Evidence for the Use of Raw Materials for the Manufacture of Black-Gloss Ware and Italian Sigillata at Arezzo and Volterra

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Abtract

A program of compositional analysis involving the mineralogical (optical miscroscopy, petrographic analysis) and chemical (NAA) characterization of Black-Gloss Ware and Italian Sigillata from the site of Cetamura del Chianti along with tiles made from potting clay from several locations in northern Etruria sheds light on the use of raw materials for the manufacture of these two pottery classes at Volterra and Arezzo. The program achieved no textural or chemical matches between the specimens of Black-Gloss Ware of likely Volterran origin and several specimens of clay from outcrops of the Plio-Plestocene marine clay in the environs of Volterra that were very probably employed for the manufacture of this pottery. This suggests that the manufacture of this pottery involved the levigation of the clay. In contrast, an excellent textural and chemical match was obtained between the specimens of Black-Gloss Ware and Italian Sigillata of likely Arretine origin and specimens of the *argille di Quarata* lacustrine clay (formation agQ) that outcrops along the Torrente Castro/Canale Maestro della Chiana to the west of Arezzo. This indicates that the manufacture of Black-Gloss Ware and Italian Sigillata at Arezzo did not involve the levigation of the clay employed. The agQ formation is overlain by a bed of peat that is effectively unique in peninsular Italy. Peat has been regularly used as a fuel for pottery manufacture in northern Europe, and it seems likely that the producers of these two pottery classes at Arezzo employed it for this purpose. The economies that these producers were able to realize thanks to ready access to clay that required minimal preparation and fuel that could be obtained together with this clay with only modest additional effort probably constituted a significant enabling factor in the emergence of the Arretine Italian Sigillata industry during the second half of the first century B.C.

KEYWORDS: Etruria, Black-Gloss Ware, Italian Sigillata, petrographic analysis, neutron activaton analysis, ceramic technology

1. Introduction

This article reports on the results of a program of ceramic compositional research that the author has recently undertaken involving the characterization of Black-Gloss Ware and Italian Sigillata from the site of Cetamura del Chianti. A full presentation of the project's results is in

the course of being published elsewhere,[1] and this contribution focuses instead on one particular aspect of these, namely their implications for our understanding of the use of raw materials for the manufacture of the these two classses of pottery at Volterra and Arezzo.

2. Program of Analysis

Cetamura del Chianti is a small Etrusco-Roman settlement located in the eastern Monti del Chianti that has been the subject of excavation by Florida State University since 1973.[2] The program of analysis is very modest in scope, involving the compositional characterization of 7 specimens of Black-Gloss Ware from contexts that can be dated ca. 325/300 – 250 B.C., 4 specimens of this class from contexts that can be date ca. 250-200/180 B.C., 29 specimens of this class from contexts that can be dated to ca. 200/180-150/125 B.C., and 24 specimens of Italian Sigillata belonging to forms that can be dated from ca. 40/10 B.C. to A.D. 100/150. The program involved the application of three techniques for compositional characterization in the following sequence: First, a small chip of each specimen was evaluated under a binocular microscope in order to formulate an initial fabric classification based on general fabric mineralogy and texture. Second, each specimen was subjected to chemical characterization by means of neutron activation analysis (at the Smithsonian Institution laboratory facility at the National Bureau of Standards at Technology, Gaithersburg, Maryland, U.S.A.) and the initial fabric classification revised on the basis of the results obtained. Third, one example of each group in the revised fabric classification was subjected to petrographic analysis in order to gain more detailed knowledge of that fabric's mineralogy, texture, and likely point of origin.

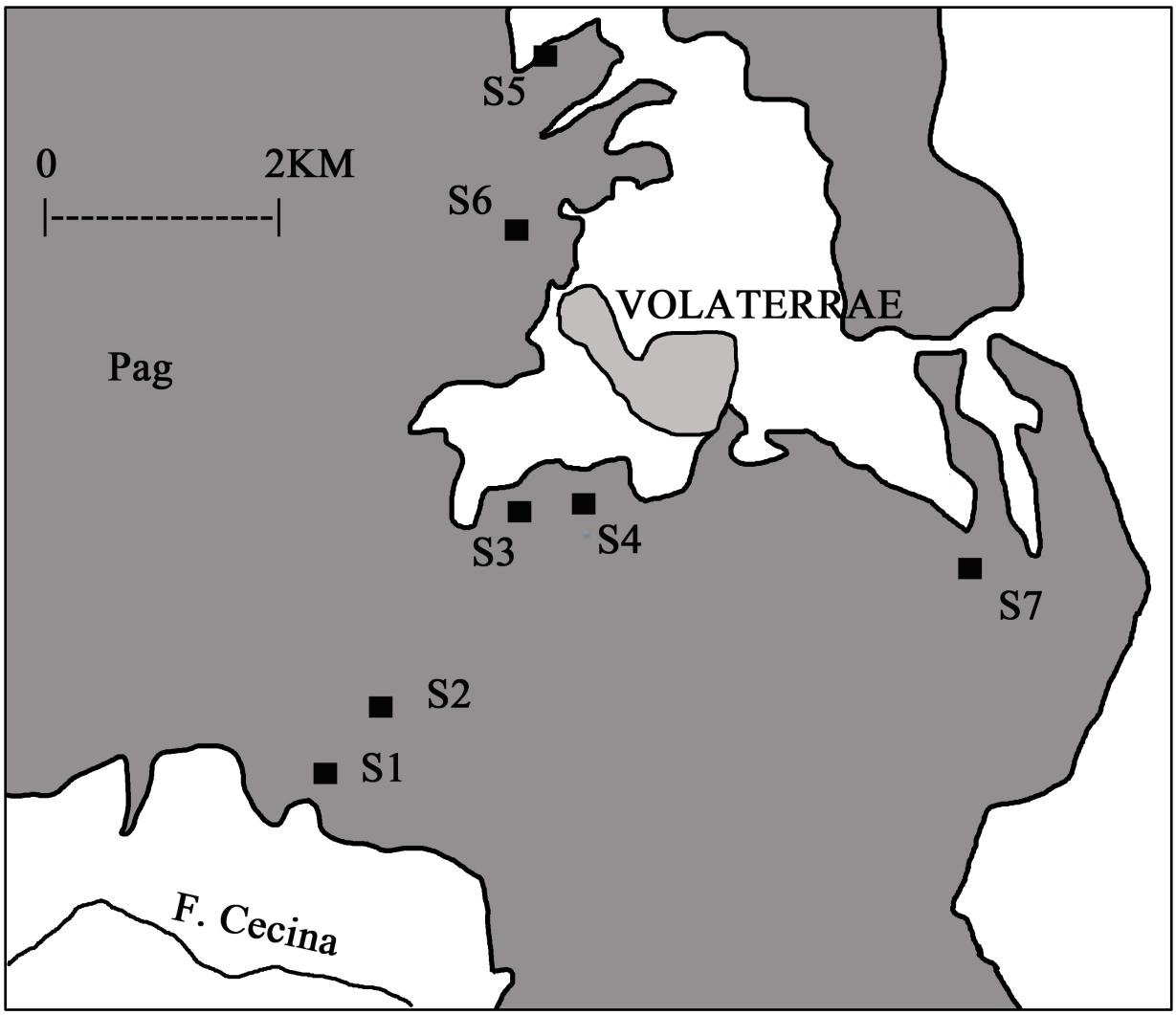
The program also involved the characterization of specimens of clay from sources thought likely to correspond to those employed for the manufacture of the pottery specimens. Each clay specimen was pulverized, hydrated, formed into a tile, and fired in an electric muffle for two hours at 900 degrees centigrade. The fired tiles were subjected to the same set of operations as the pottery specimens, with the results then compared to test the assumption that the sources in question were those employed for the manufacture of the pottery and, in cases where this was the case, to elucidate aspects of the manufacturing process.

3. Results

The results can be briefly summary as follows. For the Black-Gloss Ware it was possible to identify eight fabric groups. Four of these had a fine texture and four an intermediate to gritty texture. Of the four with a fine texture, one is certainly of Arretine origin, and the other three of probable Volterran origin. The origins of the four groups with a intermediate to gritty texture are more difficult to specify, although one may originate in the western Val di Chiana, and two in the Val d'Elsa, Val d'Arno or the Monti del Chianti. For the Italian Sigillata it was possible to identify three fabric groups. These include two fine-textured fabric groups of Arretine origin, and a fabric group consisting of a single specimen with prominent carbonate inclusions that does not appear to be of Arretine origin.

4. Raw Material Use at Volterra and Arezzo

To the author's knowledge no remains of the workshops where Volterran Black-Gloss Ware was manufactured have been recovered. Palermo does, however, report various examples of Black-Gloss ware with production defects from the Volterra - Acropoli excavations, evidence that at least some of this production took place in or near the town, itself.[3] Whether located at Volterra, in its immediate environs, or in the town's more extended hinterland, however, the evidence for the mineralogy, texture, and chemistry of Volterran Black-Gloss Ware renders it all but certain that the manufacture of this pottery involved the use of the Plio-Pleistocene marine clay (formation Pag) that outcrops extensively in the area around the town.[4] (Figs. 1 and 2) A thorough compositional investigation of these exposures would represent an enormous undertaking, and for the current program of analysis it was possible to performed only a limited program of sampling aimed at gaining some idea of the general characteristics of the clay in these exposures and the nature of its variability over the stratigraphic column. This involved the recovery of 7 clay specimens, including specimens the upper portion of the stratigraphic column in areas immediately to the southwest, east and northwest of Volterra, and from the lower and middle portions of the stratigraphic column somewhat farther afield to the southwest of the town. (Fig. 1) The tiles manufactured from these specimens proved to have a texture distinctly coarser than those of the three fine-textured fabric groups of Black-Gloss Ware of probable Volterran origin (Fig. 3.1-2), and, not surprisingly, they also displayed chemical compositions distinctly different from those of these fabric groups. While a more extensive program of sampling might



Fig, 1: Map of Volterra area showing Pag clay formation and clay sampling locations. S1-S7: Sampling Locations 1-7.

reveal a somewhat different picture, the results of this limited program suggest that the manufacture of fine-textured Black-Gloss Ware at Volerra involved the levigation of the clay.

The situation at Arezzo is distinctly different. First, we possess extensive evidence for the locus of the workshops where Arretine Black-Gloss Ware and Italian Sigillata were manufactured. Specifically, Black-Gloss Ware workshops are known at two locations – Santa Maria in Gradi and Orciolaia[5] - while workshops for Italian Sigillata are known at five locations – the two just named, plus Le Carciarelle, Piaggia di Murello, and Via Nardi – as well as at Cincelli and Ponte a Buriano, 8 km to the northwest of Arezzo.[6] (Fig. 4) Second, the geology of the Arezzo area means that potters intent on manufactuing pottery with a moderately to highly

Fig. 2: Views of outcrops of Pag clay formation: Top: view uphill over outcrop to Volterra from SW. Bottom: view downhill over outcrop to SW of Volterra.

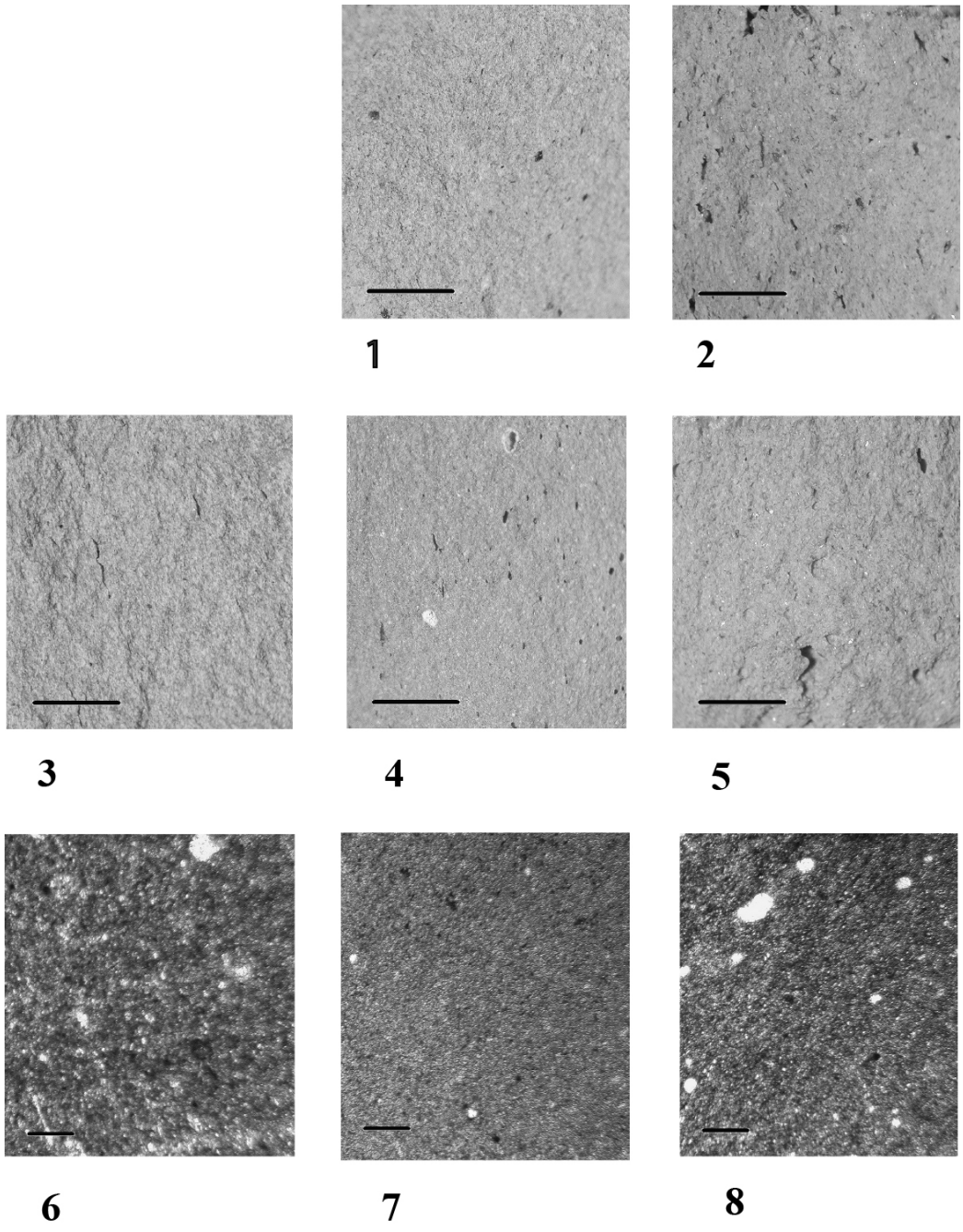


Fig. 3: Thick and thin sections of Volterra- and Arezzo-area pottery and tiles. Top row: thick sections of Volterra area materials (20X; bar in lower left equal to 200 microns): 1. Black-Gloss Ware vessel of probable Volterran origin; 2. tile manufactured from Pag clay. Middle row: thick sections of Arezzo area materials (20X; bar in lower left equal to 200 microns): 3. Black-Gloss Ware vessel of Arretine origin; 4. Italian Sigillata vessel of Arretine origin; 5. tile manufactured from agQ clay. Lower row: thin sections of Arezzo area materials (40X PPL; bar in lower left equal to 100 microns): 6. Black-Gloss Ware vessel of Arretine origin; 7. Italian Sigillata vessel of Arretine origin; 8. tile manufactured from agQ clay.

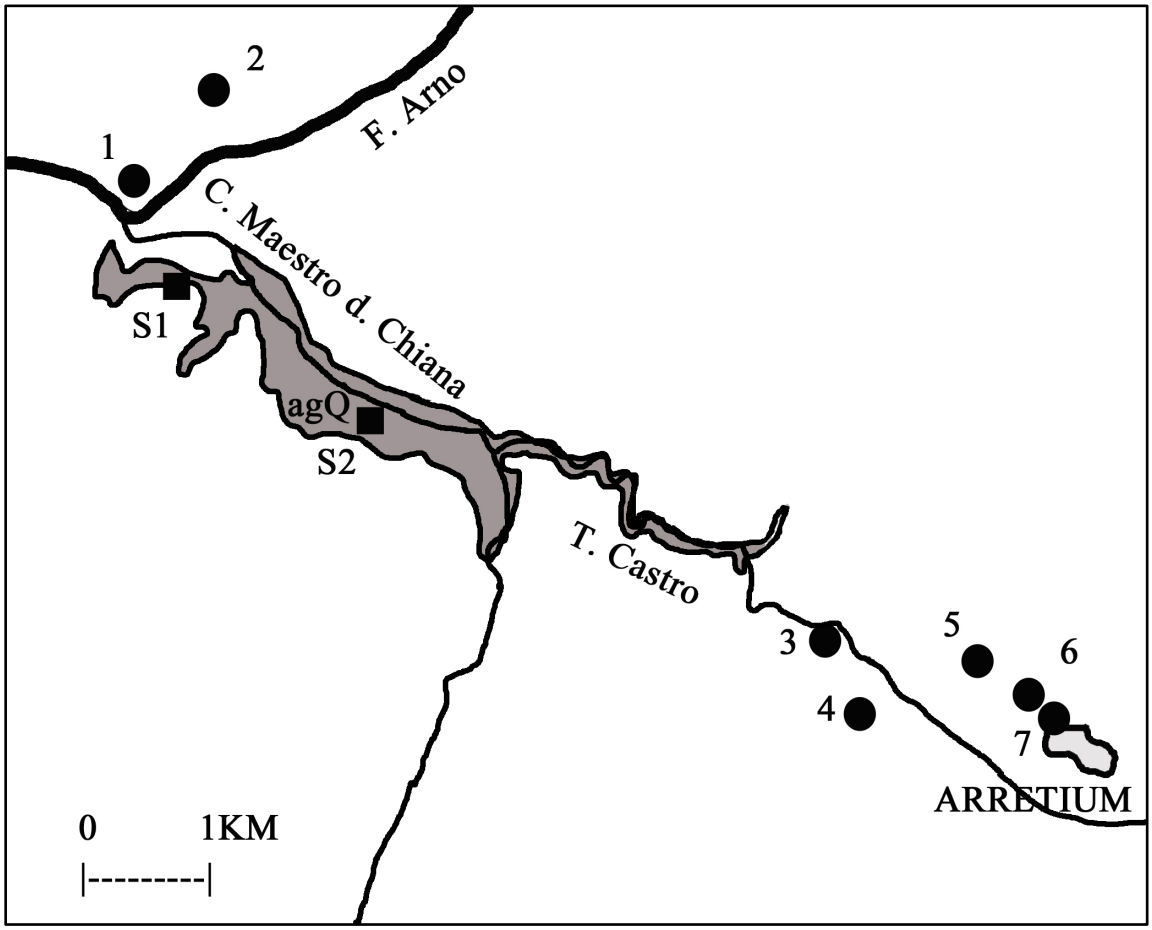


Fig. 4: Map of Arezzo area showing agQ clay formation, clay sampling locations, and locations of Black-Gloss Ware and Italian Sigillata production sites. S1-S2: Sampling Locations 1 and 2; 1: Ponte a Buriano, 2: Cincelli, 3: Le Carciarelle, 4: Orciolaia, 5: Via Nardi, 6: Santa Maria in Gradi, 7: Piaggia di Murello.

calcareous clay – as was required for the production of high-quality Black-Gloss Ware and Terra Sigillata – would have been obliged to obtain their raw material from a single formation exposed over only a very limited area. This is the so-called *argille di Quarata* (formation agQ) a bed of Plio-Pleistocene lacustrine clay that outcrops in a narrow band along the valley of the Torrente Castro - a small perennial that runs through Arezzo in a northwestern direction - from a point ca. 2 km to the west of Arezzo downstream to its confluence with the Canale Maestro della Chiana, and then in a narrow band along the valley of this artifical drainage element (which presumably follows the ancient bed of the Castro) down to its confluence with the Fiume Arno at Ponte a Buriano.[7] (Fig. 4) This formation is overlain by and to some extent interleaved with a bed of

Fig, 5: Views of sampling locations for agQ clay in environs of Arezzo: Top: Sampling Location 1 - view of bank at side of *strada bianca* where specimen obtained. Bottom: Sampling Location 2 - view of clods of clay and peat in plowed field in which specimen obtained.

Fig. 6: Clods of agQ clay obtained at Sampling Location 2.

peat (*torba* in Italian). While it proved somewhat difficult to locate exposures of this formation suitable for sampling, it was eventually possible to recover two specimens, one from an embankment along the side of a *strada bianca*, and the other in an area where plowing had cut into the roof of the formation, bringing to the surface small clods of clay. (Figs. 4-6)

Cluster analysis indicates a high degree of chemical similarity between both of these clay specimens and the fabric groups of Black-Gloss Ware and Italian Sigillata of Arretine origin. (Fig. 7) More significantly, MADCORR, a routine that calculates the statistical probability that a specimen of unknown origin might belong to a specified compositional core group,[8] returned a value of 10.6 percent for one of the two clay specimens. (Table 1) Values of five percent and greater are generally regarded as indicating a good compositional match. Optical microscopy and petrographic analysis further shows that both clay specimens and the Arretine Black-Gloss Ware and Italian Sigillata have an identical mineralogy and – importantly – an identical texture. (Fig. 3.3-8)

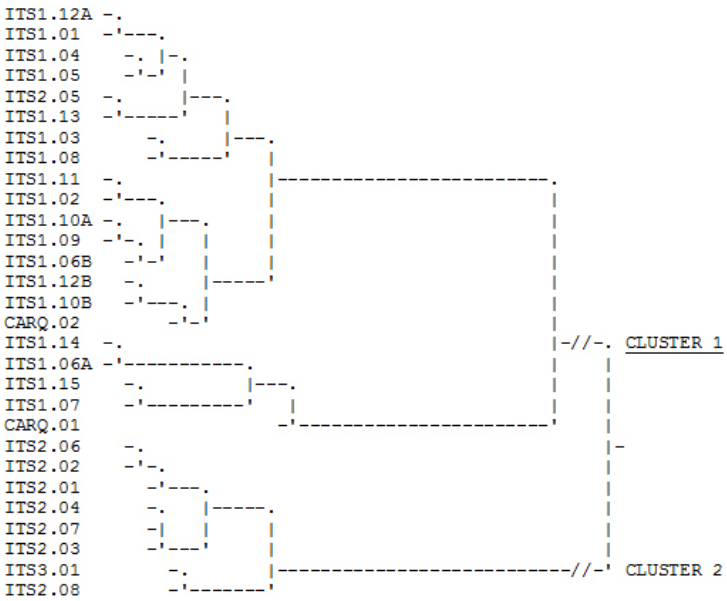


Fig. 7: Dendrogram displaying representative clustering solution for cluster analysis carried out for NAA data for all Italian Sigillata specimens (ITS) and two test tiles manufactured from agQ clay specimens (CARQ). Elements used: K, Ca, Sc, Cr, Zn, Rb, Cs, La, Ce, Nd, Sm, Eu, Yb, Hf, Ta, Th . Data transformation: log. Distance measure: mean Euclidean. Agglomeration procedure: Nature's Groups. Replicate analyses identified as A and B.

Core group	*Probability*	*Unknowns*	*Probability*
ITS1.01	97.8	ITS2.01	27.2
ITS1.02	96.8	ITS2.02	51.8
ITS1.03	89.4	ITS2.03	06.3
ITS1.04	97.7	ITS2.04	28.5
ITS1.05	92.8	ITS2.05	30.8
ITS1.06A	98.7	ITS2.06	63.7
ITS1.06B	90.2	ITS2.07	35.1
ITS1.07	91.6	ITS2.08	08.7
ITS1.08	92.8		
ITS1.09	97.0	ITS 3.01	01.3
ITS1.10A	98.6		
ITS1.10B	90.9	CARQ.01	00.0
ITS1.11	94.9	CARQ.02	10.6
ITS1.12A	90.9		
ITS1.12B	96.8		
ITS1.13	98.1		
ITS1.14	95.3		
ITS1.15	91.4		

Table 1: Results of MADCORR trial for NAA data, with Italian Sigillata Fabric Group 1 specimens (ITS1.01-15) employed as core group and the Italian Sigillata Fabric Group 2 and Fabric Group 3 specimens (ITS2.01-08, ITS3.01) and agQ clay specimens (CARQ.01-02) treated as unknowns. Elements used: Ca, Sc, Cr, Fe, Rb, Cs, :a, Ce, Sm, Yb, Hf, Th. Replicate analyses identified as A and B.

What are the implications of these results? First, that Arretine Black-Gloss Ware and Italian Sigillata were manufactured with clay obtained from the agQ formation. Second, that the location of these workshops was to some extent determined by the geography of the exposure of this formation. Third, that this clay varies somewhat in composition over the exposed portions of the formation, suggesting, among other things, that with an extensive program of analysis we should expect to identify multiple compositional groups of Black-Gloss Ware and Italian Sigillata of Arretine origin. Fourth and finally, that, contrary to what is sometimes asserted in discussions of the Arretine *terra sigillata* industry, the manufacture at Arezzo of Italian Sigillata – and also Black-Gloss Ware - did not involve the levigation of the clay.

This last point takes on particular significance if we now consider the fact that the agQ formation is associated with a sizable deposit of peat. While quite extensive in northern Europe, deposits of peat are extremely rare in Italy.[9] The largest are situated in the northern part of the country, with few of any signficance on the Italian peninsula. Where peat deposits do occur in Europe, the peat that they contain has been regularly employed as fuel, including as fuel for the firing of ceramics. Interestingly, the labor and other costs associated with the cutting and drying of peat appear to be relatively modest in comparison with those associated with the procurement and preparation of other fuels traditionally employed for ceramic manufacture. To take an example from Italy, when in the 1760s the brick manufacturing facility that operated on the estate of Nuova Olanda, near Fagano, in Friuli, switched from wood to peat, it reduced its expenditures for fuel by roughly 50 percent.[10] To the author's knolwedge, the deposit of peat associated with the agQ formation is the most extensive in peninsular Italy. The main bed varies between 1.5 and 6 meters in thickness, and has been estimated to contain 2.2 million tons of material.[11] It is extensive enough that for a time during the First World War it was subjected to large-scale commercial exploitation, with the material extracted employed as fuel. While there is no evidence that potters at Arezzo employed peat from this deposit as fuel, it would have been necessay to dig through the peat bed in order to gain access to the clay that they employed, and it seems difficult to credit that they did not, in fact, do so.

One of the great questions in Roman pottery studies and in the study of the Roman economy more generally has been the reasons why during the second half of he first century B.C. the terra sigillata industry developed at Arezzo – an inland city that did not enjoy advantageous

access to major markets. In addressing this question, the results of this project now make it seem necessary to take into consideration the fact that – in contrast, for example, with gloss-slipped tableware manufacturers at places like Volterra – Arretine producers of gloss-slipped tableware enjoyed access both to an exceptionally fine-grained, moderately calcareous clay that could be employed to manufacture high-quality products with minimal inputs of labor, and to an economical and effectively unique form of fuel that could be obtained together with this clay, introducing yet further economies into the production proess. Was it the case that the workshops that manufactured Black-Gloss Ware at Arezzo were already taking full advantage of this set of circumstances, with the local pottery sector, in effect, preadapted to exploit the situation when changed conditions beyond Arezzo during the second half of first century B.C. made it possible to distribute vast amounts of tableware to mass markets at Rome and overseas? Or did something change at Arezzo during the middle decades of the first century B.C. that saw the crystallization of this full set of conditions? For example, did the establishment there of the veteran colony see the arrival of persons with detailed knowledge of pottery manufacturing techniques not so much in the Greek East, as has generally been suggested, but rather in Gaul, Britain, and Germany, providing Arretine potters with the knowledge that they needed to make effective use of peat as fuel? Was peat a more effective fuel for the manufacture of red-gloss pottery than for black-gloss pottery, or was it more effective when employed in combination with muffle kilns of the kind employed for the manufacture of Italian Sigillata? These would appear to be some of the possibilities worth taking into considertion. We may also ask whether the availability at Arezzo of a sizable peat deposit that could be exploited for fuel did not play a signficant role in the emergence of this city as an important center for metallurtical production during the Etruscan period.

5. Conclusions

A program of analysis involving the compositonal characterization of a small number of specimens of Black-Gloss Ware and Italian Sigillata from the site of Cetamura del Chianti and several specimens of potting clay from various locales in northern Etruria by means of optical miscroscopy, NAA, and petrograhic analysis sheds light on the manufacturing process for Black-Gloss Ware at Volterra and for Black-Gloss Ware and Italian Sigillata at Arezzo. While pottery production at Volterra appears to have involved the levigation of Pag marine clay, pottery

production at Arezzo appears to have involved the use of agQ lacustrine clay, which was so fine-grained in its natural state that it did not require levigation. The deposit of agQ clay exploited for this purpose was overlain by and interleaved with a deposit of turf. It seems likely that this material was extracted. The ready availability at Arezzo of clay that could be employed more or less as it was extracted from the ground for the manfuacture of gloss-slipped pottery and fuel that could be employed for the firing of pottery likely provided potters located there with substantial production economies that played a signficant role in the emergence of the Arretine Italian Sigillata industry during the second half of the first century B.C.

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NOTES

[1] Peña, Gallimore forthcoming.
[2] de Grummond (ed.) 2000.
[3] Palermo 2003, pp. 296, 304, 306, 317, 318, 321, 323, 325.
[4] *Carta geologica d'Italia* foglio 112 Volterra, formation *Pag*.
[5] Gamurrini 1890, pp. 64-65, 68-69.
[6] Oxé *et al*. 2000, pp. 26-28; Kenrick 2006.
[7] *Carta geologica d'Italia* foglio 114 Arezzo, formation *agQ*; Merla, Abbate 1967, p. 31.
[8] Sayre 1980, pp. 9-12.
[9] Montanarella, *et al*. 2006, p. 7 Table 1.
[10] Morassi 1987.
[11] De Castro, Pilotti 1933, pp. 59-60.