BLACK-GLOSS WARE, NORTH ETRURIAN RED-SLIP WARE, AND ITALIAN TERRA SIGILLATA FROM CETAMURA DEL CHIANTI: COMPOSITION, PROVENANCE, SUPPLY, AND CONSUMPTION

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1. INTRODUCTION

The past fifteen years have seen the publication of several studies that analyze assemblages of Black-Gloss Ware from archaeological sites in Etruria with a view to documenting the geography of the production and distribution of this class of high-end tableware within this historically important region of the Italian peninsula.[2] While some of these studies have sought to shed light on these matters as an end in and of itself, others have been concerned with enhancing our understanding of general patterns of economic developments in Etruria during the Hellenistic/republican period, while others again have sought to mobilize this evidence to address aspects of the Romanization of Etruria. This article reports the results of a program of analysis undertaken with a view to contributing to this body of scholarship. The program involved the compositional analysis of examples of three classes of slipped tableware - Black-Gloss Ware, North Etrurian Red-Slip Ware – a medium to low-quality tableware produced during the second century B.C. – and Italian Terra Sigillata – the successor to Black Gloss Ware as the dominant high-end tableware in Etruria during the early imperial period - from the site of Cetamura del Chianti, a low-order Etruscan/Roman settlement situated in the Monti del Chianti area of northern Etruria. In more specific terms, the program entailed the

application of three analytical techniques – optical microscopy, neutron activation analysis, and petrographic analysis – to identify distinct compositional groups within sets of vessels belonging to each of these three pottery classes and to determine the likely provenances of these groups. Towards the second of these two goals the program also involved the compositional analysis of fired specimens of clay obtained from several locations in northern Etruria. This element of the program was undertaken on the assumption that by comparing the compositional data for the various pottery groups with those for the fired clays it might be possible to determine the general types of clay employed for the manufacture of the former and, perhaps in some cases, to identify the specific source from which the clay utilized for this purpose had been obtained.

While it proved possible to identify multiple compositional groups within the sets of vessels belonging to all three classes, the determination of the proveniences of the majority of these was problematic due to the non-diagnostic nature of the mineralogical composition of most groups, the limited number of clay specimens on hand for comparison, and the paucity of detailed form and compositional information available from production sites. Despite these limitations, it was possible to venture some general observations regarding the geography and chronology of the manufacture of these three classes of pottery in northern Etruria, the organization of the systems employed for their distribution to Cetamura, and patterns in the consumption of slipped tablewares at Cetamura over the period ca. 350 B.C. to A.D. 100.

The program of analysis also shed light on certain technological aspects of the manufacture of Black-Gloss Ware and Italian Terra Sigillata at the important production centers of Arezzo (Roman Arretium) and Volterra (Roman Volaterrae). Most significant

in this regard is the fact that it pointed to efficiencies in the manufacture of gloss-slipped tablewares available to potters at Arezzo that may well have played an important role in the emergence there of the Italian Terra Sigillata industry during the third quarter of the first century B.C., a development that has long been of interest to students of Roman ceramics and of the Roman economy more generally.

2. THE SETTLEMENT AT CETAMURA DEL CHIANTI

The site of Cetamura del Chianti (henceforth Cetamura) is a small Etruscan/Roman settlement situated in the Monti del Chianti area of northern Etruria (*comune* of Gaiole in Chianti, *provincia* of Siena; 32T 696635 m E 4818498 m N, elevation ca. 670-685 m a.s.l.).[3] It is located on the summit of a heavily wooded, NE-SW oriented ridge. The site, whose Etruscan and Roman names remain unknown to us, has been the focus of a program of archaeological investigations carried out by Florida State University since 1973.[4] It appears to have been occupied from at least the sixth century B.C. to the second century A.D., with perhaps periods of interruption during the fifth-fourth century and the first century B.C. The features excavated to date have been assigned to five phases, designated Archaic Etruscan, Late Classical, Hellenistic Etruscan 1, Hellenistic Etruscan 2, and Roman. There was also a medieval occupation on the site that does not concern us here. The Archaic Etruscan phase, which spanned some portion of the 7th and 6th centuries B.C., and the Late Classical phase, which can be dated ca. 350-300 BC, are both poorly attested, being represented by only a few isolated features. During the Hellenistic 1 phase, which can be dated ca. 300-150 B.C., the site appears to have been a center for craft production, including the manufacture of architectural ceramics (brick,

tile, and loom weights), the weaving of textiles, and probably also iron working. During the Hellenistic 2 phase, which can be dated roughly 150-75 B.C., it was the locus of a sanctuary. Whether the site was already a sanctuary during the Hellenstic 1 phase and whether it continued to function as a craft production center during the Hellenistic 2 phase, and whether it was a residential settlement and/or a market center during either or both of these phases all remain unclear. The nature of occupation during the Roman phase, which extended from at least ca. 20 B.C. to ca. A.D. 100, is similarly enigmatic, although the presence of a structure with hypocaustal heating suggests that it was perhaps the site of a modest villa. While the work carried out at Cetamura to date has not established the boundaries of the built-up area of the site during any of the phases recognized, the extent of surface remains suggests that at no point did this occupy an area of more than ca. 1 hectare.

The ridge on which Cetamura is situated lies in the eastern sector of the Monti del Chianti, roughly 12 km to the west of the Fiume Arno (Arno River). During the Hellenistic, late republican, and early imperial periods the nearest major centers were (employing these settlements' Roman names) Volaterrae, 46 km to the WSW, Saena (modern Siena), 20 km to the SSW, Arretium, 37 km to the E, Faesulae (modern Fiesole) 37 km to the NNW, and, beginning at some point in the second half of the first century B.C., Florentia (modern Florence), 35 km to the NNW. The settlement at Cetamura lay near the junction of several roads that would have provided fairly direct access to all of these centers.[5] Of particular note for the purposes of the present study is Cetamura's proximity to both Volterra and Arezzo, since the former was an important center for the manufacture of Black-Gloss Ware and probably also North Etrurian Red-Slip Ware

during the Hellenistic period, while the latter was a major center for the manufacture of Black-Gloss Ware during the Hellenistic period and Italian Terra Sigillata during the early imperial period.

Figure 1 is a map indicating the locations of the various ancient settlements mentioned in the text.

3. THE THREE POTTERY CLASSES

The three classes of tableware that constitute the focus of this study represented the high-end segment of the set of ceramic wares in use at Cetamura over the course of the Hellenistic and early imperial periods. While archaeological evidence demonstrates that architectural ceramics and perhaps also utilitarian pottery were manufactured at Cetamura, it seems unlikely that any of these three classes of pottery was produced either at Cetamura or at some other location in its immediate environs.[6]

3.1 Black-Gloss Ware

The term Black-Gloss Ware (henceforth BGW) is employed to refer to a family of tablewares characterized by the presence of a matte to glossy, dark gray, dark reddish gray, or black slip (henceforth referred to as black) that was widely manufactured and consumed in the western Mediterranean, including Italy, from the fourth to the first century B.C.[7] Its glossy black surface, which may have been regarded as conferring an appearance similar to or suggestive of that of silver plate, was attained by applying to the vessel when in a leather-hard state a coating of fine-grained, non-calcareous slip

containing a fluxing agent, and then firing the vessel in a reducing atmosphere until the slip sintered.[8]

In northern Etruria BGW normally constitutes the most abundant class of high-end tableware in pottery assemblages at sites occupied from the second half of the fourth to the middle of the first century B.C.[9] While the pottery assemblages from some sites in northern Etruria contain small amounts of BGW certainly or likely manufactured outside the region – e.g., by workshops located in Latium, northern Campania, and/or the Bay of Naples - the bulk of the vessels belonging to this class consumed in northern Etruria appear likely to have been manufactured within the region. Direct evidence for the manufacture of BGW in the form of the remains of production facilities and/or production waste (i.e., pottery with manufacturing defects, kiln furniture and other production equipment, structural elements of kilns) has been reported from ten locations in northern Etruria. These include the following: Volterra - Acropoli,[10] Montaione (two locations – Bellafonte[11] and il Muraccio[12]), Arezzo (two locations – Santa Maria in Gradi[13] and Orciolaia[14]), Montepulciano - Casa al Vento,[15] Chiancinao – Terme/Incrocio SS146 - Via Vecchia Senese,[16] and Chiusi (three locations – Orto del Vescovo,[17] Badiola, [18] and Marcianella).[19] The last is the only of these locations at which a production facility has been the subject of systematic excavation and publication.[20] Indirect evidence, including the distribution of forms, fabrics, and decorative techniques/elements/schemes, suggests that BGW was manufactured at several other locations in northern Etruria, including the area around Livorno, Pisa, Lucca, and perhaps also Populonia, Cosa, and Roselle.[21]

3.2 North Etrurian Red-Slip Ware

The term North Etrurian Red-Slip Ware (henceforth NERSW) is here employed to refer to a family of tablewares characterized by the presence of a dull to glossy reddish slip that was manufactured at several locations in northern Etruria from the late third century B.C. to the second half of the second century B.C.[22] The slip generally exhibits poor adhesion to the ceramic body, and is frequently only poorly preserved. These characteristics indicate that this class was not manufactured employing the distinctive slipping/firing technique employed for the manufacture of BGW noted above. A very substantial portion of the vessels belonging to this class are examples of a distinctive bowl with an everted, sometimes thickened rim with a furrow immediately inside it, a low wall, and a broad, flat base.[23] This form is morphologically identical to a BGW form designated Morel 1211, and is here referred to by this designation.

In northern Etruria this class represents a significant, though often only minor component of the high-end tableware assemblage at many sites occupied from the late third to the second half of the second century B.C.[24] There is direct evidence for the manufacture of NERSW from the pottery production facility at Chiusi - Marcianella that also produced BGW.[25] Indirect evidence, including the distribution of forms and fabrics and onomastic evidence provided by stamped maker's marks that very occasionally occur on vessels of this class, suggest that it was probably also manufactured at Volterra, Fiesole, Perugia, and one or more locations in the Val d'Elsa.[26]

3.3 Italian Terra Sigillata

The term Italian Terra Sigillata (henceforth ITS) is here used to refer to a family of tablewares characterized by the presence of a glossy, reddish slip manufactured at several locations in central Italy from the last third of the first century B.C. to the first half of the second century A.D. that was distributed throughout much of the Roman world and beyond.[27] Its glossy red surface, which may have been regarded as conferring an appearance similar to or suggestive of gold, was attained by the same technique as that employed for producing the glossy black surface of BGW, save that firing was carried out in an oxidizing atmosphere.[28] Examples of this class commonly bear one or more stamped maker's marks, on the basis of which it has been possible to identify numerous workshops and draw inferences about their internal organization.[29]

In northern Etruria ITS invariably constitutes the dominant element of the high-end tableware portion of pottery assemblages at sites occupied from the last quarter of the first century B.C. to the first half of the second century A.D. While some of the ITS consumed in northern Etruria may have been manufactured at workshops located outside the region – e.g., in the Po Valley, the Tiber Valley, and/or the Bay of Naples - the bulk was presumably manufactured within the region. Direct evidence for the manufacture of ITS has been reported for 13 locations in northern Etruria. These include Pisa (two locations – Via Santo Stefano[30] and Via San Zeno),[31] Rosignano Marittimo - Poggio Fiori,[32] Arezzo[33] (nine locations – Cincelli,[34] Ponte a Buriano,[35] Le Carciarelle,[36] Orciolaia,[37] Via Nardi,[38] Santa Maria in Gradi,[39] Piaggia di Murello,[40] San Francesco/Via Guido Monaco,[41] and Via dei Cenci)[42], and Torrita di Siena - Poggetti.[43] The last is the only one of these locations at which a production facility has been the subject of systematic excavation and publication.[44]

4. THE PROGRAM OF COMPOSITIONAL ANALYSIS

The program of compositional analysis involved nine operations carried out in the following order:

1. The selection of pottery specimens for analysis.

2. The collection of clay specimens for analysis.

3. The fabrication of tiles and pellets from the clay specimens.

4. The characterization of the untreated fracture surface of a chip detached from each pottery specimen and tile (optical microscopy).

5. The creation of a provisional fabric classification on the basis of these characterizations.

6. The neutron activation analysis (henceforth NAA) of each pottery specimen and pellet.

7. The analysis of the NAA data.

8. The creation of a final fabric classification taking into account the results of NAA

9. The petrographic analysis of selected pottery specimens and tiles.

It was assumed that the various fabric groups identified and characterized by means of this set operations would correspond to some appreciable degree to production groups, that is, sets of vessels manufactured by the same workshop or by multiple workshops located in the same general area employing similar raw materials and processing techniques to prepare the ceramic paste from which they formed the vessels that they manufactured.[45]

The sections that follow describe in turn the methods employed for each of these operations.

4.1 Selection of Pottery Specimens

The sampling design employed for the selection of pottery specimens for analysis was drawn up with the goal of yielding data that would provide insight into patterns in the consumption of the three classes of pottery in question at Cetamura during the Late Classical, Hellenistic 1, Hellenistic 2, and Roman phases. It was also shaped by two considerations linked to the NAA component of the project, namely the requirement that the program of analysis be limited to no more than ca. 100 specimens, and the requirement that the analytical results include data pertaining to one or more groups consisting of at least ca. 20 pottery specimens having a common provenance (or, more correctly, specimens manufactured from a ceramic paste consisting of raw materials from the same source processed in the same manner). As explained below, the second of these two considerations was linked to the requirements of MADCORR, one of the computer programs employed for the analysis of the chemical data generated by NAA. Given Cetamura's location, it was thought likely that a significant portion of the BGW from the site originated at Volterra and a significant portion at Arezzo, that at least some of the NERSW originated at Volterra, and that most or all of the ITS originated at Arezzo. In light of these assumptions it was decided that a sampling program that included ca. 40 specimens of BGW, ca. 15 specimens of NERSW, and ca. 25 specimens of ITS would likely guarantee that the program of NAA analysis would yield compositional groups of the minimum required size for materials originating at both Volterra and Arezzo (and

possibly one or more other locations). This sampling scheme would also allow for the analysis of several tiles manufactured from regional clay specimens and a small number of replicate analyses of pottery specimens, the latter undertaken with a view to generating data that would aid with the interpretation of analytical results.

The pottery specimens selected for analysis were drawn from the sets of materials recovered in the course of the 1987 and 1988 excavation seasons at the site. The specimens of BGW and NERSW included in the program of analysis were selected primarily from among the sets of materials belonging to three fairly large deposits that could be associated one with the site's Late Classical phase and the initial portion of the Hellenistic 1 phase (ca. 350-250 B.C.), one with the middle portion of the Hellenistic 1 phase (ca. 250-200 BC), and one with the late portion of the Hellenistic 1 phase and initial portion of the Hellenistic 2 phase (ca. 200-150/125 B.C.). The basic information regarding the size and makeup of these deposits, here referred to as Deposits 1, 2, and 3, respectively, is presented in Table 1. The date ranges suggested for the deposits should be regarded as approximate. It should also be noted that one of the loci constituting Deposit 3 (Structure B, Locus 2/4) was situated at the boundary between Deposit 2 and Deposit 3, and its excavation may have entailed the recovery of some materials belonging to the locus constituting Deposit 2 (Structure B, Locus 4). As the 1987 and 1988 excavations yielded no similarly large deposits that could be associated with the Roman phase the ITS specimens included in the program of analysis were selected without regard to stratigraphic context.

In selecting specimens for analysis priority was given to choosing sherds that belonged each to a different vessel as this could be determined on the basis of fragment

morphology and the appearance of body and slip. A secondary consideration was the selection of sherds that could be assigned with a high degree of confidence to a recognized form in the standard typology or typologies for the class in question,[46] with priority given to rim fragments when these were available. In the event, the limited amount of materials available combined with the fairly high degree of brokenness exhibited by these meant that in many cases the specimens of BGW and in a few cases the specimens of NERSW selected for analysis could not be assigned to a specific form or could be assigned to a specific form with something less than a high degree of confidence. This unavoidable and regrettable circumstance has had the effect of diminishing to some extent the utility of the results obtained for these two classes.

For sampling purposes the BGW was divided into two general categories on the basis of its texture as this could be observed in the hand specimen – fine-textured and intermediate-/gritty-textured. The former category was thought likely to include the materials originating at Volterra and Arezzo, while the latter was thought likely to consist of materials manufactured at one or more other locations. It should be pointed out that intermediate-/gritty-textured BGW is exceedingly rare at Cetamura compared to fine-textured BGW, representing only a very small fraction of the BGW in the site assemblage. A total of 28 fragments of fine-textured BGW were selected for analysis, including seven from Deposit 1 (representing all seven vessels attested in this deposit), four from Deposit 2, and 17 from Deposit 3. All 12 fragments of intermediate-/gritty-textured BGW among the materials excavated in 1987 and 1988 that appeared to represent a distinct vessel were selected for analysis. These included eight specimens from Deposit 3, two from other loci comparable in date to Deposit 3, and two residual

sherds from Roman or post-Roman loci. A total of 14 specimens of NERSW were selected for analysis with no consideration given to the texture of their fabric, including two specimens from Deposit 2 (representing both vessels attested in this deposit), nine from Deposit 3 (representing all nine vessels represented in this deposit), and three from other loci comparable in date to Deposit 3. Finally, 24 specimens of ITS were selected for analysis, some from Roman-phase contexts and some from contexts of apparent post-Roman date.

Appendix 1 presents a catalog of the pottery specimens included in the project.

4.2 Selection of Clay Specimens

The selection of clay specimens was guided in large measure by the evidence for clay formations presented on the relevant *fogli* (map sheets; henceforth Fg) of the standard geological map for the region, the *Carta Geologica d'Italia*, which is produced at a scale of 1:100,000.[47] Figure 2 is a map indicating the locations where the various clay specimens were obtained.

Given the assumption that a substantial portion of the ITS, BGW, and NERSW originated at Arezzo and/or Volterra, a particular effort was made to collect specimens of clay suitable for the manufacture of ceramics from the areas of these two towns. In the case of Arezzo, an evaluation of the relevant map sheet (Fg 114) suggested that the workshops located there that manufactured BGW and/or ITS likely employed clay obtained from the formation designated agQ (*argille di Quarata*/Quarata clays), a bed of fine-grained sediment deposited on the floor of the lake that occupied a basin situated to the west of Arezzo during the Plio-Pleistocene period. The geologic map shows outcrops

of this formation occurring over a narrow band running along the banks of the Canale Maestro della Chiana - an artificial watercourse initially excavated during the medieval period that serves to drain a large portion of the Val di Chiana northward into the Arno, which it joins in the vicinity of Ponte a Buriano - and the banks of the Torrente Castro, a small perennial that flows in a NW direction, passing through Arezzo and emptying into the Canale Maestro della Chiana from the east at a point ca. 3.5 km upstream of the latter's confluence with the Arno.[48] The exposures of this formation occur upstream along the Castro as far as Montione, roughly 2 km to the NW of Arezzo (taking as the city's boundary the circuit of the medieval fortification wall). Although a brief reconnaissance of the area failed to identify any extensive exposures of this formation, it was possible to obtain two specimens of agQ clay (henceforth Arezzo – Quarata clay) suitable for compositional analysis, one from a bank at the side of an unpaved road running along the left bank of the Canale Maestro della Chiana (specimen CARQ.01), and the other from the plow zone of an agricultural field a short distance back from this bank of the Canale Maestro della Chiana (specimen CARQ.02).

An evaluation of the map sheet for the area of Volterra (Fg 112) suggested that any workshops located at Volterra or in the environs of the town that manufactured fine-textured BGW and/or NERSW likely employed clay from the formation designated Pag (*argille azzurre*/blue clays), a thick bed of sediment deposited during an episode of marine transgression that occurred in the Pliocene period. This formation constitutes the end of the geologic sequence over much of the hilly terrain in the area around Volterra, with extensive outcrops occurring from elevations ranging from ca. 90 m a.s.l. to ca. 450 m a.s.l. A comprehensive sampling of the exposures of this formation was beyond the

means of the project, and a limited program of adventitious sampling was undertaken with a view to obtaining evidence for the general characteristics and the range of compositional variability exhibited by clay from this formation in the area around the town.[49] This involved the collection of four specimens of clay from four different locations to the SW of the town that lie within the formation's lower and middle sections (specimens CVLT.01-04), the collection of two specimens of clay from two different locations to the NW of the town that lie within its middle and upper sections (specimens CVLT.05-06), and the collection of a specimen of clay from a location to the ESE of the town that lies within its upper section (specimen CVLT.07).

More or less sandy marine clays of Pliocene date occur over a significant portion of the interior of northern Etruria, including an area on the south side of the Middle Arno Valley between the Fiume Era to the west and the Torrente Pesa to the east, and an area extending from the environs of Siena eastward and southward to the southern edge of the Chianti Mountains, the Val di Chiana, and the northern edge of Monte Amiata. In order to obtain some idea of the composition of these clays three specimens were collected from the face of the clay pit operated by Laterizi Arbia, a concern that manufactures architectural ceramics, located at Castelnuovo Berardenga Scalo, ca. 21 km to the SSE of Cetamura (specimens CCBS.01-03). This material belongs to the formation Fg 121 P^{2-1}ag (*argille ed argillle sabbiose*/clays and sandy clays).

More or less coarse lacustrine clays laid down during the Plio-Pleistocene period occur along the margins of the Upper, Middle, and Lower Arno Valley.[50] In order to obtain some idea of the composition of these clays, six specimens were collected from the storage area on the grounds of Cotto Pratigliolmi, a concern that manufactures

architectural ceramics located at Castelnuovo di Franco - il Matassino, ca. 15 km to the NNE of Cetamura (specimens CCFM.01-06). These clays, which were said by an employee of the concern to have been excavated from the clay pit located on the premises, presumably derive from the formation Fg 114 Vag (*argille di Figline*/Figline clays)

Since it could not be completely excluded that some of the pottery included in the project was manufactured at or near Cetamura, specimens of clay were obtained from formations exposed in the immediate environs of the site that are known to contain clay suitable for the manufacture of ceramics. An evaluation of the relevant map sheet of the geologic map (Fg 113) and the relevant map sheet in the 1/25,000 series of topographic maps (*Tavoletta F.* 113 II N.E. "Radda in Chianti") for indications of ceramic manufacturing activity during the modern period revealed two such formations. The first of these, designated csp (*calcareniti degli scisti policromi*/calcarenites derived from polychrome schists), comprises the northeast end of the NE-SW ridge on which Cetamura is situated and the saddle that separates this height from the hill located immediately to its east. This formation, of Paleogene date, consists of alternating beds of limestone, shale, and argillite, with associated deposits of clay that presumably derive from the weathering of the last of these rock types. The presence of standing water at a location on the eastern slope of the hill at an elevation of ca. 645 m a.s.l. revealed the presence of a sizable deposit of this clay, and a specimen of this material was recovered by excavation into the subsoil (specimen CCET.01). Experiments carried out with a portion of this specimen revealed that it possessed good working properties. The presence of an abandoned architectural ceramics workshop from the modern period ca.

200 m to the NW of the location where the specimen was obtained (*Tavoletta F.* 113 II N.E. UTM 967189 "*Fornace*") suggests that this deposit is substantial enough to support ceramic production on a moderate scale, and it seems likely that the manufacture of a portion of the utilitarian pottery and architectural ceramics produced at or near Cetamura during the Etruscan and Roman periods involved the use of this material.

The second formation of interest in the environs of Cetamura, designated c' (*complesso caotico - argille scagliose*/caotic complex – platy clays), is a marine formation of Holigocene date that is represented by three distinct outcrops lying within ca. 3-5 km of the site. One of these is situated ca. 2 km to the NW of Cetamura in the bottom of the valley immediately to the north of the hill on which the site is located that constitutes the upper end of the basin of the Pesa. The presence of an abandoned architectural ceramics workshop of the modern period atop this outcrop at *località* Castiglioni (*Tavoletta F.* 113 II N.E. UTM 943191 "*Fornace*") again suggests that this deposit is substantial enough to support ceramic production on a moderate scale. A specimen of this clay was obtained from a cut at the side of an unpaved road (specimen CRCS.01). The portion of the bed from which this specimen was recovered was in contact with a bed of limestone, and the specimen had a conspicuous component of fragments of calcareous rock that is probably not representative of the clay from this formation in general. In order to remove some of this material the specimen was disaggregated and sifted through a 0.5 mm steel mesh. Experiments carried out with a portion of the specimen after this procedure revealed that it possessed only moderate working properties, presumably due at least in part to an extremely high calcium content.

Additional clay specimens were obtained adventitiously from Ceramica Vulcania, an industrial cookware manufacturing concern located in Colle Val d'Elsa, a town situated ca. 26 km to the W of Cetamura. According to the plant manager, the paste employed by this concern consists of a mixture of three clays in strictly determined proportions, including a clay imported from France, a clay obtained from Altopascio, a town ca. 55 km to the NW of Colle Val d'Elsa, and a clay obtained from a source at *località* Belvedere, which he placed with some degree of uncertainty ca. 4-5 km outside Colle Val d'Elsa along the road to Monteriggioni. The plant manager stated that the Altopascio clay can be used by itself for the manufacture of cookwares if the coarse fraction is first removed. An evaluation of the relevant map sheet (Fg 105) and satellite imagery available through Google Earth suggests that this material was likely obtained from a clay pit located on the grounds of a factory for the manufacture of architectural ceramics situated ca. 2 km to the NNE of Altopascio. The material obtained at this location presumably consists of Plio-Pleistocene lacustrine sediments generally similar to those obtained farther up the Arno Valley at Castelfranco – Il Matassino. They probably belong to the formation designated Ql (*argille lignitifere, argille sabbiose, e sabbie di ambiente lacustre*/lignite bearing clays, sandy clays, and lacustrine sands). A specimen of this clay was obtained from the clay store on the Ceramica Vulcania premises (specimen CALP.01). For analysis, the coarse fraction was removed by disaggregating the specimen and sifting it through a 0.5 mm steel mesh. The plant manager indicated that the clay from *località* Belvedere was the clay employed in the past by traditional pottery producers at Colle Val d'Elsa. While there is a locale known as Belvedere ca. 2.5 km outside Colle Val d'Elsa along the road to Monteriggioni, the relevant map sheet (Fg

113) shows that the geology of this area, which consists of marine sediments and travertines and fluvial sediments derived from these, is not compatible with a material of the kind collected (as described below, a fairly coarse, non-calcareous clay). There is, however, a second locale known as Belvedere ca. 6 km to the NE of Colle Val d'Elsa, situated at the western edge of an area of lacustrine sediment of the Upper Miocene. The immediate area of this Belevedere consists of an exposure of the Mlc_2 (*conglomerati lacustri*/lacustrine conglomerates) formation, which is made up of alternating beds of calcareous material, sands, and clays. It seems possible that a formation of this kind could yield material of the sort in question, and, if so, it likely represents the place closest to Colle Val d'Elsa where clay of this kind could have been obtained. The best explanation may thus be that the clay in question derived from this second Belvedere, and that the workshop foreman, who seemed not to have direct personal knowledge of the place where it was obtained, confused a locale of this name with which he was familiar with another locale of the same name with which he was not.

This set of specimens represents only a portion of the array of clays available to potters in northern Etruria for the manufacture of the three classes of pottery under consideration. It does not, for example, include a specimen of clay formed through the alteration of ophiolitic gabbros such as occur in the vicinities of Impruneta, Figline di Prato, and Montaione;[51] a specimen of lacustrine blue clay of the Upper Miocene that outcrops over an extensive area to the East of Poggibonsi and Monteriggioni; or a specimen of fluvial clay of recent date, which occurs on the floodplains of watercourses throughout the region.

Appendix 2 presents a catalog of the clay specimens included in the project.

4.3 Fabrication of Tiles and Pellets

Circa 50 grams of material from each clay specimen was placed in a clean plastic bag and pulverized by being crushed against an aluminum plate with a rubber mallet. As previously noted, for two specimens (CRCS.01, CALP.01) the pulverized material was passed through a 0.5 mm steel mesh to remove the coarse fraction. The pulverized material was hydrated by adding de-ionized water and mixing until it became plastic. A portion of the plastic clay was modeled into a cylindrical pellet ca. 1 cm long with a diameter of ca. 0.5 cm and a flat tile ca. 1 cm wide by 4 cm long by 0.5 cm thick by being pressed into a plastic mold. The tiles and pellets were air dried and then fired in an electric muffle for two hours at 900 degrees C to convert them into a ceramic the composition of which could be usefully compared with the pottery specimens.

4.4 Optical Microscopy

A more or less flat chip measuring ca. 0.5 x 0.5 cm was detached from each pottery specimen and tile with pliers and the fresh fracture surface examined under a binocular microscope offering magnifications of 20X and 40X. Each chip was characterized for overall texture, matrix, and identity, size, condition, and abundance of inclusions. A detailed description of the methods employed for this operation appears in the introduction to Appendix 4.

4.5 Creation of Provisional Fabric Classification

The various chips were each assigned to a provisional fabric group on the basis of the results of the program of optical microscopy, with each of these fabric groups consisting of the chips within each pottery class or clay source area judged likely to represent specimens manufactured either from the same ceramic paste or from compositionally similar ceramic pastes.

4.6 Neutron Activation Analysis

Material removed from each pottery specimen and pellet was subjected to NAA at the facility formerly operated by the Smithsonian Institution's Museum Conservation Institute at the National Institute of Standards and Technology in Gaithersburg, Maryland to determine the specimen's bulk chemical composition. The material was prepared by employing a tungsten carbide burr to remove the surface from a portion of each specimen, breaking the prepared area away from the specimen, and then pulverizing this fragment in an agate mortar. The pulverized material was dried in an electric oven for 24 hours at 110 degrees C and allowed to cool in a desiccator. One hundred +/- 5 mg of this material was transferred to a cleaned polyethylene microcentrifuge tube, weighed to +/- 0.01 mg, and the tube capped. Batches of 18 specimens were packed into a polyethylene rabbit for irradiation along with two standards consisting of SRM 1633b Coal Fly Ash and a check standard consisting of SRM 679 Brick Clay. Each rabbit was irradiated for four hours at a flux of 5 x 10^{13} neutrons per cm^2 per second. The irradiated specimens, standards, and check standard were subjected to a one-hour count after 5 days and a two-hour count after 30 days. Concentrations were determined for 28 elements, including Na, K, Ca, Sc, Cr, Fe, Co, Zn, As, Br, Rb, Sr, Zr, Sb, Cs, B, La, Ce, Nd, Sm, Eu, Tb, Yb, Lu,

Hf, Ta, Th, U.[52] For two elements important for understanding the composition of ceramics – Ca and Zr – concentrations were in many cases below the detection limit (ca. 1.8 percent for Ca and ca. 65 ppm for Zr).

Replicate analyses were carried out for five of the pottery specimens with a view to obtaining information regarding the scale of the combination of compositional heterogeneity within individual specimens and analytical error (including inter-batch analytical error) and the possible effects of these factors on the structure of the NAA dataset.

4.7 Analysis of Neutron Activation Analysis Data.

Three methods were employed for the analysis of NAA data. The first of these was the simple evaluation of the values for calcium in order to determine whether the specimen was manufactured from a paste that was non-calcareous (here defined as < ca. 1.8 percent in the fired state), low calcium (ca. 1.8-4 percent), moderately calcareous (ca. 4-9 percent), or highly calcareous (> ca. 9 percent).[53]

The second method employed for the analysis of the NAA data was cluster analysis. This was used to explore the gross structure of the data set and to identify groups of specimens (including both pottery specimens and tiles) possibly manufactured with clay obtained from the same source or from highly similar and thus possibly neighboring sources. This operation involved the use of two programs originally developed by the archaeometry group at the Brookhaven National Laboratory (BNL) and later revised by the Missouri University Research Reactor (MURR) archaeometry group. These were MCONDIST, which calculates a distance matrix for the specimens included

in the analysis for a suite of elements selected by the user employing one of six distance measures also selected by the user; and MAGCLUS, which employs the distance matrix produced by MCONDIST to generate clusters of specimens having similar chemical compositions using one of seven agglomeration procedures selected by the user.[54] The result of each analysis (known as a clustering solution) is displayed in the form of a dendrogram.

Since the results of cluster analysis tend to vary substantially and often significantly (from an archaeological point of view) as a function of the distance measure and agglomeration procedure employed, and/or as a function of the suite of elements and/or set of specimens included in the analysis, numerous analyses were carried out employing different combinations of sets of specimens, suites of elements, distance measures, and agglomeration procedures. The suites of elements, distance measures, and agglomeration procedures utilized were for the most part ones known from previous experience to provide good partitioning between sets of fine-textured ceramics manufactured at different locales and/or from ceramic clays obtained from different sources in west-central Italy. In light of the variable nature of the results of cluster analysis, one of the main goals of this work was the identification of sets of specimens that tend to cluster together under a variety of different analytical parameters, the assumption being that there is a high likelihood that any such specimens were manufactured from clay obtained either from the same source or from highly similar sources. Particular attention was accorded to the locations within the dendrogram of the five pairs of replicates, since this information aids in the identification of elements of the clustering solution that should not and perhaps should be regarded as archaeologically

significant. The specific clustering solutions discussed and illustrated below represent what are regarded as the most representative results obtained in the substantially broader program of cluster analysis. They should not be viewed as constituting in a straightforward manner a definitive representation of the structure present either in the data set or in the set of specimens analyzed.

The third method employed for the analysis of the NAA data was that of calculating multivariate probability scores of group membership. This method was used to evaluate the statistical probability that individual specimens belonging to sets of specimens identified as constituting a compositional group by means of cluster analysis actually belong to the group, and to evaluate the probability that other specimens might belong to that group. This operation involved the use of a third program developed by the BNL/MURR archaeometry groups, MADCORR.[55] This routine calculates the variance-covariance matrix for a reference group of specimens defined by the user (termed the core group) for up to 15 elements specified by the user, then employs Hotelling's T^2 parameter to determine the probability that each specimen in the group might actually belong to a group having those compositional characteristics. Specimens scoring below some arbitrarily selected level – the figure most commonly employed is 5 percent – can be removed from the core group and the calculation repeated until a group displaying what the user regards as a satisfactory degree of homogeneity is obtained. The same calculation can then be carried out for specimens of unknown origin, assigning probabilities of membership in the core group to these. The program requires that the core group contain at least one more specimen than the number of elements being employed for the calculation, and tends to perform best when at least 10 elements are

used and when the number of specimens in the core group is at least twice the number of elements being employed. A core group consisting of at least 20 specimens is thus preferred. Since the set of specimens included in the analysis and the number and suite of elements employed substantially affect the results, as was the case with the program of cluster analysis, several trials were carried out employing various sets of specimens and elements with a view to identifying significant patterning in the data set, with just one of these trials here presented as a representative example.

4.8 Creation of Final Fabric Classification

The preliminary fabric classification was revised in light of the results of the program of NAA.

4.9 Petrographic Analysis

In order to obtain a more systematic characterization of the texture of the various fabrics identified and more secure and specific identifications of the various inclusions present in these thin sections were fabricated for 17 of the pottery specimens (as possible, one representative specimen from each fabric group) and these subjected to petrographic analysis. Thin sections were also fabricated and analyzed for two tiles (those manufactured from the two specimens of Arezzo-Quarata clay) so that it would be possible to perform more detailed comparisons between the texture and mineralogy of the ceramic clays in question and pottery specimens judged likely to have been manufactured from these.

5. RESULTS

The values obtained by NAA for all specimens of BGW and BGW fabric groups, all specimens of NERSW and NERSW fabric groups, and all specimens of ITS and ITS Fabric Groups are presented in Tables 2-4, respectively. The values obtained by NAA for all pellets manufactured from clay specimens are presented in Table 5. Appendix 3 presents a discussion of the methodology employed in the program of petrographic analysis and the results obtained. Appendix 4 presents the final fabric classification for both pottery and tiles, and includes the results of the program of optical microscopy.

The three subsections that follow discuss the results of the program of compositional analysis relating to each of the three classes of pottery that were the focus of the project. These are followed by a fourth subsection that discusses the results of analyses of NAA data involving pottery specimens belonging to all three classes.

5.1 Black-Gloss Ware

The optical microscopy of the 40 specimen chips revealed the presence of what were judged to be six distinct fabrics:

Preliminary Fabric A: a fine, pink fabric with a slightly to distinctly calcareous matrix (26 specimens);

Preliminary Fabric B: a fine, pink fabric with a slightly calcareous matrix containing abundant, minute, light, glistening particles (mica) (2 specimens);

Preliminary Fabric C: an intermediate-textured, pink or light red fabric with a distinctly calcareous matrix (6 specimens);

Preliminary Fabric D: an intermediate-textured, light red fabric with a non-calcareous or slightly calcareous matrix containing abundant, small, colorless grains (quartz) (1 specimen);

Preliminary Fabric E: an intermediate-textured, reddish brown fabric with a non-calcareous matrix containing frequent, small, colorless grains (quartz), frequent, small, reddish brown bodies (sedimentary rock fragments), and frequent, small, reddish brown, glistening plates (mica) (1 specimen); and

Preliminary Fabric F: a gritty, pink or reddish yellow fabric with a non-calcareous matrix containing abundant, small to medium, colorless grains (quartz) (4 specimens).

Preliminary Fabric Groups A-B correspond to the specimens classified as fine-textured BGW for sampling purposes, while Preliminary Fabric Groups C-F correspond to the specimens classified as intermediate-/gritty- textured BGW at that juncture.

The NAA data indicate that the specimens assigned to the Preliminary Fabrics A-C were manufactured with a moderately calcareous paste, while those assigned to Preliminary Fabrics D-F were produced with a non-calcareous or low calcium paste.

Cluster analysis was carried out using a variety of different parameters for the 34 moderately calcareous specimens (including two pairs of replicates) (i.e., the specimens assigned to Preliminary Fabrics A-C) and the 12 specimens of moderately to highly calcareous clay (seven specimens from Volterra, three specimens from Castelnuovo Berardenga Scalo, two specimens from Arezzo - Quarata).[56] The representative clustering solution presented here (Fig. 3) is probably best interpreted as containing seven clusters:

Cluster 1, composed of 12 of the specimens assigned to Preliminary Fabric A (including one pair of replicates) and the two examples of Arezzo - Quarata clay;

Cluster 2, composed of 10 of the specimens assigned to Preliminary Fabric A;

Cluster 3, composed of four of the specimens assigned to Preliminary Fabric A;

Cluster 4, composed of the two specimens assigned to preliminary Fabric B (including one pair of replicates);

Cluster 5, composed of the three specimens of Castelnuovo Berardenga Scalo clay;

Cluster 6, composed of the six specimens assigned to Preliminary Fabric C; and

Cluster 7, composed of the seven specimens of Volterra clay.

Cluster 1 is composed of two sub-clusters, one consisting of seven specimens of BGW analyzed in the same batch, and the other of five specimens of BGW (including one pair of replicates) and the 2 specimens of Arezzo - Quarata clay, which were analyzed in four different batches, all different from the batch in which the specimens in the first sub-cluster were analyzed. This suggests that the division of these specimens into two sub-clusters is the product of analytical error. The fact that the two specimens of Arezzo - Quarata clay are included in this cluster suggests that the examples of fine-textured BGW included in this cluster were manufactured from a clay similar to this material. Clusters 3 and 4 are linked at a relatively low level of dissimilarity, raising the possibility that the sets of specimens of BGW included in these are related to one another. The fact that the clays from Volterra and Castelnuovo Berardenga Scalo are clustered separately from the pottery specimens is not surprising, given the clays' significantly coarser texture.

Cluster analysis was also carried out using a variety of different parameters for the six low-calcium and non-calcareous specimens (including one pair or replicates) (i.e., the specimens assigned to Preliminary Fabrics D-F). The representative clustering solution presented here (Fig. 4) is probably best interpreted as containing three clusters: Cluster 1, composed of the four specimens assigned to Preliminary Fabric F; Cluster 2, composed of the pair of replicates assigned to Preliminary Fabric D; and Cluster 3, composed of the one specimen assigned to Preliminary Fabric E.

Cluster analysis was also carried out using a variety of different parameters for the same six pottery specimens and the nine specimens of non-calcareous clay (one specimen from Cetamura, six specimens from Castelfranco di Sopra – il Matassino, one specimen from Altopascio, one specimen from Colle Val d'Elsa - Belvedere). This analysis failed to identify any apparent relationship between the pottery and clay specimens.

In light of these results, the set of specimens assigned to Preliminary Fabric A are here presented as Fabric Groups 1, 2, and 3 in accordance with their assignment to Clusters 1, 2, and 3, respectively, in the representative clustering solution, while those assigned to Preliminary Fabrics B-F are here presented as Fabric Groups 4-8, respectively. Fabric Group 5 should perhaps be divided into two sub-groups, one consisting of two specimens (BGW5.01, BGW5.03) that display a highly similar chemical composition (and were accordingly linked at a low level of dissimilarity in the cluster analysis) and under the binocular microscope are distinguished from the other four specimens by their higher concentration of calcareous material and lower concentration of medium and coarse inclusions.

The program of petrographic analysis allowed this picture to be developed in somewhat greater detail. The specimens from Fabric Groups 1-4 and the two specimens of Arezzo - Quarata clay have a generally similar composition and texture, with an inclusion component consisting exclusively or almost exclusively of monocrystalline quartz and mica predominantly of silt size, ranging in some cases up to very fine sand size. The fabric groups to which the pottery specimens belong were apparently manufactured from either a fine, moderately calcareous clay, such as Arezzo - Quarata clay, or a less fine moderately to highly calcareous clay, such as Volterra clay or Castelnuovo Berardenga Scalo clay, subjected to levigation. The specimens from Fabric Groups 2-4 proved to contain slightly more material of very fine sand size than those from Fabric Group 1, including grains of monocrystalline and polycrystalline quartz, laths of mica, and, in one case, fragments of siltstone. This observation is in line with the results obtained from the optical microscopy of the specimens belonging to these same four fabric groups, which revealed that, while only one of the 12 specimens assigned to Fabric Group 1 contained rare, small, reddish brown to dark gray inclusions - probably to be identified as fragments of mudstone and/or siltstone - five of the 10 specimens assigned to Fabric Group 2 contained inclusions of this kind, as did two of the four specimens assigned to Fabric Group 3 and both of those assigned to Fabric Group 4. These observations suggest that Fabric Group 1 was manufactured from a clay different from the clay or clays employed for the manufacture of Fabric Groups 2-4.

The specimen from Fabric Group 5 contained inclusions in the silt to medium sand size range, including monocrystalline and polycrystalline quartz, mica, siltstone, and perhaps also a fragment of microfauna. This indicates that the fabric group to which it

belongs was manufactured from a sandy, moderately calcareous clay, probably of marine origin. The specimen from Fabric Group 6 had a generally similar composition, though with no evidence of microfauna, and this specimen/fabric group was likely manufactured from a less calcareous clay of marine or continental origin.

The specimens from Fabric Groups 7 and 8 contained inclusions in the silt to coarse sand size range, including grains of monocrystalline and polycrystalline quartz, laths of mica, and fragments of mudstone. The fabric groups to which they belong were manufactured from a continental clay similar to, though less coarse than the lacustrine clays from Catelfranco Di Sopra – il Matassino and Altopascio or the probable lacustrine clay from Colle Val D'Elsa - Belvedere, or from clays similar to these that were subjected to levigation.

5.2 North Etrurian Red-Slip Ware

The optical microscopy of the 14 specimen chips revealed the presence of six distinct fabrics:

Preliminary Fabric A: a fine, red or reddish yellow fabric with a distinctly calcareous matrix (two specimens);

Preliminary Fabric B: a fine, pink, reddish yellow or reddish brown fabric with a non-calcareous matrix (five specimens);

Preliminary Fabric C: an intermediate-textured, pink or reddish yellow fabric with a non-calcareous matrix containing abundant, small colorless grains (quartz) and sparse to abundant glistening plates (mica) (three specimens);

Preliminary Fabric D: a porphyritic, light red fabric containing abundant, minute to medium colorless grains (quartz), sparse glistening plates (mica), and rare, small, and reddish bodies (fragments of sedimentary and igneous rock) (one specimen);
Preliminary Fabric E: a gritty pink fabric containing very abundant, minute to small, colorless grains (quartz) (two specimens); and
Preliminary Fabric F: a gritty pink fabric containing abundant, small white bodies and reaction rims (calcium carbonate) and sparse, small colorless grains (quartz) (one specimen).

The NAA data indicate that the one of the specimens assigned to Preliminary Fabric A was manufactured from a moderately calcareous paste and the other from a highly calcareous paste, those assigned to preliminary Fabric B with a low-calcium to non-calcareous paste, those assigned to Preliminary Fabrics C-D with a non-calcareous paste, and those assigned to Preliminary Fabrics E-F with a low-calcium or non-calcareous paste.

Cluster analysis was carried out for the 12 non-calcareous and low-calcium specimens (including one pair of replicates) (i.e., Preliminary Fabrics B-F). The representative clustering solution presented here (Fig. 5) is probably best interpreted as containing three clusters:
Cluster 1, composed of the specimens assigned to Preliminary Fabric B;
Cluster 2, composed of the specimens assigned to the Preliminary Fabrics C-E; and
Cluster 3, composed of the single specimen assigned to Preliminary Fabric F.
Cluster 2 contains two sub-clusters, one consisting of the three specimens assigned to Preliminary Fabric C, and the other consisting of the one and two specimens assigned to

the Preliminary Fabrics D and E, respectively. The two specimens assigned to Preliminary Fabric E are significantly different in texture, with one non-calcareous and the other low calcium.

Cluster analysis was carried out using a variety of different parameters for these same 12 pottery specimens and the nine specimens of non-calcareous clay included in the project. This analysis failed to identify any apparent relationship between the pottery and clay specimens.

In light of these results, the two specimens assigned to Preliminary Fabric A are here presented as Fabric Groups 1 and 2, those assigned to the Preliminary Fabrics B-D presented as Fabric Groups 3-5, the two specimens assigned to Preliminary Fabric Group E presented as Fabric Groups 6 and 7, and the specimen assigned to Preliminary Fabric Group F presented as Fabric Group 8.

The program of petrographic analysis did not include a specimen of either Fabric Group 2 or Fabric Group 6 due to the absence of a fragment of a size sufficient for sectioning. The specimen from Fabric Group 1 had an inclusion component consisting of silt-sized monocrystalline quartz and mica, with small amounts of material of fine sand size, including monocrystalline and polycrystalline quartz, mica, and fragments of siltstone and mudstone. This is similar to the specimens from BGW Fabric Groups 2-4 (the specimen from Fabric Group 2, in particular), and it seems likely that this specimen/fabric group was manufactured using the same raw materials and processing techniques as these other fabric groups (i.e., fine calcareous clay or levigated, less fine calcareous clay).

The specimen from Fabric Group 3 had a notably sparse inclusion component consisting of silt-sized monocrystalline quartz and mica, with a very small amount of these materials in the fine sand range. This fabric group was likely manufactured from unusually fine, low-calcium clay or very thoroughly levigated, less fine calcareous clay.

The specimen from Fabric Group 4 had an inclusion component consisting of monocrystalline and polycrystalline quartz and mica in the silt to very fine sand size-range. This fabric group was manufactured from a fine, non-calcareous continental clay, or a coarser, non-calcareous continental clay similar to those employed for the manufacture of BGW Fabric Groups 7 and 8 subjected to levigation.

The specimen from Fabric Group 5 had an inclusion component consisting of monocrystalline and polycrystalline quartz, mica, feldspar, granite, mudstone, and siltstone in the silt to coarse sand size-range. Its composition is generally similar to those of the specimens from BGW Fabric Groups 7 and 8, and the fabric groups to which they belong were manufactured employing materials and processing techniques similar to those employed for the manufacture of these fabric groups.

The specimen from Fabric Group 7 had an inclusion component consisting of monocrystalline and polycrystalline quartz, mudstone, siltstone and mica in the silt to coarse sand size-range. It was manufactured from a sandy, low calcium clay of either marine or continental origin.

The specimen from Fabric Group 8 had an inclusion component consisting of monocrystalline and polycrystalline quartz, feldspar, mica, mudstone, and perhaps also microfauna in the silt to fine sand size-range. This is generally similar to the composition of the specimen from BGW Fabric Group 5, and this fabric group was probably

manufactured from material similar to that employed for the manufacture of this other fabric group (i.e., sandy marine clay).

5.3 Italian Terra Sigillata

The optical microscopy of the 24 specimen chips revealed the presence of a single fine, reddish fabric with a distinctly calcareous matrix. It subsumes two more or less distinct variants that almost certainly reflect differences in the temperature and perhaps also the duration of firing. Variant 1, which was presumably fired at a temperature range similar to that employed for firing the four fabric groups of fine, calcareous BGW, has a light red to pink body that displays a smooth to slightly irregular fracture surface, with a slightly irregular and less distinctly calcareous matrix that contains sparse, small, glistening plates (mica). Variant 2, which was presumably fired at a somewhat higher temperature and perhaps also for a longer period of time, displays a somewhat darker range of colors (light reddish brown, reddish brown, light red) and a smooth, often conchoidal fracture surface, with a compact matrix containing well rounded voids and prominent, small, white, calcareous bodies and reaction rims. A small number of specimens display characteristics that place them between the two variants just described, supporting the inference that the differences between the two represent the results of variability in firing conditions.

The NAA data indicate a fairly homogeneous set of specimens manufactured using a moderately calcareous paste.

Cluster analysis was carried out for the set of 24 specimens (including three pairs of replicates) and 2 specimens of Arezzo - Quarata clay using a variety of different

parameters. The representative clustering solution presented here (Fig. 6) is probably best interpreted as containing two clusters:

Cluster 1, composed of 16 specimens of ITS - including all three pairs of replicates - and both specimens of Arezzo - Quarata clay; and

Cluster 2, composed of the remaining eight specimens of ITS.

Multiple examples of both Variant 1 and Variant 2 were assigned to either cluster, confirming the assumption that this distinction relates to firing regimen rather than to composition. The positioning of the three pairs of replicates in different sub-clusters within Cluster 1 indicates that the internal structure of this cluster likely should be attributed in substantial measure to non-significant compositional variability between specimens and/or analytical error. Both of the specimens of Arezzo - Quarata clay link into their sub-cluster at a fairly high level of dissimilarity, indicating that they are not highly similar to the pottery specimens in these sub-clusters.

There is a clear compositional distinction between the Cluster 1 specimens and the Cluster 2 specimens, with those in the former set displaying values for Ca at the low end of the range attested for this element (< ca. 7 percent) and those in the latter displaying values at the high end of this range (> ca. 7 percent). The Cluster 2 specimens also display higher values for Sr and slightly lower values for the other elements, with the exception of Hf. The higher values for Sr in the Cluster 2 specimens can be attributed to the fact that this element commonly occurs in calcium carbonate and thus normally shows a positive correlation with Ca. The higher values for Hf in these specimens should probably be attributed to the presence of a somewhat more substantial presence in the fabric of fine-grained quartz, since Hf regularly occurs in zircon, a common accessory

mineral in quartz sand. The relatively low values for the other elements in the Cluster 2 specimens can be attributed to minor dilution produced by the greater concentration of Ca and perhaps also the conjectured greater concentration of quartz. These observations indicate that the Cluster 1 specimens and Cluster 2 specimens were manufactured from similar, if somewhat different clays, with the clay employed for the production of the latter set perhaps deposited in a somewhat higher energy environment that resulted in a more substantial aplastic component.

One of the two specimens of Arezzo - Quarata clay (CARQ.02) has a Ca value that falls at the boundary between the Cluster 1 specimens and Cluster 2 specimens, with the values for most of the other elements falling within the range attested for the specimens in these two groups. The other clay specimen (CARQ.01) has a Ca value somewhat below the minimum attested for the specimens in Clusters 1 and 2 and values for several alkali metals (Rb, Cs) and rare earths (La, Ce, Sm) that greatly exceed the maximum value attested for these specimens. These observations suggest that the first specimen (i.e., CARQ.02) is generally similar to the clay employed for the manufacture of the specimens of IS, while the other (CARQ.01) is not.

The calculation of multivariate probability scores of group membership (henceforth referred to as MADCORR trials) elucidates somewhat - if not in a definitive manner- the significance of the compositional variability present within the set of specimens of ITS and the relationship between these and the two specimens of Arezzo - Quarata clay. A set of MADCORR trials using various numbers and sets of elements was first carried out employing the entire set of specimens of ITS as the core group (treating each of the three pairs of replicates as two different specimens), evaluating the statistical

probability that the two clay specimens might belong to this group. The representative trial indicates a fairly homogeneous core group, with nine specimens assigned scores in the 90-99 percent range, five in the 80-89 percent range, six in the 70-79 percent range, three in the 50-55 percent range, and three in the 40-49 percent range. (Table 6) Another expression of this within-group compositional homogeneity is the fact that just three of the specimens registered values two standard deviations or more beyond the core group mean for two or more elements. Clay CARQ.02 was assigned a score of 9.7 percent, while clay CARQ.01 was assigned a value so low that it rounded to 0. While none of the values for CARQ.02 lay two or more standard deviations beyond the core group mean, no fewer than eight of those for CARQ.01 differed from this value by this amount or more. These results confirm the inference that CARQ.02 is generally, if not highly similar to the core group, while CARQ.01 is not related to it.

A second set of MADCORR trials was carried out employing Cluster 1 specimens as the core group, evaluating the statistical probability that the Cluster 2 specimens and the two clay specimens might belong to this group. These trials permitted some minor adjustments to the membership of the two groups (accounting for the differences between the final fabric classification presented here and in Appendix 1 and the representative clustering solution presented in Figure 6). The representative trial indicates a highly homogeneous core group, with 17 specimens assigned scores in the 90-99 percent range and just one specimen assigned a score below this, at 89.3 percent. For the Cluster 2 specimens, one specimen was assigned a value in the 60-69 percent range, one in the 50-59 percent range, two in the 30-39 percent range, two in the 20-29 percent range, two in the 5-10 percent range, and one in the 0-5 percent range (Table 6). Clay CARQ.01 was

again assigned a value so low that it rounded to 0, while clay CARQ.02 was assigned a value of 10.6 percent. This suggests that all but one Cluster 2 specimen is highly to somewhat related to the set of Cluster 1 specimens and that clay CARQ.02 is somewhat related to these, while the remaining Cluster 2 specimen and clay CARQ.01 are not related to the Cluster 1 specimens.

The scores assigned to the three pairs of replicates by this method in the two representative trials provide some idea of the combined effects of within-specimen inhomogeneity and analytical error in the outcome of MADCORR trials, and thus some broader insight into the significance of the scores assigned by this operation. In the first of the two trials these three pairs were assigned values of 92.0/92.1, 73.5/89.3, and 91.8/77.8, while in the second – in which all three pairs were members of the core group – they were assigned values of 91.0/96.9, 98.9/90.9, and 98.7/90.2.

As just noted, the results of the first set of MADCORR trials are compatible with the inference that the set of ITS specimens represent a single compositional group related to clay CARQ.02, while those of the second set of trials suggest that these specimens represent three compositional groups, two of which are related to one another and to clay CARQ.02. A consideration of the vessel forms, vessel form dates, and fabric variants represented in the three possible compositional groups neither supports nor weakens either interpretation, and on the basis of the information currently available it is impossible to choose between these alternative conclusions. The possibility that the Cluster 1 specimens and Cluster 2 specimens represent distinct compositional groups, however, is suggested by the fact that the Cluster 2 specimens that received the highest scores in the second trial are those with the highest values for Ca - the opposite of what

one would expect if the distinction between the two sets of specimens was simply a question of variability in the concentration of Ca. Further, the possibility that ITS3.01 represents a distinct compositional group is suggested both by the fact that its fabric displays a concentration of white, calcareous inclusions substantially greater than that displayed by any of the other specimens of ITS,[57] and by the fact that it has values substantially lower than those for the other specimens of ITS for several alkali metals (Rb, Cs) and rare earths (La, Ce, Sm, Eu, Yb, Lu), and a value that is substantially higher for Zr.

In light of these results, the Cluster 1 specimens and Cluster 2 specimens less the one anomalous specimen are here presented as Fabric Group 1 and Fabric Group 2, respectively, with the anomalous Cluster 2 specimen presented as Fabric Group 3. Due to the uncertainty regarding the significance of this division, however, fabric group data are also presented in Table 4 for the entire set of specimens of ITS.

The program of petrographic analysis did not include the specimen constituting Fabric Group 3 due to the fact that the fragment was too small to permit sectioning. The specimen from Fabric Group 2 displays a very slightly coarser inclusion component than that from Fabric Group 1, perhaps accounting for the elevated values for Hf and the depleted values for many other elements in the former relative to the latter fabric group. There is also a slight textural difference between the two specimens of Arezzo - Quarata clay, as one would expect, given the differences in their chemistry. It should be noted, however, that CARQ.02, the clay specimen that is the closest chemical match to the two fabric groups, appears to represent a less perfect textural match to the two pottery specimens analyzed in thin section than does CARQ.01.

5.4 Combined Analysis of NAA Data for All Three Pottery Classes

Cluster analysis was carried out using a variety of different parameters for the 34 specimens in BGW Fabric Groups 1-5 (including two pairs of replicates), the one specimen in each of NERSW Fabric Groups 1 and 2, and the eight specimens in ITS Fabric Group 2 in order to test for possible relationships between these fabric groups, all of which were manufactured using a moderately calcareous paste. The representative clustering solution presented here (Fig. 7) is probably best interpreted as containing five clusters:

Cluster 1, composed of all of the specimens of BGW Fabric Group 1 and all of the specimens of ITS Fabric Group 2;

Cluster 2, composed of all of the specimens of BGW Fabric Group 2 and the specimen of NERSW Fabric Group 1;

Cluster 3, composed of all of the specimens of BGW Fabric Group 5 and the specimen of NERSW Fabric Group 2;

Cluster 4, composed of all of the specimens of BGW Fabric Group 3; and

Cluster 5, composed of all of the specimens of BGW Fabric Group 4.[58]

The association of BGW Fabric Group 1 with ITS Fabric Group 2 in Cluster 1 suggests that the former group is of Arretine origin. The specimen of NERSW Fabric Group 1 is linked to three specimens of BGW Fabric Group 2 at a low level of dissimilarity, and there seems a reasonable likelihood that this association is a significant one. The same cannot be said for the placement of the specimen NERSW 2, which is linked to a single specimen of BGW Fabric Group 5 (one of the two that displays a

somewhat finer body and may represent a distinct compositional group) at a fairly high level of dissimilarity.

Cluster analysis was also carried out using a variety of different parameters for the 13 specimens in NERSW Fabric Groups 3-8 and the six specimens (including 1 pair of replicates) in BGW Fabric Groups 6-8 in order to test for possible relationships between these fabric groups - all manufactured from a non-calcareous or low calcium paste. This analysis failed to reveal any apparent relationships between these groups.

A comparison of the individual and group mean values for the two fabric groups of apparent Arretine origin included in the clustering solution discussed above, namely BGW Fabric Group 1 and ITS Fabric Group 2, confirms that the two sets of specimens are, in fact, highly similar to one another. In light of this similarity, it was judged appropriate to combine these two fabric groups to produce a composite Arezzo Fabric Group consisting of 20 specimens (including one pair of replicates).

A set of MADCORR trials was carried out employing this composite fabric group as the core group, evaluating the statistical probability that the other fabric groups consisting of specimens manufactured with a moderately calcareous paste (BGW Fabric Groups 2-5, NERSW Fabric Groups 1 and 2, ITS Fabric Groups 1 and 3) and the Arezzo - Quarata clay specimens might belong to this group. The representative trial presented here indicates a fairly homogenous core group, with 13 specimens assigned scores in the 90-99 percent range, six in the 80-89 percent range, and two in the 70-79 percent range. (Table 8) For BGW Fabric Group 2, two specimens were assigned a score in the 20-29 percent range, one specimen a score in the 5-10 percent range, and seven specimens a score in the 0-5 percent range. The 4 specimens in BGW Fabric Group 3 and the 2

specimens (including one pair of replicates) in BGW Fabric Group 4 were all assigned scores in the 0-5 percent range, while for BGW Fabric Group 5, one specimen was assigned a score in the 10-20 percent range and the remaining five specimens scores in the 0-5 percent range. The two specimens in NERSW Fabric Groups 1 and 2 were both assigned scores in the 0-5 percent range. For ITS Fabric Group 1, one specimen was assigned a score in the 90-99 percent range, one specimen a score in the 60-70 percent range, one specimen a score in the 50-60 percent range, one specimen a score in the 40-50 percent range, three specimens scores in the 30-40 percent range, one specimen a score in the 20-30 percent range, two specimens a score in the 10-20 percent range, one specimen a score in the 5-10 percent range, and seven specimens scores in the 0-5 percent range. The one specimen in ITS Fabric Group 3 was assigned a score in the 0-5 percent range. One of the two specimens of Arezzo - Quarata clay (CARQ.01) was assigned a score of 0.1 percent, while the other (CARQ.02) was assigned a score of 30.0 percent.

These results suggest that BGW Fabric Groups 3-5, NERSW Fabric Groups 1-2, and ITS Fabric Group 3 are not of Arretine origin. They further suggest that BGW Fabric Group 2 is mostly or entirely not of Arretine origin and confirm that ITS Fabric Group 1 is of Arretine origin. These results also suggest that these two fabric groups and the composite Arezzo Fabric Group (and the two fabric groups of which it is composed) each probably subsume specimens belonging to two or more distinct production groups that it might be possible to recognize as such in a program of analysis involving a substantially larger number of specimens. The results also highlight the compositional similarity between the two fabric groups that compose the Arezzo Fabric Group and BGW Fabric Group 2, and flag certain specimens assigned to the latter (BGW2.02, BGW

2.08, BGW2.10) that should perhaps be reassigned to BGW Fabric Group 1. Finally, the results indicate that there is a general similarity between clay CARQ.02 and not just the ITS manufactured at Arezzo, but also the BGW produced there. The results of the program of petrographic analysis support this last observation, in that they demonstrate a general similarity in composition and texture between the two specimens of BGW Fabric Group 1 and the specimens of ITS Fabric Groups 1 and 2 that were subjected to analysis, and between these four pottery specimens and the two specimens of Arezzo - Quarata clay.

Similar MADCORR trials were undertaken employing as the core group a possible Volterra Fabric Group composed of BGW Fabric Groups 2-4 and NERSW Fabric Groups 1-2, but the results obtained strongly suggested that this combination of specimens does not constitute a valid core group.

6. INTERPRETATION

The two sections that follow interpret the evidence for, in the first instance, the production of the three classes of pottery that are the focus of this study and, in the second, the evidence for the distribution to and consumption at Cetamura of these pottery classes. These are followed by a section that considers various implications of this project for methodological approaches to the compositional study of these three classes of tableware.

In interpreting the results obtained in this project it is important to keep in mind three considerations. First, the spans of time associated with the manufacture and consumption of the four groups of materials included in the study, that is those associated

with Deposits 1-3 – ca. 350-250 B.C., 250-200 B.C., and 200-150/125 B.C. – and that associated with the set of specimens of ITS - ca. 40/10 B.C. – ca. A.D. 100/150 - are all fairly long, and may well subsume and possibly obscure two or more distinct moments in the manufacture of the three pottery classes in question and/or in their supply to/consumption at Cetamura. Second, it is not possible to specify the extent to which Deposits 2 and 3 contain residual examples of BGW and/or NERSW, that is, vessels acquired, used, and discarded well before the period during which that stratigraphic unit in which they were recovered was deposited. Third, the small number of vessels subjected to analysis and the modest size of the groups of materials from which these were selected leave open the possibility that the results obtained are not closely representative of general patterns of production and/or supply/consumption. On account of these considerations it is prudent to view the results as generally indicative of qualitative patterns of production and supply/consumption, and, perhaps to some more limited extent, generally indicative of quantitative patterns in these. With regard to qualitative patterns, it is important to keep in mind that in some cases the examples of a particular fabric group or form attested in Deposit 2 or Deposit 3 may be residual. At the same time, the absence of any examples of a particular class, fabric group, or form from any of the four groups may not be significant.

6.1 Production

The three subsections that follow are each dedicated to one of the three pottery classes that are the focus of this study. Each subsection discusses the evidence for the various fabric groups identified for that class, considering for each of these the overall quality of

the vessels, the set of forms attested, the dates of its production, possible relationships with variants, fabric groups, etc. for that class previously recognized in the literature, and its likely provenance. Table 9 provides a synopsis of this information for convenient reference. These three subsections are followed by a subsection that considers the implications of the results of the program of analysis for certain technological aspects of the manufacture of these three classes of pottery.

6.1.1 Black-Gloss Ware

In order to interpret the evidence for the production of eight BGW fabric groups identified it is necessary first to review the results of recent research projects undertaken with a view to identifying and determining the provenance of the several variants of BGW certainly or likely manufactured in northern Etruria.

The most comprehensive study of a sub-assemblage of BGW from a site in northern Etruria carried out in recent years is Palermo's treatment of the materials from the Volterra – Acropoli excavations.[59] Palermo, building on earlier efforts to classify BGW from Volterra by Cristofani and Pasquinucci,[60] classified 2010 sherds, including 1960 that he judged likely to have originated in Etruria, assigning these latter to 12 different groups on the basis of form and the megascopic characteristics of fabric and slip. A synopsis of the results of this work is presented in Table 10.A. Six of these groups (Groups A-C, U, T, Z), accounting for 1887 sherds, he judged to be of certain or probable Volterran origin. One of these (Group T) was distinguished by having a distinctly grittier fabric than the others and a lower-quality, matte, uneven slip. Perhaps worth noting is the fact that this was the only of the BGW groups represented in the site

assemblage that included multiple examples of the Morel 1211 bowl, the most common form in NERSW.[61] A seventh group (Group S), accounting for just 2 sherds, he believed might have originated at Roselle.[62] Palermo was unable to specify more precisely the origin of the remaining five groups (Groups D, E, R, V1, V2), which accounted for 71 sherds.

Palermo carried out similar studies of the BGW recovered in the excavations at Fiesole - Via Marini/Via Portigiani[63] and in the excavations at Chiusi - Orto del Vescovo.[64] In the case of the materials from Fiesole, he assigned ca. 2080 sherds to 13 fabrics. A synopsis of the results of this work is presented in Table 10.B. Seven of these fabrics, accounting for ca. 1175 sherds (Fabrics 1-6, 9-10, 13), he judged to be of certain or possible Arretine origin, while one (Fabric 7), accounting for 665 sherds, he thought was Volterran. He was unable to specify the origin of the other three fabrics (Fabrics 8, 11-12), accounting for 240 sherds. In the case of the materials from Chiusi, he assigned ca. 3000 sherds to four different groups. A synopsis of the results of this work is presented in Table 10.C. Two of these groups (Groups B, C), accounting for ca. 2010 sherds, he judged certain to be of local origin, while the other two (Groups A1, A2), accounting for 910 sherds, he thought highly likely to be Arretine.

Turning now to programs of compositional analysis, Pasquinucci and collaborators carried out a program of petrographic analysis involving the characterization of 30 specimens of BGW from several sites in the territory of Pisa and the coastal zone of the territory of Volterra.[65] Twenty-three of these specimens, belonging to four general petrological groups or subgroups, they judged likely to have originated in northern Etruria or adjacent regions.[66] These groups include the following:

Group O (ophiolitic) (one specimen), probably originating somewhere in the vicinity of one of the various outcrops of gabbro that occur from the area of Livorno south to the northern sector of the Colline Metallifere.

Group MA (acid metamorphic) (six specimens), likely manufactured with alluvial sediments from the valley of the Fiume Serchio, in the vicinity of Lucca.

Subgroup G (generic) - non-calcareous matrix (14 specimens), perhaps manufactured with alluvial sediments from the valley of one or more of various watercourses in northern Etruria, including the Arno.

Subgroup G – calcareous matrix (two specimens), manufactured employing marine sediments or continental sediments from an area of limestone lithology.

Gliozzo and collaborators undertook a program of compositional analysis involving 22 specimens of pottery and two specimens of architectural ceramic from the Chiusi- Marcianella pottery production workshop, including four specimens of BGW and three specimens of NERSW, and nine specimens of clay from two sources in the vicinity of the workshop and three more distant sources, one situated ca. 8.5 km to its N, one ca. 15 km to its NNE, and one ca. 14.5 km to its NW.[67] This involved petrographic analysis, scanning electron microscopy, x-ray diffraction (XRD), and x-ray fluorescence (XRF). Petrographic analysis and scanning electron microscopy revealed that the specimens of both pottery classes contained quartz, quartzite, feldspar, mica, fragments of limestone, foraminifera, and, in some cases, fragments of flint and siltstone.[68] The composition of these specimens is generally compatible with that of the clay specimens taken from the two sources in the vicinity of the workshop.[69] These belong to a formation of marine sediment of middle to lower Pliocene date designated P_s^{2-1} (*sabbie e sabbie*

argillose/sands and clayey sands) on the relevant sheet of the *Carta Geologica d'Italia* (Fg 121).

Elsewhere, Frontini and collaborators completed a program of analysis involving the chemical characterization of BGW from Volterra, Arezzo, and several sites in northern Italy by means of XRF.[70] This included the analysis of 26 vessels from the Museo di Arezzo (presumably recovered in excavations in and around Arezzo) and 23 specimens recovered in the Volterra – Acropoli excavations,[71] and was carried out with a view to establishing chemical reference groups for BGW manufactured at these two centers. By using a combination of principle components analysis and linear discriminant analysis these researchers were able to define distinct, if highly similar chemical reference groups for Arezzo and Volterra,[72] and to assign some of the vessels recovered at the sites in northern Italy to one or the other of these with a high degree of confidence.

Finally, Gliozzo and Memmi Turbanti undertook a program of chemical analysis involving 149 specimens of BGW from several sites in northern Etruria - including Arezzo – Oriente (30 specimens), Volterra – Castello (31 specimens), Volterra – Museum (including vessels from various sites at or near Volterra) (32 specimens), the Chiusi-Marcianella pottery production facility (30 specimens), Chiusi – Orto del Vescovo (15 specimens), and Populonia (11 specimens) – and 10 specimens of clay from the two previously mentioned sources in the vicinity of the Marcianella workshop.[73] This project involved the combined use of NAA, XRF, inductively coupled optical emission spectroscopy (ICP-OES), and inductively coupled plasma mass spectroscopy (ICP-MS). Applying cluster analysis to the resulting data Gliozzo and Memmi Turbanti identified

eight different compositional groups.[74] One of these (Group 6) consisted of the Marcianella specimens. This displayed values closely similar to those of the clay specimens, and it appears certain that the manufacture of BGW at this establishment involved the use of this clay.[75] They were able to assign one of the remaining seven groups (Group 1) to Arezzo and another (Group 2) to Volterra on the basis of the criterion of abundance, the suite of forms represented, and these groups' general compositional similarity to groups of BGW and IS attributed to these centers in previously published studies, including that carried out by Frontini and collaborators. Another group (Group 8) consists in large measure of materials of probable Chiusine origin, while another (Group 4) consists of Campana A BGW from the Bay of Naples region.

We can now turn to the consideration of the eight BGW fabric groups identified in the current program of analysis. The vessels in Fabric Group 1 are of high quality, with a slip that is even, glossy to very glossy, and dark gray to very dark gray, often with bluish tones. Four of the 12 specimens are from Deposit 1, one from Deposit 2, and the remaining seven from Deposit 3. Six distinct forms are attested: a dish/plate (Lamboglia Form 5), three cups/bowls (Lamboglia Form 28, Morel Form 80, Morel Form 83), a thin-walled cup with one or two probably vertical handles, and a closed form of some kind. The presence of examples of this group in Deposit 1 indicates that its manufacture commenced prior to ca. 250 B.C., while the fact that it includes examples of the Lamboglia 5, 28, and 83 strongly suggests that this continued down at least to the second quarter of the second century B.C. The four examples from Deposit 1 are somewhat softer than those from Deposits 2 and 3 and should perhaps be classified as *ceramica*

protocampana, the predecessor of true BGW.[76] Two of these (BGW1.07, BGW1.09) have notably thin walls, while a third (BGW1.08) is embellished with freehand incised decoration. At least one of the examples of this fabric group from Deposit 3 (BGW 1.01, an example of the Lamboglia Form 5) can be classified as belonging to the distinctive set of vessels now widely referred to as the *Cerchia della Campana B*.[77]

The chemical and textural similarity of Fabric Group 1 with ITS Fabric Groups 1-2 and the two specimens of Arezzo - Quarata clay leave little doubt that this fabric group was manufactured at Arezzo using clay obtained from the agQ formation.

Fabric Group 1's megascopic characteristics, including the color and texture of the body and the appearance of the slip, correspond fairly well with those reported for Palermo's fabrics of assumed Arretine origin at Fiesole – Via Marini/Via Portigiani (Fabrics 1-6, 9) and his groups of assumed Arretine origin at Chiusi - Orto del Vescovo (Groups A1 and A2). Three of the four recognized forms represented are attested in these fabrics at Fiesole and all four for these groups at Chiusi. One of the variants of the Morel Form 83 attested is, however, not represented among the materials at either site, as is also the case with the open vessel with handles.

Fabric Group 1 would fall within Pasquinucci and collaborators' Subgroup G – calcareous matrix. Given its Arretine origin, it should display a chemical composition similar to that of Frontini and collaborator's Arezzo reference group and Gliozzo and Memmi Turbanti's Arretine group. Since no study has been performed to evaluate the extent to which the data presented here can be intercompared with the data presented in these two other programs of analysis, however, it is unclear what degree of similarity one should expect.[78] Frontini and collaborators' Arezzo reference group displays close (here

defined as within one standard deviation) mean values for several of the elements for which comparisons can be made (Ca, Cr, Fe, Co, Rb, Sr), though not for others (Na, K, Zn, Ba). Similarly, Gliozzo and Memi Turbanti's Arretine group displays mean values that fall within one standard deviation from the mean value for this fabric group for several elements (Na, K, Ca, Fe, Co, Zn, As, Sr, Sb, Yb, Lu, Th) and beyond one standard deviation for several others (Sc, Cr, Rb, Cs, Ba, La, Ce, Nd, Sm, Eu, Hf, U). Perhaps worth noting is the fact that all four minor constituents for which a comparison can be made display a high level of agreement with the corresponding value for this fabric group (Na: 0.57:0.59 percent; K: 2.00:2.03 percent; Ca: 6.97:7.90 percent; Fe: 5.21:5.11 percent).

The specimens in Fabric Group 2 are of high quality, with a slip that is usually even, glossy to very glossy, and dark gray to very dark gray, sometimes with bluish tones. In some cases it is matte, tends to a dusky red color, or has reddish blotches. One of the 10 specimens is from Deposit 2 and the remaining nine are from Deposit 3. Seven distinct forms are attested: a dish/plate (Lamboglia Form 5), two cups/bowls (Morel Form 80 and Form 83) two forms that may be cups (perhaps Lamboglia 10 and Morel 82), a closed form of some kind, and a lamp. The presence of examples of this group in Deposit 2 indicates that its manufacture commenced prior to ca. 200 B.C., while the fact that it includes examples of the Lamboglia 5 strongly suggests that this continued down at least to the middle of the second century B.C. Three of the vessels from Deposit 3 (BGW 2.01 and 2.03, the two examples of the Lamboglia Form 5, and BGW 2.03, the one possible example of the Lamboglia Form 10) should be classified as belonging to the *Cerchia della Campana B*.

The chemical and petrographic evidence indicate that Fabric Group 2 was manufactured from a fine, moderately calcareous clay or a less fine calcareous clay subjected to levigation. The differences in the chemical composition between this fabric group and the materials of Arretine origin included in this study suggest that it did not originate at Arezzo. Since it seems likely that a substantial portion of the BGW in Deposit 3 was of Volterran origin, the fact that all but one of the examples of BGW in this deposit that were subjected to analysis that proved to be of apparent non-Arretine origin belong to Fabric Group 2 suggests that this fabric group is from Volterra. This inference is supported by the fact that the cluster analysis of the combined NAA data assigned the specimens in Fabric Group 2 to the same cluster as the sole specimen in NERSW Fabric Group 1, as the latter may well be of Volterran origin (see below). The form evidence for this fabric group is also compatible with a Volterran origin, with all of the forms represented certainly or possibly attested for one or more of Palermo's fine-textured groups of Volterran origin from the Volterra – Acropoli assemblage and two of these forms attested for his fabric of Volterran origin from Fiesole – Via Marini/Via Portigiani assemblage. The fact that the fabric group's chemical composition differs substantially from those of the several specimens of Volterra clay does not preclude this possibility, given the latter's substantially coarser texture and the possibility that the manufacture of this fabric group involved the levigation of the clay employed for this purpose.

The vessels in Fabric Group 3 are of high quality, with an even, glossy, dark gray to very dark gray slip. Three of the four specimens are from Deposit 1, while the fourth is from Deposit 3. Four distinct forms are attested: a thin-walled cup/bowl, a cup bowl

with a curved wall and stamped decoration, a dish/plate with incised decoration, and a lamp. The presence of examples of this group in Deposit 1 indicates that its manufacture commenced prior to ca. 250 B.C., while the fact that it includes examples of a lamp suggests that this continued down at least to ca. 200 B.C. The three vessels from Deposit 1 (BGW 3.01-3) have a notably soft body (in one case not fully oxidized) and thin walls, and should perhaps be classified as *ceramica protocampana*. One of these (BGW.02) bears stamped decoration and a second (BGW 3.03) freehand incised decoration.

The two vessels in Fabric Group 4 are of high quality, with an even, slightly to very glossy, very dark gray slip. Both specimens are from Deposit 2. Two forms are attested: the Morel Form 83 cup and an open form with steep walls that may be the Morel Form 82 cup. The presence of examples of this group in Deposit 2 indicates that its manufacture commenced prior to ca. 200 B.C. As the manufacture of the Morel Forms 82 and 83 bracketed this date the form evidence does not allow any further observations regarding the chronology of this fabric group.

The chemical and petrographic evidence indicate that Fabric Groups 3 and 4 were manufactured from either fine, low-calcium or moderately calcareous clay or less fine calcareous clay subjected to levigation. As previously noted, the fact that Fabric Groups 3 and 4 are generally linked at a fairly low level of dissimilarity in cluster analysis suggests that they may be related to one another. Fabric Group 4 has a mean value for Ca that is ca. 0.8 percent higher than that for Fabric Group 3, and it appears possible that the differences in chemical composition between the two groups are in large measure the result of dilution effects produced by the higher concentration of this element in Fabric

Group 4. The more prominent presence of mica in Fabric Group 4 may be the result of a lower maximum or soaking temperature in the firing process.

Since it seems likely that some of the BGW in Deposit 1 was from Volterra, the fact that the only BGW vessels in this deposit that are not of apparent Arretine origin belong to Fabric Group 4 suggests that this fabric group is likely from Volterra. The similarity of its chemical composition with that of Fabric Group 3 raises the possibility that this other fabric group is also from Volterra. The form evidence for these two fabric groups is compatible with a Volterran origin, with the Morel Form 82, Morel Form 83, and lamps all attested for one or more of Palermo's fine-textured groups of Volterran origin. One possibility is that these two fabric groups represent some expression of Volterran production that existed prior to ca. 200 B.C., with Fabric Group 2 representing some different expression of Volterran production that existed subsequent to this point. Whether these distinct expressions of Volterran production should be understood as reflecting the activity of different workshops, the exploitation of different clay sources, the use of different manufacturing techniques, or some combination of these is unclear.

Fabric Groups 2-4 have megascopic characteristics that correspond fairly well with those reported for Palermo's fine-textured BGW groups of certain or likely Volterran origin from the Volterra – Acropoli assemblage and the Fiesole – Via Marini/Via Portigiani assemblage. They would fall within Pasquinucci and collaborators' Group G – calcareous matrix. Given their inferred Volterran origin, one or more of these three fabric groups might be expected to display a chemical composition similar to that of Frontini and collaborator's Volterra reference group and Gliozzo and Memmi Turbanti's Volterra group. Frontini and collaborators' Volterra reference group

displays mean values within one standard deviation for very few of the elements for which comparisons can be made (Fabric Group 2: Ca, Cr, Sr; Fabric Group 3: Zn; Fabric 4: Sr), and greater than this for the bulk of these (Fabric Group 2: Na, K, Fe, Co, Zn, Rb, Ba, La, Ce; Fabric Group 3: Na, K, Ca, Cr, Fe, Co, Rb, Sr, Ba, La, Ce; Fabric Group 4: Na, K, Ca, Cr, Fe, Zn, Rb, Ba, La, Ce). Gliozzo and Memi Turbanti's Volterran group displays mean values that fall within one standard deviation from the mean value for several elements for Fabric Group 2 (Sr, Co. Cr, Rb, Sc, Nd, Eu, Yb, Lu) and greater than this for several others (Fe, Ca, Na, K, Zn, As, Ba, Cs, Sb, La, Ce, Sm. Hf, Th, U). In contrast, this group displays mean values that fall within one standard deviation from the mean value for only a few elements for Fabric Groups 3 and 4 (Fabric Group 3: K, Z, Co; Fabric Group 4: Sr, Zn, C, Nd, Lu, U) and greater than this for the bulk of the elements (Fabric Group 3: Fe, Ca, Na, Sr, As, Cr, Rb, Sc, Ba, Cs, Sb, La, Ce, Nd, Sm, Eu, Yb, Lu, Hf, Th, U; Fabric Group 4: Fe, Ca, Na, K, As, Cr, Rb, Sc, Ba, Cs, Sb, La, Ce, Sm, Eu, Yb, Hf, Th). The level of agreement in this case may be substantially lower than that attested in the case of the groups of Arretine origin due to the possibility that Frontini and collaborators' Volterra reference group and Gliozzo and Memmi Turbante's Volterra group include vessels belonging to two or more compositionally distinct fabric groups originating at or near Volterra, with their mean values thus representing a conflation of data for multiple fabric groups.

The vessels in Fabric Group 5 are of medium quality, with a matte to slightly glossy, dark gray slip that is sometimes thin, mottled, uneven, and/or poorly preserved. As noted above, the chemical and textural evidence suggests that this fabric group should perhaps be divided into two sub-groups, one consisting of specimens BGW5.01 and 5.03,

and the other consisting of specimens BGW5.02 and 5.04-5.06. These two sub-groups may represent distinct productions that are linked only by the fact that they were both manufactured employing a sandy, moderately calcareous clay. Four of the six vessels in this fabric group were recovered in Deposit 3, one from a locus comparable in date to Deposit 3, and one in a locus of Roman or post-Roman date. Four distinct forms are attested: a vessel with a steep upper wall and an everted rim, a bowl/dish with a thickened rim, dish/plate with groove and chatter decoration, and a closed form with a ring-footed base. Although the quality of this fabric group's slip is second rate, the fact that one of the specimens bears groove and chatter decoration demonstrates that those who manufactured it were aiming for a market that desired at least some modest embellishment of its tablewares. The presence of examples of this group in Deposit 3 indicates that its manufacture commenced prior to ca. 150/125 B.C.

The chemical and petrographic evidence indicate that Fabric Groups 5 was manufactured from sandy, moderately calcareous clay probably of marine origin. This fabric group would fall within Pasquinucci and collaborators' Group G – calcareous matrix. It is impossible to specify its point or points of origin, other than to indicate that it/these presumably lay somewhere within the area of marine sediment that extends across much of northern Etruria. While it is thus possible that it was manufactured at or near Volterra, given the location of Cetamura, the Val d'Elsa, the area around Siena, and the western side of the Val di Chiana also represent plausible possibilities. The forms represented are not attested for Palermo's group of Volterran origin with an intermediate fabric and matte, uneven slip from the Volterra – Acropoli assemblage (Group T), nor does this group include any vessels that bear groove and chattering decoration. A

Volterran origin for Fabric Group 5 thus appears unlikely. Although two of the forms attested (those represented by 5.03 and 5.06) bear a certain general resemblance to forms attested at the Chiusi – Marcianella pottery production facility, this establishment does not appear to have produced vessels with groove and chattering decoration. Further, the BGW vessels manufactured at Chiusi – Marcianella have a fabric characterized by the regular presence of microfauna, which is not the case with the specimens in Fabric Group 5. An origin at the Chiusi – Marcianella pottery production facility can thus also be ruled out. Perhaps worth noting, however, is that while Gliozzo and Memi Turbanti's Marcianella group displays mean values that fall within one standard deviation from the mean value for this fabric group for several elements (Na, K, Ca, Fe, Cr, Co, Zr, Eu. Lu, U) and beyond one standard deviation for several others (Sc, Zn, As, Rb, Sr, Sb, Cs, Ba, La, Ce, Nd, Sm, Yb, Hf, Th), all four minor constituents for which a comparison can be made display a high level of agreement with the corresponding value for Fabric Group 5 (Na: 0.91:0.92 percent; K: 2.03:2.23 percent; Ca: 6.43:6.33 percent; Fe: 4.58:4.70 percent).[79] This, together with the general similarity between some of the forms attested for Fabric Group 5 and those associated with the Chiusi – Marcianella pottery production facility, suggest that its point of origin should perhaps be sought in the western Val di Chiana rather than in the Val d'Elsa or the area around Siena. The apparent absence of any materials belonging to this fabric group from the Fiesole – Via Marini/Via Portigiani assemblage is compatible with this inference.

The sole specimen assigned to Fabric Group 6, a cup, bowl, or dish with a curved wall of low or medium quality, is from Deposit 3, indicating that this fabric group's manufacture commenced at some point prior to ca. 150/125 B.C. The chemical and

petrographic evidence indicate that this fabric group was manufactured from sandy, low-calcium clay, though whether this was of marine or continental origin remains unclear. It would fall within Pasquinucci and collaborators' Group G – calcareous matrix. Nothing can be said regarding its point of origin, except that this was likely situated near a deposit of sandy, low-calcium clay.

The sole specimen in Fabric Group 7 is of low or medium quality, with a poorly preserved, matte, dark brown slip. It belongs to a cup or bowl with a ring foot, and was recovered in a Roman or post-Roman context. Nothing can be ventured regarding this fabric group's chronology, other than to say that it should be assigned to the period during which BGW was manufactured.

The specimens in Fabric Group 8 are of low quality, with a matte, poorly preserved, dark gray or dark reddish gray slip. Three of the four specimens are from Deposit 3, and the fourth in a locus comparable in date to Deposit 3. Three distinct forms are attested: an open form with a hanging rim that is probably the Lamboglia Form 23 plate, a cup/bowl/dish with a curved wall, and a vessel with one or more loop handles. The fact that three of the specimens of this group are from Deposit 3 indicates that its manufacture commenced prior to ca. 150/125 B.C. If one of the vessels represented is, indeed, an example of the Lamboglia 23, this would suggest that its manufacture commenced by at least the early second century B.C.

The chemical and petrographic evidence indicate that Fabric Groups 7 and 8 were manufactured from an intermediate, gritty, or coarse continental clay, perhaps subjected to levigation. Both would fall within Pasquinucci and collaborators' Group G – non-calcareous matrix. Little can be said about their likely points of origin, except that these

must have lain in an area where there was access to clay of this kind and perhaps not convenient access to calcareous potting clay. Given the low quality of the vessels in these two fabric groups (particularly in comparison with the quality of those in the roughly contemporaneous Fabric Groups 1-2 and 5), it seems unlikely that the workshops that manufactured them normally distributed their products over a large market area. In light of these considerations, their points of origin should probably be sought in the Monti del Chianti or the Upper Arno Valley.

On the basis of this evidence it is possible to formulate the following outline of the development of BGW production in northern Etruria: Beginning at some point prior to ca. 250 B.C. and perhaps as early as ca. 350 B.C. two workshops – one at Arezzo and the other probably at Volterra – produced a high-quality version of BGW that we can characterize as *ceramica precampana*. This consisted in substantial measure of thin-walled forms which were sometimes (regularly?) embellished with freehand incised decoration and, in the case of the vessels originating at the second production locus, stamped decoration. The fact that freehand incised decoration was sometimes, perhaps regularly executed by workshops at both production loci suggests that the manufacture of BGW at this time involved a skill set somewhat different from and labor inputs perhaps somewhat greater than those associated with its manufacture at these same two loci during later periods. The manufacture of two other classes of high-end tableware produced at Volterra during this period – Red-Figure Ware and Overpainted Ware – involved substantial inputs of a somewhat analogous form of labor (free-hand painting with slip), and this practice should perhaps be considered in relation to these two wares. On the one hand, there may have been a general connection, with BGW producers

pitching their output to meet the expectations of consumers accustomed to using high-end tablewares embellished with linear surface decoration of some sort. On the other hand, in the case of BGW from Volterra there may have been a direct connection, in that it seems possible that the workshops responsible for manufacture of these two wares also manufactured BGW or shifted their operations from the manufacture of one or both of these wares to the production of BGW. The manufacture of high-quality BGW continued at Arezzo down through at least ca. 175/150 B.C., with the introduction by 200 B.C. and perhaps as early as 250 B.C. of new forms with thicker walls (and presumably bearing stamped and incised concentric grove and chatter decoration and devoid of freehand incised decoration), including towards the end of this period some of those recognized as constituting the production termed the *Cerchia della Campana B*. This production appears to have involved clay obtained from the same source as that exploited during the earlier period, pointing towards continuity of manufacturing techniques and, along with this, perhaps also productive units and the specific location of production. The production of high-quality BGW appears to have continued at the other locus of production thought likely to be Volterra through at least ca. 150 B.C., though with apparent shifts in the clay source, paste preparation practices, and/or firing technique, pointing towards possible discontinuity in productive units and/or the specific location of production. The workshop or one of the multiple workshops responsible for this production may also have manufactured medium-quality NERSW for part or all of the period ca. 200-150 B.C.

Beginning at some point before ca. 150/125 B.C. and probably after ca. 200 B.C. workshops located in three or perhaps four different places in northern Etruria, probably

neither Arezzo nor Volterra, initiated the production of medium- and low-quality BGW. These may have been located in the Val di Chiana, the Val d'Elsa, the area around Siena, and/or the Monti del Chianti. How much later than ca. 150/125 B.C. this production continued is unclear. The workshop at Chiusi-Marcianella, which does not appear to have been one of these establishments, may offer a model for the organization of production of this kind. This establishment, which operated from the late third century to the late second or early first century B.C., manufactured a wide variety of wares, including, in addition to BGW that can be classified as medium to low quality, NERSW, thin-walled ware, commonware, cookware, and amphoras. This evidence suggests that the second century B.C. saw the extension of a decorative technique – surfacing with a glossy black slip – associated with high-quality vessels (perhaps manufactured by specialized - in the sense that they normally manufactured only a limited range of wares - potters working in the context of workshops that produced only a limited range of high-end products) to products of more modest associations, perhaps manufactured by establishments that turned out a wide array of products through the labor of non-specialized potters. However, the fact that one of the vessels of medium-quality BGW included in the study had its floor decorated with grooves and chattering suggests that in some instances, at least, the potters who manufactured vessels of this kind did so with the intention of supplying the same market niche as that supplied by the producers of high-quality BGW. We may conjecture that, whereas the workshops that manufactured high-quality BGW needed to be located at or near concentrations of consumers that could generate sufficient demand to support the operation of such (specialized?) high-end production - namely the major demographic and political centers, including specifically

Arezzo and Volterra - establishments that manufactured medium- to low-quality BGW within a mixed production strategy could have been located elsewhere - at or near lower-order centers or in the countryside, and, since the quality of the finished product was in some cases, at least, not a major consideration, in areas that did not enjoy convenient access to fine-grained calcareous clay.

6.1.2 North Etrurian Red-Slip Ware

As was the case with BGW, it is necessary to review the results of recent research projects undertaken with a view to identifying and determining the provenance of the several variants of NERSW before considering the evidence for the eight fabric groups recognized for this class. As with BGW, the most comprehensive recent study of a site sub-assemblage of this class is Palermo's study of the material from the Volterra – Acropoli excavations.[80] He classified 289 sherds of NERSW, assigning these to two different groups on the basis of the megascopic characteristics of fabric and slip. A synopsis of the results of this work is presented in Table 11.A. Palermo's Group 1, which accounted for 64 sherds, was attested in just two forms, a bowl identical to the Morel Form 1211 in BGW and an *askos* identical to the Morel Form 8251 in BGW, with the later form represented by just two sherds. His Group 2, which accounted for 225 sherds, was attested in a variety of open and closed forms, including the Morel Form 1211 bowl, which form accounted for one-quarter of the total number of sherds. He equated Group 1, which has a finer body and more thick and regular slip than Group 2, with the production group that scholars have generally termed "Volterran pre-sigillata", noting that while a portion of the vessels that scholars have assigned to this class does, in

fact, originate at Volterra, some portion was manufactured by workshops situated elsewhere, most likely, in his view, at Perugia and Chiusi. Palermo distinguished four distinct bodies within his Group 2, all characterized by a texture less fine than that associated with Group 1 and a thin, uneven slip that is powdery to the touch, and believed that this group likely subsumed the products of multiple workshops located in different places. A substantial portion of this group (probably including the vessels in Palermo's Body 3, though also perhaps those in his Body 1 and Body 2) has a fabric and slip with characteristics similar to those of his Volterra – Acropoli BGW Group T and Palermo believed that these vessels may well have been manufactured by the workshop or workshops responsible for the manufacture of this production group, which was/were located at Volterra. This inference is supported by the fact that, as previously noted, Group T was the only one of Palermo's BGW groups of presumed Volterran origin that included multiple examples of the Morel Form 1211.

Palermo carried out a similar study of the NERSW from the Fiesole – Via Marini/Via Portigiani excavations.[81] In this instance he classified 2705 sherds, assigning these to five fabrics. Two of these (Bodies 1, 3), together accounting for 2445 sherds, he identified as being of local origin. One of these two bodies (Body 1) was attested in both the Morel Form 1211 bowl and various other open and closed forms, while the other (Body 3) was attested in various open forms, none of which was the Morel Form 1211. A third fabric (Body 4), represented by 30 sherds, Palermo believed to be from Volterra, and a fourth (Body 5), accounting for 15 sherds, he believed originated somewhere in northern Etruria. Both of these latter two fabrics were attested exclusively in the Morel Form 1211. He declined to suggest a probable point of origin for the fifth and final fabric

(Body 6), which was represented by 215 sherds belonging to one or more unidentified closed forms. Palermo also studied the NERSW from the excavations at Chiusi – Orto del Vescovo, and while the results of this work remain unpublished, he does indicate in passing in his study of the NERSW from Volterra – Acropoli that the vessels from this other site, presumably of Chiusine origin, can be distinguished from the vessels in his Volterra – Acropoli Group 1 on the basis of their slip, which is thinner, more uneven, and of a somewhat different color.[82] A synopsis of the results of Palermo's work with the materials from these two sites is presented in Tables 11.B-C.

In the area of compositional studies, as previously noted, Gliozzo and collaborators included three specimens of NERSW in their compositional study of materials from the Chiusi - Marcianella pottery production facility.[83] While petrographic analysis and electron microscopy indicated that these specimens had a mineralogical composition similar to that of the four specimens of BGW included in the program of analysis, XRF revealed that they had a distinctly lower composition for CaO than did the specimens of this other class - 8.4 percent mean CaO (= 6.0 percent Ca), as opposed to 11.1 percent mean CaO (= 7.9 percent Ca).[84]

It should be noted that the evidence from the Volterra – Acropoli excavations suggested that the Morel Form 1211 bowl was in use there mainly during the period ca. 200-180 BC, with perhaps some continuing use into the period ca. 180-140 B.C.[85] The evidence from the Chiusi – Marcianella excavations indicated a closely similar range of dates for the manufacture of this form there, extending from the end of the third to the first quarter of the second century B.C.[86]

Turning now to the eight NERSW fabric groups identified in the current study, the sole specimen in Fabric Group 1 is of probable medium quality, with a poorly preserved, red slip. It is an example of the Morel Form 1211 bowl and was recovered in Deposit 3. The presence of this sherd in Deposit 3 indicates that the manufacture of this fabric group commenced prior to ca. 150/125 B.C., while the fact that it is an example of the Morel Form 1211 suggests that this date can be pushed back to ca. 180 B.C.

The chemical and petrographic evidence indicate that this specimen/fabric group was manufactured from a fine, highly calcareous clay or a less fine calcareous clay subjected to levigation. As noted above, cluster analysis assigned this specimen to the same cluster as the specimens in BGW Fabric Group 2, and it appears likely that it originated in the same place as this fabric group. As discussed above, various considerations suggest that BGW Fabric Group 2 originated at Volterra, and it thus seems likely that this specimen/fabric group was also manufactured there. The characteristics of the body of the sole specimen attested may correspond to those indicated by Palermo for a group of assumed Volterran origin attested among the Volterra – Acropoli materials (Group 2, Body 2) and a fabric of assumed Volterran origin attested among the Fiesole – Via Marini/Via Portigiani materials (Body 4).

The sole specimen in Fabric Group 2 is of high quality, with a glossy red slip that is continuous on the interior surface and spotty on the exterior surface. It belongs to a cup, bowl or dish with an inflected wall that is probably not the Morel Form 1211 bowl, and was recovered in Deposit 2. The appearance of the body and slip are distinct from those of the other examples of this class in the Cetamura assemblage, and it seems possible that it is, in fact, an example of BGW that was fired (intentionally or otherwise)

in an oxidizing atmosphere.[87] The presence of this sherd in Deposit 2 indicates that the manufacture of this fabric group commenced prior to ca. 200 B.C.

The chemical and optical microscopic evidence indicate that this specimen/fabric group was manufactured from a fine, moderately calcareous clay or a less fine calcareous clay subjected to levigation. Cluster analyses of the calcareous BGW and NERSW employing various suites of elements, distance measures, agglomeration procedures associate this specimen in some instances with BGW Fabric Group 5 (as discussed above) and in others (not presented here) with BGW Fabric Group 2. These results are somewhat contradictory with regard to the issue of this specimen's point of origin, since in the first case they suggest that it is not of Volterran origin, while in the second they suggest that it is. The fine texture of this specimen suggests, however, that it is more likely related to BGW Fabric Group 2.

The specimens in Fabric Group 3 are of medium quality, with a poorly preserved, glossy red slip. Four were recovered in Deposit 3, while the fifth was recovered in a locus comparable in date to Deposit 3. All are examples of the Morel Form 1211 bowl. The presence of examples of this fabric group in Deposit 3 and a locus of comparable date indicates that its manufacture commenced prior to ca. 150/125 B.C., while the fact these are examples of the Morel Form 1211 suggests that this date can be pushed back to ca. 180 B.C.

The chemical and petrographic evidence indicate that this fabric group was manufactured from a fine, non-calcareous to low-calcium clay or a less fine non-calcareous to calcareous clay subjected to unusually thorough levigation. The low Ca values and the absence of microfauna indicate that (despite some similarity in the rim

forms attested) this fabric group is not a product of the Chuisi - Marcianella workshop. The characteristics of the body and slip may correspond to those indicated by Palermo for a group of assumed Volterran origin attested among the Volterra – Acropoli materials (Group 2, Body 2, Slip 2). The low calcium content, low abundance of inclusions, and overall appearance of the fabric suggest that it was manufactured employing a material different from those utilized for the production of the other calcareous fabric groups examined in this study. One possibility worth considering is that it was manufactured using material obtained from the formation of lacustrine clay of the Upper Miocene located in the area to the E of Poggibonsi and Monteriggioni in the upper Val d'Elsa (Fg 113 formation Mla_2 [*argille azzurre lignitifere*/lignite-bearing blue clays]). If so, this fabric group may constitute all or part of the production of this class that has been posited for the Val d'Elsa on the grounds of distributional evidence.

The specimens in Fabric Group 4 are of either medium or low quality, with a poorly preserved red slip. Two were recovered in Deposit 3, and the third in a locus comparable in date to Deposit 3. All are examples of the Morel Form 1211 bowl. The presence of examples of this fabric group in Deposit 3 and a locus of comparable date indicates that its manufacture commenced prior to ca. 150/125 B.C., while the fact these are examples of the Morel Form 1211 suggests that this date can be pushed back to ca. 180 B.C.

The chemical and petrographic evidence indicate that this fabric group was manufactured from continental clay of intermediate texture or a gritty to coarse clay of this kind subjected to levigation. If the latter, it seems possible that this was the same clay as that employed for the manufacture of NERSW Fabric Group 6. The

characteristics of the body and slip may correspond to those indicated by Palermo for a group of assumed Volterran origin attested among the Volterra – Acropoli materials (Group 2, Body 3, Slip 2) and/or for a fabric of assumed north Eturian origin among the Fiesole – Via Marini/Via Portigiani materials (Body 5/Slip 10). Little can be said about this fabric group's likely point of origin, except that this must have lain in an area where there was access to clay of the kind just indicated. Given the fact that there does not appear to be a strong association of calcareous clay with the manufacture of this class, there is a less strong basis for assuming that this fabric group was manufactured in an area that did not enjoy convenient access to calcareous potting clay than was the case with the non-calcareous fabric groups of BGW. For this reason an origin in the Upper Val d'Elsa as well as in the Monti del Chianti and Upper Arno Valley all seem possible. The possibility that there is a substantial amount of material perhaps belonging to this fabric group among the materials in the Fiesole – Via Marini/Via Portigiani assemblage is compatible with this inference.

The specimen in Fabric Group 5 is of medium or low quality, with a poorly preserved red slip. It is an example of the Morel Form 1211 bowl, and was recovered in Deposit 3. The presence of this sherd in Deposit 3 indicates that the manufacture of this fabric group commenced prior to ca. 150/125 B.C., while the fact that it is an example of the Morel Form 1211 suggests that this date can be pushed back to ca. 180 B.C.

The chemical and petrographic evidence indicate that this fabric group was manufactured from non-calcareous continental clay of a porphyritic texture. The characteristics of the body and slip may correspond with those indicated for Palermo's Group 2, Body 1/Slip 1 or 2. The presence of fragments of granite suggests that this

fabric group originated somewhere along the coast of northern Etruria opposite Elba, the closest source of rock of this kind, thus perhaps somewhere in the territory of Populonia, Vetulonia, or Roselle.

The specimen in Fabric Group 6 is of medium or low quality, with a poorly preserved red slip. It is an example of a closed form of some kind, and was recovered in Deposit 3. The presence of this sherd in Deposit 3 indicates that the manufacture of this fabric group commenced prior to ca. 150/125 B.C.

The chemical and optical microscopic evidence indicate that this specimen/fabric group was manufactured from a gritty, non-calcareous clay of continental origin or a coarse clay of this kind subjected to levigation. For the same reasons as those indicated for NERSW Fabric Group 4, an origin in the Upper Val d'Elsa, the Monti del Chianti, or the Upper Arno Valley seems possible.

The specimen in Fabric Group 7 is of medium or low quality, with a poorly preserved red slip. It is an example of a closed form of some kind, and was recovered in a locus comparable in date to Deposit 3. This indicates that the manufacture of this fabric group commenced prior to ca. 150/125 B.C.

The chemical and petrographic evidence indicate that this specimen/fabric group was manufactured from a gritty, low-calcium clay or a coarse clay of this kind subjected to levigation, Nothing can be said regarding this fabric group's point of origin, except that this must have been situated near a deposit of sandy, low-calcium clay.

The sole vessel in Fabric Group 8 is of medium or low quality, with a poorly preserved red slip. It is an example of a deep/medium open form or a closed form of

some kind, and was recovered in Deposit 2. This indicates that the manufacture of this fabric group commenced prior to ca. 200 B.C.

The chemical and petrographic evidence indicate that this specimen/fabric group was manufactured from a gritty, low-calcium clay, probably of marine origin, or a coarse clay of this kind subjected to levigation. It presumably originated somewhere in the area of marine sediments in northern Etruria. The characteristics of the body and slip of the sole example attested may correspond to those indicated by Palermo for a group of assumed Volterran origin attested among the Volterra – Acropoli materials (Group 2, Body 3, Slip 1 or 2). It may be effectively identical to Volterra – Acropoli BGW Group T (specifically, this group's Body 1 variant), an observation pointing to a possible Volterran origin.

On the basis of this evidence it is possible to formulate the following outline of the development of NERSW production in northern Etruria: At some point prior to ca. 200 B.C. a workshop, perhaps located at Volterra, began producing medium- to low-quality NERSW, including a cup or closed form of some kind. A second workshop, also perhaps located at Volterra, may have begun producing high-quality NERSW, including an open form of some kind, at some point prior to this same date. Beginning at some point prior to ca. 180 B.C. and perhaps as early as ca. 200 B.C. workshops located in four different places in northern Etruria began to manufacture medium- to low-quality NERSW, largely or exclusively examples of the Morel Form 1211 bowl, with this production perhaps continuing until as late as ca. 150/125 B.C. One of these establishments probably lay in the coastal zone near Populonia, Vetulonia and Roselle, another may have been located at Volterra, one in the upper Val d'Elsa, and one in the

upper Val d'Elsa, the Monti del Chianti, or the upper Arno Valley. The establishment perhaps located at Volterra may have been the same workshop that produced high-quality BGW there during this period. At some point prior to 150/125 B.C. and perhaps as early as ca. 200 B.C. two workshops began to manufacture closed forms in medium-/low-quality NERSW. One of these establishments may have been the same the establishment that manufactured examples of the Morel 1211 bowl that was perhaps located in the upper Val d'Elsa, the Monti del Chianti, or the upper Arno Valley.

The emergence and spread across much of northern Etruria of the production of the Morel Form 1211 bowl in NERSW over the period ca. 200 – 180 B.C. (continuing perhaps with substantially diminished intensity until as late as ca. 150/125 B.C.) is a phenomenon of considerable interest. These vessels were manufactured by workshops at at least five different production loci (those documented in the current study, plus Chiusi – Marcianella), at least one of which (Chiusi – Marcianella) was, as noted above, the seat of operations of an establishment that turned out a variety of products, including also medium- to low-quality BGW.[88] These vessels, which are known from both domestic and funerary contexts across the region, were regularly embellished with stamped decoration and on some occasions were also provided with a maker's stamp. They must have proved strongly attractive to consumers for some reason or reasons that elude us, and one is tempted to characterize the phenomenon of their widespread production and use within northern Etruria over a period of perhaps no more than two decades as a fad. It would be interesting to know where the manufacture of this vessel type originated and why its manufacture and use spread across the region in the way that it did. It is perhaps worth noting in this connection that on the basis of the evidence currently available it

appears that while this vessel type was likely manufactured by at least one workshop at or near Volterra, no pottery workshop at Arezzo would appear to have elected to produce some version of this form.

6.1.3 Italian Terra Sigillata

The vessels in the three fabric groups attested for ITS are all of high quality. There are 11 forms attested for Fabric Group 1: six platters/plates (Conspectus Form 1, 4, 12, 18, 19, 20), one dish (Conspectus Form 3), and four cups (Conspectus Form 14, 29, 34, 37). The chronologies of these forms suggest that its manufacture commenced prior to ca. 10 B.C. and continued through to at least ca. A.D. 40. There are six forms attested for Fabric Group 2: four platters/plates (Conspectus Form 4, 6, 12, 20), one dish (Conspectus Form 3), and one cup (Conspectus Form 23). The chronologies of these forms suggest that its manufacture commenced prior to ca. A.D. 15 and continued through to at least ca. A.D. 40. There is one form attested for Fabric Group 3 – the Conspectus 20 or 21 platter/plate. Its chronology suggests that the manufacture of this fabric group commenced prior to ca. A.D. 90.

The chemical and textural similarity of Fabric Groups 1-2 and the two specimens of Arezzo - Quarata clay leave little room for doubt that these two fabric groups were manufactured at Arezzo using clay obtained from this formation. The low score assigned to the sole vessel in Fabric Group 3 in the second set of MADCORR trials suggests that it was not manufactured using paste derived from Arezzo - Quarata clay, hence is probably not from Arezzo. The texture and mineralogical composition of this vessel are compatible with the possibility that it originated somewhere other than Arezzo.

6.1.4 Technological Aspects of Manufacture

In thin section the two specimens of Arezzo - Quarata clay display a notably fine texture, with a sparse aplastic component consisting of fine-grained quartz and mica with the occasional fragment of mudstone or siltstone or polycrystalline quartz. Examples of the three fabric groups apparently manufactured from this clay (BGW Fabric Group 1 and ITS Fabric Groups 1 and 2) display a texture and mineralogy effectively identical to those of Arezzo - Quarata clay, indicating - as one might suppose, given the fine texture of this clay - that the workshops that manufactured these fabric groups employed this material more or less as it was extracted from the ground, having no need to improve the working properties of the paste or the performance properties of the finished products by removing the coarse fraction of its aplastic component through levigation.

As noted, the compositional distinction between the vessels in ITS Fabric Group 1 and those in ITS Fabric Group 2 appears to reside mainly in the fact that the former group displays relatively low Ca values (ca. 4.5 – 7 percent) and relatively high values for most of the other elements assayed and the latter group relatively high Ca values (ca. 7-9 percent) and relatively low values for most of these other elements. A program of analysis carried out by Schneider and Hoffman that involved the characterization of 124 ITS vessels recovered at various of the workshop sites at Arezzo (including the more distant Cincelli workshop) by means of XRF may further elucidate the nature of the distinction between these two fabric groups.[89] This set of materials can be readily divided into three groups on the basis of their CaO content. These include a group of 44 vessels recovered at the workshop of Ateius at Arezzo - Via Nardi and stamped with this

maker's name, which display a relatively high CaO value (group mean 13.0 +/- 1.1 percent; = 9.29 +/- 0.8 percent Ca), a group of 15 vessels recovered at the workshop of Perennius at Arezzo –Santa Maria in Gradi (roughly 500 m to the SE of Via Nardi) and stamped with this maker's name, which display a relatively low CaO value (group mean 3.64 +/- 1.1; = 2.60 +/- 0.8 percent Ca), and the remaining 65 specimens, including various stamped and unstamped vessels from various workshop sites, including the one at Cincelli, which display an intermediate CaO value somewhat closer to that of the first group (group mean 9.73 +/- 0.7; = 6.95 +/- 0.5 percent Ca).[90] While these values cannot be directly compared with those obtained in the program of analysis reported here, it may be worth noting that the ratio of group mean Ca values for the two largest of the three groups – the first and the third (9.29/6.95 = 1.34) - is effectively identical to that for the ratio of the group mean Ca values for Fabric Group 2 and Fabric Group 1 (8.04/6.12 = 1.31). The compositional difference between Fabric Groups 1 and 2 may thus reflect the difference between a specific source of Arezzo - Quarata clay exploited by the Ateius workshop that yielded material with a high concentration of Ca and one or more other such sources exploited by various other workshops that yielded material with an intermediate concentration of Ca.[91] The Perennius workshop might have exploited yet some other source that yielded clay with a low concentration of Ca. It should be underscored that it is not here being suggested that the Fabric Group 2 vessels are all products of the Ateius workshop – this is impossible, given the fact that this establishment operated for a brief period between ca. 15 and 5 B.C., whereas several of the forms attested for Fabric Group 2 date to appreciably later than this[92] - but rather that these were perhaps manufactured from clay obtained from the same source as that

exploited by the Ateius workshop. The difference in chemical composition between the two specimens of Arezzo - Quarata clay subjected to analysis is compatible with the assumption that compositional differences of this degree may characterize clay obtained from two different if not particularly distant parts of the agQ formation. While it cannot be excluded that these compositional distinctions might be the result of the levigation of Arezzo - Quarata clay, the fine texture of this clay and its textural and chemical similarity to Arretine ITS makes this seem improbable.

Worth noting is the fact that the beds of clay in the agQ formation are interleaved with and in some areas overlain by deposits of peat (*torba* in Italian) and peaty lignite (so-called "brown coal", a substance intermediate between peat and coal).[93] Beds of peat are extremely rare in peninsular Italy, and in the areas of northern Europe where peat is abundant it has been regularly employed as a fuel for the firing of pottery. The digging of Arezzo - Quarata clay likely would have required the excavation of peat and lignite, or could have been carried out in concert with the excavation of peat and lignite, and it seems possible, perhaps even highly likely, that peat (or both peat and lignite) were employed as fuel for the firing of the pottery manufactured with this clay. The availability of this highly unusual fuel that could have been obtained at low costs in terms of labor input and transport would have represented a considerable advantage for tableware producers in the Arezzo area, and this, together with economies offered by ready access to Arezzo - Quarata clay, which, unlike the calcareous marine clay commonly employed for the manufacture of gloss-slipped pottery elsewhere in west-central Italy, could have been employed without recourse to the labor intensive practice

of levigation, may have constituted a set of advantages that lay behind the development of the ITS industry at Arezzo in the third quarter of the first century B.C.[94]

The workshops in the Arezzo area that manufactured BGW and ITS would also have utilized a second clay – presumably non-calcareous and iron-rich - to produce the slip that they employed to surface their products. For this purpose they most likely employed material obtained from a source belonging either to the formation designated Qt (*argille sabbiose fluviali*) or to that designated Qt_1 (*argille e ciottoli arenacei fluviali*), both fluvial deposits of the Upper Pleistocene, which constitute the end of the geologic sequence over most of the Arezzo basin.[95] They presumably removed the fine fraction of what was likely a gritty to coarse clay through levigation, decanting the supernatant into tanks where it was reduced to a slurry through evaporation.

The specific locations of the several known production sites for BGW and ITS in the Arezzo area strongly suggest that the siting of these establishments was significantly affected by the geography of the exposures of Arezzo - Quarata clay, with an effort made to locate workshops close to one of these outcrops in order to achieve economies in the use of this material. Particularly suggestive in this regard is the presence of workshops on the right bank of the Arno at Ponte a Buriano and Cencelli, more or less directly opposite the westernmost exposures of this formation in the vicinity of the Canale Maestro della Chiana/Arno confluence. The workshops at the other six Arezzo locations - Le Carciarelle, Orciolaia, Piaggia di Murello, Santa Maria in Gradi, Via Nardi, and San Francesco/Via Guido Monaco - all lie to the west of the area occupied by the Roman-period (and presumably also pre-Roman) town, and are thus closer to rather than farther from the exposures of the agQ formation that occur along the banks of the Castro. Of

particular interest in this regard is the fact that possible production debris perhaps indicative of an ITS workshop has also been reported from Montione, located at the easternmost of these exposures, and thus the one situated closest to Arezzo.[96]

The NAA data pertaining to the five fabric groups of likely or possible Volterran origin, including BGW Fabric Groups 2, 3, and 4, and NERSW Fabric Groups 1 and 8, demonstrate no relationship to the seven examples of marine clay from outcrops of the Pag formation in the environs of Volterra. This is hardly surprising, as test tiles manufactured from these clay specimens all have a coarser texture than the vessels in all but the last of these five fabric groups. While it seems highly likely that clay from this formation was employed for the manufacture of these fabric groups, it is unclear whether the lack of any compositional correspondence between these fabric groups and the specimens analyzed stems from the fact that the clay employed for this purpose was obtained from one or more different parts of the formation that yielded material with a finer texture and substantially different chemistry (including, among other things, substantially lower Ca values) or from the fact that the clay employed was subjected to levigation.

In order to evaluate the second of these two possibilities one of the two less course-textured clay specimens of Pag clay, CVLT.07, was subjected to levigation. The fine fraction was then employed to produce a fired tile and pellet, which were then subjected to optical microscopy and NAA according to the set of procedures described above. The pulverized clay specimen was levigated by being poured into a beaker of de-ionized water and allowed to stand for 60 seconds. The supernatant was then decanted into a second beaker and allowed to dry by evaporation for seven days, with the water

remaining at the end of this period removed by pipette and the sediment employed to fashion the tile and pellet. The tile (designated CVLT.07FF, with FF standing for fine fraction) displayed a texture only slightly less coarse than that of the test tile manufactured from the bulk clay specimen (Fig. 16B). The NAA data for CVLT.07FF are reported in Table 5 in the row immediately below those for CVLT.07 for ease of comparison. While most of the values for the levigated specimen differ substantially from those for the bulk specimen, with, most notably, the Ca value declining from 11.2 to 9.28 percent, the overall chemical composition of the levigated specimen is still significantly different from that of any of the vessels belonging to the various fabric groups of possible Volterran origin. While it seems possible that a levigation procedure in which the clay was allowed to settle for substantially longer than 60 seconds might yield a material with a texture and chemistry similar to those of some of the vessels belonging to the fabric groups in question, the results of this trial do not permit one to decide between the alternative explanations noted above to account for the divergence in composition between the pottery of assumed Volterran origin and the tiles made from Pag clay.

As was the case with the BGW and ITS workshops at Arezzo, the establishments at Volterra that manufactured BGW and perhaps also NERSW would have required the use of a non-calcareous, iron rich clay to produce slip. They might have obtained this material from deposits of alluvial sediment (formation Q_2t [*depositi alluvionali terrazzati*]) that occur along the margins of the valley of the Fiume Cecina, ca. 7 km to the SW, S, and SE of the town.

There is at present no definitive information regarding the locations of the workshops in the Volterra area that produced these two classes of pottery. As the evidence from Chiusi – Marcianella indicates, both classes might have been produced by a single establishment. While Palermo reports several examples of BGW with production defects from the Volterra – Acropoli excavations (terming these "*scarti di fabbrica*" [workshop or manufacturing discards]), he does not provide any details regarding the nature of these defects.[97] It is not possible to determine whether these should be considered wasters, that is, vessels with production defects of a kind that would have precluded their distribution, even as seconds, and thus whether the presence of these vessels should be taken as evidence for the manufacture of BGW somewhere in the immediate vicinity of the Volterra – Acropoli excavation.[98] In light of the fact that Volterra is situated atop a substantial hill (the area enclosed by the walls lies at ca. 500-540 m a.s.l.), the fact that the fabric groups of possible Volterran origin display substantial chemical variability, the fact that the outcrop of Pag clay that produced the most fine-textured material was, at ca. 120-125 m a.s.l., near the bottom of the exposure of this formation (and also the closest to the Cecina of the outcrops sampled), and the possibility that the clay employed for slip was obtained from alluvial deposits along the valley of the Cecina, it seems possible that these vessels were produced by multiple workshops, some or all of which were situated outside Volterra, possibly well downslope to the SW, S, or SE of the town at no great distance from the Cecina.[99] These establishments might have been located even further afield within the territory of Volterra.[100]

Potters in various locales in northern Etruria without access to fine-textured, moderately calcareous clays such as those available at Arezzo and Volterra employed the clays available to them locally to produce both BGW and NERSW. In the case of BGW, the resulting vessels tended to have what was likely regarded as a less esthetically satisfactory surfacing, with a slip characterized by a matte appearance, blotchiness, and at times a more reddish color that was prone to flaking. These vessels were rarely provided with incised or stamped decoration, probably due in part to the fact that this was difficult to execute on vessels manufactured in a paste having an intermediate, gritty, or coarse texture. It is possible that in some cases workshops enjoyed convenient access to multiple clay sources belonging to a single formation or to different formations that yielded clays with substantially different compositions, and it is thus possible that two or more of the fabric groups identified in this study originated at a single establishment. Sets of fabric groups that are particularly worthy of consideration in this regard are the non-calcareous BGW Fabric Groups 7 and 8 and NERSW Fabric Groups 3, 4, and 6, and the low-calcium BGW Fabric Group 6 and NERSW Fabric Groups 7 and 8. In the case of NERSW Fabric Groups 4 and 6, it appears possible that the former was, in fact, manufactured with a fine fraction of the clay employed for the manufacture of the latter, perhaps by the same workshop. It may even be the case that a single workshop produced vessels in both non-calcareous and calcareous fabrics.[101]

6.2 Supply and Consumption

The mobilization of the results of the program of analysis to reconstruct patterns in the supply to Cetamura and consumption there of the three pottery classes that are the focus

of this study is constrained not only by the three considerations noted at the beginning of this section (the breadth of the four time periods recognized, the possible effects of residuality, the limited number of specimens analyzed), but also by the fact that, as seen in the three preceding subsections, in the majority of cases it is not possible to determine the specific locus or in some cases even the general area where the various fabric groups recognized originated. The significance of the figures for the relative representation of the various classes and fabric groups is further constrained by the methods employed to select specimens for inclusion in the program of analysis. For Deposit 1, all seven of the BGW vessels in the deposit (all of which were fine-textured) were selected for analysis. For Deposits 2 and 3, in contrast, an adventitious selection of 21 specimens of fine-textured BGW (Fabric Groups 1-4) were chosen for analysis from among a substantially larger set of BGW vessels, along with all six specimens of intermediate-/gritty-textured BGW (Fabric Groups 5-8) and all eight specimens of NERSW. For the latter two deposits there is thus no way to judge the extent to which the figures for the relative representation of the various fabric groups of fine-textured BGW are representative of the figures for these deposits as a whole. Further, intermediate-/gritty-textured BGW and NERSW are both over-represented to some unspecifiable extent with respect to fine-textured BGW. Since all additional examples of intermediate-/gritty-textured BGW and some additional examples of NERSW recovered in other loci during the 1987 and 1988 field seasons were also selected for analysis, these two groupings are over-represented to some unspecifiable extent with respect to fine-textured BGW in comparison with their representation among the 1987 and 1988 pottery assemblages as a whole, with the former grouping (i.e., intermediate/gritty-textured BGW) also over-represented to some

unspecifiable extent in comparison to NERSW. Finally, the specimens of ITS included in the program of analysis were selected adventitiously from among the substantially larger set of ITS vessels excavated during the 1987 and 1988 field seasons. There is thus no way to judge the extent to which the figures for the relative representation of the three ITS fabric groups attested are representative of their representation within the 1987 and 1988 pottery assemblages as a whole.

The interpretation of the evidence produced by the program of analysis is also rendered problematic by the difficulty in establishing the nature of the occupation at Cetamura during any one of the four phases to which it pertains. While it is clear that the site was the venue of various sorts of craft production during the Hellenistic 1 phase and considerable – one is tempted to say intensive - cult activity in the form of the deposition of votive offerings during the Hellenistic 2 phase, and while excavation at the site has yet to uncover any architectural remains that can be identified as residential structures, it seems a reasonable assumption that during each of the four phases under consideration there was some sort of residential community present on the site. The apparently small size of the site – never apparently more than ca. 1 hectare in area – suggests that this cannot have consisted of more than a few score individuals at any time, if not, indeed, considerably fewer than this. That the site also served as a local market center during the first three phases also appears possible, with the presence of a concentration of craftsmen of various kinds and/or the presence of a sanctuary perhaps amplifying its role as a central place beyond what otherwise might have been the case. Given the rugged terrain of the Monti del Chianti, which would have rendered movement time-consuming and difficult, and what was likely the low population density of the area relative to many

other parts of northern Etruria,[102] unless the sanctuary drew large numbers of worshippers from beyond its immediate environs on a regular basis, the size of the population that the site might have served as a market center cannot have been very large, perhaps several hundreds of individuals at the most.

The artifactual and ecofactual content of the Hellenistic 2 votive features excavated at the Cetamura during the period 2005-2008 (utilitarian pottery, BGW, roof tiles, frequent iron nails, rare coins, animal bone, carbonized plant remains) is not dissimilar in many respects from domestic refuse, and it would be difficult to distinguish between deposits consisting or redeposited votive material and deposits consisting of domestic refuse. As a consequence, it is impossible to develop a clear idea as to whether the vessels recovered in loci datable to the Hellenistic 2 phase - and perhaps also those datable to the Hellenistic 1 and Late Classical phases - were acquired for what we might term domestic use or for use as a votive (not overlooking the fact that objects acquired for domestic use might later be employed as votives), and whether these were discarded at the conclusion of their use life as domestic equipment or were deliberately placed in votive deposits. In light of this circumstance the approach taken here will be to consider the materials from Deposits 1-3 on the basis of the assumption that they were all acquired and employed for domestic uses by persons resident at Cetamura, and to then offer some additional comments based on the assumption that some or all were acquired and used as votives by persons not necessarily resident at Cetamura. This will be followed by a consideration of the Roman-period materials. Tables 1 and 12 provide synopses of the information relevant to these discussions.

The supply to and consumption at Cetamura of the three classes of pottery that are the focus of this study for domestic uses would have been determined by the geography of their production, the mechanisms employed for the distribution of the products of the various establishments involved in this production, the geography of these distribution systems, and the choices made by the inhabitants of Cetamura to acquire specific vessels from among the set of those made available to them by the distribution system. The vessels belonging to these three classes of pottery might have reached those who used them either through sale or gift exchange. In the case of sale, consumer choice would have been governed by considerations of the price and attractiveness of the vessels, with the latter a complex and difficult to define attribute embodying considerations of appearance, anticipated functionality/performance, and various other associations (e.g., stylishness). The exchange of vessels as gifts presupposes an arrangement whereby the craftsman producers were in some way socially and/or economically dependent upon elites, who received all or some portion of their output and disposed of this as gifts made either to other elites in the interest of cultivating their relations with these or to social inferiors in the context of the operation of their patronage network.[103] In situations of this sort consumer choice presumably would have played only a limited or no role. That pottery of the kind here under consideration reached consumers by means of this mechanism on a regular basis may be doubted, however, and it seems likely that sale represented the dominant means whereby it reached those who consumed it.

Vessels belonging to these three classes might have reached consumers via a variety of market mechanisms. The workshops that produced these wares might have marketed them to middleman wholesalers, to retailers, and/or directly to consumers.

These establishments might have done this at one or more of three different loci: the workshop facility, a fixed facility (i.e., a shop) physically separate from though situated at no great distance from the workshop facility, or at some more remote location. In the last of these three possibilities workshop members might have sold their products either by participating in a periodic market or by peddling (i.e., selling to individual households or other groupings of consumers door-to-door in towns and/or at the farm gate in rural areas). Middlemen might have acquired the vessels that they marketed either directly from the workshop or from another middleman, and might have sold these either to another middleman or to a retailer. They might have accomplished the latter operation by sale at a fixed facility situated close to the workshop facility, at a fixed facility at some other location, by participating in a periodic market, or by peddling. Retailers might have acquired the vessels that they marketed either directly from the workshop or from a middleman, and would have sold these directly to consumers. They might have accomplished the latter operation by sale at a fixed facility situated close to the workshop facility, at a fixed facility at some other location, by participating in a periodic market, or by peddling. It would not be surprising if in some cases individuals combined the roles of middleman and retailer, selling sometimes to middlemen and/or retailers and sometime directly to consumers.

Persons resident at Cetamura might have acquired examples of these pottery classes at any or all of three different loci: at Cetamura, itself, by purchase from a retailer operating a fixed facility or from a workshop associate or retailer participating in a periodic market or operating as a peddler; at or near the workshop facility, either at the workshop facility, itself, at some other fixed facility operated by a workshop associate or

a retailer, or from a workshop associate or a retailer participating in a periodic market; or at some third location, from a retailer operating a fixed facility, or from a workshop associate or a retailer participating in a periodic market. Small numbers of coins have been recovered at Cetamura in contexts dating to the Hellenistic 1/2 phases, suggesting that the local economy was to some extent monetized by the second century B.C., and we should remain open to the possibility that by this time and perhaps also earlier small-scale commercial transactions such as these involved the use of coin rather than or alongside barter.

The composition of Deposit 1 suggests that during the period of its formation (ca. 350-250 B.C.) the inhabitants of Cetamura consumed small amounts of high-quality BGW. This belonged to at least two different fabric groups from two production loci that both should probably to be classified as *ceramica protocampana*. The first of these (Fabric Group 1) originated at Arezzo. It is represented by four vessels belonging to at least two forms - a thin-walled cup and one or more bowls/dishes/plates, in one instance bearing incised decoration. The second (Fabric Group 3) most likely originated at Volterra. It is represented by three vessels belonging to three forms - a thin-walled cup/bowl, a cup/bowl with stamped decoration, and a dish/plate with incised decoration.

The composition of Deposit 2 suggests that during the period of its formation (ca. 250-200 B.C.) the inhabitants of Cetamura consumed substantial amounts of high-quality BGW and very small amounts of NERSW, some of medium/low quality and some perhaps of high quality. The BGW belonged to at least three fabric groups from perhaps just two production loci. The first of these (Fabric Group 1) is the fabric group of Arretine origin attested in Deposit 1. It is represented by at least one vessel that may be a

Lamboglia 28 cup/bowl. The second (Fabric Group 2) is of probable Volterran origin. It is represented by at least one vessel that is a Morel Form 80 cup/bowl. The third (Fabric Group 4) is also probably of Volterran origin. It is represented by at least two vessels belonging to two forms - the Morel Form 82 cup and an open vessel that may be the Morel Form 83 bowl. While neither of the BGW fabric groups of probable Volterran origin is the same as the BGW fabric group of Volterran origin represented in Deposit 1, the second of these may perhaps be related to this other fabric group. The NERSW belonged to two fabric groups from one or two production loci. The first of these (Fabric Group 8) is of medium/low quality and may perhaps originate at Volterra. It is represented by a single vessel that is probably either a closed form or a cup. The second (Fabric Group 2) is of high quality and may also originate at Volterra. It is represented by a single vessel that is a cup, bowl, or dish. This may, in fact, be a misfired example of BGW, perhaps belonging to one of the two fabric groups of probable Volterran origin represented in this deposit (BGW Fabric Group 2).

The composition of Deposit 3 suggests that during the period of its formation (ca. 200-150/125 B.C.) the inhabitants of Cetamura consumed substantial amounts of high-quality BGW and very small amounts of both medium-/low-quality BGW and medium-/low-quality NERSW. The high-quality BGW belonged to at least three different fabric groups from two or three production loci. The first of these (Fabric Group 1) is the fabric group of Arretine origin attested in Deposits 1 and 2. It is represented by at least seven vessels belonging to at least five forms – the Lamboglia Form 5 dish/plate, the Lamboglia 28 cup/bowl, the Morel Form 80 cup/bowl, the Morel Form 83 bowl, and a closed form of some kind. The second (Fabric Group 2) is the fabric group of probable Volterran

origin attested in Deposit 2. It is represented by at least nine vessels belonging to at least seven forms - the Lamboglia Form 5 dish/plate, a form that may be the Lamboglia Form 10 cup, the Morel Form 80 cup/bowl, an open form that may be the Morel Form 82 cup, the Morel 83 bowl, a closed vessel of some kind, and a lamp. Some of the vessels belonging to both these fabric groups can be assigned to the so-called *Cerchia della Campana B*. The third fabric group (Fabric Group 3) is that of probable Volterran origin attested in Deposit 1. It is represented by at least one vessel that is a lamp. The medium-/low-quality BGW belonged to at least three (or possibly four) different fabric groups probably originating at three (or perhaps four) production loci. None of these is attested in either Deposit 1 or 2. The first (Fabric Group 5) is a medium-quality fabric group (or perhaps two compositionally similar fabric groups) that may have originated at a location (or two locations) in the western Val di Chiana, the Siena area, and/or the Val d'Elsa. It is represented by four vessels belonging to at least three forms – a vessel with an everted rim, a cup, bowl, or dish with a thickened rim, and a dish or plate with groove and chatter decoration. An example of this fabric group recovered in a locus of a date similar to that of Deposit 3 is a closed form of some kind with a ring foot. The second of these fabric groups (Fabric Group 6) is a medium-/low-quality fabric group that presumably originated in an area of sandy, low-calcium clay. It is represented by a single vessel that is cup, bowl, or dish. The third of these fabric groups (Fabric Group 8) is a low-quality fabric group that may have originated in the Monti del Chianti or the Upper Arno Valley. It is represented by two vessels that belong to two forms – an open form that is probably the Lamboglia Form 23 plate and a cup, bowl or dish. An example of this fabric group

recovered in a locus of a date similar to that of Deposit 3 is a vessel with one or more broad, loop-shaped handles.

The NERSW in Deposit 3 belonged to five different fabric groups of medium or medium/low quality from at least three and as many as five production loci. None of these fabric groups is attested in either Deposit 1 or 2. For all but the last of these the only form represented is the Morel Form 1211 bowl. The first (Fabric Group 1), represented by a single vessel, is a medium-quality fabric group that may be of Volterran origin and may be related to one of the two high-quality BGW fabric groups of probable Volterran origin represented in this deposit (Fabric Group 2). The second (Fabric Group 3), represented by four vessels, is a medium-quality fabric group that may have originated in the Val d'Elsa. The third (Fabric Group 4), represented by a single vessel, is a medium-/low-quality fabric group that may have originated in the Val d'Elsa, the Monti del Chianti, or the Upper Arno Valley. The fourth (Fabric Group 5), represented by a single vessel, is a medium-/low-quality fabric group that may have originated in the area of Populonia, Vetulonia or Roselle. The fifth and last (Fabric Group 6) is a medium-/low-quality fabric group that may have originated in the area of Upper Val d'Elsa, the Monti del Chianti, or the Upper Arno Valley, perhaps at the same location as NERSW Fabric Group 4. It is represented by single vessel that is a closed form of some kind. A locus of a date similar to that of Deposit 3 yielded a sherd of NERSW belonging to yet another fabric group (Fabric Group 7). This fabric group, of medium/low quality, originated somewhere in an area of sandy, low-calcium clay. The sole example is a closed form of some kind.

On the basis of this evidence we can make the following inferences regarding the supply to and consumption of slipped tableware at Cetamura over the site's Late Classical, Hellenstic 1 and Hellenstic 2 phases: During the period represented by Deposit 1 the inhabitants of the settlement consumed high-quality BGW manufactured at two production loci, Arezzo and probably Volterra. Whether the products of these two loci were distributed to Cetamura in sequence, in alternation, or to some extent simultaneously is unclear. The fact that four of the seven BGW vessels in this deposit originated at Arezzo and the other three at the other production locus may indicate that over the course of this period both of these production loci provided a significant portion of the BGW consumed at the settlement. While the small size of the deposit renders any inferences based on the absence of evidence extremely tenuous, the fact that the deposit contained no BGW originating elsewhere may indicate that no other production loci distributed BGW to Cetamura during this period, or at least that none provided a significant portion of the BGW consumed there. The evidence, though scant, suggests that a substantial portion of the BGW vessels consumed at Cetamura during this period were embellished with freehand incised decoration, the execution of which would have required somewhat greater effort, attention, and perhaps also skill than did the execution of the stamped decoration common on BGW vessels in the periods of Deposits 2 and 3. Deposit 1 also contained one sherd of Overpainted Ware and one sherd of Red-Figure Ware - both probably of Volterran origin - demonstrating that other classes of slipped tableware were consumed at Cetamura over at least some portion of the period that it represents, probably though in quantities significantly smaller than those in which BGW was consumed. Thus, while the producers of BGW perhaps invested more labor in its

manufacture than they did during later periods, BGW did not represent the top end of the repertoire of slipped tablewares consumed at the site.

The consumption of slipped tableware originating at just two production loci, one or perhaps both of which corresponded with the major demographic, political and perhaps also religious centers in the region, does not presuppose the presence of complex distribution mechanisms. We might, for example, imagine that during this period the inhabitants of Cetamura acquired the BGW vessels that they used directly from the workshops where they were produced in the context of occasional trips to Arretium and Volaterrae carried out primarily for social, political, religious, or other economic purposes. Alternatively, these vessels might have reached consumers at Cetamura through the activities of a numerically restricted group of peddlers (perhaps based at or near the two production loci), who supplied high-end tablewares (and perhaps other craft goods) to areas located far from the major population centers, where the inhabitants did not enjoy convenient access to higher-order fixed or even lower-order periodic markets.

It is difficult to say much regarding consumption of slipped tablewares at Cetamura during the period represented by Deposit 2 due to the extremely small size of the deposit and the small number of vessels from it that were included in the program of analysis. The consumption of BGW demonstrates both points of continuity and change with respect to the preceding period. The fabric group of Arretine origin attested in Deposit 1 continued to be consumed by the inhabitants of the settlement. The fabric group of probable Volterran origin represented in Deposit 1 is not represented, though two other high-quality fabric groups of probable Volterran origin are attested, one perhaps related to this fabric group. This situation might represent some change in the

organization or technology of BGW production at Volterra rather than any change in the mechanisms whereby it became available to consumers at Cetamura or change in preferences on the part of consumers at Cetamura. The presence of NERSW in the form of one closed vessel and perhaps also one open vessel, both of possible Volterran origin, is of some interest, in that it indicates that the inhabitants of Cetamura were not entirely unfamiliar with or indifferent to the attractiveness of tableware decorated with a reddish slip in the period prior to the appearance of the Morel Form 1211 bowl.

While Deposit 3 displays elements of continuity with Deposits 1 and 2, it also shows some conspicuous differences. Both the BGW fabric group of Arretine origin attested in Deposits 1 and 2 and one of the two BGW fabric groups of probable Volterran origin attested in Deposit 2 continued to be consumed at Cetamura. The fact that the former accounts for seven of the 25 BGW vessels from this deposit subjected to analysis and the latter for nine of these vessels suggests that both production loci provided a substantial portion of the BGW consumed by the inhabitants of the settlement during this period. The fabric group of probable Volterran origin attested in Deposit 1 though not Deposit 2 is represented by a single vessel, a lamp. This might be a residual vessel, represent ongoing production of this fabric group, or perhaps the ongoing limited or specialized production of this fabric group.

New in the period represented by Deposit 3, however, is the presence at Cetamura of BGW vessels belonging to three fabric groups of medium or medium to low quality that appear likely to have been manufactured somewhere in northern Etruria other than Arezzo or Volterra. These fabric groups, which cumulatively account for eight of the 25 BGW vessels in this deposit that were subjected to analysis, have fabrics that are

distinctly coarser than those of the fabric groups attested in Deposits 1 and 2 and less glossy, less even slips that were less resistant to wear and chipping. Probably to be related to these fabric groups is an additional low-quality BGW fabric group represented by a single vessel that was recovered in a context deposited during the last quarter of the first century B.C. or later, presumably as a residual.

During the period represented by Deposit 3 these new medium- to low-quality productions constitute a minor, if perhaps significant portion of the BGW consumed by the inhabitants of Cetamura. This appears to represent the acceptance by at least some consumers of the application of a decorative technique previously associated with high-end vessels to vessels with more modest associations. While it seems possible that this development occurred within the context of emulation, a social strategy wherein persons of lower socio-economic status adopt cultural elements (sometimes including items of material culture) associated with persons of higher status for purposes of status enhancement,[104] more detailed analysis of status-specific mortuary and domestic assemblages will be necessary before this possibility can be properly considered.

Also new in the period represented by Deposit 3 is the appearance of the Morel Form 1211 bowl in NERSW, which constitutes a numerically minor (both in general and in comparison with BGW) if nonetheless significant element of the pottery assemblage. The eight examples of this form present in the deposit belong to four different fabric groups of medium to low quality. One of these might have originated at Volterra, while the other three presumably originated somewhere else in northern Etruria. As already noted, the fairly rapid and widespread adoption of this vessel type in northern Etruria suggests that it held some particular attractiveness for consumers, including apparently,

some of the inhabitants of Cetamura. The only specimen of NERSW present in Deposit 3 that is not an example of the Morel Form 1211 is a closed form that perhaps originated in the Val d'Elsa, the Monti del Chianti, or the Upper Arno Valley, and may have been manufactured by the same workshop as one of the examples of the Morel Form 1211 from this deposit.

The period represented by Deposit 3 appears to differ from those represented by Deposits 1 and 2 by the presence of a substantially greater degree of richness in the set of slipped tablewares being consumed by the inhabitants of Cetamura. This greater richness is expressed in the number of classes, fabric groups within classes (reflecting, presumably to some extent, the number of workshops involved in supplying the site), and qualities of products available to the inhabitants of the settlement. While this is doubtless to some extent an apparent rather than a real difference determined by the substantially larger size of Deposit 3 and the large number of Deposit 3 materials selected for inclusion in the program of analysis - not to mention the authors' decision to regard NERSW as a class of pottery appropriate for consideration together with BGW and thus appropriate for inclusion in this study - various kinds of external evidence (e.g., the evidence for the periods of activity of the BGW workshops at Chiusi - Marcianella, Montaione – Bellafonte, and Montaione – Il Muraccio; the chronology for the manufacture of the Morel Form 1211 in NERSW) support the assumption that this distinction is to some appreciable degree a real one. This is also expressed in the appearance in the Cetamura pottery assemblage (and also in that from the Volterra – Acropoli excavation) at this time of Internal Red-Slip Cookware cooking pans – items of apparent regional origin that appear to have been high performance vessels that were manufactured at a limited

number of production loci and distributed over much of northern Etruria during the second century B.C.[105] This development can probably be associated in a general way with the intensification of the commercial economy that occurred in northern Etruria and other parts of peninsular Italy (e.g., Campania) during the decades following the end of the Second Punic War. It is interesting that the impact that this expansion in the intensity and complexity of economic activity in northern Etruria had on the material expression of day-to-day living was not limited to the major centers, such as Volterra, Fiesole, and Chiusi, but can also be discerned in the archaeological record of a marginal – probably not just in geographical, but also in economic, social and cultural terms - settlement such as Cetamura.

The distribution of this substantially wider array of craft goods to Cetamura presumably required a more developed and perhaps more complex set of mechanisms than that suggested for the period of Deposit 1. We may imagine, for example, that this involved a substantially more regular and intensive flow of peddlers into marginal areas of northern Etruria such as the Monti del Chianti or, alternatively, the establishment of a periodic market either at Cetamura or in some other locale close enough to Cetamura to allow persons resident there to frequent it on a regular basis. Less probable, given what was likely the very modest size of Cetamura's population, was the establishment there of one or more fixed retailers of craft goods, including non-local pottery. Alternatively, we may imagine that there was greater volatility in the arrangements for the provision of Cetamura with slipped pottery, with suppliers and, along with them, the products of different workshops replacing one another in more rapid succession than had been the case in earlier periods.

The significant possibility that some portion of the BGW and NERSW vessels contained in one or more of Deposits 1-3 – the last of these, in particular - were brought to Cetamura by persons not resident there to be left as a votive offering requires us to revise somewhat this picture, since this opens up the possibility that at least some of the examples of these two classes reached Cetamura through a process unrelated to the marketing mechanisms just considered. The apparent absence at Cetamura of elaborate religious structures and of large, elaborate, and costly votive offerings and the site's marginal location with respect to what were likely the region's major routes of travel and trade combine to suggest that the sanctuary located there was probably one of predominantly local importance (that is to say, that it drew few worshippers from any appreciable distance). If so, it may be doubted that the practice of bringing votive offerings to the sanctuary led to the introduction into the site assemblage of substantial numbers of vessels belonging to production groups with areas of market distribution that did not normally embrace the Cetamura area. The relative representation of high-quality versus medium-/low-quality vessels (and along with this, the relative representation of the various productions present in the site assemblage) may also have been determined to some extent by this practice, although it is impossible to say in which way, as the preponderance of worshippers may have thought it appropriate to leave attractive, high-quality vessels as offerings, or may rather have had regular recourse to the practice of leaving medium-/low-quality vessels, as these were more readily and/or cheaply available and performed equally well as a high-quality vessel as a votive offering.

Turning now to the Roman phase, the ranges of the manufacturing dates for the various ITS forms represented in the program of analysis suggest that these materials

were produced over a span at time extending at the very least from ca.10 B.C. to ca. 40 A.D. One of the forms represented was manufactured beginning as early as ca. 40 B.C., several might have been manufactured as late as the second half of the first century A.D., and one as late as the first half of the second century A.D., raising the possibility that the materials analyzed were produced over a span of time substantially greater than this. Over the course of the period represented by these vessels the inhabitants of Cetamura consumed ITS belonging to two different fabric groups (Fabric Groups 1 and 2) (although, as discussed above, perhaps better regarded as a single fabric group) of Arretine origin, one of which (Fabric Group 2) appears to be more closely related to the BGW fabric group of Arretine origin (Fabric Group 1) than the other in terms of its compositional characteristics. The first of these fabric groups is represented by 15 vessels belonging to 11 different forms, including four cup forms (Conspectus Forms 14, 29, 34, 37), one dish form (Conspectus Form 3), and six platter/plate forms (Conspectus Forms 1, 4, 12, 18, 19, 20). The second is represented by eight vessels belonging to six or seven different forms, including one cup form (Conspectus 23), one dish form (Conspectus 3), and four or five platter/plate forms (Conspectus 4, 6, 12, 20, and perhaps also 21). One of the vessels analyzed, an example of the Conspectus Form 20 or 21 platter/plate, a form manufactured over the period ca. A.D. 40-90, belonged to a third fabric group (Fabric Group 3) that appears not to be of Arretine origin.

During the period of time spanned by the set of ITS specimens included in the program of analysis the slipped tablewares consumed by the inhabitants of Cetamura – probably by this time a substantially different kind of settlement than it had been during the earlier periods covered in this study – were almost exclusively of Arretine origin,

with but one of the specimens analyzed – a platter/plate dating to the middle or second half of the first century A.D. - apparently manufactured somewhere other than Arezzo. This vessel was most likely manufactured at one of the other production loci for this class located in northern Etruria rather than somewhere outside the region. Given the prominent position of Arezzo in the manufacture of ITS and its proximity to Cetamura, it is hardly surprising that the near totality of the examples of this class consumed at Cetamura during this period were Arretine products. Indeed, it seems likely that very substantial amounts of Arretine ITS were transported to the Tyrrhenian coast for long-distance distribution by being moved north along the *Via Cassia Vetus* to Florence and then west along the *Via Quinctia* to Pisa. On the first leg of this route consignments of pottery would have passed within no more than ca. 12 km of Cetamura, and it seems quite possible that pottery sellers based in the region took advantage of this traffic to organize a distribution system that provided for the economical supply of Arretine products to settlements in the Monti del Chianti, including Cetamura.[106] The specific contours of any such system would likely be obscured by the uniformity of the supply.

6.3 Methodological Considerations

The results of the program of analysis permit various observations regarding the methods employed to study the three classes of pottery that are its focus, and, in particular, the analysis of their composition with a view to defining distinct production groups and determining the likely provenances of these.

First, it is worth noting that the inexpensive, low-tech technique of optical microscopy allowed the ready identification (if not the determination of the provenance)

of several distinct fabric groups of BGW and NERSW that presumably correspond more or less to distinct production groups. NAA was essential only for the identification of discreet fabric groups within the set of fine-textured specimens for each of the three pottery classes. Petrographic analysis was employed with the limited goal of obtaining a more detailed textural/mineralogical characterization of the various fabric groups recognized by means of these other two forms of analysis, and its utility for the identification of fabric/production groups was not tested. While the fine-textured specimens represent the bulk of the materials (including all of the examples of ITS) and the results obtained by means of NAA are highly important within the larger program of analysis, the value of those obtained by means of optical microscopy should not be discounted. This is a point particularly worth making in light of the fact that two recent studies of the sizable sub-assemblage of BGW from the Volterra – Vallebuona site - one undertaken by Di Giuseppe, the other by Roth – assign these materials to putative production groups on the basis of the characteristics of their body and slip as these can be observed with the naked eye.[107] This effectively means dividing the sub-assemblage into two groups - one consisting of fine-textured/high-quality vessels and the other of more coarse-textured/low-quality vessels - and these two authors' interpretations, which seek to mobilize their results to engage broad issues concerning the Romanization of northern Etruria, proceed on the basis of this representation of the material. The results of the current program of analysis suggest that the latter grouping could likely be subdivided into multiple fabric groups by means of optical microscopy, leading to significantly more nuanced and verisimilar interpretations of this body of material. The use of optical microscopy is particularly attractive now that the wide availability of low-cost, easy-to-

operate digital microscopes means that it is possible to produce images of the fabrics of large numbers of pottery specimens at magnifications of up to 40-50 X at effectively no cost and in a modest amount of time.[108]

Second, our ability to contextualize the results of the program of analysis reported here was been very substantially circumscribed by the difficulty encountered in associating the several fabric groups identified with specific production sites or general production areas. This highlights the pressing need for archaeology to identify, excavate, and study pottery production sites within northern Etruria and more generally with a view to determining the range of products manufactured, the compositional characteristics of these, the scale, organization and technology (including specific forming techniques the traces of which might be recognized on workshop products) of production, and the chronology of the establishment's activity.[109] Studies like Roth's of the materials from Volterra – Vallebuona that depend heavily on logical assumptions rather than concrete evidence regarding the organization and technology of production run the risk of being mistaken in ways that might invalidate them.[110]

Lastly, the utility of the program of analysis reported here is substantially circumscribed by its extremely small size. As noted, the small size of the deposits from which materials were selected for compositional analysis and the limited number of specimens subjected to such analysis make for an appreciable likelihood that any patterns discernible in the results are not broadly indicative of the broader qualitative or quantitative patterns of production and consumption that should be of interest to archaeologists. Of particular concern is the likelihood that NAA datasets such as the one

generated in the course of this project may be too small to permit the recognition of the underlying compositional structure in all but the simplest sets of circumstances.

7. CONCLUSIONS

A group of 40 specimens of BGW, 14 specimens of NERSW, and 24 specimens of ITS from the site of Cetamura and 22 ceramic tiles/pellets fabricated from clay specimens obtained from eight different sources across the northern Etruria region were subjected to a program of compositional analysis that involved optical microscopy, NAA, and petrographic analysis. The aims of this work were to identify distinct compositional groups within each of these three classes of pottery, to determine the likely provenances of these groups, and to employ these results to elucidate patterns in the production of these three classes of pottery in northern Etruria and their supply to and consumption at Cetamura.

Optical microscopy proved effective for identifying compositional groups of pottery characterized by differences in gross fabric texture and mineralogy, while NAA, used in combination with cluster analysis and a computer program that calculates statistical probabilities of group membership, was able to identify distinct groups among the pottery specimens with a fine-textured fabric. Petrographic analysis permitted the generation of detailed descriptions of the fabrics of these groups. In all, it was possible to identify eight compositional groups of BGW, eight compositional groups of NERSW, and three compositional groups of ITS. Several of these groups are represented by but a single specimen. The effort to find matches between the compositional groups of pottery and the clay specimens was largely unsuccessful due to the fact that the clays analyzed

were probably in many cases not those employed in antiquity for the manufacture of the pottery, the dearth of diagnostic rock and mineral inclusions in the pottery and clays, and the fact that in some cases the clays may have been subjected to levigation as part of the paste preparation process, significantly altering their texture, aplastic mineralogy, and chemistry. A robust textural and chemical match was, however, obtained between a clay specimen from the *argille di Quarata*, a lacustrine formation exposed over a narrow area immediately to the northwest of Arezzo and one fine-textured compositional group of BGW and two closely related fine-textured compositional groups of ITS, all clearly of Arretine origin. Three groups of BGW and two of NERSW could be conjecturally assigned to Volterra on the basis of a combination of historical considerations and internal evidence, while one group of BGW could be tentatively assigned to the area of Populonia/Vetulonia/Roselle on the basis of possibly diagnostic rock fragments. The remaining three groups of BGW, six groups of NERSW, and one group of ITS could be speculatively associated with general zones within northern Etruria, including Volterra, the upper Val d'Elsa, the area around Siena, the Monti del Chianti, the upper Arno Valley, and the western Val di Chiana, on the basis of historical considerations and gross mineralogy.

The data regarding diachronic patterns in the production of these three classes of pottery in northern Etruria and their supply to and consumption at Cetamura must be treated with caution due to the small number of specimens analyzed and the limitations involved in dating these and the fact that some of the vessels included in the study may have reached the site as votive offerings. During the period ca. 350-250 B.C. the inhabitants of Cetamura consumed high-quality BGW from two sources, Arezzo and

probably Volterra, with both apparently supplying a significant portion of the market. The Volterran potters likely employed marine clay, which they were obliged to levigate. The Arretine potters appear to have employed unlevigated clay from the *argilla di Quarata* formation, and perhaps also fired their kilns with peat, which they were able to excavate together with this clay This may well have constituted a nexus of advantages that was instrumental in the later emergence of the Arretine ITS industry. During the period ca. 250 – 200 B.C. this pattern may have continued, with perhaps some alterations to the organization or technology of BGW manufacture at Volterra and the introduction of NERSW in the form of a medium- to low-quality production perhaps from Volterra.

During the period ca. 200 – 150/125 B.C. the inhabitants of Cetamura continued to consume significant amounts of high-quality BGW from Arezzo and probably Volterra, but also now consumed significant, if perhaps more modest amounts of medium- and low-quality BGW probably originating at three or four other locations in northern Etruria, including some situated in some of those areas listed above. They also consumed significant amounts of one particular vessel form in NERSW, the Morel1211 bowl, a high- to low-quality product manufactured at four different locations in northern Etruria, and small amounts of medium- to low-quality closed vessels in NERSW originating in two other locations, including perhaps Volterra and places in some of those areas listed above. The small amount of comparative evidence available suggests that these medium- to low-quality productions of BGW and North-Etrurian Red-Slip Ware may have been manufactured by workshops that turned out a wide range of products. Such a production model may contrast with that of the workshops at Arezzo and presumably Volterra, where high-quality BGW originated, which may have been more

specialized. The wide array of slipped tablewares consumed at Cetamura during this period points to the existence of a more developed and perhaps more complex set of distribution mechanisms than that in place during the earlier periods.

During the period ca. 40/10 B.C. – A.D. 100/150 ITS was the sole class of slipped tableware consumed at Cetamura, and virtually all of this originated at Arezzo. This is hardly surprising, given the prominent role of Arezzo in the ITS industry, the proximity of Arezzo to Cetamura, and the likelihood that the mechanisms for the distribution of Arretine ITS to overseas markets would have allowed for its economical distribution to settlements in the Monti del Chianti.

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APPENDIX 1: POTTERY CATALOG

This appendix presents catalog entries for the 78 pottery specimens included in the program of anlysi. These are arranged first by pottery class, then by fabric group, then by form. For the specimens of BGW the typological schemes employed are those published in Lamboglia 1952 and the supplement to this published in Morel 1963, with reference also to Morel 1994 as warranted. For the specimens of NERSW the sole form for which a typological designation is employed is drawn from the typological scheme for BGW published in Morel 1994. For ITS the typological scheme employed is that published in Ettlinger 1990 (= Conspectus).

Each entry begins with the specimen's catalog number, followed in parentheses by its accession number, stratigraphic unit, and deposit number, as relevant. In cases in which a specimen was subjected to petrographic analysis this is also indicated. This is followed by a brief description of the piece and, where useful, additional information regarding its form, production, and/or date. All parts of a vessel between its rim and base are characterized as wall, with the area above/inside of a ring foot referred to as floor. Colors for ceramic bodies here and in Appendices 2 and 4 are given using the notation from the *Munsell Soil Color Charts*, interpolating between color chips as this seemed warranted. All dimensions are given in centimeters. The following abbreviations are employed to indicate dimensions: d. = diameter; ft.= foot; h. = handle; r. = rim; th. = thickness; w. = wall.

Drawings of the specimens of BGW Fabric Group 1 are presented in Figure 8, of BGW Fabric Group 2 in Figure 9, of BGW Fabric Groups 3-8 in Figure 10, of NERSW Fabric Groups 1-8 in Figure 11, of ITS Fabric Deposit 1 in Figure 12, and of ITS Fabric

Groups 2-3 in Figure 13. No drawing is presented for two specimens, both BGW lamps: BGW2.10 and BGW3.04. For rim or base fragments for which it was possible to establish the rim or base diameter with some degree of certainty both a section profile and an exterior view are presented (employing the figure for the mid-point in cases where a measurement was obtained as a range, e.g., 22 for a measurement of 21-23 cm). For those specimens too small to permit a determination of the rim or base diameter but large enough to allow the determination of the proper orientation just the section profile is presented, with a top line or bottom line and lines showing interior features projected to the right and lines showing exterior features projected to the left. For specimens too small to permit a determination of the proper orientation, the section profile is presented in what is thought most likely to be the correct orientation, with the top line or bottom line omitted. A section profile is provided for specimens that are body sherds, with a drawing of the sherd also provided in cases where this bears incised decoration.

Black-Gloss Ware

Black-Gloss Ware Fabric Group 1

Lamboglia Form 5 (dish/plate with broad, flat floor, low, more or less sharply curved wall with rounded rim, and ring foot)

BGW1.01 (C-87-085; Locus: Structure B 02 [= Deposit 3]; thin section) Fragment of rim and wall. Hard, pinkish gray (5YR 7/2) body with poorly preserved, matte, dark gray slip on both surfaces. D. r. ca. 16.

Form/production/date: Morel Form 5/2255. This form attested for presumed Arezzo production at Fiesole – Via Marini – Via Portigiani (Body 3) in context dated 150-125

B.C. [111] and at Chiusi – Orto del Vescovo (Group A1) in small amounts in contexts dated 200-170 B.C. and in abundance in contexts dated 170-140 B.C.[112]

Lamboglia Form 28 (cup/bowl with gently curved wall with slightly everted rim and ring foot)

BGW1.02 (C-S-048; Locus: Structure B 02 [= Deposit 3]) Fragment of rim and wall. Soft, pink (4YR 7.2/4) body with glossy slip, very dark gray with bluish tones, on both surfaces. D. r. 20-21; th. w. 0.5.

Form/production/date: Morel Form 28/2652-3. These forms attested for presumed Arezzo production at Fiesole – Via Marini – Via Portigiani (Bodies 1 and 3) in contexts dated 150-125 B.C.,[113] and at Chiusi – Orto del Vescovo (Group A1) in abundance in contexts dated 170-140 B.C.[114]

Open vessel with everted rim and steep upper wall (Lamboglia Form 28?)

BGW1.03 (C-S-039; Locus: Structure B 04 [= Deposit 2]) Fragment of rim and wall. Soft, pink (5YR 7.5/4) body with slightly glossy to glossy slip, dark reddish brown to very dark gray with bluish tones, on both surfaces. Th. w. 0.5.

Form/production/date: For date of Lamboglia 28 in Arezzo production see BGW1.02. This is too late for date posited for closing of Deposit 2.

Morel Form 80 (cup/bowl with shallow, gently curved wall with everted/ downcurved rim and ring foot)

BGW1.04 (C-S-043; Locus: Structure B 02 [= Deposit 3]) Fragment of rim. Soft, pink/light brown (7YR 6.5/4) body with glossy slip, very dark gray with bluish tones, on both surfaces. Th. w. 0.5.

Form/production/date: Morel Form 80 produced by Arezzo and Volterra workshops throughout third century B.C.[115]

Morel Form 83 (bowl with moderately curved wall, thickened, undercut rim, and ring foot)

BGW1.05 (C-S-045; Locus: Structure B 02 [= Deposit 3]) Fragment of rim and wall. Soft, pink (4YR 7.2/2) body with glossy slip, dark gray to very dark gray with bluish tones, on both surfaces. D. r. 15-16; th. w. 0.3.

Form/production/date: Morel Form 83/2536/2538. These forms attested for presumed Arezzo production at Fiesole – Via Marini – Via Portigiani (Bodies 4, 13) in contexts dated 150-125 B.C.[116] and at Chiusi – Orto del Vescovo (Group A1) in abundance in contexts dated 170-140 and in small amounts in contexts dated 110-50 B.C.[117]

BGW1.06 (C-S-044; Locus: Structure B 02 [= Deposit 3]) Fragment of rim and wall. Broad groove on exterior surface immediately below rim. Soft, pink (5YR 7/4) body with glossy slip, very dark gray with metallic luster, on both surfaces. Th. w. 0.5.

Form/production/date: Morel Form 83/2563. This form is not attested for presumed Arezzo production at either Fiesole – Via Marini – Via Portigiani or Chiusi – Orto del Vescovo. It is attested for assumed Volterra productions (Groups A-C and T) at Volterra

– Acropoli in small amounts in contexts dated to end fourth/beginning third century, second half third century, and mid second century B.C.[118]

Cup with thin, steep, slightly curved upper/middle wall and one or (most likely) two (most likely horizontal) handles attached to the wall well below rim

BGW1.07 (C-88-166; Locus: Trench AA 07 [= Deposit 1]) Ten fragments (some joining) of rim, upper wall, and handle attachment. Soft, pink (7.5YR 7.2/4) body with black slip on both surfaces. Th. w. 0.3/0.4.

Form/production/date: Level of handle attachment suggests form similar to Morel 4244 cup, attested in presumed Volterra productions from last quarter fourth and third centuries B.C.[119]

Open form (bowl/dish/plate) with flat floor with incised decoration

BGW1.08 (C-88-135; Locus: Trench AA 06 [= Deposit 1]) Fragment of floor. Soft, pink (7.5YR 7/4) body with slightly glossy, dark gray slip on interior surface and one patch on exterior surface. Incised decoration on interior surface consisting of circular groove with lines radiating from it. Th. w. 0.4/0.5.

Open form (dish/plate) with near horizontal, slightly curved lower wall

BGW1.09 (C-S-001; Locus: Trench AA 06 [= Deposit 1]; thin section) Fragment of lower wall. Soft, pink (4YR 6.8/4) body with glossy, dark gray slip on both surfaces. Th. w. 0.35-0.4.

BGW1.10 (C-S-002; Locus: Trench AA 07 [= Deposit 1]) Fragment of lower wall. Soft pink (4.5YR 7/4) body, shading to slightly grayer near interior surface, with glossy, black slip on both surfaces. Th. w. 0.5.

Vessel with everted rim with furrow in outer face

BGW1.11 (C-S-047; Locus: Structure B 02 [= Deposit 3]) Fragment of rim. Soft, pink (5YR 7/4) body with glossy to very glossy slip, very dark gray with bluish tones, on both surfaces.

Closed vessel with steep, straight lower wall

BGW1.12 (C-S-051; Locus: Structure B 02/04 [= Deposit 3]) Fragment of lower wall. Light wheel ridging on interior surface. Hard, pink (5YR 7/4) body with very glossy slip, very dark gray with bluish tones, on both surfaces. Th. w. 0.4.

Black-Gloss Ware Fabric Group 2

Lamboglia Form 5

BGW2.01 (C-S-050; Locus: Structure B 02/04 [= Deposit 3]) Fragment of rim and wall (Morel 2252). Hard, pinkish gray (5YR 7/2) body with very glossy slip, very dark gray with bluish tones, on both surfaces. Th. w. 0.6.

BGW2.02 (C-S-052; Locus: Structure B 02/04 [= Deposit 3]) Fragment of rim and wall. Medium hardness, pink (5YR 6.8/4) body with very glossy slip, very dark gray with

bluish tones, on both surfaces. D. r. 25-26; th. w. 0.4. (Analysis of data for chemical composition suggests might belong to BGW Fabric Group 1.)

Form/production/date: Both probably Morel Form 5/2250 series. Morel Form 2255 attested in presumed Volterra production at Fiesole – Via Marini – Via Portigiani (Body 7) in context dated 150-125 B.C.[120] Morel 2250 series attested in presumed Volterra production at Volterra – Acropoli (Group T) in contexts dated to mid-second and first half of first century B.C,[121] and Morel Form 2252 attested in presumed Volterra productions at Volterra – Acropoli (Groups A-C, U) in contexts dated to mid second and first half of first century B.C.[122]

Vessel with thin, steep, concave upper wall and single vertical handle (Lamboglia Form 10 cup?)

BGW2.03 (C-S-038; Locus: Structure B 02 [= Deposit 3]) Fragment of rim, wall, and attachment of strap handle. Soft, pink (5YR 7/4) body with poorly preserved, slightly glossy, reddish brown to very dark gray slip on interior surface and a few spots on exterior surface. Th. w. 0.3.

Form/production/date: Probably Morel Form 10/3450 series, especially Form 3451. These forms attested in assumed Volterran production at Volterra – Acropoli (Groups A-C) in contexts dated to beginning of second, mid second, and first half of first century B.C,[123] and at Fiesole – Via Marini – Via Portigiani (Body 7) in context dated 150-125 B.C.[124]

Morel Form 80

BGW2.04 (C-S-040; Locus: Structure B 04 [= Deposit 2]) Fragment of rim and wall. Soft, pink (5YR 7.5/3) body with glossy to very glossy slip, very dark gray slip with bluish tones, on both surfaces. D. r. ca. 18; th. w. 1.0-1.1.

Form/production/date: See BGW1.03. Probably Morel Form 80/1262. This form attested in presumed Volterran production at Volterra – Acropoli (Group U) in contexts dated to beginning of the second century B.C.[125]

Open vessel with steep, gently curved middle/upper wall with rim slightly thickened on interior (Morel Form 82 cup?)

BGW2.05 (C-S-046; Locus: Structure B 02 [= Deposit 3]; thin section) Fragment of rim and wall. Soft, pink (7YR 7/4) body with glossy slip, very dark gray with bluish tones, on interior surface, and matte to slightly glossy slip, dark gray to very dark gray with reddish brown blotches on exterior surface. Th. w. 0.4

Form/production/date: Probably Morel Form 82/4100 series. This series attested in presumed Volterran production at Volterra – Acropoli (Groups A-C) in abundance in contexts dated from end of fourth/beginning of third to middle of second century, and in small mounts in contexts dated to first half of first century B.C.[126]

Morel Form 83

BGW2.06 (C-S-035; Locus: Structure B 02 [= Deposit 3]) Fragment of rim and wall. Soft, pink (5YR 7.5/4) body with matte to slightly glossy, very dark gray to black slip on both surfaces. D.r. 14-17; th. w. 0.4.

Form/production/date: Morel Form 83/2538. This form attested in presumed Volterran productions at Volterra – Acropoli (Groups A-C, T, U, and Z) in small amounts in contexts dated from end of fourth to second half of third century, in abundance in contexts dated from end of third to middle of second century B.C., and in small amounts in contexts dated to first half of the first century B.C.[127]

Open vessel (dish/plate) with flat, horizontal lower wall with concentric groove decoration

BGW2.07 (C-S-037; Locus: Structure B 02 [= Deposit 3]) Fragment of lower wall. Soft, pink/light reddish brown (5YR 6.5/4) body with glossy to very glossy slip, very dark gray to black with bluish tones, on both surfaces. Incised decoration on interior surface consisting of two circular grooves. Th. w. 1.0-1.4.

Open vessel (dish/plate) with straight, horizontal lower wall

BGW2.08 (C-S-036; Locus: Structure B 02 [= Deposit 3]) Fragment of lower wall. Soft, pink (7.5YR 6.8/4) to gray (10YR 5.5/1) body with glossy to very glossy, very dark gray slip on both surfaces. Th. w. 0.6. (Analysis of data for chemical composition suggests might belong to BGW Fabric Group 1.)

Closed vessel with steep, gently curved lower wall

BGW2.09 (C-S-033; Locus: Structure B 02 [= Deposit 3]) Fragment of middle/lower wall. Turning grooves on interior surface. Soft, pink (7.5YR 6.8/3.5) body with matte to

slightly glossy slip, very dark gray to very dusky red, on exterior surface and one drip on interior surface. Th. w. 0.5-0.7.

Lamp

BGW2.10 (C-87-078; Locus: Structure B 02 [= Deposit 3]) Fragment of wall. Soft, pink (4.5YR 8/4) body with very poorly preserved, matte, dark gray to very dark gray slip on both surfaces. Th. w. 0.5. (Analysis of data for chemical composition suggests might belong to BGW Fabric Group 1.)

Form/production/date: Lamps attested in presumed Volterran production at Volterra – Acropoli (Groups A-C) in contexts dated to beginning and middle of second century B.C.[128]

Black-Gloss Ware Fabric Group 3

Open form (cup/bowl) with thin, straight, steep upper wall

BGW3.01 (C-88-173; Locus: Trench AA 07 [= Deposit 1]) Fragment of rim and upper wall. Soft, pink (7.5YR 7/4) body with black slip on both surfaces. D.r. ca. 14; th. w. 0.3.

Open form (cup/bowl) with curved lower wall and floor with stamped decoration and ring foot

BGW3.02 (C-88-125; Locus: Trench AA 06 [= Deposit 1]; thin section) Four fragments of wall, ring-foot, and floor. Soft, pink (7YR 7.5/4) body with no slip preserved on either

surface. Interior surface preserves traces of what appears to be stamped decoration consisting of palmettes. D.ft. 8; th.w. 0.4.

Form/production/date: Perhaps Pasquinucci Form 82/Morel Form 4115 or similar, which is attested at Volterra in presumed Volterran production (Pasquinucci Produzione D = Volterra – Acropoli Groups A-C) and dated to third to first half of second century B.C.[129]

Open form (dish/plate) with slightly curved, horizontal lower wall with incised decoration

BGW3.03 (C-88-168; Locus: Trench AA 07 [= Deposit 1]) Fragment of lower wall. Soft, pinkish gray (7.5YR 6.5/2) body with glossy, very dark gray slip on both surfaces. Incised decoration on interior surface consisting of radiating lines in groups of three enclosed by two circular grooves. Central line in each group of three straight, two flanking lines bent outward at their distal end. Th. w. 0.4.

Lamp

BGW3.04 (C-87-232; Locus: Structure B 02 [= Deposit 3]) Fragment of wall. Soft, pink (7.5YR 7/4) body with glossy, dark gray to very dark gray slip on both surfaces. Th. w. 0.6.

Form/production/date: For date of production of BGW lamps at Volterra see BGW2.10.

Black-Gloss Ware Fabric Group 4

Open vessel (cup/bowl/dish) with steep, gently curved upper/middle wall with rim coming to point at inner side (Morel Form 82 cup?)

BGW4.01 (C-S-041; Locus: Structure B 04 [= Deposit 2]; thin section) Fragment of rim and upper wall. Soft, pink (5YR 7.5/4) body with very glossy, very dark gray slip on both surfaces. Th. w. 0.4.

Form/production/date: For date of production of Morel Form 82 at Volterra see BGW 2.05.

Morel Form 83

BGW4.02 (C-S-042; Locus: Structure B 04 [= Deposit 2]) Fragment of rim and upper wall. Soft, pink (5YR 7/4) body with poorly preserved, slightly glossy, very dark gray slip on both surfaces. Th. w. 0.5.

Form/production/date: Morel Form 83/2538. For date of production of this form at Volterra see BGW 2.06.

Black-Gloss Ware Fabric Group 5

Vessel with steep, concave upper wall with everted rim

BGW5.01 (C-S-049; Locus: Structure B 02 [= Deposit 3]) Fragment of rim and wall. Hard, pink (5YR 7/3) body with poorly preserved, matte, dark gray slip on both surfaces. Th. w. 0.5.

BGW5.02 (C-S-056; Locus: Trench 21.5N15W 06) Fragment of rim and wall. Slightly gritty, pink (5YR 7/4) body with matte, dark gray slip on both surfaces. Th. w. 0.6.

Open vessel (cup/bowl/dish) with steep, curved upper wall and thickened rim with pointed outer face

BGW5.03 (C-S-034; Locus: Structure B 02 [= Deposit 3]) Fragment of rim and wall. Hard, light reddish brown (5YR 6/3.5) body with poorly preserved, glossy slip, mottled dark brown to very dark gray, on both surfaces. Th. w. 0.5.

Form/production/date: Perhaps from vessel similar to Chiusi – Marcianella VN II.11.2, dated first quarter to middle second century B.C.[130]

Open vessel (bowl/dish) with straight, slightly inclined lower wall

BGW5.04 (C-S-054; Locus: Structure B 02/04 [= Deposit 3]) Fragment of wall. Slightly gritty, pink (4.5YR 7.5/4) body with dark gray slip on both surfaces. Th. w. 0.4-0.6.

Open vessel (dish/plate) with straight, slightly inclined lower wall with groove and chatter decoration

BGW5.05 (C-S-057; Locus: Structure B 01 [= Deposit 3]; thin section) Fragment of wall. Incised decoration on interior surface consisting of two circular grooves enclosing two or three rows of chattering. Slightly gritty, light red (3.5YR 6/4) body with matte to slightly glossy, dark gray slip, even on interior surface, uneven on exterior surface. Th. w. 0.3-0.8.

Closed vessel with ring foot and steep lower wall

BGW5.06 (C-88-074; Locus: Trench +2R 8.5 01) Fragments of wall, ring foot, and floor. Slightly gritty, pink (6.5YR 7/4) body with poorly preserved, matte, reddish gray to dark reddish gray slip on exterior of wall and interior and exterior of foot. D. ft. ca. 5; th. w. 0.9.

Form/production/date: Perhaps from vessel similar to Chiusi – Marcianella VN X.1.1, dated end of third to middle second century B.C.[131]

Black-Gloss Ware Fabric Group 6

Open vessel (cup/bowl/dish) with curved wall

BGW6.01 (C-S-032; Locus: Structure B 02 [= Deposit 3]; thin section) Fragment of wall. Soft, light red (2YR 6/8) body with poorly preserved, glossy slip, mottled reddish brown/dark reddish brown, on both surfaces. Th. w. 0.5.

Black-Gloss Ware Fabric Group 7

Open vessel (cup/bowl) with ring foot and sloping floor

BGW7.01 (C-S-055; Locus: Trench 25N9E 04; thin section) Fragment of ring foot and floor. Slightly gritty, reddish brown (5YR 6.2/4) body with very poorly preserved, matte, dark brown slip on interior and exterior of foot and floor.

Black-Gloss Ware Fabric Group 8

Open vessel with shallow, slightly curved upper wall, vertical hanging rim (Lamboglia Form 23 plate?)

BGW8.01 (C-87-081; Locus: Structure B 02 [= Deposit 3]; thin section) Fragment of rim and wall. Gritty, pink (4YR 7.5/4) body with (matte?) gray slip on both surfaces. Th. w. 0.7.

Form/production/date: Lamboglia Form 23 (= Morel 1120-1130 series) widely attested in northern Etruria in late third and early second century B.C.[132]

Open vessel (cup/bowl/dish) with curved, moderately inclined middle/lower wall

BGW8.02 (C-S-058; Locus: Structure B 01 [=Deposit 3]) Fragment of wall. Gritty, reddish yellow (5YR 7/6) body with light gray core with very poorly preserved matte, dark gray slip on both surfaces. Th. w. 0.5

Vessel with one or more broad, loop-shaped handles

BGW8.03 (C-88-068; Locus: Trench -1R8.5 01) Three joining fragments of strap handle. Two broad furrows on both surfaces from pulling. Slightly gritty, reddish yellow (4.5YR 6/6) body with poorly preserved, matte, dark reddish gray slip on all surfaces. Th. w 1.2; width h. 3.5.

Unidentified form

BGW8.04 (C-S-053; Locus: Structure B 02 [= Deposit 3]) Fragment of wall. Gritty, pink (4YR 7.5/4) body with very poorly preserved, matte, dark gray slip on one surface.

North Etrurian Red-Slip Ware

North Etrurian Red-Slip Ware Fabric Group 1

Morel 1211 (Bowl with everted rim with furrow inside, low wall, and broad, flat base)

NERSW1.01 (C-S-064; Locus: Structure B 01 [= Deposit 3]; thin section) Fragment of rim and wall. Soft, light reddish brown (5YR 6/3.5) body with poorly preserved, red (2.5YR 4.5/8) slip on both surfaces. Th. w. 0.6.

Form: Shape of rim perhaps very close to example from Volterra – Acropoli Group 1.[133]

North Etrurian Red-Slip Ware Fabric Group 2

Open vessel (cup/bowl/dish) with straight, horizontal lower wall and abrupt bend to steep middle wall

NERSW2.01 (C-87-338; Locus: Structure B 04 [= Deposit 2]) Fragment of floor of open form (not Morel 1211). Soft, reddish yellow (4YR 6.8/7.5) body with glossy red (2.5YR 4.5/6) slip on interior surface and matte, spotty, dusky red slip (2.5YR 3/1.5) on exterior surface. Th. w. 0.7. (Appearance and analysis of data for chemical composition suggest might belong to BGW Fabric Group 2 or 5.)

North Etrurian Red-Slip Ware Fabric Group 3

Morel 1211

NERSW3.01 (C-87-061; Locus: Structure B 02 [= Deposit 3]) Two joining fragments of rim and wall. Soft, pink (4YR 7.5/4) body with poorly preserved, reddish slip on both surfaces. D. r. 19-21.

NERSW3.02 (C-87-062; Locus: Structure B 02 [= Deposit 3]) Two joining fragments of rim and wall. Soft, reddish yellow (4YR 7/6) body with poorly preserved, slightly glossy, red (10R 4.5/8) slip on both surfaces. D. r. 18-21.

NERSW3.03 (C-S-061; Locus: Structure B 02 [= Deposit 3]) Two non-joining fragments of rim and wall. Soft, reddish yellow (3.5YR 6.5/6) body with poorly preserved, slightly glossy, red (2.5YR 4.5/6) slip on both surfaces. Th. w. 0.5-0.6..
Form: Shape of rim very close to example from Volterra – Acropoli Group 2.[134]

NERSW3.04 (C-S-059; Locus: Structure B 02 [= Deposit 3]; thin section) Fragment of rim and wall. Soft, pink (6.5YR 6.5/4) body with poorly preserved, slightly glossy, red (3YR 4.5/6) slip on interior surface. Th. w. 0.4.

NERSW3.05 (C-S-066; Locus: Trench -1R8.5 02) Fragment of rim and wall. Soft light reddish brown (4YR 6/4) body with poorly preserved, red (2.5YR 5/6) slip on interior surface. Th. w. 0.5.
Form: Shape of rim very close to two examples from Chiusi – Marcianella.[135]

North Etrurian Red-Slip Ware Fabric Group 4

Morel 1211

NERSW4.01 (C-S-060; Locus: Structure B 02 [= Deposit 3]) Fragment of rim and wall. Soft, reddish yellow (4YR 6/7) body with poorly preserved, red (2.5YR 5/7) slip on interior surface. Th. w. 0.5.

NERSW4.02 (C-S-065; Locus: Structure B 01 [Deposit 3]) Fragment of rim. Soft body, pink (5YR 8/4), with light red (2.5YR 6/6) core, with poorly preserved, reddish slip on interior surface.

NERSW4.03 (C-S-068; Locus: Trench 76.5N4W 05; thin section) Fragment of rim. Soft reddish yellow (4YR 7/6) body with poorly preserved, red (3YR 5/6) slip on both surfaces.

North Etrurian Red-Slip Ware Fabric Group 5

Morel 1211

NERSW5.01 (C-S-062; Locus: Structure B 01 [Deposit 3]; thin section) Fragment of rim and wall. Soft body, light red (2.5YR 5.8/6) body with faint pink core with poorly preserved, red (2.5YR 5/6) slip on both surfaces. Th. w. 0.5.

Form: Shape of rim very close to example from Volterra – Acropoli Group 2.[136]

North Etrurian Red-Slip Ware Fabric Group 6

Closed vessel with curved shoulder and neck

NERSW6.01 (C-S-063; Locus: Structure B 01 [Deposit 3]) Fragment of shoulder. Soft pink (4.5YR 7/3.5) body with poorly preserved, reddish slip on exterior surface. Th. w. 0.3-0.4.

North Etrurian Red-Slip Ware Fabric Group 7

Closed vessel with straight, inclined shoulder

NERSW7.01 (C-S-069; Locus: Trench 0.R6 02; thin section) Fragment of wall. Wheel ridging on interior surface. Soft pink (4.5YR 7/3.5) body with poorly preserved, red (2.5YR 5/8) slip on exterior surface. Th. w. 0.3-0.4.

North Etrurian Red-Slip Ware Fabric Group 8

Vessel with steep, concave upper wall or neck (deep/medium open or closed vessel?)

NERSW8.01 (C-87-330; Locus: Structure B 04 [= Deposit 2]; thin section) Fragment of rim and upper wall. Soft pink (4.5YR 7/3.5) body with poorly preserved, red (2.5YR 4.5/7) slip on both surfaces. Th. w. 0.4.

Form/production/date: Form perhaps close to deep/medium open vessel from Volterra – Acropoli Group 2 dated 150-50 B.C. and/or deep/medium vessel from Chiusi – Marcianella dated end third to first quarter second century B.C.[137]

Italian Terra Sigillata

Italian Terra Sigillata Fabric Fabric Group 1

Conspectus Form 1 (Platter/plate with sloping wall and plain rim)

ITS1.01 (C-87-261; Locus: Trench 29N18E 03) Fragment of rim and wall. Soft, light red (lighter than 10R 6/6) body with glossy, red (2.5YR 4.8/6) slip on both surfaces. D.r. 21.5; th. w. 0.5.

Form/date: Conspectus Form 1.1.1; ca. 40-10 B.C.[138]

Conspectus Form 3 (Dish with sloping wall with bead rim)

ITS1.02 (C-S-090; Locus: Trench 21.5N9W 06) Fragment of rim and wall. Soft, light red (1.5YR 7/6) body with glossy, red (10R 4.5/6) slip on both surfaces. Th. w. 0.5.

Form/date: Conspectus Form 3.1?; ca. A.D. 40 – first half of second century.[139]

ITS1.03 (C-S-091; Locus: Trench 26N10.5E 06) Fragment of rim and wall. Soft, pink (5YR 6.8/4) body with glossy, red (10R 4.8/8) slip on both surfaces. Th. w. 0.4.

Form: Conspectus Form 3.2? For date see ITS1.02.

ITS1.04 (C-87-380; Locus: Trench 21.5N15W 06) Fragment of rim and wall. Medium hardness, light red (1.5YR 6/7) body with glossy, red (1YR 4/8) slip on both surfaces. Th. w. 0.5.

Form: Conspectus Form 3.3. For date see ITS1.02.

Conspectus Form 4 (Platter/plate with curving wall and plain rim)

ITS1.05 (C-S-088; Locus: Trench 29N18E 03) Fragment of rim and wall. Medium hard, pink (4YR 7/4) body with glossy, red (10R 4.2/8) slip on both surfaces. D.r. 15-16; th. w. 0.4.

Form/date: Conspectus Form 4.3.1; ca. 10 B.C.-A.D. 15.[140]

ITS1.06 (C-88-013; Locus: Trench 21.5N15W 09) Fragment of rim and wall (Conspectus Form 4.6.1?). Light red (2.5YR 6.2/6) body with glossy, reddish slip on both surfaces. D.r. 12-16; th. w. 0.3.

Form/date: Conspectus Form 4.5/4.6: ca. A.D. 15-55.[141]

Conspectus Form 12 (Plate/platter with narrow hanging lip)

ITS1.07 (C-87-363; Locus: Trench 21.5N15W 06) Fragment of rim and wall. Soft, light red (2YR 6/6) body with glossy, red (2.5YR 4.5/8) slip on both surfaces. Th. w. 0.4.

Form/date: Conspectus Form 12.2.2; ca. 15 B.C. - A.D. 10.[142]

ITS1.08 (C-87-017; Locus: Trench 29N15E 03) Two joining fragments of rim and wall. Soft, pink/light reddish brown (4.5YR 7.5/4) body with glossy, red (10R 4.5/8) slip on both surfaces. Th. w. 0.4-0.6.

Form/date: Conspectus Form 12.1? For date see ITS1.07.

Conspectus Form 14 (Campanulate cup with narrow hanging rim)

ITS1.09 (C-88-004; Locus: Trench 21.5N9W 06) Fragment of rim and wall. Medium hardness, reddish brown (2YR 5/4) body with glossy, reddish slip on both surfaces. Th. w. 0.3.

Form/date: Conspectus Form 14.1.3; ca. 15 B.C. – A.D. 10.[143]

Conspectus Form 18 (Platter/plate with concave vertical rim)

ITS1.10 (C-88-099; Locus: Trench 21.5N9W 07) Fragment of rim and wall. Medium hardness, reddish yellow (4YR 6/6) body with glossy, reddish brown/red (2YR 4/5) slip on both surfaces. Th. w. 0.3-0.4.

Form/date: Conspectus Form 18.2?; ca. 10 B.C. – A.D. 30.[144]

Conspectus Form 19 (Platter/plate with concave vertical rim and quarter-round molding or step between wall and floor)

ITS1.11 (C-87-124; Locus: Trench 29N12E 03) Fragment of rim and wall. Medium hardness, light red (2.5YR 6/6) body with glossy, red (2.5YR 5/6) slip on both surfaces. D.r. ca. 18; th. w. 0.3-0.4.

Form/date: Conspectus Form 19.2.1; ca. A.D. 1-40.[145]

Conspectus Form 20 (Platter/plate with smooth or finely molded vertical rim or platter) or Form 21 (Plate with smooth or finely molded vertical rim and quarter-round molding or step between rim and floor)

ITS1.12 (C-88-202; Locus: Trench 23N9E 04) Fragment of rim and wall. Dolphin appliqué on exterior surface of wall. Soft, reddish yellow (4.5YR 6.5/6) body with glossy, red (2.5YR 5.2/8) slip on both surfaces. D.r. ca. 15-17; th. w. 0.5.

Form/date: Conspectus Form 20.4 or 21.3; ca. A.D. 40-90.[146]

Conspectus Form 29 (Cylindrical cup with hollow base)

ITS1.13 (C-88-193; Locus: Trench 23N9E 03) Fragment of rim and wall. Soft, light reddish brown (2YR 6/4) body with glossy, red (2YR 4.5/6) slip on both surfaces. D.r. 9.5; th. w. 0.3.

Form/date: Conspectus Form 20.4 or 21.3; ca. A.D. 15-95.[147]

Conspectus Form 34 (Hemispherical cup with short vertical rim and pronounced flange on wall)

ITS1.14 (C-88-194; Locus: Trench 23N9E 03; thin section) Fragment of rim and wall. Rosette appliqué on exterior surface of wall. Soft, pink (4YR 7.5/5) body with glossy, red (2YR 5/6) slip on both surfaces. D.r. 11-12; th. w. 0.3.

Form/date: Conspectus Form 34.1.2; ca. A.D. 30-100.[148]

Conspectus Form 37 (Hemispherical cup with articulated rim)

ITS1.15 (C-S-084; Locus: Trench 23N9E 03) Fragment of rim and wall. Two rows of chattering on upper surface of rim. Soft, pink (4YR 7.5/4) body with glossy, red (1YR 4.5/8) slip on both surfaces. D.r. 7-8; th. w. 0.3.

Form/date: Conspectus Form 37.1.2; ca. A.D. 25-100.[149]

Italian Terra Sigillata Fabric Fabric Group 2

Conspectus Form 3

ITS2.01 (C-S-085; Locus: Trench 23N9E 04) Fragment of rim and wall of dish. Medium hard, pale red (10R 5.8/4) body with glossy, red (10R 4.5/6) slip on both surfaces. Th. w. 0.4.

Form/date: Conspectus Form 3.1.2. For date see ITS1.02.

Conspectus Form 4

ITS2.02 (C-S-086; Locus: Trench 25N9E 04) Fragment of wall of platter/plate. Soft, pink (5YR 7/4) body with glossy, red (10R 4.2/6) slip on both surfaces. D.r. 7-8; th. w. 0.7.

Form/date: Conspectus Form 4.5.1? For date see ITS1.06.

Conspectus Form 6 (Platter/plate with plain curving wall and quarter-round molding between wall and floor or platter) or Form 21

ITS2.03 (C-S-089; Locus: Trench 21.5N15W 07) Fragment of wall. Medium hard, light red (2YR 6/6) body with glossy, red (10R 4.5/8) slip on both surfaces. Th. w. 0.6.

Form/date: Conspectus Form 6.1-3 or 21.1-2; ca. A.D. 1-60 or ca. 5 B.C.-A.D. 50.[150]

Conspectus Form 12

ITS2.04 (C-S-087; Locus: Trench 25N9E 04) Fragment of rim and wall. Soft, pink (4.5YR 6.8/4) body with glossy, red (2.5YR 4/7) slip on both surfaces. Th. w. 0.3.

Form/date: Conspectus Form 12.2.2? For date see ITS1.07.

Conspectus Form 20

ITS2.05 (C-88-192; Locus: Trench 23N9E 03/04) Five joining fragments of rim and wall. Soft, pink (4YR 7.5/4) body with glossy, red (1YR 4.5/8) slip on both surfaces. D.r. 18; th. w. 0.7.

Form/date: Conspectus Form 20.2.1; ca. A.D. 1-50.[151]

Conspectus Form 20 or Form 21

ITS2.06 (C-S-083; Locus: Trench 23N9E 03; thin section) Fragment of rim and wall. Soft, pink (4YR 7/4) body with glossy, red (2.5YR 4.2/6) slip on both surfaces. Th. w. 0.5.

Form/date: Conspectus Form 20.2.1?; ca. A.D. 1-50.[152]

ITS2.07 (C-S-092; Locus: Trench 26N10.5E 06) Fragment of wall. Soft, pink (4.5YR 7.5/4) body with glossy, red (10R 4.4/6) slip on both surfaces.

Conspectus Form 23 (Conical cup with smooth vertical rim)

ITS2.08 (C-88-098; Locus: Trench 21.5N15W 13) Fragment of rim and wall. Chattering on exterior face of rim and on carination. Medium hardness, pink (5YR 7/4) body with glossy, red (2.5YR 4.5/6) slip on both surfaces. Th. w. 0.4.

Form/date: Conspectus Form 23.2; ca. A.D. 25-75.[153]

Italian Terra Sigillata Fabric Group 3

Conspectus Form 20 or Form 21

ITS3.01 (C-87-314; Locus: Trench 18.5N12W 15) Fragment of rim and wall. Rosette appliqué on exterior surface of wall. Medium hardness, light red (2YR 6/6) body with glossy, red (1.5YR 4.5/7) slip on both surfaces. Th. w. 0.4.

Form/date: Conspectus Form 20.4 or 21.7; ca. A.D. 40-90.[154]

APPENDIX 2: CLAY CATALOG

This appendix presents catalog entries for the 22 clay specimens included in the program of analysis. These are arranged first by geologic period and then by source.

Each entry begins with the specimen's catalog number (referring to a larger corpus of potting clays from Toscana, Umbria, Lazio, and Campania collected by one of the authors (JTP),[155] followed in parentheses by the map coordinates and elevation of the point where it was collected, where this information is known. This is followed by information regarding the nature of the specimen, the geologic formation from which it derives, the method of collection, the identity of the collector and the date of collection, the method employed to produce a test tile from it, and, finally, an indication of the material's color in its raw and fired states.

Paleogene Clay

Cetamura (Provincia di Siena)

CCET.01 (Clay 21) (ca. 0.2 km ENE of Cetamura; 32T 696805 m E 4818527 m N, elevation 645 m a.s.l.) Clod of clay from formation Fg 113 csp (*calcareniti degli scisti policromi*/calcarenites belonging to the polychrome schists) recovered from pit dug into seep by JTP (8/11/90). Fired to 900 degrees C. Color: raw: mottled, mostly light gray (2/5Y 7/1); fired: reddish yellow (4YR 6/6).

Holigocene Marine Clay

Radda - Castiglioni (Provincia di Siena)

CRCS.01 (Clay 22) (ca. 2.5 km NE of Radda and ca. 2.0 km WNW of Cetamura; 32T 694724 m E 4818880 m N, elevation 418 m a.s.l.) Clod of clay from formation Fg 113 c' (*complesso caotico - argille scagliose*/caotic complex – platy clays) recovered from road cut by JTP (8/11/90). Coarse fraction removed by sifting disaggregated bulk specimen through 0.5 mm steel mesh. Fired to 900 degrees C. Color: raw (bulk clay): very pale brown/pale brown (10YR 6.5/3); fired: light reddish brown (4YR 6.2/3.5).

Upper Miocene Lacustrine Clay (?)

Colle Val d'Elsa – Belvedere (Provincia di Siena)

CCVB.01 (Clay 11) Clod collected from clay store on grounds of Ceramica Vulcania cookware factory (Colle Val d'Elsa) by JTP (8/8/90). Said to be from clay pit at località Belvedere, ca. 4-5 to SE of town, though more likely from locale of this name ca. 6 km to NE of town. Perhaps from formation Fg 113 Mlc_2 (*conglomerati lacustri*/ lacustrine conglomerates). Fired to 900 degrees C. Color: raw: brownish yellow (1Y 6/8); fired: light red (2.5YR 5.8/8).

Pliocene Marine Clay and Sandy Clay

Volterra (Provincia di Pisa)

CVLT.01 (Clay 53) (ca. 5.0 km SW of Volterra; 32T 647420 m E 4803480 m N, elevation 120-125 m a.s.l.) Clod of clay from outcrop of formation Fg 112 Pag (*argille azzurre/*blue clays) recovered from surface of plowed field by JTP (7/24/91). Fired to 900 degrees C. Color: raw: light gray/light brownish gray (2.5Y 6.5/2); fired: pink/reddish yellow (4.5YR 7/5).

CVLT.02 (Clay 54) (ca. 4.5 km SW of Volterra; 32T 647758 m E 4803736 m N, elevation 105-115 m a.s.l.) Clod cut from weathered scarp of outcrop of formation Fg 112 Pag (*argille azzurre*/blue clays) by JTP (7/24/91). Fired to 900 degrees C. Color: raw: gray (5Y 5/1); fired: pink (4.5YR 7.5/4).

CVLT.03 (Clay 55) (ca. 2.1 km SW of Volterra; 32T 649249 m E 4805930 m N, elevation 238-240 m a.s.l.) Clod cut from unweathered scarp of outcrop of formation Fg 112 Pag (*argille azzurre*/blue clays) by JTP (7/24/91). Fired to 900 degrees C. Color: raw: light gray (5Y 6.5/1); fired: pinkish white (7YR 8/2).

CVLT.04 (Clay 56) (ca.2.0 5 km SW of Volterra; 32T 649623 m E 4805815 m N, elevation 280-290 m a.s.l.) Clod cut from weathered scarp of outcrop of formation Fg 112 Pag (*argille azzurre*/blue clays) by JTP (7/24/91). Fired to 900 degrees C. Color: raw: gray (5Y 5.5/1); fired: pink (4.5YR 7/4).

CVLT.05 (Clay 58) (ca. 4.6 km NW of Volterra; 32T 648371 m E 4810885 m N, elevation 215-225 m a.s.l.) Clod cut from weathered scarp of outcrop of formation Fg 112 Pag (*argille azzurre*/blue clays) by JTP (7/24/91). Fired to 900 degrees C. Color: raw: gray/dark gray/olive gray (4Y 4.5/1.5); fired: pink (5.5YR 7/4).

CVLT.06 (Clay 57) (ca. 2.4 km NW of Volterra; 32T 649370 m E 4808962 m N, elevation 290-292 m a.s.l.) Clod cut from weathered scarp of outcrop of formation Fg

112 Pag (*argille azzurre*/blue clays) by JTP (7/24/91). Fired to 900 degrees C. Color: raw: light olive gray (4Y 6/2); fired: light red/reddish yellow (3.5YR 6.5/6).

CVLT.07 (Clay 2) (ca. 3.2 km ESE of Volterra; 32T 653521 m E 4806089 m N; elevation 315-325 m a.s.l.) Clod of clay from outcrop of formation Fg 112 Pag (*argille azzurre*/blue clays) recovered from surface of plowed field by JTP (8/9/90). Fired to 900 degrees C. Color: raw: light gray (3.5Y 7/1); fired: light reddish brown (4YR 6.5/4).

Castelnuovo Berardenga Scalo (Provincia di Siena)

CCBS.01 (Clay 4) (ca. 0.4 km ENE of Castelnuovo Berardenga Scalo; 32T 701980 m E 4798074 m N, elevation 234 m a.s.l.) Clod cut from face of Laterizi Arbia architectural ceramics factory clay pit cut into formation Fg 121 Pag^{2-1} (*argille ed argillle sabbiose*/clays and sandy clays) by JTP (8/10/90). Fired to 900 degrees C. Color: raw: light gray (2.5Y 7/1); fired: light reddish brown (4YR 6/4).

CCBS.02 (Clay 5) (ca. 0.4 km ENE of Castelnuovo Berardenga Scalo; 32T 701936 m E 4798073 m N, elevation 230 m a.s.l.) Clod cut from face of Laterizi Arbia architectural ceramics factory clay pit cut into formation Fg 121 Pag^{2-1} (*argille ed argillle sabbiose*/clays and sandy clays) by JTP (8/10/90). Fired to 900 degrees C. Color: raw: light gray (5Y 7/1); fired: reddish yellow (4YR 6.2/6).

CCBS.03 (Clay 6) (ca. 0.4 km ENE of Castelnuovo Berardenga Scalo; Tav. 32T 701904 m E 4798077 m N, elevation 228 m a.s.l.) Clod cut from face of Laterizi Arbia

architectural ceramics factory clay pit cut into formation Fg 121 Pag^{2-1} (*argille ed argillle sabbiose/*clays and sandy clays) by JTP (8/10/90). Fired to 750 degrees C. Color: raw: light gray (5Y 7/1); fired: pink/light reddish brown (4YR 6.5/4).

Plio-Pleistocene Lacustrine Clay

Altopascio (Provincia di Lucca)

CALP.01 (Clay 9) Clod collected from clay store on grounds of Ceramica Vulcania cookware factory (Colle Val d'Elsa) by JTP (8/8/90). Said to be from Altopascio, thus probably from formation Fg 105 Ql (*argille lignitifere, argille sabbiose, e sabbie di ambiente lacustre*/lignite bearing clays, sandy clays, and lacustrine sands). Fine fraction obtained by passing pulverized bulk specimen through 0.5 mm mesh. Fired to 900 degrees C. Color: raw (bulk clay): white (2.5Y 8/1), with surfaces oxidizing very pale brown/yellow (10Y 5.8/5); fired: pink (lighter than 7.5YR 8/4).

Castelfranco di Sopra – Il Matassino (Provincia di Arezzo)

CCFM.01 (Clay 14) (ca. 1.5 km NE of Figline Valdarno) Clod collected from clay store on grounds of Cotto Pratigliolmi architectural ceramics factory by JTP (8/10/90). Said to be from clay pit on premises, thus presumably dug from formation Fg 114 Vag (*argille di Figline*/Figline clays). Fired to 900 degrees C. Color: raw: gray/light gray (5Y 6.5/1); fired: reddish yellow (4.5YR 6.7/6).

CCFM.02 (Clay 15) (ca. 1.5 km NE of Figline Valdarno) Clod collected from clay store on grounds of Cotto Pratigliolmi architectural ceramics factory by JTP (8/10/90). Said to

be from clay pit on premises, thus presumably dug from formation Fg 114 Vag (*argille di Figline*/Figline clays). Fired to 900 degrees C. Color: raw: light yellowish brown (2.5Y 6/4); fired: light red (2YR 6/8).

CCFM.03 (Clay 16) (ca. 1.5 km NE of Figline Valdarno) Clod collected from clay store on grounds of Cotto Pratigliolmi architectural ceramics factory by JTP (8/10/90). Said to be from clay pit on premises, thus presumably dug from formation Fg 114 Vag (*argille di Figline*/Figline clays). Fired to 900 degrees C. Color: raw: pale brown (10YR 6/4); fired: light red (2YR 5.8/8).

CCFM.04 (Clay 17) (ca. 1.5 km NE of Figline Valdarno) Clod collected from clay store on grounds of Cotto Pratigliolmi architectural ceramics factory by JTP (8/10/90). Said to be from clay pit on premises, thus presumably dug from formation Fg 114 Vag (*argille di Figline*/Figline clays). Fired to 900 degrees C. Color: raw: pale yellow (2.5Y 6.8/4); fired: light red (2YR 6/8).

CCFM.05 (Clay 18) (ca. 1.5 km NE of Figline Valdarno) Clod collected from clay store on grounds of Cotto Pratigliolmi architectural ceramics factory by JTP (8/10/90). Said to be from clay pit on premises, thus presumably dug from formation Fg 114 Vag (*argille di Figline*/Figline clays). Fired to 900 degrees C. Color: raw: 5Y 5.5/1 (gray); fired: reddish yellow (4YR 5.5/8).

CCFM.06 (Clay 19) (ca. 1.5 km NE of Figline Valdarno) Clod collected from clay store on grounds of Cotto Pratigliolmi architectural ceramics factory by JTP (8/10/90). Said to be from clay pit on premises, thus presumably dug from formation Fg 114 Vag (*argille di Figline*/Figline clays). Fired to 900 degrees C. Color: raw: light olive gray (5Y 6/2); fired: light red/red (2.5YR 5.5/8).

Arezzo – Quarata (Provincia di Arezzo)

CARQ.01 (Clay 59) (ca. 7.5 km NW of Arezzo; 32T 726274 m E 4819943 m N, elevation 208 m a.s.l.) Clod cut from weathered scarp in formation Fg 114 agQ (*argille di Quarata*/Quarata clays) by JTP (7/26/91). Fired to 900 degrees C. Color: raw: dark brownish gray/very dark gray (2.5Y 3.5/2); fired: light red (2.5YR 6/7).

CARQ.02 (Clay 60) (ca. 6.0 km NW of Arezzo; 32T 726926 m E 4819673 m N, elevation 208 m a.s.l.) Clod of clay from formation Fg 114 agQ (*argille di Quarata*/Quarata clays) recovered from surface of plowed field by JTP (7/26/91). Fired to 900 degrees C. Color: raw: light gray/light olive gray (5Y 6.5/2); fired: light red (2.5YR 7/8).

APPENDIX 3: PETROGRAPHIC ANALYSIS

This appendix describes the program of petrographic analysis, discussing the methods employed, presenting its results in tabular form and discussing these.

In order to obtain a more systematic characterization of the texture of the various fabrics identified in the project and more secure and specific identifications of the inclusions present in these thin sections were fabricated for 17 pottery specimens and subjected to petrographic analysis.[156] These included 2 specimens of BGW Fabric Group 1 and 1 specimen each of BGW Fabric Groups 2-8, 1 specimen each of NERSW Fabric Groups 1, 3-5, and 7-8, and 1 specimen each of ITS Fabric Groups 1-2. No thin section was fabricated for a specimen of either NERSW Fabric Groups 2 and 6 or of ITS Fabric Group 3 due to the lack of a sherd of the requisite size. Thin sections were also fabricated and analyzed for the tiles manufactured from each of the two specimens of Arezzo – Quarata clay (CARQ.01, CARQ.02) so that detailed comparisons could be made of the texture and mineralogy of these clays and pottery specimens judged likely to have been manufactured from them.

Methods

The analysis of each thin section involved the following operations:

1. An estimate was made of the percentage of area of the section occupied by the three basic components of the ceramic body – matrix (the micromass, that is, particles in the fine silt [ca. 10 microns] and smaller size range, presumably for the most part more or less completely transformed clay minerals and, in the case of calcareous ceramic bodies,

calcium carbonate), inclusions (mineral grains and rock fragments in the coarse silt range [ca. 10 microns] and larger), and voids (cavities in the very fine sand size range (ca. 50-100 microns) and larger - by reference to comparator charts.[157] The values reported should be regarded as highly approximate, with figures in the 1-3 percent range representing minor variability that can be apprehended at the low end of the scale.

2. The matrix was characterized for color in approximate terms utilizing the set of color names employed in the *Munsell Soil Color Charts* and for its level of optical activity. Since matrix color varies appreciably in accordance with the thickness of the section this information is intended to communicate only a general idea of the color of this component of the ceramic body. No concentration features (e.g. discreet areas of matrix exhibiting a distinct color or a distinctively higher or lower concentration of opaque and/or translucent bodies) were observed. In three specimens the matrix was found to be partially optically active, while in the rest it proved to be optically inactive.

3. The inclusion component was characterized for body identification (as this could be determined or inferred), abundance (percentage of area), condition, and size. For this the following methods were employed:

Abundance: The percentage of area occupied by each kind of inclusion relative to that occupied by all inclusions was estimated using a comparator chart. The following frequency categories were employed: predominant (> 70 percent); dominant (50-70 percent); frequent (30-50 percent); common (15-30 percent); few (5-15 percent); very few (3-5 percent); rare (0.5-3 percent); very rare (< 0.5 percent).[158]

Condition: The degree of angularity/roundedness was characterized using a comparator chart.[159] The following categories were recognized: angular, subangular, subrounded, rounded.

Size: The size distribution for each kind of inclusion was estimated. The following set of size categories was employed: silt (ca. 10-50 microns); very fine sand (50-100 microns); fine sand (100-200 microns); medium sand (200-500 microns); course sand (500-1000 microns).[160]

An effort was also made to perform a rough quantitative assessment of the distribution of translucent inclusions across the set of size categories. For this, a DCM 130 digital video camera (resolution 1.3 megapixels) was employed to take two photomicrographs – one under plane-polarized light (PPL), the other under cross-polarized light (XPL) - of an area of each thin section judged to be representative of the whole at a magnification of 40 times. The resulting images each covered an area measuring approximately 3.2 x 2.0 mm. The images were opened in Photoshop CS5 for analysis using the View/Show/Grid command, which overlays onto the image a grid composed of squares that at the scale employed have sides measuring ca. 75 microns. The Crop Tool cursor icon consists of a square with sides equal to ca. 50 microns at this scale, and this device was used to determine the approximate size of bodies or areas of interest. Using the XPL image (in which all voids and some portion of the translucent mineral grains and rock fragments were extinguished) a count was made of the number of bodies visible in each of the five size intervals. (In the event, none of the images proved to contain any bodies in the coarse sand interval.) Reference was made to the PPL image in some cases to clarify the nature of a body visible in the XPL image. While the figures

obtained in this way represent only a portion of the bodies present in the portion of the section included in the image, the relative proportions of the number of bodies in the various size intervals probably represent a useful approximation of their true overall representation.[161] The raw count data were converted to percentages of the total count in order to facilitate comparison between sections. Since, the visibility in thin sections of transparent bodies in the lower end of the silt interval varies according to the thickness of the section (and also the intensity of illumination), percentage figures were also produced for just the data pertaining to the four sand intervals.

4. The void component was characterized for shape, abundance, and size range.
The following shapes were recognized: vesicles (regular, fairly spherical cavities), vughs (highly irregular, fairly spherical cavities) and channels (highly elongated cavities). The following size categories were employed: meso (50-500 microns); macro (500-2000 microns).[162]

A summary of the results of the analysis of all 19 thin sections is presented in Table 13. A photomicrograph of a representative area of each of the thin sections taken at a magnification of 40X under PPL is presented in Figures 14A-E.

Discussion of Results

The eight specimens with a fine texture and moderately to highly calcareous chemistry - including five of the nine examples of BGW (BGW1.02, 1.09, 2.05, 3.02, 4.01), one of the six examples of NERSW (NERSW1.01), and both of the examples of ITS (ITS1.14, 2.06) analyzed - display highly similar compositions, with their inclusion component

comprised exclusively or almost exclusively of silt-sized (presumably monocrystalline) quartz and mica. In some examples there are also very rare occurrences of inclusions in the very fine to medium sand size-range, including grains of quartz and laths of mica, grains of polycrystalline quartz and possibly feldspar, and fragments of mudstone and siltstone. This composition indicates that these specimens were manufactured either from a fine calcareous clay or a less fine calcareous clay subjected to levigation. These might have been either a marine clay, such as the Volterra clays, Castelnuovo Berardenga Scalo clay, or Radda - Castiglione clay, or a continental clay laid down in a calcareous environment, such as Arezzo – Quarata clay. The inclusions represented in these specimens are all extremely common and do not shed light on their likely points of origin.[163]

Of these materials, the two specimens of BGW assigned to Arezzo on the basis of the chemical evidence (BGW1.02, 1.09) differ somewhat from one another, with one (BGW1.09) displaying a slightly coarser set of inclusions and a higher apparent ratio of mica to quartz. One of the two specimens of ITS (ITS2.06) - both also assigned to Arezzo on the basis of the chemical evidence - displays a somewhat coarser set of inclusions than the other, with a lower apparent ratio of quartz to mica. Between them, these four specimens contain only a single inclusion that can be identified as something other than monocrystalline quartz or mica - a grain of polycrystalline quartz present in one of the examples of ITS.

The tiles fabricated from the two specimens of Arezzo - Quarata clay (CARQ.01, 02) display characteristics similar to those of the two specimens of BGW and two specimens of ITS assigned to Arezzo on the basis of their chemical composition,

although, in contrast to these specimens, they each contain a single rock fragment of fine sand size, in one case mudstone and in the other siltstone. The overall textural similarity of these two clay specimens to the four pottery specimens suggests that the latter were manufactured from unlevigated clay obtained directly from the same parent formation as the clay specimens. The two specimens of Arezzo - Quarata clay differ somewhat from one another, with one (CARQ.01) having an inclusion component that contains slightly more quartz grains at the coarse end of the silt size category. This observation is compatible with the fact that the two specimens display somewhat different chemical compositions.

The three specimens of BGW and the specimen of NERSW conjecturally assigned to Volterra on the basis of their chemical composition (BGW2.05, 3.02, 4.01; NERSW1.01) display relatively more (although still only very rare) inclusions in the very fine sand to fine sand size range (and, in one instance, a rock fragment of medium sand size) than do the specimens of BGW and ITS assigned to Arezzo, with a greater incidence of polycrystalline quartz and sedimentary rock fragments. All of the Volterra clays collected and analyzed have a substantially coarser texture than these specimens, suggesting either that there were one or more sources of very substantially finer clay known to Volterran potters that were not sampled, which must be regarded as a distinct possibility, given the very considerable extent and complexity of the beds of marine clay exposed in the environs of the town, or that the manufacture of these two classes of pottery at Volterra required the levigation of the clay employed for this purpose.

The specimen of NERSW with a fine texture and a low-calcium chemistry (NERSW3.04) has a matrix that is partially optically active, indicating a less than

thorough firing regimen, and an unusually sparse inclusion component comprised of silt-sized (presumably monocrystalline) quartz and mica and a very few grains of monocrystalline quartz and laths of mica of very fine sand size. The specimen in question was probably manufactured from an unusually fine low-calcium clay or a less fine calcareous clay subjected to very thorough levigation.

The specimen of BGW with a body of intermediate texture and a moderately calcareous chemistry (BGW5.05) has an inclusion component characterized by a notable presence of grains of monocrystalline and polycrystalline quartz in the silt to medium sand size-range, some of this quite angular, with rare to very rare occurrences of other materials in this same size-range, including siltstone and mica, and perhaps also feldspar and microfauna. This composition indicates that this specimen was manufactured from a sandy, moderately calcareous clay, most likely of marine origin, suggesting that this fabric group originated somewhere in the area of marine sediment that extends across much of northern Etruria.

The specimen of BGW with a body of intermediate texture and a low-calcium chemistry (BGW6.01) has an inclusion component characterized by a notable presence of grains of monocrystalline and polycrystalline quartz in the silt to very fine sand size-range, with rare to very rare occurrences of silt-size mica and coarse sand-size polycrystalline quartz. In this case, whether this specimen was manufactured from a sandy clay of marine or continental origin is unclear.

One of the specimens of NERSW with a gritty texture and a low-calcium chemistry (NERSW8.01) has an inclusion component consisting of grains of monocrystalline and polycrystalline quartz and feldspar, laths of mica, fragments of

mudstone, and perhaps also a fragment of microfauna in the silt to fine sand size-range. Here again, the possible presence of microfauna suggests that the specimen in question was manufactured from a sandy marine clay, indicating a point of origin somewhere in the zone of marine sediments.

A second specimen of NERSW with a gritty texture and a low-calcium chemistry (NERSW7.01) has an inclusion component composed of grains of monocrystalline and polycrystalline quartz, laths of mica, and fragments of mudstone and siltstone in the silt to fine sand size-range. In this case, whether this specimen was manufactured from a sandy clay of marine or continental origin is again unclear.

The specimens of BGW with an intermediate texture and a non-calcareous chemistry (BGW6.01) and a gritty texture and a non-calcareous chemistry (BGW8.01) have an inclusion component characterized by the presence of grains of monocrystalline and polycrystalline quartz, laths of mica, and fragments of mudstone in the silt to medium or coarse sand size-range. The first of these is distinguished by the presence of a substantially greater abundance of mudstone, the other by the presence of somewhat coarser inclusions, very small amounts of calcite and perhaps also feldspar, and a matrix that is partially optically active. The manufacture of these specimens presumably involved the use of a continental clay generally similar to, if substantially less coarse than the Plio-Pleistocene lacustrine clays from Catelfranco Di Sopra – Il Matassino and Alto Pascio, or the possible Miocene lacustrine clay from Colle Val D'Elsa – Belvedere. Alternatively, their manufacture might have involved the use of clays generally similar to these subjected to levigation. Given the broad preference for calcareous clay for the manufacture of BGW, this suggests that these specimens likely originated in locales that

did not enjoy convenient access to a calcareous clay suitable for the production of pottery. General geographical considerations suggest that these may have lain somewhere in the Chianti Mountains and/or the Upper Arno Valley. Specimens of various utilitarian wares from Cetamura of likely local manufacture display similar suites of inclusions when analyzed in thin section, underscoring the possibility that these specimens originated at no great distance from the site.

The specimen of NERSW with an intermediate texture and a non-calcareous chemistry (NERSW4.03) has a matrix that is partially optically active and an inclusion component comprised of grains of monocrystalline and polycrystalline quartz and laths of mica in the silt to very fine sand size-range. The specimen of this class with a porphyritic texture and a non-calcareous chemistry (NERSW5.01) has an inclusion component that is composed of grains of monocrystalline and polycrystalline quartz and feldspar, laths of mica, and fragments of mudstone, siltstone, and granitic rock fragments in the silt to coarse sand size-range. These two specimens are generally similar to the specimens of BGW Fabric Groups 6 and 8 analyzed in thin section, and were also presumably manufactured from continental clays generally similar to, though less coarse than, those from Castelfranco Di Sopra – Il Matassino, Alto Pascio, and Colle Val d'Elsa – Belvedere, or from clays similar to these subjected to levigation. The presence of granitic rock fragments in the specimen with a porphyritic texture is a point of some interest. Rock fragments of this kind have not been observed in utilitarian wares from Cetamura of likely local origin that have been examined in thin section, and this specimen may well have originated beyond the site's immediate locale. The nearest source of granite is situated on the western end of the Island of Elba, ca. 125 km to the SW of Cetamura, and

it may be that this specimen originated somewhere along the coast at no great distance from Elba.[164] It seems possible that the specimen with an intermediate texture was manufactured from a fine fraction of the clay employed for the production of the specimen with a porphyritic texture or, perhaps more likely, given the possibility that the latter originated at some considerable distance from Cetamura, the clay employed for the manufacture of the specimen with a non-calcareous fabric and a gritty texture (NERSW6.01), which was not analyzed in thin section.

APPENDIX 4: POTTERY AND TILE FABRICS

This appendix presents a catalogue of the 19 pottery fabrics and 14 tile fabrics recognized in the program of analysis. These are arranged first by material (with pottery preceding tiles), then ware (for pottery) and source (for tiles).

The description of each fabric is based on the results of the program of optical microscopy. This involved the observation of the untreated fracture surface of a freshly detached chip under a binocular microscope at magnifications of 20X and 40X. Chips were detached from the specimens by means of a pair of pliers, glued to a piece of notecard with the fracture surface facing up, and the notecard labeled with the specimen's accession number.

The attributes characterized and values employed for this operation include the following:

Fracture surface: conchoidal (smooth, with distinct curved areas), regular (smooth and flat), slightly irregular, irregular (hummocky), highly irregular (cliffs and valleys).

Matrix composition: non-calcareous (no light areas), slightly calcareous (some clearly discernible light areas), distinctly calcareous (extensive, clearly discernible light areas);

Matrix topography: smooth, rough, coarse (rich in inclusions slightly too small to resolve under microscope, with no continuous glassy phase).

Inclusion/void abundance (estimated as percent of area of chip fracture surface by reference to comparator charts):[165] sporadic (< ca. 1%), sparse (ca. 1-5%), frequent (ca. 5-10%), abundant (ca. 10-20%), very abundant (> ca. 20%).[166]

Inclusion/void size: Size: (estimated on basis of microscope reticule) fine (< ca. 0.2 mm; too small to measure), medium (ca. 0.2-0.50 mm), coarse (ca. 0.50-1.0 mm), very coarse (> ca. 1.0 mm).

Inclusion roundedness (estimated by reference to comparator chart):[167] angular, subangular, subrounded, rounded.

The likely identifications of the various kinds of inclusions noted are indicated in parentheses.

Figures 15A-E present a photomicrograph of a representative example of each of the pottery fabrics at a magnification of 20X. Figures 16A-D present a photomicrograph of a representative example of each of the tile fabrics at the same magnification.

Black-Gloss Ware Fabric 1 (fine, moderately to highly calcareous)

Provenance: Arezzo.

Hand specimen (12 specimens):

Body: soft, occasionally hard; pink (4YR 6.8/4, 4YR 7.2/4, 4.5YR 7/4, 5YR 7/4, 5YR 7.2/4, 7.5YR 7.2/4), occasionally pink/light brown (7YR 6.5/4), or pinkish gray (5YR 7/2).

Slip: usually well preserved, occasionally poorly preserved; glossy to very glossy, occasionally matte; dark gray, very dark gray, or black, often with bluish tones, occasionally dark reddish brown varying to dark gray.

40X magnification (12 specimens):

Regular to slightly irregular, occasionally slightly conchoidal fracture surface with smooth to rough, slightly to distinctly calcareous matrix containing absent to frequent,

minute, light glistening particles (mica), absent to sparse, minute to small, dark particles/plates (mica), and absent to sporadic, small voids.[168] (Fig. 15A)

Black-Gloss Ware Fabric 2 (fine, moderately calcareous)

Provenance: Area of calcareous sediment. Probably Volterra.

Hand specimen (10 specimens):

Body: soft, occasionally medium hardness to hard; pink (5YR 6.8/4, 5YR 7/4, 5YR 7.5/3, 5YR 7.5/4, 5YR 8/4, 7.5YR 6.8/3.5, 7.5YR 7/4), occasionally pinkish gray (5YR 7/2) or light reddish brown (5YR 6.5/4).

Slip: usually well preserved, occasionally poorly preserved; usually glossy to very glossy, occasionally matte or slightly glossy; dark gray, very dark gray or black, often with bluish tones, occasionally reddish brown or dusky red.

40X magnification (10 specimens):

Regular to slightly irregular fracture surface with smooth to rough, slightly to distinctly calcareous matrix containing absent to frequent, minute to small, light glistening particles/plates (mica), absent to sparse, minute to small, dark particles/plates (mica), absent to sporadic, small to medium, reddish brown to dark gray glistening bodies (fragments of mudstone and/or siltstone), and absent to sporadic, small voids. (Fig. 15A)

Black-Gloss Ware Fabric 3 (fine, low calcium to moderately calcareous)

Provenance: Area of calcareous sediment. Probably Volterra.

Hand specimen (4 specimens):

Body: soft, pink (7.5YR 7/4, 7.5/4) or pinkish gray (7.5YR 6.5/2).

Slip: usually poorly preserved; sometimes glossy; dark gray, very dark gray, or black.

40X magnification (4 specimens):

Regular to slightly irregular fracture surface with smooth to rough, non-calcareous to slightly calcareous matrix containing absent to abundant, minute to small, light glistening particles/plates (mica), absent to sparse, minute to small, dark particles/plates (mica), sporadic, small, reddish brown to dark gray, glistening bodies (fragments of mudstone and/or siltstone), and absent to sparse, small voids. (Fig. 15A)

Black Gloss Ware Fabric 4 (fine, moderately calcareous, micaceous)

Provenance: Area of calcareous sediment. Probably Volterra.

Hand specimen (2 specimens)

Body: soft; pink (5YR 7/4, 5YR 7.5/4)

Slip: well or very poorly preserved; slightly glossy to very glossy; very dark gray or black.

40X magnification (2 specimens):

Regular to slightly irregular fracture surface with smooth to rough, slightly calcareous matrix containing very abundant, minute, light, glistening particles (mica), frequent, small, dark plates (mica), sporadic, small, reddish brown to dark gray, glistening bodies (fragments of mudstone and/or siltstone), and absent to sparse, small voids. (Fig. 15A)

Black-Gloss Ware Fabric 5 (intermediate, moderately calcareous)

Provenance: Area of calcareous (probably marine) sediment. Not Arezzo. Not Chiusi – Marcianella. Probably not Volterra. Western Val di Chiana? Val d'Elsa? Siena?

Hand specimen (6 specimens):

Body: hard to slightly gritty; pink (4.5YR 7.5/4, 5YR 7/3, 5YR 7/4, 6.5YR 7/4), light red (3.5YR 6/4), or light reddish brown (5YR 6/3.5).

Slip: often poorly preserved; matte, slightly glossy or glossy; dark gray, occasionally mottled reddish gray to dark reddish gray or dark brown to very dark gray.

40X magnification (6 specimens):

Slightly irregular to irregular fracture surface with rough to coarse, notably calcareous matrix (regular occurrence of distinct white areas) containing absent to sparse, small, colorless grains (quartz), absent to sparse, minute to small, dark, glistening particles/plates (mica), sporadic, small, reddish brown to dark gray, glistening bodies (fragments mudstone and/or siltstone), absent to sparse, small, white bodies and reaction rims (calcium carbonate), and absent to sparse, small to medium voids. (Fig. 15B)

Black Gloss Ware Fabric 6 (intermediate, low-calcium)

Provenance: Provenance: Area of calcareous sediment. Not Arezzo. Not Chiusi – Marcianella. Volterra? Val d'Elsa? Siena? Western Val di Chiana?

Hand specimen (1 specimen):

Body: soft; light red (2YR 6/8).

Slip: poorly preserved; glossy; mottled reddish brown/dark reddish brown.

40X magnification (1 specimen):

Irregular fracture surface with coarse, slightly calcareous matrix containing sparse, small, colorless grains (quartz), sporadic, medium, red bodies (fragments of mudstone and/or siltstone), sparse, small, round reaction rims (calcium carbonate), and sparse, small, voids. (Fig. 15B)

Black-Gloss Ware Fabric 7 (intermediate, non-calcareous, micaceous)

Provenance: Area of continental sediment probably far from area of calcareous sediment. Monti del Chianti? Upper Arno Valley?

Hand specimen (1 specimen):

Body: gritty, reddish brown (5YR 6.2/4).

Slip: poorly preserved, matte, dark brown.

40X magnification:

Irregular fracture surface with coarse matrix containing frequent, small, subangular to subround, colorless grains (quartz, perhaps some feldspar), frequent, small, rounded, reddish brown, glistening, bodies (fragments of mudstone and perhaps also siltstone), and frequent, minute to small, light, glistening particles/plates (mica). (Fig. 15B)

Black-Gloss Ware Fabric 8 (gritty, non-calcareous)

Provenance: Area of continental sediment probably far from area of calcareous sediment. Monti del Chianti? Upper Arno Valley?

Hand specimen (4 specimens):

Body: slightly gritty to gritty; pink (4YR 7.5/4) or reddish yellow (4.5YR 6/6, 5YR 7/6).

Slip: poorly preserved; matte; gray, dark gray, or dark reddish gray.

40X magnification:

Irregular to highly irregular fracture surface with coarse matrix containing frequent to abundant, small to medium, subangular to subround, colorless and milky grains (quartz, some probably polycrystalline, probably some feldspar), absent to sporadic, medium, reddish brown and dark plates (mica), absent to sporadic, medium to very large, reddish, glistening bodies (fragments of mudstone and/or siltstone), and absent to sparse, small to medium voids. (Fig. 15B)

North Etrurian Red-Slip Ware Fabric 1 (fine, highly calcareous)

Provenance: Area of calcareous sediment. Not Arezzo. Probably Volterra.

Hand specimen (1 specimen):

Body: soft, light reddish brown (5YR 6/3.5).

Slip: poorly preserved; red.

40X magnification (1 specimen):

Regular fracture surface with smooth, distinctly calcareous matrix. (Fig. 15C)

North Etrurian Red-Slip Ware Fabric 2 (fine, moderately calcareous)

Provenance: Area of calcareous sediment. Not Arezzo. Not Volterra? Volterra?

Hand specimen (1 specimen):

Body: soft, reddish yellow (4YR 6.8/7.5).

Slip: slightly glossy to matte; red.

40X magnification (1 specimen):

Regular fracture surface with smooth, distinctly calcareous matrix containing sporadic, small, reddish brown, glistening bodies (fragments of mudstone and/or siltstone). (Fig. 15C)

North Etrurian Red-Slip Ware Fabric 3 (fine, non-calcareous to low calcium)

Provenance: Area of calcareous sediment. Not Chiusi – Marcianella. Upper Val d'Elsa?

Hand specimen (5 specimens):

Body: soft, pink (4YR 7/4, 4YR 7.6/4, 6.5YR 6.5/4) or reddish yellow (3.5YR 6.5/6, 4YR 7/6).

Slip: poorly preserved; slightly glossy, red (2.5YR 5/6, 3YR 4.5/6, 4YR 7/6).

40X magnification (5 specimens):

Regular to slightly irregular fracture surface with smooth to rough, non-calcareous matrix containing absent to sporadic, small, colorless grains (quartz), absent to sporadic, small, dark plates (mica), absent to abundant, minute to small, light, glistening particles/plates (mica), absent to sporadic, small, dark gray to reddish brown, glistening bodies (fragments of mudstone and/or siltstone), and sporadic to sparse, small voids. (Fig. 15C)

North Etrurian Red-Slip Ware Fabric 4 (intermediate, non-calcareous)

Provenance: Area with access to continental clay. Upper Val d'Elsa? Monti del Chianti? Upper Arno Valley?

Hand specimen (3 specimens):

Body: soft; pink (5YR 8/4) or reddish yellow (4YR 6/7, 4YR 7/6).

Slip: poorly preserved; red (2.5YR 5/7, 3YR 5/6).

40 X magnification (3 specimens):

Slightly irregular fracture surface with rough to coarse, non-calcareous matrix containing abundant, minute to small, subangular to subrounded, colorless grains (quartz), abundant, minute to small, light, glistening particles/plates (mica), absent to sporadic, small to medium, reddish bodies (fragments of mudstone and/or siltstone), absent to sparse, small white bodies (calcareous?). (Fig. 15C)

North Etrurian Red-Slip Ware Fabric 5 (porphyritic, non-calcareous)

Provenance: Area of continental sediment containing fragments of granite. Coast of northern Etruria opposite Elba?

Hand specimen (1 specimen):

Body: soft; light red (2.5YR 5.8/6).

Slip: poorly preserved; red (3YR 5/6).

40 X magnification (1 specimen):

Irregular fracture surface with rough, non-calcareous matrix containing abundant minute to small, subangular to subrounded, colorless grains (quartz), sparse, minute to small, light, glistening particles/plates (mica), sparse, medium to large, subangular, colorless grains (quartz, some polycrystalline), sporadic, small to medium, subrounded, reddish bodies (fragments of mudstone and/or siltstone), sporadic, small to large subrounded, reddish brown, glistening bodies (igneous rock?), sporadic, medium to large, subrounded, white bodies (calcareous?), and sparse, medium voids. (fig. Fig. 15D)

North Etrurian Red-Slip Ware Fabric 6 (gritty, non-calcareous)

Provenance: Area with access to continental clay. Upper Val d'Elsa? Monti del Chianti? Upper Arno Valley?

Hand specimen (1 specimen):

Body: soft; pink (4.5YR 7/3.5).

Slip: poorly preserved; reddish.

40 X magnification (1 specimen):

Irregular fracture surface with discontinuous matrix containing very abundant, minute to small, subangular to subrounded, colorless grains (quartz), sparse, minute to small, light, glistening particles/plates (mica), sparse, small, dark, glistening plates (mica), sporadic, small to medium, subrounded, reddish bodies (fragments of mudstone and/or siltstone), and sparse, small, rounded voids. (Fig. 15D)

North Etrurian Red-Slip Ware Fabric 7 (gritty, low calcium)

Provenance: Provenance: Area of calcareous sediment. Not Arezzo. Volterra? Val d'Elsa? Siena? Western Val di Chiana?

Hand specimen (1 specimen):

Body: soft; pink (4.5YR 7/3.5).

Slip: poorly preserved; red (2.5YR 5/8).

40 X magnification (1 specimen):

Irregular fracture surface with discontinuous matrix containing abundant, minute to small, subangular to subrounded, colorless grains (quartz), sparse, minute to small, light, glistening particles/plates (mica), sporadic, small to medium, subrounded, reddish bodies

(fragments of mudstone and/or siltstone), sparse, small, rounded white bodies (calcareous?), and sparse, small, rounded voids. (Fig. 15D)

North Etrurian Red-Slip Ware Fabric 8 (gritty, low calcium)

Provenance: Area of calcareous (probably marine) sediment. Volterra? Western Val di Chiana? Val d'Elsa? Siena?

Provenance:

Hand specimen (1 specimen):

Body: soft; pink (4.5YR 7/3.5).

Slip: poorly preserved, red (2.5YR 4.5/7).

40X magnification (1 specimen):

Irregular fracture surface with coarse, slightly calcareous matrix containing abundant, small, white bodies and reaction rims (calcium carbonate), sparse, small, subangular, colorless grains (quartz), and sparse, small voids. (Fig. 15E)

Italian Terra Sigillata Fabric 1 (fine, moderately calcareous)

Provenance: Arezzo.

Two variants determined by degree of firing:

Variant 1 (regularly fired):

Hand specimen (7 specimens):

Body: hard, light red (lighter than 10R 6/6, 1.5YR 6/7, 2YR 6/6), pink (4YR 7.5/4, 5YR 6.8/4), pink/light reddish brown (4.5YR 7.5/4), or reddish yellow (4.5YR 6.5/6).

Slip: well preserved; glossy, red (10R 4.5/8, 10R 4.8/8, 1YR 4/8, 1YR 4.5/8, 2.5YR 4.5/8, 2.5YR 4.8/6, 2.5YR 5.2/8).

40X magnification (7 specimens):

Smooth to slightly irregular fracture surface with slightly to distinctly calcareous matrix containing absent to sporadic, small, rounded, white bodies and reaction rims, absent to sparse, minute to small, light, glistening plates (mica), and absent to sparse, small, voids. (Fig. 15E)

Variant 2 (highly fired):

Hand specimen (6 specimens):

Body: hard, light reddish brown (2YR 6/4), reddish brown (2YR 5/4), light red (1.5YR 7/6, 2.5YR 6/6, 2.5YR 6.2/6), or reddish yellow (4YR 6/6).

Slip: well preserved; glossy, red (10R 4.5/6, 2YR 4.5/6, 2.5YR 5/6) or reddish brown/red (2YR 4/5).

40X magnification (6 specimens):

Smooth, compact, often conchoidal fracture surface with smooth, distinctly calcareous matrix containing sparse, small, rounded white bodies and reaction rims (calcium carbonate) and sporadic to sparse, small, rounded voids.

Italian Terra Sigillata Fabric 2 (fine, moderately calcareous)

Provenance: Arezzo.

Two variants determined by degree of firing:

Variant 1 (regularly fired):

Hand specimen (6 specimens):

Body: hard, pink (4YR 7/4, 4YR 7.5/4, 4.5YR 6.8/4, 4.5YR 7.5/4, 5YR 7/4).

Slip: well preserved; glossy, red (10R 4.2/6, 10R 4.4/6, 1YR 4.5/8, 2.5YR 4/7, 2.5YR 4.2/6, 2.5YR 4.5/6).

40X magnification (6 specimens):

Smooth to slightly irregular fracture surface with calcareous matrix containing absent to sporadic, small, rounded, white bodies and reaction rims, absent to sparse, minute to small, light, glistening plates (mica), and absent to sparse, small, voids.

Variant 2 (highly fired):

Hand specimen (2 specimens):

Body: hard, pale red (10R 5.8/4) or light red (2YR 6/6).

Slip: well preserved; glossy, red (10R 4.5/6, 10R 4.5/8).

40X magnification (2 specimens):

Smooth, compact, sometimes conchoidal fracture surface with smooth, distinctly calcareous matrix containing sparse, small, rounded, white bodies and reaction rims (calcium carbonate) and sparse, small, rounded voids. (fig. 15E)

Italian Terra Sigillata Fabric 3 (fine, moderately calcareous)

Provenance:

Hand specimen (1 specimen):

Body: hard, light red (2YR 6/6).

Slip: well preserved; glossy, red (1.5YR 4.5/7).

40X magnification:

Smooth, compact, conchoidal fracture surface with smooth, distinctly calcareous matrix containing frequent small, rounded, white bodies and reaction rims and sparse, small, rounded voids. (Fig. 15E)

Cetamura Clay (porphyritic, non-calcareous)

Hand specimen (1 specimen):

Body: reddish yellow (4YR 6/6).

40X magnification (1 specimen):

Irregular fracture surface with smooth matrix containing abundant, small to large, angular to well rounded, often platy, light brown to reddish brown bodies (siltstone or argillite) and sparse, small to large, angular to rounded, light gray to dark gray bodies (sandstone or limestone), and abundant, medium, voids. (Fig. 16A)

Radda – Castiglioni Clay (gritty, calcareous)

Hand specimen (1 specimen):

Body: light reddish brown (4YR 6.2/3.5).

40X magnification (1 specimen):

Irregular fracture surface with gritty matrix containing sparse, medium to large, rounded to well rounded, dull, porous, dark gray to reddish gray bodies (mudstone), sporadic, medium to large, light gray bodies (limestone?), and sparse, medium, voids. (Fig. 16A)

Colle Val D'Elsa – Belvedere Clay (coarse, non-calcareous)

Hand specimen (1 specimen):

Body: light red (2.5YR 5.8/8).

40X magnification (1 specimen):

Very irregular fracture surface with discontinuous matrix containing very abundant, small to medium, subangular to rounded, colorless grains (quartz), sporadic, small to large, subrounded to rounded, reddish brown and black bodies (fragments of mudstone and /or siltstone), and sporadic, medium voids. (Fig. 16A)

Volterra Clay 1 (fine, calcareous)

Hand specimen (1 specimen): (CVLT.02)

Body: pink (4.5YR 7.5/4).

40X magnification (1 specimen):

Slightly irregular fracture surface with smooth, calcareous matrix containing sparse, small to medium, subrounded to rounded, reddish brown, glistening bodies (mudstone and/or siltstone), sparse, small to medium, voids, some lined with white (calcareous) material. (Fig. 16A)

Volterra Clay 2 (fine/intermediate, calcareous)

Hand specimen (1 specimen): (CVLT.07)

Body: light reddish brown (4YR 6.5/4).

40X magnification (1 specimen):

Slightly irregular fracture surface with smooth matrix containing very abundant small, rounded colorless and milky grains (quartz), sparse, small to medium, subrounded to

rounded, reddish brown, glistening, bodies (mudstone and/or siltstone), and frequent, small to medium, voids (Fig. 16B)

Volterra Clay 3 (intermediate, calcareous)

Hand specimen (1 specimen): (CVLT.05)

Body: pink (5.5YR 7/4).

40X magnification (1 specimen):

Irregular to highly irregular fracture surface with discontinuous matrix containing very abundant, small to medium, subrounded to rounded colorless grains (quartz), sparse, small, subrounded to rounded, reddish brown glistening bodies (mudstone), sparse, medium, angular to rounded white bodies (calcareous), sporadic, small, medium gray bodies (serpentine?), and sparse, medium, voids. (Fig. 16B)

Volterra Clay 4 (intermediate, calcareous)

Hand specimen (1 specimen): (CVLT.01)

Body: reddish yellow (4.5YR 7/5).

40X magnification (1 specimen):

Irregular fracture surface with smooth matrix containing abundant, small to medium, subrounded, colorless grains (quartz), abundant small to medium, subrounded, reddish brown glistening bodies (fragments of mudstone and/or siltstone), frequent, small, rounded medium to dark gray bodies (serpentine?), and sparse, small, white bodies (calcareous). (Fig. 16B)

Volterra Clay 5 (coarse, calcareous)

Hand specimen (2 specimens): (CVLT.03,CVLT.04)

Body: pinkish white (7YR 8/2), pink (4.5YR 7/4).

40X magnification (2 specimens):

Body: highly irregular fracture surface with discontinuous matrix containing sparse, small to medium, subrounded reddish brown bodies (fragments of mudstone and/or siltstone), absent to sparse, small to medium, subrounded white bodies (calcium carbonate), and sparse to frequent, medium, voids. (Fig. 16C)

Volterra Clay 6 (coarse, calcareous)

Hand specimen (1 specimen): (CVLT.06)

Body: light red/reddish yellow (3.5YR 6.5/6).

40X magnification 1 specimen):

Body: highly irregular fracture surface with discontinuous matrix containing sparse, small to medium, subrounded reddish brown bodies (fragments of mudstone and/or siltstone), and absent to sporadic, small to medium, rounded, white bodies (calcareous), and sparse to frequent, medium, voids. (Fig. 16C)

Castelnuovo Berardenga Scalo Clay (fine/intermediate, calcareous)

Hand specimen (3 specimens):

Body: pink/light reddish brown (4YR 6-6.5/4), reddish yellow (4YR 6.2/6).

40X magnification (3 specimens):

Slightly irregular granular fracture surface with discontinuous matrix containing very abundant minute to small, rounded, colorless grains (quartz; at lower end of visible range), sparse to abundant, minute to medium, light, glistening particles/plates (mica), sporadic, small to medium, subrounded to rounded, reddish brown, glistening bodies (fragments of mudstone and/or siltstone), and sparse, small to medium, voids, some line with white (calcium carbonate) material. (Fig. 16C)

Altopascio Clay (coarse, non-calcareous)

Hand specimen (1 specimen):

Body: pink (lighter than 7.5YR 8/4).

40X magnification (1 specimen):

Very irregular fracture surface with gritty matrix containing abundant, small to large, subangular to rounded, colorless grains (quartz; some polycrystalline), sporadic, small to large, subrounded to rounded, reddish brown and black bodies (mudstone and/or siltstone), sporadic, medium to large, subrounded, light gray bodies (calcareous?), and sporadic, medium, rounded voids. (Fig. 16C)

Castelfranco Di Sopra – Il Matassino Clay (coarse, non-calcareous)

Hand specimen (6 specimens):

Body: light red/red (2-2.5YR 5.5-6/8), reddish yellow (4-4.5YR 5.5-6.7/6-8).

40X magnification (6 specimens):

Very irregular fracture surface with gritty to discontinuous matrix containing abundant to very abundant, small to large, angular to rounded, colorless and milky grains (quartz), and sporadic to sparse, small to medium, round voids. (Fig. 16D)

Arezzo – Quarata Clay (fine, calcareous)

Hand specimen (2 specimens):

Body: light red (2.5YR 6-7/7-8).

40X magnification (2 specimens):

Regular to slightly conchoidal fracture surface with smooth, weakly calcareous matrix containing sparse, small voids. (Fig. 16D)

LIST OF WORKS CITED

AA.VV. 1990. *Archeologia urbana a Fiesole: lo scavo di Via Marini – Via Portigiani*. (Florence).

Aprosio, M. 2003. "La ceramica a vernice rossa." In G. Pucci and C. Mascione eds., 155-60.

Aprosio, M., and A. Pizzo 2003. "La ceramica a vernice nera." In G. Pucci and C. Mascione eds., 91-154.

Blackman, M. J. 1984. "Provenience studies of middle eastern obsidian from sites in highland Iran." In J. Lambert ed. *Archaeological Chemistry III* (Washington, D.C.) 19-50.

Blackman, M. J., S. Mery, and R. Wright. 1989. "Production and exchange of ceramics on the Oman Peninsula from the perspective of Hili." *Journal of Field Archaeology* 16.1: 61-77.

Bonamici, M. ed. 2003. *Volterra. L'acropoli e il suo santuario. Scavi 1987-1995*. vols. 1-2 (Pisa).

Camilli, A., E. Stanco, E. De Carolis, G. Gazzetti, L. Caretta, L. Pontacolone, and M.Incitti. 2009. *Ceramica romana: guida allo studio*, vol. 1 (Rome).

*Carta Geologica d'Italia.*Various dates. (Rome).

Cibbechini, F., and J. Principal. 2004. "Per chi suona la Campana B?" In DeSena, E., and H. Dessales eds. *Metodi e approcci archeolgici: l'industria e il commercio nell'Italia antica/Archaeological methods and approaches: Industry and commerce in ancient Italy. BAR-IS* 1262, 159-72.

Cristofani, M., and M. Cristofani Martelli. 1972. "Ceramica *presigillata* da Volterra." *MEFRA* 84: 499-514.

Curry, J. 1996. *Black gloss pottery from the kiln area at Cetamura del Chianti, Italy*. Unpublished M.A. thesis, Department of Classics, Florida State University.

De Castro, C., and C. Pilotti. 1933. *I giacimenti di lignite della Toscana*. Memorie descrittive della Carta Geologica d'Italia. Vol. XXIII. (Rome).

de Grummond, N.T. ed. 2000. *Cetamura Antica: Traditions of Chianti*. (Tallahassee).

de Grummond, N.T. 2001. "Cult of the kiln." *Archaeology* 54.1: 58-60.

de Grummmond, N. T. ed. 2009. *The Sanctuary of the Etruscan Artisans at Cetamura del Chianti: The Legacy of Alvaro Tracchi*. (Florence).

Di Giuseppe, H. 2005. “Un confronto tra l’Etruria settentrionale e meridionale dal punto di vista della ceramica a vernice nera.” *PBSR* 73: 31-84.

De Giuseppe, H. 2012. *Black-Gloss Ware in Italy: Production Management and Local Histories*. (*BAR-IS* 2335)

de Marinis, G. and P. Pallecchi. 2008. “Caratterizzazione composizionale e tecnologica della produzione ceramica delle fornaci del Vingone.” In Shepherd et al. 241-45, Tav. XV and XVI.

Ettlinger, E. 1990a. “Die italische Produktion.” In Ettlinger ed., 4-13.

Ettlinger, E. 1990b. “Bemerkungen zum Herstellungsprozess sowie zu Qualtitäten und Farben.” In Ettlinger ed., 26-38.

Ettlinger, E. ed. 1990. *Conspectus formarum terrae sigillatae italico modo confectae*. Materialien zur Römisch-Germanischen Kerramik 10. (Bonn).

Ewell, C. 2000. *An Etruscan Hellenistic Workshop: The Kiln and Artisans’ Zone at Cetamura del Chianti*. Ph.D. dissertation, Department of Classics, Florida State University.

Fabbri, F., E. Martelli, P. Pallecchi, and M.A. Turchetti. 2006. "Rassegna delle attestatazioni di fornaci ed aree di scarti nel medio Valdarno. Scede." In Shepherd et al. 301-11.

Frontini, P., M.T. Grassi, D. Locatelli, and E. Mello. 1995. "Contributo delle analisi chimiche mediante fluorescenza X per la determinzaione di provenienza della ceramica a verrnice nera in Italia settentrionale." *Sibrium* 22: 329-401.

Frontini, P. and M.T. Grassi eds. 1998. *Indagini archeometriche relative alla ceramica a vernice nera: nuovi dati sulla provenienza e la diffusione. Milano 22-23 novembre 1996*. (Como).

Fülle, G. 1997. "The internal organization of the Arretine *terra sigillata* industry: problems of evidence and interpretation." *JRS* 87: 111-55.

Gamurrini, G.F. 1890. "Arezzo – Di una nuova figulina di vasi neri e rossi, scoperta all'Orciolaia presso Arezzo." *NSc*: 63-72.

Garzanti, E., S. Canclini, F. Moretti Foggia, and N. Petrella. 2002. "Unraveling magmatic and orogenic provenance in modern sand: the back-arc side of the Apennine thrust belt, Italy." *Journal of Sedimentary Research* 72:2-17.

Gazzetti, G. 2009. "Terra sigillata italica e nord-italica." In Camilli et al. 105-38.

Gliozzo, E., Kirkman, I.W., Pantos, E., and I. Memmi Turbanti. 2004. "Black gloss pottery: production sites and technology in northern *Etruria*, Part 2: gloss technology." *Archaeometry* 46.2: 227-46.

Gliozzo, E., and I. Memmi Turbanti. 2004. "Black gloss pottery: production sites and technology in northern *Etruria*, Part 1: provenance studies." *Archaeometry* 46.2: 201-25.

Gliozzo, E., I. Memmi, and L. Foresi. 2003. "Lo studio archeometrico delle produzioni ceramiche." In Pucci and Mascione eds., 275-314.

Houston, M. 1978. *Cetamura Black-Glaze Pottery*. Unpublished M.A. thesis, Department of Classics, Florida State University.

Kenrick, P. 2006. "Italian sigillata: the view from Arezzo." In Menchelli and Pasquinucci eds., 201-206.

Klynne, A. 2006. "Consumption of Italian Sigillata: yesterday, today, and tomorrow." In D. Malfitana, J. Poblome, and J. Lund eds. *Old pottery in a new century: innovating perspetions on Roman pottery studies.* Atti del Convegno Internazionale di Studi, Catania, 22-24 Aprile 2004. Catania, 167-74.

Lamboglia, N. 1952. “Per una classificazione preliminare della ceramica campana.” Atti del I^{o} Congresso Internazionale di Studi Liguri, Monaco – Bordighera – Genova, 10-17 April 1950. (Cuneo) 139-206.

Lippolis, E. 1984. *La necropoli del Palazzone di Perugia: ceramiche comuni e verniciate*. Archaeologia perusina 2. (Rome).

Matthew, A.J., A.J. Woods, and C. Oliver. 1991. “Spots before the eyes: new comparison charts for visual percentage estimation in archaeological material.” In A. Middleton and I. Freestone eds. *Recent developments in ceramic petrology*. British Museum Occasional Papers 81, 211-63.

Menchelli, S., and M. Pasquinucci eds. 2006. *Territorio e produzioni ceramiche. Paesaggi, economia e società in età romana. Atti del covegno internazionale Pisa 20-22 ottobre 2005*. Instrumenta 2 (Pisa)

Michelotti, B., A. Maggiani, and M. Cristofani. “Volterra. Scavi 1969-1971.” *NSc* 1973, suppl., 7- 290.

Michelucci, M., and A. Romualdi. 1974. “Per una tipologia della ceramica a vernice nera di Roselle.” *StEtr* 42: 99-110.

Miller, D. 1985. *Artifacts as Categories: A Study of Ceramic Variability in Central India*. (Oxford).

Mirti, P., and P. Davit. 2001. "Technological characterization of Campanian pottery of Type A, B and C and of regional products from ancient Calabria (southern Italy)." *Archaeometry* 43.1: 19-33.

Montagna Pasquinucci, M. 1974. "La ceramica a vernice near del Museo Guarnacci di Volterra." *MEFRA* 84: 269-498.

Morel, J.P. 1963. "Notes sur la céramique étrusco-campanienne à vernis noir de Sardaigne et d'Arezzo." *MEFRA* 75: 7-58.

Morel, J.P. 1994. *Céramique campanienne: les formes*. BEFAR 244 (Rome, 2nd edition).

Morel, J.P. 2009. "Le produzioni ceramiche a vernice nera di Arezzo." In G. Camporeale and G. Firpo eds. *Arezzo nell'antichità.* Rome, 125-33.

Mosca, A. 2002. *Un sistema stradale romano tra Roma e Firenze*. Accademia Toscana di Scienze e Lettere "La Colombara". Studi 200 (Florence).

Ostman, R. 2004. *The city and complexity: Volterra, Italy. Pottery production during the Hellenistic Etruscan and the Late Roman to Late Antique period*. BAR-IS 1251. (Oxford)

Oxé, A., Comfort, H., and P. Kenrick. 2000. *Corpus vasorum arretinorum: a catalogue of the signatures, shapes and chronology of Italian sigillata*. Antiquitas 3.41. (Bonn).

Pallecchi, P. 2008. "Il contesto geomorfologico dell'area del Vingone e la disponibilità di materie prime per la fabbricazione delle ceramiche." In Shepherd et al., 283-4.

Palermo, L. 1990a. "Ceramica a vernice nera." In AAVV, 103-14.

Palermo, L. 1990b. "Ceramica a vernice rossa." In AAVV, 114-24.

Palermo, L. 1998. "Contributo alla conoscenza della ceramica aretina a vernice nera: i materiali dello scavo di Chiusi, Orto del Vescovo." In Frontini and Grassi eds., 119-30.

Palermo, L. 2003a. "Ceramica a vernice nera." In M. Bonamici ed., 284-345, 486-95.

Palermo, L. 2003b. "Ceramica a vernice rossa." In M. Bonamici ed., 346-58, 496-98.

Paolucci, G. 2003. "Archeologia del territorio Chiusino: appunti sulle strutture produttive tra tarda età repubblicana ed età imperiale." In G. Pucci and C. Mascione eds., 11-14.

Pasquinucci, M., D. Alessi, S. Bianchini, F. Cibecchini, L. Cherubini, A. Del Rio, S. Menchelli, P. Spinesi, M. Vallebona, and C. Capelli. 1998. "Ceramica a vernice nera dall'Etruria settentrionale costiera. Primo contributo alla caratterizzazione delle produzioni locali e delle importazioni." In Frontini and Grassi eds., 101-18.

Paturzo, F. 1996. *Arretina vasa: la ceramica aretina da mensa in età romana. Arte, storia, tecnologia.* (Cortona).

Peña, J.T. 1989. "Internal red-slip cookware (Pompeian red ware) from Cetamura, Italy: mineralogical composition and provenience." *AJA* 94: 647-61.

Peña, J.T. 1993. "Two studies of the provenience of Roman pottery through neutron activation analysis." In W.V. Harris ed. *The inscribed economy: production and distribution in the Roman empire in light of instrumentum domesticum*. JRA suppl. 6, 107-120.

Peña, J.T. forthcoming. "Evidence for the use of raw materials for the manufacture of Black-Gloss Ware and Italian Sigillata at Arezzo and Volterra." In G. Olcese ed., *Proceedings of* Immensa Aequora *workshop, Università di Roma, La Sapienza, Rome, Italy, 1/24-26/11*.

Peña, J.T. and M.J. Blackman. 1994. “A neutron activation study of Plio-Pleistocene marine clays from west-central Italy: compositional variability and implications for the proveniencing of Italian fineware pottery.” In F. Burragato et al. eds. *First European workshop on archaeological ceramics* 313-21.

Principal, J. 2005. “Las cerámicas del círculo de la Campaniense B.” In Roca Roumens, M., and I. Fernández García eds. *Introducción al estudio de la cerámica romana: una breve guía de referencia*. Monográfico nº 1 de CVDAS. (Málaga), 47-61.

Pucci, G. Ed. 1992. *La fornace di Umbricio Cordo. L’officina di un ceramista romano e il territorio di Torrita di Siena nell’antichità*. (Florence).

Pucci, G., and C. Mascione eds. 2003. *Manifattura ceramica etrusco-romana a Chiusi. Il complesso produttivo di Marcianella*. (Bari).

Roth, R. 2007. *Styling Romanization; pottery and society in Central Italy.* (Cambridge).

Sayre, E. 1980. *Brookhaven Procedures for the Statistical Use of Multivariate Archaeometric Data* (Brookhaven national Laboratory Microfiche 21693).

Schneider, G., and B. Hoffman. 1990. “Chemische Zusammensetzung italischer Sigillata.” In Ettlinger ed., 27-38.

Shepherd, E., G. Capecchi, G. de Marinis, F. Mosca, and A. Patera. 2008. *Le fornaci del Vingone a Scandicci. Un impianto produttivo di età romana nella valle dell' Arno*. Rassegna di archeologia classica e postclassica 22B. (Florence).

Stanco, E. 2009a. "Ceramica a vernice nera." In Camilli et al. 19-90.

Stanco, E. 2009b. "Ceramica a vernice rossa di periodo repubblicano." In Camilli et al. 91-104.

Sternini, M. ed. 2012. *La fortuna di un artigiano nell'Etruria romana*. (Arcidosso).

Stoops, G. 2003. *Guidelines for Analysis and Description of Soil and Regolith Thin Sections*. (Madison).

Tracchi, A. 1978. *Dal Chianti al Valdarno*. Recognizioni archeologiche in Etruria 3. (Rome).

Vilucchi, S. 2012. "Arezzo e la produzione di terra sigillata italica: i protaganisti e le evidenze archeologiche." In Sternini 2012, 7-21.

Wells, C. 1990. "A note on the term 'pre-sigillata'." In Ettlinger ed., 4.

Whitbread, I. 1995. *Greek transport amphorae: a petrological and archaeological study.* The British School at Athens Fitch Laboratory Occasional Papers 1. (Athens).

Williams, F. 1995. *Red Gloss Pottery from Cetamura del Chianti*. Unpublished M.A. thesis, Department of Classics, Florida State University.

Winter, A. 1978. *Die antike Glanztonkeramik: praktische Versuche*. Keramikforschungen III. (Mainz)

NOTES

[1] SCG undertook the characterization of the ceramic thin sections reported on in this article. All other elements of the proram of analysis were undertaken by JTP. The collection of the pottery and clay specimens subjected to compositional analysis was undertaken with the support of a National Endowment for the Humanities Travel to Collections Grant. The neutron activation analysis portion of the program was undertaken in course of a post-doctoral fellowship held in 1990 by JTP at the Smithsonian Institution's Conservation Analytical Laboratory (now known as the Museum Conservation Institute) under the supervision of M. James Blackman and Pamela Vandiver. JTP would like to express his sincere appreciation to Blackman, Vandiver, and Nancy T. de Grummond, the director of the Cetamura excavations, for their generous and crucial support with various aspects of the program of analysis, and to Jordi Principal for sharing with him his knowledge of various aspects of the production of Black-Gloss Ware. Earlier treatments of some portions of the work reported in this article appeared in Peña 1993 and Peña and Blackman 1994.

[2] Di Giuseppe 2005; Gliozzo and Memmi Turbanti 2004; Palermo 1998; 2003a; Pasquinucci et al. 1998; Roth 2007. See now also Di Giuseppe 2012, which the authors were not able to consult for this article.

[3] All UTM coordinates and elevations reported in this article were obtained from Google Earth.

[4] See de Grummond ed. 2000, 6 and 2009, 24-25 for the history of research at Cetamura and de Grummond ed. 2000, 7-22 and 2009, 17-23 for an overview of the remains at the site and its occupational history. The address of the project web site is http://www.fsu.edu/~classics/cetamura/.

[5] See Tracchi 1978, 119-124 for the road network in the area around Cetamura.

[6] See Ewell 2000 and de Grummond 2001 for the evidence for the manufacture of ceramics at Cetamura.

[7] See Stanco 2009a for a recent overview of this class of pottery.

[8] Winter 1978; Mirti and Davit 2001, 20; Gliozzo et al. 2004.

[9] For BGW from Cetamura see Houston 1978 and Curry 1996.

[10] Palermo 2003a, 296 nos. 16, 18, 304 no. 39, 306 no. 45, 317 no. 74, 318 no. 81, 321 no. 91, 323 n.97, 325 no. 105.

[11] Fabbri et al. 2006, 310 no. 28.

[12] Fabbri et al 2006, 310-11 no. 29.

[13] Gamurrini 1890, 64-5.

[14] Gamurrini 1890, 68-9.

[15] Paolucci 2003, 11-12.

[16] Paolucci 2003, 12.

[17] Palermo 1998, 122.

[18] Paolucci 2003, 12-14.

[19] Pucci and Mascione 2003.

[20] Pucci and Mascione 2003.

[21] Di Giuseppe 2005, 37; Principal 2005, 50. See Michelucci and Romualdi 1974 for Roselle.

[22] See Stanco 2009b for a recent overview of this class of pottery.

[23] Following Cristofani and Cristofani Martelli 1972 this series of vessels is sometimes referred to in the literature as "Volterran presigillata". See Lippolis 1984, 33; Wells 1990; and Palermo 1990b, 114 for the problematic nature of this term.

[24] For NERSW from Cetarmua see Williams 1995.

[25] Aprosio 2003, 155-56.

[26] Palermo 1990b, 114-5; 2003b, 346-8. Cristofani and Cristofani Martelli 1972, 511 states that an example of the Morel 1211 bowl belonging to this class from Volterra is a waster, although the basis for this identification is unclear.

[27] See Ettlinger 1990a and Gazzetti 2009 for overviews of this class of pottery.

[28] Winter 1978; Ettlinger 1990b, 34; Gliozzo et al. 2004.

[29] Oxé et al. 2000 ; Fülle 1997.

[30] Oxé et al. 2000, 30.

[31] Oxé et al. 2000, 30.

[32] Oxé et al. 2000, 30.
[33] Fülle 1997, 130 fig. 2, 136-9; Oxé et al. 2000, 25-9; Kenrick 2006; Vilucchi 2012, 8-9 fig. 1, 12-13.
[34] Oxé et al. 2000, 26.
[35] Oxé et al. 2000, 27.
[36] Oxé et al. 2000, 26.
[37] Oxé et al. 2000, 26.
[38] Oxé et al. 2000, 27-8; Sternini 2012.
[39] Oxé et al. 2000, 27.
[40] Oxé et al. 2000, 26-7.
[41] Fülle 1997, 138
[42] Vilucchi 2012, 8-9 fig. 1.
[43] Oxé et al. 2000, 33.
[44] Pucci 1992.
[45]A single workshop may employ multiple ceramic pastes with distinctive working properties or that result in finished vessels with different characteristics with the result that it turns out vessels belonging to multiple fabric groups. See, for example, the evidence for the Roman-period pottery workshop at Vingone – Scandicci summarized below at n. 101.
[46] For BGW these were Lamboglia 1954 and Morel 1963, supplemented with Morel 1994 as useful. For NERSW there is no standard typology. The bulk of the specimens selected for analysis, however, belong to a single form included in Morel 1994. For ITS this was Ettlinger ed. 1990, with the forms here referred to according to standard procedure as "*Conspectus*"
[47] The Fgs consulted included the following: 105 Lucca; 112 Volterra; 113 Castel Fiorentino; 114 Arezzo; 119 Massa Marittima; 120 Siena; 121 Montepulcinao.
[48] The course of the Canale Maestro della Chiana between the Castro confluence and the point where it empties into the Arno presumably follows more or less what was the lower course of the Castro prior to the former's excavation. The outcrops of the agQ formation along the Canale Maestro della Chiana thus presumably correspond more or less to outcrops that occurred along the lower course of the Castro in antiquity.
[49] See Ostman 2004, 191-204 for a study of clay specimens obtained from several different parts of this formation in the area around Volterra, with particular emphasis on the suitability of these for the manufacture of ceramics during antiquity.
[50] For the purposes of this study the term Upper Arno Valley is used to refer to the portion of the Arno Valley extending from the confluence of the Canale Maestro della Chiana downstream to the confluence of the Sieve, the term Middle Arno Valley to refer to the portion extending from the confluence of the Sieve downstream to the confluence of the Elsa, and the term Lower Arno Valley to refer to the portion extending from the confluence of the Elsa downstream to the river's mouth.
[51] See Pallecchi 2008 for this clay.
[52] For the analytical parameters associated with this procedure see Blackman 1984, 23-5; Blackman et al. 1989, 64-5.
[53] In practice, when chips of specimens in which the concentration of calcium was ca. four percent or greater as determined by NAA were examined under the binocular microscope the matrix displayed a readily discernible pattern of dense white stippling. For specimens in which the concentration of calcium was less than ca. four percent this pattern was not usually apparent.
[54] See Sayre 1980, 3-6 for descriptions of the BNL versions of these two programs.
[55] See Sayre 1980, 9-12 for a description of the BNL version of this program.
[56] The specimen of clay from Radda – Castiglione was excluded from this procedure due to its extremely high calcium value (28.9 percent).
[57] Unfortunately, the specimen for ITS3.01 was not large enough to permit the fabrication of a thin section, thus precluding the possibility of carrying out a detailed comparison of its fabric with that of the other specimens of ITS. Klynne 2006 169 reports the existence of an Arretine ITS fabric characterized by a substantial concentration of large, calcareous inclusions. That this does not correspond to the fabric in question, however, is suggested both by the fact that it is associated with the forms Conspectus Form 3 and 34, and by the fact that it apparently has a chemical composition similar to that of standard Arretine ITS.
[58] Cluster analysis was also performed for the entire group of 60 pottery specimens manufactured using a moderately calcareous clay (i.e., the specimens in question plus the 15 specimens comprising IS Fabric

Group1 and the one specimen comprising ITS Fabric Group 3). The clustering solutions obtained were problematic, however, embodying considerable mixing of the specimens in BGW Fabric Groups 1, 2 and 4.
[59] Palermo 2003a.
[60] Michelotti et al. 1973; Montagna Pasquinucci 1974.
[61] Palermo 2003a, 315-6 n. 70, 326 tab., 490 fig. 21.10-15, documenting 24 examples as Morel 1210. Palermo 2003a, 292 no. 6, 309 tab, 486 fig. 17.10 documents a single example, again as Morel 1210, for Group B.
[62] For BGW from Roselle see Michelucci and Romualdi 1974, especially pp. 102-08, Group RII.
[63] Palermo 1990a
[64] Palermo 1998.
[65] Pasquinucci et al. 1998.
[66] Pasquinucci et al. 1998, 102-4.
[67] Gliozzo et al 2003.
[68] Gliozzo et al. 2003, 286 Tab. 2, 287, 291-2.
[69] Gliozzo, et al. 2003, 311.
[70] Frontini et al. 1995.
[71] Frontini et al. 1995, 351-60.
[72] Frontini et al. 1995, 338 Tab. 3.
[73] Gliozzo and Memmi Turbanti 2004.
[74] Gliozzo and Memmi Turbanti 2004, 206-10.
[75] Gliozzo and Memmi Turbanti 2004, 211.
[76] See Stanco 2009a, 20-21 for *ceramica protocampana*.
[77] Cibbechini and Principal 2004; Principal 2005; Morel 2009, 128-30.
[78] Any effort to compare the data generated by these two programs of analysis with the data obtained in the current program of analysis requires the conversion of the values for the four minor constituents (Na, K, Ca, and Fe) from oxide form to the equivalent elemental value, as has been done for the discussion presented here.
[79] Gliozzo and Memmi Turbanti's possible general Chiusi group (Group 8) does not display a similar level of agreement for these same elements.
[80] Palermo 2003b.
[81] Palermo 1990b.
[82] Palermo 2003b, 347 n. 725.
[83] Gliozzo et al. 2003.
[84] Gliozzo et al 2003, 303 Tab. 17.
[85] Palermo 2003b, 349, 357.
[86] Aprosio 2003, 157,
[87] See Palermo 2003a, 348, 358 for an example of BGW with a red gloss from the Volterra – Acropoli excavations. See Morel 1996, 519-20 for BGW with a red gloss in general.
[88] Aprosio and Pizzo 2003.
[89] Schneinder and Hoffman 1990, 30-31, 37 Tabelle 3.
[90] For the location of the Ateius and Perennius workshops see Fülle 1997, 130 fig. 2; Oxé et al. 2000, 27-28.
[91] Gliozzo and Memmi Turbanti 2004, 206-9, 215 Table A1, in their program of chemical analysis of BGW described above, identified what they believed were two distinct, though related subgroups of BGW vessels within their group of Arretine origin, one of which was characterized by a higher degree of compositional homogeneity. Both subgroups display a wide range of CaO figures that embody considerable overlap with one another, however, and it is clear that they do not correspond to ITS Fabric Groups 1 and 2.
[92] See Oxé et al. 2000, 28 for the date of the Ateius workshop at Arezzo .
[93] *Carta geologica d'Italia Foglio* 114 key agQ/Argille di Quarata; De Castro and Pilotti 1933, 59-60.
[94] See Peña forthcoming for a fuller exposition of this argument.
[95] Clay obtained from a deposit lying within the Q_t formation was, for example, apparently employed in recent times by a factory for the manufacture of architectural ceramics located 6 km to the north of Arezzo at *località* Giovi Le Cave. On a visit to this facility by JTP in 1991 an informant, who stated that her

family had operated this establishment (which had ceased operations many years previously), indicated that it had employed clay excavated on the premises.

[96] Paturzo 1996, 36.

[97] See note 9, above.

[98] Palermo (2003a, 325 no. 105.) regarded at least one of the pieces with production defects as constituting evidence that the form to which it belongs (in this case a krater) was produced at Volterra.

[99] Ostman 2004, 195 reaches generally similar conclusions regarding the likely locus of pottery production in the vicinity of Volterra in antiquity, basing her inferences on the working properties of the clay obtained from the various outcrops of the Pag formation that she sampled in her program of analysis.

[100] It seems possible that one or more of the BGW fabric groups assigned to Volterra may, in fact, have originated at one or the other of the two workshops that produced this class that have been identified in the vicinity of Montaione, ca. 17 km to the NNE of Volterra.

[101] Instructive in this regard is the evidence for the range of fabrics associated with a Roman-period pottery workshop located at Scandicci - Vingone, ca. 5 km SW of Florence and 30 km NW of Cetamura, at the juncture between the southwestern margin of the Florence – Prato- Pistoia Basin and the northeastern edge of the Monti del Chianti. Excavations demonstrated that this establishment was active ca. 20 B.C. – A.D. 20, manufacturing thin-walled ware, commonware, coarseware, cookware, amphoras, and architectural ceramics. A program of petrographic analysis involving workshop products revealed the presence of six distinct fabrics; see de Marinis and Pallecchi 2008. Four of these fabrics appear to have been manufactured from clay obtained from four different clay sources, each yielding material with a distinct composition. Three of these sources appear to be deposits of alluvial sediment, and were presumably located at no great distance from the workshop. Two of these sources yielded clay that appears to have been non-calcareous (Gruppo 1 and 4), while the third yielded clay that appears to have been calcareous (Gruppo 3). The fourth source (Gruppo 5), employed exclusively for the manufacture of cookwares, appears to have been associated with an outcrop of gabbro located in the vicinity of Impruneta, ca. 9 km to the SE of the workshop. One of the other two fabrics appears to represent the fine fraction of the material obtained from one of the two apparently non-calcareous sources of alluvial clay (Gruppo 2), and the other to represent material obtained from one of the apparently calcareous sources of alluvial clay with the addition of chamotte (ground ceramic) temper (Gruppo 6).

[102] The authors are aware of no settlement data that might permit a useful estimate of the density of the population of the area around Cetamura at any point during antiquity. Modern data suggest, however, that figures during antiquity were likely on the low side of the range. According to the *tuttiitalia* website (http://www.comune.gaiole.si.it/categoria/1-il-comune/il-comune), the *comune* in which Cetamura is located, Gaiole in Chianti, which has an area of 129 km^2, had 2,737 residents as of January 1, 2011, for a density of 21 persons/km^2. This figure placed Gaiole in Chianti 248th to 255th in density for the 287 *comuni* in the region of Tuscany. According to the *Comuni d'Italia* website (http://spazioinwind.libero.it/liberscuola/comunitaliani.htm), the highest population figure registered for Gaiole in Chianti in the national censuses that have been carried out in the first year of each decade since Italian unification occurred in the very first of these, that is, in the one undertaken in 1861, when it was credited with 4753 inhabitants. If the boundaries of the *comune* were the same as its current boundaries, this would represent a density figure of 37 persons per km^2.

[103] Roth 2007, 87-8, 93-4 assumes that high-end BGW from Volterra, specifically vessels belonging to the so-called Malacena Group, were regularly distributed as gifts via mechanisms of this kind.

[104] See Miller 1985, 185-87 for emulation.

[105] See Peña 1989 for Internal Red-Slip Cookware from Cetamura.

[106] See Mosca 2002, 191-5 for this section of the *Via Cassia Repubblicana*,.

[107] Di Giuseppe 2005, 37, 40; Roth 2007, 103.

[108] One of the authors (JTP) has found that using a Dino-Lite 413T digital microscope with the associated DinoCapture software he can in the course of one hour produce and archive ca. 80-100 photomicrographs of prepared pottery chips suitable for use in optical microscopy of the kind employed in this study. This suggests that a team of two persons could readily prepare and photograph 500 specimens in the course of a single day's work.

[109] To the authors' knowledge, in northern Etruria for the periods in question the set of pottery production sites that have been subjected to systematic excavation, study, and publication is at present limited to just

three : Chiusi – Marcianella, Torrita di Siena – Poggetti, and Scandicci – Vingone. For the last of these see note 103.
[110] In the case of Roth's study, the assumption that the production of high-quality BGW at Volterra involved the use of both a kick wheel and a double-firing technique (Roth 2007, 82-4) appears to be unwarranted and, in the view of the authors', very probably incorrect on both counts.
[111] Palermo 1990a, 105 no.3, 112 tab.
[112] Palermo 1998, 120 tab.
[113] Palermo 1990a, 108-9 nos. 26 and 28, 113 tab, 348 fig. 26.
[114] Palermo 1998, 120 tab., 128 fig. 18, 129 fig. 19.
[115] Palermo 2003a, 293.
[116] Palermo 1990a, 107 no. 22, 112 tab.
[117] Palermo 1998, 120 tab.1, 129 fig. 31.
[118] Palermo 2003a, 296 no. 16, 309 tab.; 319 no. 84, 327 tab.
[119] Morel 1996, 298, pl. 122.
[120] Palermo 1990a, 105 no. 4, 112 tab.
[121] Palermo 2003a, 316 no. 71, 326 tab., 490 fig. 21.16.
[122] Palermo 2003a, 292-3 no. 7, 309 tab., 486 fig. 17.9; 329 no. 113, 331 tab., 493 fig. 24.8.
[123] Palermo 2003a, 301 no. 31, 310 tab., 488 fig. 19.4.
[124] Palermo 1990, 110 no. 37, 113 tab.
[125] Palermo 2003a, 329 no. 114, 331 tab., 493 figs. 24.9 and 24.11.
[126] Palermo 2003a, 302-303 nos. 33-34, 310 tab., 488 fig. 19.11-15.
[127] Palermo 2003a, 296 no. 15, 309 tab., 487 fig. 18.7-9; 312 no. 61, 314 tab.; 318-9 nos. 80-81, 327 tab., 492 fig. 23.1-2; 329-30 no. 116, 331 tab.
[128] Palermo 2003a, 306 no. 45, 311 tab.
[129] Pasquinucci 1972, 284 fig. 2.7 and 16, 365.
[130] Aprosio and Pizzo 2003, 104-5, 114 tav. VII VN.II.1.2 (sic).
[131] Aprosio and Pizzo 2003, 119, 122 tav. IX VN X.1.1.
[132] Aprosio and Pizzo 2003, 96-97.
[133] Palermo 2003b, 349 no. 1, 496 fig. 27.3.
[134] Palermo 2003b, 350 no. 2, 496 fig. 27.5.
[135] Aprosio 2003, 159 tav. XXV VR I.1.2, VR I.1.4.
[136] Palermo 2003b, 350 no. 2, 496 fig. 27.5.
[137] Palermo 2003b, 353 no. 14, 497 fig. 28.6; Aprosio 2003, 158 no. VR VIII.1.1, 159 tav. XXV VR VIII.1.1.
[138] Ettlinger 1990, 52.
[139] Ettlinger 1990, 56.
[140] Ettlinger 1990, 58
[141] Ettlinger 1990, 58
[142] Ettlinger 1990, 72.
[143] Ettlinger 1990, 76.
[144] Ettlinger 1990, 82.
[145] Ettlinger 1990, 84.
[146] Ettlinger 1990, 86, 88.
[147] Ettlinger 1990, 104.
[148] Ettlinger 1990, 112.
[149] Ettlinger 1990, 116.
[150] Ettlinger 1990, 62, 86.
[151] Ettlinger 1990, 86.
[152] Ettlinger 1990, 86.
[153] Ettliner 1990, 92.
[154] Ettlinger 1990, 86, 88.
[155] A database that will offer a full presentation of the information relating to these clays is currently being prepared for on-line publication as part of the *California Classical Studies* initiative.

[156] The thin sections analyzed in this study were fabricated by Quality Thin Sections of Tucson, Arizona.
[157]The charts employed were those published in Matthew et al. 1991, especially that on p. 241.
[158] See Whitbread 1995, 379 table A3.1, 385-6 for the use of this scale in ceramic petrography.
[159] Stoops 2003, 53 fig. 4.14.
[160] See Stoops 2003, 49 for this set of size categories.
[161]The data presumably over-represent somewhat certain kinds of bodies regularly present in the set of thin sections analyzed - in particular relatively large grains of polycrystalline quartz - which remain visible regardless of the orientation of the microscope stage under crossed polars.
[162] See Whitbread 1995, 380 for these shapes and size categories.
[163] See Garzanti et al. 2002 passim for the representation of various mineral grains and rock fragments in beach and river sands from several locales in northern Tuscany.
[164] See Garzanti et al. 2002, 5, 7 fig. 3.A, 8, 10, 13 for granite fragments in beach sands from various locales in northern Tuscany.8887
[165] Matthew et al. 1991.
[166] Readers should note that while these values can be compared to the figures presented for the percentage of the ceramic body represented by matrix, inclusions and voids in the program of petrographic analysis reported in Appendix 3 (Table 12, column 2), they cannot be compared with the values presented for the percentages of the various types of inclusions (Table 12, column 4), as these represent estimates for the percentage of the area in the thin section occupied by inclusions rather than the percentage of the total area of the ceramic body. In order to underscore the non-compatible nature of the results obtained by means of these two characterization operations different sets of percentage ranges and associated names were employed.
[167] Stoops 2003, 53 fig. 4.14.
[168] One specimen, BGW1.05, displays sporadic, medium, subrounded, dark gray to reddish gray bodies (mudstone and/or siltstone).