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Regional Lydian pottery at Daskyleion: testing stylistic classification by chemical analysis

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In memory of Professor Tomris Bakır

Abstract

This paper presents the results of an interdisciplinary study of Lydian pottery excavated at Daskyleion between 1988 and 2002. Before becoming the satrapal centre of Hellespontine Phrygia in the Achaemenid period, to judge by the historical and archaeological evidence, Daskyleion had close interrelations with the Lydian kingdom. Previous stylistic and macroscopic fabric studies of Lydian pottery from Daskyleion have shown that as well as items produced in the Lydian capital of Sardis, ceramics may also have been imported from other production centres in the region of Greater Lydia (Gürtekin-Demir 2002). New chemical analysis by neutron activation (NAA) of 31 samples from Daskyleion presented here confirms this suggestion. We determined four chemical provenance groups of Lydian pottery, each of them defined by an element pattern which is distinct from the pottery made in Sardis. Although these four provenance groups cannot be located at present due to the lack of reference data from potential Lydian-style ceramic production centres in Anatolia, they prove that other production centres existed outside Sardis. Daskyleion may have been one of those.

Özet

Bu çalışma, Daskyleion'da 1988-2002'de bulunmuş olan bir grup Lydia seramiği üzerinde yapılan disiplinlerarası çalışmanın sonuçlarını ortaya koymaktadır. Arkeolojik ve tarihi veriler doğrultusunda, Hellespontos Phrygiası'nda yer alan Daskyleion, Akhemenid dönemde satraplık merkezi olmadan önce, Lydia Krallığı ile de önemli bağlantılara sahipti. Daskyleion'da ele geçen Lydia seramikleri üzerinde daha önce yapılmış olan stilistik ve makroskopik araştırmalar, Lydia seramiklerinin Sardis dışındaki emperyal Lydia topraklarında ve hatta Lydia kültürel eksenini içerisindeki farklı Anadolu merkezlerinde de bölgesel olarak üretilmiş olabileceği fikrini ortaya koymuştur (Gürtekin-Demir 2002). Bu çalışmada sunulan Daskyleion'daki 31 örnek üzerinde yapılan nötron aktivasyon analizi (NAA) sonuçları bu öneriyi desteklemektedir. Çalışmamızda Lydia seramiğinin dört farklı kimyasal köken grubu tespit edilmiştir; her bir grup Sardis üretimi olanlardan farklı bir element modeli ortaya koymaktadır. Lydia stilinde seramik üreten Anadolu'daki diğer potansiyel merkezlerdeki referans verilerin eksikliğinden dolayı söz konusu dört köken grubunun hangi merkez/merkezlerle ilişkili olduğunu bilemiyoruz; ancak, Sardis dışındaki merkezler olduğunu net bir şekilde ortaya koyabilmekteyiz. Sardis dışında Lydia tipi seramik üreten aday merkezlerden bir tanesi olasılıkla Daskyleion olmalıdır.

Ancient Daskyleion is situated near the modern village of Ergili, ca 30 km inland from the coast of the Propontis (Marmara Denizi) (fig. 1). Archaeological excavations initially started under the directorship of E. Akurgal in 1954–1959, were later resumed by T. Bakır in

1988 and are currently continued by K. İren (İren 2010: 251; Bakır 2011: 17–19). The settlement reaches back to at least the eighth century BC (Bakır 2003: 1; 2004: 56; 2006; 2011: 35–36) and was a prominent centre already during the seventh and early sixth centuries BC.

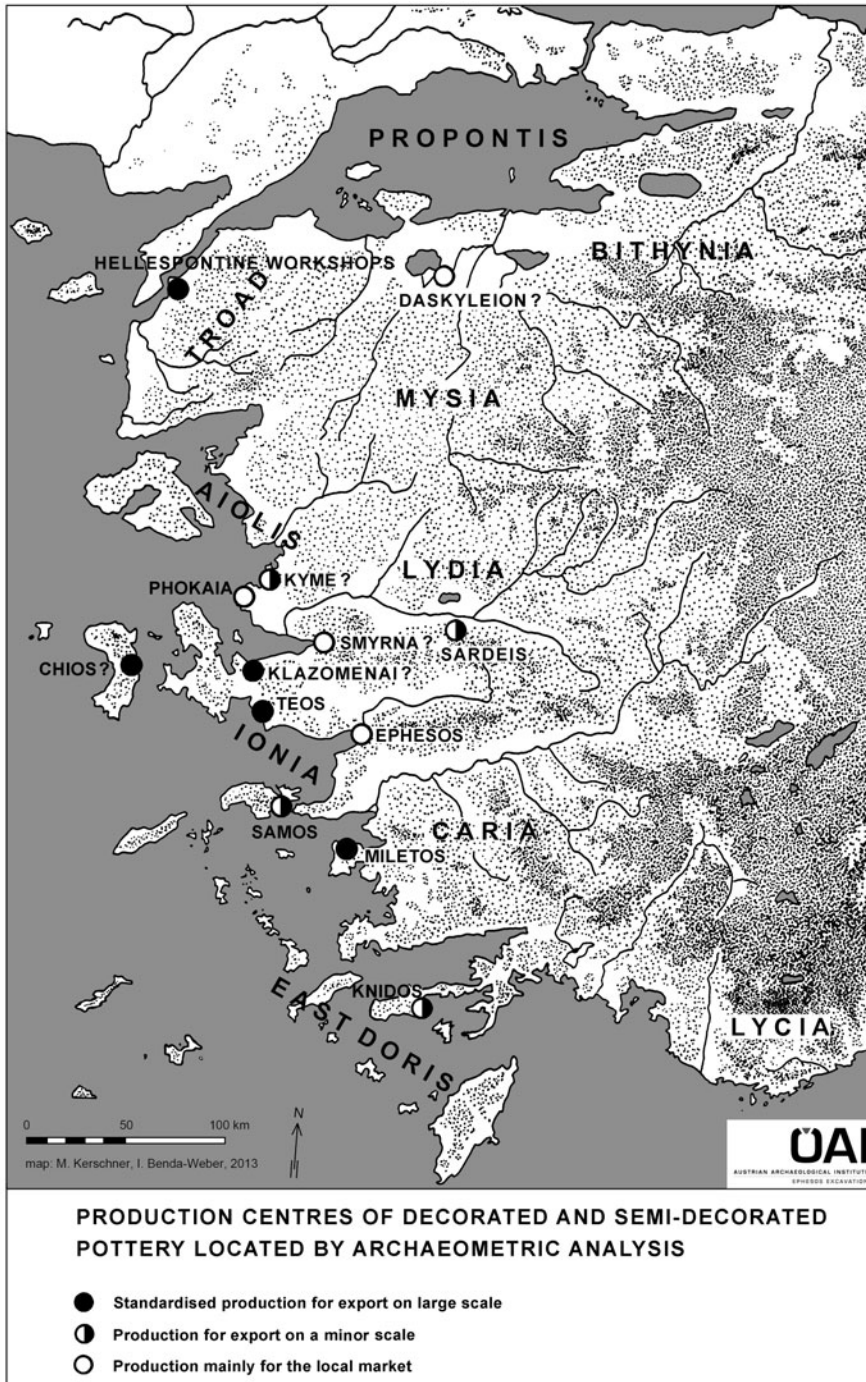


Fig. 1. Map of Asia Minor showing pottery production centres determined through archaeometric analysis.

Following the Persian conquest of western Anatolia in the third quarter of the sixth century, Daskyleion became the Persian satrapal capital of Hellespontine Phrygia (Hdt. 3.120, 126; 6.33; Thuc. 1.129. 1; see Bakır 1995: 274–79; 2001; 2003; 2011: 51–57; 2012; İren 2010). The royal residence of the satrap was famous for its spacious palace gardens (*paradeisos*) located nearby Lake Daskylitis (modern Manyas Gölü; Xen. *Hell.* 4.1.15). Daskyleion was a multicultural settlement, showing both Phrygian and Lydian elements since the seventh century BC. The aspects of Phrygian culture are especially evident on

Phrygian inscriptions and at a sanctuary of the Phrygian goddess Matar (Bakır 1997: 233; 2004: 59; 2011: 35–41; Ateşlier 2006: 132–45). The interrelations with Lydia (the main focus of this article) were manifold and intensified during the later part of the seventh and the early sixth centuries.

Lydian rule expanded over large parts of western and central Anatolia in the late seventh and especially the first half of the sixth century BC. The relationship between political power and changing styles of material culture is complex and has been extensively discussed for the

Roman (e.g., Woolf 2014) and Achaemenid (e.g., Khatchadourian 2016) empires. In the case of Lydia, political dominance influenced and stimulated the cultural interaction between the Lydians and their neighbours, although it was not the only or even the decisive factor. In fact, mutual influences in the material culture of Lydians, Ionians, Aeolians and Carians can be traced equally in periods of independence from the Lydian kingdom (Kerschner 2005: 129–41; 2010; Greaves 2010: 16–20).

Ceramics are a good way of seeing this process at work. Lydian styles of pottery spread over many areas of western and central Anatolia, be it as a consequence of intensified trade relations and/or because Lydian products became increasingly fashionable among their neighbours (Kistler 2012; Kerschner 2017: 106–07, fig. 12.9). The best-known examples come from Sardis, the capital of the Lydian kingdom. Lydian-style pottery has been found in a number of cultural regions of western Anatolia, including Caria, Propontis, Pisidia, Lycia and Phrygia, which are all located to the west of the Halys River (for the distribution of Lydian pottery see e.g., Gürtekin 1998: 2, n. 2–3, 133, n. 388, 211, n. 555; Gürtekin-Demir 2021: 120–23; Gürtekin-Demir forthcoming). In central Anatolia, Lydian-type pottery has also been found at sites located beyond what is thought to be Lydian territory, immediately to the east of the Halys River (e.g., Von Der Osten 1937: 32, fig. 53, 44, pl. 11). Lydian-type ceramics occur also in Greek cities and settlements in Ionia and Aiolis, especially those bordering on Greater Lydia (Kerschner 1997: 208–10, 219–23; 2005: 134–39; Paspalas 2009: 348–53; Kerschner 2010: 250–56; 2019; for the term Greater Lydia, see Roosevelt 2009).

It is unclear how we should interpret the wide distribution of Lydian pottery. Its export may be regarded as a source of economic income, which in this case, is not any different from other regional pottery classes. Whether the Lydian political power had any imposing role in the diffusion of Lydian pottery is difficult to answer, since ancient pottery trade is often unaffected by political developments (Gürtekin-Demir forthcoming). However, there is evidence that the production of Lydian pottery was not as centralised as once thought but was carried out at several different production centres.

Local production of Lydian-type pottery at the Greek cities of Smyrna and Ephesus was proven by NAA carried out by H. Mommsen (Kerschner 2005: 137, fig. 5; 2007: 233–35, pl. 33.1–2; 2010: 254–55, fig. 3; 2017: fig. 12.9; 2019: 379, 382–83). In the zone of intensified connectivity along the main routes between Sardis and the harbour cities on the East Aegean coast – Smyrna, Ephesus and presumably also Kyme – a hybrid East Greek-Lydian style developed, for which the term ‘Hermos Valley style’ has been proposed (Kerschner 2017: 111–12; 2019: 386–93). Furthermore, macroscopic studies of Lydian-type pottery

from central Lydia, northern Caria (Tabae), Daskyleion and Gordion call attention to the multiple regional production centres (Gürtekin-Demir 2002; 2007; 2021; forthcoming; Gürtekin-Demir, Polat 2015). Until recently, only a few examples of Lydian-style pottery from beyond central Lydia have been scientifically analysed: at Gordion (Gürtekin-Demir 2021: 6–7; Kealhofer et al. forthcoming), Ephesus (Kerschner 2005; 2007), Smyrna (Kerschner 2005: 137; Dupont, Lungu 2020: 122–26) and Kelainai (Dupont, Lungu 2020: 112–16). The analysed samples from these sites are quite few, except for the Gordion samples, which are close in number to the Daskyleion samples presented here.

In this respect, this study of Lydian pottery samples at Daskyleion has a significant contribution to make. It reveals important evidence for both Sardian imports and also distinct regional provenance groups.

Relations between Daskyleion and Lydia according to the literary evidence

We have some idea about relations between Daskyleion and Lydia from ancient Greek and Roman literary texts. However, as these were all written significantly later than the events they describe, and from an external (that is, non-Lydian or Daskyleion) viewpoint, their accounts must be treated with caution. Herodotus (1.28, 1.74) states that the Lydian kingdom controlled nearly all regions to the west of the Halys River by the first half of the sixth century. Croesus, the last king of the Mermnad dynasty, even imposed tribute upon the Greek poleis along the coast (Hdt. 1.6, 3.89). It seems likely that Daskyleion had already come under Lydian dominance by the seventh century BC (Bakır 2011: 47, 49).

The early Roman historian Nikolaos of Damascus mentions the relations between Daskyleion and the Lydian kingdom during the Heraclid dynasty in Lydia in the Lydian section of his ‘universal history’ (*Brill’s New Jacoby (BNJ)* 90 F44a-F47). This narrative account deals with events that allegedly took place in the Early Iron Age, a period for which Nikolaos had no contemporary sources. Therefore, its historic authenticity has to be critically scrutinised (Roosevelt 2012: 899–900). The name of the city, Daskyleion, is evidently derived from the personal name, Daskylos. According to Nikolaos, Daskylos was the grandfather of King Gyges and a Lydian nobleman of the Mermnad family. He relates further that Daskylos was murdered by Adyattes II, son of Lydian King Ardys I, for fear that he would usurp the kingdom. Daskylos’ wife, who was pregnant at the time (with a son also to be named Daskylos), fled to her native Phrygia (Hellas Pontine Phrygia). Daskylos II grew up in exile and got married. His son, Gyges, was born in Pontus and was sent to Lydia when he was 18 to live with his uncle at Sardis. These events are alleged to have taken place some time during the late eighth or the early seventh centuries. It has been suggested that

Daskyleion was previously called Aphneum, and hence the original name of the nearby Lake Daskylitis (modern Manyas Gölü) was Aphnitis Limne (İren 2010: 250).

Hipponax of Ephesus implies another possible connection between Lydia and Daskyleion. The Ionian iambic poet lived at Ephesus in the mid-sixth century BCE and was a contemporary of Croesus (Masson 1962; Hawkins 2013; Dale 2018). His account is therefore more reliable than that of Nikolaos of Damascus, who referred to events which (allegedly) occurred about seven centuries before his own lifetime. Lydians were widely famous for an unguent which may have been *baccaris* and was possibly stored in a container called a lydion. Hipponax mentions the word *baccaris* in the same phrase as Daskyleion and Croesus (Fragment 104 [West]; Greenewalt 1973: 120, n. 33). This fragment is, however, small and incomplete, so that the meaning is unclear. The relevant initial lines demonstrate that *baccaris* was applied to the nostrils just like Croesus did, and the next line includes the site name Daskyleion. J. G. Pedley suggested that this may point to the quality of the *baccaris* at Daskyleion during Croesus' time (Pedley 1972: 43–44, no. 131). However, recent analysis of the fragment by A. Dale indicates that *baccaris* may have been used to mask the smell of female genitals, to judge by other ancient sources and the fact that the word 'Daskyleion' in the next line was likely a pun on the word *daskios*, meaning 'densely-shaded, bushy' (Dale 2018: 10, n. 13).

The evidence of the literary texts, as fragmentary and as unreliable as it may be, points to some level of ideological engagement and economic interaction between the people of Sardis and of Daskyleion, as well as political control. This is supported by the archaeological evidence, which shows a strong impact of Lydian culture. For example, the presence of Lydian inscriptions (Bakır, Gusmani 1993; see also van Beelen 2012) suggests that Lydian-speaking people may have lived at Daskyleion, where the community also included other residents who spoke Phrygian and perhaps other local languages. This impression is heightened by the presence of Lydian graffiti. Due to constraints of space, a full discussion of the archaeological evidence is not presented here, but of course one of the key forms of archaeological evidence for Lydian cultural influence at Daskyleion is the presence of Lydian pottery – the focus of this article.

Lydian pottery: a short overview of typological, stylistic and technical aspects

Lydian pottery has hitherto been studied mainly at Sardis, where by far the largest quantity of it has been excavated. For that reason, the chronotypology of Lydian wares and decoration conventions is best known from the capital of the Lydian kingdom. The evidence from Sardis allows us to establish the general characteristics of styles, painting techniques, decorative elements, decoration schemes,

shapes and chronology of the pottery and fabrics produced in the Lydian heartland (Greenewalt 1966; 1971; 1973; 2010a; 2010b; Gürtekin 1998; Gürtekin-Demir 2007: 48–49; 2011; Kerschner 2019: 364–75; Ramage et al. 2021). Among the most distinctive aspects of Lydian pottery are painting conventions such as marbling and streaky-glaze, and distinctive forms such as the so-called lydion. The classification of wares and styles that has been developed at Sardis can also be applied to the Lydian-type pottery from Daskyleion (Gürtekin-Demir 2002; 2007).

Painted Lydian pottery at Sardis dates to at least as early as the ninth century, and pottery in the Lydian tradition continued to be made into the Hellenistic period (although in later periods it was restricted to fewer forms such as oinochoe, wave-line amphora/hydria and column-krater; and a smaller range of painting styles: Rotroff, Oliver 2003: 60–66). Up to now, chemical analyses have proven local pottery production at Sardis from the Archaic into the Late Roman period (Cahill 2021), but it is very likely that it goes back further.

In terms of shape, many Lydian pottery shapes adopt models from the Greek repertoire, but influence in the opposite direction is also traceable; for example, stemmed dishes, which occur much earlier in Sardis than in Ionia. The earliest traces of stemmed dishes at Sardis are to a large extent painted in black-on-red, bichrome and red/brown on creamy white; they are attested in levels associated with Lydian IV (ninth to mid-eighth century) and III (late eighth century) (Gürtekin-Demir 2021: 29; Ramage et al. 2021: HoB 278, PC 26–27; HoB 325–326, HoB 374–375). Amphora and hydria are the most common storage vessels. The dinos was used but not as frequently as the column krater, which becomes common in the sixth century BC. Medium-sized vessels include the lekythos, oinochoe and skyphos-krater; small vessels include bowls with a ring base, stemmed dishes and skyphoi. The Greek forms kantharos and phiale are less common. Phrygian forms include the one-handled jug, sieve-spouted jug and ceramic imitations of Phrygian metal bowls (Gürtekin-Demir 2014).

The most famous Lydian vessel shape is the lydion which was primarily favoured for its content: precious unguents (Greenewalt 1966: 1–119; 2010b; Gürtekin-Demir 2021: 46–53). The shape was popular not only in Anatolia but also overseas, and it was locally produced in and out of Anatolia (for example, Ionia, mainland Greece and Italy) during the sixth and fifth centuries. There are various sizes of this shape. Lydions were found both in domestic contexts and in graves as burial offerings. The regional local productions in Asia Minor have distinct fabrics and surface treatments; however, they follow the decorative conventions of lydions at Sardis, such as streaky, fluted, marbling and banded.

In terms of decoration, streaky-glazed and marbled pottery were popular in the sixth and fifth centuries and

are particularly characteristic of Lydian pottery. The bichrome and black-on-red painting techniques are not exclusively Lydian but can be traced at various Aegean and Mediterranean potters' centres in the first half of the first millennium BC, with regional variations. Yet early versions of distinctive Lydian bichrome and Lydian black-on-red at Sardis date back to the ninth and eighth centuries, and continue into the seventh century (Gürtekin-Demir 2011; 2021: 9–12, 26–27; Ramage et al. 2021: 11–16). The Lydian black-on-red continued into the sixth century; however, the traditional bichrome seems to have fallen out of fashion by the early sixth century. There are three major colours preferred for painting: bright red-to-brown, iron-oxide slip, similar to Greek slips; a matt dark paint; and white (Greenewalt 1970: 58, 60–61; Ramage et al. 2021). White is often used as a slip or a coat for the backgrounds of decoration and occasionally on transitional bands, whereas red is also used as a background colour for decoration in black in the black-on-red technique.

The painting techniques and styles may be classified into three basic groups:

1. Conventional techniques related to the broader Anatolian *koine* (black-on-red and bichrome), the peculiarly Lydian versions of which favour certain slip colours and forms of geometric decoration (Gürtekin-Demir 2014: 233–34)
2. Uniquely Lydian innovations (streaky glazed and marbled). Marbled and streaky-glazed pottery may be counted among the most popular local Lydian conventions
3. Local styles inspired by archaic Greek pottery; for example, imitations of late Protocorinthian linear kotyle, imitations of cups with everted rim (so-called Ionian cups), Sardis wild goat style, so-called early Fikellura, waveline amphoras/hydriae, and the so-called Ephesian and Ephesianising wares (Greenewalt 1966; 1970; 1971; 1973; 2010a; 2010b; Kerschner 1997: 132–35, 219–23; Gürtekin-Demir 2002; 2007; 2011; 2013; 2014; 2021; Ramage et al. 2021).

A further note is needed on the so-called Ephesian and Ephesianising wares mentioned under point 3 above. The so-called Ephesianising ware stylistically imitated the so-called Ephesian Ware group of pottery (Greenewalt 1973: 114; Kerschner 1997: 132–35; 219–23; Gürtekin-Demir 2002: 115–19). Identified at Sardis, Ephesus, Miletus, Güre, Metropolis and Daskyleion, Ephesian Ware features floral decorations and animal friezes reminiscent of Greek Orientalizing styles, and linear patterns similar to those practised in the black-on-red and bichrome paintings. It is notable for its delicate, precise drawings and its thick, glossy, fine white slip and bright red and matte dark paints.

It represents a blend of Greek Orientalizing and Anatolian Iron Age decoration. Greenewalt suggested that it was produced in Lydia between the mid-seventh and mid-sixth centuries BC (Greenewalt 1973: 119–20; cf. Kerschner 1997: 219–23). Ephesianising ware imitates the painting technique and the decorative system of the Ephesian ware but lacks the same level of precision, and lacks animal friezes or floral decoration (Gürtekin-Demir 2002: 115). The slip of Ephesianising ware is often faded or not well preserved, whereas the slip of the Ephesian Ware frequently adheres strongly to the surface of the clay.

In terms of fabric, the fabric of most Lydian pottery at Sardis is red to orange in colour. It is often soft and flaky with a considerable amount of mica. Other macroscopically visible inclusions look to be tiny flecks of stones. The variability in the inclusions of the fabric points to different methods of clay preparation (like levigating and deliberate addition of temper) and/or different local clay sources. Clay with inclusions is more common with bichrome, black-on-red, marbling and streaky-glazed wares, whereas pottery with figural decoration and other very fine products (such as Orientalizing 'Sardis Style', so-called Early Fikellura, Ephesian Ware and some delicate marbling and streaky-glazed examples) frequently has a hard-fired, fine fabric with only a small amount of mica or even no mica at all (Ramage et al. 2021: 11, n. 44).

Aim and methodology

Lydian-type painted pottery discovered at Daskyleion is dated between the late seventh and fifth centuries BC (Gürtekin-Demir 2002; 2007). With regard to its fabric, the majority of it (ca 85%) is macroscopically similar to contemporaneous pottery found at Sardis. These presumed imports from Sardis include bichrome, marbled, streaky-glazed, banded and perhaps the so-called early Fikellura and Ephesian wares.

This interdisciplinary study investigates the actual provenance of individual wares of Lydian pottery excavated at Daskyleion in order to differentiate the imports from Sardis and the local or regional products of Lydian-style pottery. The former reveal commercial relations between the Lydian capital and Daskyleion, and the latter demonstrate a Lydian cultural impact on a wider scale in western Anatolia. Daskyleion is an eminently suitable centre for such a study because it was not only an important city within the periphery of the Lydian kingdom but also a place with its own multicultural character that merged Lydian, Phrygian and local elements. Previous evaluation of macroscopic aspects of painting techniques, glazes and fabrics of Lydian painted pottery from Daskyleion, as well as from Sardis and Gordion, has flagged that there was more than one production centre for Lydian-style pottery (Gürtekin-Demir 2002; 2007; 2021).

Our investigation was carried out in two stages. First the relevant pottery was studied macroscopically. Several wares were distinguished according to surface treatment, decoration conventions and fabric (Gürtekin-Demir 2002). Following this, a representative number of samples was selected from each ware to be scientifically analysed by neutron activation (NAA). This method has been in use for ceramic samples in the Bonn archaeometry group since the mid-1980s and is a modified version of the measurement procedures of the Berkeley archaeometry laboratory (Perlman, Asaro 1969). It is described at length in Mommsen et al. 1991. Up to 30 trace and minor elements, if present above detection limits, can be determined to characterise the elemental concentration profile of a pottery sample of ca 80 mg, usually taken by drilling with a clean corundum drill bit. The samples were irradiated at the research reactor of the GKSS at Geesthacht, Germany, and subsequently transported to Bonn for the measurements. The Bonn pottery standard calibrated with the Berkeley pottery standard was used. The data evaluation and the search for groups of pottery samples of the same composition was done with the statistical filter method developed at Bonn (Beier, Mommsen 1994).

The aim of this archaeometric analysis is to test how well the abovementioned archaeological criteria can be used to distinguish locally and regionally produced Lydian pottery from imports of the metropolitan workshops in Sardis. If macroscopic criteria achieve a high hit rate, they can be safely applied to classify large amounts of pottery, as the application of archaeometric analyses is usually limited by logistical and financial constraints. We further explore for which of the macroscopically defined wares high hit rates can be achieved.

Unfortunately, no potter's workshop or artefacts connected with ceramic production (like kiln wasters) have been discovered at Daskyleion. Therefore, our sample selection does not include primary artefacts that define the local elemental pattern of the site. Local production cannot yet be proved since we lack such reference materials. It will, however, be argued which non-Sardian provenance group/s was/were likely to have been produced at Daskyleion or in its vicinity on the basis of the frequency of the provenance groups amongst the samples.

Analysing Lydian pottery at Daskyleion: sample choice

The sample set analysed by neutron activation at Bonn comprises 31 ceramic fragments (labelled Dask 8–38: figs 3–9, see catalogue) excavated at Daskyleion under the direction of Bakır. These samples were selected out of ca 200 pieces of Lydian-type pottery found before 2005. The sample choice includes a representative set of pieces of the Lydian decoration conventions such as red and white bichrome, streaky glazed, marbled, banded and Ephesian-

ising ware. The majority of the pieces selected had features or surface treatments that were in some respect visually different from those of Sardis fabrics, since the principal goal was to determine regional products from outside Sardis. These included banded lydions (nos. 14, 15); streaky glazed skyphoi (nos. 16, 17, 23); marbled closed vessel fragments (nos. 18, 26), open vessel fragment (no. 27) and lydions (nos. 20–22); red bichrome one-handled jug (no. 28); and Ephesianising ware (nos. 10–13, 29–31). Samples which were macroscopically close to Sardian fabrics included a marbled open vessel (no. 24), a krater (no. 25) and a closed vessel (no. 7); streaky glazed skyphoi (nos. 3, 6); red bichrome closed vessels/amphorae (nos. 1, 4, 5) and dish (no. 9); white bichrome closed vessels (nos. 8, 19); and a fluted lydion (no. 2).

Results of the NAA: imports from Sardis and local/regional productions

The raw NAA concentration data are presented online for access and download at mommsen.hiskp.uni-bonn.de. They were evaluated by the Bonn statistical filter procedure (Beier, Mommsen 1994), and six different provenance groups could be formed (SarP, SarQ, UI80 – UI83, UI = unlocated group). They are clearly distinguishable, as the result of a Discriminant Analysis shown in fig. 2 demonstrates. The average elemental concentration patterns of these groups are given in table 1.

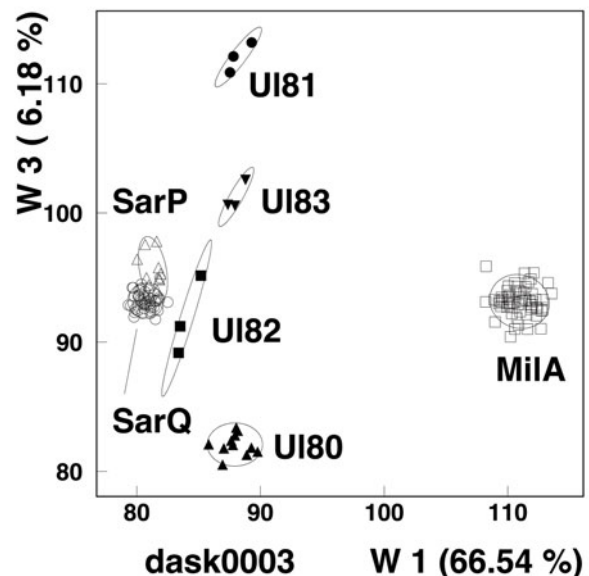


Fig. 2. Result of a discriminant analysis of 141 samples, corrected for dilution, assuming seven clusters. Plotted are the discriminant functions $W1$ and $W3$ which cover 67% and 6% of the between group variance. The ellipses drawn are the 2σ boundaries of the groups. The groups are well separated, only groups SarP and SarQ from Sardis are close in composition.

	SarP		SarQ		UI80		UI81		UI82		UI83	
	10 samples		49 samples		11 samples		3 samples		3 samples		3 samples	
	M	$\sigma(\%)$	M	$\sigma(\%)$	M	$\sigma(\%)$	M	$\sigma(\%)$	M	$\sigma(\%)$	M	$\sigma(\%)$
As	37.5	(55.)	32.1	(45.)	30.9	(24.)	97.5	(42.)	73.8	(38.)	177.	(61.)
Ba	855.	(14.)	835.	(9.2)	768.	(18.)	818.	(42.)	848.	(6.4)	954.	(34.)
Ca%	2.83	(11.)	2.79	(22.)	1.29	(21.)	6.40	(17.)	6.18	(24.)	8.48	(12.)
Ce	98.6	(2.4)	102.	(3.5)	97.6	(5.4)	71.5	(4.7)	77.3	(5.0)	75.8	(2.8)
Co	28.3	(2.5)	26.1	(4.1)	18.4	(5.7)	40.9	(13.)	28.4	(8.2)	35.1	(3.1)
Cr	151.	(3.6)	148.	(5.4)	117.	(3.8)	553.	(5.3)	328.	(15.)	426.	(2.6)
Cs	31.6	(25.)	22.9	(20.)	13.6	(8.6)	27.2	(1.7)	19.5	(1.9)	25.9	(9.2)
Eu	1.77	(1.8)	1.81	(2.2)	1.44	(3.7)	1.21	(9.3)	1.31	(3.8)	1.35	(2.8)
Fe%	7.49	(5.8)	6.58	(5.6)	4.64	(3.6)	6.16	(3.3)	5.05	(4.3)	5.39	(1.8)
Ga	36.8	(6.6)	32.2	(15.)	28.7	(12.)	40.9	(58.)	34.2	(63.)	21.1	(14.)
Hf	4.60	(14.)	5.84	(13.)	6.24	(11.)	3.90	(3.9)	4.96	(7.9)	4.25	(4.4)
K%	3.49	(6.1)	3.34	(3.9)	3.39	(5.1)	3.31	(4.3)	2.93	(1.9)	2.74	(1.5)
La	45.4	(2.3)	46.6	(2.6)	42.9	(3.8)	34.2	(8.5)	36.9	(4.2)	36.8	(3.1)
Lu	0.59	(3.4)	0.59	(4.3)	0.54	(5.6)	0.40	(5.4)	0.46	(4.1)	0.43	(5.1)
Na%	1.01	(18.)	1.19	(15.)	1.34	(11.)	0.57	(16.)	0.92	(2.6)	0.70	(6.8)
Nd	40.6	(6.6)	42.1	(4.4)	35.1	(4.8)	27.3	(8.7)	30.1	(4.5)	31.0	(3.8)
Ni	164.	(26.)	112.	(30.)	86.5	(38.)	559.	(3.6)	291.	(5.4)	454.	(17.)
Rb	184.	(2.9)	165.	(4.0)	212.	(2.9)	164.	(6.3)	175.	(5.7)	172.	(1.8)
Sb	7.85	(26.)	5.35	(16.)	2.86	(12.)	6.97	(20.)	4.52	(3.3)	5.77	(5.1)
Sc	25.7	(3.8)	23.5	(3.3)	16.2	(3.4)	21.6	(2.1)	18.0	(3.1)	19.2	(1.2)
Sm	7.81	(9.3)	8.10	(4.0)	7.08	(3.6)	5.33	(8.7)	5.87	(1.8)	5.93	(2.8)
Ta	0.90	(6.7)	0.99	(5.0)	1.20	(2.4)	0.83	(5.7)	0.92	(4.1)	0.82	(5.7)
Tb	1.06	(5.8)	1.11	(6.0)	1.05	(5.7)	0.68	(7.2)	0.84	(5.8)	0.85	(6.2)
Th	15.2	(3.9)	15.3	(2.7)	18.1	(2.1)	15.9	(7.0)	15.2	(1.8)	15.2	(1.6)
U	2.64	(8.9)	3.01	(11.)	2.09	(8.0)	2.80	(24.)	2.60	(5.3)	3.44	(17.)
W	2.97	(21.)	2.71	(11.)	4.34	(8.3)	3.05	(27.)	3.69	(5.1)	3.21	(11.)
Yb	3.73	(3.0)	3.85	(4.2)	3.74	(6.2)	2.35	(2.7)	2.95	(4.1)	2.84	(2.3)
Zn	145.	(6.3)	130.	(4.9)	91.6	(5.2)	95.3	(10.)	96.8	(15.)	99.2	(11.)
Zr	121.	(44.)	188.	(34.)	154.	(29.)	90.9	(76.)	119.	(98.)	--	

Table 1. Average elemental concentration values M in $\mu\text{g/g}$ (ppm), if not indicated otherwise, of groups of samples from Sardis and Daskyleion. σ is the standard deviation (root mean square deviation) in %. The individual samples have been corrected with a best relative factor with respect to the grouping values.

Sardian imports

Among the 31 samples of Lydian type pottery from Daskyleion analysed here, two samples – a fragment of a closed vessel of red bichrome ware (Dask 21, no. 1) and a fluted lydion, painted with alternate colours in red and white (Dask 26, no. 2) – show the distinctive elemental profile SarP, attributed to Sardis. Three samples – a streaky-glazed Lydian skyphos (Dask 12, no. 3) and two closed vessels of red bichrome ware (Dask 20, no. 4; Dask 22, no. 5) – belong to the provenance group SarQ, which is the second dominant compositional group for Lydian pottery from Sardis. Thus, these five

samples are imports from Sardis at Daskyleion. The provenance group SarP can be located at Sardis with certainty, as it comprises a kiln waster: a fragment of a misfired Hellenistic hemispherical mouldmade relief bowl (inv. P98.94:10916, sample no. Sard 57, cf. Rotroff, Oliver 2003: 95, 113–14, cat. no. 461, pl. 79). It will be fully discussed, together with the second Sardian provenance group SarQ, in a separate publication by the present authors together with N. Cahill. SarQ was preliminarily published in Kerschner 2005: 135–39, fig. 4, and Kerschner, Mommsen 2009: 92 with fig. 1. SarP and SarQ are the two dominant chemical groups in a NAA of

77 samples from Sardis measured at Bonn. They cover nearly 60% of this sample set. These elemental profiles are very similar, differing only by lower values for Rb, Fe and Sc in the SarQ pattern. Local production frequently contains two or even more local element profiles where ancient potters used different clay sources and/or different mixtures and ways of preparation (for example, Miletus, Ephesus) (Akurgal et al. 2002: 37–50; Kerschner et al. 2002).

Unlocated provenance groups

Among the remaining samples, four distinct element profiles – U180, U181, U182 and U183 (UI = unlocated) – could be formed but are not otherwise represented in the ca 12,500 NAA samples of the Bonn NAA database of the central and eastern Mediterranean. These patterns have so far occurred only at Daskyleion. They may have been produced at Daskyleion itself, but it is equally possible that they were produced at another site and imported to Daskyleion. Due to this uncertainty, these groups are designated ‘UI’. It is likely that one or more of these still unlocated element profiles represent(s) the local ceramic production at Daskyleion. This applies in particular to U180, which occurs most frequently among the Lydian-type pottery found at the site. However, in the absence of unequivocal reference samples (like kiln wasters or vessels from the original fill of a potter’s kiln), this hypothesis cannot be evaluated for the time being. These groups must have been produced at pottery centres other than Sardis within the sphere of Lydian culture, given they are Lydian-style ceramics. To locate these provenance groups, further NAA of reference material from other potential production centres will be necessary. In view of this, we will assume that the members of these ‘UI’ groups are non-Sardian products, as their element patterns are distinct from the Sardian provenance groups SarQ and SarP.

Outliers and additional material

Nine of our samples from Daskyleion were compositional singletons and have no match within the Bonn database. In most cases, such compositional outliers are likely to be members of still unrecognised provenance groups. Or they might even be members of the Sardis groups with an ancient or modern contamination. Archaeometrically, nothing can be concluded from these results.

To these 31 samples analysed for this article, we can add the evidence from NAA previously conducted on seven samples of pottery from the excavations of E. Akurgal at Daskyleion in 1956/57. Four of them were published in Akurgal et al. 2002: 111–12, nos. 81–83, 85, figs 51–54, pl. 8 under the label ‘Smyr[na]’, since the

fragments were stored in the excavation house of Bayraklı/Izmir. Later we changed the label to ‘Dask[y]leion’ for the excavation site (Smyr 17, 18, 19, 20, renamed Dask 1, 2, 3, 4).

- Two samples showed the Milesian provenance group MilA (Akurgal et al. 2002: 37–46, fig. 3; Kerschner, Mommsen 2009: 83, 92, fig. 1). Both were examples of Milesian wild goat style of the phases Milesian Archaic Ic–Id (Kerschner, Schlotzhauer 2005: 25–45): one is a shoulder fragment of an oinochoe (Dask 1) with a row of geese to the right (Akurgal et al. 2002: 39–40, 111 no. 81, fig. 51, pl. 8), the other is a lid (Dask 3), showing an equestrian in the central tondo surrounded by an animal frieze (Akurgal et al. 2002: 39–40, 111–12, no. 82, fig. 52, pl. 8). Two unpublished samples – Dask 5 and 6 – are also members of MilA.

- Dask 4, a rim fragment of a dish with meander band on the interior (Akurgal et al. 2002: 112 no. 83, fig. 54, pl. 8), represents a type frequently attested at Daskyleion (Gürtekin–Demir, personal observation). It is a member of provenance group U182 (which was as yet unknown in Akurgal et al. 2002: 112, when this fragment was still a chemical singleton).

- Dask 2 is a fragment of a Lydian-type oinochoe decorated with small concentric three-quarter circles arranged to form a scale pattern (Akurgal et al. 2002: 112 no. 85, fig. 53, pl. 8). The sample has close parallels at Sardis (Dupont, Lungu 2020: 124–26, fig. 21) and Gordion (Gürtekin–Demir 2021: no. 20), as well as with another fragment from Daskyleion studied here (no. 19). Dask 2 belongs to provenance group U181.

- Dask 7, an unpublished fragment of a banded bowl belongs to the provenance group U180.

Comparative data sets for the unlocated provenance groups

As stated above, two of the provenance groups identified in the Lydian pottery of Daskyleion are consistent with previously known provenance groups produced at Sardis and therefore indicate Sardian imports (SarP and SarQ). It remains to identify the other four provenance groups (U180, U181, U182 and U183) and to consider whether each of these represents a single workshop or a range of production sites.

Recent research on the provenance groups of material from the Marmara basin (Luke et al. 2015) has the potential to shed light on this. Unfortunately, however, the groups given in Luke et al. 2015 are formed with the raw data not correcting for possible shifts and have such large spreads (coefficients of variation) that we can state they do not point to a single production workshop, presumably not even to a single production region. Since the raw data of samples in Luke et al. 2015 are not given, a statistical re-evaluation to form proper provenance groups is not possible.

Comparative data is also available from recent analysis of Sardinian material (Kealhofer et al. 2013). But again, according to our experience and today's knowledge, the concentration patterns of the pottery groups presented have very large spreads and do not represent a certain paste used in a specific pottery workshop. Thankfully, the authors published the raw data at opencontext.org/projects/cbd24bbb-c6fc-44ed-bd67-6f844f120ad5 with the list of samples including photographs and a link to the csv file for download (opencontext.org/tables/e653f4f9-78a6-40c8-9d85-2a62bd4f48db). A coarse re-evaluation of these NAA data with the Bonn statistical filter method results in the formation of more than ten groups with acceptably low spreads. Assuming the data can be compared without an interlaboratory calibration to the Bonn data (there are samples measured in both laboratories), groups similar to the Bonn Sardis groups SarP and SarQ, but also groups of imported vessels from, for example, Euboea or the Aiolis and other sites with known patterns in Bonn can be found in this 'Pactolus Macrogroup'. This demonstrates that the group-forming procedures should utilise the high precision of the NAA method to distinguish between different group patterns with nearly similar composition and not discuss macrogroups with unusually high spreads of concentrations. It is satisfying that members of our groups SarP and SarQ are detected in these datasets. But the smaller Bonn groups UI80–83 are not represented there.

Another potential source of comparative data comes from XRF studies. P. Dupont and V. Lungu recently published XRF analyses of Lydian and related pottery from Sardis, Daskyleion, Kelainai and Gordion, as well as from a few Greek sites in Ionia and the Black Sea area (Dupont, Lungu 2020). This included 13 samples from Daskyleion (Dupont, Lungu 2020: 114, 118, 136, 140, nos. Pro 2–14, fig. 7) which come from the private collection of the late J. J. Jully (Dupont, Lungu 2020: 113 with n. 5), who had presumably collected stray finds during a visit at the site. Ten of these samples are classified as 'undifferentiated common ware'; the remainder are 'one fragment of fine Ephesian ware and two others decorated in the Wild Goat style'. Only the sample of Ephesian ware is illustrated (Dupont, Lungu 2020: fig. 7). Dupont and Lungu use these samples as reference material for Daskyleion, although each of them could be imported to the site. None of these fragments are primary reference material for a local ceramic production. Nevertheless, Dupont and Lungu (2020: 134–36) interpret 'the predominant homogenous chemical group of Daskyleion consisting of common pottery' as an elemental fingerprint of the local pottery production and, in addition, they tentatively hypothesise that Ephesian ware might have 'origi-

nated ... from that somewhat provincial city, at least from the Hellespontus/Propontis area'. There is no evidence for this hypothesis. Furthermore, the scientific data are not transparently presented, so that they can neither be verified nor compared with our own chemical groups. Dupont and Lungu (2020: 114 fig. A) present an unreadable dendrogram, which does not show what samples belong to which group, and they do not give the average concentration patterns of their proposed groups. Because they have no suitable reference material, their attributions to production sites are not proven but are, rather, archaeological assumptions. The XRF Data are recorded, but without the experimental uncertainties or an address for download.

Deciphering Lydian painted pottery samples of Daskyleion

Unfortunately, the comparative data sets discussed above do not help us to fix a geographic origin for any of the four unlocated element profiles that we identified in the NAA analysis. Instead, a closer analysis of these element profiles, undertaken alongside a macroscopic analysis of the sherds and wares, does offer some suggestions. An overview of the different ware types and their NAA grouping is shown in table 2. A discussion of each ware type is set out below.

Red bichrome (three Sardinian; two unlocated)

In the group of Lydian red bichrome pottery are three closed vessel fragments that probably belong to amphorae or oinochoai and are decorated with rows of pendent concentric semicircles or hooks. This typical decorative scheme is consistent in the closed vessels at Sardis and elsewhere where Lydian pottery is reported (Gürtekin-Demir 2021: 12, 16–17). It is common during the seventh and early sixth centuries. Nos. 1, 4, 5 (closed vessels) are all Sardinian products in terms of both their style and their element pattern. The case is different with no. 9: here, the fabric and decoration (red bichrome carinated dish) suggest a Sardinian product, whereas the chemical composition revealed membership of a group of still unknown, probably non-Sardinian origin (UI80). Close parallels of this Lydian red bichrome carinated dish are common at Sardis (e.g., Gürtekin 1998: 140, 157, pl. 20, no. 63; Ramage et al. 2021: HoB 442, 515, 546, 741). Similar Lydian red bichrome examples have been excavated at Gordion (Gürtekin-Demir 2021: nos. 1–2) and Thyateria (Akdeniz, Eron 2017: 89, fig. 9). The elemental profile of the red bichrome one-handled jug (no. 28) that macroscopically shows a non-Sardinian fabric is not a member of groups SarP or SarQ but a singleton with a pattern that is not found at Sardis; therefore, this might suggest a regional product of a yet-unknown workshop.

Archaeological classification	NAA elemental concentration groups							
	Local Sardis		Unknown provenance, Sardis possible					Totals
	SarP	SarQ	U180	U181	U182	U183	Singles	
White bichrome			8		19			2
Red bichrome	1	4, 5	9				28	5
Fluted with alternate colors red and white	2							1
Streaky glazed		3	6	16, 17			23	5
Marbled			7		18	20, 21, 22	24, 25, 26, 27	9
Ephesianising			10, 11, 12, 13				29, 30, 31	7
Banded			14, 15					2
Total	2	3	10	2	2	3	9	31

Table 2. Overview of archaeological groups compared to the Bonn NAA results of the samples from Daskyleion. Given are the cat. nos.

White bichrome (two unlocated)

Lydian white bichrome samples included an amphora (no. 8) and a closed vessel fragment (no. 19), both of which are close to Sardian fabric and are stylistically similar to the white bichrome pottery at Sardis. However, chemical analysis revealed that no. 8 belongs to group U180 and no. 19 to U182. Thus, Lydian white bichrome pottery was probably also regionally produced with at least two distinct clay compositions.

Streaky glazed (one Sardian; four unlocated)

The samples that are compositionally consistent with imports from Sardis included a streaky-glazed skyphos with additional white bands (provenance group SarQ, no. 3). Some of the streaky-glazed skyphoi at Daskyleion have glossy paint with a metallic sheen similar to Sardian products. Two (nos. 3, 6) out of five streaky-glazed pottery pieces look macroscopically Sardian, but only no. 3 was assigned to SarQ; no. 6 belongs to U180. The rest of the streaky-glazed fragments (nos. 16, 17, 23) were identified as non-Sardian elemental groups (U181, U181 and singleton respectively).

Fluted (one Sardian)

A shoulder fragment of a lydion from Daskyleion with bright red and white colours applied on horizontal flutes (provenance group SarP, no. 2) is comparable to the horizontally fluted lydions found at Sardis (Metropolitan Museum Inv. no. 26.199.204; Bilgin et al. 1996: 216–17, fig. 13a [Bintepe Tumulus area], Gordion (Gürtekin-Demir 2021: pl. 56, no. 46) and Kibyrtis (Corsten, Hülten 2012: 77–78, no. 7), and in ‘Tomba de Vasi Greci’ from Caere (Greenewalt 2010b: 203). The deep

horizontal flutes painted with alternate red and white colours are commonly combined with marbling decoration and are mainly preferred on large lydions rather than smaller, standard-size versions.

Marbled (nine unlocated)

None of the marbled fragments identified by their painting styles and fabrics as Sardian belonged to local Sardian groups (SarQ, SarP): no. 7 was identified as U180, and nos. 24 and 25 are singletons. The non-Sardian marbled pottery also falls into non-Sardian elemental groups: no. 18 is assigned to U182, nos. 20–22 to U183 and nos. 26 and 27 to singletons.

Ephesianising (seven unlocated)

A total of seven Ephesianising pottery pieces that seemed to be non-Sardian products were sampled (nos. 10–13, 29–31), and all of them turned out to belong to unlocated provenance groups. Four of them (nos. 10–13) are from U180, and the other three sherds are singles.

Briefly put, the macroscopic difference between Sardian products and those from unknown locations outside Sardis is as follows:

Decoration. The majority of non-Sardian pottery (provenance groups U180–83 and singletons) is decorated with matte paints and fabrics that distinguish them from Sardis production. Furthermore, the non-Sardian pottery of provenance groups U181–83 and singletons were coarsely decorated with marbling and streaky glaze. However, the two bichrome examples similar to Sardis examples were compositionally identified as non-Sardian provenance group U180 (nos. 8–9).

Macroscopic fabric analysis. The non-Sardian fabrics from as-yet unknown locations may be macroscopically divided into two groups: a) non-Sardian Type 1: fine, hard-fired, non-micaceous and porous, and frequently includes tiny flecks of limestone and grit (this fabric group is commonly decorated with marbling and streaky glaze); b) non-Sardian Type 2: a highly micaceous fabric common to Ephesianising ware and including some of the streaky-glazed pottery.

NAA fabric analysis. NAA generally confirmed these macroscopic groups. It was previously suggested that 12 of the analysed pieces (nos. 10–12, 17, 19–21, 23, 26, 27, 29, 31) were non-Sardian productions (Gürtekin-Demir 2007: 57–61; nos. 12, 13, 17, 20, 21, 23, 25 [non-Sardian Type 1] and nos. 26, 30, 37, 38, 40 [non-Sardian Type 2]). None of non-Sardian Type 1 corresponds with UI80; but it corresponds with UI81 (nos. 16, 17), UI83 (nos. 20, 21) and three singletons (nos. 23, 26, 27). Non-Sardian Type 2 exclusively includes Ephesianising ware and corresponds with UI80 (nos. 10–12) and two singletons (nos. 29, 31).

Conclusion

This study of the correlations between stylistic and elemental aspects of Lydian painted pottery is based on only a small selection of samples excavated at Daskyleion. Thus, the results do not cover the total Lydian ceramic assemblages at Daskyleion, nor do they represent an overview of provincial production centres. Instead, we aim to provide an initial step in integrating archaeological and archaeometric data on Lydian pottery through a selection of specific classes of decorated pottery of Lydian type. We should keep in mind that the main criterion for this sampling strategy was to analyse pieces of Lydian type which show a non-Sardian fabric and/or surface treatment. The few actual Sardian products were selected as reference samples in order to test our visual identification of the related standard Sardian pottery groups.

The results presented here indicate that the majority of the samples which had been macroscopically identified as either Sardian or non-Sardian fabrics belonged to the provenance groups UI80–83, which are chemically distinct from the Sardian groups SarQ and SarP and presumably represent local and/or regional productions. The stylistic and elemental correlations clearly suggest that pottery of Lydian type was not only produced at and distributed from Sardis. The non-Sardian provenance groups UI 80–83 (and the probably non-Sardian singletons) may be products of pottery centres either in Greater Lydia or elsewhere within the Lydian cultural sphere. One of the production places may have been Daskyleion, espe-

cially in the case of provenance group UI 80, which is the most frequent chemical group among the non-Sardian fabrics found at the site. It will be possible to verify this hypothesis if primary reference material like kiln wasters become available from Daskyleion or from other possible production sites.

According to the geochemical analysis, only five samples out of 31 from Daskyleion were actually produced at Sardis (nos. 1–5; SarQ and SarP). These five samples had been identified as Sardian imports and were intentionally chosen for sampling (see also Gürtekin-Demir 2002: nos. 29, 30, 194). The remaining vessels seem to be regional products from outside the Lydian capital. SarQ and SarP include three red bichrome, one streaky-glazed and one fluted lydion. The analysis determined that the UI80 non-Sardian provenance group was the largest group, consisting of ten (and one previously analysed) pottery fragments of Lydian type; that is, nearly one-third of a total of 31 samples. In fact, the analysed pieces constitute only a small percentage of the total ceramic assemblage of Lydian type at Daskyleion. The majority of this assemblage (85%) seems to be associated by style and fabric to the Sardian products (Gürtekin-Demir 2002: 138, table 1). However, some of the pieces identified visually as Sardian turned out to be regional (such as no. 9).

UI80 comprises ten samples (nos. 6–15) and, as mentioned above, is the most numerous provenance group within our sample set. It includes a variety of decoration styles, such as Ephesianising, streaky glazed, marbled, white bichrome, red bichrome and banded. Each of the other smaller provenance groups (UI81–83) comprises only two or three samples. Two streaky-glazed samples (nos. 16, 17) are from UI81 and one marbled (no. 18) and a white bichrome fragment (no. 19) are from UI82. UI83 includes only three marbled lydions (nos. 20–22). Nine samples are singletons (nos. 23–31): of these, four are marbled, three Ephesianising, one is streaky glazed, and one red bichrome pottery.

Dask 2, a Lydian pottery fragment from E. Akurgal's excavation decorated with adjacently arranged concentric pendent three-quarter circles (Akurgal et al. 2002: 112, no. 85, then still a chemical singleton) falls into the same group UI81 as two other provincial streaky-glazed skyphoi (nos. 16, 17). Two close parallels, in terms of surface treatment, decoration and fabric were excavated at Sardis and Gordion. The Sardis example (uninventoried) was analysed by P. Dupont, who suggested that the elemental profile was distinct from the Sardis provenance but close to the chemical pattern of the Aeolis region (Dupont, Lungu 2020: 124–26, fig. 21). The data provided, however, do not allow one to verify this interpretation, as discussed above. The Lydian example from

Gordion belongs to a skyphos and was macroscopically assigned to 'Provincial fabric I', which is similar to Sardian productions in terms of fabric and style (Gürtekin-Demir 2021: 3, no. 20). The Gordion sample was analysed by L. Kealhofer and P. Grave, who have analysed nearly a thousand samples, including other Lydian pottery; the results will be published in the near future (Kealhofer et al. forthcoming; see also Gürtekin-Demir 2021: 6–7). Kealhofer and Grave associated the relevant sherd with the Sardis/Pactolus source (Gürtekin-Demir 2021: 7, Table 6). It is interesting to note here that the same pattern is apparently also practised on no. 19, belonging to the chemical group U182. Consequently, Lydian pottery with the same arrangement of three-quarter circles is attested from Sardis, Daskyleion and Gordion. Whereas the examples from Sardis, Gordion and Dask 23 show the same surface treatment and the colour combination (that is, brown or red over creamy white slip), Dask 2 has no slip, but the dark brown glaze is applied directly on the clay surface. All of the fragments are assigned to distinct chemical groups: two fragments from Daskyleion to U181 and U182; one fragment from Gordion to Sardis.

It is interesting to note here that none of the marbled samples belonged to Sardis provenance groups. However, this clearly does not mean that marbled ware was not imported from Sardis to Daskyleion; there are many fragments with marbled decoration from Daskyleion with a fabric that macroscopically looks Sardian. Archaeometric results suggest that there are at least two different provenance groups (U182, U183) outside Sardis, and potentially other sites (singletons, nos. 24–27), that produced marbled ware.

As NAA has shown, there are some production centres which are characterised by two or more NAA groups, as in the case of, for example, Sardis, Ephesus and Miletus. Reasons for the simultaneous occurrence of two or more elemental patterns at one site include the exploitation of several, geochemically different clay sources in the vicinity and/or variations in the preparation of the clay paste. Mixtures of different clays result in new elemental patterns (Akurgal et al. 2002: 47, 92; Kerschner et al. 2002: 199; Kerschner, Mommsen 2009: 83, 86; Schwedt, Mommsen 2004). Therefore, it is theoretically possible that all four provenance groups U180–83 were produced at Daskyleion. But it is also possible that this only applies for one or two of these groups – or for none of them. This question cannot be solved without securely located reference samples.

The chemical analysis did confirm that all of the Ephesianising samples were indeed regional products, as suggested earlier by means of macroscopic evaluation

(Gürtekin-Demir 2007). This correlative conclusion is also true for various examples of streaky-glazed and marbled pottery (nos. 16–18, 20–23, 26, 27).

The NAA of Lydian wares from Daskyleion has shown the potential of archaeometric provenance determination for assessing the variety within the material culture of a multi-ethnic city. Furthermore, it gives insights into the economic networks of the site by defining the origins of imported pottery. These connections may be either direct or indirect, as the transporters are usually unknown. In view of the Sardian and non-Sardian products in Daskyleion as well as at other sites, it is clear that Sardis, as a capital of the Lydian kingdom, was not the only centre where Lydian pottery was distributed. The multiple provenance groups evinced by this study demonstrate that there was a decentralised Lydian ceramic production. This study exposes the importance of multidisciplinary research into ceramic provenance groups that also combines archaeometric results and stylistic evaluations and demonstrates how either method alone would offer more limited explanations when compared to the correlative definitions of pottery production centres.

The possibility of localising regional production centres depends on finding suitable reference material. Such artefacts as kiln wasters or clay objects from a potter's workshop are currently lacking not only for Daskyleion, but also for other possible pottery workshops in Greater Lydia and in the larger part of interior western Anatolia. The production centres along the east Aegean coast, on the other hand, have been more intensively explored through NAA and other archaeometric methods. Scientific research on pottery production at inland sites of Anatolia is still in its infancy and requires further efforts to clarify this complex situation.

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Catalogue of samples

(All measurements in m; L.=length; W.=width; Th.=thickness; D.=diameter; H.=height)

Chemical Group SarP (fig. 3)

1. Analysis no. Dask 21

Red bichrome. Closed vessel body fragment.

Section between Trenches I and III, AVS.

L. 0.044; W. 0.041; Th. 0.006.

Clay reddish yellow (5YR 6/8). Decoration red (2.5YR 4/6) and dark reddish brown. Ext., from top to bottom, lower part of pendent concentric hook? over a reserved surface; two horizontal matt black lines; red painted area. Published Gürtekin-Demir 2002: no. 30.

2. Analysis no. Dask 26

Fluted. Lydion body fragment.

Section between Trenches I and III, AUR. Inv no: 529.

L. 0.077.

Clay light red (2.5YR 6/6). Ext., horizontal flutes in alternate colours of red (2.5YR 4/8) and white (10YR 8/2).

Published Gürtekin-Demir 2002: no. 194.

Chemical Group SarQ (fig. 4)

3. Analysis no. Dask 12

Streaky/plain painted with additional white. Skyphos body fragment.

Trench 18/a, DAJ.

L. 0.023; W. 0.032; Th. 0.002–0.003.

Decoration streaky glazed with metallic sheen with additional white. Ext., two horizontal bands over streaky-glazed surface. Int., streaky glazed.

4. Analysis no. Dask 20

Red bichrome. Closed vessel body fragment.

Persian Terrace 02/XI. FLM.

L. 0.024; W. 0.036; Th. 0.006.

Clay reddish yellow (5YR 6/8). Decoration red (2.5YR 4/6) and dark brown. Ext., a row of partially preserved pendent concentric circles or hooks.

5. Analysis no. Dask 22

Red bichrome. Closed vessel shoulder fragment.

Survey, AIT.

L. 0.06; W. 0.065; Th. 0.007–0.008.

Clay burnt (brown 10 YR 5/3). Decoration dark red to black (burnt, 5 YR 2.5/1-4/2). Ext., partially preserved pendent concentric hook or circle over a band.

Published Gürtekin-Demir 2002: no. 29.

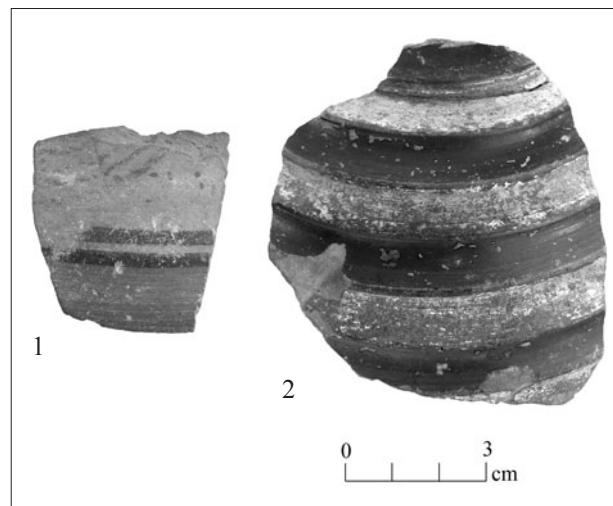


Fig. 3. Sampled pottery at Daskyleion, chemical group SarP: no. 1, Dask 21 (red bichrome closed vessel); no. 2, Dask 26 (fluted lydion).

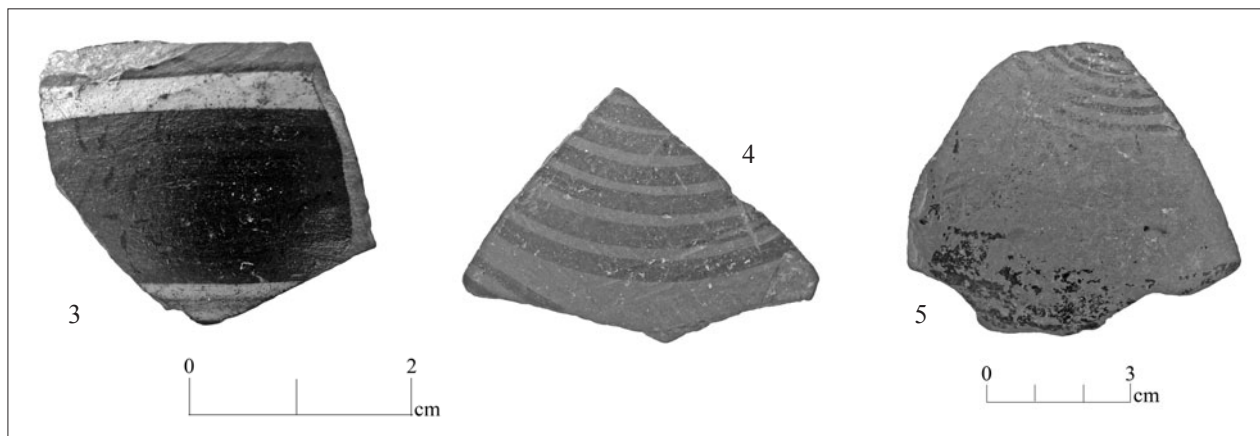


Fig. 4. Sampled pottery at Daskyleion, chemical group SarQ: no. 3, a streaky glazed skyphos; nos. 4–5, red bichrome closed vessels; Dask 12, 20, 22 respectively.

Chemical Group U180 (fig. 5)

6. Analysis no. Dask 10

Streaky glazed. Skyphos rim and body fragment.

Trench F6 c1, BFO.

H. 0.066; Th. 0.004–0.006.

Clay light red (2.5 YR 6/8). Decoration red (2.5 YR 5/8) to dark reddish grey (2.5 YR 3/1). Ext., from top to bottom, rim plain painted; reserved band; streaky painted. Int., streaky painted.

Published Gürtekin-Demir 2002: no. 45.

7. Analysis no. Dask 16

Marbling glazed. Closed vessel shoulder fragment.

Trench F5, BNK.

L. 0.052; W. 0.047; Th. 0.006–0.007.

Clay reddish yellow (5YR 5/6). Decoration reddish brown (2.5 YR 4/4) over creamy white slip. Ext., from top to bottom, a row of petals; single horizontal band; vertical marbling.

Published Gürtekin-Demir 2002: no. 84.

8. Analysis no.: Dask 24

White bichrome. Amphora shoulder fragment.

Trench 19, DKE. Inv. no: 1532.

L. 0.041; W. 0.075; Th. 0.012.

Clay red (2.5 YR 5/6) with grey core. Decoration red over creamy white slip. Ext., from top to bottom, single horizontal band; concentric circle with a central dot.

Published Gürtekin-Demir 2002: no. 19.

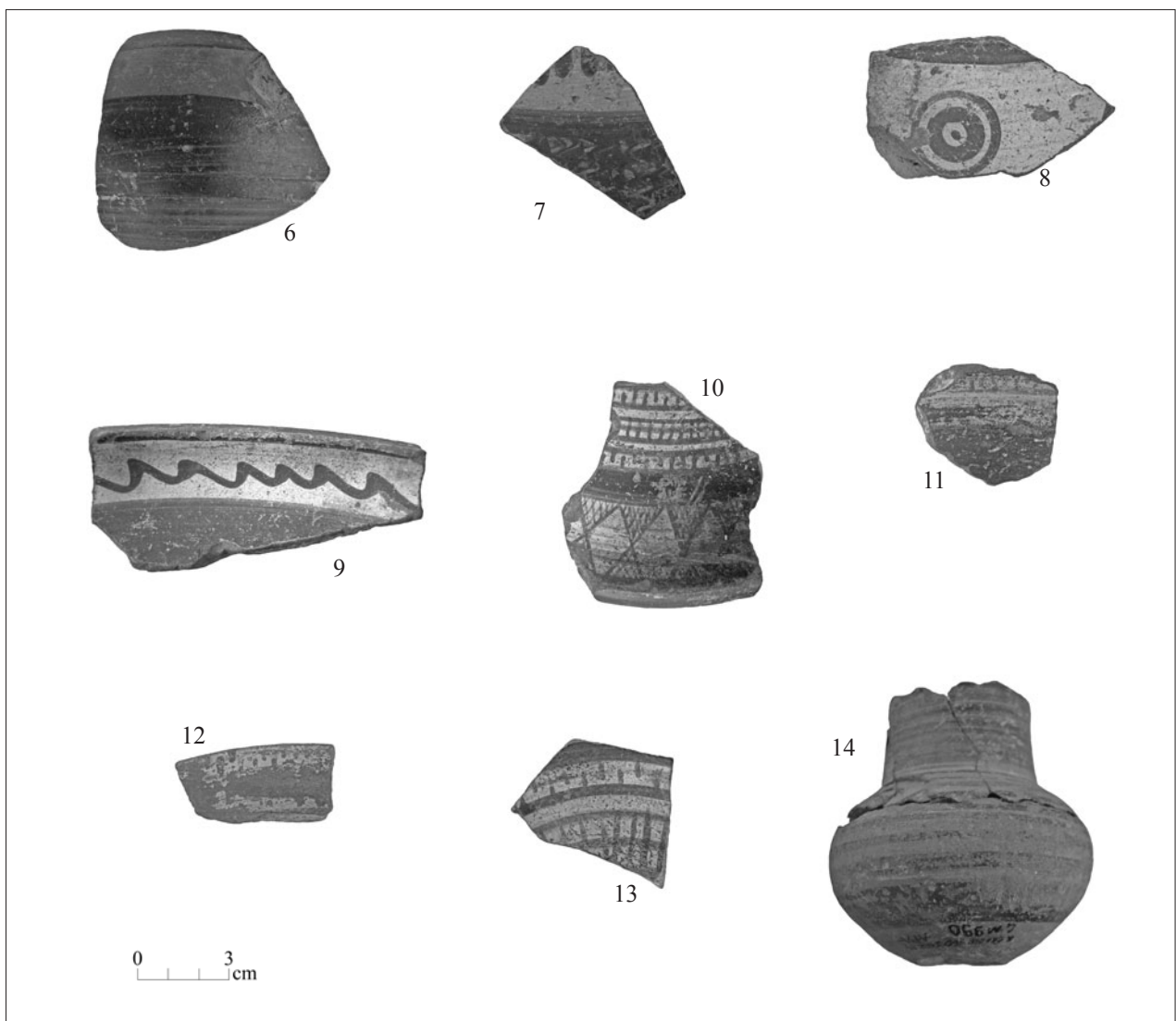


Fig. 5. Sampled Pottery at Daskyleion, chemical group U180: no. 6, Dask. 10 (streaky-glazed skyphos); no. 7, Dask 16 (marbled closed vessel); nos. 8–9, Dask 24–25 (bichrome pottery); nos. 10–13, Dask 29, 31–33 (Ephesianising ware); no. 14, Dask 34 (banded lydion).

9. Analysis no. Dask 25

Red bichrome. Dish rim and body fragment.

Trench F5, BRT.

D. (rim) 0.033; H. 0.027; Th. 0.01.

Everted rim; carinated below rim. Clay reddish brown (5 YR 6/4). Decoration red over creamy white slip. Ext., Red banded over slip. Int., from top to bottom, over rim, red painted; single horizontal wavy line on a white slipped band; red painted.

Published Gürtekin-Demir 2002: no. 23.

10. Analysis no. Dask 29

Ephesianising stand fragment.

Trench F6 East, CUT. Inv. no: 1226.

D. (base) 0.19; H. 0.052; Th. 0.01.

Clay reddish yellow (5 YR 6/8) with grey core. Decoration dark brown (7.5 YR 4/4) and yellowish red (5 YR 5/8) over creamy white slip. Ext., from top to bottom, single horizontal brown line framing the upper and lower borders of dog-tooth row; reserved band; single horizontal brown line framing the upper and lower borders of ladder row, single horizontal line crossing the ladder row at centre; reserved band; single horizontal brown line framing the upper and lower borders of dog-tooth row; horizontal red band; wide band, framed with a single horizontal brown line above and below: a row of linked, cross-hatched hour-glass pattern; horizontal red band. Int., red painted.

Published Gürtekin-Demir 2007: no. 40.

11. Analysis no. Dask 31

Ephesianising dish rim and body fragment.

Trench 1, ARN.

D. (rim) 0.336; H. 0.03; Th. 0.003.

Everted rim. Clay reddish yellow (5 YR 6/6) with grey core. Decoration reddish brown (2.5 YR 5/4) over creamy white slip. Ext., from top to bottom, dog-tooth row framed with single horizontal line above and below; two horizontal lines; plain painted. Int., two horizontal lines over rim; traces of paint.

Published Gürtekin-Demir 2007: no. 26.

12. Analysis no. Dask 32

Ephesianising dish rim and body fragment.

Trench F6 East, BVJ. Inv. no: 786.

D (rim). 0.322; H. 0.02; Th. 0.007.

Everted rim. Clay red (2.5 YR 5/6). Decoration reddish brown (5 YR 4/3) and red (10 R 4/8) over creamy white slip. Ext., a row of dog-tooth framed with a horizontal line above and below. Int., red painted.

Published Gürtekin-Demir 2007: no. 30.

13. Analysis no. Dask 33

Ephesianising dish body fragment.

Trench F6 East-North, COK. Inv. no: 1293.

L. 0.055; W. 0.049; Th. 0.005–0.007.

14. Analysis no. Dask 34

Banded. Lydion neck and body fragment.

Trench 1, AOR and APA. Inv. no. 360.

D. (belly) 0.072; H. 0.082.

Clay yellowish red (5 YR 5/6). Decoration black to yellowish red (5 YR 25/1-5/8) over creamy white slip. Ext., neck, streaky painted; spiral banded from the end of neck to mid-body; single horizontal band on lower body.

Published Gürtekin-Demir 2002: no. 109.

15. Analysis no. Dask 35

(not illustrated)

Banded. Lydion lower body fragment.

Trench 1, ANZ. Inv. no: 350.

D. (belly) 0.088; H. 0.061.

Clay reddish yellow (5 YR 5/6). Decoration black to yellowish red (5 YR 2.5/1-5/8) over creamy white slip. Ext., neck, streaky painted; spiral banded from end of neck to mid-body; single horizontal band on lower body.

Published Gürtekin-Demir 2002: no. 107.

Chemical Group U181 (fig. 6)

16. Analysis no. Dask 8

Streaky glazed. Skyphos lower body and foot fragment.

Trench F6 East, CAN and CAP.

D. (base) 0.068; H. 0.068; Th. 0.004–0.006.

Deep bowl; low conical foot. Clay yellowish red to reddish yellow (7.5 YR 6/6-7.4 YR 7/6). Decoration matt reddish yellow to black (5 YR 6/8-2.5/1). Ext., streaky glazed all over. Int., plain black painted.

Published Gürtekin-Demir 2007: no. 20.

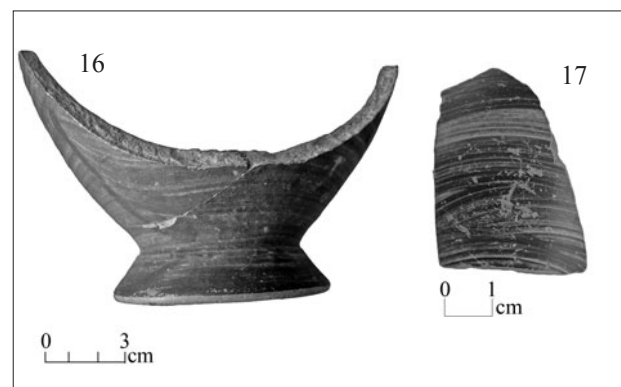


Fig. 6. Sampled Pottery at Daskyleion, chemical group U181: nos. 16–17, Dask 8, 11 (streaky-glazed skyphos).

17. Analysis no. Dask 11
Streaky glazed. Skyphos lower body fragment.
Trench Terrace Wall, APN.
L. 0.041; W. 0.029; Th. 0.003–0.007.
Clay reddish yellow (7.5 YR 7/6). Decoration matt reddish brown (2.5 YR 4/4) with additional white. Ext., single horizontal white band over streaky painted surface. Int., streaky painted.
Published Gürtekin-Demir 2007: no. 23.

Chemical Group Ul82 (fig. 7)

18. Analysis no. Dask 13
Marbling glazed. Closed vessel body fragment.
Trench Biltenler 1, CDI. Inv. no: 956.
L. 0.044; W. 0.039; Th. 0.004.
Clay very pale brown (10 YR 7/4). Decoration red (2.5 YR 4/8) over creamy white slip. Ext., curled marbling.
Published Gürtekin-Demir 2002: no. 88.

19. Analysis no. Dask 23
White bichrome. Closed vessel body fragment.
Trench F6 East, BKZ. Inv. no: 653.
L. 0.024; W. 0.023; Th. 0.004.
Clay yellowish red (5 YR 5/6). Decoration red (10 R 4/8) over creamy white slip. Ext., pendent three-quarter concentric circles arranged to form scale pattern.
Published Gürtekin-Demir 2002: no. 20.

Chemical Group Ul83 (fig. 8)

20. Analysis no. Dask 36
Marbling glazed. Lydion body fragment.
Trench N 10, DVZ. Inv. no: 1796.
H. 0.05; Th. 0.005.
Clay yellowish red (5 YR 5/6). Decoration dark brown over creamy white slip. Ext., wide vertical marbling.
Published Gürtekin-Demir 2002: no. 20.

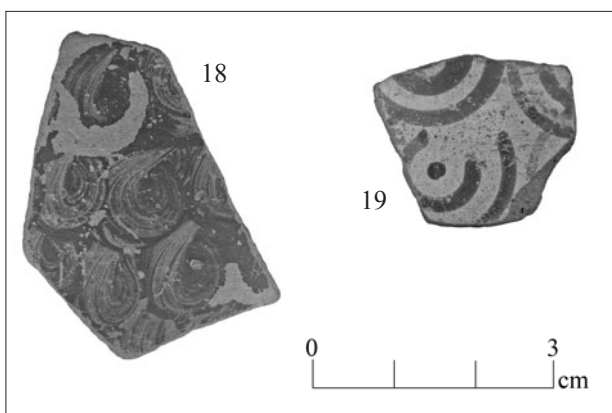


Fig. 7. Sampled pottery at Daskyleion chemical group Ul82: no. 18, Dask 13 (marbled closed vessel); no. 19, Dask 23 (white bichrome closed vessel).

21. Analysis no. Dask 37
Marbling glazed. Lydion body fragment.
Trench 27 (4th Sondage).
L. 0.038; W. 0.067.
Decoration red (2.5 YR 4/8) over creamy white slip. Ext., wide vertical marbling.
Published Gürtekin-Demir 2007: no. 13.

22. Analysis no. Dask 38
Marbling glazed. Lydion body fragment.
Trench Persian Terrace 02/XIII, FKI.
L. 0.037; W. 0.043; Th. 0.005–0.01.
Decoration dark brown over creamy white slip. Ext., from top to bottom, plain painted area; reserved band; three parallel horizontal lines; curled marbling from lower shoulder to the end of body.

Chemical Singletons (fig. 9)

23. Analysis no. Dask 9
Streaky glazed. Skyphos lower body and foot fragment.
Trench F6, COJ. Inv. no: 1135.
D. (base) 0.042; H. 0.042; Th. 0.002–0.004.
Clay reddish yellow (7.5 YR 7/6). Decoration matt dark brown (7.5 YR 3/2) to very dark grey (7.5 YR 3/2). Ext. and interior streaky glazed.
Published Gürtekin-Demir 2002: no. 21.

24. Analysis no. Dask 14
Marbling glazed. Open vessel body fragment.
Trench F6, DCP.
L. 0.042; W. 0.046; Th. 0.006–0.007.
Clay reddish yellow (5 YR 6/8). Decoration red (2.5 YR 5/8) over creamy white slip. Ext., vertical stripe, vertically marbled. Int., plain painted.
Published Gürtekin-Demir 2002: Sardian fabric, no. 79.

25. Analysis no. Dask 15
Marbling glazed. Krater neck and shoulder fragment.
Trench 25 (Terrace Wall), DPB. Inv. no: 1624.
L. 0.039; W. 0.101; Th. 0.005–0.006.
Clay reddish yellow (5 YR 6/6). Decoration red (10 R 4/8) over creamy white slip. Ext., a horizontal band over neck; thin vertical marbling over body. Int., plain painted.
Published Gürtekin-Demir 2002: no. 81.

26. Analysis no. Dask 17
Marbling glazed. Closed vessel body fragment.
Trench F6 North, BYD.
L. 0.067; W. 0.075; Th. 0.006–0.008.
Clay reddish yellow (5 YR 6/6). Decoration reddish brown (5 YR 4/3). Ext., wide horizontal marbling.
Published Gürtekin-Demir 2002: no. 17.

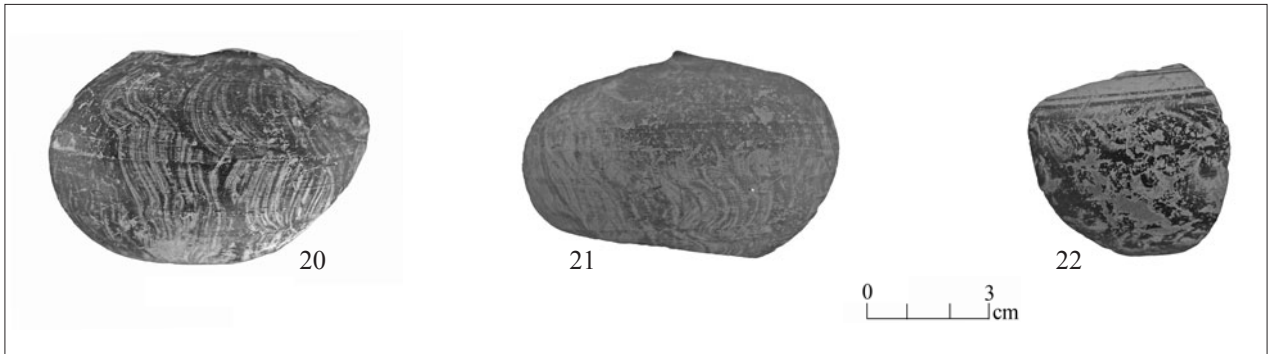


Fig. 8. Sampled pottery at Daskyleion chemical group Ul83: nos. 20–22, Dask 36–38 (marbled lydion).

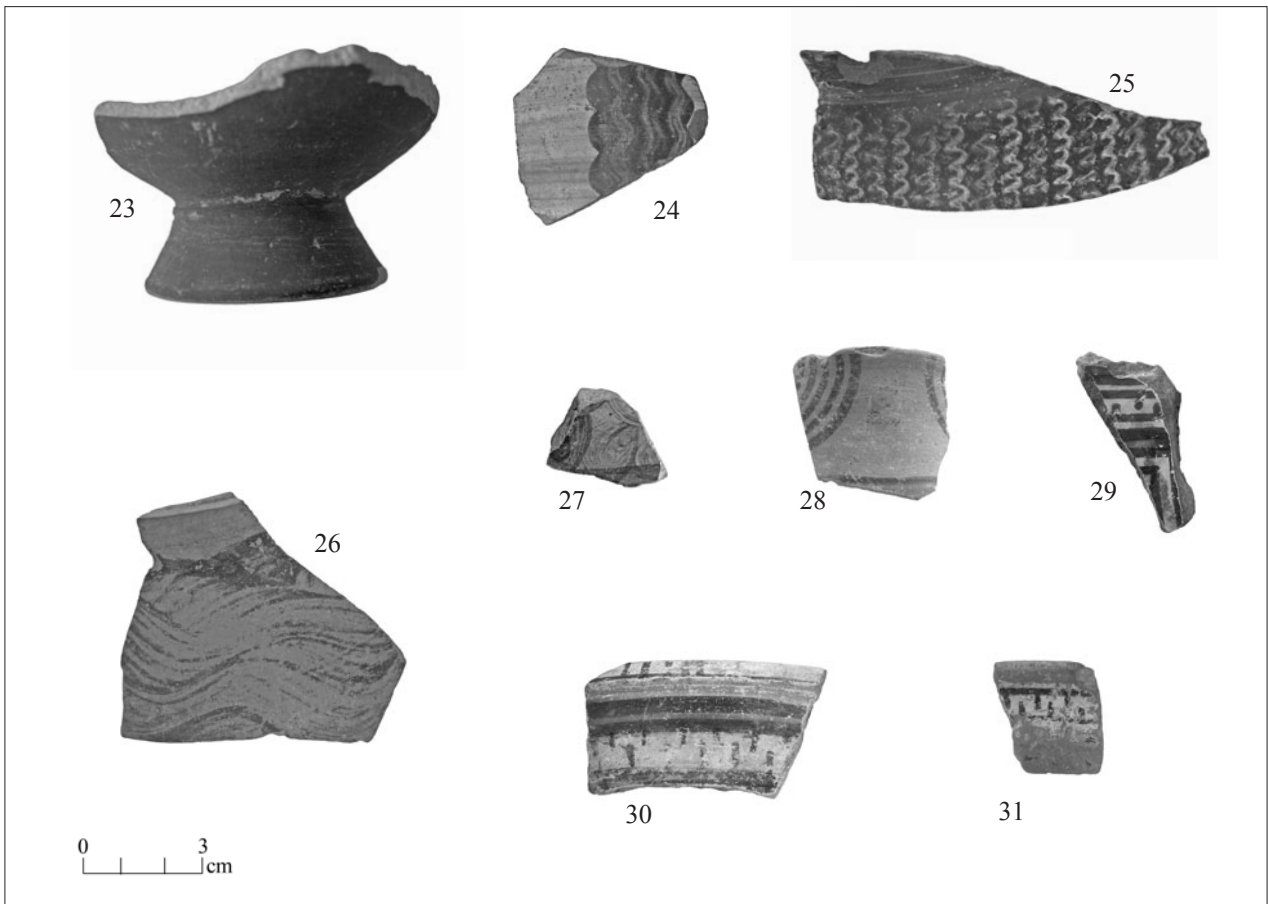


Fig. 9. Sampled pottery at Daskyleion, chemical singletons: no. 23, Dask 9 (streaky-glazed skyphos); nos. 24–27, Dask 14, 15, 17, 18 respectively (marbled pottery); no. 28, Dask 19 (red bichrome one-handed jug); nos. 29–31, Dask 27, 28, 30 respectively (Ephesianising ware).

27. Analysis no. Dask 18
Marbling glazed. Open vessel body fragment.
Trench 23, DOS.
L. 0.027; W. 0.03; Th. 0.007.
Clay reddish yellow (7.5 YR 7/6). Decoration dark brown (7.5 YR 6/4). Ext., curled marbling framed with a horizontal band below. Int., plain painted.
Published Gürtekin-Demir 2002: no. 25.

28. Analysis no. Dask 19
Red bichrome. One-handed jug rim and body fragment.
Trench Terrace Wall (Sondage 3), EKC. Inv. no: 2074.
D. (rim) 0.039; H. 0.035; Th. 0.003–0.004.
Published Gürtekin-Demir 2002: no. 28.

29. Analysis no. Dask 27
Ephesianising dish body fragment.

Trench F6, CON. Inv. No, 1266.

H. 0.024; Th. 0.009.

Clay reddish yellow (5 YR 6/8) with grey core. Decoration dark brown (7.5 YR 4/4) and yellowish red (5 YR 5/8) over thick white slip. Ext., from top to bottom, lower part of concentric squares; horizontal red line framed with a horizontal brown line above and below; dogtooth row framed with a brown horizontal line above and below; horizontal brown line; horizontal red line. Int., from top to bottom, single horizontal red line; single horizontal brown line; dog-tooth row framed with a brown horizontal line above and below; horizontal red line framed with a horizontal brown line above and below; partially preserved concentric brown square.

Published Gürtekin-Demir 2002: no. 38.

30. Analysis no. Dask 28

Ephesianising dish rim and body fragment.

Survey, BKH.

H. 0.025; Th. 0.007.

Flaring rim. Clay light red (2.5 YR 6/6). Decoration dark reddish brown (5 YR 3/3) and yellowish red (5 YR 5/8) over creamy white slip. Ext., from top to bottom, horizontal line; dog-tooth pattern framed by a single horizontal line above and below. Over rim, parallel vertical lines. Int., from top to bottom, two rows of adjacent horizontal lines with alternate red and brown colours; dog-tooth row; single horizontal brown line; single horizontal red line.

31. Analysis no. Dask 30

Ephesianising dish rim and body fragment.

Trench 25 (Terrace Wall), DSA. Inv. no: 1637.

H. 0.026; W. 0.025; Th. 0.007.

Flaring rim. Clay reddish yellow (5 YR 6/8). Decoration very dark grey (5 YR 3/1) over creamy white slip. Ext., from top to bottom, dog-tooth row framed with single horizontal line above and below. Int., over rim, parallel vertical lines.

Published Gürtekin-Demir 2002: no. 37.

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