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Greco-Italic Amphorae from the Punta Romana Shipwreck (Sardinia – Italy)

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ABSTRACT

The remains of the amphorae cargo wrecked close to Punta Romana (Capo Ferrato – Sardinia) has been analyzed through archaeological comparison with well-known typologies, and also by mineralogic, petrographic and chemical analyses in order to ascertain the provenance of the ceramics. The fragments have been identified as Greco-Italic amphorae types MGS III and MGS III–IV produced in the Ischia and Campania kilns in the 4th–3rd century BC. SEM-EDS analyses confirmed the origin from the Campania region, while petrography and XRD analyses allowed two different production areas of the shipwreck cargo to be ascertained, namely: the Lacco Ameno furnaces on the island of Ischia; and the furnaces operating in the Capua district.

1. Introduction

The ceramics analyzed come from the shipwreck of Punta Romana that is located on the coast of Capo Ferrato (Muravera – Sardinia) at a depth ranging from about 12 to 25 metres. The archaeological remains are dispersed over a wide area owing to the force of the waves impacting on the basaltic rocks of the promontory and the residual ceramics are deeply fragmented. However, contrary to their theft by divers and the destructive activity of the sea, several fragments of diagnostic value may still be found among the seabed rocks (Figure 1), often protected by the *Posidonia oceanica* seagrass growing about the site. The possible presence of a shipwreck is announced by the presence of two iron anchors lying a few metres away, though yet unstudied, while there is no evidence of any wooden remains of the hull.

Although the site has been known from some time ago, the wreck has never been studied and its existence is only mentioned in the list of shipwrecks pertaining to the

Mediterranean by Gianfrotta and Pomey (1981); however, underwater exploration of the coast from Capo Ferrato to Villasimius has confirmed that the wreck noticed by these two authors probably refers to a Roman shipwreck with a cargo of bricks and tiles lying offshore the small Isola dei Cavoli in front of the Villasimius harbor.

The survey carried out in 2011 along the coast of Capo Ferrato (Figure 2) ascertained the wide dispersion of the cargo and gave an opportunity to sample some significant elements that referred to the same pottery typology, which was recognizable as Greco-Italic amphorae.

1.1 The Greco Italic amphorae

The term “Greco-Italic” was used for the first time in the 1950s by Fernand Benoit (1958) to define a group of 400 amphorae discovered in several underwater sites close to Marseilles (Will 1982). The studies regarding this peculiar typology of ceramic containers started with the development of underwater archaeology, since the amphorae are the most abundant artefacts comprising the cargo of shipwrecks. In particular, the Greco-Italic amphorae represent the principal

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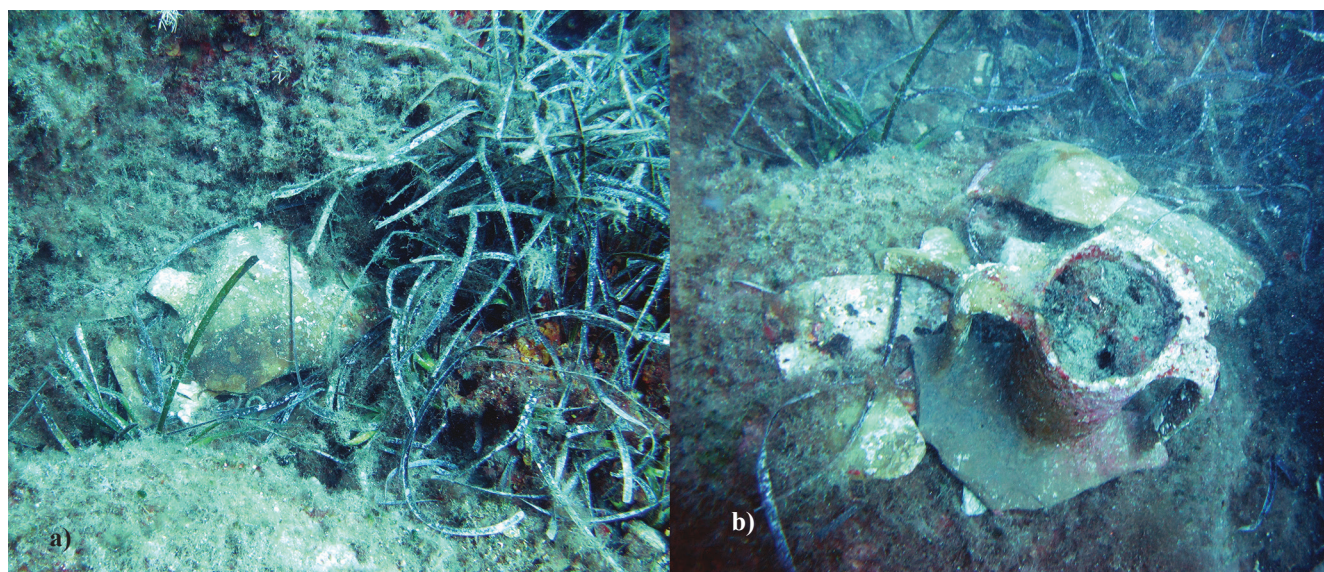


Figure 1. The amphorae fragments in their seabed location: a) Sample PR4; b) Sample PR1.

container used between the 4th and 2nd century BC for the commerce of wine in the Mediterranean area, as confirmed by a synthetic analysis on the diffusion of the Greco-Italic amphorae in the Mediterranean basin made by Rossi (2000) with particular reference to finds recovered during the excavation of the Ancient Harbour of Pisa.

As reported by Long (1987), Greco-Italic amphorae of the Grand Congloué shipwreck can be dated back to between the end of the 3rd and start of the 2nd century BC. The same dating is proposed by Costantini (2011) for fragments recovered in the excavations of Piazza Duomo in Pisa, although the production of this peculiar typology of amphorae started in the 4th century BC. However, the profile of the rim of the

amphorae from the latter two sites differs from that of the fragments collected in the Capo Ferrato site (Figure 3) owing to the different inclination of the lip.

According to several authors, the shape of the Greco-Italic amphorae modified over time owing to their different areas of production as well as their dating. The most evident modifications involved both the rim profile and the base, while the body shape is quite invariant (Py *et al.* 2001).

An overview of the archaeological questions related to these materials was provided by Olcese (2007) and the most important ones are connected to the identification of their origin (Greece or Greek colonies of the south of Italy) and the localization of the production centres of this typology

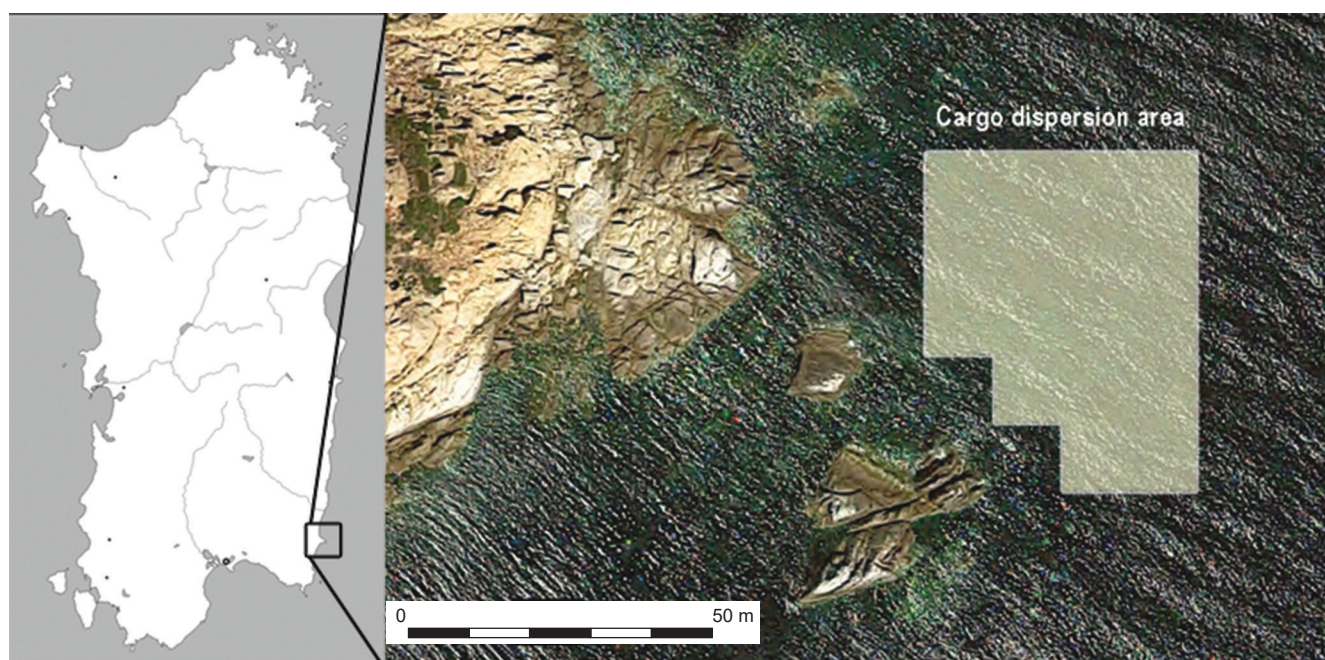


Figure 2. The area investigated with the underwater survey (from Google Maps).

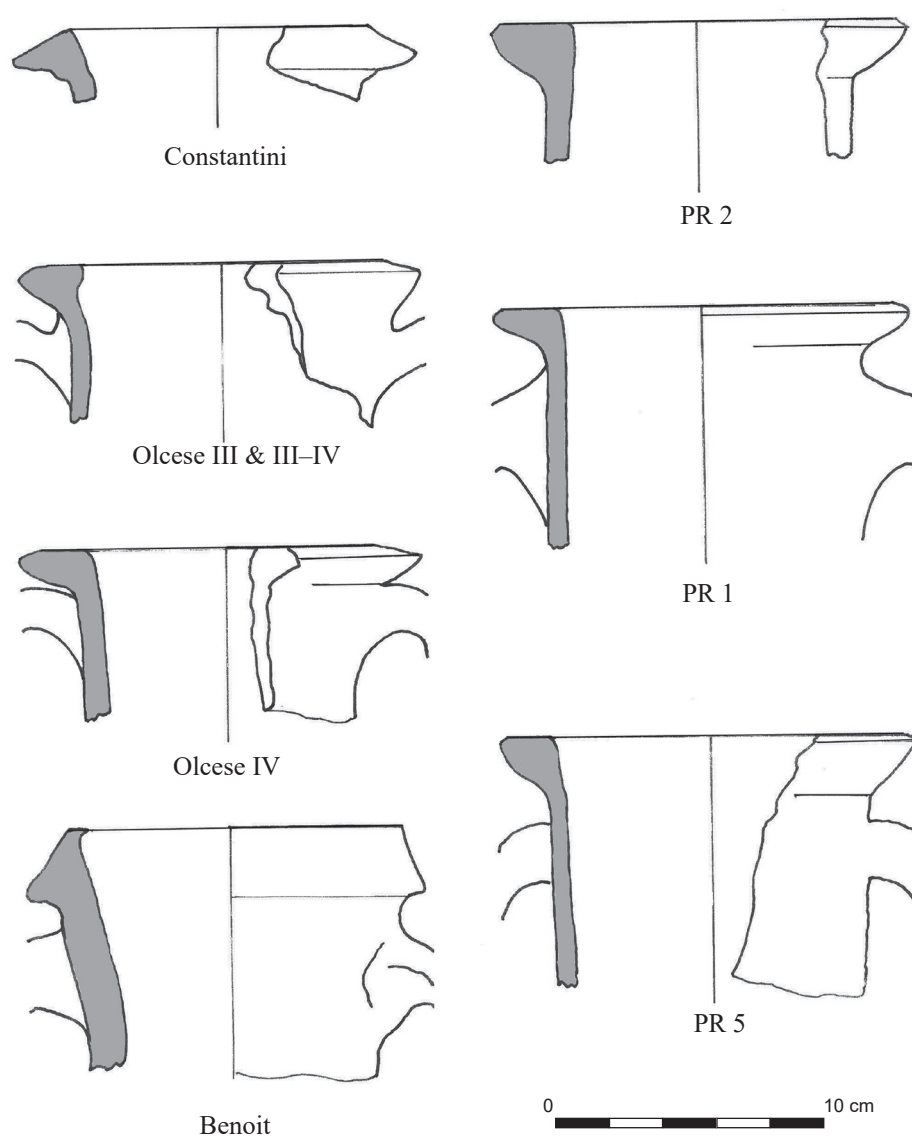


Figure 3. Rim types of the Greco-Italic amphorae from several sites and authors. Elaborated by the authors from Costantini 2011, Olcese 2012 and Benoit 1958.

of amphora. At present, many production areas have been localized – varying from the southern regions of the ancient Etruria to the Gulf of Naples in the so-called Tyrrhenian volcanic belt (Cibecchini, Capelli 2013). However, most of the production areas are concentrated in southern Italy, such as in Campania and Sicily, according to Olcese (2012), who recognized several interesting production furnaces on the island of Ischia, among which our samples may probably be located. In particular, looking at the rim shape, the fragments from Punta Romana seem to be very similar to those of the Lacco Ameno types MGS III and MGS III–IV dating back to the 4th–early 3rd century BC.

Referring to this chronological and typological framework, one of the goals of the present work is to find the archaeometric data necessary to individuate the most probable provenance of the Greco-Italic amphorae found in the site of Punta Romana.

2. Materials and methods

The analyzed ceramics can be ascribed to the Greco-Italic type, with peculiar reference to the MGS III or MGS III–IV typology ascribed by Olcese (2012) to the production of Ischia that dates back to the 4th–3rd century BC. In particular, the fragments pertain respectively to a base (PR6), two edges with part of the neck (PR2 and PR5), two shoulders with part of the handles (PR3 and PR4) and the upper part of an amphora with handles and part of the rim (PR1); all samples are shown in Figure 4. The diagnostic fragments recovered for documentation and sampling have been relocated to their original places in order not to modify the archaeological significance of the site.

Petrographic analysis were carried out on six thin sections, which were obtained by embedding small fragments extracted from the samples into synthetic resin, using a polarizing

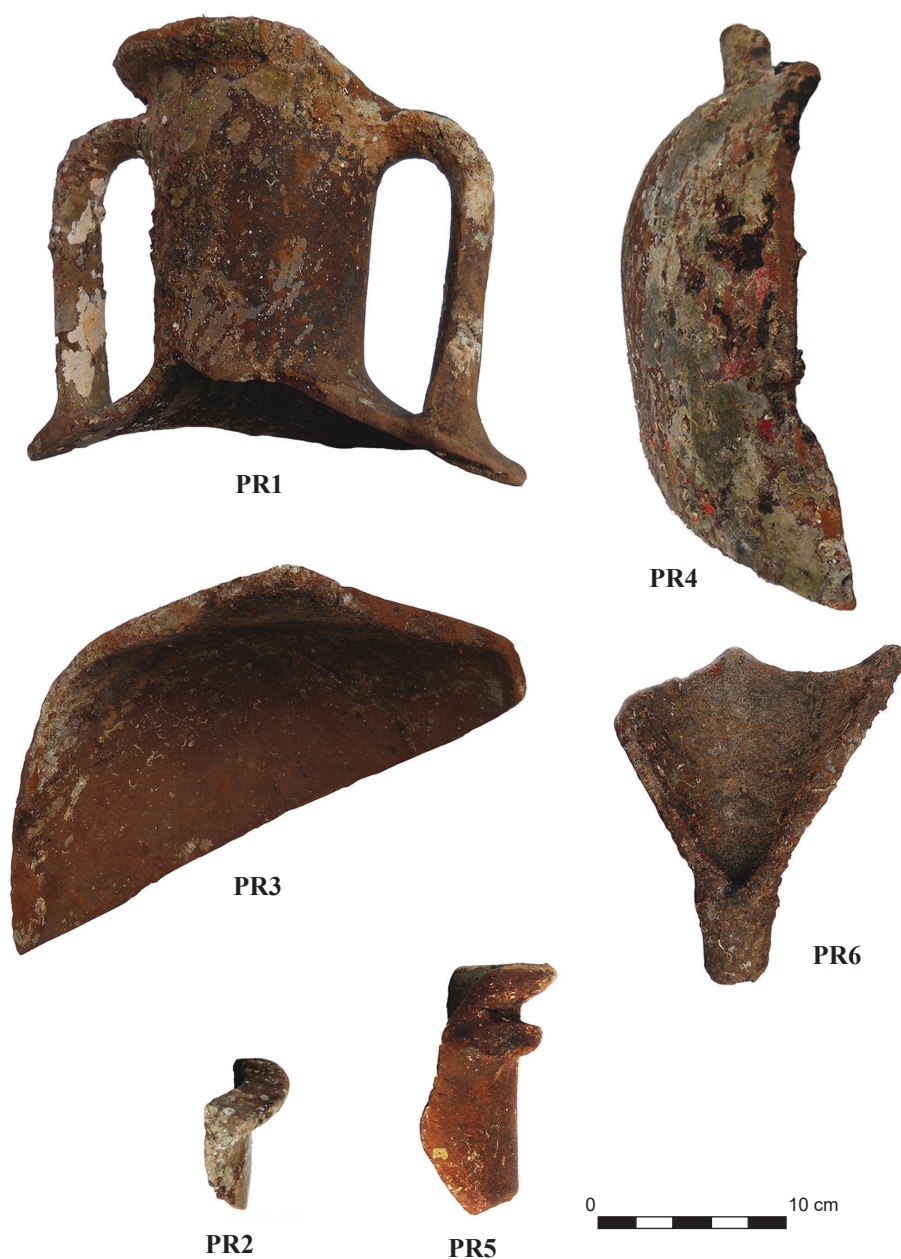


Figure 4. Diagnostic materials from the Punta Romana shipwreck site.

microscope Leitz Ortholux II to obtain information on the characteristics and mineral composition of the ceramic paste.

The mineralogical composition of the powdered samples has been established in random conditions by X-Ray diffractometry by means of a Seifert instrument equipped with an X-Ray tube using Cu k-alpha radiation ($\lambda = 1.5405 \text{ \AA}$). The specimens were analyzed in the 2θ range from 4° to 65° and a scanning angle rate of $0.02^\circ/\text{min}$.

The chemical composition has been obtained by SEM-EDS, using a LEO1450VP microscope equipped with a microanalysis system INCA 300 for quantitative determination, analyzing (three measurements for each sample) the random powdered samples properly compacted

on an adhesive support in order to have a flat surface that reduces the influence of the sample geometry and enables all analyses to be performed in the same conditions.

3. Results

Comparing the mineralogical composition obtained by XRD analyses confirms that the ceramics are similar in terms of temper contribution. Indeed, quartz predominates in all samples, while calcite remains in the minority along with dolomite (Figure 5). K-Feldspars and plagioclases are mixed in comparable quantities confirming that the temper fraction

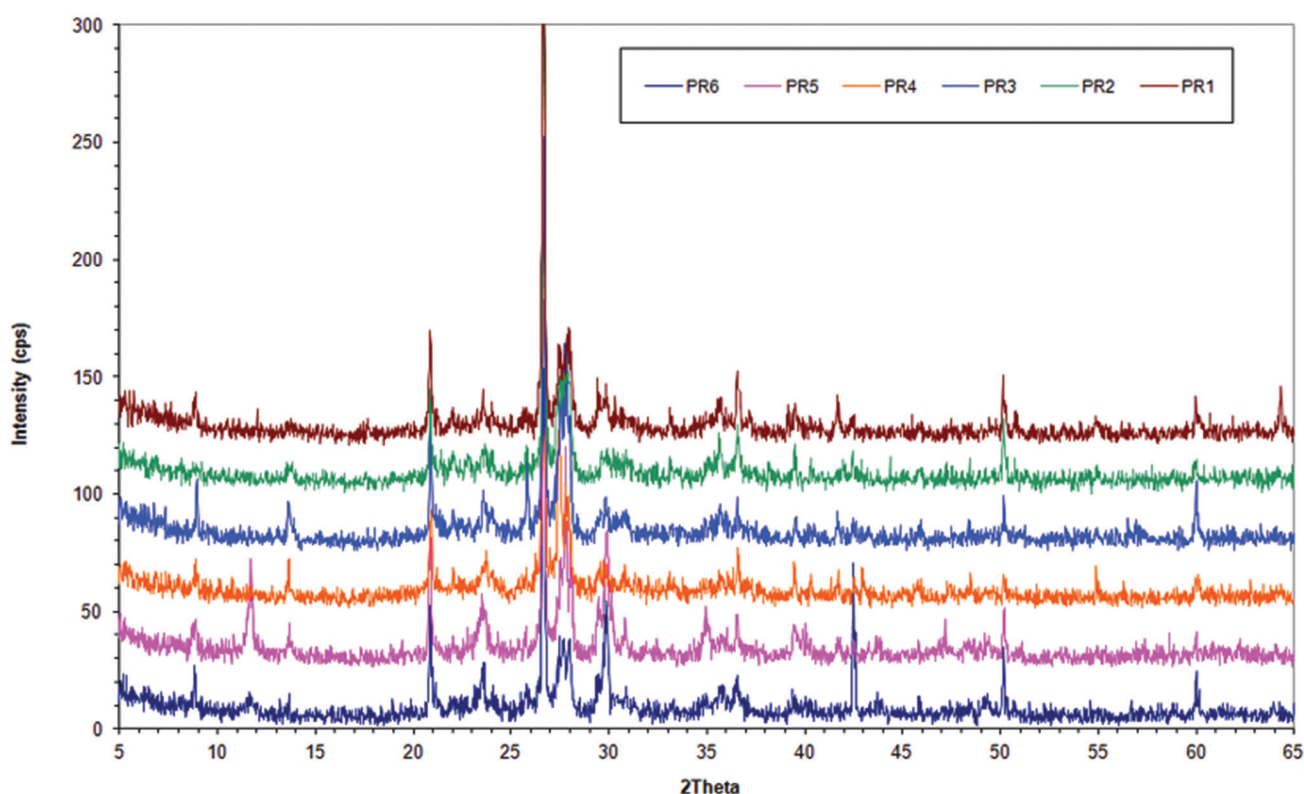


Figure 5. Comparison of the random XRD spectra of the ceramic samples.

was probably obtained by mixing sands from different origins, as confirmed by the presence of pyroxenes that come from volcanic areas.

The composition of each sample has been better ascertained by petrographic analyses performed on thin cross-sections. Figure 6 illustrates the most important characteristics of the samples, summarized in Table 1.

Samples PR5 and PR6 show only an optically-active matrix containing both microcrystalline calcite and quartz, as well as micas. Micro-fossils are also present in these samples, confirming that the clay comes from a depositional basin. As for their temper composition, the rocks commonly present are limestone, generally in semi-rounded particles, and round fragments of olivine-basalt, sometimes mixed

Table 1. Results of the petrographic analyses. Legend: Colours indicate pertinence to the same class of component, as well as their presence in the sample.

Sample		Matrix						Temper																
		Isotropic	Micritic			Fossils			Rocks						Minerals									
			Calcite	Quartz	Micas	Globigerinae	Mollusk	Algae	Limestone	Olivine Basalt	Phonolite	Quartzite	Pumice	Volcanic Glass	Quartz	K-Feldspars	Plagioclases	Orthopyroxenes	Clinopyroxenes	Olivine	Iddingsite	Biotite	Muscovite	Hematite
PR 1	YES																							
PR 2	YES																							
PR 3	YES																							
PR 4	YES																							
PR 5	NO																							
PR 6	NO																							

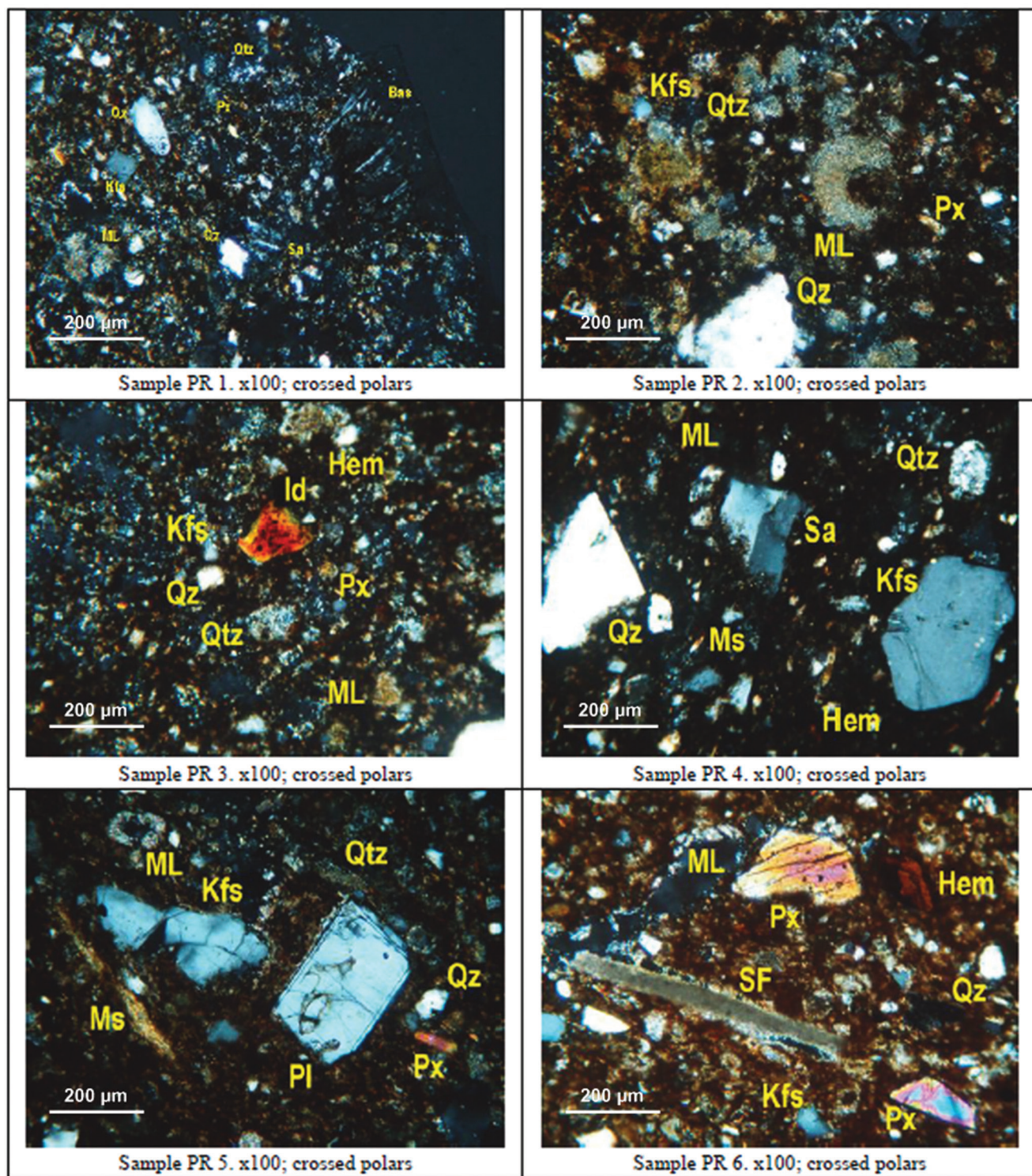


Figure 6. Petrographic analysis separates out the components of the temper, and the optical properties of the matrix. Legend: Bas = Basalt, ML = Micritic Limestone, Qtz = Quartzite, Hem = Hematite, Id = Iddingsite, Kfs = K-Feldspar, Ms = Muscovite, Pl = Plagioclase, Px = Pyroxene, Qz = Quartz, Sa = Sanidine, SF = Shell Fragment.

with pumice and volcanic glass; the phonolite and quartzite are generally angularly shaped. Quartz and K-feldspars are abundant in the mineral fraction, with sanidine prevailing among the microcline and orthoclase. Plagioclases are also diffused in the temper and may be attributed to albite

and labradorite, which are the main components of basalt. Pyroxenes are present in their different varieties, but diopside is the most abundant, as confirmed by the XRD analyses. Olivine is often altered to iddingsite, and may be used as a marker component. By contrast, micas are ubiquitous and do

Table 2. Chemical composition of the analyzed samples (wt % \pm 0.1%).

Sample	SiO ₂	Al ₂ O ₃	CaO	Fe ₂ O ₃	MgO	Na ₂ O	K ₂ O	TiO ₂	Sum
PR1	53.9	17.4	9.5	6.5	6.9	2.4	2.8	0.7	100.0
PR2	57.4	15.0	7.5	9.8	4.3	2.3	2.7	1.1	100.0
PR3	55.9	14.3	9.6	10.9	3.6	2.5	2.5	0.5	100.0
PR4	54.1	16.8	10.1	7.3	4.8	2.6	3.2	0.9	100.0
PR5	46.5	16.4	15.9	6.7	9.4	1.6	2.7	0.7	100.0
PR6	51.1	16.2	14.6	6.8	6.2	1.5	2.7	0.8	100.0

not have diagnostic significance, as does hematite, due to the firing temperature and conditions, and calcite, which is of secondary origin.

The chemical composition of the samples from the SEM-EDS analyses is summarized in Table 2.

From the table, it clearly appears that all samples have the same composition except for the CaO content of samples PR5 and PR6, where MgO is also higher than in the other samples owing to the presence in the temper of traces of dolomite, as confirmed by the XRD analyses.

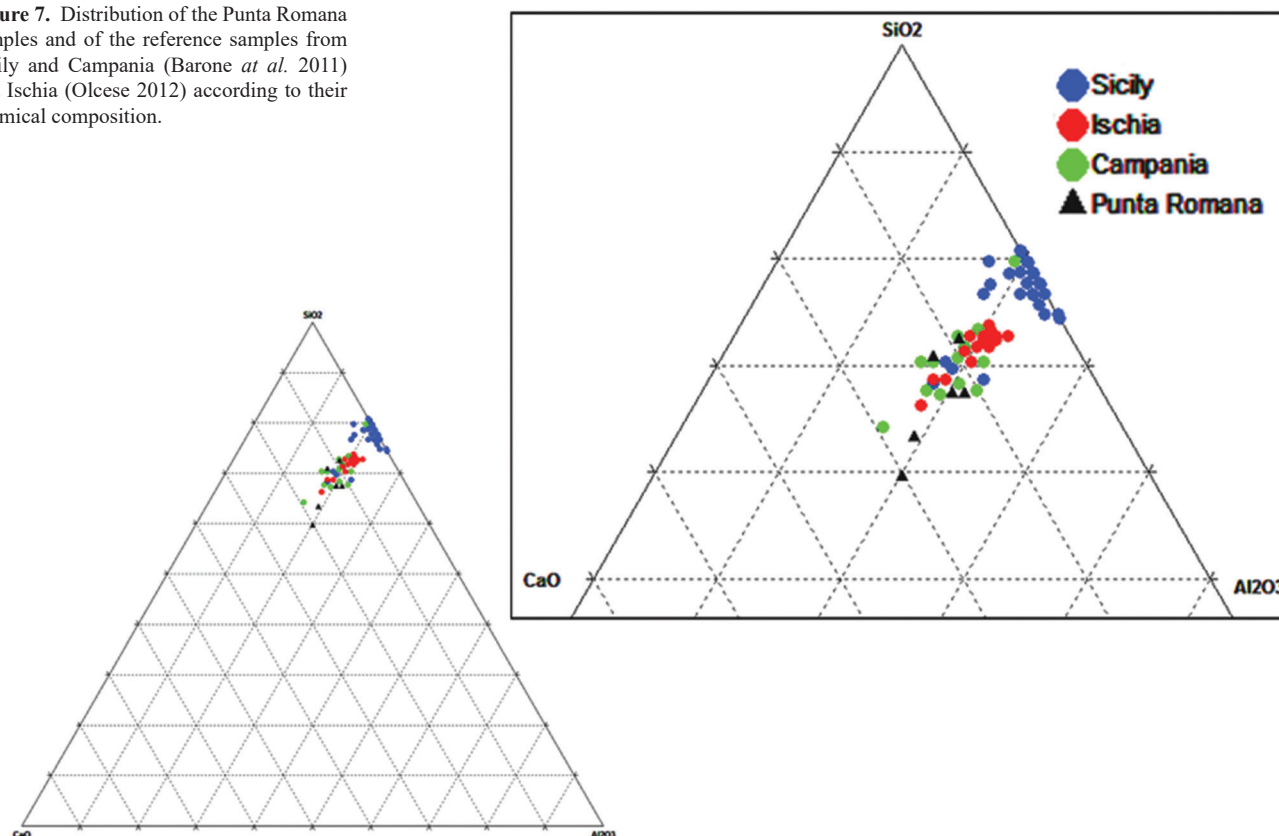
4. Discussion

The analytical results make it possible to divide the samples into two groups. The first cluster contains the samples from PR1 to PR4 and is characterized by their isotropic matrix and

the presence in the temper of olivine degraded to iddingsite, which is the result of the transformation of olivine under hydrothermal conditions. This mineral is relatively common in the volcanic outcrops of Ischia (Fedele, Morra 2011), where the strong hydrothermal activity activates this process.

The second cluster only contains the samples PR5 and PR6 and is characterized by an optically-active matrix due to the contemporary presence of micritic calcite and fossils that may be referred to Foraminifera and sporadically to Mollusks and Algae. This implies the use of a clay formed in an alluvial environment like that of the Volturno river basin in the Capua district (De Bonis *et al.* 2013), where, in ancient times, many outcrops of clay were cultivated for the extraction of the raw material for the production of ceramics, as confirmed by De Bonis (2010). Thus, the analytical data allows the hypothesis of a dual provenance for the Punta Romana amphorae, both located in the Gulf of Naples area:

Figure 7. Distribution of the Punta Romana samples and of the reference samples from Sicily and Campania (Barone *et al.* 2011) and Ischia (Olcese 2012) according to their chemical composition.



the first cluster comes from Ischia, while the second comes from the Capua region, according to the information reported in De Bonis *et al.* (2014).

Comparison of the chemical composition of the Punta Romana samples with those extracted from the literature of authors that extensively studied the Greco-Italic amphorae production confirms this hypothesis.

Indeed, the ceramics produced in Sicily are located in a very restricted cluster (Figure 7) characterized by the highest content of SiO_2 (Barone *et al.* 2011). By contrast, the Campania productions describe a larger cluster that also contains the amphorae produced in the furnaces of Ischia (Olcese 2012); indeed, the latter refer to the III and III–IV rim types that are similar to that of the Punta Romana shipwreck and were produced in the Santa Restituta kilns in the Lacco Ameno district. As in the figure, the first cluster of Punta Romana amphorae is included in the Ischia production, while the second cluster is located at the boundaries of the large Campania cluster owing to its high content of CaO.

The distribution of CaO wt% content against SiO_2 (Figure 8a) verifies that the quality and origin of the clays differ according to their origin. The Greco-Italic

amphorae produced in Sicily contain very low calcite, while the calcium content increases in the productions from the Campania region, including the Ischia types that are intermediate. However, the content values of CaO and SiO_2 vary with good correlation, confirming that the composition of the raw material deeply affects the chemical composition of the fabric. Figure 8b highlights how the composition of the temper fraction affects the distribution of the ceramics; indeed, the high content of the aluminum oxide in the Campania productions suggests that, in this case, the temper content is greater than in the Sicilian production, but also that the mineral composition differs as well. This is confirmed by Figures 8c and 8d, where the content of CaO and K_2O , respectively, are shown against the Na_2O content. In both cases, the Sicilian productions differ from that of the Campania region in their abundance of calcite (Figure 8c), and because the Campania productions are richest in plagioclases owing to the different acidity of their volcanic district of origin. In all cases, the samples from the Punta Romana shipwreck locate to the Campania production cluster and are very close to the samples fired in the kilns of Ischia.

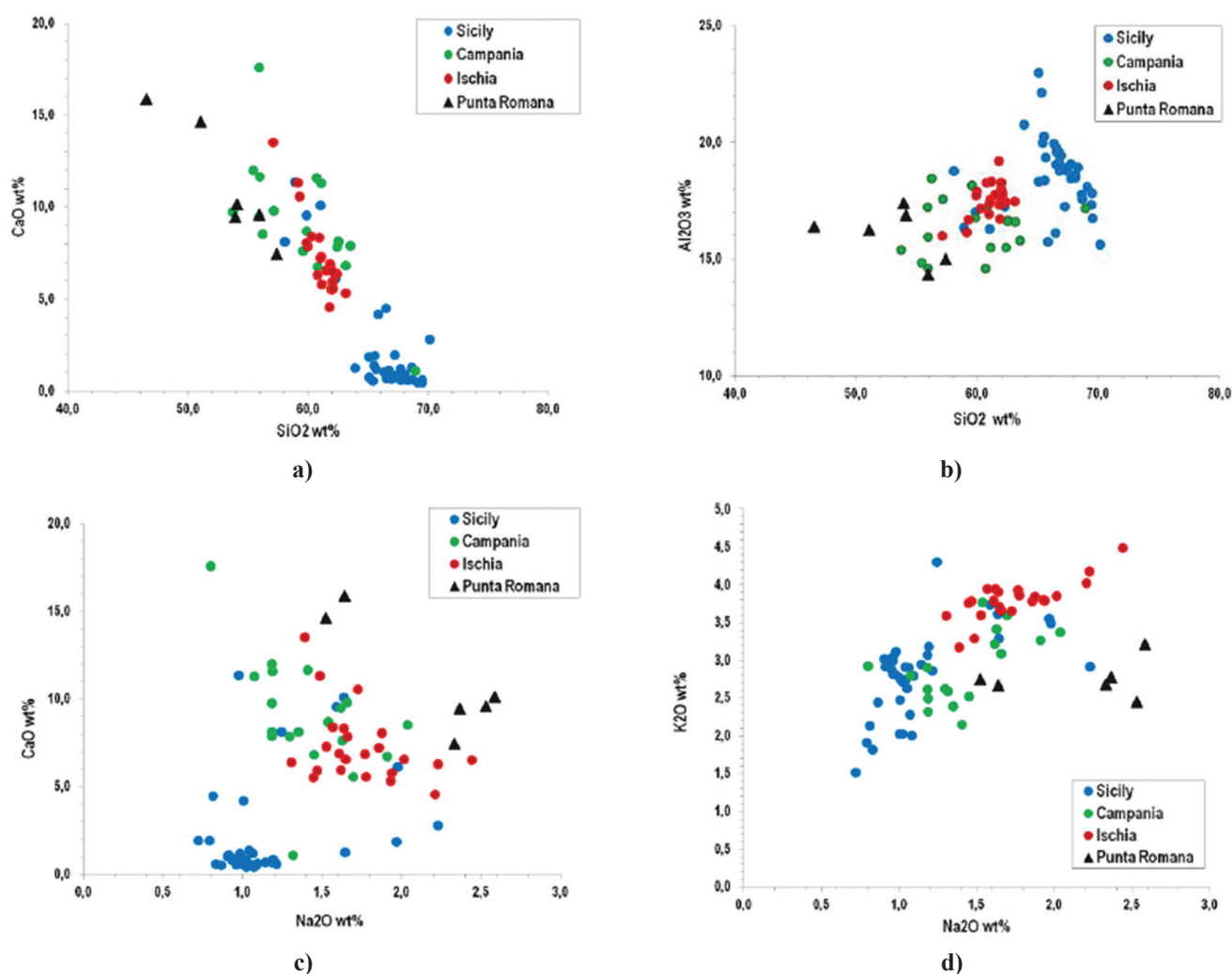


Figure 8. Different correlation graphs among some chemical components of the Greco-Italic amphorae.

5. Conclusion

The comparison of the Punta Romana fragments with Greco-Italic amphorae produced in the Lacco Ameno (Ischia) furnaces induces the hypothesis that the shipwreck cargo pertains to the III and III–IV types dating back to the 4th century BC. (Olcese 2012).

The chemical composition data confirm that all samples from Punta Romana were produced in the Campania region, but also that they pertain to two different production centres. Samples PR1, PR2, PR3 and PR4 were produced in the furnaces of Ischia, as confirmed by the presence in the temper fraction of olivine transformed to iddingsite, according to the hydrothermal conditions of the island. By contrast, although the rim shape is the same, samples PR5 and PR6 were produced in the Capua district where marl-clay containing Foraminifera outcrops extensively. Thus, the Punta Romana cargo seems to be mainly composed by amphorae coming from the Campania region, which is also where they have been produced. As for the commercial route, in the absence of exhaustive archaeological studies of the site, we may only hypothesize that the ship was sailing along the oriental coast of Sardinia following a route well protected from the NW wind. This route seems to be preferred by ships heading towards the harbour of Olbia, which had been the centre of the maritime traffic starting from the 6th century BC (D’Orlando 2004), but also by those headed towards the Massilia harbour that was preferably reached sailing along the Tirrenian coast (Cibecchini 2011). As for the 1st century AD shipwreck found in 1992 only three miles to the south of Punta Romana (Salvi 1994), it is impossible to ascertain the final destination of the Punta Romana ship; however, the Campania origin of the cargo allows to hypothesize that this region was probably the starting point of their journey. Owing to the ascertained use of the Greco-Italic amphorae for transporting wine, the finds of Punta Romana may contribute towards the confirmation of the importance of the routes of eastern Sardinia for the wine trade in the Mediterranean world.

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