, 8, 12, 15, 18, and 20), bone aplastic additives never register in the point counting at a rate higher than 1 percent of the counted aplastic inclusions. As a matter of fact, it reached 1 percent in only two slides, thin sections 12 and 15. In the other five slides, bone was noted during the initial scanning of the slides but never occurred in large enough numbers to actually be found in the counting cross-hairs. In sub-group 2, consisting of two thin sections (7 and 10), bone tempering makes up 7 percent and 3 percent, respectively, of the point-counted inclusions.

Grog makes up between 1-6 percent (mean of 3.3 percent) of the aplastic inclusions noted in the nine slides while the sand constituent ranges between 7 and 19 percent (mean=12.1 percent) of the inclusions. The major difference between the sub-groups is in terms of the percentage of bone tempering in the thin sections. It is possible that in the case of the seven specimens with low bone percentages, the only bone derives from the processing of the bone-tempered grog added to the clay fabric. On the other hand, the higher percentages of bone tempering in the sub-group 2 specimens may be due to bone deriving not only from the bone-tempered grog but also as an additional additive to the clay fabric.

Given that the majority (68 percent) of the sand in each of the thin sections is silt-sized (Table 5), it is likely that the sand was a natural constituent element in the clay for all the samples in this category. Both the percentage of sand in the paste, as well as the size of the sand grains, suggests that the sand is a natural constituent of the clay fabric. As such, the group of vessels represented by these thin sections appear to be made of the same clay. In addition, the percentage of grog present in the fabric of these specimens is very similar. Taken on the whole, the two temper sub-groups appear to be made by the same craftswomen or using the same technological steps and procedures, with the exception of the grog employed as the aplastic additive. The absence of bone in Temper Group II and its presence in the grog temper of Temper Group I (sub-groups 1 and 2) slides may be indicative of two distinct ceramic traditions, or to an flexible technological approach employed by the same Caddo potters to make clay vessels.



**Table 5. Distribution of grog and quartz by size category, Temper Group I.**

Size category	Grog (count/percent)	Quartz (count/percent)
Very coarse sand	11/19	–
Coarse sand	27/47	–
Medium sand	17/30	2/1
Fine sand	2/4	18/10
Very fine sand	–	37/21
Silt	–	121/68
Total	57	178

*Temper Group I: Sub-Group 1*

*Sherd No. 4 (Figure 1)*



Figure 1. Sherd No. 4, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Striated

*Paste Color (PPL):* 2.5YR 8/6

*B-fabric (XPL):* Speckled/Active

*Edge Description:* same as the rest of the paste; spots appear to be missing.

*Temper Description:* Many of the crushed sherds seemed to have the same paste as the thin section. However, many of the grog pieces also contain small pieces of bone, some of which has been ground out of the grog and introduced in the clay fabric of the vessel.

*Comments:* Diagonal voids in the thin section; some voids cross the thin section entirely; bone present but small; may derive from grog.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	80.0	Paste	200	83.7
Quartz	23	9.2	Sand	23	9.6
Grog	11	4.4	Grog	11	4.6
Bone	1	0.4	Bone	1	0.4
Muscovite	1	0.4	Mica	1	0.4
Clay pellet	1	0.4	Other	3	1.3
Opacu	2	0.8			
Voids	11	4.4	<b>Total</b>	<b>239</b>	
<b>Total</b>	<b>250</b>				

*Also present:* mica (common; tiny rods); alkaline feldspar (uncommon), hematite (uncommon).

*Common inclusion in grog:* quartz, bone.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .24	.07	.03
<b>Bone</b>	.24	N/A	N/A
<b>Grog</b>	.32 – 2.56	1.1	.06
<b>All Inclusions</b>	.02 – 2.56	.38	.04

*Sherd No. 5 (Figure 2)*

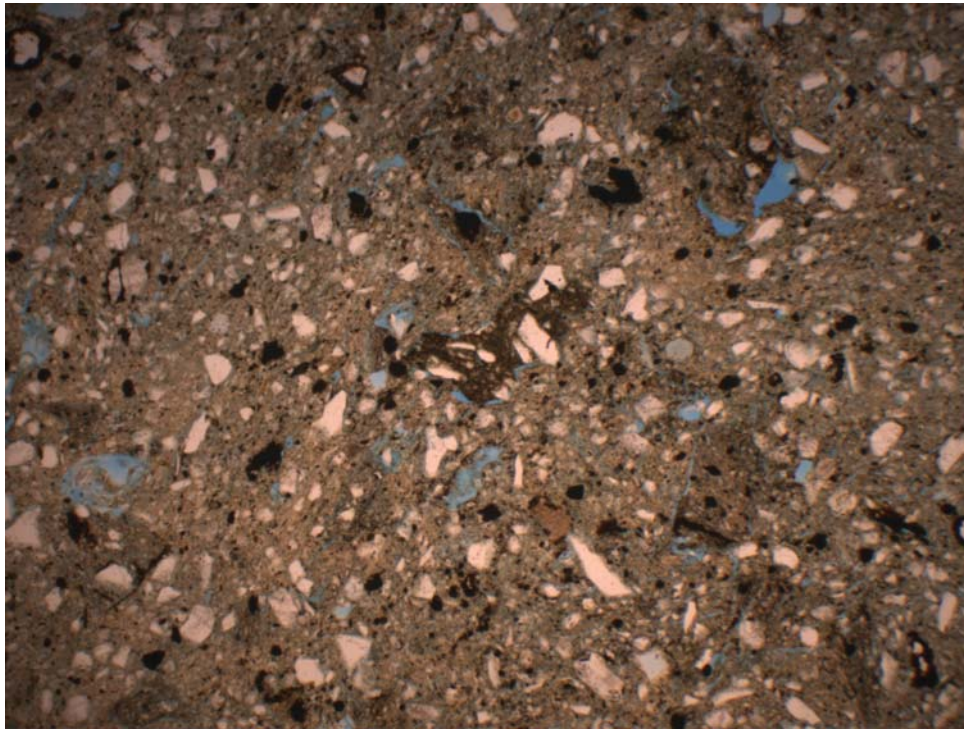


Figure 2. Sherd No. 5, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 7.5YR 4/6

*B-fabric (XPL):* Speckled/Slightly Active

*Edge Description:* One edge lighter and active (10YR 7/6)

*Grog Description:* Bone noted but never fell under cross-hairs to be counted; the bone appears in the grog inclusions. Parent clay is silty.

*Comments:* Orientation of inclusions random.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	86.6	Paste	200	88.9
Quartz	19	8.2	Sand	19	8.4
Grog	3	1.3	Grog	3	1.3
Alkali feldspar	1	0.4	Other	1	0.4
Muscovite	1	0.4	Mica	1	0.4
Clay pellet	1	0.4	Other	1	0.4
Voids	6	2.6	<b>Total</b>	<b>225</b>	
<b>Total</b>	<b>231</b>				

*Also present:* mica (common, various forms); bone (common); rock conglomerate (uncommon); polycrystalline quartz (uncommon); plagioclase (rare).

*Common temper found in grog:* quartz and bone.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .14	.06	.04
<b>Grog</b>	.5 – 1.12	.79	.74
<b>All Inclusions</b>	.04 – 1.12	.15	.04

**Sherd No. 8 (Figure 3)**

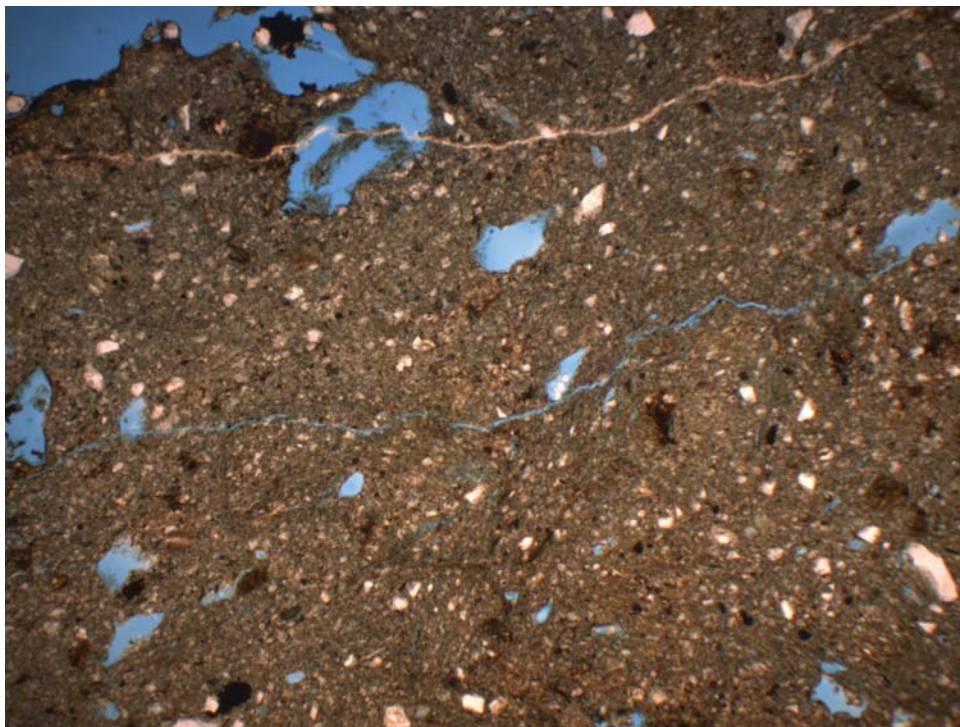


Figure 3. Sherd No. 8, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 2.5YR 4/4

*B-fabric (XPL):* Undifferentiated

*Edge Description:* One edge lighter (2.5YR 6/4 –speckled/slightly active)

*Grog Description:* Low number of bone probably derived from temper in grog

*Comments:* Inclusions are randomly oriented.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	70.2	Paste	200	76.7
Quartz	41	14.4	Sand	48	18.4
Grog	9	3.2	Grog	9	3.4
Poly crystalline quartz	2	0.7	Mica	2	0.8
Alkali feldspar	5	1.8	Other	2	0.8
Plagioclase	1	0.4	<b>Total</b>	<b>261</b>	
Muscovite	1	0.4			
Opaque	2	0.7			
Voids	24	8.4			
<b>Total</b>	<b>285</b>				

*Also present:* chert (uncommon); bone (rare); hornblende (uncommon).  
*Common temper found in grog:* small bone.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – 0.31	.06	.02
<b>Grog</b>	.14 – 1.12	.54	.48
<b>All Inclusions</b>	.02 – 1.12	.15	.02

**Sherd No. 12 (Figure 4)**

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 7.5YR 6/6

*B-fabric (XPL):* Speckled/Slightly Active

*Edge Description:* One edge slightly dark (7.5YR 5/4); the other edge darker (7.5YR 3/4)

*Temper Description:* Pieces of large bone present in fabric but generally uncommon.

*Comments:* Inclusions are randomly oriented.

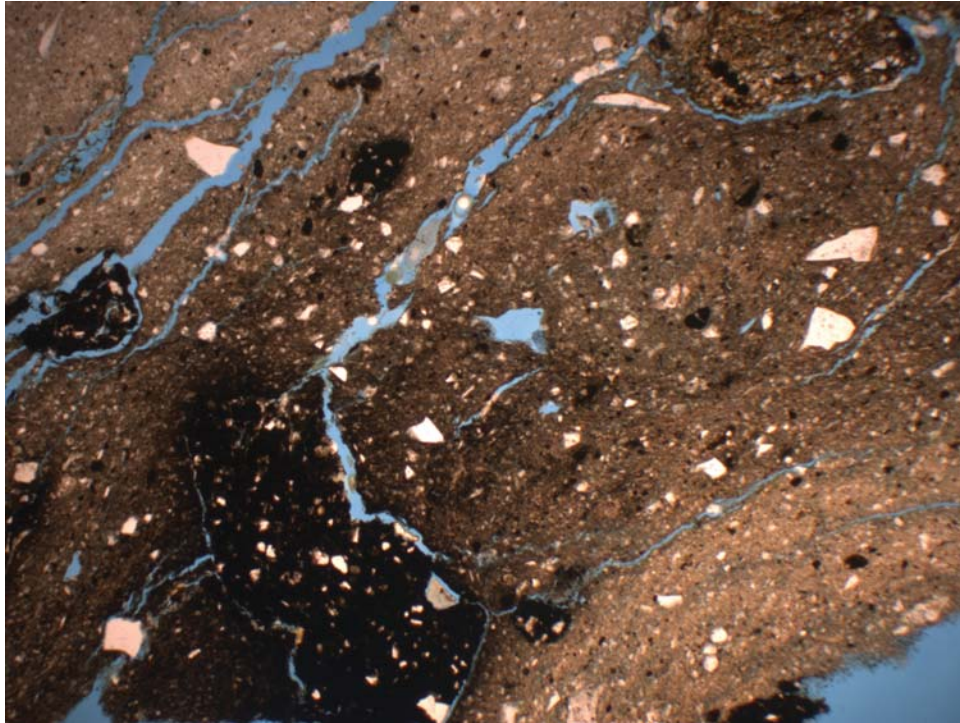


Figure 4. Sherd No. 12, Musgano site.

**Point Count:**

Paste/ Inclusion	Count	%	Simplified Inclusion Category	Count	%
Paste	200	82.0	Paste	200	87.8
Quartz	19	7.8	Sand	22	9.8
Grog	4	1.6	Grog	4	1.8
Bone	1	0.4	Bone	1	0.4
Polycrystalline quartz	1	0.4	Mica	1	0.4
Alkali feldspar	1	0.4	<b>Total</b>	<b>228</b>	
Biotite	1	0.4			
Chalcedony	1	0.4			
Voids	16	6.6			
<b>Total</b>	<b>244</b>				

*Also present:* mica (abundant; tiny rods); chert (uncommon); rock conglomerate (uncommon); plagioclase (rare).

*Common inclusion in grog:* quartz; bone.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .10	.06	.04
<b>Bone</b>	.04	N/A	N/A
<b>Grog</b>	.36 – 1.40	.82	.38
<b>All Inclusions</b>	.02 – 1.40	.19	.04

*Sherd No. 15 (Figure 5)*

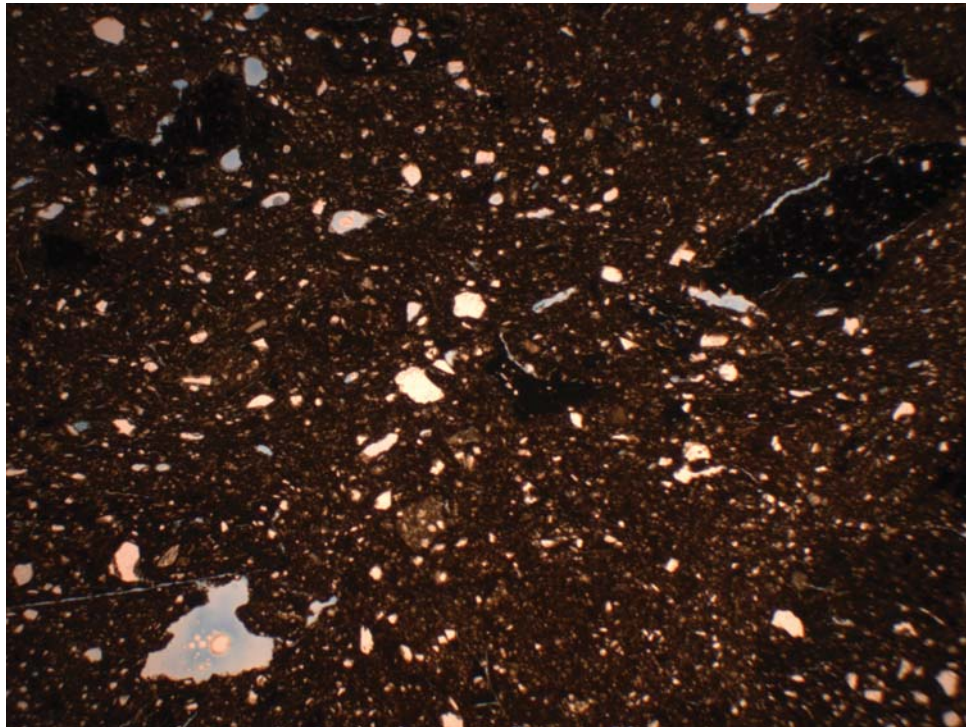


Figure 5. Sherd No. 15, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 2.5YR 8/6

*B-fabric (XPL):* Striated/Active

*Edge Description:* One edge darker in spots (10YR 7/6)

*Grog Description:* While grog contains bone temper, the abundance of bone may actually indicate the deliberate addition of bone to the clay fabric.

*Comments:* Orientation of inclusion is random.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	72.7	Paste	200	79.7
Quartz	28	10.2	Sand	33	13.1
Grog	11	4.0	Grog	11	4.4
Bone	3	1.1	Bone	3	1.2
Polycrystalline quartz	1	0.4	Other	4	1.6
Alkali feldspar	4	1.5	<b>Total</b>	<b>251</b>	
Opaque	4	1.5			
Voids	24	8.7			
<b>Total</b>	<b>275</b>				

*Also present:* mica (common, tiny rods); hematite (common); plagioclase (rare); mafic (augite; rare).  
*Common inclusions in grog:* quartz, bone.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .14	.06	.02
<b>Bone</b>	.02 – .94	.48	.02
<b>Grog</b>	.30 – 1.46	.62	.34
<b>All Inclusions</b>	.02 – 1.46	.21	.02

*Sherd No. 18 (Figure 6)*

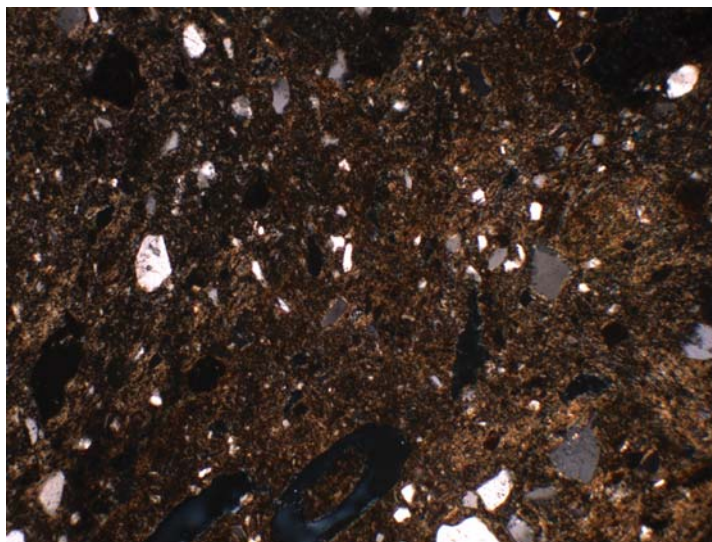


Figure 6. Sherd No. 18, Musgano site.



Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 10YR 4/4

*B-fabric (XPL):* Undifferentiated.

*Edge Description:* One edge lighter but spots missing (10YR 6/6, Speckled/Active).

*Grog Description:* Grog appears to be tempered with bone; bone is rare and small

*Comments:* Bone rare but likely from grog.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	75.5	Paste	200	81.6
Quartz	32	12.1	Sand	39	15.9
Grog	6	2.3	Grog	6	2.4
Polycrystalline quartz	2	0.8	<b>Total</b>	<b>245</b>	
Alkali feldspar	3	1.1			
Chert	2	0.8			
Voids	20	7.5			
<b>Total</b>	<b>265</b>				

*Also present:* bone (rare); plagioclase (uncommon); rock conglomerate (rare); chalcedony (rare).

*Common temper in grog:* quartz, bone.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .18	.08	.04
<b>Grog</b>	.04– 1.76	.84	.70
<b>All Inclusions</b>	.02 – 1.76	.19	.04

*Sherd No. 20 (Figure 7)*

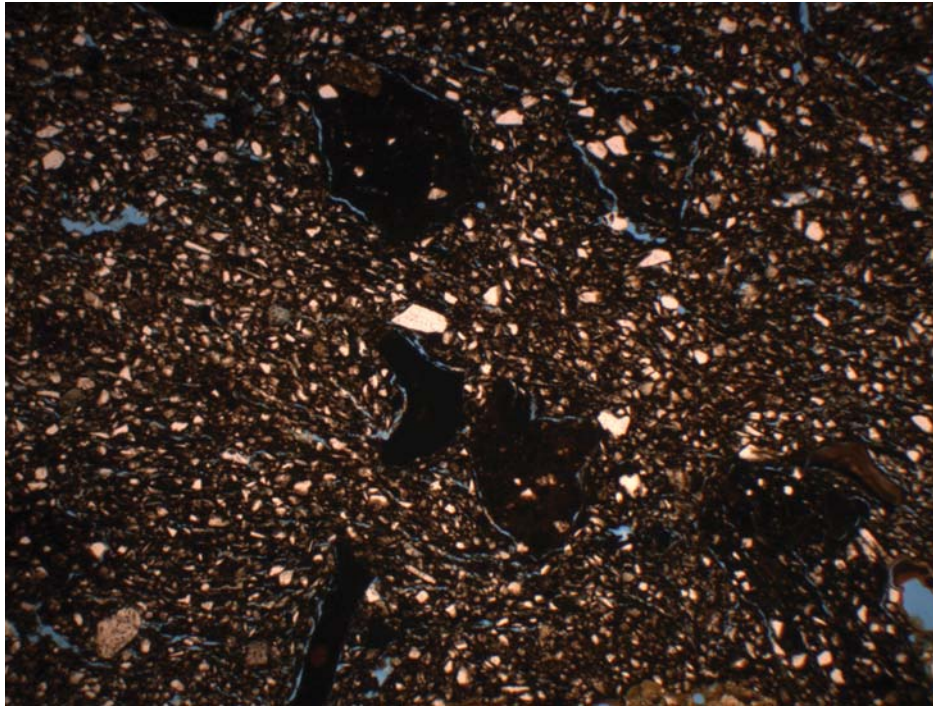


Figure 7. Sherd No. 20, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 7.5YR 6/6

*B-fabric (XPL):* Speckled/Slightly Active

*Edge Description:* Same as rest of paste; large section of one side of the thin section is missing.

*Grog Description:* Generally tempered with bone and quartz.

*Comments:* Orientation of inclusions is random.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	82.0	Paste	200	85.1
Quartz	16	6.6	Sand	17	7.2
Grog	13	5.3	Grog	13	5.5
Polycrystalline quartz	1	0.4	Other	5	2.1
Opaque	5	2.0	<b>Total</b>	<b>235</b>	
Voids	9	3.7			
<b>Total</b>	<b>244</b>				

*Also present:* mica (uncommon, various forms); alkali feldspar (uncommon); hematite (abundant but not under cross-hair).

*Common inclusions in grog:* bone and quartz;

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .14	.05	.04
<b>Grog</b>	.36 – 2.0	.87	.66
<b>All Inclusions</b>	.02 – 2.0	.44	.08

***Temper Group I: Sub-Group 2***

As indicated earlier, these two slides are considered to be from a sub-group of Temper Group I due to the higher percentages of bone temper noted in them during the petrographic analysis. It is likely that the two vessels represented by these sherds may actually contain bone temper not only derived from the bone-tempered grog present in the fabric but also as an additional additive to the clay fabric.

***Sherd No. 7 (Figure 8)***

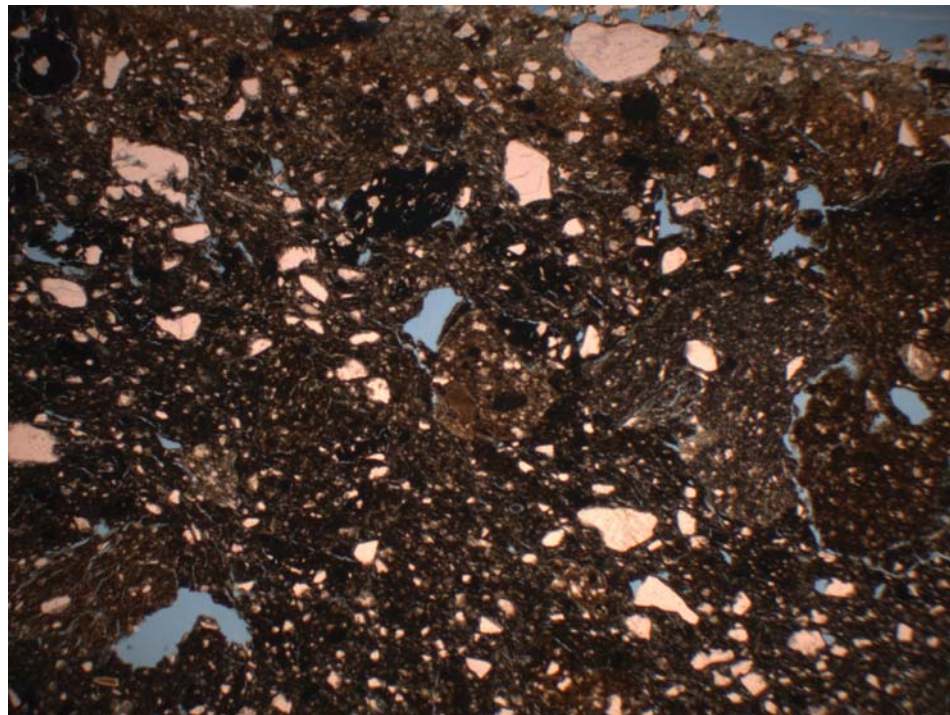


Figure 8. Sherd No. 7, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL)*: Continuous*Paste Color (PPL)*: 7.5Y 4/4, with spots of 2.5Y 3/3*B-fabric (XPL)*: Speckled/Slightly Active*Edge Description*: Same as the rest of the paste.*Grog Description*: Generally tempered with bone and sand. Many of the crushed sherds have the same paste as the thin section.*Comments*: Orientation of inclusions is random.**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	67.3	Paste	200	72.7
Quartz	46	15.5	Sand	51	18.5
Grog	7	2.4	Grog	7	2.5
Bone	13	4.4	Bone	13	4.7
Alkali feldspar	5	1.7	Mica	3	1.1
Muscovite	3	1.0	Other	1	0.4
Clay pellet	1	0.3	<b>Total</b>	<b>275</b>	
Voids	22	7.4			
<b>Total</b>	<b>297</b>				

*Also present*: mica (abundant; various forms); biotite (uncommon); plagioclase (common); rock conglomerate (rare).*Common inclusions in grog*: quartz; bone.**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .12	.06	.06
<b>Bone</b>	.24 – 1.34	.9	.68
<b>Grog</b>	.22 – .84	.6	.64
<b>All Inclusions</b>	.02 – 1.34	.22	.06

*Sherd No. 10 (Figure 9)*

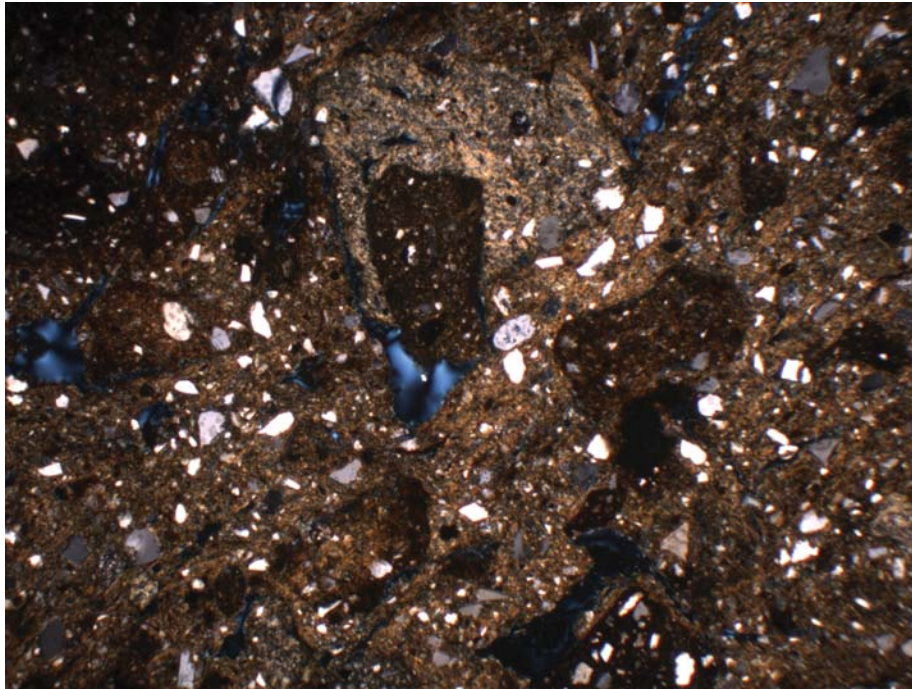


Figure 9. Sherd No. 10, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 10Y 6/6

*B-fabric (XPL):* Speckled/ Active

*Edge Description:* Darker in spots on both edges; 10YR 5/4 and 10YR 2/2

*Grog Description:* Quartz and bone present in the grog.

*Comments:* Orientation of inclusions is random; several bright opaques noted.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	73.3	Paste	200	74.6
Quartz	41	15.0	Sand	45	16.8
Grog	9	3.3	Grog	9	3.4
Bone	8	2.9	Bone	8	3.0
Alkali feldspar	2	0.7	Other	6	2.2
Opaque	6	2.2	<b>Total</b>	<b>268</b>	
Chert	1	0.4			
Rock conglomerate	1	0.4			
Voids	5	1.8			
<b>Total</b>	<b>273</b>				

*Also present:* mica (common, various forms); polycrystalline quartz (uncommon); plagioclase (uncommon); hematite (abundant).

*Common inclusions in grog:* quartz; bone.

**Inclusion Size (mm):**

	Range	Mean	Median
<b>Sand</b>	.02 – .22	.06	.04
<b>Bone</b>	.16 – 1.26	.06	.52
<b>Grog</b>	.38 – 1.52	.86	.76
<b>All Inclusions</b>	.02 – 1.52	.25	.04

**Temper Group II: Grog Tempered Sandy Paste**  
(grog contains no bone temper, n=7: 1, 2, 6, 9, 14, 16, 17)

Each of the seven thin sections in this group contain both grog and sand constituents in the paste. The grog ranges from as little as 1 percent to as much as 10 percent (mean=5.4 percent) of the point counting. In contrast, the sand constituent ranges from 12 percent to as high as 19 percent (mean=15.1 percent) of the point counting.

The size analysis of the grog and quartz particles also is informative about whether the sand present in the paste is a purposefully added aplastic inclusion or simply a natural constituent of the parent clays employed in the manufacture of the pottery. Table 6 lists the breakdown of grog and quartz within the seven thin sections placed in this temper group.

**Table 6. Distribution of grog and quartz by size category.**

Size category	Grog (count/percent)	Quartz (count/percent)
Very coarse sand	13/23	–
Coarse sand	27/48	–
Medium sand	14/25	5/2
Fine sand	2/4	28/12
Very fine sand	–	73/31
Silt	–	131/55
Total	56	237

The large majority of the grog particles fall in the coarse and very coarse sand size categories (i.e., 0.5-1.0 mm and 1.01-2.0 mm size groups). This is not surprising given that the reduction of pieces of pottery to fine-gained powder takes a significant amount of effort. The pieces of ceramic have to be broken, crushed, and then subsequently ground to reach a sufficiently fine texture to add to the clay fabric. In contrast, the

quartz that occurs in abundance in the clay fabric has a size distribution dominated by silt and very fine sand size classes (0.02-0.06 and 0.07-0.12 mm). Only a small fraction of the quartz falls in the medium sand size group, suggesting that the quartz is a natural constituent of the clays rather than an aplastic additive. Regardless, however, the presence of sand does perform the same function in the clay fabric, namely increasing thermal shock resistance.

***Sherd No. 1 (Figure 10)***



Figure 10. Sherd No. 1, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 2.5 YR 7/6

*B-fabric (XPL):* Speckled/ Active

*Edge Description:* N/A

*Grog Description:* The very edge of both sides is a little darker (2.5 YR 4/4).

*Comments:* Inclusions randomly oriented.

**Point Count:**

Paste/ Inclusion	Count	%	Simplified Inclusion Category	Count	%
Paste	200	74.9	Paste	200	76.9
Quartz	31	11.6	Sand	31	11.9
Grog	27	10.1	Grog	27	10.4
Other	2	0.7	Other	2	0.8
Voids	7	2.6	<b>Total</b>	<b>260</b>	
<b>Total</b>	<b>267</b>				

*Also present:* mafic (rare); hornblende (rare); hematite (common); polycrystalline quartz (rare)  
*Common temper found in the grog:* quartz and bone.

**Inclusion Size (mm):**

	Range	Mean	Median
<b>Sand</b>	.02 – .16	.06	.04
<b>Grog</b>	.32– 1.82	.81	.70
<b>All Inclusions</b>	.02 – 1.82	.41	.60

*Sherd No. 2 (Figure 11)*

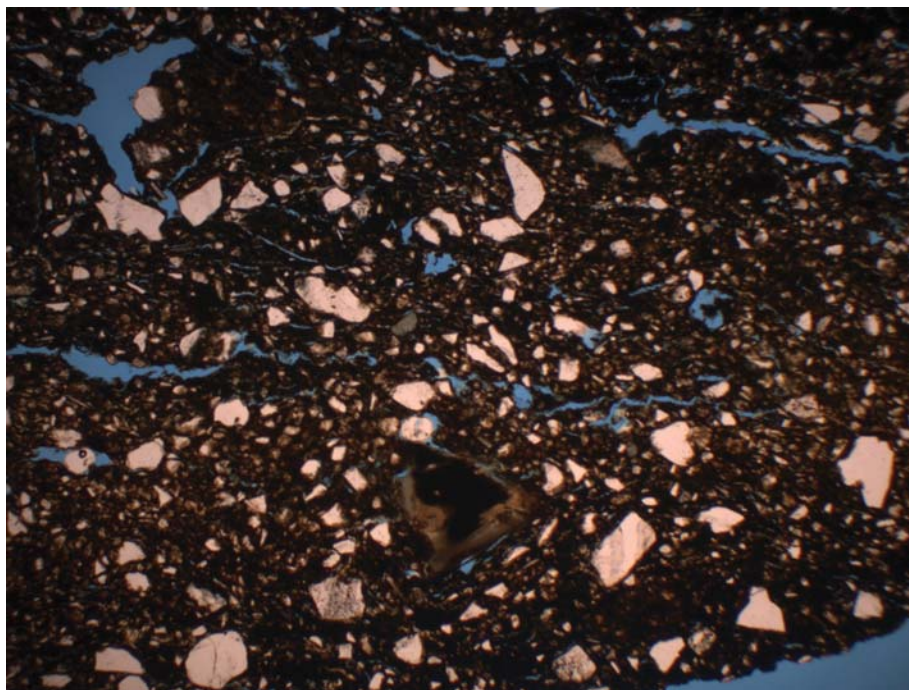


Figure 11. Sherd No. 2, Musgano site.



Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 2.5Y 8/4

*B-fabric (XPL):* Speckled/Active

*Edge Description:* One edge is darker in spots (10YR 6/6)

*Grog Description:* Uncommon and similar to paste of sherd.

*Comments:* Inclusions randomly oriented.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	70.2	Paste	200	72.7
Quartz	64	22.4	Sand	64	23.3
Grog	1	0.4	Grog	1	0.4
Mica	1	0.4	Mica	1	0.4
Other	9	3.2	Other	9	3.3
Voids	10	3.5	<b>Total</b>	<b>275</b>	
<b>Total</b>	<b>285</b>				

*Also present:* mica (common, various forms); mafic (rare); hematite (abundant), hornblende (uncommon); polycrystalline quartz (uncommon)

*Common temper found in the grog:* quartz.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .22	.10	.08
<b>Grog</b>	.76	.76	.76
<b>All Inclusions</b>	.02 – 2.8	.1.2	.08

**Sherd No. 6 (Figure 12)**

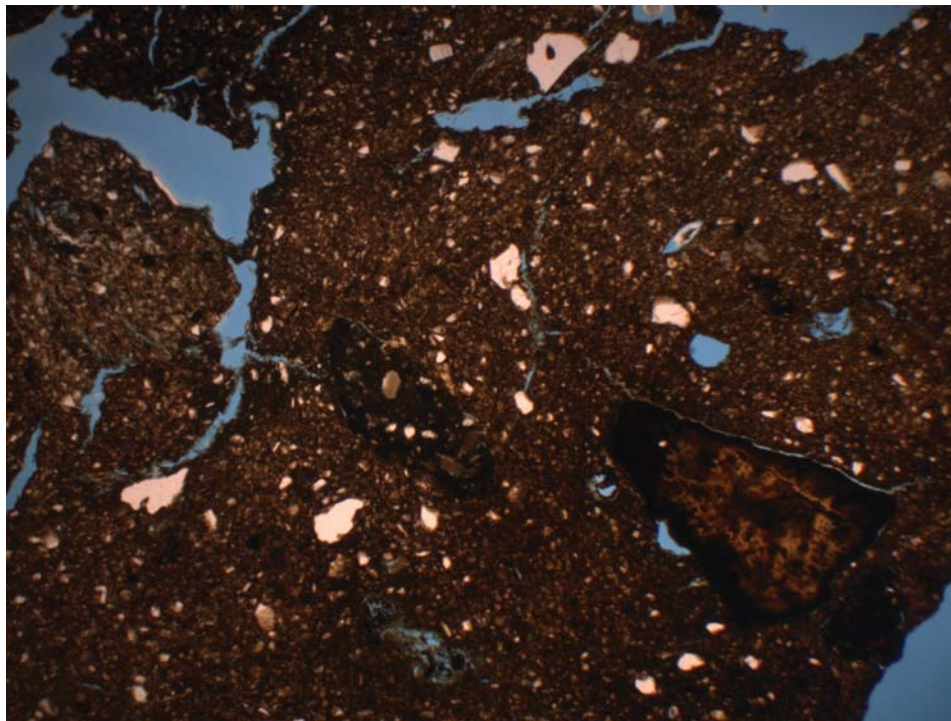


Figure 12. Sherd No. 6, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Mottled

*Paste Color (PPL):* 10Y 7/6 with light streaks of 10YR 4/4

*B-fabric (XPL):* Speckled/Active

*Edge Description:* Edges same as the rest of the paste.

*Grog Description:* Generally tempered with sand or grog. Several have the same paste as the thin section.

*Comments:* Orientation of inclusions is random; some very red opaques noted.

**Point Count:**

Paste/ Inclusion	Count	%	Simplified Inclusion Category	Count	%
Paste	200	81.3	Paste	200	85.5
Quartz	25	10.2	Sand	29	12.4
Grog	2	0.8	Grog	2	0.9
Polycrystalline quartz	3	1.2	Other	3	1.3
Rock conglomerate	1	0.4	<b>Total</b>	<b>234</b>	
Opaque	3	1.2			
Voids	12	4.9			
<b>Total</b>	<b>246</b>				

Also present: mica (uncommon, various forms), hematite (common); chert (uncommon)  
 Common temper found in grog: quartz.

**Inclusion Size (mm)**

	Range	Mean	Median
<b>Sand</b>	.02 – .18	.06	.04
<b>Grog</b>	.18 – .78	.49	.50
<b>All Inclusions</b>	.24 – .98	.61	.78

*Sherd No. 9 (Figure 13)*

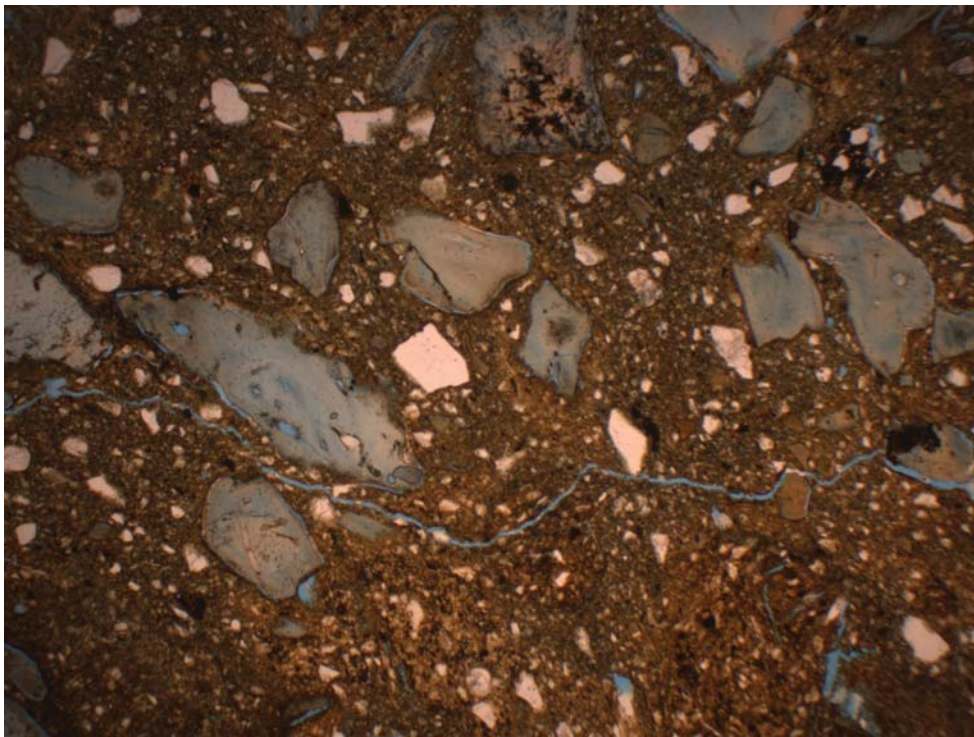


Figure 13. Sherd No. 9, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 10YR 7/6

*B-fabric (XPL):* Speckled/ Active

*Edge Description:* One edge is darker (10YR 2/2)

*Grog Description:* Grog consists of the same sandy paste as the vessel fabric; orientation of temper and distinct color of grog separates it from paste of vessel

*Comments:* Inclusions are randomly oriented.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	70.2	Paste	200	74.9
Quartz	43	15.1	Sand	48	18.1
Grog	16	5.6	Grog	16	6.0
Polycrystalline quartz	2	0.7	Mica	1	0.4
Alkali	2	0.7	Other	2	0.7
Opakes	2	0.7	<b>Total</b>	<b>267</b>	
Muscovite	1	0.4			
Rock conglomerate	1	0.4			
Voids	18	6.3			
<b>Total</b>	<b>285</b>				

*Also present:* mica (common, various forms); plagioclase (common); hematite (uncommon); chert (common).  
*Common temper found in grog:* quartz.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – 0.18	.06	.02
<b>Grog</b>	.46 – 1.46	.80	.88
<b>All Inclusions</b>	.02 – 1.46	.24	.02

*Sherd No. 14 (Figure 14)*

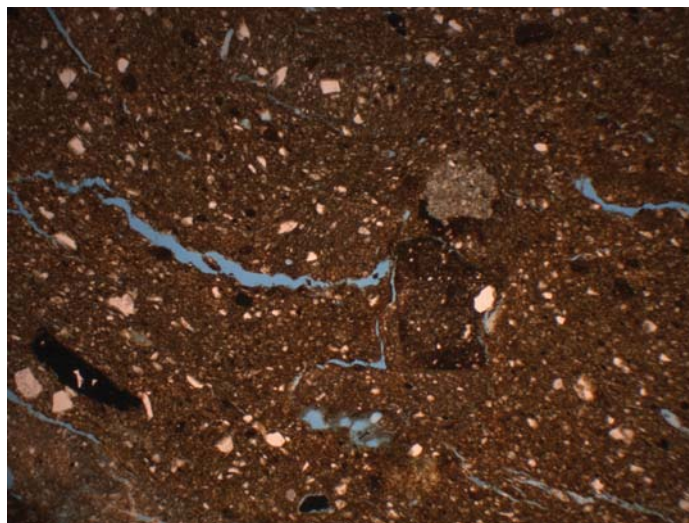


Figure 14. Sherd No. 14, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 10YR 6/6

*B-fabric (XPL):* Speckled/ Active

*Edge Description:* Edges slightly lighter in spots (10YR 7/4); one edge is more active in XPL.

*Grog Description:* Generally same as the paste from which sherd is made.

*Comments:* Inclusions are randomly oriented.

**Point Count:**

Paste/ Inclusion	Count	%	Simplified Inclusion Category	Count	%
Paste	200	73.3	Paste	200	74.6
Quartz	41	15.0	Sand	52	19.4
Grog	9	3.3	Grog	9	3.4
Polycrystalline quartz	8	2.9	Mica	6	2.2
Alkali feldspar	2	0.7	Other	1	0.4
Muscovite	6	2.2	<b>Total</b>	<b>268</b>	
Clay pellet	1	0.4			
Chert	1	0.4			
Voids	5	1.8			
<b>Total</b>	<b>273</b>				

*Also present:* mica (uncommon; tiny rods); hematite (common); plagioclase (rare).

*Common temper found in grog:* quartz.

**Inclusion Size (mm):**

	Range	Mean	Median
<b>Sand</b>	.02 – 0.12	.06	.04
<b>Grog</b>	.40 – 1.72	.94	.70
<b>All Inclusions</b>	.02 – 1.72	.15	.04

**Sherd No. 16 (Figure 15)**



Figure 15. Sherd No. 16, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 10YR 3/3

*B-fabric (XPL):* Undifferentiated

*Edge Description:* One edge and side has lighter color, 2.5YR 7/6—speckled/active.

*Grog Description:* Generally uncommon and when present it is tempered with sand or is simply sandy paste fabric used as temper

*Comments:* Inclusions are randomly oriented.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	73.8	Paste	200	76.3
Quartz	43	15.9	Sand	45	17.2
Grog	16	5.9	Grog	16	6.1
Alkali feldspar	2	0.7	Mica	1	0.4
Muscovite	1	0.4	<b>Total</b>	<b>262</b>	
Voids	9	3.3			
<b>Total</b>	<b>271</b>				

Also present: mica (uncommon, tiny rods); mafic (rare); chert (uncommon); polycrystalline quartz (uncommon).  
Common temper found in the grog: quartz.

**Inclusion Size (mm):**

	Range	Mean	Median
<b>Sand</b>	.02 – 0.16	.08	.06
<b>Grog</b>	1.04	N/A	N/A
<b>All Inclusions</b>	.02 – 1.04	.11	.04

**Sherd No. 17 (Figure 16)**

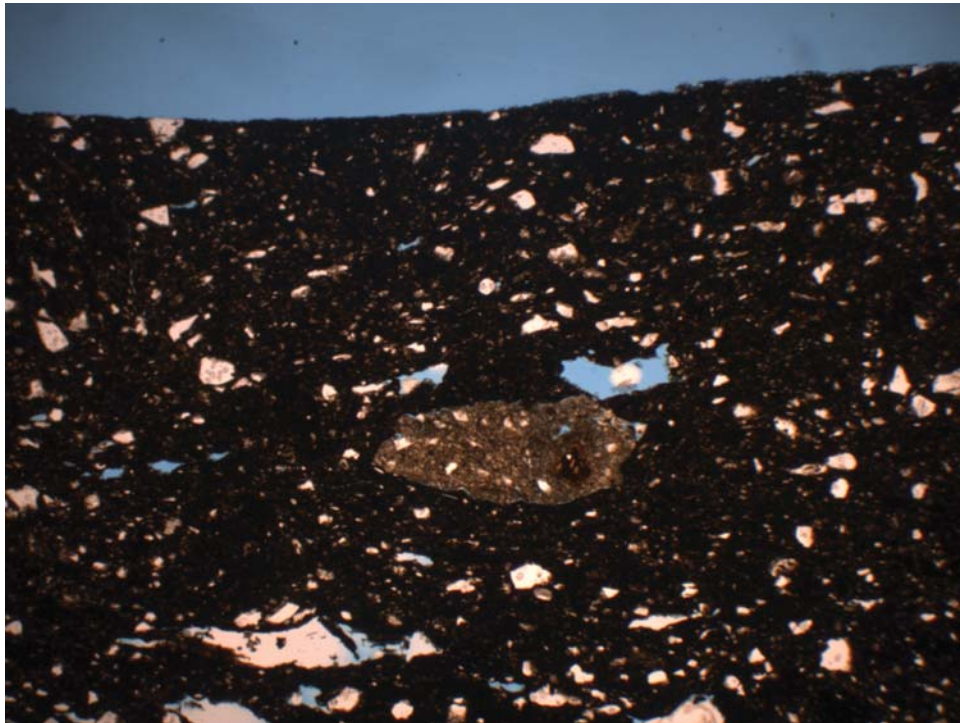


Figure 16. Sherd No. 17, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Mottled

*Paste Color (PPL):* 2.5YR 7/6, with spots of 2.5YR 4/4

*B-fabric (XPL):* Speckled/Active

*Edge Description:* Same as rest of the previously described sherds: more active on one edge and some dark to black spots on the opposite edge (2.5YR 2/3).

*Grog Description:* Generally tempered with quartz.

*Comments:* Orientation of inclusions is random.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	79.7	Paste	200	81.6
Quartz	35	13.9	Sand	38	15.5
Grog	6	2.4	Grog	6	2.4
Polycrystalline quartz	1	0.4	Other	1	0.4
Alkali	2	0.8	<b>Total</b>	<b>245</b>	
Opaque	1	0.4			
Voids	6	2.4			
<b>Total</b>	<b>251</b>				

*Also present:* mica (uncommon, tiny rods); mafic (rare); chert (uncommon); plagioclase (uncommon); polycrystalline quartz (rare); hematite (uncommon).

*Common temper found in the grog:* quartz.

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .18	.085	.01
<b>Grog</b>	.03 – .56	.44	.04
<b>All Inclusions</b>	.02 – .54	.13	.01

**Temper Group III: Sandy Paste (untempered)**  
(n=2; 3, 19)

Two thin sections are included in Temper Group (TG) III. Both were from vessels made using the same sandy clays employed in the making of the vessels grouped into TG I and TG II. The percentage of sand in the two sherds is 14 percent and 28 percent, respectively. The higher of the two figures is well above the mean of sand in the clay fabric of either TG I or TG II. As such, it may be indicative of the use of a distinct clay source compared to the one used in the making of the TG I and II vessel thin sections.



*Sherd No. 3 (Figure 17)*



Figure 17. Sherd No. 3, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 5Y 7/6

*B-fabric (XPL):* Speckled/Slightly Active

*Edge Description:* sports along the edge are missing.

*Comments:* Clay pellets common.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	82.7	Paste	200	84.8
Quartz	34	14.1	Sand	34	14.4
Mica	1	0.4	Mica	1	0.4
Other	1	0.4	Other	1	0.4
Voids	6	2.5	<b>Total</b>	<b>236</b>	
<b>Total</b>	<b>242</b>				

*Also present:* mica (uncommon; tiny rods); mafic (rare); biotite (rare); hornblende (rare); hematite (uncommon).

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .34	.09	.06
<b>All Inclusions</b>	.02 – .76	.08	.06

*Sherd No. 19 (Figure 18)*

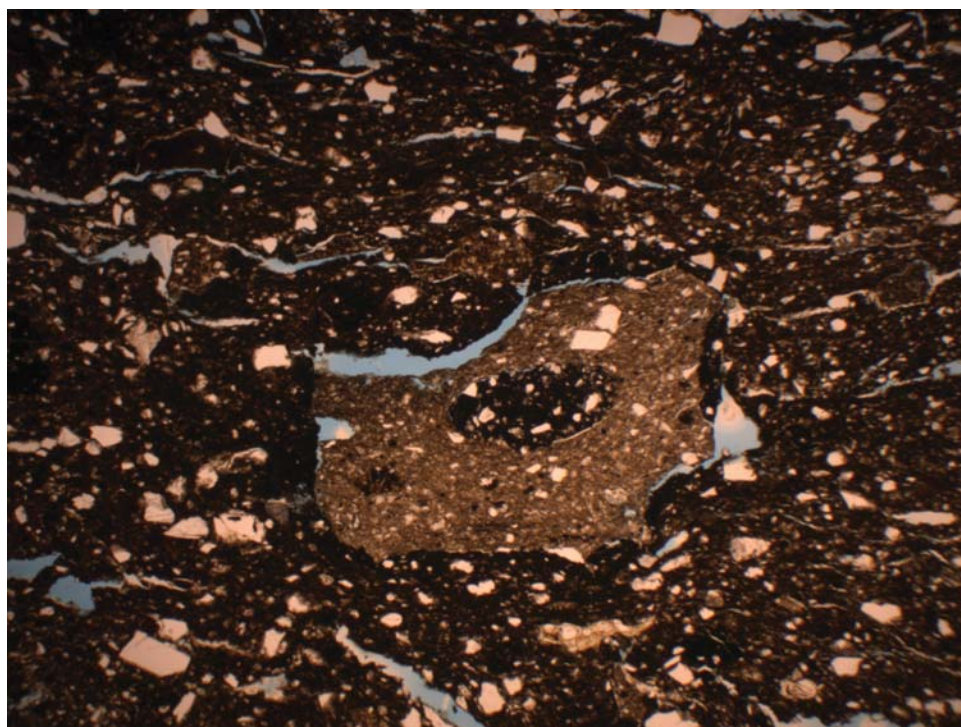


Figure 18. Sherd No. 19, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 5YR 7/6

*B-fabric (XPL):* Speckled/Slightly Active

*Edge Description:* One edge slightly browner than other (10YR 5/6).

*Comments:* Clay pellets same as fabric but darker (5Y 3/2); have distinct edges; quartz and feldspars are weathered.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	63.5	Paste	200	66.0
Quartz	62	19.7	Sand	86	28.4
Polycrystalline quartz	8	2.5	Mica	5	1.7
Alkali feldspar	14	4.4	Other	12	4.0
Plagioclase	2	0.6	<b>Total</b>	<b>303</b>	
Muscovite	3	1.0			
Clay pellet	12	3.8			
Rock conglomerate	2	0.6			
Voids	12	3.8			
<b>Total</b>	<b>315</b>				

*Also present:* mica (common; various forms); mafic (augite, rare); hematite (uncommon).

**Inclusion Size (mm)**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .20	.05	.04
<b>All Inclusions</b>	.02 – 1.18	.14	.04

**Temper Group IV: Bone-Tempered Sandy Paste  
(n=2; 11, 13)**

Two sherd thin sections are classified in this temper group. Both are manufactured using the same sandy paste clay seen in the previous groups of thin sections. Sandy inclusions constitute 20 percent and 16 percent of the point counted aplastic inclusions, respectively. In addition, neither has grog tempering in the clay fabric. However, the two thin sections differ in terms of the quantity of bone temper noted in the paste. One specimen has a few large pieces of burnt and ground bone but the numbers were so small that they were never counted during the systematic point counting. The other specimen has a large (14 percent) percentage of bone.

**Sherd No. 11 (Figure 19)**

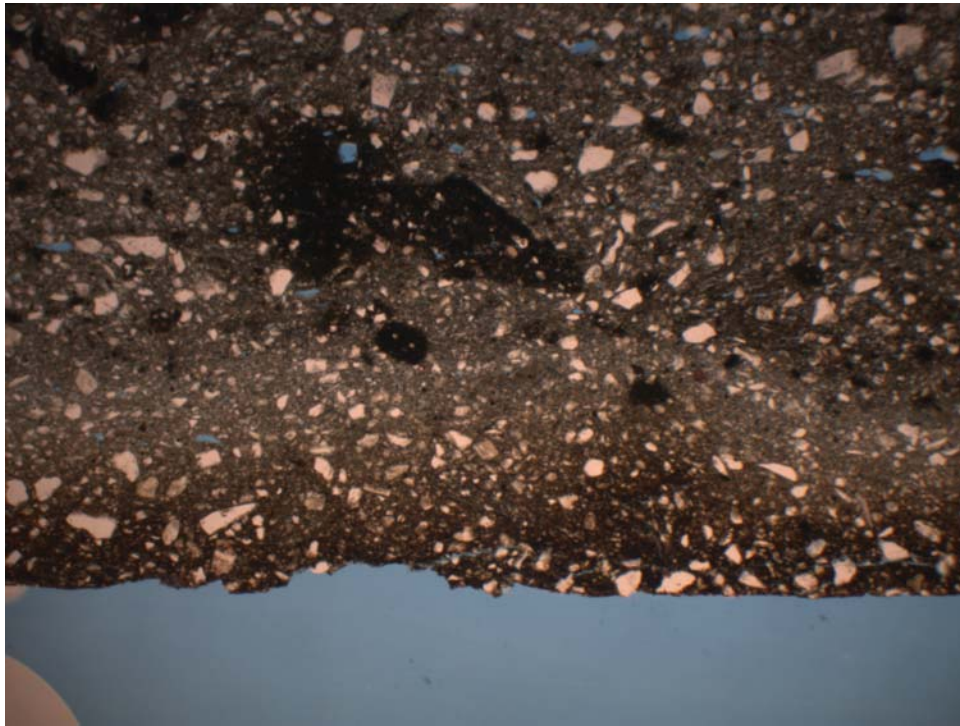


Figure 19. Sherd No. 11, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 10YR 3/4

*B-fabric (XPL):* Undifferentiated

*Edge Description:* Edges same as the rest of the paste.

*Comments:* Uncommon but large pieces of bone noted in thin section.

**Point Count:**

Paste/ Inclusion	Count	%	Simplified Inclusion Category	Count	%
Paste	200	77.9	Paste	200	79.7
Quartz	43	16.7	Sand	51	20.3
Polycrystalline quartz	2	0.8	<b>Total</b>	<b>251</b>	
Alkali feldspar	3	1.2			
Chert	1	0.4			
Rock conglomerate	2	0.8			
Voids	6	2.3			
<b>Total</b>	<b>257</b>				

Also present: mica (uncommon, various forms); hematite (uncommon); bone (uncommon).

**Inclusion Size (mm):**

	Range	Mean	Median
<b>Sand</b>	.02 – .26	.08	.04
<b>All Inclusions</b>	.02 – .26	.08	.04

*Sherd No. 13 (Figure 20)*

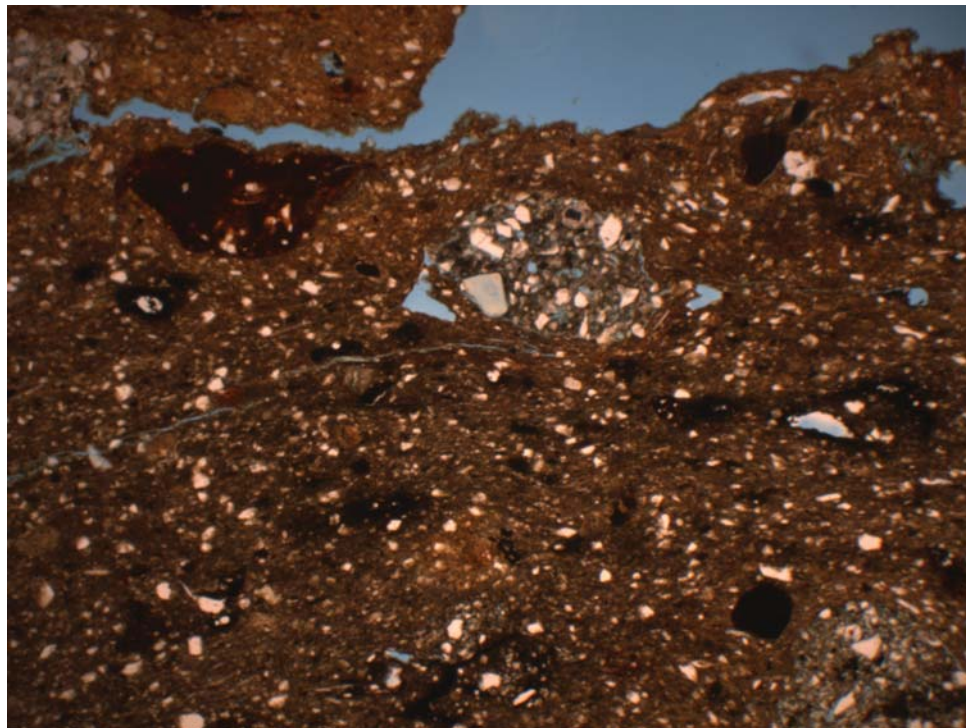


Figure 20. Sherd No. 13, Musgano site.

Paste in plane light 4x

Paste in cross-polar light 4x

*Paste Matrix (PPL):* Continuous

*Paste Color (PPL):* 7.5YR 6/6

*B-fabric (XPL):* Speckled/Active

*Edge Description:* Edges same as the rest of the paste.

*Comments:* Inclusions are randomly oriented.

**Point Count:**

<b>Paste/ Inclusion</b>	<b>Count</b>	<b>%</b>	<b>Simplified Inclusion Category</b>	<b>Count</b>	<b>%</b>
Paste	200	65.4	Paste	200	68.5
Quartz	40	13.1	Sand	46	15.8
Bone	42	13.7	Bone	42	14.4
Clay pellet	1	0.3	Other	3	1.0
Alkali feldspar	5	1.6	<b>Total</b>	<b>291</b>	
Opaque	2	0.7			
Rock conglomerate	1	0.3			
Voids	15	4.9			
<b>Total</b>	<b>306</b>				

*Also present:* mica (abundant, various forms); hematite (common); chert (uncommon); polycrystalline quartz (uncommon); plagioclase (uncommon); mafic (augite, rare).

**Inclusion Size (mm):**

	<b>Range</b>	<b>Mean</b>	<b>Median</b>
<b>Sand</b>	.02 – .18	.07	.04
<b>Bone</b>	.08 – 1.7	.47	.44
<b>All Inclusions</b>	.02 – 1.7	.26	.04

**SUMMARY AND CONCLUSIONS**

The petrographic analysis of the 20 thin sections from utility ware and fine ware ceramic vessel sherds recovered from the Musgano site (41RK19) revealed that all of the sherds appear to have been made of the same sandy paste parent clay fabric and are thus of local manufacture. In addition, four temper groups were defined on the basis of the temper types employed as aplastic additives to this sandy clay.

There are utility wares and fine wares represented in all four temper groups; utility wares are best represented by Temper Group I, subgroup 2 (100 percent), while between 42.9-50.0 percent of the sherds in the other temper groups are utility wares. The same range of decorative elements from similar types (primarily Maydelle Incised) are present in the utility wares in Temper Groups I-II, and IV, including incised, incised-punctated, and tool punctated decorations, while the one brushed-applied sherd thin section falls in Temper Group III. Engraved fine wares are most commonly made from Temper Group II-IV clays and temper recipes (50.0-57.1 percent), while engraved wares are absent in Temper Group I, subgroup 2 thin sections, and uncommon (28.6 percent) in Temper Group I, subgroup 1 thin sections.

The most common temper in the fabric of the sherds from the Musgano site is grog. Two kinds of grog temper were used in the manufacture of the new vessels. One group of vessels (Temper Group I) is tempered

with grog that itself was tempered with bone. Nine thin sections are included in this temper group. Bone appears in very small amounts in both the grog pieces as well as in the clay fabric of the newly-made vessels. It is likely that the bone in the clay fabric derives from the processed grog. Two sub-groups of thin sections can be differentiated in this temper group. Seven of the nine specimens contain only minimal amounts of bone, typically less than 1 percent of the point-counted aplastic inclusions. The remaining two specimens can be considered as members of a second sub-group because they contain bone temper ranging from 3-7 percent of the point counts, suggesting that perhaps additional bone was added to the clay fabric itself. The second group of vessels (Temper Group II) are tempered with grog that contains no bone. Seven specimens are included in this temper group. The sandy grog appears to be of the same clay fabric as the clay from which the vessels are actually made. The fact that two distinct grog types are employed in the making of sandy paste vessels may indicate that technologically there is no difference in the manufacture of vessels with bone-tempered grog versus un-tempered grog, which seems supported by the fact that both utility wares and fine wares with similar decorative elements are found in all four temper groups. On the other hand, the use of bone-tempered grog in the manufacture of otherwise sandy and non-bone temper-containing vessels may be an indication of social relationships and cultural transmission between Caddo potters of distinct but nearby traditions (i.e., a contemporaneous bone-tempered tradition exists in the Angelina River basin and the Toledo Bend Reservoir area on the mid-Sabine River). The final two temper groups contain a total of four thin sections. Temper Group III consist of two specimens that are un-tempered with the exception of the sand constituent in the sandy paste clay fabric. The two specimens in Temper Group IV contain bone tempering in the typical sandy paste clay fabric seen in all of the thin sections from the Musgano site. There is no evidence of grog in these two thin sections, suggesting that the bone present in these two specimens may represent a distinct technological tradition of vessel manufacture from the grog-tempered specimens, and distinct technological and functional differences have been detected in the manufacture of Caddo utility wares and fine wares in East Texas. It is also possible, however, that the group represents an example of individual variability in technological approaches to ceramic vessel manufacture and use.

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