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RECONSTRUCTING REGIONAL TRAJECTORIES: THE PROVENANCE AND DISTRIBUTION OF ARCHAIC TO HELLENISTIC CERAMICS IN CENTRAL *PISIDIA* (SOUTH-WEST TURKEY)*

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Analytical ceramic studies offer the opportunity to determine cultural development and change on the basis of origin and use of raw materials. In this particular study, an archaeometric approach on ceramics in central Pisidia contributes to the discussion of contact and exchange between indigenous communities and several cultural spheres of influence on a long-term timescale (eighth to second centuries BCE*). Morphological data as well as mineralogical (optical microscopy;* $n = 273$*) and chemical composition (by ICP–OES/MS;* $n = 122$*) of ceramics and raw materials show distinct resource zones for the production and distribution of ceramics in this connecting region of Anatolia. The use of trace element profiles (REE, HFSE, LILE and TTE) in particular is regarded as instrumental in detailing high-resolution provenancing of ceramics. The ceramic provenance indicates different patterns of material interactions during the Archaic, Classical and Hellenistic periods. A significant increase in regional interaction occurs coinciding with the development of pottery activities at Sagalassos.*

KEYWORDS: ICP–MS, PETROGRAPHY, ANATOLIAN CERAMICS, CERAMIC PROVENANCE, ARCHAIC, CLASSICAL AND HELLENISTIC PERIODS

INTRODUCTION

The ancient city of Sagalassos is a well-documented archaeological site in central *Pisidia* (Waelkens 1993; Waelkens and Poblome 1993, 1995, 1997; Waelkens and Loots 2000; Degryse and Waelkens 2008), and was a regional centre during the Roman Imperial and Early Byzantine periods, administering a territory of approximately 120 000 hectares. Within the framework of studying this regional centre, a number of interdisciplinary survey and excavation campaigns yielded promising ceramics dating from the Archaic, Classical and Hellenistic periods. These ceramics make it possible to characterize the development of the region under study prior to the initiation of the large-scale production of tablewares during the Roman Imperial period. Interestingly, the morphological features of the ceramics generally suggest an Anatolian and (northern) Levantine connection rather than Aegean-inspired production. The broader political spectrum of Western and Central Anatolia was dominated by Phrygian ambitions (ninth to early seventh centuries BCE), followed by a period of Lydian control (early seventh century to 547–6

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BCE), Achaemenid imperialism (547–6 to 334 BCE) and Hellenistic state formation processes (333–25 BCE). Although no direct connection can be made with these platforms of societal structure, material culture makes it possible to trace wider and intricate processes of change and craft choices in past communities.

The use of petrographic and geochemical techniques on a large sample set of ceramics ($n = 273$) makes it possible to address the problem of identifying the selection and use of clay raw materials. This study aims to map the provenance, selection and distribution network of raw materials and ceramics on a long-term scale, and thereby move beyond a static categorical classification of types and periods. In this way, changes in ceramic production can be identified at the intra- and inter-regional scale by: (1) defining the provenance of ceramic materials; (2) exploring the possibility of characterizing local, regional and imported wares; and (3) mapping their production and circulation from the Archaic into the Hellenistic periods in south-west Anatolia.

THE SITES IN CENTRAL *PISIDIA* AND THE BURDUR PLAIN

In recent years, interdisciplinary surveys and excavations at Düzen Tepe and Sagalassos, intensive surveys within the adjoining valley of Ağlasun and more fieldwork in the neighbouring valleys of Çanaklı (Poblome *et al.* 2002; Poblome and Degeest 2003; Neyt *et al.* 2012), Çeltikçi (Belören, Aykırıkça, Hisar and Seydiköy/Tepecik), Kuzköy (Kepez Kalesi) and Bereket (Bereket and Kökez) (Kaptijn *et al.* 2013) and in the wider area of the Lake Burdur plain (Düver/Yarımada and Kozluca) conducted by the Sagalassos Archaeological Research Project have yielded substantial amounts of Archaic, Classical and Hellenistic pottery (Braekmans 2011; Poblome *et al.* 2013a, 2013b).

The geographical area discussed in this paper corresponds approximately to the territory dependent on Roman Imperial Sagalassos (Fig. 1) (Waelkens *et al.* 1997). This region in south-west Anatolia is located in the western part of the Turkish Taurus mountain range and consists of several adjoining river and valley systems. The region adjoins natural thoroughfares from the Pamphylian and Lycian coast to inland Anatolia. In particular, there are clear geographical connections between the Burdur plain and the Çeltikçi valley. The valley of Ağlasun is located further inland and has a less obvious connection to these thoroughfares.

The archaeological sites of Düver and Seydiköy are currently regarded as the main Archaic principalities in the region under study. These sites, situated on prominent landscape features, can be described as major settlements governing large agricultural plains. Recent survey work in the Burdur plain revealed contemporary rural sites, fortification systems and ritual sites, possibly related to the principality at Düver (Poblome *et al.* 2013b). This Archaic settlement pattern seems to have continued in the following centuries in the Burdur plain, with a major shift during Roman Imperial times. As far as the Çeltikçi valley is concerned, in Hellenistic times, the focus of the settlement shifted from Seydiköy to the mountain site of Belören.

Düzen Tepe is a main Classical/Hellenistic site, located approximately 1.8 km from Sagalassos. Both the architecture and material culture found at the site seem to reflect contemporary Pisidian styles and fit a Classical/Hellenistic chronological timeframe. Systematic occupation of the site seems to end in the course of the second century BCE (Vanhaverbeke *et al.* 2010; Braekmans *et al.* 2011; Vyncke *et al.* 2011; Poblome *et al.* 2013a, 2013b). Sagalassos, on the other hand, became a major polis in the region from mid-Hellenistic times (around ~200 BCE) onwards, following the conquest of *Pisidia* by Alexander the Great in 333 BCE.

Figure 1 *The Roman Imperial territory of Sagalassos, including the plain of Burdur (Sagalassos Archaeological Research Project). The area south of the dotted line was added in the Early Imperial period.*

During the Hellenistic period, communities gradually converged into larger territories associated with a number of centralized poleis, such as at Termessos, Belören/Keraia and Sagalassos. The success of Sagalassos can possibly be explained by its more advantageous setting for water, raw materials and space for economic activities, and follows wider processes of social change also noted at, for example, the Pisidian poleis of Selge and Termessos (Poblome *et al.* 2013a, 2013b). At the end of the Hellenistic period, Sagalassos had established itself as a regional centre. The settlement controlled an area stretching from Lake Burdur in the west to the Aksu river in the east, bordering the flanks of the Beşparmak mountain range in the south and the Akdağ mountain range in the north (Waelkens and Poblome 1997).

GEOLOGICAL BACKGROUND

Geological research in the area of Sagalassos was described in detail by Muchez *et al.* (2008), who documented the area's petrography and mineralogy and the geochemistry of its rocks. The region's main geological spectrum consists of a magmatic component that can be defined as two main formations: an ophiolitic mélange and a volcanic tuff system (Özgür *et al.* 1990). Another prevalent geological feature is flysch deposits, which are essentially composed of conglomerate, sandstone and shale. Furthermore, the area is dominated by both autochthonous carbonates, deposited on the Bey Dağları platform, and allochtonous limestones.

The clay resources used for pottery production at Sagalassos in Roman Imperial to Early Byzantine times have been extensively described (Degryse *et al.* 2003; Degryse and Poblome 2008; Neyt *et al.* 2012). During these periods, detritic clays of eroded flysch deposits and ophiolitic clays were commonly used for coarse wares. The Sagalassos tableware was exclusively made with detritic lake sediments from the Çanaklı valley, located approximately 6–8 km from the site (Ottenburgs *et al.* 1993; Poblome *et al.* 2002). Ceramic production in earlier periods seems to include far more variability and the question remains as to how these productions were organized and connect to geographical and political developments.

Several other important clay resources were discovered in the region. The clays around the sites of Seydiköy and Belören in the valley system of Çeltikçi were formed by the weathering of northern Bey Dağları limestone formations and southern ophiolite rocks. The site of Kepez Kalesi at the north-western end of the valley revealed a rather large pocket of very weathered ophiolite. On the western border of the territory, the valley system to the south of Lake Burdur yielded several lake deposits that can easily weather to suitable clays for ceramic production (Neyt *et al.* 2012).

THE POTTERY

The material examined in this study spans over the period between the Archaic and the mid-Hellenistic eras (eighth to second centuries BCE), prior to the well-known production of Roman and later periods. In total, 15 ware groups (based on ~30 000 sherds) were identified on the basis of their macroscopic properties, and by combining surface/decorative, technological and compositional features (Fig. S1 and Table S1) (Braekmans 2011). Eleven sites were included in this study, spanning several geographical regions and sites: (1) Ağlasun valley—Düzen Tepe and Sagalassos; (2) Çeltikçi and Kuzköy valleys—Belören, Kepez Kalesi, Aykırıkça, Hisar and Seydiköy; (3) Bereket valley—Bereket and Kökez and (4) in the wider area of the Lake Burdur plain—Düver/Yarımada and Kozluca.

The Archaic pottery spectrum in the region mainly consists of 'black-on-red' and 'matte-painted' tablewares (Braekmans 2011; Poblome *et al.* 2013b). Black-on-red pottery is distinguished by its black linear and geometric decoration scheme on a red–brown slip. This ware group has mainly been found in Cyprus and in the Levant (Schreiber 2003), but in its specific regional make-up it is traditionally considered to have been produced somewhere in south-west Anatolia. However, no production sites have been identified yet (Mellaart 1955). In addition, the quality of slips and paint tends to differ greatly, so that the objects can often be better described as covered in a 'matte black or brown–black paint', which probably involved the same manganese paint commonly used in Anatolia (Schaus 1992). Mellaart (1955) and Birmingham (1964) discuss locally produced varieties in Phrygia, Lydia, the region around Burdur (at the border of Phrygia) and in Cilicia. This matte-painted pottery, although not similar in quality to 'black-on-red' wares, often bears similar banded slipped decoration in various forms and qualities.

Both the south-west Anatolian 'black-on-red' and the matte-painted ceramics were mostly retrieved from the Düver and Seydiköy sites. Common wares attributed to the Archaic period are highly variable but tend to include high-fired oxidized material, less enriched in inclusions than the objects in later periods. One type of pottery ('Aykırıkça ware') does display very different characteristics. This type of ware is unique in the region in that it contains a considerable amount of organic temper material.

Almost all sites yielded considerable amounts of Classical–Hellenistic pottery, which suggests that these sites were occupied, intermittently or continuously, from the fourth to the second centuries BCE. This chronological framework is mainly based on typologically analogous material (e.g., echinus bowls) (Rotroff 1997; Braekmans 2011). A common type of tableware attributed to this period is the so-called 'buff-ware', which has a buff-coloured, highly levigated, soft fabric. A few pieces with a dull thin slipped surface were retrieved from Düzen Tepe (Hayes 1991). The same fabric appears to have been used for so-called black-glazed pottery. This type of pottery was a widespread product in the Mediterranean basin, especially from 600 BCE to roughly the third century BCE. Black-glazed pottery is regarded as having originally been an Athenian monopoly, but it was later also produced locally in several other regions. These 'local' products were often of such high quality that they are difficult to distinguish from 'Attic or other Anatolian' black glaze. In several places, this black-glazed pottery still prevailed during the third century BCE. In addition to its characteristic black-slipped surface, the material is also characterized by ring bases and stamped or incised decoration (Sparkes and Talcott 1970). To the south of *Pisidia*, evidence of local production has been found at Perge (Recke 2003) and Sillyon (Küpper 1997).

Common wares can be described in general as oxidized ‘orange’-coloured ceramics without any surface treatment apart from partial to full smoothening. These wares focus especially on a generic jar and jug functionality. Cooking wares, on the other hand, were almost always enriched in volcanic material and/or mica minerals, especially in the Ağlasun and Çanaklı valleys. At other sites, limestone was commonly attested as a dominant inclusion type, occasionally in association with chert flakes.

Hellenistic material includes a wide variety of plain-slipped orange to brown tablewares, as well as a small set of completely reduced ceramics. This kind of tableware was generally very hard-fired and completely levigated. At Sagalassos, recent excavations have revealed deposits with material indicating that from the late third century BCE onwards, ceramic production developed differently from that of the rest of the region (Braekmans 2011; Poblome *et al.* 2013a, 2013b). These wares are characterized by both reddish and grey–brown slips that are more evenly applied than in earlier periods. From a morphological point of view, the presence of mould-made bowls, as well as the reduced popularity of echinus bowls in favour of more open forms with downturned, rolled and bevelled rims, seems to indicate that this type of fabric dates from the late third to second centuries BCE. These Hellenistic ceramics were not found at Düzen Tepe, or at any other site in the region, which might indicate that the material culture of the two sites began to follow divergent paths from the late third century BCE onwards. It also seems to indicate that the potters of Sagalassos gradually began to supply ceramics to its growing territory.

METHOD

Optical microscopy was used as a primary analytical method for providing a sustainable fabric classification, incorporating information on an object’s origin, production (textural analysis) and burial. Thin sections ($n = 273$) were analysed on a Leica DM-LP microscope (Leica Microsystems, Germany), using plane-polarized and cross-polarized light conditions. The quantity of inclusions was estimated by looking at several grids and measuring these against other inclusions and matrix.

After the assessment of the petrographic results, 124 out of 273 samples were selected for additional compositional analysis. Samples were selected from all petrographic groups, covering a complete range of variation. To avoid contamination, surface weathering, altered parts, carbonate sinters and so on, only interior sections of the samples were submitted to bulk geochemical analysis. For every sample, at least 2 g was powdered using a SPEX mini-mill for homogenization purposes. Samples were mixed with a lithium metaborate and lithium tetraborate flux and subsequently fused in an induction furnace.

Inductively coupled plasma – mass spectrometry (ICP–MS) is well established as a rapid and precise method for the determination of elemental composition, especially for trace and rare earth elements (REE) in geological samples (Jarvis 1988). The following elements provided a relative standard deviation of $< 5\%$ on these sample materials: SiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, K_2O, TiO_2, P_2O_5, Ba, Sc, Sr, V, Y and Zr by ICP–OES, and trace elements—Cr, Co, Ni, Cu, Rb, Nb, Cs, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Er, Tm, Yb, Lu, Pb, Th and U—by ICP–MS. The accuracy and quality of the method was controlled by a series of certified standards (see also Table S3): WMG-1, NIST 694, DNC-1, BIR-1, MICA-FE, GXR-2, LKSD-3, MAG-1, NIST 1633b, W-2a, JSD-3 and CTA-AC-1.

This procedure involved a molten bead being rapidly digested in a weak nitric acid solution (5%). In this way, major oxides, including SiO_2, REEs and other high field strength elements (HFSE) were added to the solution. A geochemical analysis was carried out in order to identify the general similarities and differences between the sherd compositions and to assess levigation/tempering procedures by evaluating trace element chemistry.

Based on the 'provenance postulate' (Weigand *et al.* 1977), homogenous compositional groups of pottery can be indicators of geographically restricted sources or 'source zones'. These sources can be identified by comparing the ceramic samples to raw materials. Multivariate statistics, such as principal component analysis (PCA), are widely used as a pattern-recognition technique by identifying subgroups in the compositional data. The contribution of specific elements to group separation can be observed together with the degree of variability. PCA is commonly used both as a tool to discover subgroups, and to assess the coherence of hypothetical groups suggested by other criteria; for example, petrographic groups, archaeological context and stylistic features (Baxter 2001; Michelaki and Hancock 2011).

RESULTS

Petrography

Thirteen petrographic groups are determined based on their common mineralogy. This results in several detailed 'provenance groups' (Table 1 and Fig. 2), which provide a link with the geological substrate. Fabric groups are identified according to their association with the mineralogical composition of the major geological units in the region (i.e., autochtonous and allochtonous limestones, ophiolitic mélange and flysch).

The 'volcanic-biotite' and 'volcanic-chert' groups are identified by a dominant presence of large idiomorphic biotite, pyroxene, amphibole, chert, plagioclase and basalt clasts. All these inclusions are indicative of an ophiolitic origin of the raw material. Both of these petrographic groups occur extensively within the Ağlasun valley. Overall, the volcanic grains at Düzen Tepe can be described as altered basalt inclusions, with elongated plagioclase crystals and K–Ca amphibole phenocrysts. Furthermore, the volcanic-biotite group is especially rich in elongated biotite grains.

The 'calcite-sedimentary', 'grog-calcite' and 'volcanic-sedimentary' groups contain few siltstone/sandstone fragments, which may argue in favour of a local limestone or flysch origin. The presence of plastic, mostly rounded, clay pellets acts as a primary fabric classifier, which probably refers to the original part of the clayey raw material. The texture of these pellets, however, is not always similar. These clay pellets may indicate a flysch-based raw material or may represent intentional or unintentional mixture of source material. These petrographic groups seem to have been widely distributed throughout the region.

Other, less common, but highly distinct petrographic groups include material enriched in muscovite, serpentinite, radiolarian chert and mudstone grains. Muscovite crystals and radiolarian chert occur mainly in samples derived from the Lake Burdur and/or Bereket areas. Serpentinite and mudstone materials, on the other hand, were primarily detected within the Ağlasun and Çeltikçi basin.

The petrographic group that contains metamorphic-related inclusions (mica schist, low-grade metamorphic siltstone and quartzite) was most likely to have been produced from non-local clay

Table 1 *The results of the petrographic analysis, by petrographic group (1–13)*

Petrographic fabric	*1 Calcite-sedimentary (n = 50)*	*2 Volcanic-biotite (n = 65)*	*3 Volcanic-sedimentary (n = 38)*	*4 Radiolarian chert (n = 7)*	*5 Volcanic-chert (n = 21)*
Ware groups	Düzen Tepe CW;[*] (late) Hellenistic tableware; buff ware; Çeltikçi CW; matte-painted; oxidized tableware	Düzen Tepe CW; oxidized tableware; Aykırıkça ware; Çeltikçi CW	Düzen Tepe CW; Sagalassos CW; Çeltikçi CW	Kozluca CW; Hellenistic tableware	Düzen Tepe CW; matte-painted; Çeltikçi CW
Site	Düzen Tepe, Sagalassos, Hisar- Aykırıkça, Düver, Kepez Kalesi, Bereket-Kökez, Seydiköy-Belören	Düzen Tepe, Hisar- Aykırıkça, Kepez Kalesi, Seydiköy-Belören	Düzen Tepe, Sagalassos, Hisar-Aykırıkça, Hacilar, Düiver, Kepez Kalesi, Bereket-Kökez, Seydiköy-Belören	Kozluca, Bereket-Kökez	Düzen Tepe, Sagalassos, Hisar-Aykırıkça, Kepez Kalesi, Bereket-Kökez, Seydiköy-Belören
Matrix (XP)	Red–brown; calcareous	Light brown to dark red–brown; non-calcareous	Yellowish to reddish brown; non-calcareous	Red–brown; non-calcareous	Dark brown; non-calcareous
General inclusion size	150–250 μm; 500 μm – 2 mm	50–500 μm	100–250 μm; max. 4 mm	250–750 μm	100–500 μm
Porosity	Medium to extensive, highly variable, result of weathering and alteration	Irregular, cracked pattern of elongated pores (++)[†]	Angular pores, irregular, or porosity restricted to scattered micropores, few elongated pores	Mostly limited, although elongated pores are common	Non-porous to abundant elongated pores, oriented, well-sorted
Approximate void size (μm)	200–750 μm	250 μm	150–250 μm	150–250 μm	50–250 μm
% Paste	60	Up to 40	60	70	Up to 40
Inclusions	Dominant: rounded limestone (+); (biotite and calcitic) sandstone (+); calcite (++); subangular K-feldspars (+) Accessory: chert (–); intermediate rock fragments (< 500 μm) (– –); micritic textures (–); pyroxene (– –); plagioclase (–); Fe-oxides (– –); amphibole (– –)	Dominant: (euhedral) hornblende (+), biotite inclusions (++); rounded and angular K-feldspars (+) to (sub)angular sanidine and anorthoclase (few are twinned); gabbroid (biotite phenocrysts) and andesitic/basaltic rock fragments (++); plagioclase (+); ortho- and clinopyroxene (augite) (+) Accessory: olivine (– –); subrounded iron oxides (–); calcite (– –), rare chert (– –)	Dominant: weathered (biotite) sandstones (+), large calcitic concretions (+), (andesite-basalt) volcanic fragments (+) (note: common alteration features); K-feldspars (++) Accessory: gabbro (– –); siltstone (– –); chert (–); calcite (–), rounded orthopyroxene (–); euhedral amphiboles (–); biotite (– –); plagioclase (–), small iron oxides (–)	Dominant: mudstone/siltstone (+), radiolarian chert (++) micritic limestone (+) Accessory: rounded calcite (–); K-feldspar (–); small Fe-oxides (–)	Dominant: weathered limestone (+), micritic limestone (+); (sub) rounded chalcedony chert (++); subrounded calcite (+)Accessory: andesite and basalt with large alkali feldspar phenocrysts (–) (presence of alteration features); altered biotite sandstone (–); ortho- and clinopyroxene (–); idiomorphic amphibole (–); biotite (– –); K-feldspar (–); plagioclase (– –); olivine minerals (– –); subrounded iron oxides (– –)
Clay pellets and grog	Subrounded clay pellets (+); rounded grog fragments (–)	Clay pellets (–)	Rounded (calcareous) clay nodules (+); rounded grog (–)	Rounded clay pellets (– –)	Rounded clay pellets (–); rounded grog fragments (+)
Quartz	High variability in quartz content	Low-sphericity quartz, evenly distributed	Evenly distributed, mostly rounded quartz (+)	(Poly)quartz (–)	Evenly distributed (poly)quartz
% (Sub)rounded versus % (sub)angular	80–20	10–90	80–20	70–30	10–90

Table 1 *(Continued)*

Petrographic fabric	*6 Muscovite (n = 9)*	*7 Mudstone (n = 7)*	*8 Serpentinite (n = 8)*	*9 Metamorphic (n = 5)*
Ware groups	Düver CW	Metamorphic ware; Düver CW	Düver CW; matte-painted; black-on-red	Metamorphic ware
Site	Düver, Düzen Tepe	Düzen Tepe, Sagalassos, Bereket-Kökez, Seydiköy-Belören	Düzen Tepe, Sagalassos, Düver	Düzen Tepe, Sagalassos
Matrix (XP)	Reddish brown to dark brown matrix, high optical activity	Brown greenish non-calcareous microcrystalline, optical active	Optical active, dark brown calcareous groundmass	Low optical activity, homogenous red–brown colour
General inclusion size	50–1000 μm	250–500 μm (max. 2 mm)	100 μm – 2 mm	250 μm and 500 μm (max. 3 mm)
Porosity	Limited porosity, restricted to micropores evenly scattered throughout the matrix; pores appear in elongated form	Irregular pattern of voids, 'cracked' structure of elongated pores	Extensive porosity, especially around the inclusions, oriented, radiating cracks	Common to few voids, predominantly medium-sized with very few macropores, weak alignment to vessel margins, irregular shaped, limited microporosity
Approximate void size (μm)	50–150 μm	Up to 1 mm	Up to 400 μm	150–500 μm
% Paste	80	60	60	60
Inclusions	Dominant: calcite (+); limestone (+) euhedral muscovite (++); subangular K-feldspar (+)Accessory: small rounded sandstone (– –); micritic limestone (– –); basalt (– –); serpentine (–); Fe-oxides (–)	Mudstone/siltstone (++) sandstone (+); chert (+); small rounded iron oxides (++)Accessory: andesitic, basaltic and gabbroid rocks with amphibole and K-feldspar phenocrysts (–); calcite (–); rounded K-feldspars (sanidine-anorthoclase) (–); angular plagioclase (– –)	Dominant: serpentine (++)Accessory: limestone (– –); sandstone (– –); basaltic rocks (–); small rounded and angular Fe- oxides (– –); K-feldspars (–)	Dominant: low-grade metamorphic rock fragments (++); mica schist (+); muscovite (+)Accessory: quartzite (–); amphibolite (–); calcite (– –); K-feldspars (– –); Fe-oxides (– –)
Clay pellets and grog	Dark-coloured clay pellets (–)	Rounded clay pellets (+); rounded grog fragments (+)	/	High-fired clay nodules (+)
Quartz	Few rounded quartz (150–250 μm)	Fissured (+)	Small-sized (–)	Angular (++)
% (Sub)rounded versus % (sub)angular	80–20	60–40	80–20	30–70

deposits. There is no record of quartzite or schist lithology in the region under study. A ceramic containing such rock fragments is therefore most likely to have been produced with material from outside the region. Fabrics enriched in these distinctive inclusions were mainly found at Düzen Tepe and Düver.

The tablewares, however, are more homogeneous. These ceramics can be divided into three main petrographic groups, labelled 'Fine-grained A to C' (FGA–C). Group FGA was only

Table 1 *(Continued)*

Petrographic fabric	*10 Grog-calcite (n = 8)*	*11 Fine-grained A (n = 18)*	*12 Fine-grained B (n = 21)*	*13 Fine-grained C (n = 16)*
Ware groups	Hellenistic tableware; Düzen Tepe CW; matte-painted	Buff tableware; oxidized tableware	Black glaze; buff tableware; SRSW; (Late) Hellenistic tableware; oxidized tableware; black-on-red	Buff tableware; black glaze; (Late) Hellenistic tableware
Site	Düzen Tepe, Sagalassos, Hisar-Aykırıkça, Kozluca, Bereket-Kökez, Seydiköy-Belören	Düzen Tepe	Düzen Tepe, Sagalassos, Düver, Seydiköy-Belören	Düzen Tepe, Sagalassos, Kepez Kalesi, Bereket-Kökez
Matrix (XP)	Calcareous; red crystalline matrix, high optical activity	Buff–brown; non-calcareous; minor vitrification	Reddish brown; non-calcareous; minor vitrification	Yellow–brown; highly calcareous
General inclusion size	250–750 µm (max. 3 mm)	250–500 µm	50–150 µm	50–200 µm
Porosity	Porosity of the fabric is minimal although large pores occur infrequently	Very small and rounded micropores (++)	Micropores (–)	Micropores (++)
Approximate void size (µm)	50–100 µm	50–100 µm	50–100 µm	50–150 µm
% Paste	70	80	90	90
Inclusions	Dominant: limestone (+); calcite (+) Accessory: subrounded sandstone (–); shell (– –); K-feldspar (– –)	Dominant: biotite (++); plagioclase (+); K-feldspar (+) Accessory: small intermediate rock fragments (–); rounded calcite (– –); rare chert (– –); sandstone (– –); pyroxene (–); amphibole (–); serpentine (– –)	Accessory: pyroxenes (– –) weathered amphibole (–); biotite (–); small angular K-feldspars (–); calcite (– –); limestone (– –); basalt (–)	Dominant: calcite (++), shell fragments (+); crinoids (+) Accessory: calcitic sandstone (– –); limestone (–); micrite (–); biotite (– –); K-feldspars (–); (sub)angular opaque minerals (– –)
Clay pellets and grog	High-sphericity clay nodules (+); rounded grog (+)	Grog (– –)	Absent	Absent
Quartz	(–)	Small, evenly distributed (–)	Small quartz grains (50–150 µm), rare polyquartz	Variable amounts of quartz, mostly rare to average
% (Sub)rounded versus % (sub)angular	60–40	60–40	60–40	70–30

*CW, common ware.
†Relative amounts of inclusions: ++, > 20%; +, 10–20%; –, 5–10%; – –, < 5%.

attested at Düzen Tepe and is characterized by the mixing of calcareous clays and iron-rich clays. Furthermore, small feldspar and biotite minerals (< 100 µm) are associated with altered volcanic rock fragments. On the other hand, the FG–B group represents very levigated material, including ceramics from the entire Ağlasun valley, and this group is very similar in nature to the petrography of the Roman 'Sagalassos red slip ware' (Degryse and Poblome 2008; Neyt *et al.*

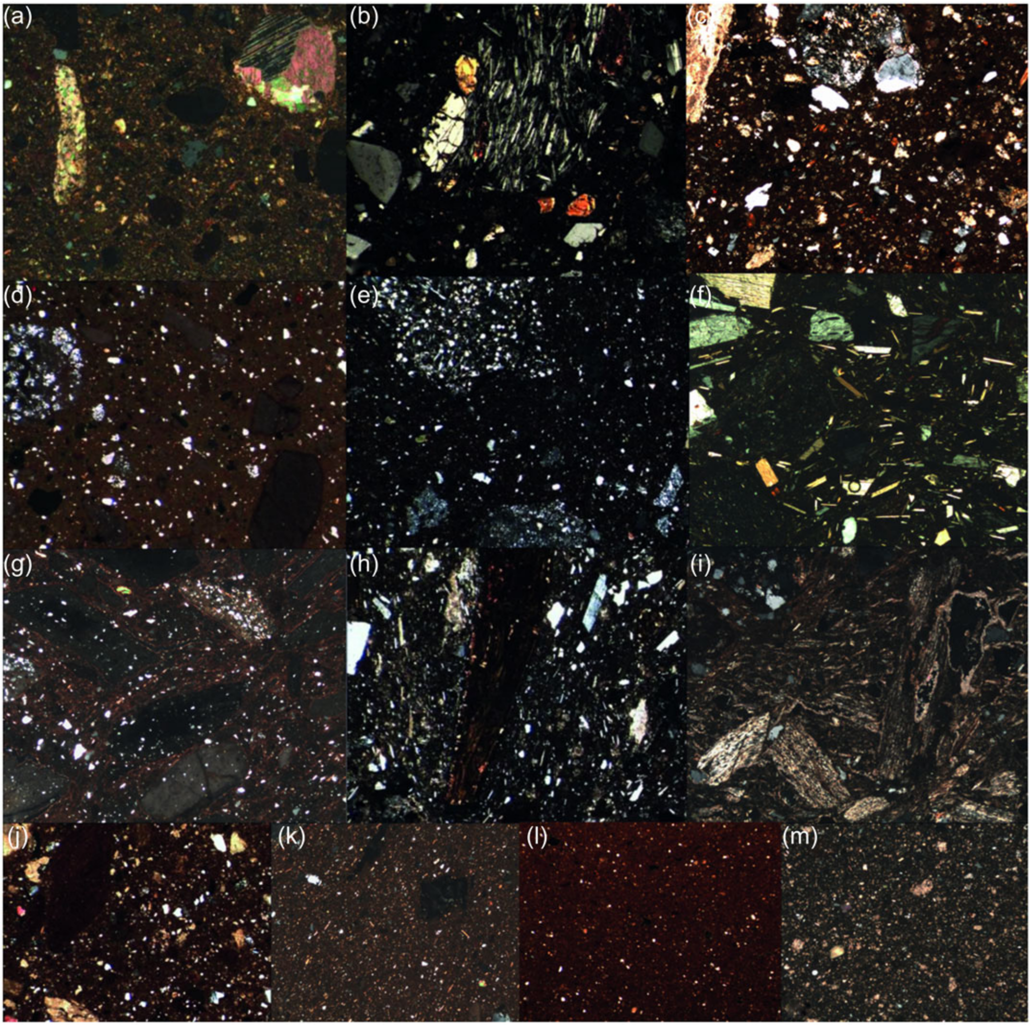

Figure 2 *Overview micrographs of all petrographic groups: (a) calcite-sedimentary; (b) volcanic-biotite; (c) volcanic-sedimentary; (d) radiolarian chert; (e) volcanic-chert; (f) muscovite; (g) mudstone; (h) serpentinite; (i) metamorphic; (j) grog-calcite; (k) fine-grained A; (l) fine-grained B; (m) fine-grained C. The photomicrographs (scale is 2 mm across) are taken with crossed polars.*

2012). The FG–C group is distinctive in its high carbonate content, including calcite, limestone, fossil and shell fragments. This mineralogical composition covers a large geographical area and is indicative of the Bereket, Burdur and Ağlasun valley areas.

Chemical composition

In order to evaluate the petrographic groupings and assess its variability on a geochemical scale, a bulk geochemical analysis was carried on 124 samples. Analytical results were $\log_{10}$-

normalized over the concentration of La for statistical analysis in function of normality as well as to correct for possible alterations (Buxeda i Garrigós 1999). The main element concentration was recalculated on a loss-on-ignition (LOI) free basis. A PCA analysis of all elements (n = 38) explained 80.68% of the total variance in the data in the first three factors (Table S2). PC 1 comprises positive loadings (> 0.70) for Na_2O, Ba, Sr, Zr, Nb, La to Gd, Hf, Th and U, as well as small positive contributions from K_2O and Al_2O_3 and small negative loadings from MgO. PC 2 contains high positive loadings for Tb to Lu, Y and TiO_2. A small negative loading is linked to CaO. PC 3 is dominated by negative loadings for Cr, Co and Ni, and associated with negative contributions from Fe_2O_3, Sc and V. According to these factors, the large set of elements can be reduced and characterized into groups of geochemically related elements. 'High field strength elements' (HFSE), 'large ion lithophile elements' (LILE), 'transition trace elements' (TTE) and 'rare earth elements' (REE) were all grouped to compare ceramics and clay materials. Notable correlations were discovered between Na_2O and the LILE elements, as well as between K_2O and the REE and HFSE elements. As expected, Cr and Ni, Y with HREE, Zr with LREE–Hf–Ta–Th–U, Fe–Sc–V, Sr–Ba and K–Rb show significant positive correlation factors. In addition, Sr (and Ba) show(s) a strong correlation with LREE–Hf–Ta–Th–U, instead of a correlation with CaO, as might be expected in carbonate/shell tempered pottery (Cogswell *et al.* 1998).

To provide an overview of the available compositional groups, a cluster diagram of the first two components (Fig. 3) was constructed incorporating material from all sites. Seven groups are identified (with three singletons/outliers removed) and defined by 'A', 'B', 'C', 'D', 'E', 'F' and 'G' (Table 2).

Group differentiation is based on differences in main element composition as well as group of elements having similar properties. High MgO, Fe_2O_3 and TTE as well as a lower K_2O content sets group A (n = 2) apart from the other groups. Group B (n = 8) has mainly a lower total Fe_2O_3, MgO and TTE, and a high LILE and CaO content (15–20 wt%). Group C (n = 16) displays a bulk major element composition that is similar to that of group B, with the exception of systematic lower CaO content. In addition, group D (n = 15) is composed of major element concentrations comparable to group C. However, the trace element composition shows differentiation, with an overall higher REE and LILE composition and lower TTE values. Group E (n = 12) is characterized by especially low CaO values, correlating with a higher Al_2O_3 content (up to 20 wt%).

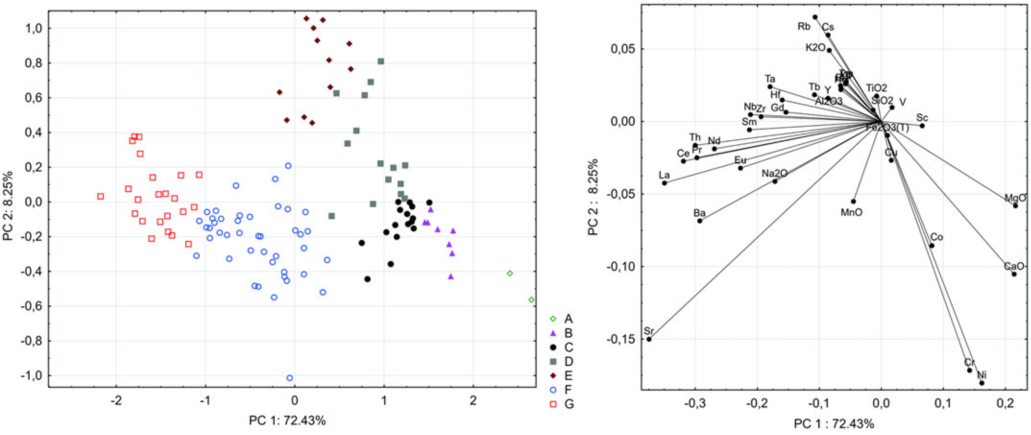

Figure 3 *The graphical output of a PCA of the assigned production groups, including a loading plot.*

Table 2 *The geochemical results of the regional defined production groups, as well as a summary of clay values based on Degryse and Poblome (2008) and Neyt et al. (2012). Total REE counts are not reported for clay raw materials; values listed are La (ppm)*

	Ceramic production groups													
	Group A (n = 2)		*Group B (n = 8)*		*Group C (n = 16)*		*Group D (n = 15)*		*Group E (n = 12)*		*Group F (n = 43)*		*Group G (n = 23)*	
Petrography	*Muscovite*		*Radiolarian chert; fine-grained C*		*Calcite-sedimentary; fine-grained C*		*Calcite-sedimentary; fine-grained B; grog-calcite*		*Serpentinite; mudstone; fine-grained B; metamorphic*		*Volcanic-sedimentary; fine-grained A; volcanic-chert*		*Volcanic-biotite*	
Ware groups	*Düver CW*		*Hellenistic tablewares; Kozluca CW*		*Hellenistic tableware; black-on-red; Çeltikçi CW; matte-painted; black glaze*		*Sagalassos red slip ware; Sagalassos CW; Düzen Tepe CW; matte-painted; oxidized tablewares; buff ware*		*Metamorphic ware; Düver CW; black-on-red*		*Çeltikçi CW, Düzen Tepe CW; matte-painted; buff ware; oxidized tablewares*		*Aykırıkça ware; Düzen Tepe CW*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
SiO_2 (wt%)	54.22	0.17	51.94	3.88	55.37	3.14	56.35	4.44	59.43	4.10	59.20	3.46	57.73	1.37
Al_2O_3 (wt%)	14.27	0.83	12.35	1.57	14.98	0.65	15.74	2.27	19.64	2.11	18.19	1.94	21.34	1.71
Fe_2O_3(T) (wt%)	11.02	0.00	7.06	0.99	8.20	0.54	7.16	0.83	8.58	0.87	7.76	1.11	7.35	0.85
MnO (wt%)	0.19	0.02	0.11	0.02	0.12	0.03	0.11	0.03	0.12	0.06	0.15	0.03	0.15	0.02
MgO (wt%)	9.40	1.43	6.45	1.19	6.23	0.93	4.05	1.28	3.60	1.33	3.01	1.38	1.73	0.62
CaO (wt%)	8.21	2.16	17.63	3.69	10.32	3.73	11.38	6.87	2.81	1.38	5.66	3.56	3.66	1.84
Na_2O (wt%)	0.97	0.09	0.78	0.24	0.89	0.19	0.75	0.29	0.92	0.28	1.45	0.43	2.32	0.56
K_2O (wt%)	0.69	0.10	2.65	0.33	2.70	0.40	3.15	0.64	3.50	1.12	3.27	0.44	4.08	0.40
TiO_2 (wt%)	0.91	0.07	0.71	0.09	0.87	0.08	0.88	0.15	0.97	0.11	0.87	0.14	0.86	0.09
P_2O_5 (wt%)	0.13	0.03	0.33	0.10	0.32	0.11	0.44	0.26	0.42	0.47	0.45	0.24	0.78	0.45
Sc (ppm)	45	6	15	3	19	4	17	3	20	2	16	3	13	3
V (ppm)	220	3	103	18	131	23	117	27	140	18	115	19	114	20
Ba (ppm)	231	73	419	90	442	94	536	268	668	217	1335	414	2478	550
Sr (ppm)	96	3	352	96	232	60	297	110	258	190	1092	404	2291	702
Y (ppm)	22	5	20	3	23	3	26	4	33	6	33	6	38	4
Zr (ppm)	94	16	121	20	149	14	170	30	213	45	296	60	435	74
Cr (ppm)	1930	778	383	44	429	111	223	90	283	140	373	238	145	52
Co (ppm)	57	1	27	5	35	10	27	24	26	8	28	15	18	4
Ni (ppm)	335	35	296	111	305	91	159	107	167	107	196	101	88	37
Cu (ppm)	55	7	44	9	58	23	48	17	49	10	53	48	48	21

(Continues)

Table 2 *(Continued)*

	Ceramic production groups													
	Group A (n = 2)		*Group B (n = 8)*		*Group C (n = 16)*		*Group D (n = 15)*		*Group E (n = 12)*		*Group F (n = 43)*		*Group G (n = 23)*	
Petrography	*Muscovite*		*Radiolarian chert; fine-grained C*		*Calcite-sedimentary; fine-grained C*		*Calcite-sedimentary; fine-grained B; grog-calcite*		*Serpentinite; mudstone; fine-grained B; metamorphic*		*Volcanic-sedimentary; fine-grained A; volcanic-chert*		*Volcanic-biotite*	
Ware groups	*Düver CW*		*Hellenistic tablewares; Kozluca CW*		*Hellenistic tableware; black-on-red; Çeltikçi CW; matte-painted; black glaze*		*Sagalassos red slip ware; Sagalassos CW; Düzen Tepe CW; matte-painted; oxidized tablewares; buff ware*		*Metamorphic ware; Düver CW; black-on-red*		*Çeltikçi CW, Düzen Tepe CW; matte-painted; buff ware; oxidized tablewares*		*Aykırıkça ware; Düzen Tepe CW*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Rb (ppm)	21	2	66	12	97	20	111	32	134	51	113	22	148	25
Nb (ppm)	6	1	13	3	16	3	18	4	21	4	31	8	50	13
Cs (ppm)	1	0	4	1	6	1	7	3	8	3	8	5	7	1
Pb (ppm)	13	8	16	5	18	9	23	10	25	17	39	17	66	26
Th (ppm)	4	0	7	1	10	1	12	2	18	3	30	9	53	9
U (ppm)	1	0	2	0	3	0	3	1	4	1	5	2	9	2
Total REE (ppm)	79	13	113	14	150	17	180	26	268	41	450	115	851	144
Total LILE (ppm)	348	73	840	96	777	130	951	303	1068	358	2549	795	4924	1195
Total HFSE (ppm)	129	22	166	25	205	19	234	39	294	52	402	78	594	95
Total TTE (ppm)	2307	773	571	46	672	143	432	104	518	155	586	258	337	81

CW, common ware.

(Continues)

Table 2 *(Continued)*

	Regional clay groups (mean values)							
	Çanaklı clays	*Burdur*	*Ağlasun valley flysch*	*West Ağlasun valley*	*Düzen Tepe ophiolite*	*Central Ağlasun valley flysch/ limestone*	*Düzen Tepe clay pit*	*Seydiköy flysch*
SiO_2 (wt%)	54.57	47.88	63.56	57.58	58.40	50.77	54.59	62.15
Al_2O_3 (wt%)	16.31	10.92	13.08	15.62	21.30	13.10	25.77	16.93
Fe_2O_3(T) (wt%)	8.31	7.13	6.59	9.96	6.74	6.78	9.50	7.57
MnO (wt%)	0.12	0.15	0.15	0.23	0.16	0.15	0.14	0.17
MgO (wt%)	5.58	9.62	2.93	4.99	1.98	5.45	2.75	2.35
CaO (wt%)	10.28	19.87	8.97	7.06	2.85	18.94	2.08	5.55
Na_2O (wt%)	0.96	1.83	1.35	0.95	2.74	1.42	0.97	1.14
K_2O (wt%)	2.74	1.68	2.45	2.12	4.62	2.37	2.93	2.94
TiO_2 (wt%)	0.89	0.72	0.72	1.27	0.85	0.77	1.02	0.92
P_2O_5 (wt%)	0.24	0.21	0.20	0.22	0.36	0.25	0.25	0.28
Sc (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
V (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Ba (ppm)	459	227	713	412	2812	805	1393	936
Sr (ppm)	302	374	733	282	3004	922	785	887
Y (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Zr (ppm)	159	86	204	143	501	190	450	293
Cr (ppm)	261	456	497	440	106	315	121	323
Co (ppm)	25	28	26	35	17	20	19	22
Ni (ppm)	232	306	210	155	46	175	103	160
Cu (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Rb (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Nb (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Cs (ppm)	6.2	2.9	5.2	2.7	9.3	3.5	9.1	6.2
Pb (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Th (ppm)	13.5	5.2	15.6	8.6	60.3	14.7	60.9	19
U (ppm)	2.8	1.6	3.5	1.8	10.5	3.2	6	3.5
Total REE (ppm)	52	19	72	45	265	64	227	88
Total LILE (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Total HFSE (ppm)	nd	nd	nd	nd	nd	nd	nd	nd
Total TTE (ppm)	nd	nd	nd	nd	nd	nd	nd	nd

nd, Not determined.

Groups F and G are characterized by high REE, LILE and HFSE levels, while the TTE content is far lower than in any other group. Group F (*n* = 43) has high Al_2O_3, Na_2O and TTE major element concentrations, as well as lower CaO and MgO values. The overall trace element concentration is much higher than in groups A–E. Only group G (*n* = 23) has even higher values, especially with respect to the LILE and REE element content.

DISCUSSION

The results presented here contribute to the discussion on how local communities interacted with various cultural spheres of influence and the existing resources. The assessment of the origin and use of raw materials for pottery production can act as an indicator of this phenomenon. Central *Pisidia*, in particular, seems to have interacted on various scales during the first millennium BCE, with Phrygian, Lydian, Persian, Hellenistic and Roman spheres of influence. The goal of this study was to discover the extent of imported and locally produced pottery throughout the region and periods studied, as well as to identify the use of locally abundant raw materials throughout a long chronological period. Possible locations for clay mining were found in several valley systems, with clays weathered from the local flysch, limestone and ophiolite bedrock.

A comparison of ceramics and raw materials

A comparison of the bulk chemical compositional groupings between the pottery and comprehensive results on clay sources (Degryse and Poblome 2008; Neyt *et al.* 2012) derived by PCA discloses (at least) four distinct types of resources used in the region (Fig. 4 and Table 2). These can be subdivided into a non-regional group (A), Burdur basin groups (B and E), detrital clay groups from the Çanaklı and Ağlasun basin (C and D), a mixed flysch–limestone group (F) and an ophiolitic–volcanic group (G) based on both common petrology and clay chemistry. LILE, TTE, HFSE and REE all contribute to the chemical differentiation of the analytical data set.

Group A (*n* = 2) can be considered as very distinct from the other chemical groups. The high contents of TTE (~2000 ppm) and MgO (~10 wt%) in this group indicate a very specific

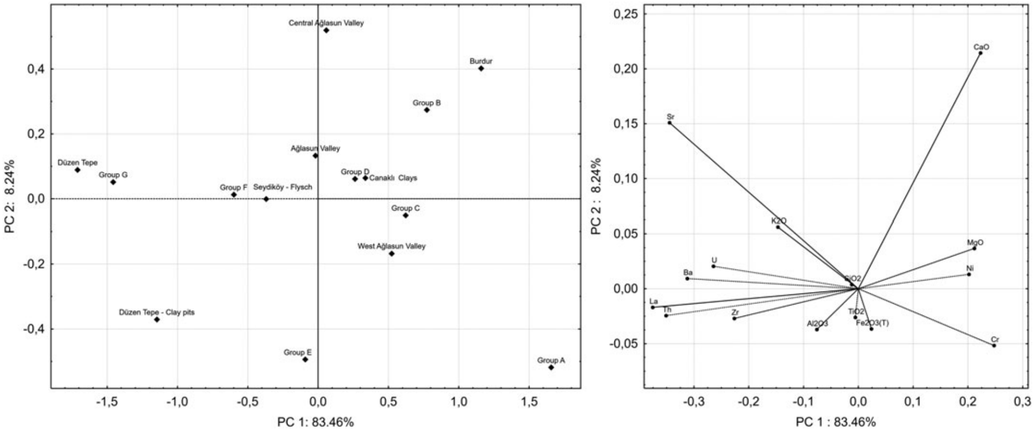

Figure 4 *The graphical output of a PCA of both the defined ceramic groups and the clay raw materials (data on clays derived from Degryse and Poblome 2008; Neyt et al. 2012).*

authigenic Mg-smectite based clay. Depletion in REE elements (~80 ppm total) is apparent, in contrast to LREE enrichment in all the other groups. Petrographically, an extensive amount of muscovite minerals might indicate a metamorphic substrate of the clays used. Also, the near absence of K_2O and feldspar minerals is apparent for this provenance group.

Group B (*n* = 8) is characterized by very high levels of CaO (up to 20 wt%) and relatively low amounts of trace elements. This signature is compatible with the calcareous sediments of the Lake Burdur area. The calcareous nature is replicated in thin-sectioning, and systematically described by the petrographic groups 'fine-grained C' group and 'radiolarian chert'. Interestingly enough, all the pottery in these groups is uniquely related to Hellenistic material derived either from Sagalassos and Kozluca.

Group E (*n* = 12) is a distinctively different product of Düver ceramics, potentially also derived from the Düver area. Petrographic analysis provided several groups ranging from fine-grained B material to 'mudstone'- and 'serpentinite'-enriched groups. Although no compatible clays are analysed, the mineralogical composition could point to lake sediments to the south of the Burdur area (Neyt *et al.* 2012), but the evidence at this point remains too tentative to firmly attribute these types of materials. However, what is important is that this Düver group of ceramics was extensively attested well into the Hellenistic period.

The material from group D (*n* = 15) is closely related to the detrital clays from the Çanaklı valley. These clay resources seem to have been used for production over a long time span. The levigated nature of the sherds, which increases chronologically up to the late Hellenistic and Sagalassos red slip wares, is characteristic. The main petrographic groups are 'calcite-sedimentary', 'grog-calcite' and 'fine-grained B'. Their variation seems to be related to the degree of levigation and the presence of chert, weathered amphibole and pyroxene inclusions (reminiscent of an influx of material from an igneous source, derived from the Lycean nappes). Of specific interest is the Ağlasun valley, where ceramics from the Classical and Hellenistic periods, from both Düzen Tepe and Sagalassos, seem to have been consistently produced using similar clay sources (Braekmans *et al.* 2011). As a proxy for the use of the Çanaklı clays, for example, 'Sagalassos red slip ware' samples are systematically situated within the petrographic groups 'fine-grained B' and chemical group D. However, these clays are relatively rich in MgO content (6–7 wt%), which is not represented in sherds belonging to the other ware groups, suggesting the possible use of several different outcrops. In addition, a significant amount of Late Hellenistic material from Sagalassos was attributed to group C (*n* = 16). Although similar to group D, chemical group C is more compatible with the detrital clays from the western part of the Ağlasun valley.

Flysch is a common lithology in the region and is described as a weathering product of Mesozoic limestone and ophiolite deposits (Degryse *et al.* 2008). The observed differences in chemical composition are mostly related to the CaO content, which can be explained by the calcareous and limestone-rich nature of these sherds. The petrographic classification of group F (*n* = 43) is highly variable, encompassing mostly a 'volcanic-sedimentary' and 'volcanic-chert' provenance, often enriched in sandstone fragments. This discrepancy is mostly due to the variable amounts of (weathered) volcanic minerals (probably derived from weathered ophiolite) and calcite content. The sedimentary component may be explained by the clays weathered from ophiolite found on the flanks of the mountain ranges around the Ağlasun and Çeltikçi valleys (Neyt *et al.* 2012). The absence of biotite and magnetite might indicate mechanical transport, which refines clays from heavy mineral and mica components.

Most of the sites around the Çeltikçi valley, Kepez Kalesi, Seydiköy and Belören seem to be especially rich in this type of material. Clays sampled at Seydiköy are supposed to have been formed by the weathering of the northern Bey Dağları limestone formations and the southern ophiolitic rocks (Neyt *et al.* 2012). Therefore, the flysch clays from both Seydiköy and the Ağlasun valley also form an ideal candidate for a raw material. Pottery attributed to this group seems to represent the main type of production in the region. The allocation to the Archaic and Classical(–Hellenistic) period ('matte-painted' pottery and 'buff wares') points to a chronological variation, since no Late Hellenistic material was attributed to this group. Very little pottery from the Burdur plain can be traced to this provenance.

Group G ($n = 23$) is characterized by a very high LILE elements content (most notably Sr and Ba) and a rather low TTE elements content. High Al_2O_3 and low CaO contents, combined with high contents of Hf and Th, are the most distinct geochemical features of this group.

With respect to the petrographic composition, all sherds are enriched in variable amounts of volcanic and igneous rock components. Idiomorphous amphiboles, (ortho)pyroxenes, abundant biotite minerals, K-feldspars and intermediate to mafic volcanic rocks are the most characteristic elements of provenance. The high content of biotite grains might indicate a fairly unaltered deposit. Transported deposits would enhance deterioration of the biotite grains as well as the amphibole fragments. The (angular) feldspar component appears to be rather 'fresh' and does not suffer from the alteration effects detected in other fabrics.

The ophiolite sequences around the site of Düzen Tepe are highly discernible by the trace element composition of the basaltic-andesite, andesite and dacite rocks. The anomalously high content of Sr and Ba is higher than expected in andesitic rocks. These andesites are closely associated with volcanic tuff deposits and lava flows at Gölçük (Jakes and White 1972; Muchez *et al.* 2008). This feature is directly replicated in the geochemical profile of ceramic group G, which was also validated by the petrographic data. Clays on and around the site of Düzen Tepe itself were also analysed as a comparison (Neyt *et al.* 2012). Apart from higher Al_2O_3 content, these clays also seem to be enriched in both REE and Th. As a result, it can be firmly suggested that the illite-rich clays from Düzen Tepe were used to produce the ceramics associated with group G. Pottery groups related to this provenance group seem to be associated with the entire range of 'common wares' found at the sites of Düzen Tepe and Aykırıkça, favouring both fabrics associated with storage functionalities as well as fabrics associated with 'cooking ware' products. No tableware seems to have been produced using these clays.

Chronological trajectories in ceramic production

Archaic period (eighth to sixth centuries BCE) The Archaic period is characterized by a continuous use of similar resources throughout the region on the basis of both the petrographic and geochemical data. This period is best represented at the sites in the area of Lake Burdur, especially Düver. Provenance groups enriched in serpentinite, muscovite and (radiolarian) cherts, using raw materials chemically enriched in either CaO or TTE, seem to have been favoured in contrast to the other ceramic groups. In addition, Archaic high-quality painted pottery—for example, the 'black-on-red' ware—was only found systematically at Düver.

The sites situated around the Bereket basin are dominated by a calcite-sedimentary and volcanic-sedimentary component. However, unlike the Çeltikçi sites, we found neither volcanic-biotite fabrics nor 'fine-grained B' material. Instead, muscovite, radiolarian chert and 'fine-grained C' fabrics seem to point to a closer connection with the Burdur area in terms of material distribution.

From a petrographic view, another production type of the Archaic period, the 'Aykırıkça ware', is composed of a 'volcanic-biotite' group, setting it apart from the rest of the material culture. This ware group is uniquely related to the site of Aykırıkça and the Ağlasun valley. From a chemical point of view, this volcanic-biotite material correlates with Classical material in chemical group G. Overall, none of these pottery groups appear to have travelled far beyond their respective valley systems.

Classical period (fifth to third centuries BCE) With respect to this period, the site of Düzen Tepe was studied most extensively, both chemically and petrographically. The petrographic analysis suggests that the material from the site is dominated by the volcanic-biotite group, utilizing a raw material that had already been in use since the Archaic period. However, the distribution of this petrographic group is limited to the nearby valley systems, decreasing proportionally as the distance from Düzen Tepe increases. This particular petrographic group can be seen as indicative for the production of Classical period common wares at Düzen Tepe. Similarly, considering the tableware component of the assemblage, the 'fine-grained A' fabric is also restricted to the site of Düzen Tepe. On the basis of the data provided here, we can conclude that the 'buff tableware' of Düzen Tepe and the (partly) slipped 'orange–red tableware' (or oxidized tablewares) are not distributed across any other sites in the area, which, moreover, suggests that production either took place at the site itself or in its direct vicinity (Braekmans *et al.* 2011; Poblome *et al.* 2013b). Only 'buff tableware' belonging to the 'fine-grained B' petrographic group is found more commonly throughout the Ağlasun valley (and beyond).

At Sagalassos, a similar picture emerges, although the volcanic-sedimentary and volcanic-chert groups play a greater role in the material from Sagalassos. Since no evidence for production of ceramics with 'volcanic-biotite' petrography was found at Sagalassos, the use of the associated raw material seems to have ceased around the Hellenistic period. At this time, Sagalassos began to play an important economic role in the area. Another change in fabric preference can be associated with fine-grained ceramics, since no 'fine-grained A' sherds ('buff wares') were documented at Sagalassos. On the other hand, 'fine-grained' groups B and C are replicated at Sagalassos, including the typical Attic 'black glaze' sherds, which continued into both the Hellenistic red-slipped tableware and the more greyish-brown mottled coloured late Hellenistic tableware, which was also compositionally consistent with Early Imperial red-slipped pottery. This shift in resource selection for fine-grained, or tableware, production signifies an important differentiation in production strategy between potters at Düzen Tepe and Sagalassos.

The sites located in the valleys adjoining Düzen Tepe (Hisar, Aykırıkça, Seydiköy, Belören and Kepez Kalesi) roughly show similar fabric proportions. Most of the ceramics found at these sites are composed of calcite-sedimentary material. The material evidence from Düver is rather scarce, but remains consistent with the Archaic material.

Hellenistic period (third to first centuries BCE) Raw material selection in the Hellenistic period appears to have formed a continuation from the Classical period. However, most of the differentiation is linked to the tableware assemblages. The Hellenistic assemblage at Kozluca is characterized by a very distinct production, both petrographically and chemically, from the material of Sagalassos. In this respect, many of the typical brown–grey late Hellenistic tablewares from Sagalassos could well be related to the site of Kozluca (or to a Burdur area provenance) on the basis of their chemical signature (group B). What is interesting in this respect is the abundance of this material at the Sagalassos site, which clearly represents a different product of late Hellenistic tableware than the more frequently used Çanaklı clays. The material evidence is rather scarce so far, but it seems to point to an interaction on a far larger, regional scale, coinciding with the establishment of Sagalassos as a regional production centre. Düzen Tepe, on the other hand, probably never had that much influence in the area of Burdur and was restricted to the Ağlasun valley system. It is plausible that Sagalassos monopolized the production of regionally spread tableware from the late Hellenistic period onwards. The use of the finer Çanaklı clay leads to the emergence of a proto-industrial production for regional and international exchange in the form of the 'Sagalassos red slip ware', the production of which continued into the seventh century AD (Poblome 1999; Poblome *et al.* 2012).

CONCLUSION

The data presented here show large differences in locally produced ceramics, especially between the areas of Düzen Tepe/Sagalassos, Seydiköy/Belören/Bereket and the Burdur plain. There is evidence of exchange of wares, although this phenomenon seems to have been largely restricted to the region itself. Material interactions seem to have been especially important throughout the Bereket and Çeltikçi basins from the Archaic period onwards. It is clear that initially, there was only limited exchange between the Burdur basin and the Ağlasun area, while more intensified contact only began from the Hellenistic period onwards. Both petrographic and chemical reference groups can improve the characterization of the pottery of this region of Anatolia, providing prevalent data for the understanding of pottery technology and distribution from the Archaic to the Hellenistic period and contributing to the determination of the development of cultural changes in Anatolia.

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