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The Founder of GACUK Matti Egon with the 'unusual bouquet' offered by the scholars.

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The Heraion of Samos under the microscope

A preliminary technological and provenance assessment of the Early Bronze Age II late to III (*c.* 2500–2000 BC) pottery

Sergios Menelaou

MSc Alumnus/PhD Post-graduate, the University of Sheffield, Department of Archaeology

Introduction

The island of Samos is located in the eastern Aegean, at the southernmost extension of the cultural region covering the north and east Aegean islands (Poliochni on Lemnos, Thermi on Lesbos, Emporio on Chios) and western Anatolian littoral (Troy, Liman Tepe, Bakla Tepe, Miletus).[1] Lying south of Chios and the Izmir region coast and east of Ikaria, it is separated from the Asia Minor coastline (Mycale Strait) by less than 1.5 km.

The first systematic investigation of the Heraion Early Bronze Age (hereafter EBA) settlement was undertaken by Milojčić (1953–1957) in the area between the Hera Temple and the North Stoa, as well as underneath the Pronaos: five successive architectural phases were uncovered, designated as Heraion I–V (2500–2000 BC) and spanning the second half of the 3rd millennium BC.[2] Subsequently, Walter (1958–1960) revealed a great part of the prehistoric, fortified settlement in the area beneath the north and east Prostasis and to the east of the Temple,[3] while the fieldwork undertaken by Isler[4] in 1966 to the north of the North Stoa supplemented knowledge about the late EBA phase (Heraion V). The excavations undertaken by Kyrieleis and Weisshaar[5] in 1981 in the area north of the Sacred Road documented four successive EBA architectural phases that date to Heraion I and earlier, i.e. before 2500 BC.[6] Finally, the recent investigations of Kouka (2009–2013), directly north of the excavated area of 1981, revealed for the first time the earliest core settlement and brought to light successive architectural phases dating from the Late Chalcolithic through to the early EBA II.[7]

The extensive settlement of the EBA Heraion lies on the south-central coast of Samos, in the most fertile plain of the island between the two main branches of the Imvrasos river.[8] It constitutes the largest prehistoric island settlement with proto-urban characteristics in the eastern Aegean, covering a surface of 35,000 m².[9]

Given the absence of previous analytical studies, as well as the paucity of publications and preliminary reports on pottery from the prehistoric Heraion,[10] the present research provided the opportunity to investigate by petrographic means the Samian ceramic technological tradition. This last is representative, for a significant chronological period, of the wider Aegean area: a time characterised by large-scale interaction and the emergence of new socio-political and economic structures.[11] The phase concerned covers the EBA II late to III in relative chronological terms[12] and represents five centuries of occupation (*c.* 2500–2000 BC).[13]

Materials and methods

Thin-section petrography, i.e. the microscopic examination of ceramic samples, allows the identification and characterisation of the main rock and mineral inclusions (composition, quantity, shape, grain size and distribution) and textural features (microstructure, colour, and optical activity) of the fabrics, providing information on aspects both of technology (raw material processing and clay preparation, firing characteristics, forming techniques) and provenance (geological and/or geographical).[14] This range of information can be combined with macroscopic and stylistic analysis, in order to produce more archaeologically meaningful results with respect to the production, consumption and distribution of ceramics.

An initial study of the pottery assemblage was carried out on hand-specimens, based on criteria such as vessel type/shape, surface treatment, decoration, firing condition and a macroscopic assessment of the fabric. Detailed catalogues of this information are presented elsewhere.[15]

The ceramic repertoire of Heraion I–V is characterised by a wide variety of shapes that represent different functional

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1 Kouka 2002, 299–300, map 1, table 1; Kouka 2013, 576.
2 Milojčić 1961, 56–67, table 3; Kouka 2002, 279–284.
3 Walter 1963, 286–289;1976, fig. 3.
4 Isler 1973.
5 Kyrieleis *et al.* 1985, 409–418, fig. 35.
6 The ceramic material from the old (1981) and recent (2009–2013) excavations in the area north of the Sacred Road are currently under study by Dr O. Kouka and the author.
7 Niemeier and Kouka 2010; 2011; 2012; Kouka 2013, 575–576, online fig. 1, http,//www.aja.online.org/imagegallery/1647; 2014a; 2014b, 49-52; forthcoming.
8 Milojčić 1961, 1; Walter 1976, fig. 3; Kouka 2013, 575.
9 Kouka 2002, 285–286, 294, pls 45–55; 2014a, 52; forthcoming.
10 Milojčić 1961, 38–52; Kyrieleis *et al.* 1985, 416–417, figs 42–43.
11 E.g. Sotirakopoulou 1997; Şahoğlu 2005.
12 Manning 1995, 51–63, 81–86; Kouka 2002, table 1; Kouka 2013, fig. 1; Şahoğlu 2005, 344, fig. 2; and forthcoming.
13 Manning 1995, 157–160, 172–174.
14 E.g. Quinn 2013.
15 This paper draws on the author's MSc research, under the supervision of Dr P.M. Day at the University of Sheffield (Menelaou 2013).

categories. The majority of the pottery comprises handmade vessels, although a small proportion of shapes (mainly shallow bowls and plates) dating to the EBA III period (Phases Heraion IV–V) depict the first vessels to be manufactured on a rotary device, as revealed through macroscopic evidence. The basis of this study comprises both slipped and smoothed/washed monochrome wares; most frequent are those with red/orange and reddish-brown surfaces and less so the ones with light grey to dark grey/black colour. Only a small portion of the fine and medium-coarse ware vessels is covered with a burnished, rarely lustrous, slip. Usually the slip is poorly preserved, due to erosion from the high water table of the plain around the settlement. The vessels rarely bear plastic or incised decoration.[16]

After a broad classification of the macroscopic fabrics, which reveals that the majority of the pottery is made of coarse raw materials related to metamorphic geological deposits (e.g. quartzites, schists, phyllites), only a small number of open and closed vessels deriving from well-stratified contexts were selected for petrographic analysis.[17] A total of forty-four coarse, medium-coarse, and fine ware samples of eating, drinking and serving, storage, and cooking vessels are represented, from shapes like deep and shallow bowls, plates, two-handled cups, jugs, jars, pithoi, tripod bowls, pyxides and askoi.

Standard thin-sections were prepared by the author at the facilities of the Department of Archaeology, University of Sheffield. Once a preliminary separation of the groups — and subgroups where necessary — had been achieved, each group was described individually according to the system proposed by Whitbread.[18]

The primary objectives of the study were:

1. To classify the samples into fabric groups;
2. To characterize petrographically the production technology of the pottery assemblage;
3. To identify the geological and/or geographical provenance of the samples, and to distinguish between local products and possible imports;
4. To trace possible connections with contemporary sites of the eastern Aegean region;
5. To assess the assumption that specific ceramic forms correlate with certain fabric groups;
6. To examine the diachronic development of the ceramic assemblage and the persistence of the manufacturing traditions through time.

Petrographic results

A considerable degree of compositional, textural, and technological variability was noted between the samples examined. The petrographic analysis resulted in the establishment of three main fabric groups (Fabrics 1, 2, and 4), two small groups and several loners, i.e. distinct fabrics that are found in single samples.[19]

Fabric 1 accommodates the majority of the analysed samples, although is further distinguished into two subgroups (1a and 1b) due to the texture and grain size of the common inclusions, technological features such as clay mixing,[20] and occasionally the firing conditions. This class has a very fine, highly micaceous, red-firing fabric, characterised by well to moderately sorted sub-angular to sub-rounded inclusions, of very fine to medium sand grain size (0.05 mm to 0.2 mm). It contains rare, coarse non-plastic inclusions, such as metamorphic rock fragments and polycrystalline quartz (<0.65 mm). The most prominent characteristic of this fabric is the dominant presence of small to medium-sized mica laths (Subgroup 1a), mainly biotite, and fine monocrystalline quartz (<0.2 mm) (Subgroup 1b, **Fig. 1a)**. The representative samples of this group belong to fine ware open and closed vessels like shallow bowls, deep bowls, and jugs/jars.[21] A considerable chronological span exists between the samples (Heraion II–V), probably indicating the continuation of this very fine and well-processed fabric throughout the settlement's life.

Fabric 2 is a fairly coarse to semi-coarse, homogeneous group, characterised by the dominant presence of sub-angular to sub-rounded monocrystalline quartz (<0.65 mm) and muscovite mica (<0.55 mm). There is a slight variability within the fabric and between the different samples in terms of their textural properties, quantity of quartz and mica, and the optical activity of the micromass, but they generally display a well-packed texture (**Fig. 1b**). Apart from the common presence of the aforementioned minerals, the coarse fraction contains also few polycrystalline quartz fragments, very few to rare metamorphic rock fragments, and rare to absent sedimentary ones. This class consists of tableware vessels, such as deep and tripod bowls, one plate, and a one-handled jug, with generally undecorated brown to reddish-brown or black burnished surfaces.[22] The samples display a chronological uniformity (Heraion I–II).

Fabric 3 constitutes a fairly coarse group (<2.8 mm), characterised by the frequent presence of rounded to sub-rounded, fresh and mainly altered volcanic rock fragments (**Fig. 1c**), with fine to medium-grained basic composition (basalt or dolerite). Most of these inclusions appear with altered devitrified matrices, while others exhibit clear texture. The groundmass is relatively fine; the presence of coarse non-plastic inclusions together with organic matter is most probably the result of tempering. The roundness of the inclusions and their sparseness from the fine fraction implies that they derive from a secondary clay, which has been transported via water, rather than being crushed and added intentionally. This homogeneous group comprises

[16] Milojčić 1961, pls 32.1; 43.17; 48.31; 49.8; 24.12.
[17] Milojčić 1961, 38–52, pls 2–12.
[18] Whitbread 1989; 1995, 379–388.
[19] Only selected fabrics are discussed in detail here. See also, Menelaou forthcoming.
[20] Menelaou forthcoming, fig. 3.
[21] Milojčić 1961, pls 22.9; 36.20; 38.50; 39.27; 44.1.
[22] Milojčić 1961, pls 35.26; 46.4; 48.29.

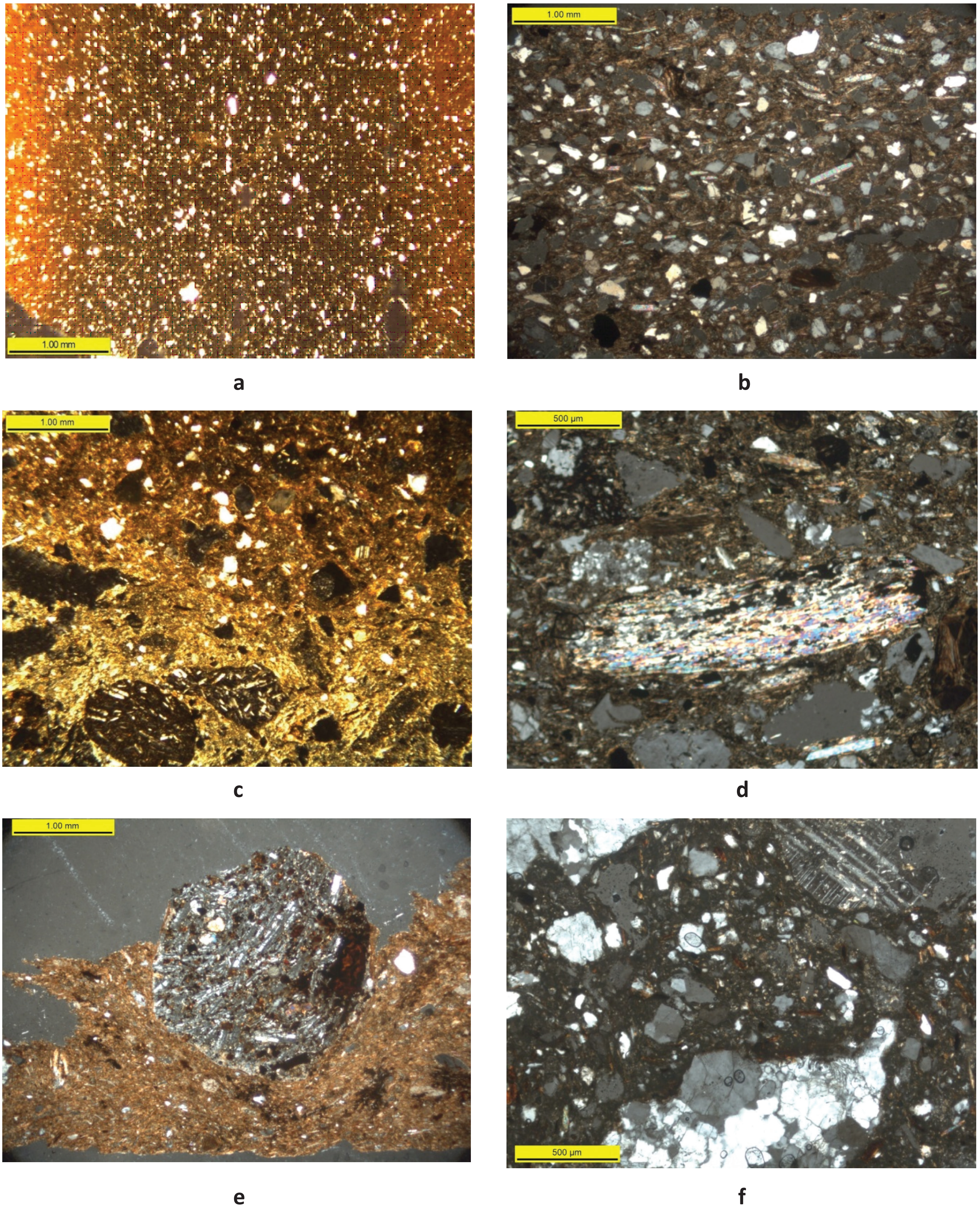

Fig 1. a-f. Micrographs: (a) Fabric 1b, Fine mica and monocrystalline quartz; (b) Fabric 2: Coarse quartz and muscovite mica; (c) Fabric 3: Well-rounded volcanic inclusions; (d) Fabric 4a: Muscovite-schist fragment; (e) HT12/06: Rounded basalt with porphyritic texture; (f) HT12/30: Acid igneous textures, myrmekite and perthitic microcline. All images taken in crossed polars.

of undecorated, poorly smoothed, coarse ware storage vessels,[23] roughly dating to Heraion I–II.

Fabric 4 is divided into two subgroups (4a and 4b), based upon the varied presence of individual rock fragments. Subgroup 4a is characterised by the common presence of intermediate grade, medium-grained metamorphic rock fragments (mica-schists, muscovite-quartzite schists, phyllites) (**Fig. 1d**) and their constituent minerals (monocrystalline and polycrystalline quartz, mica), and occasionally micritic-sparitic limestone. The samples forming Subgroup 4b exhibit a considerable variability, in terms of the amount of metamorphic rock fragments (mica-schists and phyllites) and the rare presence of fine-grained sedimentary (siltstone) and igneous/volcanic rock fragments.[24] Fabric 4 constitutes a generally homogeneous to fairly heterogeneous and chronologically coherent group (Heraion I), as it comprises of handmade, coarse and semi-coarse ware vessels that relate to the preparation and consumption of food, such as deep bowls and cooking pots.[25]

Loner Fabrics:

HT12/01 represents the coarsest fabric among the pottery assemblage and is characterised by the dominant presence of serpentinite fragments (<3.5 mm) and common to few low-grade metamorphic rocks (mica-schists, phyllites, quartzites).[26] There is also a small amount of medium-fine fragments of pyroxenes, olivines, biotites, and plagioclases, i.e. the main constituents forming the basic/ultrabasic igneous rocks before they are transformed to serpentinite. The base clay is characterized by a dark red/orange colour that probably reflects an oxidising atmosphere. The micromass ranges from moderately optically active to optically inactive, implying that it has been fired to a relatively high temperature. The presence of common inclusions in both the fine and coarse fraction of the groundmass indicates that it is not the product of tempering, but rather is part of the primary clay composition. Its coarseness can be explained by the vessel shape, namely a pithos of Heraion I.

HT12/04 is characterised by the frequent presence of polycrystalline quartz fragments and a substantial amount of sub-angular to angular serpentinite inclusions (<1.6 mm), set in a fine groundmass.[27] In contrast with the previous fabric, the serpentinite fragments are smaller in size and more fresh-looking and homogeneous in texture and colour, implying the exploitation of different geological deposits. The presence of such coarse non-plastic inclusions, as well as their pronounced bimodal distribution, suggest the deliberate addition of the raw materials in the base clay. Its macroscopically identified metallic texture and hard-baked fabric, together with the optically inactive micromass that displays a slight colour differentiation between the reddish-brown margins and the greenish-grey core, suggests that it has been high-fired to an incomplete oxidising atmosphere. It is represented by a handmade, large storage vessel that dates to Heraion II.

HT12/06 is characterised by a fine ware fabric that exhibits evidence for incomplete clay mixing of a non-calcareous mica-rich clay with a calcareous one, as can be suggested by the presence of distinctive calcareous domains and swirls in the groundmass.[28] The first is related to a metamorphic environment, as indicated by the presence of few to rare metamorphic rock fragments, while the calcareous clay seems to derive from an igneous geological deposit, as the very rare presence of rounded igneous inclusions (probably basalt, <2.8 mm) implies (**Fig. 1e**). It is represented typologically by a characteristic Samian shape of the EBA III, the hybrid two-handled depas cup.[29]

HT12/08 constitutes a medium-coarse fabric characterised by the low presence of large (<1.68 mm) twinned and zoned feldspar (plagioclase) phenocrysts, microfossils, and volcanic glass fragments, set in a very fine calcareous groundmass.[30] This light brown-yellowish fabric appears to have been fired to a low temperature, according to the high optical activity of the micromass. It is represented by a bowl/cup.

HT12/30 represents a coarse fabric characterised by the common presence of sub-angular to sub-rounded acid igneous rock fragments (<1.68 mm), deriving most probably from granitic/microgranitic deposits. The rock fragments are mainly composed of quartz, alkali feldspars, and occasionally small amount of biotite mica, amphiboles, and iron-oxides set in a granular interlocking texture. Various types of intergrowth textures occur in this fabric, such as myrmekite, perthite, and microgranite (**Fig. 1f**). The presence of common constituents in the fine fraction probably indicates the natural accession of the non-plastic content within the paste. It appears to have been fired to a moderate to high temperature, according to the weakly optically active to optically inactive texture of the micromass. The shape represented is an open jar.

HT12/33 represents a coarse fabric characterised by the dominant presence of sub-angular to angular inclusions of calcite, and micritic-sparitic limestone occasionally.[31] It also contains sparse inclusions of monocrystalline and polycrystalline quartz (<0.4 mm), and muscovite mica. The angularity, size (<1.6 mm), and distribution (single-spaced with random orientation) of the main inclusions, implies that this fabric is most probably the result of tempering, after crushing the raw materials. It has been high-fired, as suggested by the altered texture of the calcite crystals and the optically inactive, calcareous micromass.

23 Milojčić 1961, pls 32.1; 48.31.
24 Menelaou forthcoming, fig. 9.
25 Milojčić 1961, pls 35.10 and 19; 3.81.
26 Menelaou forthcoming, fig. 10.
27 Menelaou forthcoming, fig. 11.
28 Menelaou forthcoming, fig. 4.
29 Milojčić 1961, pl. 47.1.
30 Menelaou forthcoming, fig. 5.
31 Menelaou forthcoming, fig. 12.

Reconstruction of ceramic technology

Based on the distinguishing criteria of grain size distribution, roundness and angularity, and mineralogical composition, an assessment of the paste preparation was attempted.

The majority of the samples are characterised by the use of non-calcareous, coarse clays rich in metamorphic rocks. The presence of poorly sorted non-plastic inclusions may imply the utilisation of unrefined, naturally occurring alluvial sediments rich in silicate minerals (Fabrics: 2 and 4; Loners: HT12/01, HT12/06, HT12/08, and HT12/30). In contrast, the fine ware samples may have been subjected to sieving or levigation for the removal of the larger inclusions, or more likely suggest the utilisation of naturally refined clays (Fabric 1). Tempering in the form of plastic and non-plastic materials was practised for the paste preparation of Fabric 3, and Loners HT12/04 and HT12/33. The addition of organic matter (e.g. chaff/straw), as evidenced by the presence of remaining elongated voids parallel to the samples' margins, ensures lower plasticity and better workability of the clay mix (e.g. Fabric 3). Indications for the mixing of two different clay sources were also detected, although usually in an incomplete state, the result of the utilisation of a mica-rich clay and a calcareous one (Fabric 1b: HT12/34 and HT12/35; Loner: HT12/06). It is not always feasible to distinguish between deliberate clay mixing and the use of a naturally heterogeneous clay source.

The optical activity and the colour of the groundmass were used to indicate the firing temperature and condition of the pottery. The majority of the ceramic samples have been fired to a low to moderate temperature, judging from the optically active, red/orange to reddish-brown matrix in most cases. However, a number of samples were detected to be relatively high-fired, from their optically inactive or slightly active micromass (Fabric 4a: HT12/20; Loners: HT12/01, HT12/04, HT12/30, and HT12/33). Occasionally, the presence of colour differentiation between the core and the margins (dark grey/black and reddish-brown respectively) indicates that the vessels were subjected to differential atmospheric conditions, i.e. different episodes of oxidation and reduction (Fabric 1a: HT12/24 and HT12/26; Fabric 1b: HT12/25 and HT12/34; Fabric 2: HT12/07, HT12/14, and HT12/21). Evidence for a reducing atmosphere is restricted to Fabric 1a (HT12/36), Fabric 2 (HT12/22), and Fabric 4a (HT12/20). No correlation between the high-fired examples with those bearing a slipped surface was noted, with HT12/33 being the only exception. Future compositional analysis (Scanning Electron Microscope) will shed more light on these issues.

The forming techniques and surface treatments applied were not examined in great detail, due to the lack of obvious evidence under the microscope. Possible coil joins were attested in Fabric 1a (HT12/24) and Fabric 4b (HT12/10), as indicated by the concentrically-arranged inclusions. Other examples are likely to be wheel-made or wheel-finished according to macroscopic evidence (HT12/14, HT12/24, HT12/26, HT12/29, and HT12/32). As well as the slipped and burnished surfaces identified, the exhibition of a strong alignment of the lath-like inclusions (mica) towards a preferred direction (Fabric 1a: HT12/27, HT12/37, HT12/38, and HT12/39) could attest that the surface was subjected to a degree of pressured scraping or smoothing.

Form, function and fabric

Although the selected samples are not numerically representative of the assemblage's quantity, it is feasible to suggest that some kind of distinction exists between vessels of similar form and shape. This is most obvious in the bowls of different types, which are represented both in fine and coarse ware versions. In addition, a correlation between the composition and function of the vessels is observable, related to the different functional categories represented, i.e. tableware, storage, cooking ware. Such are likely to constitute homogeneous compositional groups in most cases. These functional categories, however, are not restricted to a single fabric.

It is noteworthy that the coarser fabrics correspond to larger vessels, which are functionally related to the storage of food or liquids – such as pithoi, jars, and occasionally large deep bowls (Fabric 3; Loners: HT12/01, HT12/04, and HT12/30). This technological choice reflects the potter's decision to enhance the performance characteristics and mechanical/physical properties of these vessels. However, it is necessary to examine a larger number of samples more rigorously in order to establish strong associations between fabric groups, vessel forms and related functions.

Diachronic assessment of the ceramic assemblage

The micro-temporal analysis demonstrates that the ceramic fabrics distinguished are chronologically coherent and are restricted to certain phases of the settlement. Only in a few cases were they found to extend further. In the late EBA II period (Heraion I–III) are discernible the majority of the material, the coarser fabrics and the use of a considerably broader range of exploited raw materials. In contrast, the fabrics dating to EBA III (Heraion IV–V) reflect the use of finer raw materials, subjected to more intensive processing: this implies the probable existence of some form of standardised mode of production.

The fabric groups were generally found to reflect the use of different clay mixes and/or different technological choices. Irregularities between samples of the same group occur, as might be expected, considering the early character of the site under investigation. Therefore, it is the sheer chronological span of the settlement that could account for a diachronic change between different groups, as well as any synchronic diversity between samples belonging to the same group. This can be best explained by postulating: 1) the development of different recipe variants used by different potters, 2) the natural variation of the raw materials used by a single workshop, 3) and/or the probable existence of more than one production unit within the vicinity of the site under investigation. However, the lack of any direct evidence for excavated kilns and associated installations related to pottery workshops prevents any further discussion.

Ceramic provenance determination

The majority of the fabrics were found to be compatible with the local geology of Samos, reflecting various geological areas in the vicinity of the site. The mineralogical variability of the ceramic thin-sections corresponds to the complex geological background of the study area, which is situated in the south part of the alluvial plain formed by the Imvrasos river. The geology of the area is characterised mainly by metamorphic rocks, although other minor geological formations are also present. By examining the availability of these raw materials using geological literature and maps,[32] it has been possible to identify the likely sources exploited by the local potters throughout the period under investigation.

A comparative examination of the contemporary material from Liman Tepe and Bakla Tepe in the Izmir region is also discussed in this section, with respect to the provenance interpretation of a few samples.[33]

Among the classes distinguished, Fabrics 1, 2, 4, and Loners HT12/01, HT12/04, HT12/06, HT12/30, HT12/33 represent a range of varied local groups. Their composition reflects the use of different rock deposits as temper sources and/or different clay sources deriving from regional outcrops in a radius of 5–10 km from the site. For instance, Fabric 4 may relate to the Chora-Heraion alluvial formation that is rich in metamorphic rocks, likely transported via the Imvrasos river from the south outcrops of the Ampelos schists.[34]

The rock and mineral suite of Fabric 1 is not diagnostic as to its origin, but its highly micaceous texture and the rare presence of metamorphic inclusions, suggest that it is potentially local. Fabric 1b (especially HT12/25) finds very close parallels in Fabric 7 from Liman Tepe, which is made up of the so-called 'Urfirnis' sauceboats, probably imported from Melos, and is related to equivalent wares from the contemporary settlements of Akrotiri on Thera, Ayia Irini on Kea, and Poros-Katsambas on Crete.[35] The absence of 'Urfirnis' sauceboats from the Heraion of this period, and the fact that HT12/35 represents a typical Samian shape characteristic of the Heraion IV (i.e. a neck-handled jug with trumpet mouth[36]) at present, prevents any secure assessment of these compositional/technological similarities. Future work requires the integration of chemical analysis.

Samples HT12/01 and HT12/04 provide evidence for the local production of coarse ware storage vessels, related to the small-sized, partly schistose ophiolite and peridodite-serpentinite bodies respectively, that occur as sills within the Ampelos schists, only 5 km north-west from the site.[37]

Although most of the samples were tied down to a local geological environment and were found to represent readily available raw materials in the vicinity of the settlement, a number yet are probably the result of exchange with nearby sites.

A first insight into the probable local movement of pottery is given by HT12/30. This sample reflects an acid igneous geological background, that is limitedly presently to the westernmost part of Samos in the form of intrusive dykes (plutonic rocks: diorites, granites, and granodiorites), not easily accessible by land.[38] Similar rock deposits occur at the east and southeast of Kuşadası, which lies on the coast opposite Samos,[39] and in the central Aegean, i.e. Naxos, Mykonos, Tinos, and Serifos.[40] This geology is also known to exist on the nearby island of Ikaria, which lies only a few km west from Samos.[41]

Fabric 3 provides the strongest link between the Samian pottery and the harbour site of Liman Tepe during the late EBA II. Its mineralogy and general texture exhibit a striking resemblance with Fabric 1 from Liman Tepe, which has been suggested to be locally produced from a volcanic source, located westwards of the site and to the east of the Karaburun peninsula.[42] Similar geological deposits can be also found on Samos,[43] but much less frequently. They are restricted to the lower series of the Karlovasi basin and the east and west sides of the Ampelos Massif intersecting as sills within the schist bodies.[44] The textural differences between the volcanic rocks identified within the Heraion fabrics (HT12/06), as well as the absence of altered basalt inclusions from the rest of the fabric groups, when combined with the aforementioned arguments, imply that the vessels of this group may have been imported from Liman Tepe. This, however, must remain a tentative conclusion, until further analyses provide stronger evidence.

Despite the obvious textural and superficial compositional similarities between the samples from Bakla Tepe and the

[32] IGME, 1979; Mezger *et al.* 1985; Whitbread 1995, 123–125; Ring *et al.* 1999; Pe-Piper and Piper 2007.
[33] Day *et al.* 2009a. Hereby, I would like to thank Dr O. Kouka, Dr P.M. Day and Dr V. Şahoğlu for permission to study comparatively the ceramic material from Liman Tepe and Bakla Tepe, analysed within the framework of the 'Kastri Group Pottery Project' and stored at the Department of Archaeology, University of Sheffield.
[34] IGME, 1979.
[35] Day *et al.* 2009a, 342.
[36] Milojčić 1961, pls 13.1–2; 19.1–3; 27.4; 39.6; 42.15–16; 43.14; 47.13; Isler 1973, 172, right; Benzi 1997, 385–386, pl. 1f, fig. 5680; Sotirakopoulou 2008, 549.
[37] IGME, 1979.
[38] IGME, 1979; Mezger *et al.* 1985, 353–354, figs 1–2.
[39] Gessner *et al.* 2001, fig. 5.
[40] Henjes-Kunst *et al.* 1988, 126–127, figs 1–2.
[41] Higgins and Higgins 1996, 144, fig. 13.11.
[42] Day *et al.* 2009a, 341, 343.
[43] Ring *et al.* 1999, 1577, fig. 2; Pe-Piper and Piper 2007, 75.
[44] IGME, 1979.

Heraion, especially Fabric 2, the absence of chalcedonic quartz from the samples of the latter site and its frequent presence in the ones from Bakla Tepe,[45] impede further association between the two.

Technological tradition and interregional interaction

In this section, a small number of vessels traditionally considered as products of *Anatolianising* or *Cycladicising* influence are discussed.

The majority of the samples comprising the pottery assemblage of this study are mostly compatible with the local ceramic repertoire. Only a small fraction represents newly emerged ceramic shapes that infiltrate the existing assemblages, such as the hybrid depas-tankard cups,[46] the shallow bowls and the plates,[47] the askoi[48], the spherical pyxides, and the incised jugs.[49] Their appearance probably corresponds with other technological developments such as the introduction of the potter's wheel and the improvement in the burnishing technique.

These shapes are generally considered in Helladic-Cycladic terms as representative of the 'Lefkandi I-Kastri Group' pottery horizon.[50] This horizon was thought to be the product of contacts between the western Anatolian littoral and central Anatolia first, followed by its technological transmission through the northeast Aegean islands, westwards to the Cyclades and mainland Greece.[51] The northeast Aegean islands, i.e. Lemnos, Lesbos, Chios, and Samos, will have constituted the geographical stepping stones and cultural intermediaries between western Anatolia and the central Aegean in this transmission, maintaining contacts in place since the Final Neolithic/Late Chalcolithic period.[52]

In the present study, the absence of shapes like tankards, depas cups, bell-shaped cups, beaked jugs, which appear gradually in phase Heraion III,[53] prevents the deduction of holistic conclusions regarding the range of the so-called West Anatolian drinking set. However, the analysis of hybrid depas-tankard cups[54] (HT12/06 and HT12/36), wheel-made plates (Fabric 1a: HT12/29; Fabric 4: HT12/14; HT12/32), and shallow bowls (Fabric 1a: HT12/37 and HT12/39; Fabric 4b: HT12/12) provided some useful preliminary insights.

In particular, these shapes were found to incorporate a range of different fabric groups compatible with the local geology of the island. The presence of these shapes in well-defined fabric groups alongside other traditional ones, confirm probably that their manufacture was embedded within the local ceramic tradition.

The askos or 'duck vase' is a shape typical of late Early Cycladic production, which turns up at the Heraion in the EBA III. Sample HT12/42 was initially expected to reflect a distinctive geology not compatible with Samos, based on the assumption that this vase-type was being fabricated in the Cyclades.[55] The typical incised decoration of this shape can be found throughout the central Aegean, in the east and southeast Aegean islands[56] and in west Anatolia.[57] The microscopic analysis, however, revealed a non-diagnostic fabric that finds close parallels with Fabric 1. This finding could suggest that this askos is a local product,[58] probably an imitation of a Cycladic example, so confirming Rutter's view about the existence of a local tradition in the east Aegean and more specifically on Samos.[59] However, at this time and in the absence of readily available comparative material from the Cyclades, this remains only a suggestion.

A relatively fine fabric, rich in mica, is attested for the majority of these samples, corresponding to the typical Samian clay mixes. The preliminary petrographic results revealed an interesting picture, adding to the analysis of contemporary material from Bakla Tepe, Akrotiri on Thera, Panormos on Naxos, and Ayia Irini on Kea.[60] The aforementioned sites demonstrated a similar mineralogical variability between these shapes, whereas a more complex picture emerges at Liman Tepe, where there is a clear fabric distinction between the normal domestic assemblage and the newly-fashioned shapes.[61] Although these new forms reflect a conceptual transformation in ceramic design, their coexistence with traditional ones corresponds to a picture of technological continuity, conformation, and/or adaptation to the existing patterns and approaches, rather than comprising a strict culturally, geographically, and chronologically homogeneous phenomenon.[62] This is also confirmed by the production of local variations and hybrids of the prototype shapes, especially in the EBA III.[63] Local adaptations are also observed in EBA II–III Thebes.[64]

The sampling of further material covering the full range of these shapes and from various sites will shed new light on the importance of these local mechanisms of tradition and innovation. Thus a more regional understanding of these cultural changes should emerge.

45 Day *et al.* 2009a, 342.
46 Milojčić 1961, pls 14.6–8; 15.4 and 8; 21.5; 39.22; 41.9–10, 12–15; 43.33; 47.1; Şahoğlu 2014, 305.
47 Milojčić 1961, pls 22.9; 29; 44.1; 46.2–7.
48 Milojčić 1961, pls 15.2; 18; 19.8; 20.2–3; 23.1; 24.7–13; 38.16; 42.17; Isler 1973, 173, top centre and right.
49 Milojčić 1961, pls 15.3; 36.19; 41.22; 48.5–20; 49.8–9; Isler 1973, 173, left.
50 Rutter 1979; 2012, 73–79.
51 Day *et al.* 2009a, 338; Rutter 2012, 74.
52 Milojčić 1961, 43–48, 59; Doumas and Angelopoulou 1997; Angelopoulou 2008, 149; Sotirakopoulou 2008, 536, 546.
53 Milojčić 1961, pls 21.1; 28.7; 39.23; 47.3–9.
54 Cf. example from Miletus in Kouka 2013, 575, fig. 4, right; from Beycesultan in Şahoğlu 2014, 303, fig. 6.
55 Milojčić 1961, 23 [15], 48, 65, pl. 24.12; Sotirakopoulou 1993, 8; Sotirakopoulou 1997, 35.
56 Milojčić 1950; Marketou 1990; Benzi 1997, 388.
57 Kouka 2013, 574–575.
58 Isler 1973, 175.
59 Rutter 1985, 17.
60 Day *et al.* 2006; 2009a; 2009b.
61 Day *et al.* 2009a, 343.
62 Angelopoulou 2008; Sotirakopoulou 2008, 127–128; Şahoğlu 2014, 304.
63 Rutter 2012, 76–77.
64 Hilditch *et al.* 2008.

Conclusions

Thin-section analysis of forty-four pottery samples from the settlement of the Heraion on the island of Samos, dating to the late EBA II-III, has successfully permitted their mineralogical characterisation and the suggestion of potential provenance areas of production. The limited number of the analysed samples does not allow any holistic understanding of the cultural/technological/ social developments taking place during that period. Nevertheless, the present study has laid the foundations for an analytical background to the ceramic technological tradition.

Even at this preliminary stage, it is evident that most samples have been locally produced, as they reflect the use of available raw materials compatible with the site's broader geological background. Anticipating somewhat, the technological/mineralogical diversity attested to in the range of fabrics could well indicate a number of potters/ production units within the Heraion's vicinity. Apart from this 'on-site' production, the recognition of probable non-local fabrics adds to the picture of pottery circulation within a framework of regional and interregional exchange networks, already well-developed during the Aegean EBA II-III.

Future developments in the analysis of comparative material from contemporary sites across the Aegean, and more particularly in the eastern Aegean, will establish clearer synchronisms for this generally neglected cultural/ geographical region.

In turn, this will combine with the stylistic, petrographic, chemical and contextual analyses from the Heraion settlement, enhancing what we know about both the diachronic and synchronic development of the EBA Samian ceramic technological tradition.

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Contacts

sergioslim89@hotmail.com
menelaou.sergios@gmail.com

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