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Connecting crafting communities: reconstructing interactions between communities in and out of Cyprus in the early third millenium BC

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CHAPTER 6:

Pottery Production in
Late Chalcolithic Cyprus:
A Compositional and
Technological Study

Chapter 6 — Pottery Production in Late Chalcolithic Cyprus: A Compositional and Technological Study

Following the macroscopic analysis presented in the previous chapter, 81 sherds from the four sites in question were sampled for further analysis, by employing ceramic thin section petrography and hhXRF. In this chapter the analytical methodology and research objectives are presented, followed by an overview of the geology of Cyprus and the results of the analyses. Finally, the conclusions drawn from these analyses regarding pottery production in Late Chalcolithic Cyprus are outlined.

6.1. Ceramic Thin Section Petrography

6.1.1. Analytical methodology and research objectives

Ceramic petrography was employed for the mineralogical characterization of the chosen samples, and for the identification of micro-morphological characteristics which may indicate their provenance or production technology. Sections were cut from the ceramics sherds and were prepared into thin slides that were attached to glass to create thin sections, whose average thickness doesn't surpass 30 microns. This process was conducted by me at the Science and Technology in Archaeology and Culture Research Center (STARC) of The Cyprus Institute, under the supervision of Dr. Maria Dikomitou-Eliadou and Dr. Jelena Živković, within the framework of short-term fellowship for PlaCe-ITN, a Horizon2020 Research and Innovation Programme (under the Marie Skłodowska-Curie grant agreement No 956410).

The thin sections were studied using a cross-polarising petrology microscope, which enables the study of inclusions under different optical conditions. The mineralogical composition of each sample was determined, via the identification of the inclusions in each thin section. The recording system used for this was developed by Dikomitou Eliadou (2012), and is based on that proposed by Whitbread (1995). The recording of petrographic information comprises of descriptions of the microstructure, groundmass, matrix, inclusions in fine and coarse fraction, amorphous and textural concentration features (acfs and tcfs), as defined by Whitbread (1995) (see Appendix II – Glossary). The shape, texture and degree of sorting of the mineral and rock inclusions were recorded, and references were made to the grain size, shape and distribution. The visual charts used for this were derived from Orton & Hughes (2003), and Quinn (2013), and are presented in Appendix III. Additionally, photomicrographs in cross- and plain-polarised transmitted light (XP and PP), were taken to visually represent the fabrics and facilitate their comparison. The final images for publication were taken using a ZEISS Axiolab 5 microscope with an Axiocam 208 color camera at the STARC, The Cyprus Institute, and a Leica DM2700 P microscope with a Leica MC190 HD color camera at the Cyprus American Archaeological Research Institute (CAARI). Detailed descriptions of the fabric groups identified during this study are presented in Appendix IV.

Emphasis has been given to defining petrographic fabric groups within the samples, and the recording of any information concerning the several stages of the *chaîne opératoire* of each fabric's manufacture. It should be noted that in this study, when it comes to the petrographic descriptions, the term “fabric” “refers to the arrangement, size, shape, frequency and composition of components of the ceramic material” (Whitbread, 1995, p. 368). In this thesis, it also includes the mineralogical and chemical characteristics of each sample, and the characteristics related to the samples' microstructure. Fabric groups were defined, and there was an effort to recognize “core clusters” of samples that are identical or very similar (Plog & Steadman, 1989, p. 211). Mineralogical fabric groups were defined according to the presence or absence of constituents in the clay matrix of each sample, their density and mode of distribution. Samples which could not be assigned to any of the fabric groups were described as outliers and have been assigned their own fabrics.

The division of the samples into fabric groups and the recording of all visible information on their *chaîne opératoire* provided the basis for the identification of production centres, the presence or absence of imported pottery, the conduction of intra- and inter- site technological and compositional comparisons, and the identification of pottery technologies and their degree of variability at a local, regional, and inter-regional level. Therefore, the results of the petrographic analysis are compared to the results of the macroscopic analysis, facilitating an assessment of the established typological grouping of pottery wares and providing additional evidence to the technology of production of the wares in question.

6.1.2. The Geology of Cyprus

As discussed in Chapter 2, Cyprus is comprised of four main geological zones: the Troodos Ophiolite zone in the center of the island, the Kyrenia zone in the north, the Mamonia Complex zone in the west, and the Circum Troodos Sedimentary succession zone (Constantinou, 2002).

The Troodos Ophiolite is the most impressive geomorphological feature of Cyprus, forming its central component and extending over about 3, 200 km² (Zomeni, 2019, p. 23). In general, an ophiolite is a sequence of rock types, comprised of deep-sea sediments on top of basaltic pillow lavas, dykes, gabbro and ultramafic peridotite (Allaby, 2020). The Troodos is one of the most thoroughly studied ophiolites in the world. Additionally, the Troodos Ophiolite is of primary importance for the water supply of the island, with good aquifers, water-bearing permeable rocks, that feed perennial rivers transport around the Troodos and the plains. Several rivers flow from the Troodos massif into the sedimentary deposits of the surrounding valleys, creating alluvia that are ideal for clay extraction. Finally, the Troodos Ophiolites include the Cyprus-type massive sulphide copper ore deposits that have been of great importance for the island from the Bronze Age onwards.

Especially important for the Paphos region is the Mamonia Complex, which is situated in the southeast part of the island and it is comprised of igneous, sedimentary and metamorphic rocks, such as limestone, mudstone, quartzitic sandstone, marble, chert, amphibole, serpentine, pillow lavas and chert (Constantinou, 2002; Constantinou & Panagides, 2013, pp. 55-60). The Mamonia Complex is divided in two groups: the Upper Triassic – Lower Cretaceous Agios Photios group, and the Upper Triassic – Lower Cretaceous Dhiarizos group.

The Kyrenia zone in the north, covers the Pentadaktylos mountain range and the Karpas peninsula, and it is comprised of carbonates and sedimentary rocks, mainly limestone, sedimentary rocks like chert, and igneous and metamorphic rocks like dolomite and marble (Cyprus Geological Survey 2012; Ducloz, 1972; Constantinou, 2002; Constantinou & Panagides, 2013, pp. 61-74). Finally, the Circum Troodos Sedimentary Succession zone is an extensive zone of autochthonous sedimentary deposits, extending between the Kyrenia and Troodos ranges, comprised of bentonitic clays mélange, marl, volcanoclastics, chert, chalk, limestone, calcarenite, evaporite and clastic sediments (Constantinou, 2002; Constantinou & Panagides, 2013, pp. 75-89). A similar geological profile encircles the Troodos mountains, making it very difficult to pinpoint one source of ceramics from this zone (Dikomitou, 2012, p. 137).

Even though the geology of Cyprus has been studied thoroughly, when it comes to ceramic provenance we are faced with a difficult task. This is due to the categorization of the island into geological formations, the repetitive occurrence of multifaceted assemblages in almost all geological zones involving sedimentary, igneous and metamorphic rocks, and finally the similar geology around the Troodos.

When employing archaeometric methods for studying ancient pottery and defining their provenance, there are two basic assumptions: first, that pottery from specific areas has specific chemical composition, and differences between clay sources are larger than differences within the same clay source; and second, that the petrographic fabric groups with the highest frequency at a site represent the local production (Brodie, 1998, p. 11-12). To validate these hypotheses, a combination of data from various analyses and an overall assessment of the geology of the region is crucial.

6.1.3. Sampling Strategy and Overview of Samples

Due to the differences between the sites mentioned above, different sampling methods were followed per case. At *Chlorakas-Palloures*, samples were taken from residential contexts that are safely dated to the Late Chalcolithic, from Plots 568 and 355 (Figure 55). In total, 21 samples were selected from ten Late Chalcolithic round houses from eleven trenches in both plots. Middle Chalcolithic and Late Chalcolithic houses are circular, with stone foundations, flat roofs, and a central plastered hearth (Steel, 2004, p. 88; Peltenburg, 2014, pp. 256-257). In some cases Chalcolithic houses are semi-subterranean structures without stone foundations (Croft & Thomas, 2003, pp. 123-132). In *Chlorakas-Palloures* only two building of this type have been recovered so far, namely Buildings 13 and 14 (samples from this Buildings are not included in this study). Most of the pottery selected (14 samples), comes from two trenches that were thoroughly excavated in 2021, i.e., BI21 and BT13. BI21 is situated in Plot 355. Part of it was first excavated by the Paphos Museum during the rescue work in 2017. Subsequently the plot was confiscated and further excavations took place by the *Palloures Archaeological Project*.

BI21 was excavated in 2019, 2021, 2023 and 2024, and contains a large Late Chalcolithic building (Building 15), with in-situ pottery clusters. Although the centre of Building 15 is well-preserved, including the pot cluster, a plastered hearth and multiple layers of plastered floors and features; the rest is almost gone, due to ploughing and later pits. Only one small segment of the stone wall has been preserved. Samples for this study include sherds recovered during the 2021 season and sherds recovered during the 2017 rescue excavations, whose location has been georeferenced safely within the in-situ pottery clusters.

BT13 is situated in the southern part of Plot 568. It was first excavated in 2015, and excavations resumed in 2021. The samples included here were recovered during the 2021 season, from at least two Late Chalcolithic buildings situated within the trench (Building 18 and Building 22). Building 18 is a partially preserved round house in the northern profile of the trench, comprised of two wall segments, an entrance, a pivot stone and a large concentration of in-situ pottery and ground stone tools in the profile. Building 12 is preserved in adjacent trench BU13, but in BT13 only its wall collapse has been recovered so far.

The remaining samples have been selected from eight Late Chalcolithic buildings from seven trenches. Buildings 4, 5, 7, 8, and 12, in trenches BR10, BU12, BV13, BX14, and BU13 respectively, are regular round houses with stone foundations, mudbrick walls and plastered hearths. Building 1 from trenches BQ09 and BP09 is also a round house with stone foundations, but of monumental size. Its diameter is ca. 14 m and the preserved wall has ca. 1,5 m width. Lastly, in trench BO19, Units 6 and 9 have not been assigned a building number but features indicate a residential area. Therefore, in this study it is referred to as Building X.

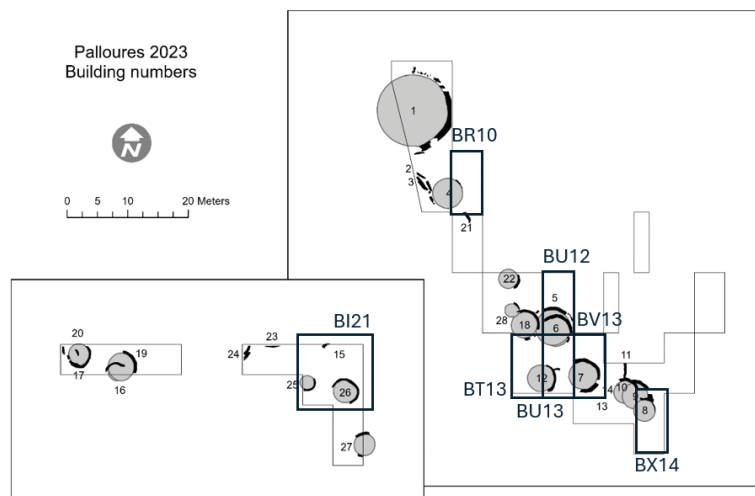


Figure 55: Overview of buildings from where samples were taken in Chlorakas-Palloures (created by Victor Klinkenberg and Maria Hadjigavriel)

Based on macroscopic studies of the pottery, it has been argued that maybe the communities of Kissonerga-Mosphilia and Chlorakas-Palloures shared clay sources and technological knowledge (Paraskeva, 2015; Hadjigavriel, 2021). Therefore, for this study, pottery from Kissonerga-Mosphilia has been sampled primarily to be compared with that of Chlorakas-Palloures. Diane Bolger selected six RB/B sherds and five SW sherds for analysis from *in situ* contexts associated with structures, which are safely dated to Period 4 (Late Chalcolithic). Specifically, two sherds come from Building 706, one sherd from Building 834, three sherds from Building 1044, three sherds from the pot spread in Building 1052, three sherds from the pot spread 1162 in Building 1052, and one sherd from Building 1165.

For Ambelikou-Agios Georghios, after the macroscopic analysis was conducted, 25 samples were selected for further analysis: namely seven sherds of RL, two sherds of RB/B, five SW, eight RBL, and three sherds of CW. Similarly, following the macroscopic analysis of the Politiko-Kokkinorotsos assemblage, 24 samples were selected for further analysis: seven sherds of Fabric A (RBL), seven sherds of Fabric B (RL), seven sherds of Fabric D (RBL) and three sherds of the Coarse Variety. At these sites, the context of the sherds was not taken under consideration.

For this project, 20 RB/B sherds have been sampled, of which nine are from Chlorakas-Palloures and six from Kissonerga-Mosphilia. All of them are bowls. In addition, two rim sherds from Ambelikou-Agios Georghios have been sampled due to their morphological and stylistic similarities to RB/B.

Subsequently, 17 SW sherds have been sampled: seven from Chlorakas-Palloures, (four rims from bowls, a rim of a jar and two jar body sherds); four jar body sherds, and one bowl body sherd from Kissonerga-Mosphilia; and five sherds from Ambelikou-Agios Georghios (one spout and four body sherds of closed vessels, likely jars). Finally, five LChalRM sherds from Chlorakas-Palloures have been sampled, four from jars, two body sherds and two rims, and one rim of a bowl.

From Ambelikou-Agios Georghios, in addition to the seven sherds possibly from the Paphos region mentioned above, seven RL, five RBL, and three CW sherds have been sampled. For the RL and RBL, eight are rims of bowls, one rim of jar, and three bowl body sherds. From Politiko-Kokkinorotsos, for this study, seven Fabric A sherds have been sampled, three rims of bowls, and four rims of jars. Also, seven Fabric D sherds have been sampled, three bowl rims and four jar rims. Finally, three CW sherds were sampled from Politiko-Kokkinorotsos. An overview of the samples is presented in Table 14 below and in Appendix IV. The macroscopic analysis of these 81 samples is presented in Appendix V.

Table 14: Overview of samples selected for archaeometric analysis (created by Maria Hadjigavriel)

OVERVIEW OF SAMPLES							
Ware - Shape - Vessel Part			Chlorakas- <i>Palloures</i>	Kissonerga- <i>Mosphilia</i>	Ambelikou- <i>Agios Georghios</i>	Politiko- <i>Kokkinorotsos</i>	Total sherds per ware
Red Black Stroked-Burnished Ware (RB/B)	Bowl	body	-	5	-	-	20 sherds
		rim	9	1	5	-	
Spalled Ware (SW)	Bowl	body	-	-	-	-	17 sherds
		rim	-	-	-	-	
	Jar	body	2	5	4	-	
		rim	5	-	-	-	
		spout	-	-	1	-	
Red Lustrous Ware (RL)	Bowl	body	-	-	1	-	14 sherds
		rim	-	-	5	1	
	Jar	body	-	-	-	-	
		rim	-	-	1	6	
Red Black Lustrous Ware (RBL)	Bowl	body	-	-	2	-	19 sherds
		rim	-	-	3	6	
	Jar	body	-	-	-	-	
		rim	-	-	-	8	
Late Chalcolithic Red Monochrome Ware (LChalRM)	Bowl	body	-	-	-	-	5 sherds
		rim	1	-	-	-	
	Jar	body	2	-	-	-	
		rim	2	-	-	-	
Coarse Ware (CW)	Pan or Tray	base	-	-	3	3	6 sherds
Total sherds per site			21 sherds	11 sherds	25 sherds	24 sherds	81 sherds

6.1.4. Petrographic examination of samples

As a result of the petrographic examination, the 81 ceramic samples were divided in seven different petrographic fabrics and four outliers (Table 15). An overview of these fabrics and the outliers is present in the Tables 16, 17 and 18 below. A detailed description of all seven fabrics can be found in Appendix VI.

Table 15: The identified petrographic fabrics, as defined by ceramic thin section petrography (created by Maria Hadjigavriel)

Fabric no.	Short fabric description	No. of samples	% of samples	Samples	Wares	Macrofabric Group	Site(s) represented
I	Fabric with dominant presence of argillaceous inclusions	9	11%	S25, S28, S29, S30, S31, S32, S47, S72, S73	RB/B	1	► Palloures (6 samples) ► Mosphilia (1 sample) ► Ambelikou (2 samples)
II	Fabric with dominant presence of argillaceous inclusions, common sandstone and few dolerite fragments	7	9%	S26, S27, S33, S46, S48, S50, S52	RB/B	1	► Palloures (3 samples) ► Mosphilia (4 samples)
III	Fabric with dominant presence of micritic limestone and chert	17	21%	S34, S35, S36, S37, S38, S39, S40, S51, S53, S54, S55, S56, S74, S75, S76, S77, S78	SW	2	► Palloures (7 samples) ► Mosphilia (5 samples) ► Ambelikou (5 samples)
IV	Fabric with dominant presence of amphibole, feldspars and quartz	5	6%	S41, S42, S43, S44, S45	LChalRM	3	► Palloures (5 samples)
V	Fabric with dominant presence of carbonates	10	12%	S4, S8, S11, S14, S15, S18, S19, S20, S21	RL,RBL	4	► Politiko (10 samples)
VI	Fabric with dominant presence of feldspars and dolerite	14	17%	S1, S2, S3, S5, S6, S7, S9, S12, S10, S13, S16, S17, S22, S23, S24	RL,RBL, CW	4 6	► Politiko (14 samples)
VII	Fabric with dominant presence of dolerite and basalt	15	19%	S57, S58, S59, S60, S61, S62, S63, S64, S65, S66, S67, S68, S69, S70, S81	RL,RBL, CW	5 6	► Ambelikou (15 samples)
Outlier 1	Fabric with dominant presence of red argillaceous inclusions	1	1.25%	S49	RB/B	1	► Mosphilia (1 sample)
Outlier 2	Fabric with dominant presence of igneous inclusions and chert	1	1.25%	S71	RBL	5	► Ambelikou (1 sample)
Outlier 3	Fabric with dominant presence of quartz, basalt and clinopyroxenes	1	1.25%	S79	CW	6	► Ambelikou (1 sample)
Outlier 4	Fabric with dominant presence of chert and orthopyroxenes	1	1.25%	S80	CW	6	► Ambelikou (1 sample)
Totals		81	100				

Table 16: Description of the seven main petrographic fabrics of this study (created by Maria Hadjigavriel)

Petrographic Fabric	Fabric I	Fabric II	Fabric III	Fabric IV	Fabric V	Fabric VI	Fabric VII
Sample (n=) (% of the overall sample)	9 (11%)	7 (9%)	17 (21%)	5 (6%)	10 (12%)	14 (17%)	15 (18%)
Sample codes	S25, S28, S29, S30, S31, S32, S47, S72, S73	S26, S27, S33, S46, S48, S50, S52	S34, S35, S36, S37, S38, S39, S40, S51, S53, S54, S55, S56, S74, S75, S76, S77, S78	S41, S42, S43, S44, S45	S4, S8, S11, S14, S15, S16, S18, S19, S20, S21	S1, S2, S3, S5, S6, S7, S9, S12, S10, S13, S17, S22, S23, S24	S57, S58, S59, S60, S61, S62, S63, S64, S65, S66, S67, S68, S69, S70, S81
Matrix (XP)	light to dark orange; moderately optically active to optically inactive	dark orange to dark brown; moderately optically active	dark yellow/orange to dark brown; moderately optically active	yellow to dark orange and dark brown/grey; moderately optically active	dark orange/red to dark grey/brown; moderately optically active	yellow to red/orange, and dark grey/brown; moderately optically active	dark orange/red to dark grey/brown; moderately optically active
Voids	rare meso planar voids parallel to the section's margins (<2%); rare macro vughs (<5%); dominant meso and micro vughs (<10%); randomly oriented; close- to double-spaced	some mega planar voids parallel or vertical to the section's margins (<5%); frequent meso and micro vughs (<10%); randomly oriented; close- to double-spaced	common to few planar voids, parallel to the section's margins (<5%); rare meso vughs (<2%); dominant micro vughs (<10%); randomly oriented; close- to double-spaced	common to few planar voids parallel to the section's margins (<10%); rare meso vughs (<2%); common micro vughs (<5%); randomly oriented; close-to double-spaced	rare to absent planar voids (<2%); rare macro vughs (<5%); common meso and micro-vughs (<10%); randomly oriented; single to open-spaced	rare to absent planar voids (<2%); rare macro vughs (<2%); common meso and micro-vughs (<5%); randomly oriented; single to open-spaced	rare to absent planar voids (<1%); rare macro vughs (<2%); common meso and micro-vughs (<5%); randomly oriented; single to open-spaced

Table 17: Description of the seven main petrographic fabrics of this study (created by Maria Hadjigavriel)

Petro-graphic Fabric	Fabric I	Fabric II	Fabric III	Fabric IV	Fabric V	Fabric VI	Fabric VII
Grain size - coarse fraction - fine fraction	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below
c:f:v 0.0625mm	45:45:10	50:45:5	50:45:5	55:35:10	45:45:10	55:40:5	45:45:10
Inclusions	poorly sorted inclusions; bimodal grain-size distribution; dominant argillaceous inclusions (++); common chert & opaques(+); few monocrystalline quartz(-); rare sandstone, textural concentration features & feldspars (-)	poorly sorted inclusions; bimodal grain-size distribution; dominant argillaceous inclusions, chert & serpentinite (++); common sandstone, polycrystalline quartz & opaques(+); few siltstone, gabbro, basalt & micritic limestone(-)	poorly sorted inclusions; bimodal grain-size distribution; dominant micritic limestone, chert & argillaceous inclusions (++); common sandstone, polycrystalline quartz, opaques & serpentinite (+); few polycrystalline quartz, basalt and calcite (-)	well sorted inclusions; bimodal grain distribution; dominant amphiboles, feldspars, monocrystalline & polycrystalline quartz(++); common serpentinite, basalt, olivine, dolerite (+); few gabbro, sandstone, quartzite, opaques & micritic limestone (-)	poorly sorted inclusions; bimodal grain distribution; dominant microfossils, micritic limestone & feldspars(++); common serpentinite, opaques, basalt, polycrystalline quartz(+); few sandstone & dolerite(-); rare olivine, orthopyroxenes & clinopyroxenes (-)	poorly sorted inclusions; bimodal grain distribution; dominant feldspar, polycrystalline quartz & dolerite (++); common serpentinite, biotite, monocrystalline quartz, opaques, clay pellets & orthopyroxenes (+), few basalt & clinopyroxenes (-); rare olivine, sandstone, micritic limestone & microfossils (-)	poorly sorted inclusions; bimodal grain distribution; dominant dolerite & basalt(++); common clinopyroxenes, feldspar, monocrystalline & polycrystalline quartz & opaques(+); few amphiboles & olivine(-); rare granitic rock
% (sub) rounded - % (sub) angular	60-40	50-50	50-50	40-60	30-70	60-40	60-40

Table 18: Description of the four outliers of this study (created by Maria Hadjigavriel)

Petro-graphic Fabric	Outlier 1: Fabric with dominant presence of red argillaceous inclusions	Outlier 2: Fabric with dominant presence of igneous inclusions & chert	Outlier 3: Fabric with dominant presence of quartz, basalts & clinopyroxenes	Outlier 4: Fabric with dominant presence of radiolarian chert & orthopyroxenes
Sample (n=) (% of the overall sample)	1 (1%)	1 (1%)	1 (1%)	1 (1%)
Sample codes	S49	S71	S79	S80
Matrix (XP)	light to dark orange; moderately optically active	dark orange/red to dark grey/brown; moderately optically active	dark orange/red to dark grey/brown; moderately optically active	dark orange/red to dark grey/brown; moderately optically active
Voids	dominant mesa & micro vughs (<10%); some mesa planar voids, occasionally parallel to the section's margins (<5%); rare macro vughs (<2%); randomly oriented; close- to double-spaced	rare to absent planar voids (<1%); rare macro vughs (<2%) and common mesa & micro-vughs (<5%); randomly oriented; single to open-spaced	rare to absent planar voids (<1%); rare macro vughs (<2%); common mesa & micro-vughs (<5%); randomly oriented; single to open-spaced	rare to absent planar voids (<1%); rare macro vughs (<2%); common mesa & micro-vughs (<5%); randomly oriented; single to open-spaced
Grain size - coarse fraction - fine fraction	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below	- from pebbles to fine sand - of fine sand & below
c:f:v 0.0625mm	60:35:5	45:45:10	45:45:10	65:25:10
Inclusions	poorly sorted inclusions; bimodal grain-size distribution; dominant red/brown argillaceous inclusions (++); common chert & opaques (+); few quartz (-); rare sandstone (-)	poorly sorted inclusions; bimodal grain-size distribution; dominant dolerite & radiolarian chert (++); common feldspars, sandstone, opaques & quartz (+); few olivine (-)	poorly sorted inclusions; bimodal grain-size distribution; dominant quartz, basalt & clinopyroxenes (++); common feldspar, dolerite & opaques(+); few olivine (-)	poorly sorted inclusions; bimodal grain-size distribution; dominant radiolarian chert, orthopyroxenes & micritic limestone (++); common quartz & opaques (+); few olivine (-)
% (sub) rounded - % (sub) angular	60-40	60-40	60-40	60-40

Fabric I: Fabric with dominant presence of argillaceous inclusions

Fabric I, accounts for 11% of the overall dataset (9 samples). Out of nine samples, six have been sampled from *Chlorakas-Palloures*, one from *Kissonerga-Mosphilia*, and two from *Ambelikou-Agios Georghios*, and all correspond to the RB/B ware. It is characterized by the dominant presence of argillaceous inclusions, coexisting with chert and sandstone. It should be noted that the term “argillaceous inclusions” is used following Whitbread (1986), who uses it to describe a broad range of argillaceous materials, including rock fragments and clay pellets. Here, they vary in composition and textural characteristics, even within the same thin section, so this term is preferred. Most are mudstone fragments, mostly grey ones with some visible unidentified constituents in very fine fraction. Some are partly oxidised presenting an area of colour transformation to brown or brownish-red. There are also some that are range to dark yellow, and a few are dark reddish-brown. Other inclusions are chert, opaques, and monocrystalline quartz. Rarely, sandstone containing iron oxides, quartz, opaque and/or mica, and small feldspar fragments occurs. Also, some rare textural concentration features are present in some of the samples. For example, in S25, there’s a textural concentration feature 1.8 mm in long diameter, containing argillaceous material, quartz and small sedimentary rock fragments of grey/beige micritic texture with a darker brown fabric.

Overall this is a sedimentary-oriented fabric, with a relatively fine matrix. The clay matrix is thick and in red/dark red colours. There are no indications of clay refinement, considering the size of the inclusions. The argillaceous inclusions vary in colour due to the temperature and atmosphere during firing. Variation in firing conditions is also indicated by the fact that samples range from optically active to totally optically inactive and blackened (e.g. S25) (Figures 56, 57, 58, 59).

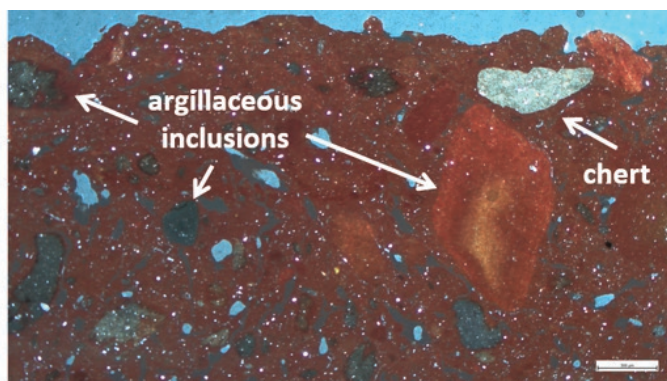


Figure 56: S31
– RB/B from
Chlorakas-Palloures,
assigned to Fabric
I (photomicrograph
taken under XP x2,5)

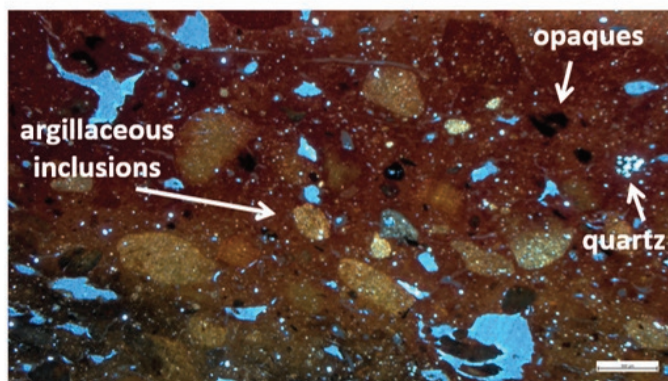


Figure 57: S47
– RB/B from
Kissonerga-Mosphilia,
assigned to Fabric
I (photomicrograph
taken under XP x2,5)

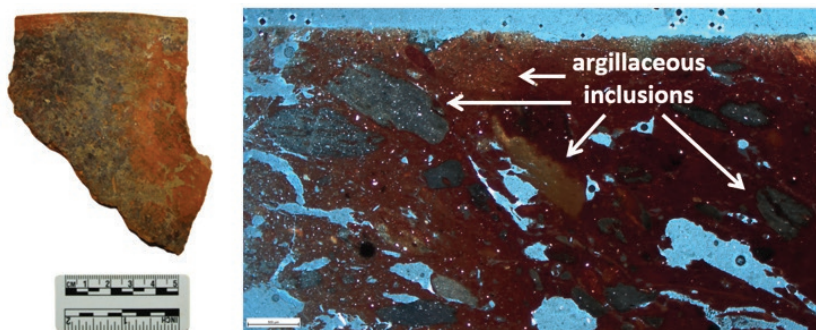


Figure 58: S73 – RB/B from Ambelikou-Agios Georghios, assigned to Fabric I (photomicrograph taken under XP x2,5)

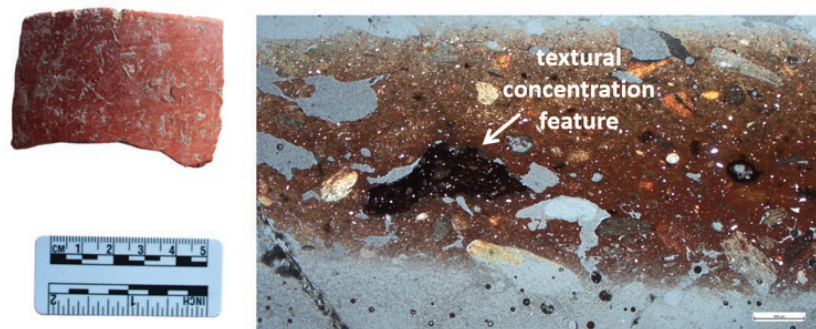
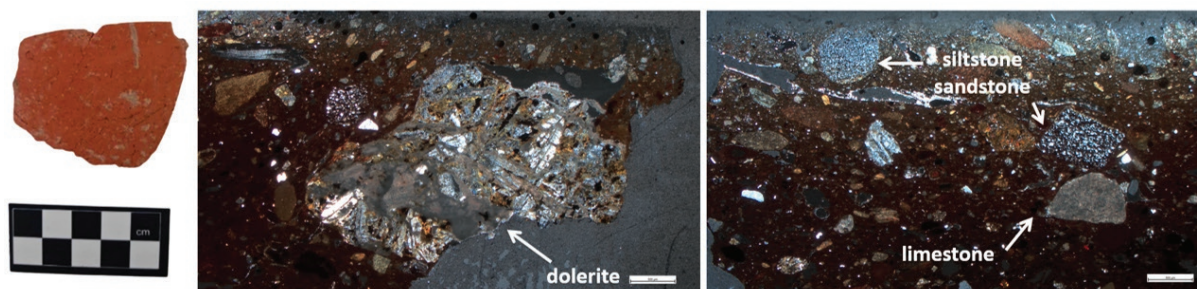


Figure 59: S25 – RB/B from Chlorakas-Palloures, assigned to Fabric I (photomicrograph taken under XP x2,5)

Fabric II: Fabric with dominant argillaceous inclusions, common sandstone and few dolerite fragments

Fabric Group II (7 samples, 9% of the overall sample), is dominated by argillaceous inclusions but also contains sandstone and dolerite. Samples derive from Chlorakas-Palloures and Kissonerga-Mosphilia, and all correspond to the RB/B ware. Just like in Fabric I, grey/blue, yellow and red argillaceous inclusions, these being mudstone fragments are dominating the matrix. Chert and serpentinite are also common inclusions, and polycrystalline quartz, opaques, siltstone, and sandstone have also been recorded (Figures 60 and 61). Overall this fabric is similar to Fabric I, but appears to derive from a different clay source since there is more mixing of various inclusions and the matrix is quite heterogeneous. The red/orange colour of serpentinite is due to the firing temperature, indicating firing above 650°C, since serpentinite changes colour in the range of 650°-750°C (Figure 62).

Figure 60: S26 – RB/B from Chlorakas-Palloures, assigned to Fabric II (photomicrographs taken under XP x2,5)



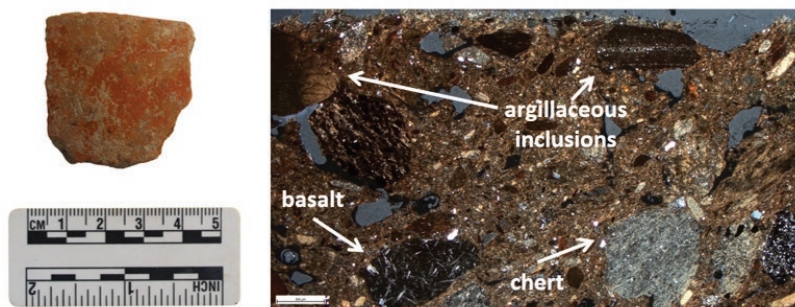


Figure 61: S46 – RB/B from Kissonerga-Mosphilia, assigned to Fabric II (photomicrographs taken under XP x2,5)

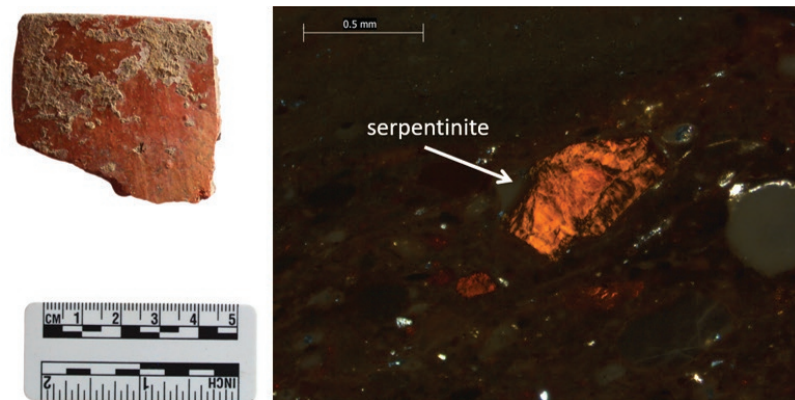


Figure 62: S33 - RB/B from Chlorakas-Palloures, assigned to Fabric II (photomicrograph taken under XP x5)

Fabric III: Fabric with dominant presence of micritic limestone and chert

Fabric III is defined by the dominant presence of micritic limestone, and chert. It is the largest fabric group within the sample, representing 21% (17 samples). All the samples correspond to the SW and derive from all sites except from Politiko-Kokkinorotsos. Micritic limestone fragments can be up to 5 mm in diameter, and contain microfossils, opaques and quartz grains in fine fraction, and occasionally, they contain iron oxides. Chert fragments are smaller, not exceeding 0.8 mm in diameter. Sandstone, serpentinite, monocrystalline quartz and opaques are also common inclusions of this fabric, along with a few fragments of basalt and some polycrystalline quartz grains. In fine fraction, argillaceous inclusions, opaques, quartz, mica, serpentinite and feldspars are observed (Figures 62, 63, 64). In some samples large calcite fragments are present. Overall, there seems to be hardly any refinement in this fabric group, and there are a lot of plant inclusions. Three samples (S36, S39, S40), are distinguished by the overly dominant presence of monocrystalline quartz in both coarse and fine fraction. However, this might be because of the lack of variability in the thin sections, and they are not different enough to be categorized as a different fabric group or sub-group.

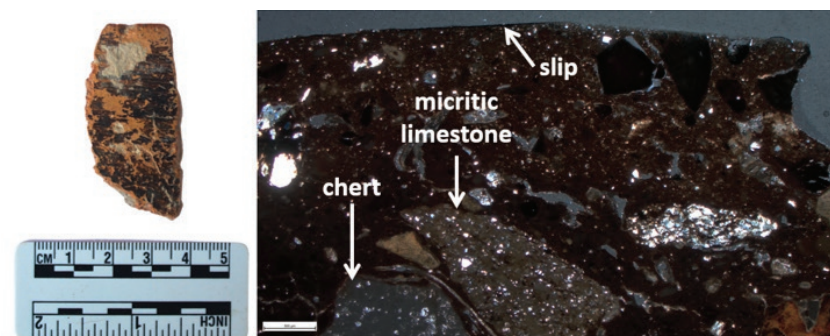


Figure 63: S37 - SW from Chlorakas-Palloures, assigned to Fabric III (photomicrographs taken under XP x2,5)

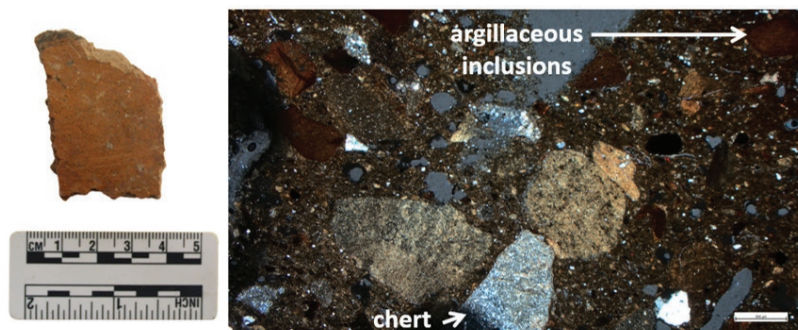


Figure 64: S51 - SW from Kissonerga-Mosphilia, assigned to Fabric III (photomicrographs taken under XP x2,5)

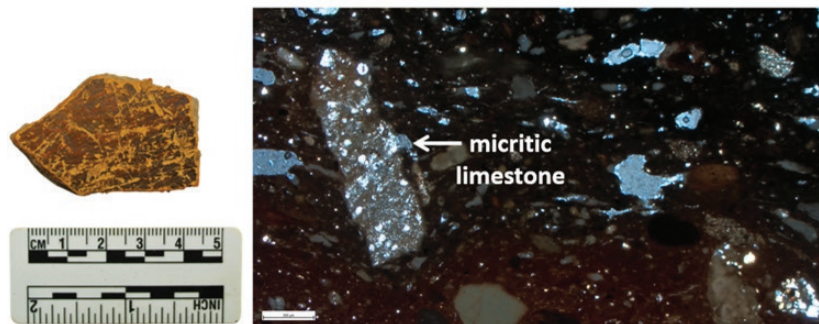


Figure 65: S77 - SW from Ambelikou-Agios Georghios, assigned to Fabric III (photomicrographs taken under XP x2,5)

Fabric IV: Fabric with dominant presence of amphiboles, feldspars, and quartz

Fabric IV is completely different from the first three fabric groups, as it is an amphibole-rich fabric dominated by feldspars and quartz (5 samples, 6% of the overall sample). All five samples have been sampled from Chlorakas-Palloures and correspond to the same macroscopically identified ware, the LChalRM. All samples are moderately optically active. The groundmass is homogenous throughout the fabric with a biscuit core in grey/black shades, that takes up the bulk of the section. Planar voids parallel to the section's margins are the most common (<10%), indicating the presence of organic inclusions in the clay.

Amphiboles dominate this fabric. Feldspars, mostly plagioclase, and quartz are also dominant, while serpentinite, olivine, dolerite and basalt are very common. Less commonly, gabbro fragments are present. The same goes for sandstone inclusions comprised of iron oxides, quartz, feldspars, opaques and/or mica. A few fragments of quartzite, opaques and micritic limestone are also observed. The characteristic red slip is visible in thin sections. Clay refinement seems to have taken place during the making of this fabric, as it seems less coarse than the other fabrics, as it appears to be more homogenous and better sorted (Figures 66, 67, 68, 69). There seems to be clay refinement in this fabric group and the moderately to well sorted inclusions indicate standardization of clay processing. Sample S43 seems to be a coarser version of the same fabric group.

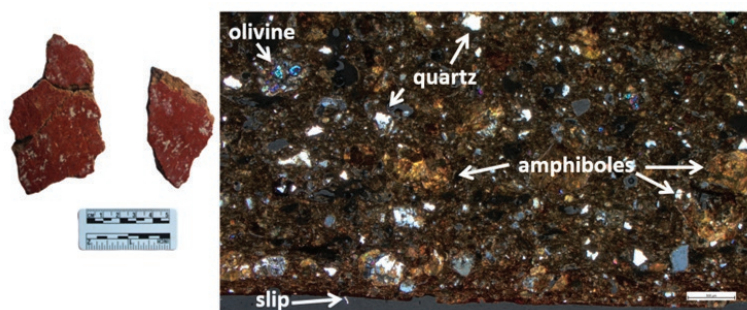


Figure 66: S41 - LChalRM from Chlorakas-Palloures, assigned to Fabric IV (photomicrographs taken under XP x2,5)

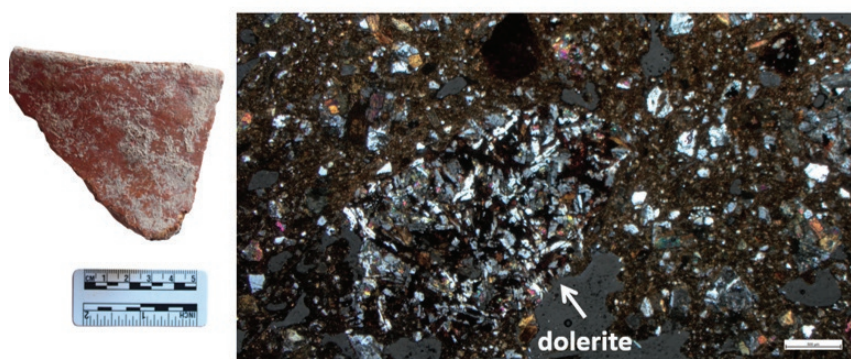


Figure 67: S43 - LChalRM from Chlorakas-Palloures, assigned to Fabric IV (photomicrographs taken under XP x2,5)

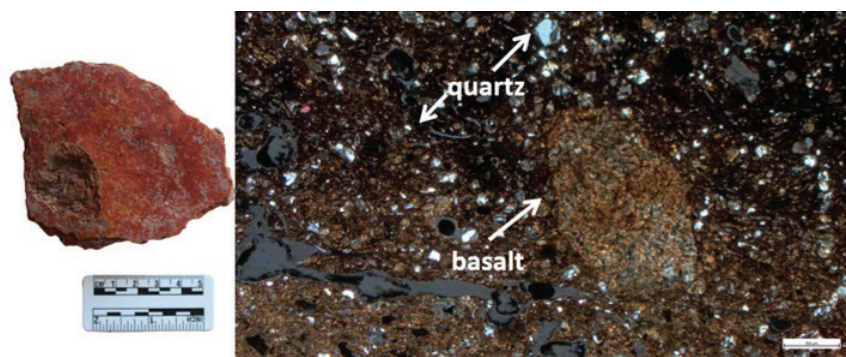


Figure 68: S44 - LChalRM from Chlorakas-Palloures, assigned to Fabric IV (photomicrographs taken under XP x2,5)

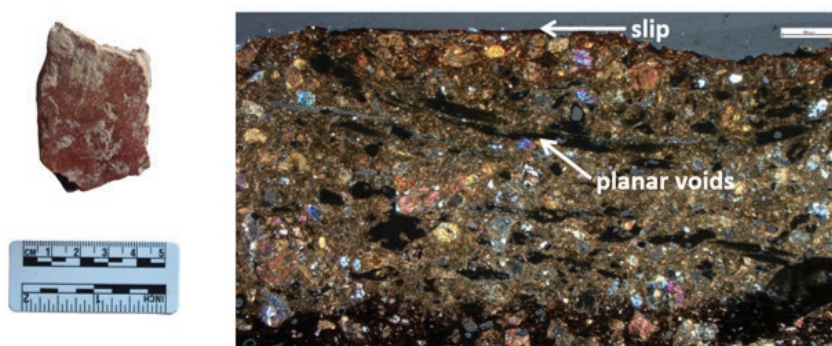


Figure 69: S45 - LChalRM from Chlorakas-Palloures, assigned to Fabric IV (photomicrographs taken under XP x2,5)

Fabric V: Fabric with dominant presence of carbonates

Fabric V is dominated by carbonates, microfossils, micritic limestone and feldspars (10 samples, 12% of the overall sample). All of the samples belonging to this Fabric Group have been sampled from Politiko and they correspond to two macroscopically identified wares: RL and RBL. The microfossils are the dominant inclusion of this group. They are predominantly foraminifera, some open and some calcite-filled, but other types of bioclasts exist. The ones that are calcite-filled are often covered by opaques or iron oxides.

Micritic limestone, containing microfossils, opaques and quartz grains in fine fraction, and feldspars, mostly plagioclase are also dominant. Other common inclusions of this fabric are serpentinite, basalt, opaques and polycrystalline quartz, along with a few fragments of, sandstone, dolerite, olivine, and more rarely clinopyroxenes, and orthopyroxenes (Figures 70 and 71). As far as technology is concerned, the very well-preserved microfossils in this fabric, are indicative of its firing in temperatures that did not have an impact on carbonaceous materials. This seems to be the finest fabric of the overall sample.

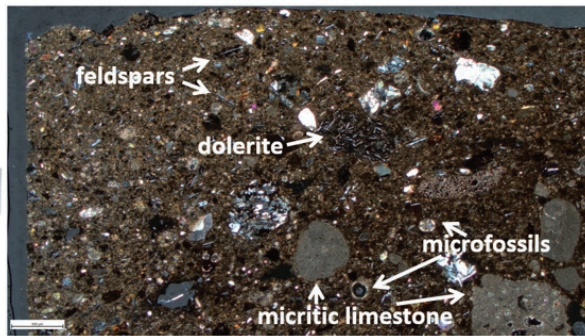


Figure 70: S4 - RBL from Politiko-Kokkinorotsos, assigned to Fabric V (photomicrographs taken under XP x2,5)

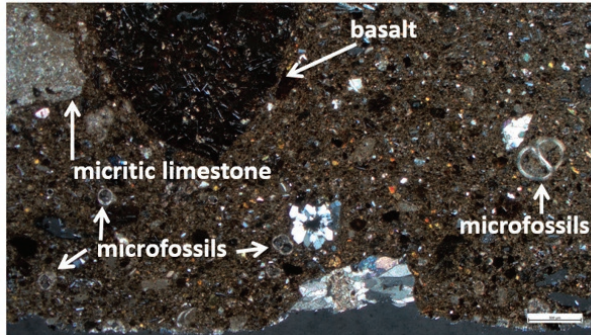


Figure 71: S8 - RBL from Politiko-Kokkinorotsos, assigned to Fabric V (photomicrographs taken under XP x2,5)

Fabric VI: Fabric with dominant presence of feldspars and dolerite

Fabric VI (14 samples, 17% of the overall sample), is dominated by feldspar, polycrystalline quartz and dolerite inclusions. All of the samples have been sampled from Politiko-Kokkinorotsos and correspond to three macroscopically identified wares: RL RBL, and CW. Dolerite fragments are often weathered in this fabric and occur in larger sizes, up to 3 mm in diameter. Monocrystalline quartz, serpentinite, biotite, clay pellets, opaques and orthopyroxenes are also observed. More rarely, olivine, basalt, clinopyroxenes, sandstone, micritic limestone and microfossils are also present. In fine fraction, feldspars, quartz, opaques, biotite, microfossils, mica and limestone are observed (Figures 72 and 73). Overall this is a microcrystalline calcareous matrix, less high-fired than Fabrics I, II and III.

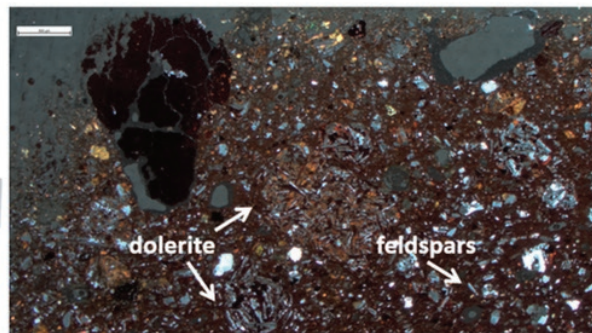


Figure 72: S3 - RL from Politiko-Kokkinorotsos, assigned to Fabric VI (photomicrographs taken under XP x2,5)

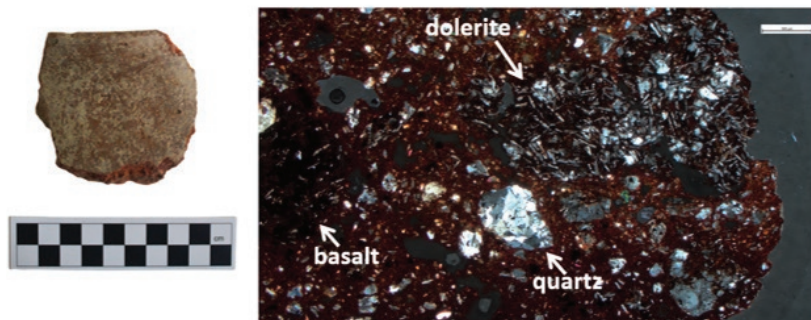


Figure 73: S6 - RL from Politiko-Kokkinorotsos, assigned to Fabric VI (photomicrographs taken under XP x2,5)

Fabric VII: Fabric with dominant presence of dolerite and basalt

Lastly, Fabric VII is the second largest fabric group of the sample (15 samples, 19% of the overall sample). All samples belonging to this group are from Ambelikou-Agios Georghios and they correspond to three macroscopically identified wares: RL, CW, and RBL. It is a fabric dominated by dolerite and basalt fragments. Clinopyroxenes and feldspars, mainly plagioclase, are present in large quantities. Quartz and opaques are also common, along with fewer amphibole grains and olivine (Figures 74, 75, and 76). Overall, there is no systemic processing of the clay at any stage of the chaîne opératoire. The mineral grains and rock fragments often seem weathered. The overwhelming presence of dolerite indicates that the clay source is situated up in the Troodos mountains.



Figure 74: S58 - RL from Ambelikou-Agios Georghios, assigned to Fabric VII (photomicrograph taken under XP x2,5)



Figure 75: S61 - RBL from Ambelikou-Agios Georghios, assigned to Fabric VII (photomicrograph taken under XP x2,5)

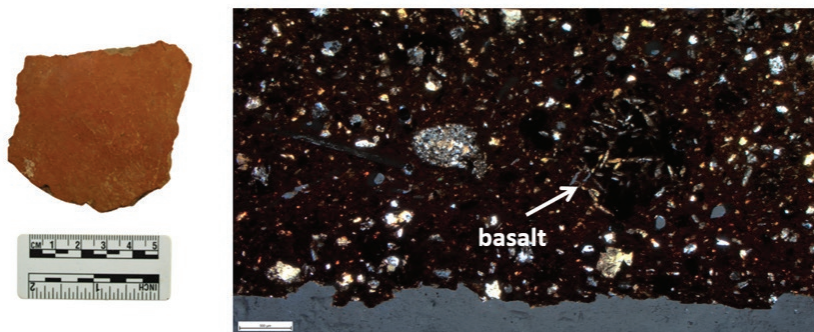


Figure 76: S65 - RL from Ambelikou-Agios Georghios, assigned to Fabric VII (photomicrograph taken under XP x2,5)

Outliers

In addition to the seven petrographic fabric groups, there are four outliers. These are samples that could not be assigned to any of the fabric groups and therefore they are classed as separate categories.

Outlier 1 – Fabric with dominant presence of red argillaceous inclusions

To begin with, S49 is an outlier that is extremely similar to Fabric I, but it is distinguished by the fact that argillaceous inclusions are exclusively of red to brown colour, with some visible microcracks and darker outlines (Figure 77). The sample is from Kissonerga-Mosphilia and corresponds to the macroscopically identified ware RB/B. Just like Fabric I, it is a sedimentary-oriented fabric, fine and pure, enriched with argillaceous inclusions and it is high-fired. The homogeneous size and distribution of the red argillaceous inclusions in this sample indicate that they have been added as temper in the clay mix. Interestingly, it is similar to a petrographic fabric of pithoi from Alassa, a Late Bronze Age site, identified by Nodarou (2017, Fabric Group 8, 9 and 10). Additionally, it also seems to be similar to Fabric IX, identified at Kissonerga-Ammoudhia, an Early-Middle Bronze Age site, by Graham (2013, p. 296-297. Appendix 4).

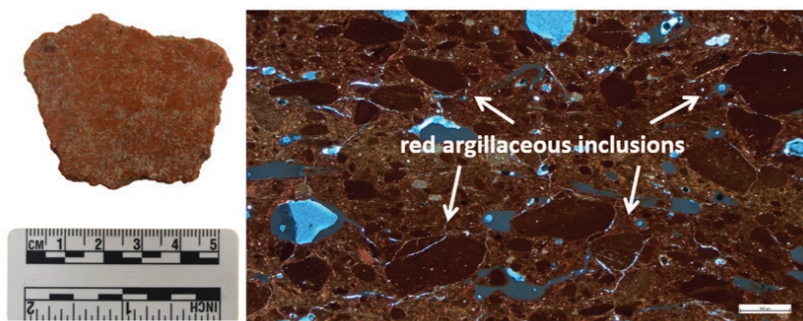


Figure 77: S49 - RB/B from Kissonerga-Mosphilia, assigned as an Outlier (photomicrograph taken under XP x2,5)

Outlier 2 – Fabric with dominant presence of igneous inclusions and chert

Outlier S71 was sampled from Ambelikou-Agios Georghios, and it corresponds to the RBL ware. This sample has close affinities to Fabric VII, but sedimentary inclusions, like chert and sandstone, are present as well (Figure 78).

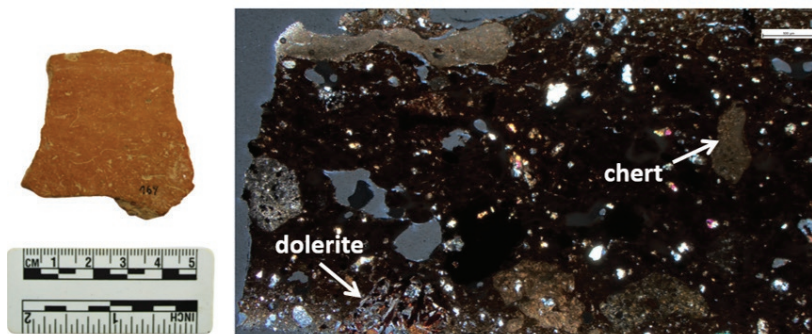


Figure 78: S71 - RL from Ambelikou-Agios Georghios, assigned as an Outlier (photomicrograph taken under XP x2,5)

Outlier 3 – Fabric with dominant presence of quartz, basalt and clinopyroxenes

Outlier S79, also sampled from Ambelikou-Agios Georghios, is dominated by the presence of basalt, clinopyroxenes and quartz (Figure 79). It corresponds to CW.

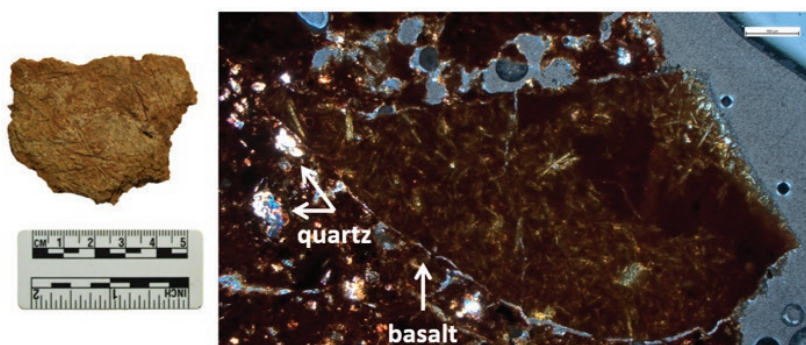


Figure 79: S79 - CW from Ambelikou-Agios Georghios, assigned as an Outlier (photomicrograph taken under XP x2,5)

Outlier 4 – Fabric with dominant presence of chert and orthopyroxenes

Finally, S80 is the fourth outlier of this dataset. It is also sampled from Ambelikou-Agios Georghios and corresponds to the CW. It is characterized by the dominant presence of radiolarian chert, orthopyroxenes and micritic limestone (Figure 80).

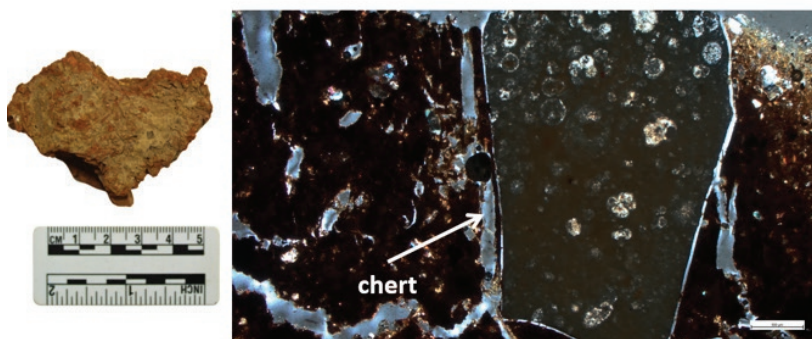


Figure 80: CW from Ambelikou-Agios Georghios, assigned as an Outlier (photomicrograph taken under XP x2,5)

6.2. The Chemical/Elemental Study of Samples – hhXRF

6.2.1 Analytical Methodology and Research Objectives

In addition to ceramic petrography, all 81 samples were also analysed with handheld X-ray fluorescence spectroscopy (hhXRF), to determine their bulk geochemical composition. As a method, it was chosen due to its cost-effectiveness, and the data selected were studied and interpreted carefully, keeping in mind the advantages and limitations of the method when studying a material category as heterogeneous as ceramic assemblages (Hein *et al.*, 2021; Sorresso & Quinn, 2020; Holmqvist, 2016).

The analytical instrument employed was a Hitachi XMET 8000 handheld XRF analyzer. The analyzer was always mounted on the 'flex stand' with a lead-lined box, in which samples were safely lying on the area of radiation, and were analysed without the need to hold the device. Analysis was conducted on a fresh section, exposing the fabric, which was as flat as possible. Areas with large inclusions or voids, the slip, paint layers and external post-depositional encrustations, were avoided as much as possible. The measurement spot diameter was approximately 9mm in size. Each sample reading lasted for 120 seconds using the proprietary "mining mode", according to a combination of empirical calibrations and fundamental parameters. Three measurements were conducted for each sample. The elements Mg, Al, Si, P, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Rb, Sr, Nb, Sb, Ba, and Pb were recorded in weight percent.

One reference sample, certified reference material SARM69 in the form of pressed-powder pellet, was analysed once at the beginning, once at the middle, and once at the end of each analytical day to cross-check the quality of the day and calibrate the measurements (Jacobson *et al.*, 2002). This reference sample was selected based on its matrix similarities to the analytical material. The results were averaged after calibration. Instrument calibration was conducted following the methodology developed at UCL Institute of Archaeology (Wilke, 2017; Sorresso & Quinn 2020). The raw data were exported into an Excel workbook for processing. Elements whose concentration of an element showed poor reproducibility or it was below the instrument's detection level, and elements that are known to be affected by post-depositional alteration or whose associated values presented very poor reproducibility or/and their measured values presented >20% relative error when assessed with the analysis of the standard reference materials, were excluded (Frankel & Webb, 2012, p. 1382). Therefore, further statistical processing includes the sub-composition of 15 elements, which showed adequate accuracy and precision based on the analysis of the reference material SARM69, which was used to calibrate the measurements, and structured variation in the dataset. These are Si, Al, Ti, Cu, Zn, Fe, V, Mg, Mn, Ba, Sr, Ca, Ni, K, and Rb (Figure 81).

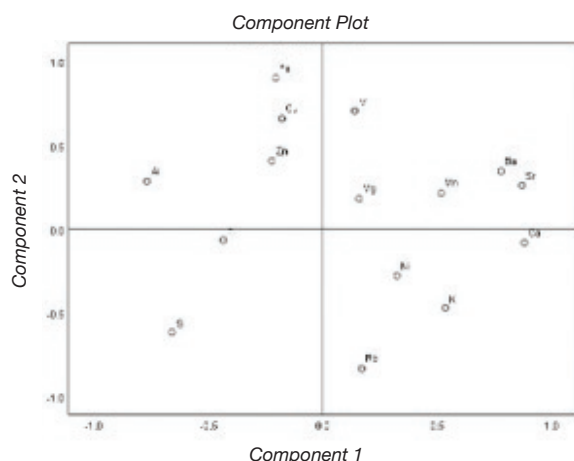


Figure 81: PCA component plot using the hhXRF dataset

The assessment of the generated elemental data and their interpretation were based mainly on group characteristics, involved a limited number of elements, therefore documenting only a small fraction of the dataset's compositional variability. The aim of this analysis was to test the correspondence between elemental and petrographic groupings, and between the typological and technological groupings, as defined by petrographic and macroscopic analysis respectively. To this end, Principal Component Analysis (PCA) was applied on this dataset using the IBM Statistics SPSS 29 statistical package, to explore patterns and assess data variation. The data used for PCA analysis are presented in Appendix VII. The first two principal components, accounting for 49.8% of the data variance, were considered the most appropriate for demonstrating meaningful patterns. Samples S19, S22, S31 and S33 were removed from the final PCA scatterplots, as these were distant outliers, impacting the positioning of all other samples in the scatterplots. These outliers can be explained by faulty instrument readings and not by compositional differentiation; petrographically S19 belongs to Fabric Group V, S22 belongs to Fabric Group VI, S31 belongs to Fabric Group 1, and S33 belong to Fabric Group II. By faulty instrument reading I mean that some elements were not measured consistently or at all. Finally, S49, S71, S79 and S80 were also removed, since petrographically they were categorized as outliers, therefore not contributing to the assessment of groupings and patterns of elemental data. Therefore, only 73 out of 81 samples were used for further statistical processing.

6.2.2. The Chemical/Elemental Data

Overall, the hhXRF results confirm the categorizations made during both the macroscopic and petrographic analysis. When the samples are labelled according to the petrographic fabric, there is a clear differentiation between fabrics from western Cyprus and the rest, as products of distinct regional traditions, with raw materials deriving from their respective geological environments (Figures 82 and 83). To begin with, during the petrographic analysis it was established the Fabric Groups I, II and III have strong similarities, being sedimentary clay-based fabrics dominated by argillaceous inclusions, with the addition of micritic limestone and igneous components in Fabric III. Their strong correlations are verified in the elemental analysis, as they are situated close to each other and do not form distinct elemental groupings. Instead, they are scattered along the lower part of the horizontal axis (PC1). Fabric Groups I and II correspond exclusively to the macroscopic ware RB/B, while Fabric Group III corresponds only to SW sherds.

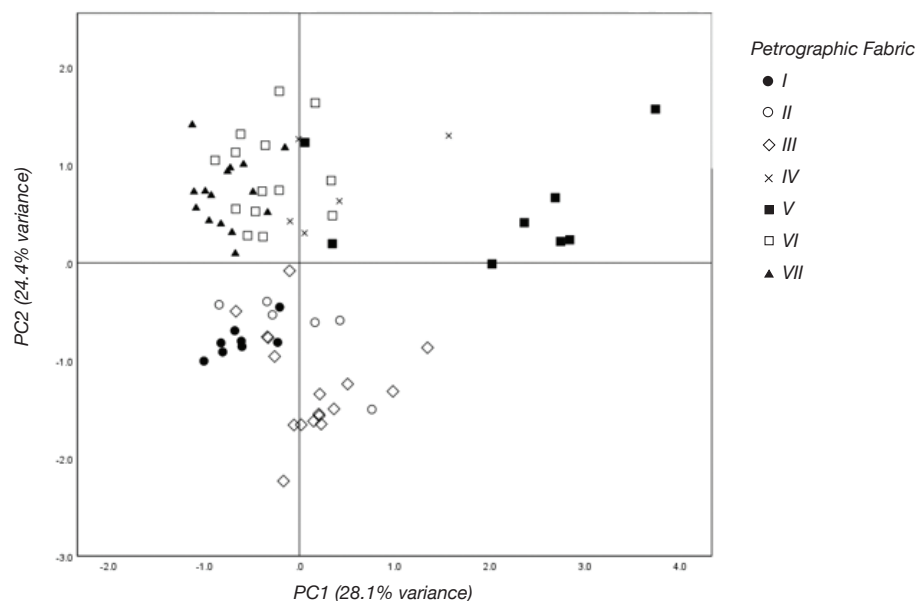
The higher K component in some Fabric Group III samples can be attributed to the fineness of the fabric, as the K content in ceramic composition can increase when sediment grain size decreases (Degryse & Braekmans, 2014, p. 194). In other words, a large inclusion in the “shoot area” can affect the results. Additionally, the two RB/B and five SW samples from *Ambelikou-Agios Georghios*, which petrographically were ascribed to Fabric Groups I and III respectively also belong to this cluster.

On the other hand, all five samples ascribed to petrographic Fabric Group IV and macroscopic ware LChalRM are situated along the upper part of the horizontal axis (PC1), apart from one sample with a higher V component which strays towards the right. This confirms the differentiation of these samples from those from the Ktima (i.e. *Chlorakas-Palloures* and *Kissonerga-Mosphilia*). This amphibole-rich fabric is situated in a cluster with samples that have been ascribed to Fabric Groups VI and VII. All three fabrics are dominated by igneous components like feldspars, dolerites and/or basalts and they correspond to the macroscopic wares RBL, RL and CW.

Almost all samples ascribed to Fabric Group V are situated in a distinct cluster in the eastern part of the scatterplot. This confirms the petrographic observations describing this as a fabric dominated by carbonates, as here we can see that the samples are high in Ca, Ba and Sr components. The position of two samples closer to the igneous cluster along the upper part of the vertical axis (PC2) can be explained by the common presence of igneous components like feldspars and basalt in the fabric composition.

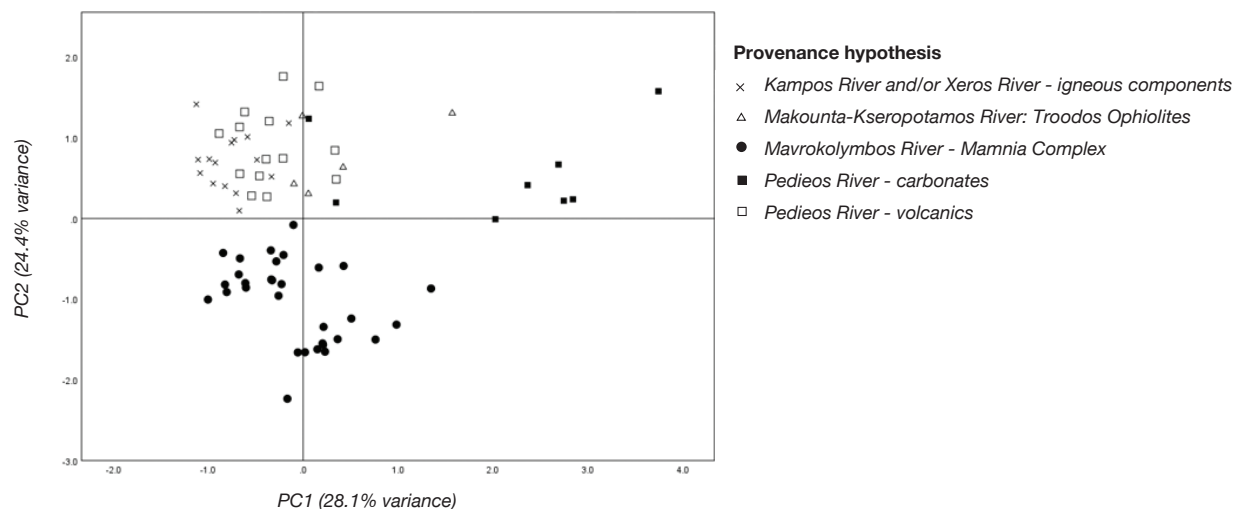
Figure 82: PCA scatterplot using the hhXRF dataset. Samples labelled according to petrographic fabric

PCA scatterplot using the hhXRF dataset. Samples labelled according to petrographic fabric



In order to establish possible provenance detailed geological maps were consulted, in order to find the closest river to each of the sites, with the most similar geological components to each petrographic fabric. As a result, the following provenance hypotheses were established, after consulting the detailed Geological Maps of each area in question: clays for Fabrics I, II, and III were probably sourced along the Mavrokolymbos River, which belongs to the Mamonia Complex; Fabric IV from the Makounta-Kseropotamos Rivers, where Troodos Ophiolites are prevalent. Lastly, due to the fact that all the Fabric Group VI samples come from Politiko-Kokkinorotsos and all the Fabric Group VII come from Ambelikou-Agios Georghios, their provenance hypothesis is different, ascribing the Politiko material to the igneous deposits along the Pedieos River and the Ambelikou material to igneous deposits along the Kampos and/or Xeros Rivers. These are illustrated in the figure below. More details on the provenance hypotheses are provided later in this thesis.

Figure 83: PCA scatterplot using the hhXRF dataset. Samples labelled according to provenance hypothesis



6.3. Concluding Discussion: Integrating the Macroscopic, Petrographic, and Elemental Data

The results of the macroscopic, petrographic and chemical analyses of the data shed light on both the pottery production in the Late Chalcolithic in all four sites, but also on the interactions between these places. To begin with, all the petrographic fabrics described in this chapter show strong affinities to the macroscopic wares. The degree of fabric variability across the island is, as expected, quite high with mineralogical and technological differences between fabrics. This can be linked to observations made during the macroscopic analysis of the wares. The results regarding several aspects of the pottery production processes and in turn, the interactions between the different communities are presented here.

6.3.1. Clay Procurement and Preparation: Local Production and Exchange of Pottery between Communities

Clay provenance and preparation have been investigated macroscopically, petrographically and chemically, to identify local production and exchange of pottery between communities. The first three fabric groups (Fabric I, II and III) and the outlier S49 contain the same types of inclusions and they could be locally produced in the area of the Ktima Lowlands in the Paphos region, with raw materials selected from the same clay sources, in the same region. As already mentioned, to establish the origin of the materials, detailed geological maps were consulted to identify the closest rivers to each site with geological components similar to the petrographic fabric. Consequently, the following hypotheses regarding provenance were formulated: Clays for Fabrics I, II, and III likely originated from the Mavrokolymbos River within the Mamonia Complex. Fabric IV likely originated from the Makounta-Kseropotamos Rivers, known for the prevalence of Troodos Ophiolites. Notably, Fabric Group VI samples from Politiko-Kokkinorotsos and Fabric Group VII samples from Ambelikou-Agios Georghios had different provenance hypotheses. The Politiko material is suggested to have originated from igneous deposits along the Pedieos River, while the Ambelikou material is attributed to igneous deposits along the Kampos and/or Xeros Rivers. These hypotheses are explained further in this section.

Fabrics I and II are very similar in composition, containing almost the exact same inclusions. What differentiates them is the presence of dolerite, basalt and occasionally micritic limestone in Fabric II. Therefore, Fabric II could be from a nearby but different clay source, where igneous elements are more prevalent. Likewise, Fabric III is also characterized by the dominant presence of micritic limestone and chert, along with argillaceous inclusions. Igneous rocks like dolerite and basalt are also present. Interestingly, all the samples that belong to the macroscopically identified ware RB/B belong to the petrographic Fabrics I or II. This includes two samples that have been selected from Ambelikou-Agios Georghios (S72 and S73) (Figure 84). Similarly, all the samples that belong to the macroscopically identified ware SW belong to petrographic Fabric III, including the five sherds sampled from Ambelikou-Agios Georghios (S74, S75, S76, S77, S78) (Figure 85).

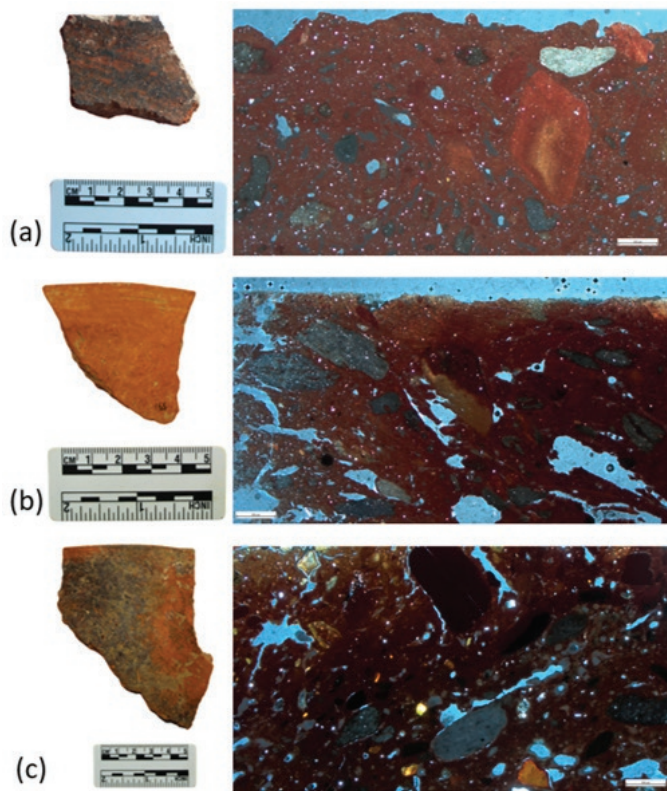


Figure 84: RB/B sherds that belong to Fabric I, from Chlorakas-Palloures (a), and Ambelikou-Agios Georghios (b, c) (photographs by Maria Hadjigavriel)

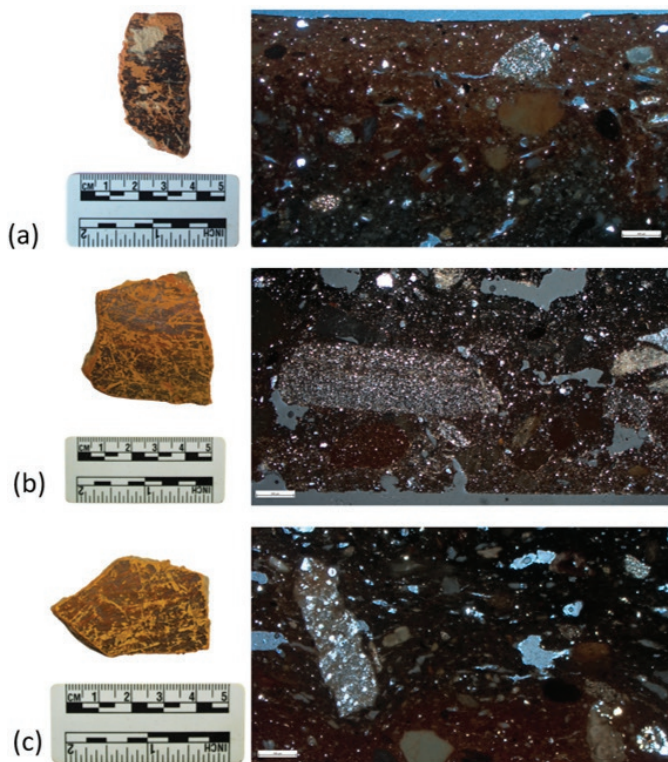


Figure 85: SW sherds that belong to Fabric III, from Chlorakas-Palloures (a), and Ambelikou-Agios Georghios (b, c) (photographs by Maria Hadjigavriel)

Therefore, the petrographic analysis has shown that RB/B was produced in two petrographic fabrics exclusively; Fabric I and Fabric II. They are very similar sedimentary fabrics with an abundance of argillaceous inclusions, differentiated by the presence of volcanic inclusions, like dolerite, in Fabric II. Similarly, SW from both sites has been produced in Fabric III, a micritic limestone and chert-rich fabric that is similar to the other two. The clay sources that seem more probable for the production of these fabrics are the ones from the Mamonia outcrops along the Mavrokolymbos River, which begins in the Lefkara, Kalogrea-Adana and Lapithos Formations, traverses a Harzburgite and Serpentinite Formation Group and the Mamonia Complex (GEOportal of Cyprus Geological Survey Department; Hydrological Map 2015; Figure 86). After consulting the geological maps of the area, the geological profile of the deposits along the Mavrokolymbos River are the closest match to the geological profile of these petrographic fabrics. The Mavrokolymbos River is situated ca. 4km north-east of Kissonerga-Mosphilia and ca. 8km north-east of Chlorakas-Palloures. This is consistent with Robertson's (1989) report on petrographic analysis of ceramics from Kissonerga-Mosphilia, who argued that the clays used at the site could have been collected from the Lower and Upper Pillow lava deposits near Mavrokolymbos and Marathounda. The presence of igneous components in Fabric II and Fabric III can be explained by the presence of igneous components along the western part of the region, along the Mavrokolymbos River.

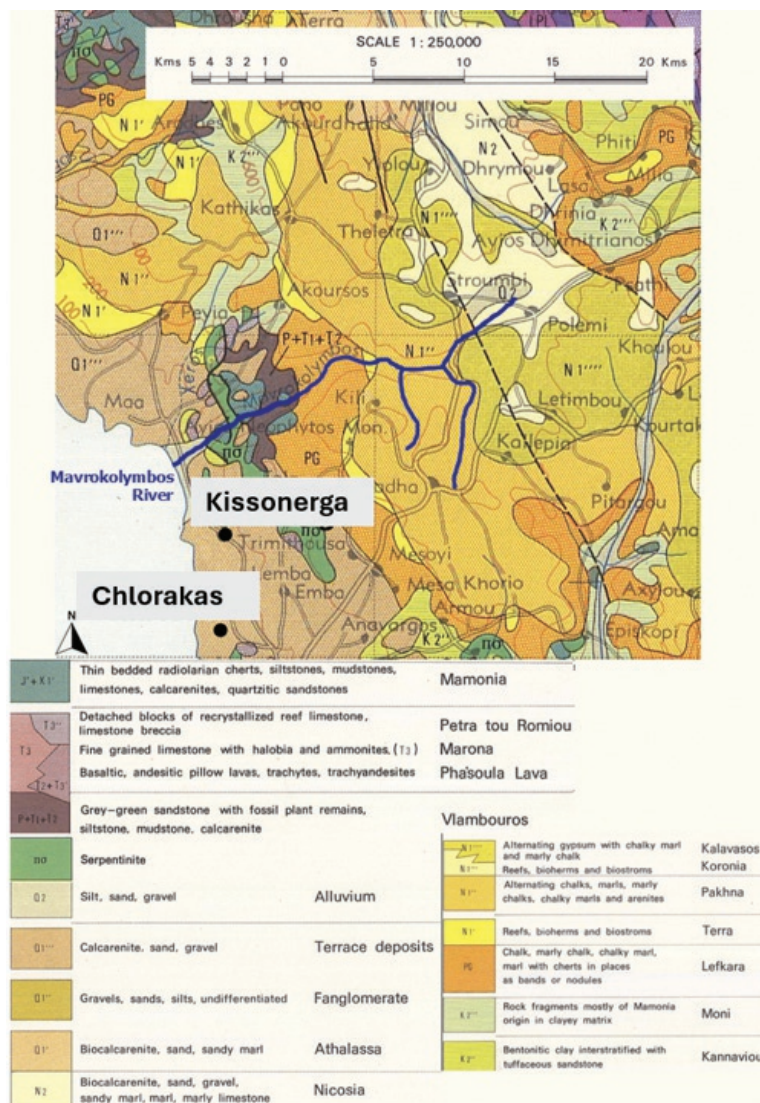
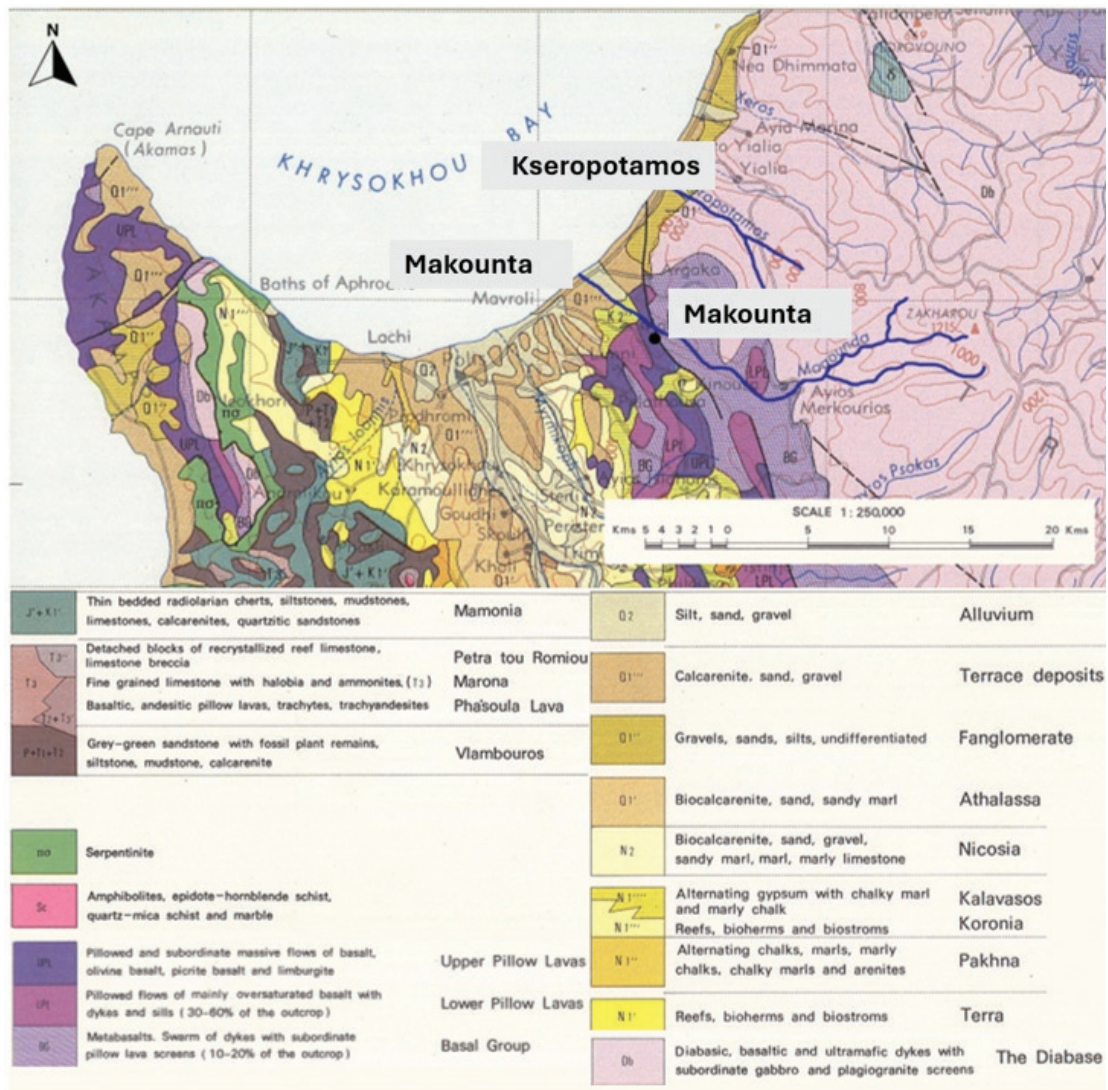


Figure 86: Geological map of the Ktima Lowlands, where Fabrics I, II, III occur (created by Markos Kapsalis and Maria Hadjigavriel after Pantazis, T. (1979). Geological Map of Cyprus Scale 1:250,000. Geological Survey Department Cyprus)

The elemental data from the hhXRF analysis of the sample confirms the petrographic analysis results. Overall, the evidence suggests two distinct clay preferences for the production of Red Black Stoked-Burnished Ware (RB/B) and the Spalled Ware (SW). Fabrics I and II were used exclusively for the production of RB/B, while Fabric II can be considered a more mixed variation of the clay used for Fabric I, with also igneous elements in the clay. Fabric III is used exclusively for the production of SW. In the case of *Kissonerga-Mosphilia*, the existence of a specific clay preference for the production of RB/B has already been suggested in the past based on macroscopic observations (Bolger *et al.* 1998). Overall, in terms of clay preparation, although distinct clay preferences can be recognized in the case of RB/B and SW, it seems that the potters did not process the clay much and evidence for intentional temper is lacking. It is worth mentioning that Sample 49, which is an RB/B sherd but has been categorized as an outlier due to the overwhelming presence of red argillaceous inclusions, resembles a petrographic fabric of pithoi from Alassa identified by Nodarou (2017, Fabric Group 8, 9 and 10). Additionally, it also seems to be similar to Fabric IX, identified at the Early-Middle Bronze Age site *Kissonerga-Ammoudhia* by Graham (2013, p. 296-297, Appendix 4). It might therefore reflect a pattern in the area that evolved later in the Bronze Age, or it might represent an import from the southern coast and the region of Erimi.

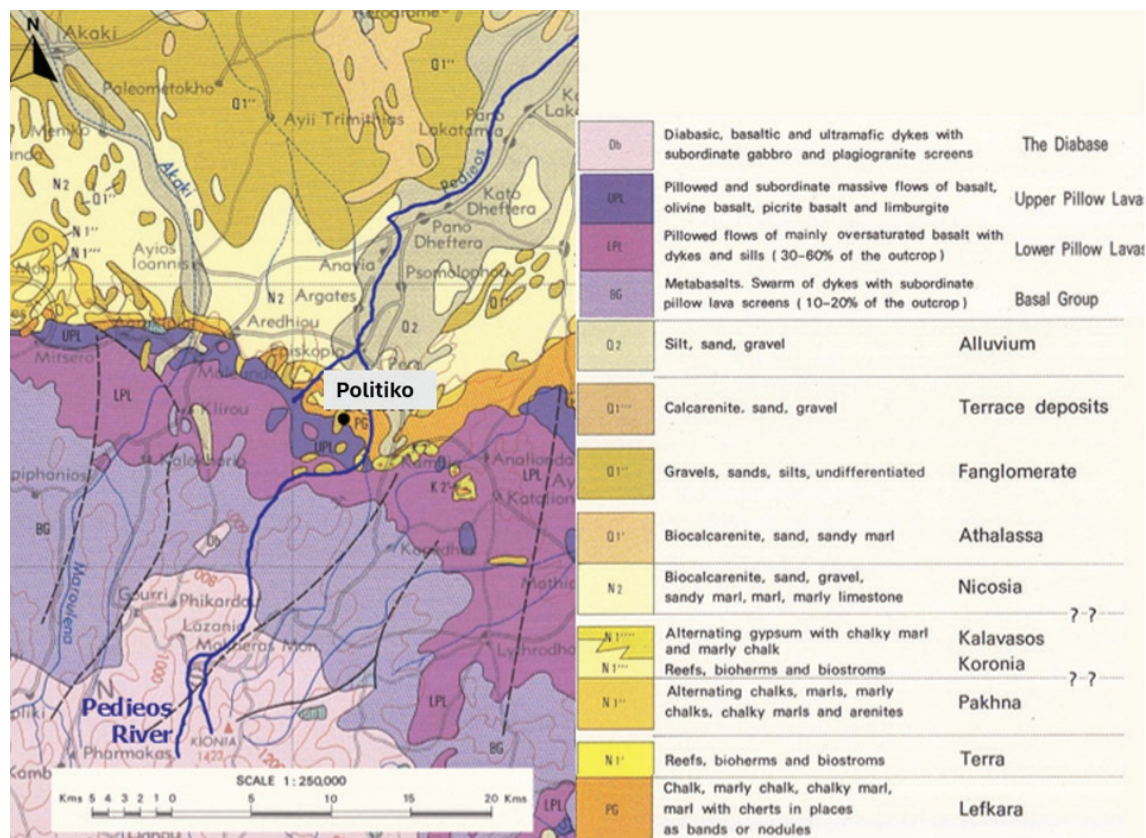
Interestingly, the third ware sampled from *Chlorakas-Palloures*, the LChalRM, does not seem to be of local origin. This has been already suggested during the macroscopic analysis and has been confirmed by the petrographic analysis. Petrographic Fabric IV is completely different than the aforementioned three (Fabric I, II, III). It is an amphibole-rich fabric with feldspars and quartz. The common presence of long planar voids indicates the presence of organic material in the clay paste. The presence of amphiboles and all the other igneous minerals and rocks in the matrix suggests a clay source in the foothills of the Troodos mountain range. Based on macroscopic observations, these sherds resemble the main Late Chalcolithic ware from the site of *Makounta-Voules*, but also Chalcolithic pottery occurring more widely in the Polis region and Akamas at sites like *Androlykou* and *Kalo Chorio* (Lisa Graham and Charalambos Paraskeva after personal communication). The Polis area is situated mainly on the Mamonia Complex, but very close to the northwestern borders of the Troodos. The *Makounta-Kseropotamos* Rivers begins from the foothills of Troodos, in the geological formation of Sheeted Dykes (Diabase), traversing the Upper and Lower Pillow Lavas and Basal Group, and the Mamonia Complex – including serpentinite (GEOportal of Cyprus Geological Survey Department; Hydrological Map 2015; Figure 87). Therefore, based on the petrographic analysis, the Polis area, could have been the production area of petrographic Fabric IV.

Figure 87: Geological map of the Polis region, a possible place of origin for Fabric IV (created by Markos Kapsalis and Maria Hadjigavriel after Pantazis, T. (1979). Geological Map of Cyprus Scale 1:250,000. Geological Survey Department Cyprus)



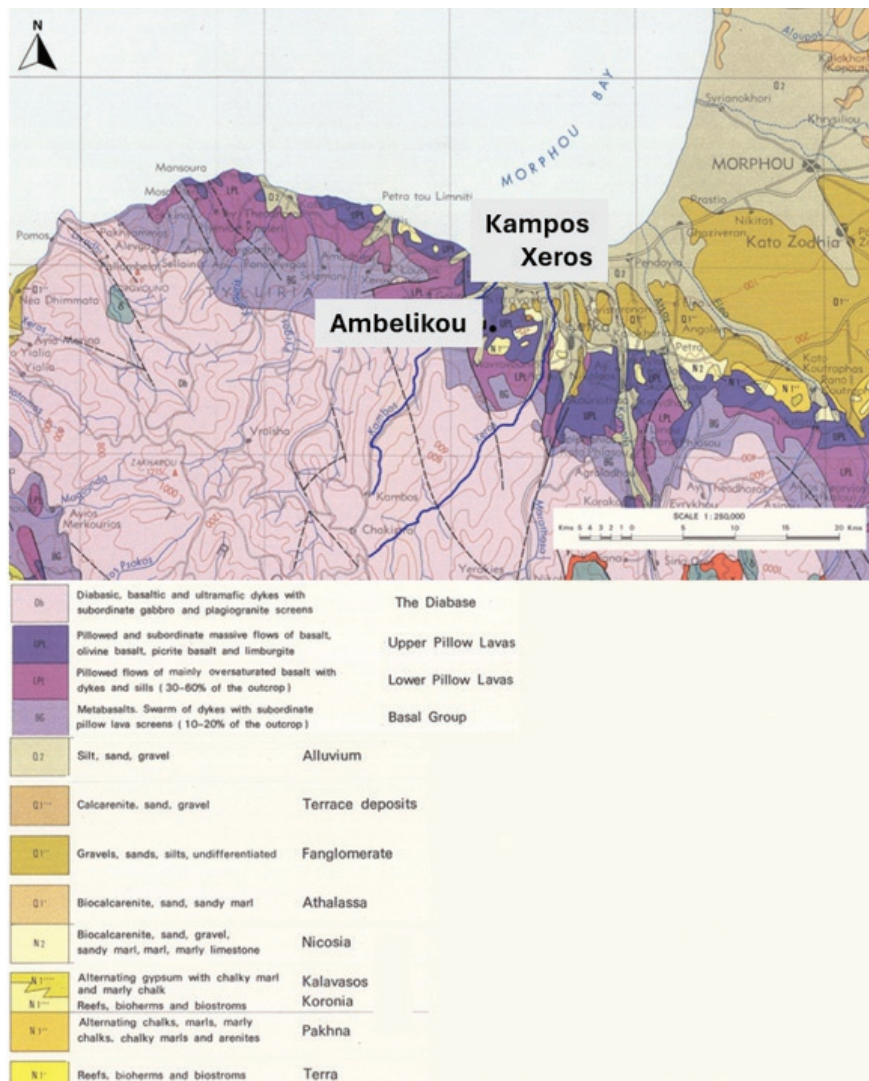
Moving away from western Cyprus and onto the Mesaoria Plain, all samples retrieved from the Politiko-Kokkinorotsos are ascribed to two petrographic fabrics: Fabric V and VI. Both fabrics contain similar types of inclusions but their main difference is the dominant presence of calcite and microfossils in Fabric V. Foraminifera occur in calcareous chalk and limestone beds which are present across the island (Graham, 2013, p. 320; Cyprus Geological Department). On the other hand, Fabric IV is defined by the overwhelming presence of feldspar, polycrystalline quartz and dolerite. All the samples of this fabrics are RL or RBL, with three samples in Fabric VI being CW (S22, S23, S24). Overall, both of these petrographic fabrics contain the same types of inclusions and they could be locally produced in the area of Mesaoria plain, with materials retrieved from Pedieos river valley. This is the longest river in Cyprus, starting from the hilltops of Troodos, crossing the Mesaoria plain towards and through Nicosia. Even though the Mesaoria plain belongs to the Circum Troodos Sedimentary Succession, igneous and volcanic elements are carried by rivers from the Troodos Ophiolite (GEOportal of Cyprus Geological Survey Department; Hydrological Map 2015; Figure 88).

Figure 88: Geological map of the Politiko-Kokkinorotsos area, where Fabrics V and IV occur (created by Markos Kapsalis and Maria Hadjigavriel after Pantazis, T. (1979). Geological Map of Cyprus Scale 1:250,000. Geological Survey Department Cyprus)



Finally, in northwestern Cyprus, the overwhelming majority of samples from Ambelikou-Agios Georghios have been ascribed to Fabric VII. These include all the RL and RBL samples, and one CW sample. Therefore, the only samples that are not local are the ones sampled as RB/B and SW, and one RBL (S71) and two CW (S79, S80) that have been categorized as outliers. However, this fabric group and the tree aforementioned outliers from this site contain the same type of inclusions, dominated by igneous components, suggesting that they were produced locally with materials retrieved from the Kampos River or the Xeros River. These rivers are situated ca. 3km west and 5km east of the modern-day village of Ambelikou respectively. Both stem from the Troodos mountains, hence the overwhelming presence of igneous inclusions and volcanic rocks in their deposits as they travers alluvial deposits, Upper and Lower Pillow Lavas and Basal Formations, and the Apalos, Athalassa, Kakkaristra and Nicosia Formations (GEOportal of Cyprus Geological Survey Department; Hydrological Map 2015; Figure 89). This provenance hypothesis is in accordance with Robertson (1989), who after analysing five samples from this site concluded that the clays fit the local geology.

Figure 89: Geological map of the Ambelikou-Agios Georghios area, where Fabric VII occurs (created by Markos Kapsalis and Maria Hadjigavriel after Pantazis, T. (1979). Geological Map of Cyprus Scale 1:250,000. Geological Survey Department Cyprus)



6.3.2. Surface Treatment and Decoration, and Vessel Shapes: People Circulating Between Communities

Surface treatment and vessel shapes have been investigated to illustrate mediated interactions. What all the wares sampled in this study have in common, besides CW and SW, is that they are red and/or black monochrome and burnished. As already mentioned, all RB/B sampled for this study derive from three sites, Chlorakas-Palloures, Kissonerga-Mosphilia and Ambelikou-Agios Georghios, and are self-slipped, shiny, of red to pink and orange colours, and are highly burnished with often visible burnishing strokes. Since they are self-slipped, surface treatment is not evident in thin section. The SW sample is also quite homogenous when it comes to surface treatment, as all sherds are covered with a thinly applied dull red to grey-black and/or beige slip. The interior is often left untreated. Sometimes, the surfaces are pock marked (spalled), and burnishing strokes are visible just like the

RB/B sherds. The LChalRM sherds, all ascribed to Fabric IV, are the only ones that are covered with a thick layer of red slip, which is always visible in thin section (e.g. S45; Figure 90). The interior is often left untreated. RL and RBL sherds from both Ambelikou-Agios Georghios and Politiko-Kokkinorotsos are red to orange (10 R 4/4-5/6) and burnished, but not as much as RB/B. RBL sherds have surfaces that are blackened, usually uniformly on the interior side and along the rim or irregularly on the exterior side. In the case of CW, surfaces on both sides are always left untreated, while vegetal imprints are evident on one or both sides.

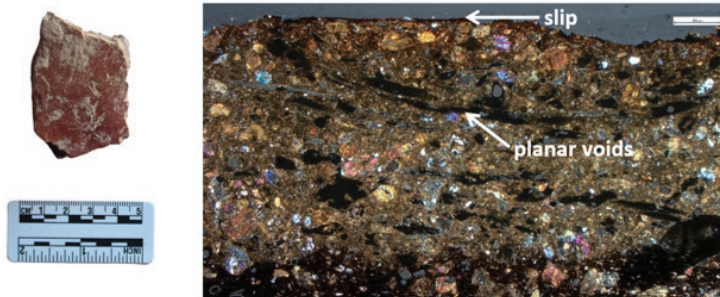
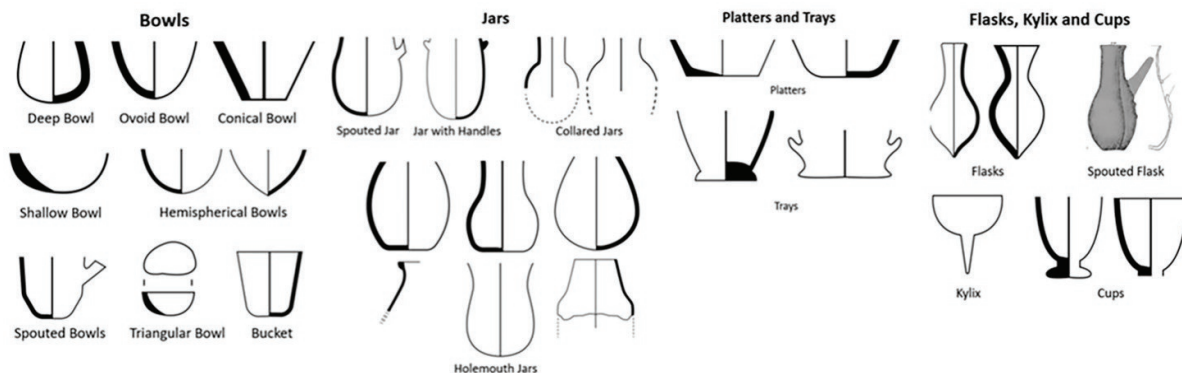


Figure 90: LChalRM S45 from Chlorakas-Palloures. The slip is visible along the outer margin of the thin section (created by Maria Hadjigavriel)

RB/B seems to have been preferred for bowls, and SW for jars (Stewart, 1985; Bolger *et al.*, 1998; Hadjigavriel, 2021; Figure 91). All but one of the LChalRM samples are from jars, a trend that is in accordance with the overall presence of this ware in Chlorakas-Palloures, where it occurs mostly in large storage jars. It is worth mentioning that S41 comes from a large storage jar with three vertical handles, which was found in situ and contained several artefacts, including a copper axe made of Anatolian ore (Düring *et al.* 2018; 2021; Figure 92). Even though its shape is unusual, petrographically, this sample shows no differences to the rest of Fabric IV. Further, both RL and RBL wares occur in bowls and jars, with no pattern emerging. All six CW samples are pans or trays. In general, one can say that the shapes repertoire of Late Chalcolithic domestic pottery is not elaborate, consisting mainly of several kinds of bowls and storage jars, sometimes spouted, jugs, and platters. Due to the small size of the sherds and also the limited amount of samples, no significant patterns have emerged in the macroscopic or the statistical analysis.

To conclude, similarities in both surface treatment, decoration, and vessel shapes repertoire between all four sites included in this study suggest that even through similar techniques are used across the island, distinct regional pottery traditions are in place. The closer links between Chlorakas-Palloures and Kissonerga-Mosphilia can be explained due to the geographical proximity of the settlements (ca. 10 km), while Politiko-Kokkinorotsos and Ambelikou-Agios Georghios also present stronger similarities with each other.

Figure 91: The repertoire of vessel shapes in Late Chalcolithic Cyprus – not in scale (created by Maria Hadjigavriel and Ermina Emmanouel)



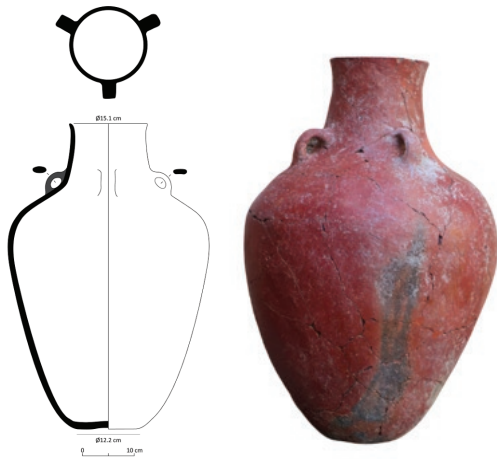


Figure 92: The jar containing a copper axe from Chlorakas-Palloures (S41) (after Düring et al. 2018 and the Palloures Project Archive)

6.3.3. Vessel Forming Techniques and Firing: Long-Term Interactions – People Relocating and Living at Different Communities

Regarding forming techniques, petrographic analysis supports the notion that Late Chalcolithic pottery was crafted using compressive methods without rotary kinetic energy (potter's wheel), such as pinching and drawing, coiling, and slab-building. Bolger and Shiels (2003, p. 136) proposed that at Kissonerga-Mosphilia, pinching and coiling, were employed for forming bowls, while coiling and slab-building techniques were used for creating large jars (Figure 93). Both macroscopic and petrographic analyses validate these assertions, suggesting these techniques were employed across all samples from the four sites. However, due to the limited quantity of sherds from all four sites, a comprehensive and detailed reconstruction of vessel forming techniques is not undertaken here.



Figure 93: Vessel forming techniques used in the Chalcolithic: vessels directly modelled from a lump of clay (upper) and vessels constructed with coiling (lower) (photographs by ©Souzana Petri)

Finally, regarding firing techniques, it has been proposed that for Chalcolithic pottery firing, pit firing and bon-firing (fires in a pit or on the ground surface) were more likely than kilns. Late Chalcolithic potters appeared to have developed the ability to achieve higher temperatures and better controlled firing compared to the Middle Chalcolithic period, resulting in harder vessels. Middle Chalcolithic RW sherds typically exhibit soft to medium hardness, suggesting they were possibly fired at low temperatures in open fires. In contrast, Late Chalcolithic pottery was fired at steadily rising high temperatures, reaching up to 600-800 °C. Although these temperatures may not seem high, they are considered significant for these firing techniques, requiring expertise and precision, indicating the possible use of insulated bonfires. Additionally, firing was used for aesthetic purposes in some wares analysed for this study.

Blackened surfaces on RB/B vessels from all sites may have occurred accidentally due to factors such as misfire, fire-flashing, incorrect pot positioning, or imperfect control of oxygen flow and temperature increase during firing. Alternatively, intentional blackening may have been achieved by deliberately altering the atmosphere from oxidizing to reducing during firing. Macroscopic analysis reveals differences in firing between RB/B and SW sherds, which are typically uniformly fired but may exhibit a central core with diffused or sharp margins, indicating a reduction phase during firing or intentional prevention of iron oxidation in the clay. LChalRM sherds are generally not as hard as RB/B and SW, but they commonly feature a dark central core, referred to as a “biscuit core.” These observations are confirmed by ceramic thin section petrography, where cores are often visible.

At Ambelikou-Agios Georghios and Politiko-Kokkinorotsos, RBL sherds typically have black lustrous interior surfaces and occasionally blackened exterior rims or surfaces, achieved deliberately through targeting or black-top techniques. Accidental blackening can be distinguished from intentional blackening by the sooty deposit left behind on the surface. Similarly, RL sherds from both sites often exhibit a central core with diffused or sharp margins, as also evident in thin section. Potters in the north-central region of the island appear to have had better control over firing processes, resulting in uniform black surfaces, while Ktima Lowlands potters produced irregular blackened surfaces. CW sherds from these sites indicate soft, crumbly sherds fired at very low temperatures, suggesting they were used as trays rather than cooking vessels. Overall, evidence suggests that we have various regionally distinct crafting communities in Late Chalcolithic Cyprus.

6.4. Concluding Summary

To conclude, this study has revealed a series of highly regional pottery production traditions, one shared between Chlorakas-Palloures and Kissonerga-Mosphilia, one at the Polis region, and one in each of the other sites. It can be argued that Chlorakas-Palloures and Kissonerga-Mosphilia seem to share pottery traditions, making the same wares, using the same clay sources, surface treatment and forming techniques, and have the same vessel shape repertoire. This is evident by the fact that all RB/B sherds sampled from these sites are ascribed to both Fabric I and Fabric II, and all SW sherds to Fabric III. RB/B and SW sherds from both sites cannot be distinguished, not petrographically, not in terms of surface treatment or shape or forming techniques. Therefore, the inhabitants of these two settlements would have long-term direct contacts with each other, with people, materials and technological knowledge circulating. This is no surprise given their close geographical proximity and contemporaneity. Additionally, the emergence of community specialization is proposed, suggesting that these two pottery wares might have been produced by one crafting community and then distributed to other sites. This suggestion is discussed further in Chapter 8.

Additionally, the petrographic analysis suggests the preference of two types of clay for the production of RB/B and SW at both sites, supporting the argument for increased standardization of pottery production which had come forth previously, based on morphological and statistical studies (see Bolger & Webb, 2013; Wallace, 1995). Typically, a clay recipe requires clay, temper, and water. Temper typically refers to material intentionally added to a mixture for a specific purpose. However, evidence for tempering is lacking in both the macroscopic and the ceramic thin section petrography analyses. Therefore, I argue that for a preference of specific local clay sources along Mavrokolymbos River, clays rich in argillaceous inclusions for RB/B and rich in limestone for SW, rather than the intentional creation of clay recipes.

The ceramic petrography and the hhXRF analysis have confirmed the assumption that LChalRM was not produced in the Ktima Lowlands. Therefore, the presence of LChalRM sherdage in Chlorakas-Palloures, almost exclusively in the form of large storage jars, indicates that the settlement obtained significant part of its assemblages from other areas of the island. This is confirmed further by the presence of both RB/B and SW sherds at Ambelikou, which petrographically fit perfectly into Fabric I (S72, S73) and Fabric III (S74, S75, S76, S77, S78). Both of these Fabrics come from the Ktima Lowlands region.

On the other hand, Ambelikou-Agios Georghios and Politiko-Kokkinorotsos seem to represent different local ceramic traditions, with red and black monochrome vessels that are often thicker. The fact that Late Chalcolithic pottery from these sites can find its closest parallels in each other has been argued before based on morphological studies (Webb *et al.*, 2009; Hadjigavriel, 2019). Besides the Ktima Lowlands imports and two outliers, all sherds sampled from Ambelikou-Agios Georghios are ascribed to one petrographic fabric – Fabric VII, indicating local production of both RBL and RL wares. The outliers S79 and S80 are both CW sherds that were sampled to cross-check local clays. They have been categorized as outliers due to the overwhelming presence or absence of specific inclusions. However, they have affinities with petrographic Fabric VII, and their differences might be because of the much coarser nature of the ware. Similarly, all samples from Politiko-Kokkinorotsos are ascribed to two petrographic wares – Fabric V and VI, including sherds from both RL and RBL wares, and the three CW sherds.