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MERSİN ÜNİVERSİTESİ

KILIKIA ARKEOLOJİSİNİ ARAŞTIRMA MERKEZİ

BİLİMSEL SÜRELİ YAYINI 'OLBA'

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Dipnot (kitaplar için)

Richter 1977, 162, res. 217.

Dipnot (Makaleler için)

Oppenheim 1973, 9, lev.1.

Diğer Kısaltmalar

age.	adı geçen eser
ay.	aynı yazar
vd.	ve devamı
yak.	yaklaşık
v.d.	ve diğerleri
y.dn.	yukarı dipnot
dn.	dipnot
a.dn.	aşağı dipnot
bk.	Bakınız

4. Tüm resim, çizim ve haritalar için sadece "fig." kısaltması kullanılmalı ve figürlerin numaralandırılmasında süreklilik olmalıdır. (Levha, Resim, Çizim, Şekil, Harita ya da bir başka ifade veya kısaltma kesinlikle kullanılmamalıdır).

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   c. The indication fig.:

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      * If many figures in sequence are to be indicated, a short hyphen without

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Footnotes (for books):

Richter 1977, 162, fig. 217.

Footnotes (for articles):

Oppenheim 1973, 9, pl.1.

Miscellaneous Abbreviations:

op. cit.	in the work already cited
idem	an auther that has just been mentioned
ff	following pages
et al.	and others
n.	footnote
see	see
infra	see below
supra	see above

4. For all photographies, drawings and maps only the abbreviation 'fig.' should be used

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13. Special fonts should be loaded to the CD.

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THE GRECO-ITALIC AMPHORAE FOUND ON MALTEPE TUMULUS IN PHOCAEA

Emre OKAN* – Cenker ATİLA** – Ali Akın AKYOL***

ÖZ

Phokaia Maltepe Tümülüsünde Bulunan Greko-İtalik Amphoralar

Ionia'nın en büyük kentlerinden biri olan Phokaia, Orientalizan Dönem'den, Geç Antik Çağ'a kadar seramik üretimi yapan önemli bir merkezdir. Kent içinde ortaya çıkarılan arkeolojik alanlar arasında seramik çöplüklerinin geniş yer tutması bunun kanıtıdır. 1992 yılı kazı sezonunda, İÖ 4. yüzyıla tarihli bir tümülüsün dolgusunda, arkaik sur duvarının küçük bir bölümü keşfedilmiştir. Ancak bu tümülüsün arkaik sur duvarını korumak dışındaki önemli bir özelliği, seramik çöplüğü olarak kullanılmış olmasıdır. Bu durum bize kentin özellikle Hellenistik Dönem seramik üretimi hakkında önemli bilgiler vermiştir. Tümülüsün dolgusunda yapılan kazılarda çok sayıda ve farklı tipte seramik ortaya çıkarılmıştır. Bu seramikler içinde, Batı Akdeniz üretimi olarak bilinen Greko-Italik amphoraların yoğun olarak bulunması, bu amphora formunun Phokaia'da da üretilmiş olabileceği fikrini akla getirmiştir. Bu amaçla toplam 40 adet ağız-boyun ve dip parçası bu yayın içinde incelendi. Bunun yanında, üretimin varlığını ispat etmek amacıyla, farklı açmalarda bulunmuş amphoralardan kil örnekleri ve yakınlardaki dere yataklarından alınan toprak örneklerinin petrografik ve kimyasal analizleri yapılmıştır. Bu analizler sonucunda Greko-Italik amphoraların İÖ 3. ve 2. yüzyıllarda Phokaia'da da üretildikleri anlaşılmıştır.

Anahtar Kelimeler: Phokaia, Greko-Italik, Maltepe Tümülüsü, Seramik Üretimi, Amphora, Hellenistik.

ABSTRACT

Phocaea, which was one of the biggest cities in Ionia, was also an important pottery production centre from the Orientalising Period to the Late Antique Period. The many large pottery dumps which were unearthed in different sites in the modern city of Foça

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are evidence of this large-scale production. During the 1992 excavation season, a small part of the Archaic Period city wall of Phocaea was discovered in the fill of a fourth century mound referred to as Maltepe. However, in addition to preserving the archaic city wall for millennia, the other feature of this mound was its use as a ceramic dump. This situation gives us much important information about the pottery production in the city, especially during the Hellenistic Period. Many different pottery types were unearthed from the fill of the tumulus. Numerous Greco-Italic amphora fragments of the form known as western Mediterranean were also found among other pottery in the course of the tumulus excavation. The existence of these fragments here suggests that this type of amphora may have been produced in Phocaea. A total of 40 rim and base fragments were studied for this publication. In addition, in order to discover proof of their production in Phocaea, clay samples taken from the amphora fragments and soil samples taken from the local stream bed were analysed petrographically and chemically. As a result of these analyses, it was established that Greco-Italic amphorae were also produced in Phocaea in the third and second centuries BC.

Keywords: Phocaea, Greco-Italic, Maltepe Tumulus, Ceramic Production, Amphora, Hellenistic.

1. Introduction

The ancient city of Phocaea, one of the largest cities in the Ionian region, has been on the scene as a settlement since the second millennium BC. It was also one of the most important ceramic production centres of Western Anatolia from the Orientalizing Period[1] to the Late Antique Period. This production was spread over nearly all the city in the Hellenistic and Roman Periods. During recent excavations, ceramic workshops and dumps located in and around the city centre have revealed the potential of the production in the city[2].

During the 1992 excavation season, with the discovery of the Maltepe Tumulus south of the city dated to the Hellenistic Period (fig. 1), a fairly well-preserved part of the city wall of the Archaic Period was also uncovered (fig. 2, a,b,c). This tumulus has not only protected the ancient city wall, but has also provided important information about the city's ceramic production, especially in the Hellenistic and Roman Periods. During excavations on the tumulus, fill in order to explore the continuation of the city wall, the discovery of a large number of ceramic pieces and large pieces of ceramic slag

1 In 2002, near the south-west coast of Büyük Deniz in Foça, an orientalizing pottery workshop was uncovered during a construction excavation. As a result of this excavation, workshop walls, kiln and its dumpster were discovered (Özyiğit 2003, 443-444). But, pottery finds, which are belong to this workshop, are in the publication process now.

2 During the third period of the Phocaea excavations, which have been continuing since 1989, especially in the areas close to the center of the city, a large ceramic dump was unearthed. Almost all of these dumps have been dated to the Hellenistic and Roman Periods. Özyiğit 1990, 127-28; Özyiğit 1992, 5-7; The best preserved part of the Phocaea city walls of the Archaic Period is contained inside the fill of a tumulus called the Maltepe Tumulus. The soil covering the tumulus built at the end of the Hellenistic Period was taken from the dump of the nearby Hellenistic period workshops and transported there. Özyiğit 1993, 18-19

showed that the soil there was brought from the dumps of nearby ceramic workshops[3].

Commercial amphorae occupied an important place in the tumulus fill, where different types of ceramic groups were present. Mushroom-shaped rim amphorae were one of the most numerous groups among the commercial amphora pieces recovered from the Maltepe Tumulus fill. It is recognised that the mushroom-rimmed amphora tradition began with the Corinth type A amphorae in the Archaic Period and continued to increase and diversify in the period following the fourth century. The production of mushroom-rimmed amphorae was established in the cities of Knidos, Rhodes, Kos, Peparethos and Samos from the fourth century BC[4]. However, at this point, the Greco-Italic amphorae entering the literature as products of the western Mediterranean (southern Italy, Sicily, Ischia Bay and the Bay of Naples) are a matter of particular interest. The aim of the present work was to reveal the typology of the Greco-Italic amphorae recovered from the Maltepe Tumulus fill and to determine whether or not they were produced in Phocaea.

From the fourth century BC onwards, Greco-Italic amphorae began to be produced in the western Mediterranean, especially in Italy, in a form that included both Roman and Greek characteristics *"The several varieties of commercial amphora which since the 1950's have been loosely called "Greco-Italic" reflect, and not only in name, the pan-Mediterranean, Graeco-Roman character of Hellenistic trade. As this article seeks to explain, Greco-Italic amphoras are at once Hellenistic and Roman Republic"*[5]. The term 'Greco-Italic' was first used by F. Benoît during the identification of over 400 amphorae discovered in the Grand-Congloué 1 shipwreck located in the Marseilles basin[6]. Will, in one of the most extensive studies on Greco-Italic amphorae, said that for the most part, underwater wrecks rather than land excavations will shed light on the development of the Greco-Italic amphorae form and trade routes[7].

In recent years, most of the ancient shipwrecks found in the western Mediterranean, especially in underwater surveys of the Italian Peninsula and the Sicilian, French and Spanish coasts, carried Greco-Italic amphorae. These discoveries reveal very important data that will shed light on the chronological, typological and commercial development of this amphora type. Until recent years, studies on Greco-Italic amphorae concentrating on production centres rather than the morphological features of these amphorae have led to some problems in the typological definition of Greco-Italic amphorae. The first of these studies on the classification of these amphorae was made by N. Lamboglia[8] who used the term 'Lamboglia 4' to describe amphorae produced after 250 BC, while F. Benoît defined this type as 'série républicainne 1[9]. Many of

3 Özyiğit 1993, 18-19

4 Selçuk 1997, 105-108

5 Will 1982, 338

6 Benoit 1961, 211-34

7 Will 1982, 338.

8 Lamboglia 1955, 264-65

9 Benoit 1957, 251-252

the views that emerged after Will's classification work tended to criticize Will's descriptions or to prove them invalid[10]. Manacorda notes that in the articles published in 1986 and 1989, the term 'Greco-Italic' is misleading and should be abandoned, and that in general, the 'Early Greco-Italic' group carrying Greek stamps is distinctly separate from the 'Late Greco-Italic' group that carries Latin stamps[11]. One of the most recent and most comprehensive works on the typological development of Greco-Italic amphorae was done by Vandermersch. In this work, Vandermersch distinguished six types of Greco-Italic amphorae under the name of MGS (Magno-Greek and Siciliote) belonging to the time period 440/430 BC up to 210 BC[12]. Within this group, the forms between Type III and V, like the amphorae of the Roghi wrecks in Secca di Capistello and Panarea, carry only Greek stamps[13].

On the other hand, with samples found in the wrecks of Ischia and the Gulf of Naples and in the wrecks off the coast north of Sicily, G. Olcese formed a new typology based on Vandermersch, and identified several intermediate forms of this typology that were not classified by Vandermersch[14]. All intermediate forms were contemporaneous with previous and subsequent forms, and this study thus clearly demonstrated the form development of Greco-Italic amphorae.

2. Material and Methods

During the preparatory phase of this paper, the Greco-Italic amphora fragments recovered from the layers in dating from the Hellenistic Period of the ancient city of Phocaea were examined[15]. The work of drawing, photographing and cataloguing was carried out on the approximately 200 rim, body and base fragments. During the preparation of a publication on the commercial amphorae of Phocaea covering the extensive period of time dating from the Archaic Period to the Late Roman Period, as the Greco-Italic amphorae were in large numbers, it was decided that they would be examined separately when it came to the question of whether or not production had been carried out in the city. At this stage, drawings, photographs, and inventory work were carried out on about 2000 amphorae from archaic to the late antiquity, and Greco-Italic amphorae were found to account for about 10% of all the amphora fragments studied as part of the abovementioned chronological process[16]. Of the total of 45 Greco-Italic

10 Cibecchini 2005, 51.

11 Cibecchini 2005, 51; Manacorda 1989, 443-444.

12 Vandermersch 1994, 61-86

13 Cibecchini 2005, 51

14 Olcese 2012, 37

15 All of these amphoras, which are dated to Hellenistic period, are publication process now. We are planning to publish all the Phocaean amphoras dated from archaic to late antiquity as a book of Phocaea Excavations. Because of this, the other Greco-Italic amphora finds will be examined in detail in this process.

16 The number and rate of the other mushroom rim amphoras are not certain. 2000 amphora fragments abovementioned express the general number of studied amphoras from archaic to the late antiquity. So, we have no any idea about the ratio of greco-italic amphoras to the other mushroom types yet.

amphorae included in this article, 33 are rim/neck and 12 are base fragments.

The Maltepe Tumulus fill was at the same time a ceramic dump[17], thus making it an important archaeological site for Phocaea. However, because of the lack of a strong stratigraphy in terms of dating, the classification of the Greco-Italic amphorae recovered here was made, in particular, through published studies on similar finds from production areas on land and from underwater wrecks in the western Mediterranean.

3. Greco-Italic Amphorae Finds of the Maltepe Tumulus

Greco-Italic amphorae are generally characterized by the outflaring, triangular cross-section of the rim, an ovoidal or pear-shaped belly and an elongated base structure[18]. Hesnard notes that the ratio of the height to the thickness of the triangular cross-section of the rim is important to recognise whether an amphora with only a rim fragment preserved is Greco-Italic. According to Hesnard, if this ratio is '1' or slightly less, the amphora is Greco-Italic; otherwise it is a Dressel 1 amphora[19]. Greco-Italic amphorae are classified as Republican Period amphorae. Production of the earliest Greco-Italic amphorae began from the middle of the fourth century BC (about 350 BC). The last representatives of the series are contemporary with the Dressel 1 form. Both forms were among those found where they had been left in the Roman camps of Numantia in Spain in 133 BC[20]. The main production area was the Italian Peninsula, which includes the regions of Ischia Bay[21], Naples[22] Campania, South Etruria and Latium[23].

The Greco-Italic amphorae located within the Phocaea Maltepe Tumulus fill are an important contribution to the amphora typology of Phocaea's Hellenistic Period. During the excavations to uncover the fortification wall of the Archaic Period, the excavations in the tumulus fill were left unfinished. With the completion of the work in this area, much more important data will come to light. Thus, at this point, Greco-Italic amphorae have been found in this fill, and at the same time, because of the ceramic dump, it brings to mind the question: 'Are these amphorae of Phocaea manufacture?'

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17 While the pottery sherds was not encountered on the tumulus generally, numerous pottery fragments was found on the tumulus of Maltepe. The existing of the slags in the filling of this tumulus reveal that this soil was brought from pottery workshops east of the tumulus. These ceramic dumps do not give the definite stratification, because the soil on this mound might be brought from different wokshop dumpsters in different times. Unfortunately, it is not possible to reach the ruins of these workshops today, because all of the workshops are under the modern town of Foça. Özyiğit 1993, 13.

18 Loughton 2003, 179

19 Benquet-Piot 1981, 253, note 33; Tchernia offers a formula to distinguish between Greco-Italic V and Dressel 1 amphorae. Accordingly, if the ratio of the total height of an amphora to the widest body diameter is less than 2.9 cm, he says they are Greek-Italic amphorae and the others are Dressel 1; Tchernia 1986, 309

20 Loughton 2003, 179.

21 Olcese 2012, 11-14.

22 Olcese 2005/6, 60

23 Loughton 2003, 179; Hesnard et al. 1986, 24-26.

As a matter of fact, the results of the clay analyses that have been carried out will clearly reveal the answer.

Although these amphorae have been divided into many types and formed the subject of a Master's thesis published in 1997[24], when the Maltepe Tumulus is examined in terms of the Greco-Italic amphorae form, particularly with the aid of the triangular cross-section profiles, two separate forms can be identified which are derivatives of one another.

3.1. Form 1 (Olcese Type V-VI / VI)

The Greco-Italic amphorae identified within the Maltepe Tumulus fill were defined as early Form 2 group amphorae. This group of amphorae were identified as Type V/VI-VI in the classification of Olcese. Type VI is the prototype of the Dressel 1 amphorae, one of the most commonly used forms of the Late Republican era. A total of 17 rim-neck fragments from the Maltepe Tumulus find are examined in this publication (fig. 3,1-17). It is not easy to distinguish or clarify the amphora bases which might have belonged to this group because they were also used in the subsequent Type VI amphorae. However, we can easily say that all of the Greco-Italic base specimens from the Maltepe Tumulus belong to the Form 1 and Form 2 Groups. Thus, in view of this, the earliest Greco-Italic amphora production in Phocaea must have started from the end of the third century BC. The presence of Dressel 1 amphorae in excavations in the city indicates that this production or trade continued until the beginning of the Imperial Period.

3.1.1. Form features and clay structure

The Maltepe Tumulus fill Form 1 (Olcese Type V/VI-VI) amphorae belong to a type transitioning from Type V to Type VI in the classifications of Vandermersch and Olcese. The Ischia samples are classified as Type V/VI-VI[25]. A great deal is known about the general form of Type V / VI-VI since it has been discovered in great numbers on the Italian Peninsula, especially in Naples[26]. As a form, this type has a longer and narrower structure than its predecessors. This elongation can be seen in almost all parts of the amphora (neck, body, handles and base).

The outer edges of the rim of the Maltepe Tumulus Form 1 type (Type V/VI-VI) amphorae are more curved than in the Type V amphorae and the outer surface and lower part of the rim form an angle of 35-45 degrees (A total of 78 Greco-Italic amphorae found in the cargo of the Sanguinaires off the west coast of the island of Corsica. The fragments found by Chibeccini were identified as the Gr. Italic Type Vc[27]). Intact amphorae taken from underwater sites play a great role in the understanding of the

24 Selçuk 1997.

25 Olcese 2012, 35-37

26 Olcese 2012, 37

27 Cibecchini et al 2012, 37-40

general features of the form of this group of amphorae. For example, two different sizes of Greco-Italic amphorae found in the western part of the Tour Fondue (250-225 BC)[28] measuring 71cm in height, with a massive triangular section, an inner diameter of about 12.2 cm and a rim form of 18 cm in diameter can be seen as similar to the Phocaea samples. In addition, one Tour Fondue wreck amphora has a short, inverted conical neck, wide curved shoulders, a top-shaped body just below the widest point of the shoulders, and a 10 cm long cylindrical base[29].

In the Phocaea Greco-Italic amphorae, of the total of 17 rim-neck parts included in this group, all have an outward-flaring and in some instances slightly down-drooping rim with a fuller triangular cross-section. The necks of the amphorae narrow toward the shoulder. A few specimens give an idea of the upper handle combinations, as can be understood from these examples with handles just below the rim at the upper part of the neck (fig. 3). Amphorae with similar rim structures were discovered at a depth of approximately 42m off Tour d'Agnello, at the northern tip of the island of Corsica in 1979[30]. The amphorae in the wreck had an average diameter of 12cm. The bases of the Form 1, along with the bodies, were also elongated and narrow. Form 1 amphorae, which we can date into the Late Republican Period, also display similar long, cylindrical bases. Two different base forms have been identified among the Greco-Italic amphorae at the Sanguinaires A wreck site off the island of Corsica. One base ends with a distinctive knob and the other has a toe that is rounded[31]. Among the base samples found in Phocaea, there are examples ending in the shape of a knob (fig. 4, 33-38). For examples closest to this base form, it would be useful to look again at the cargo of the Tour d'Agnello wreck[32]. When the base structures of these amphorae are examined, it is observed that they have a height ranging from 7.5-10 cm and that the toe generally finishes with a knob.

The clay composition will be given in more detail in part 4 of this article which deals with the analyses, but from the exterior it can be understood that in nearly all of the Phocaea Form 1 amphorae, the clay used was brown or brown-toned in colour and had additions of a large proportion of sand and a little mica. Apart from this, in most of the samples, a beige-coloured coating is seen on the outer surface as a distinctive feature.

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28 The Tour Fondue wreck lies at a depth of about 20 m and is located off the Giens Peninsula 600 m in the south/southwest direction from the La Tour Fondue harbour, 8 km from the ancient Olbia site near Marseilles in the south of France. Two Greco-Italic amphorae of different sizes (one measuring 60 cm and the other 71 cm high) found in this wreck, with the help of similar ones found in the Tour D'Agnello and Haute-Crose wrecks, were dated to the third century and placed between Type V and Type VI in Vandermersch's MGS typology. As a matter of fact, the Tour Fondue wreck where these amphorae were recovered is dated to the second half of the third century. Dangréaux 2012, 22-23, Pl. XX

29 Dangréaux 2012, Pl. XX.2

30 The Greco-Italic amphorae located in the cargo of the wreck have attracted attention because of their different dimensions. These amphorae have a height ranging from 72cm to 90cm and a body diameter ranging from 34 cm to 37 cm. Liou 1982, 452-454. figs. 16-17

31 Cibecchini et al. 2012, 39-40, figs. 11-12

32 Liou 1982, 452-54, figs. 16-17

3.1.2. Dating

Amphorae recovered from wrecks and correctly dated with their contexts are especially important for the Phocaea amphorae of Form 1 (Type V/VI-VI). It was mentioned above that wrecks could help to date the Phocaea Form 1 amphorae. The Rhodes, Knidos, Marseilles and Punic amphorae found in the cargo of the Sanguinaires A wreck in Corsica also help to date their Greco-Italic contemporaries. In addition to this, the Campania A ceramics and other material dating to the first half of the second century BC are also important for dating. In the light of all this material, the Sanguinaires A wreck has been dated from the end of the third century to the beginning of the second century BC[33]. Along with the underwater and land excavations, there are also important references to help in the dating of the Phocaea Form 1 amphorae. For example, rim fragments belonging to Greco-Italic amphorae dating to the first quarter of the second century BC were recovered in Mondragone near Falerne[34]. In Spain, in the Catalan region, Greco-Italic amphorae dated from the end of the third century to the beginning of the second century BC are important both in terms of dating and in determining the distribution areas of these amphorae. The rim-neck and base specimens among the Greco-Italic amphora fragments found in these excavations are important references for the Phocaea Form 1 amphorae[35]. The important point here is that of the Greco-Italic amphorae, (fig. 3-4,1-38) the specimens in the Phocaea Form 1 group, which included the most numerous specimens, also used the toe in the form of a cap[36].

In Spain, in the context dated to 2nd century BC at avenue of Pery Junquera in San Fernando in the gulf of Bahia, some Greco-Italic amphora fragments were found and published in 2004[37]. When Spanish examples compared with Phocaean Greco-Italic amphoras, we can say that most of the Spanish samples similar to the Phocaea Group 1 amphoras in terms of both their rim and base forms[38].

The above-mentioned underwater specimens along with specimens found in Spain show that, unlike the rim form, there is no standard for the base forms of amphorae. In Santa Maria del Cedro, an important Italian archaeological settlement in Cosenza, a production site dated to the end of the third century BC was discovered, and Greco-Italic amphora fragments were also found[39]. Manacorda, especially the Campania region, between the second half of the third century and the first half of the second century BC, played an important role in the production of Greco-Italic amphorae

33 Cibecchini et al. 2012, 34-52; Cibecchini 2013, 238, Tab. 1; Purpura 1974, 48-49; Purpura 1977, 60, 71, Tav. III; For chemical analysis results of amphorae recovered from the wreck, see: Olcese et al. 2013, 80-82, figs. 2-6

34 Hesnard et al. 1986, 27, fig. 11

35 Nolla – Nieto 1986, 368-76, 389, Lam. 3

36 Nolla – Nieto 1986, 389, Lam. 3, N. 7

37 Alvarez – Sanchez 2004, 441-446.

38 Alvarez – Sanchez 2004, 442, fig. 1, no. 1, 6, 8; 443, figs. 2-3, no. 1, 2.

39 Greco et al. 1978, 449, fig. 31, no. 5

and in particular, 'TR.LOISIO' stamped amphorae were a sign indicating production during this period[40]. In 1988, off the coast of Toulon southeast of Marseilles, Greco-Italic amphorae in five different forms were discovered at a depth of 80-85m in the Héliopolis 2-Nord Levant shipwreck cargo. The earliest of these amphorae, termed Group 1, date to the third quarter of the third century BC, while Group 2 were dated to the first quarter of the second century[41]. Group 3 consists of amphorae with massive triangular cross-sectioned rims, long necks, curved handles, narrow shoulders and ovoidal bodies and were dated into the first quarter of the second century BC[42]. The Phocaea Form 1 amphorae are similar to the Group 3 amphorae, especially in terms of rim and neck structure. Group 4 and Group 5 amphorae cover the final and latest dated specimens of Greco-Italic amphorae. The amphorae of these groups are narrower and longer than the amphorae of the other three groups[43]. All Greco-Italic amphorae forms produced from the end of the third century until the middle of the second century BC were contained in this underwater site.

3.2. Form 2 (Vandermersch Type VI)

The second group after Form 1 includes the latest dated Greco-Italic amphorae. Amphorae included in this group are the last amphorae of the Republican Period and with this period the production of the Dressel 1 series also starts. Benoit defines this type as a transitional form, starting from the Grande-Congloué 1 wreck amphorae, under the heading "*amphores gréco-italiques ou de transition a L'évre oblique*"[44].

This group is classified as 'Form e' by Will, and the idea of it being a form produced in Spain at the beginning of the second century is supported by the amphorae found in Ampurias[45]. Specimens found at the Phocaea Maltepe Tumulus were classified as Form 2, and include 16 rim-neck and approximately six base fragments (figs. 4-5).

3.2.1. Form Features

Form 2 amphorae are long in general appearance. Unlike Form 1, the triangular-sectioned lip has been replaced by an innovative downward-sloping rim. The neck is long and concave. The joint between the narrow shoulder and the body is marked by a noticeable ridge. The almond-shaped sectioned handles are curved. The widest point is

40 A sample bearing the seal TR.LOISI is on the inventory of the Taranto Museum. Manacorda 1986, 444, fig. 1

41 Amphorae included in this group have a height of 75-76 cm and a body diameter of 35-36 cm. Joncheray – Long 2002, 141-42, fig. 10b

42 The amphorae of this group have a height of 83-84 cm and a body diameter of 34.5 cm. Joncheray – Long 2002, 142-44, fig. 10c

43 Group 4 amphorae have a height of 88-89 cm and a body diameter of 35.5 cm, while Group 5 amphorae have a height of 92-93 cm and a body diameter of 35 cm. They were produced in the second quarter of the second century BC. Joncheray – Long 2002, 144-146, fig. 10 e-f

44 Benoit 1961, 36

45 Will 1982, 353-356. Pl. 85g

the upper body near the shoulder, which has a long ovoid shape. With the help of the intact examples recovered, it is understood that Form 2 amphorae have different base forms. Some workshops preferred the button-shaped base, while some produced flat-bottomed ones. In the inventory of this publication, all of the cylindrical bases ending in a cap-like toe, as seen in the amphorae of the Grand-Congloué 1 wreck, were also used in the Phocaea Form 2 amphorae (fig. 4, 39-44).

The Grand-Congloué 1 wreck site clearly shows that this type was also produced in two different sizes. Those of standard size have a 88-89cm height, and usually a 35-36cm, rarely 37cm, body diameter with a 25-26 liter capacity, while small-sized samples have a 63cm height and a 23cm belly diameter (These amphorae have outward-opening, slightly downward-edged rims which is not a general feature because there are amphorae with different rim profiles from the same wreck), a long, inwardly curving neck, just under the rim, and flat handles coming up directly under the rim. Some amphorae in this wreck sport curved handles 2-3cm below the rim. The shoulders are sloping, although not in each case as the shoulders exhibit a prominent ridge in two published samples. The body is ovoidal with a cylindrical base having a pointed toe ending in the form of a knob[46]. In the Phocaea Form 2 specimens, the rims usually slope downward (fig. 5) with diameters of 14-15cm, except for one example. As far as the fragments are concerned, the necks of the Form 2 amphorae should be in the long, curved form specific to Type VI amphorae. The samples included in the Form 2 group have a beige-coloured coating on the outside and, with a few exceptions, contain a large proportion of sand, varying amounts of mica and lime and some stone and black granular inclusions.

3.2.2. Dating

The role of shipwrecks in the identification and dating of typologies of Form 2 or Vandermersch Type VI amphorae is considerable. Though the wrecks are important for this amphora form, there are also samples found in dependable contexts in land excavations. For example, samples of Form 2 amphorae were recovered in a deposit in the Agora of Athens dating to the first quarter of the second century[47]. This form, which E.L.Will classifies as Form e, is a transition form to Dressel 1c amphorae, defined by Lamboglia as Type 5. Although it was produced in the first half of the second century, it has been emphasized that this form retained its existence until the end of the same century[48].

Nevertheless, the most important find in terms of the form and dating of the Form 2 amphorae is the Grand-Congloué 1 wreck. This wreck, within its context, in the context of the wreck, in addition to Greco-Italic amphorae, there are different sizes of Rhodian amphorae, a Knidos amphora, a Rhodian transition type and a Greco-Italic

46 Benoit 1961, Pl. II, figs. 32-33

47 Form 2 amphora fragments were recovered from the N10: no. 2 deposit in the Athens Agora excavations and were dated to the second century BC. Lawall 2009, 67-68, fig. 68

48 Will 1982, 355

amphora in Rhodes clay. The author interprets this amphora as a Rhodian production. In particular, the Rhodian amphorae are in the form dated to the end of the third century BC[49].

The Chretiénne C sunken cargo dated to the second quarter of the second century was discovered on the shoal of La Chretiénne near Cannes on the southern coast of France and contained approximately 500 Greco-Italic amphorae. These amphorae include the class which Benoit refers to as 'gréco-italique' or 'républicaine 1'. The measurements of the amphorae are nearly identical with each other. Their height is 87cm and body diameter is 32cm. The capacity of these amphorae, which weighing 1 kg, is 21 liters without exception. The outer edges of their beveled rims make an angle of 45 degrees with the horizontal lower plane. The tronconic neck merges at a sharp angle into the shoulder, which is marked with a ridge. The handles are flat with the upper part joined 2-3cm below the rim. The ovoidal-shaped body ends in a cylindrical 8cm-long base, with the toe highlighted as a button or cap[50]. These amphorae types have stamps on their stoppers and were dated from the second quarter of the second century by Hesnard-Gianfrotta[51].

Greco-Italic amphorae were among the cargo of the Cala Scirocco shipwreck, dating to the Late Republican Period and located at the southern end of the island of Cala Spalmatoi in the island group off the western coast of Italy. These amphorae were classified as Will Form e and have been dated to the second quarter of the second century BC[52].

At the Greco-Roman Museum in Alexandria there is a complete intact example of this group dated to the second half of the second century. This amphora has been interpreted by researchers as an indication of the period when Italian wine was first imported to Alexandria[53]. In the context in Spain which is mentioned above, some samples which are similar to Phocaea Group 2 samples, also were found[54].

Form 2 samples are not only found in the Mediterranean Basin. This form is understood to have had a wide distribution area and it is also possible to find samples, although in a small number, in the Black Sea Basin. One of them was found in the excavations in the lower part of the city of Olbia Pontica. Since archaeological evidence has proved that this part of the city of Olbia Pontica was abandoned in the middle of the second century BC or a little later[55], this amphora is probably one of the earliest and must be from the second quarter of the second century BC.

The above examples show us that the Greco-Italic amphora group which we have

49 Grace 1963, fig. 1, no. 9

50 Joncheray 1975, 79-81, fig. 34

51 Hesnard – Gianfrotta 1986, 426-27, B.35

52 Firmati 1997, 68-70, figs. 10-14

53 Şenol 2013, 403-404, fig. 2

54 Alvarez – Sanchez 2004, 442, fig. 1, no. 2-3-4; fig. 2, no. 2-3.

55 Lawall et al. 2014, 33-34, fig. 10

called Form 2 were produced in the second quarter of the second century BC and show that the Dressel 1 form emerged from this production and continued until the end of the second century BC.

4. Archaeometric Analyses of Phocaea Greco-Italic Amphorae

Despite the many archaeological finds made in the dump, without archaeometric analysis, it was difficult to say for sure that they were Greco-Italic amphorae of Phocaea production. Thus, to this purpose, soil samples were taken from Bayram Stream, the closest creek bed to the Maltepe Tumulus. Petrographic and chemical analyses were carried out on these as well as on clay samples taken from 20 of the amphora fragments (figs. 8-9). This work was done under the supervision of Ankara University, Earth Science Application and Research Centre (YEBİM) and Gazi University, Faculty of Fine Arts, Department of Conservation and Restoration of Cultural Properties, Historical Materials Research and Conservation Laboratory (MAKLAB).

The archaeometric analyse is quite important especially for ceramic -especially for commercial amphoras-studies in archaeological concept. In this context, the archaeometric analysis on Greco-Italic amphoras found in Italian Peninsula reveal the serious conclusions about to define the production areas of this kind of amphoras and in this way, provide convenience to compare with the other production centers. According to results of the archaeometric analysis, which were conducted on the Greco-Italic amphorae found in Ager Portuensis in Ostia where is one of the production centres of the Greco-Italic amphorae in Western Mediterranean, the clay of Ostia samples consist of some major elements similiar to the Greco-Italic amphoras from Phocaea. Among these elements; Al_2O_3, Fe_2O_3, K_2O and MgO especially can be seen in Phocaean samples similarly[56]. But this similarity does not prove that they were produced in Ager Portuensis or anywhere else in Italy or in Western Mediterranean.

4.1. Documentation Studies

The Phocaea Greco-Italic amphora samples were first visually evaluated, photographed using a digital camera (Canon Digital IXUS 870 IS 10 MegaPixel) and documented, and then grouped and coded for analysis (fig. 10, fig. 11). The thickness of the amphora samples was determined using a digital thickness gauge accurate to 0.01 mm (fig.12). The colours of the amphora samples were also documented by chromametric analysis (fig. 12). The Colour analyses were performed using the standard CIE (L*, a*, b*) (Commission Internationale de L'Eclairage) colour system whereby (L) is the brightness value of the colour, (+a) the red intensity value of the colour, (-a) the green density value of the colour, (+b) the yellow intensity value of the colour and (-b) the blue intensity value of the colour[57].

56 Olcese – Thierrin Michael 2009, 3-4.

57 Ohno 2007

4.2. Thin section optical microscopic analysis

Thin sections of ceramic samples from Phocaea were prepared and examined under an optical microscope. Thin sections were prepared in order to show all the layers from outside to inside of the samples[58]. An optical microscope (LEICA Research Polarizer DMLP) was used in the examinations. The photographs were made using a digital camera (Leica DFC 280) attached to the microscope and the Leica QWin Digital Imaging Program was used for evaluations. The minerals and rock fragments forming the aggregate were determined by the Point Counting Program (fig.13, fig. 14).

4.3. X-ray Fluorescence (XRF) analysis

The principles of X-ray Fluorescence (XRF) analysis are related to the principles of optical emission spectroscopy[59]. The elemental contents of the Phocaea Greco-Italic amphorae samples were determined using the X-ray Fluorescence analysis method (PED-XRF) (Fig. 14, Fig. 15). Samples selected for analysis were ground to powder in an agate mortar. The powdered samples were mixed with the chemical substance (special wacks) used for XRF analysis and then formed into 32-mm discs. These were placed in the sample area of the instrument and analysed. In this study, the X-LAB 2000 model Polarized Energy Dispersive-XRF (PED-XRF) spectrometer was used. This spectrometer has the ability to analyse elements from atomic number 11 (sodium, Na) to number 92 (uranium, U), with a sensitivity limit of 0.5 ppm for heavy elements and 10 ppm for light elements. Approximately 50 elements were identified in this study. Lithium, boron and fluorine could not be detected due to the weight loss (loss on ignition - LOI) at high temperature (950ºC). In the analysis, elementary and minor elements are given as oxide fractions (%) and trace elements are given as a concentration of parts per million (ppm). The US Geological Survey (USGS) standards and references GEOL, GBW-7109, and GBW-7309 were used in the analyses.

The results of the PED-XRF analysis of the amphora samples revealed their chemical components of SiO_2 (average: 55.64%), Al_2O_3 (average: 12.11%), CaO (average: 10.29%), Fe_2O_3 (average: 5.48%), K_2O (average: 2.37%) and MgO (average: 2.31%) (Fig. 15). In parallel with the thin section analysis, the elemental contents determined by PED-XRF analysis showed that the IFC-B9 sample (Aph. Gr4) had a chemical structure that differed in part from the other samples (Fig. 16 a-b). Based on this it is possible to say that the amphora samples which are quite similar to one another in chemical structure reflect the production of at least two different workshops. The Al_2O_3 used in the ceramic production mainly originated from the structure of the clay raw material used as a silicium source. The similarity of the amounts of Al_2O_3 suggests that the sand and/or quartz used came from the same source. The amphora samples showed similar proportions of SiO_2 and Al_2O_3 as well as MgO and K_2O contents. This similarity in the contents of the samples correlates them with the same

58 Kerr 1977; Rapp 2002

59 Ohnson et al. 1999; La Tour 1989; Shackley 2011

production addresses or relates them to workshops that used the same raw materials or had similar production techniques (fig. 16 a-b).

When the strength properties of the amphora samples were evaluated together with the chemical content determined by PED-XRF analysis, it was found that for high strength, specimens should include in their structure 30% or more SiO_2 (average, 55.64%), less than 10% CaO (average, 10.29%) and under 8% Fe_2O_3 (average, 5.48%)[60]. The high CaO content was also consistent with some of the reported rates of SiO_2 and Fe_2O_3 of the studied samples (fig. 15). In the light of these data it is possible to say that the strength of the amphora specimens indicated that their production was of average-high quality.

Strontium (Sr) is found geochemically in calcium-like and lime-containing materials (e.g., sea shells and limestone). More than 400 ppm of Sr indicates that the raw material used to make ceramics is completely of marine origin, whereas the amount of Sr is usually less than 150 ppm in terrestrial raw material containing limestone. It is also expected that zirconium (Zr) will be lower than 160 ppm if marine raw material is used in production[61]. The strontium (Sr) content of the Phocaea amphora samples ranged from average to 1749 ppm (average: 330.0 ppm), while the zirconium (Zr) content varied from 19.6 to 520.4 ppm (average: 213.9 ppm) (fig. 15). In the light of the results, the majority of the amphorae of the sample set (except IFC-B9) reflected a mixed terrestrial/marine raw material source including terrestrial/marine additives.

5. Results and Discussion

Although Greco-Italic amphoras were produced in the tradition of Aegean amphora production with mushroom shaped rim, they were mainly Italic amphoras. They are separated from the Aegean mushroom rim amphoras with distinct features which are seen on their general shapes. These differences are seen especially in the form of rim and base more prominently. Thanks to the examples which are found in different places in Aegean and Eastern Mediterranean, like Smyrna[62] and Egypt, we can see that the main amphora production centres, which especially produced of greco-italic amphora, might be trying to take a share from commercial market of Aegean and Eastern Mediterranean especially in Hellenistic Period.

The Greco-Italic amphorae of the Maltepe Tumulus, which are the subject of this article, were first studied in 1997 by Tayfun Selçuk in an unpublished Master's thesis. The samples discussed in this thesis are grouped into a great number of subtypes according to their rim and base profiles. However, the present article shows that the Greco-Italic amphorae found in the Maltepe Tumulus are not of so many different types.

The petrographic and chemical analyses of the amphorae prove they were most

60 Özışık 2000

61 Freestone et al. 2003

62 Şenol 2015, 246.

probably of Phocaea manufacture because of their presence in this dump. Another important evidence for the Greco-Italic amphora production in Phocaea is the defective amphora fragments which are found in the tumulus fill. In Fig. 6, ıt can also be seen the illustration of a whole Phocaean Greco-Italic amphora (form 1) which is illustrated according to fragments that are found in the same level of the tumulus. When these amphoras are examined, they show some structural disorders. For example, while some of them are overcooked, there are also defective samples (fig. 7)

The Khios amphorae found in the clay pool of a ceramics workshop which was previously discovered near the Persian Mausoleum were also investigated in the same way and it was subsequently recognised that Phocaea was a centre that produced Khios amphorae from the second to the beginning of the first century BC[63]. Therefore, Phocaea became focused on commercial amphora production, especially in the Hellenistic period, and emerged as one of the key cities noted for the manufacture of amphorae.

However, the evidence of Greco-Italic amphora production in the city also brings with it mixed results. Until today, the detailed studies on the topic of amphorae at the beginning of the article, the production areas where amphorae were found and the wrecks that were discovered have shown that Greco-Italic amphorae were of western Mediterranean production centred on the Naples Gulf and Ischia cities. As a matter of fact, the comprehensive studies of the production sites of Greco-Italic amphorae made by Olcese and supported by archaeometric analyses confirm this. In this case, we will need to answer the question: Why Phocaea? Why has Greco-Italic amphora production been detected only in Phocaea (at least up to the present) when there were so many cities in western Anatolia? It would be appropriate to look for the answer to this question in Phocaea's colonial history.

From 600 BC until the Alalia Sea War of 540 BC, Phocaea had founded a *thalassocracy* in the western Mediterranean. After the Alalia Sea War it lost its power in the region to the Etruscans and Carthaginians, and had to abandon its Alalia colony in Corsica[64]. Then, on the western coast of the Italian Peninsula, south of the Gulf of Naples, it founded Hyele (Velia/Elea), the last major colony city, in 540 BC[65]. Morel argued that after the destruction of Phocaea by the Persians, the commercial, emotional and religious ties with the western cities had been broken, and that even archaeological evidence was incapable of showing any solid economic ties between the cities of Marseilles, Emporion, Alalia and Hyele, while the written sources were silent on the subject[66].

At this point, the presence of the Greco-Italic amphora production in Phocaea at least in the third to the second centuries BC can be interpreted as a sign that

63 Okan-Atila-Akyol 2015

64 Morel 2006, 368-69

65 Morel 2006, 370

66 Morel 2006, 409

communications were not broken between the main city and the west. This relationship, in particular, would be a logical conclusion, given the focus on the city of Hyele as the last colony, and also taking into account its proximity to the Gulf of Naples, which was the main production area of Greco-Italic amphorae.

Phocaea's Greco-Italic amphorae must have been produced for commercial purposes. The fact that Greco-Italic amphorae were also discovered in the excavations at various points in the city (a publication on these amphorae is in preparation) confirms this assertion. The fact that they have not been found in other cities in western Anatolia indicates that this production was concentrated in the western Mediterranean. From 300-150 BC, Phocaea most likely wanted to get a share of the Greco-Italic amphorae production trade in the western Mediterranean, and would probably have used the city of Hyele for that purpose. As a matter of fact, the archaeometric analyses of the Phocaea samples revealed clay with marine content and clearly demonstrated the production of at least two workshops.

The Greco-Italic amphorae in the Maltepe Tumulus fill and the Khios amphorae of the Hellenistic Period ceramic workshop found near the Persian Mausoleum indicate that Phocaea, not so much in the Archaic Period, but especially in the third to the first centuries BC, had proven to be successful in holding the Aegean and Mediterranean trade. Consequently, at least it is possible to say that Greco-Italic amphora production was not based solely in the Western Mediterranean and especially in western Italy, but that western Anatolia also took part in this production. When we consider all the attempts and archaeometric analyses mentioned above, we can say that Phocaea might be one of the Greco-Italic amphora production centres in the Mediterranean basin. But this is not a definite result. This is just a key to the further investigations about Greco-Italic amphoras found both in Phocaea and in the other places in western Anatolia.

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Catalogue

Cat. No.1. Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14.6 cm, Height: 4.2 cm. Found at: Maltepe 5 trench; Level: Layer II; Fabric: Soft, pale-brown clay with additions of a large quantity of sand, fine mica and fine lime; Surface: Beige coating; Date: The end of the third century BC; Olcese 2011-2012, 571,579, Tav. 5.I, 1-2.

Cat. No. 2, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 11.4 cm; Height: 4 cm. Found at: Maltepe 8 trench, above the city wall; Level: Layer III; Fabric: Soft, pale, light-brown clay with additions of a very small amount of lime, a large amount of sand and a very large amount of coarse-grained mica; Surface: Beige coating; Date: The end of the third century BC; Olcese 2011-2012, 571,579, Tav. 5.I, 1-2.

Cat. No. 3, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 12.6 cm; Height: 6.7 cm. Found at: Maltepe 8 trench, above the city wall; Level: Layer III; Fabric: Very soft, pale-brown clay with additions of a very large amount of sand, a large amount of lime, inclusions of stone and a little mica; Surface: Pale, yellow-beige coating; Date: The end of the third century-beginning of the second century BC; Olcese 2011-2012, 571,579, Tav. 5.I, 1-2.

Cat. No. 4. Rim and Neck Fragment (Fig. 4)

Rim Diameter: 14.4 cm; Height: 4.4 cm.Found at: Maltepe, above the city wall; Level: Layer III; Fabric: Medium-hard, brown clay with additions of fine sand, a little lime and a little mica; Surface: Light brown; Date: The end of the third - beginning of the second century BC; Olcese 2011-201, 571,579, Tav. 5.I, 1-2.

Cat. No. 5, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 12.2 cm; Height: 3.1 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, greyish-brown clay with additions of a large amount of sand, lime, a little fine mica and black stone applied from the outside; Surface: Beige coating; Date: The end of the third - the first quarter of the second century BC; Olcese 2011-2012, 554, Tav. 2. VII, 3.

Cat. No. 6, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 12.6 cm; Height: 5.4 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, light-brown clay with additions of large amounts of sand and lime and a little fine mica; Surface: Beige coating; Date: The end of the third - the first quarter of the second century BC; Olcese 2011-2012, 554, Tav. 2. VII, 3.

Cat. No. 7, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14 cm; Height: 8.5 cm. Found at: Ph. 92, Maltepe 3 trench; Level: Layer I; Fabric: Medium-hard, brown clay with additions of a large amount of coarse-looking sand, coarse-grained lime, fine mica and stone inclusions; Surface: Orange; Date: The end of the third century BC; Olcese 2011-2012, 589, Tav. 5.XI, 3.

Cat. No. 8, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14 cm; Height: 9.8 cm. Found at: Maltepe 1 trench, above the city wall; Fabric: Soft, air-porous, light yellowish-brown clay with additions of large amounts of sand and fine mica and stone inclusions; Surface: Beige coating; Date: The end of the third - the beginning of the second century BC; Olcese 2011-2012, 573,584, Tav.5.VI, 3.

Cat. No. 9, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14 cm; Height: 7.5 cm. Found at: Maltepe 10 trench, above the city wall; Level: Layer II; Fabric: Medium-hard, brown clay with additions of a large amount of sand and a little lime; Surface: Beige coating; Date: The end of the third-the first quarter of the second century BC; Olcese 2011-2012, 573,584, Tav.5.VI, 3.

Cat. No. 10, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 13.6 cm; Height 9 cm. Found at: Maltepe Ph. 92, above the city wall; Level: Layer V; Fabric: Medium-hard, well-fired brown clay with additions of fine sand, fine lime and a large amount of fine mica; Surface: Beige coating; Date: The second quarter of the second century BC; Olcese 2011-2012, 548, Tav.2.I, 2-3; Olcese 2011-2012, 548 Tav.2.I, no. 5; Firmati 1997, 63-70, fig. 10-14.

Cat. No. 11, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14.4 cm; Height: 8.2 cm. Found at: Maltepe, above the city wall; Level: Layer III; Fabric: Medium-hard, light-brown clay with additions of a large amount of sand, black granular inclusions and small amounts of lime and mica; Surface: Very light brown with shallow groove on the lip; Date: The second quarter of the second century BC; Olcese 2011-2012, 548, Tav.2.I, 2-3; Olcese 2011-2012, 548 Tav.2.I, no. 5; Firmati 1997, 63-70, fig. 10-14.

Cat. No. 12, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14 cm; Height: 8.5 cm. Found at: Maltepe, above the city wall; Level: Layer III; Fabric: Medium-hard, brown clay with additions of sand, lime and a little mica; Surface: Light brown; Date: The second quarter of the second century BC; Olcese 2011-2011, 548, Tav.2.I, 2-3; Olcese 2011-2012, 548 Tav.2.I, no. 5; Firmati 1997, 63-70, fig. 10-14.

Cat. No. 13, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14.4 cm; Height: 6.1 cm. Found at: Maltepe, above the city wall; Level: Layer III; Fabric: Medium-hard, light-brown clay with additions of large amounts of sand and lime and a little mica; Surface: Light-beige coating; Date: The second quarter of the second century BC; Olcese 2011-2012, 548, Tav.2.I, 2-3; Olcese 2011-2012, 548 Tav.2.I, no. 5; Firmati 1997, 63-70, fig. 10-14.

Cat. No. 14, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 12.8 cm; Height: 7.5 cm. Found at: Maltepe 8 trench; Level: Layer II; Fabric: Soft, air-porous, light-brown clay with additions of a large amount of sand, stone inclusions, fire clay, fine mica and lime; Surface: Beige coating; Date: The second quarter of the second century BC; Olcese 2011-2012, 548, Tav.2.I, 2-3; Olcese 2011-2012, 548 Tav.2.I, no. 5; Firmati 1997, 63-70, fig. 10-14.

Cat. No. 15, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 14.4 cm; Height: 4.6 cm. Found at: Maltepe 8 trench; Level: Layer II; Fabric: Medium-hard, light-brown clay with additions of a large amount of sand and fine lime; Surface: Beige coating; Date: The end of the third-the beginning of the second century BC; Olcese 2011-2012, 573,584, Tav.5.VI, 3.

Cat. No. 16, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 13.4 cm; Height: 4.7 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, light-brown clay with additions of large amounts of sand and lime and a little fine mica; Surface: Beige coating; Date: The end of the third century -

the beginning of the second century BC; Olcese 2011-2012, 573,584, Tav.5.VI, 3.

Cat. No. 17, Rim and Neck Fragment (Fig. 3)

Rim Diameter: 13-13.5 cm (approx.); Height: 4.2 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, light-brown clay with additions of large amounts of sand and lime and a little fine mica; Surface: Beige coating; Date: The end of the third - the beginning of the second century BC; Olcese 2011-2012, 573,584, Tav.5.VI, 3.

Cat. No. 18, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 14.8 cm; Height: 5.5 cm.

Found at: Maltepe 5 trench; Level: Layer II; Fabric: Soft, pale-brown clay with additions of a large quantity of sand, fine mica and fine lime; Surface: Beige coating; Date: 200-140 BC; Olcese 2011-2012: 624, Tav. 7.II, 9; Benoît 1956: 25, fig. 2.22.

Cat. No. 19, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 12 cm; Height: 8 cm. Found at: Maltepe 9 trench, in brown soil above the city wall; Level: Layer I; Fabric: Soft, yellowish-red clay with additions of a large amount of sand, a little mica, stone inclusions and fire clay; Surface: Beige coating; Date: The middle - the third quarter of the second century BC; Olcese 2011-2012, 597, Tav. 6.IV, 4; Geurrero Ayuso 1984, 137, fig. 71, no. 2-3.

Cat. No. 20, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 15 cm; Height: 4.6 cm.

Found at: Maltepe 5 trench; Level: Layer II; Fabric: Soft, yellowish-brown clay with additions of a large amount of sand, stone inclusions, coarse lime and fine mica; Surface: Beige coating; Date: Second century BC; Olcese 2011-2012: 546-547, 554 Tav. 2. VII, 2.

Cat. No. 21, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 14 cm; Height: 7 cm. Found at: Maltepe, above the city wall; Level: Layer III; Fabric: Very hard, brown clay with additions of large quantities of sand and lime, a little mica and black granular inclusions; Surface: Pale brown; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 22, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 13.6 cm; Height: 7.5 cm. Found at: Maltepe 8 trench; Level: Layer II; Fabric: Soft, light brown clay with additions of a large quantity of sand, sporadic stone inclusions, a little mica and a little lime; Surface: Beige coating; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 23, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 13.2 cm; Height: 5.5 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, light-brown clay with additions of large quantities of sand and lime and a little fine mica; Surface: Beige coating; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 24, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 14.6 cm; Height: 5.7 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, brown clay with additions of a large amount of sand, a little very fine mica and large quantities of a different type of sand-like stone and black

granular inclusions unlike those in the other samples; Surface: Beige coating; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 25, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 12 cm; Height: 6 cm. Found at: Maltepe 11 trench; Level: Layer II; Fabric: Medium hard, brown clay with additions of a large quantity of sand, a little lime, a little mica and numerous black granular inclusions; Surface: Light-brown/ beige; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 26, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 12.8 cm; Height: 9 cm. Found at: Maltepe, surface; Fabric: Hard, porous, red clay with additions of a large amount of sand, abundant fine mica and a large amount of fine calcite; Surface: Clay colour, red; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 27, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 13.8 cm; Height: 5.4 cm. Found at: Maltepe 11 trench, above the city wall; Level: In brown soil. Fabric: Medium hard, light-brown clay with additions of a large quantity of sand, numerous black granular inclusions, a little mica and lime; Surface: Light beige; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 28, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 10.8 cm; Height: 6 cm. Found at: Foça 94, Maltepe SU 11 trench; Level: Layer II, in ashy soil. Fabric: Hard, brown clay with additions of a little mica, sand and a large number of black granular inclusions; Surface: Coating changing from beige to light brown according to firing condition; Date: Second century BC; Olcese 2011-2012, 546-547, 554 Tav. 2. VII, 2.

Cat. No. 29, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 14.4 cm; Height: 6.6 cm. Found at: Maltepe 8 trench; Level: Layer II; Fabric: Soft, brown clay with additions of large quantities of sand and mica and a little lime; Surface: Reddish-yellow; Date: 150-125 BC; Olcese 2011-2012, 597, Tav. 6.IV, 4; Geurrero Ayuso 1984, 137, fig. 71, no. 2-3.

Cat. No. 30, Rim and Neck Fragment (Fig. 5)

Rim Diameter: 13.6 cm; Height: 6.2 cm. Found at: Maltepe 8 trench; Level: Layer II; Fabric: Medium-hard, yellowish red clay with additions of fine sand, very little mica and a little lime; Surface: Light brown, with a pronounced groove running lengthwise from the lip; Date: 150-125 BC; Olcese 2011-2012, 597, Tav. 6.IV, 4; Geurrero Ayuso 1984, 137, fig. 71, no. 2-3.

Cat. No. 31, Rim and Neck Fragment (Fig.5)

Rim Diameter: 14,6 cm.Height:5,7 cm. Found at: Maltepe 10 trench; level: II; Fabric: Soft, brown colour, clay with additions of fine sand, very little mica, stone and black particles; creamy slip on outer surface; Date: 150-125 BC; Olcese 2011-2012, 597, Tav. 6.IV, 4; Geurrero Ayuso 1984, 137, fig. 71, no. 2-3.

Cat. No. 32, Rim and Neck Fragment

Rim Diameter: 12 cm; Height; 6 cm; Found at: Maltepe 11 trench; Level II; Fabric: medium-hard, brown colour, clay with additions of fine sand, little lime, little mica and black particles; light brown slip on outer surface. Date: 150-125 BC; Olcese

2011-2012, 597, Tav. 6.IV, 4; Geurrero Ayuso 1984, 137, fig. 71, no. 2-3.

Cat. No. 33, Base Fragment (Fig. 4)

Base Diameter: 2.8 cm; Height: 8.7 cm. Found at: Maltepe 8 trench; Level: Layer II; Fabric: Medium-hard, yellowish-red clay with additions of a little fine sand and a very small amount of fine mica; Surface: Thin beige coating; Date: 220-200 BC; Olcese 2011-2012, 574, 586, Tav. 5. VIII, 2; Cibecchini 2007: Olcese 2010, 250, 253, 260; Purpura 1977.

Cat. No. 34, Base Fragment (Fig. 4)

Base Diameter: 2 cm; Height: 8.7 cm. Found at: Maltepe 7 trench, above the city wall; Level: Layer II; Fabric: Medium-hard, heavy, light-brown clay with additions of large amounts of sand and lime and a little fine mica; Surface: Very light brown; Date: The last quarter of the third century BC; Olcese 2011-2012, 586, Tav. 5. VIII, n. 2nd; Guerrero Ayuso 1984: 137, Fig.1.

Cat. No. 35, Base Fragment (Fig. 4)

Base Diameter: 4 cm; Height: 7.2 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Medium-hard, light-brown clay with additions of a large amount of sand, lime and a little mica; Surface: Light-beige coating; Date: The last quarter of the third century BC; Olcese 2011-2012, 586, Tav. 5. VIII n. 2nd; Guerrero Ayuso 1984, 137, Fig. 1.

Cat. No. 36, Base Fragment (Fig. 4)

Base Diameter: 4.2 cm; Height: 8.8 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Medium-hard, light-brown clay with additions of a large amount of sand, a little lime and mica; Surface: Light-beige coating; Date: The first quarter of the second century BC; Olcese 2011-2012, 593, 598, Tav 6.V, 1-2; Olcese 2011-2012, 630, Tav. 7. VIII, 3; Joncheray 1975.

Cat. No. 37, Base Fragment (Fig. 4)

Base Diameter: 4.4 cm; Height: 10.5 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, light-brown clay with addition of a little fine sand; Surface: Light beige; Date: The first quarter of the second century BC; Olcese 2011-2012, 593, 598, Tav 6.V, 1-2; Olcese 2011-2012, 630, Tav. 7. VIII, 3; Joncheray 1975.

Cat. No. 38, Base Fragment (Fig. 4)

Base Diameter: 4.4 cm; Height: 10.7 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Medium-hard, light-brown clay with additions of a large amount of sand, a little lime, a little mica and black granular inclusions; Surface: Beige coating; Date: The first quarter of the second century BC; Olcese 2011-2012, 593, 598, Tav 6.V, 1-2; Olcese 2011-2012, 630, Tav. 7. VIII, 3; Joncheray 1975.

Cat. No. 39, Base Fragment (Fig. 4)

Base Diameter: 2.8 cm; Height: 13 cm. Found at: Maltepe 8 trench, above the city wall; Level: Layer III; Fabric: Soft, light-brown clay with additions of a large amount of sand, a little fine mica and very little lime; Surface: Beige coating; Date: The beginning-the first quarter of the second century BC; Joncheray 1975; Olcese 2011-2012, 607, 630 Tav. 7. VIII, 3.

Cat. No. 40, Base Fragment (Fig. 4)

Base Diameter: 4 cm; Height: 10.2 cm. Found at: Maltepe 8 trench, above the city

wall; Level: Layer III; Fabric: Soft, brown clay with additions of a large amount of sand, a little lime and a little mica; Surface: Light brown; Date: The beginning - the first quarter of the second century BC; Joncheray 1975; Olcese 2011-2012, 607, 630 Tav. 7. VIII, 3.

Cat. No. 41, Base Fragment (Fig. 4)

Base Diameter: 4 cm; Height: 11.5 cm. Found at: Maltepe 8 trench, above the city wall; Level: Layer III; Fabric: Soft, coarse- looking, very light yellowish-brown clay with additions of a large amount of sand, a little lime and very little mica; Surface: Light brown; Date: The first half - middle of the second century BC; Benoît 1956, 25-26, fig. 2:21; Joncheray-Long 2002, 145, fig. 10f, n. 16.

Cat. No. 42, Base Fragment (Fig. 4)

Base Diameter: 4 cm; Height: 11.4 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Soft, light-brown clay with additions of a large amount of sand, a little lime, a little mica and a very small number of black granular inclusions; Surface: Beige coating; Date: The first half - middle of the second century BC; Benoît 1956, 25-26, fig. 2:21; Olcese 2011-2012, 647, Tav. 7. XXV, 12; Joncheray-Long 2002, 145, fig. 10f, n. 16.

Cat. No. 43, Base Fragment (Fig. 4)

Base Diameter: 4 cm; Height: 12.3 cm. Found at: Maltepe 10 trench; Level: Layer II; Fabric: Medium-hard, light-brown clay with additions of a large amount of sand, a little lime and a little mica; Surface: Light brown; Date: The middle of the second century BC; Joncheray-Long 2002, 145, fig. 10f, n. 16.

Cat. No. 44, Base Fragment (Fig. 4)

Base Diameter: 4.2 cm; Height: 10 cm.Found at: Maltepe 8 trench; Level: Layer II; Fabric: Soft, brown clay with additions of a large amount of sand, a little coarse lime and a little mica; Surface: Light beige coating.

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Fig. 1 Location of the Phocaea and Maltepe Tumulus.

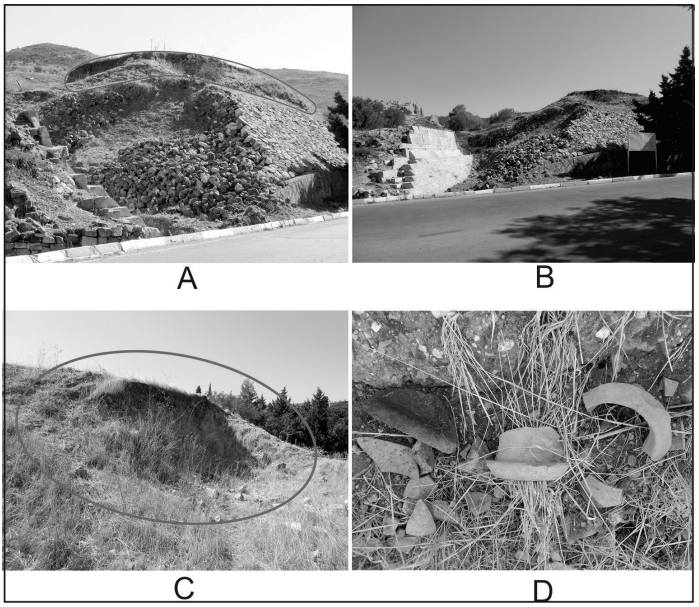

Fig. 2 Maltepe Tumulus and ceramic dumpster.

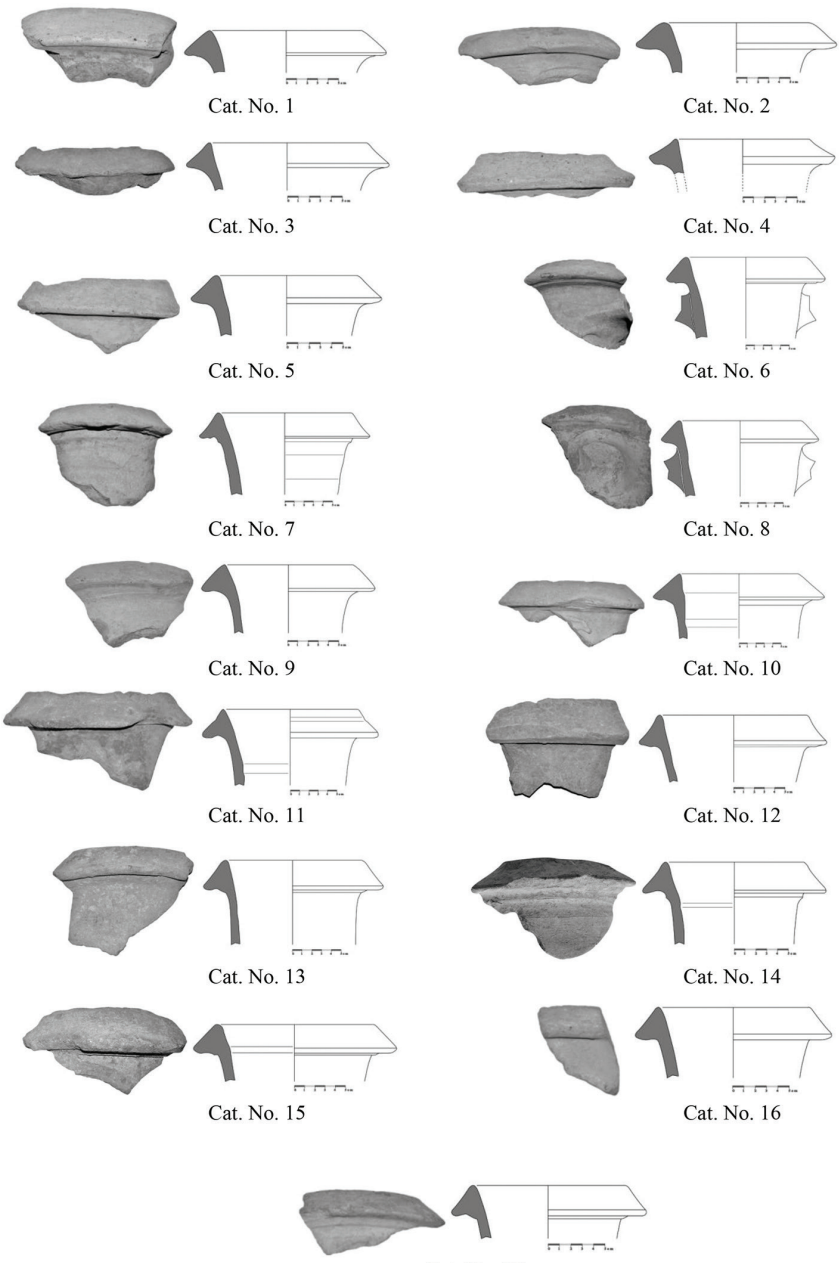

Fig. 3 Phocaea Form 1 Greco-Italic amphora rims.

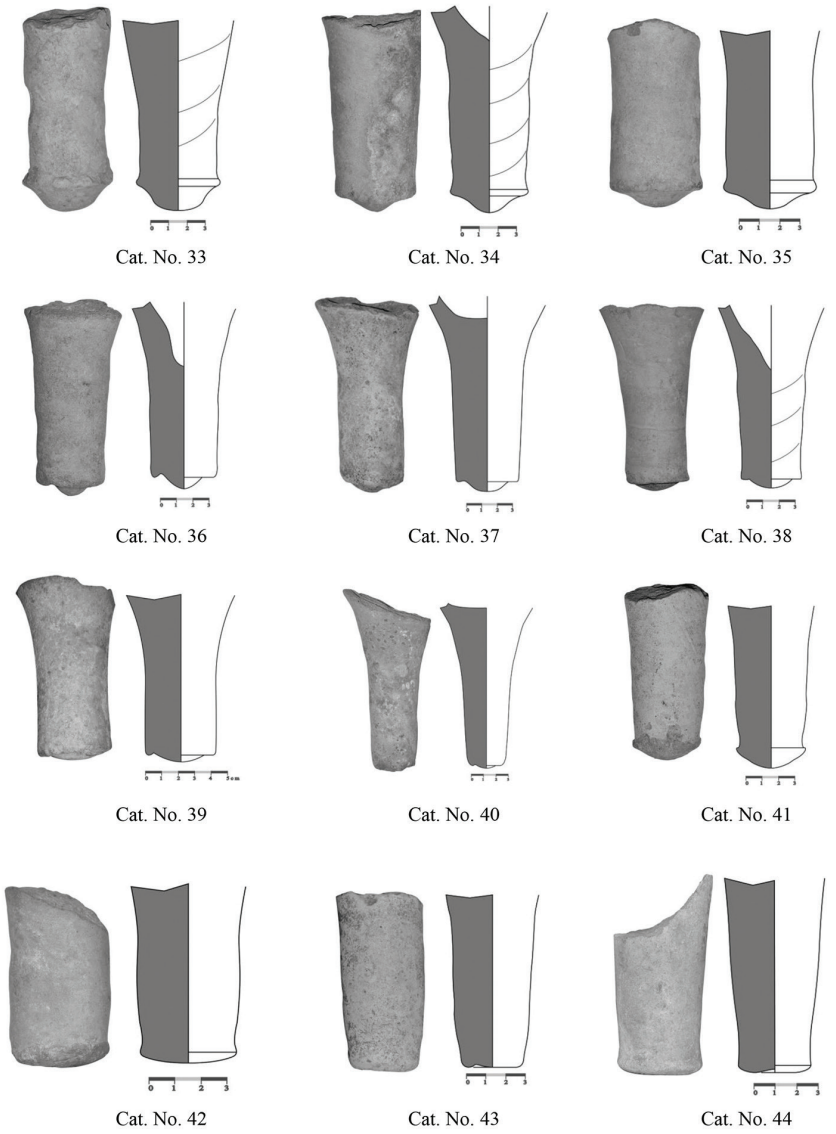

Fig. 4 Bases of Greco-Italic amphorae

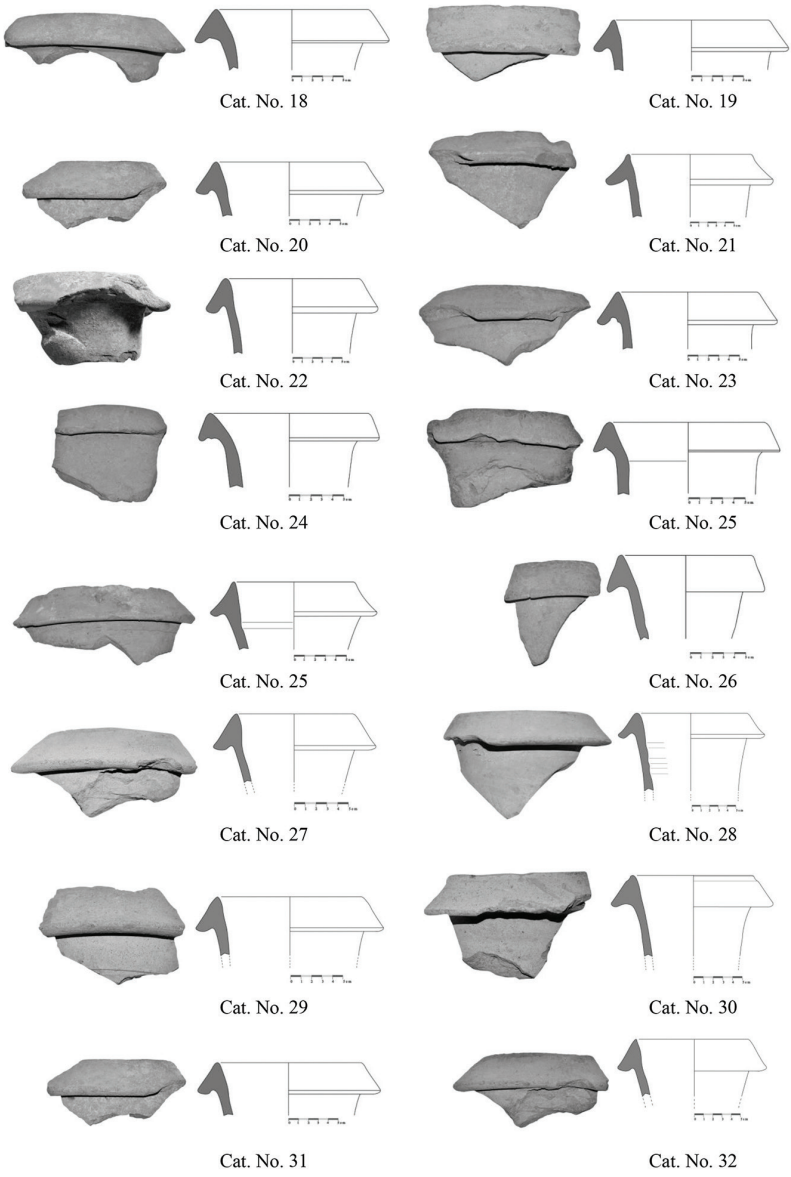

Fig. 5 Phocaea Form 2 Greco-Italic Amphora rims

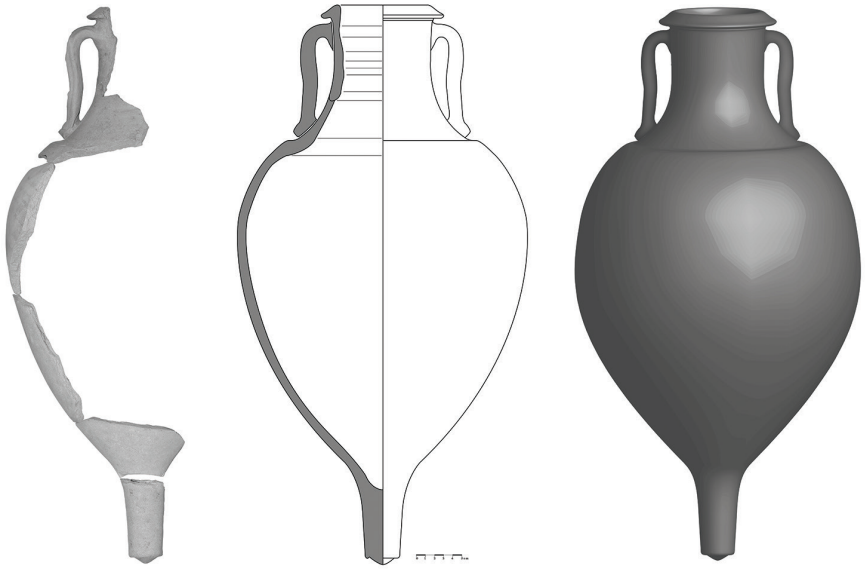

Fig. 6 The restitution of Phocaea Greco-Italic Amphora

Fig. 7 Defective production samples of Phocaea Greco-Italic amphorae

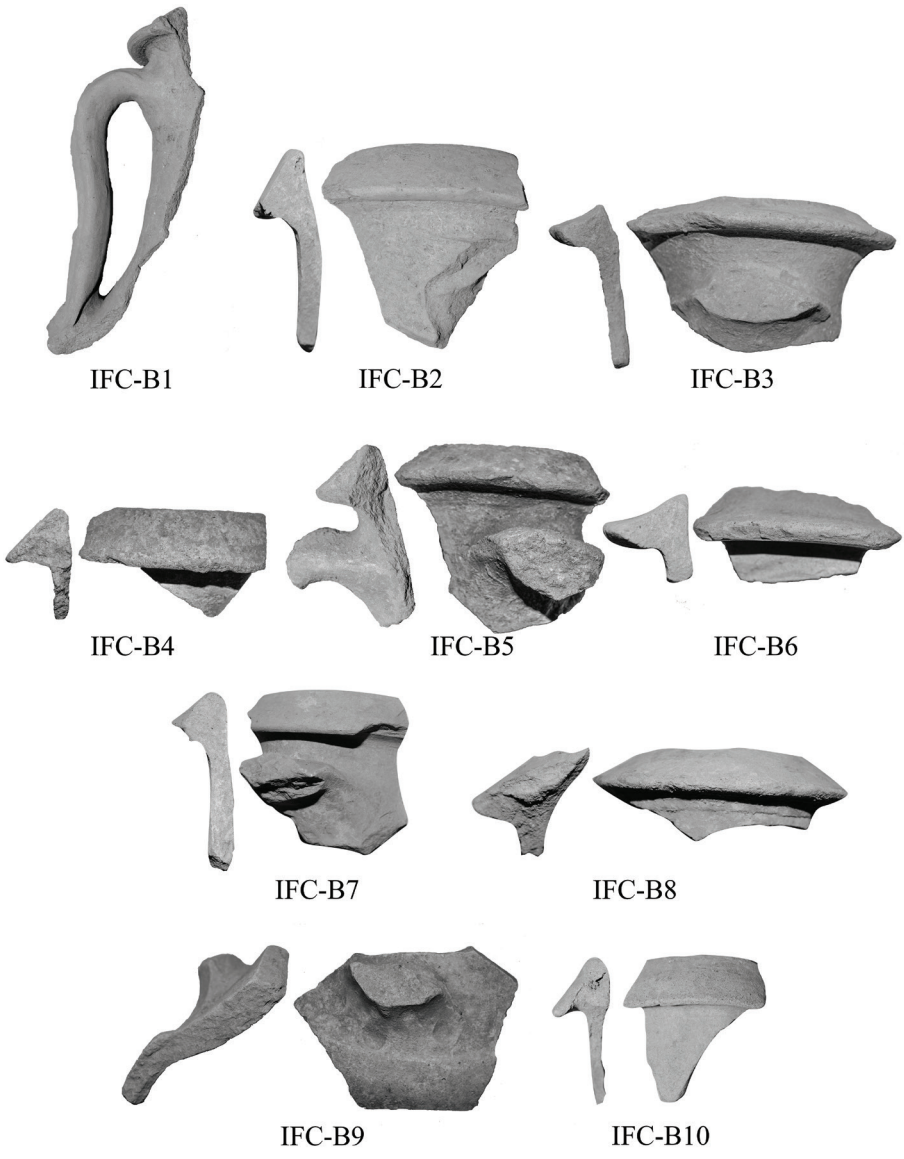

Fig. 8 Amphora fragments used for the clay analysis

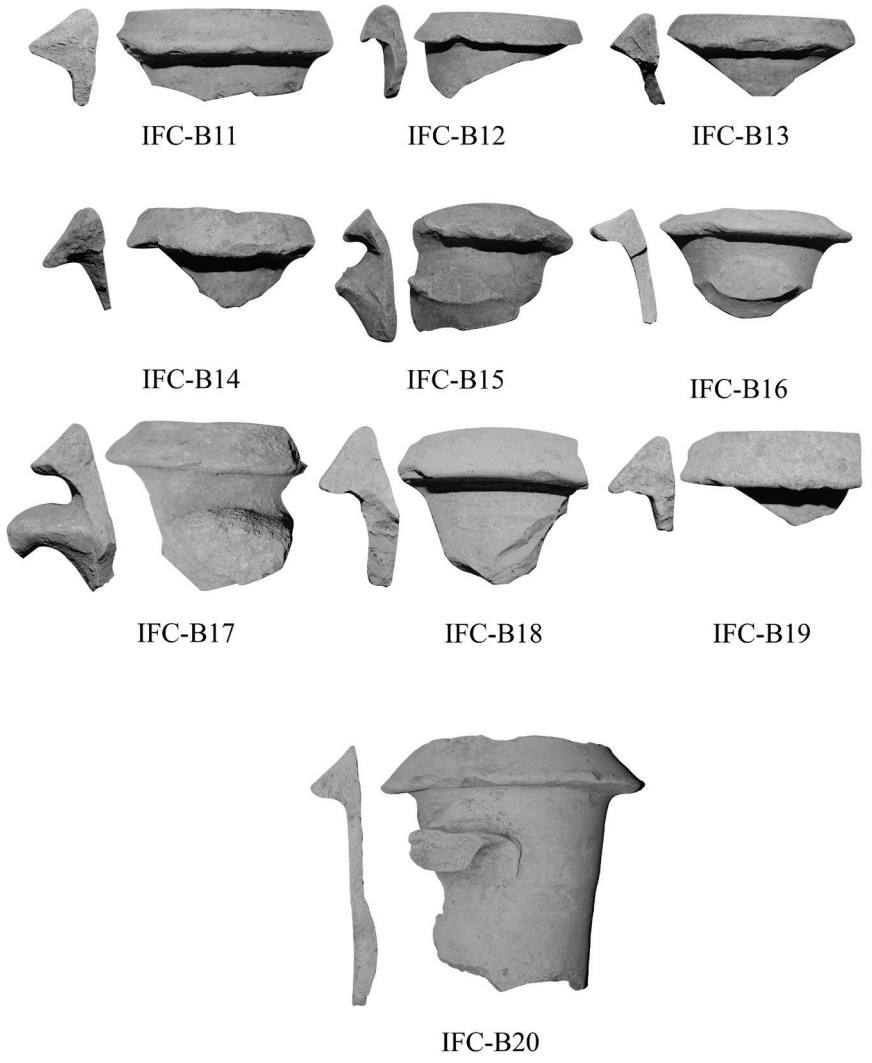

Fig. 9 Amphora fragments used for the clay analysis

Samples	Descriptions
IFC-B1	Phocaea 92, Maltepe tumulus trench 2, surface (1)
IFC-B2	Phocaea 92, Maltepe tumulus trench 2, stone fillers (2)
IFC-B3	Phocaea 92, Maltepe tumulus trench 3, in upper soil material (3)
IFC-B4	Phocaea 92, Maltepe tumulus trench 5, 2nd layer (4)
IFC-B5	Phocaea 92, Maltepe tumulus trench 5, 2nd layer (5)
IFC-B6	Phocaea 92, Maltepe tumulus trench 5, 2nd layer (6)
IFC-B7	Phocaea 92, Maltepe tumulus trench 5, 2nd layer (7)
IFC-B8	Phocaea 92, Maltepe tumulus trench 5, 2nd layer (8)
IFC-B9	Phocaea 92, Maltepe tumulus trench 5, 2nd layer (9)
IFC-B10	Phocaea 92, Maltepe tumulus trench 3, 1st layer (10)
IFC-B11	Phocaea 92, Maltepe tumulus trench s 5, 5th layer (11)
IFC-B12	Phocaea 92, Maltepe tumulus trench s 5, 5th layer (12)
IFC-B13	Phocaea 94, Maltepe tumulus trench 7, 1st layer (13)
IFC-B14	Phocaea 94, Maltepe tumulus trench 7, 1st layer (14)
IFC-B15	Phocaea 94, Maltepe tumulus trench 7, 1 st layer (15)
IFC-B16	Phocaea 94, Maltepe tumulus trench 9, 2nd layer (16)
IFC-B17	Phocaea 94, Maltepe tumulus trench 9, 2nd layer (17)
IFC-B18	Phocaea 94, Maltepe tumulus trench 9, 2nd layer (18)
IFC-B19	Phocaea 94, Maltepe tumulus trench 9, 1st layer (19)
IFC-B20	Phocaea 94, Maltepe tumulus trench 9, 1st layer (20)

Fig. 10 Descriptions of the Phocaea Greco-Italic amphora samples

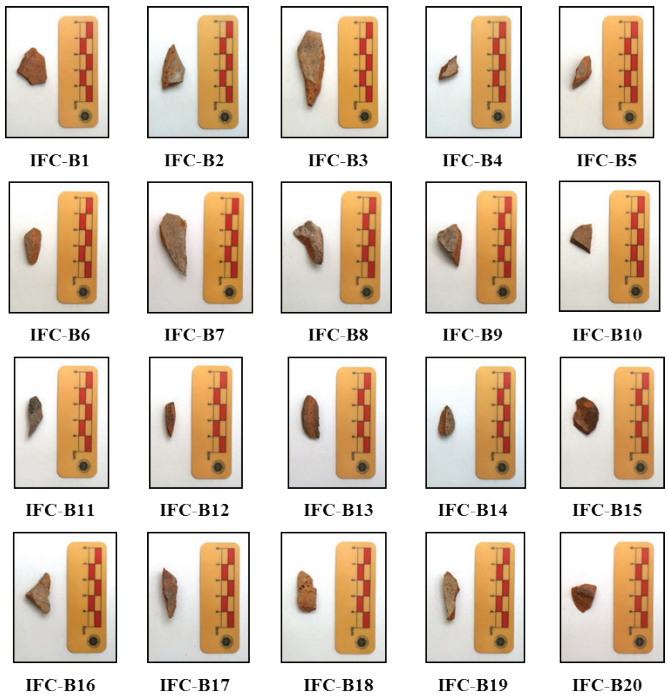

Fig. 11 Descriptions of the Phocaea Greco-Italic amphora samples

Samples	L	A	b	Thickness (mm)
IFC-B1	48.63	-5.31	23.74	4.47
IFC-B2	41.56	0.86	35.21	9.76 (max. 10.96)
IFC-B3	29.00	13.81	39.02	6.00 (max. 9.20)
IFC-B4	31.17	8.86	40.65	7.51
IFC-B5	26.71	19.29	37.09	9.34
IFC-B6	29.13	21.12	39.72	9.25
IFC-B7	28.60	23.31	39.36	9.63
IFC-B8	26.23	20.48	36.66	4.48 (max. 17.76)
IFC-B9	26.61	23.92	37.33	13.95
IFC-B10	26.99	14.71	33.78	6.86
IFC-B11	50.76	-3.52	35.37	5.19 (max. 6.08)
IFC-B12	51.95	1.90	37.07	8.09
IFC-B13	28.93	25.42	36.58	8.91
IFC-B14	41.29	-0.26	32.76	6.72 (max. 7.93)
IFC-B15	18.10	21.91	26.96	12.82
IFC-B16	26.61	23.92	37.33	8.15
IFC-B17	34.84	6.65	30.05	11.02
IFC-B18	25.08	19.80	35.35	10.13 (max. 20.83)
IFC-B19	32.97	15.25	42.73	8.32
IFC-B20	19.49	18.37	28.58	7.60
Average				**8.41**

Fig. 12 CIE colour codes (L*a*b*) and thickness of the amphora samples

Amphora Groups	T (°C)	P (%)	MTA (%)	Particle Dimension*	Rock Origin	Rocks & Minerals**
Aph. Gr1	900-950	5	22	Coarse	Sandstone	Q,Pl,Ch,By,Py,Op
Aph. Gr2	850-900	7	15	Mid	Sandstone	Q,Pl,Ch,By,Ms,Qs
Aph. Gr3	900-950	5	14	Coarsei	Sandstone	Q,Pl,Ch,Py,Op
Aph. Gr4	800-850	8	16	Mid	Alkaline Basalt	Q,Pl,Py

(*) Small / Mid / Coarse Aggregates (mm) : <0,5 / 0,5-1,0 / >1,0
T: Firing Temperature, P: Porosity, MTA: Matrix Total Aggregate Ratio, MTB: Matrix Total Binder Ratio
(**) A: Andesite, By: Biotite, Ch: Chert, D: Dacite, Ms: Muscovite, Op: Opaque Minerals, P: Porosity, Pl: Plagioclase, Py: Pyroxene, Q: Quartz, Qs: Quarzite

Grouping of the Amphora Samples:
Aph. Gr1 : IFC-B1, IFC-B3, IFC-B4, IFC-B5, IFC-B6, IFC-B7,
IFC-B11, IFC-B13, IFC-B14, IFC-B15, IFC-B18, IFC-B20
Aph. Gr2 : IFC-B2, IFC-B12, IFC-B16, IFC-B17
Aph. Gr3 : IFC-B8, IFC-B19
Aph. Gr4 : IFC-B9, IFC-B10

Fig. 13 Grouping of the amphora samples by petrographic thin section optical microscopy analysis

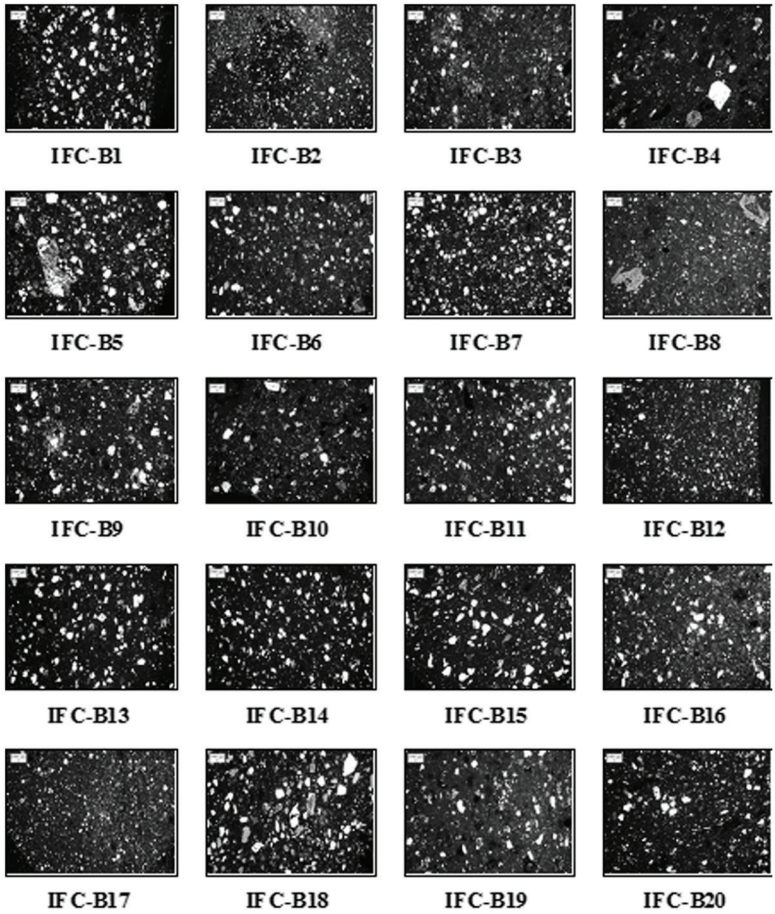

Fig. 14 Thin section microphotographies under optical microscopy

Element	Conc'n	IFC-B2	IFC-B3	IFC-B7	IFC-B9	IFC-B15	IFC-B17	IFC-B18	IFC-B20	Ort.
Na_2O		0.220	0.062	0.050	0.077	0.055	0.056	0.060	0.065	**0.081**
MgO		2.64	2.95	2.05	1.77	2.12	1.70	2.99	2.28	**2.31**
Al_2O_3		11.58	13.06	12.78	11.49	12.92	9.74	12.49	12.79	**12.11**
SiO_2		56.08	55.21	55.05	53.78	56.77	50.06	58.26	59.94	**55.64**
P_2O_5		0.163	0.299	0.242	0.282	0.485	0.111	0.160	0.300	**0.255**
SO_3		0.107	0.217	0.256	0.248	0.211	0.224	0.063	0.127	**0.182**
Cl		0.010	0.022	0.031	0.023	0.018	0.009	0.009	0.041	**0.021**
K_2O	%	2.41	2.38	2.29	2.35	2.37	2.11	2.47	2.57	**2.37**
CaO		11.17	15.33	8.92	10.65	8.25	9.59	10.59	7.78	**10.29**
TiO_2		0.623	0.622	0.587	0.579	0.620	0.473	0.615	0.609	**0.591**
V_2O_5		0.025	0.019	0.019	0.016	0.022	0.021	0.020	0.021	**0.020**
Cr_2O_3		0.018	0.012	0.017	0.031	0.047	0.021	0.031	0.023	**0.025**
MnO		0.067	0.091	0.079	0.106	0.076	0.270	0.071	0.111	**0.109**
Fe_2O_3		5.83	5.61	5.36	4.99	5.73	4.76	6.06	5.53	**5.48**
LOI*		9.06	4.12	12.28	13.62	10.30	20.85	6.11	7.82	**10.52**
Co		51.4	38.8	13.5	38.8	37.6	24.7	33.4	26.3	**33.1**
Ni		54.3	42.3	38.1	32.1	42.7	34.5	57.4	42.1	**42.9**
Cu		28	26.8	21	28.7	27.6	13.6	29.3	21.6	**24.6**
Zn		96.7	87.5	73.9	83.4	84.3	67.1	94.8	90	**84.7**
Ga		17.7	18.9	18.1	19.4	22.2	17.8	23.1	19.5	**19.6**
Ge		2.4	0.8	1	2	2.2	0.8	2.3	1.7	**1.7**
As		7	12.6	12.3	16.3	11.8	11.3	7.7	8.4	**10.9**
Se		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	**0.3**
Br		1.7	2.8	3.7	4.9	3	0.9	1.3	1.8	**2.5**
Rb		126.2	143.4	122.1	142.7	136.3	129.5	131.3	150.4	**135.2**
Sr		276.4	398.3	272.3	504.8	307.9	307.3	274.7	298.4	**330.0**
Y		23.9	22.8	18.8	26.9	23.5	23.6	25.2	32.1	**24.6**
Zr		204.1	208.2	178.9	216.8	189.9	267.5	182.2	263.7	**213.9**
Nb		15.7	20.1	20.4	21.2	20.9	27.5	15.1	29.3	**21.3**
Mo		7	2.8	2.4	3.8	3	2.9	3.3	4.5	**3.7**
Cd		1	0.9	0.8	1.1	1	1.4	0.8	0.9	**1.0**
In		1	0.8	0.8	1	0.9	1.1	1	0.9	**0.9**
Sn	ppm	1.3	2	3.1	2.8	3.9	3.9	3.4	3.8	**3.0**
Sb		1.1	1	0.9	1.3	1.1	1.2	1	1.1	**1.1**
Te		1.5	1.2	1.2	1.7	1.4	1.7	1.4	1.5	**1.5**
I		2.6	2.2	2.2	3	2.7	3	2.5	2.7	**2.6**
Cs		6.5	6.3	5.2	5.6	9.2	6.3	7.8	5.1	**6.5**
Ba		418.3	489.8	498.8	735.6	548	645.2	422.6	488.4	**530.8**
La		41.3	40.4	32.1	46.8	45.7	54.8	36.3	42	**42.4**
Ce		73.3	82.8	70.9	92	71.8	141	83.4	94.4	**88.7**
Hf		6.4	3.4	6.7	8.1	3.4	6	2.9	7.5	**5.6**
Ta		3.5	3.5	3.1	3.5	3.4	2.8	3.7	2.5	**3.3**
W		2.9	2.9	2.7	2.6	5.3	2.4	2.9	2.8	**3.1**
Hg		0.9	0.8	0.8	0.9	0.8	0.8	0.9	0.8	**0.8**
Tl		0.9	0.9	0.5	0.9	0.9	0.7	1	1.1	**0.9**
Pb		23.6	35.3	29.4	31.5	29.5	29.1	30.7	33.2	**30.3**
Bi		0.6	0.5	0.7	0.7	0.7	0.6	0.9	0.6	**0.7**
Th		11.9	19.3	14.4	15.3	17	14	12.2	17.4	**15.2**
U		7.5	9.4	5.9	7.2	7.5	5.8	7.2	7.8	**7.3**

Fig. 15 Main and trace elemental composition of the amphora samples by PED-XRF analysis

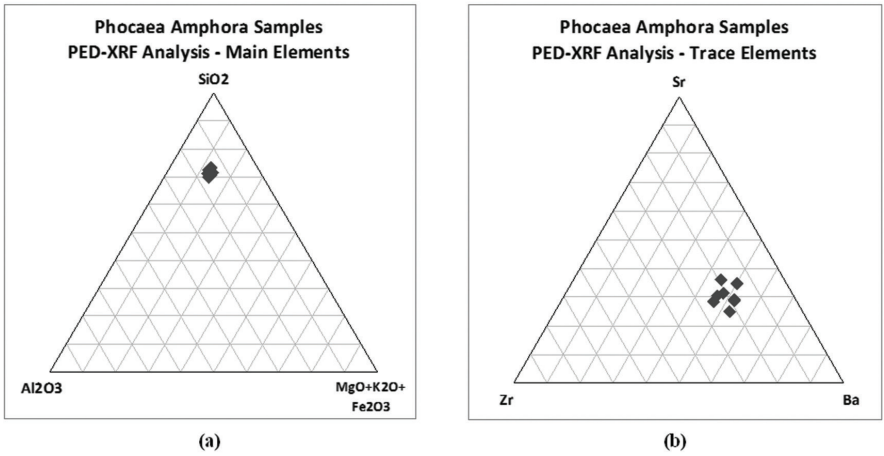

Fig. 16 Main and trace elemental composition of the amphora samples by PED-XRF analysis, Grouping of the amphora samples with their main (a) and trace (b) element compositions by PED-XRF analysis using Triangle Plotting