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285

Maja MIŠE

PERSPECTIVES OF ARCHAOMETRIC ANALYSIS ON THE HELLENISTIC WARE FROM THE EAST ADRIATIC COAST

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In this paper, the author discusses about the challenges and perspectives of archaeometric analysis on the Hellenistic ware on the East Adriatic based on hitherto published analysis. Diversity of Hellenistic types of ware – in shapes, colour of coatings and decorations – show differences in technological process, that can be understood through analysis in both archaeological and archaeometric methods. The archaeometry increasingly plays an important role in the study of archaeological artefacts, and it is necessary to stress out the importance of the integrated archaeological – archaeometric methodological approach. The author will propose, on the examples of Hellenistic ware production on East Adriatic coast, how to integrate archaeological and archaeometric analysis in researches and studies on ancient pottery production.

Key words: archaeology, archaeometry, Hellenistic ware, East Adriatic coast, fine and coarse ware

INTRODUCTION

Archaeological science – archaeometry¹ increasingly plays an important role in the study of archaeological artefacts. Whether the subjects of research are metal objects, glass or pottery vessels archaeometric methods are becoming integral part of the study of material culture, and more and more are present in publications not only in specialized journals as *Archaeometry* or *Journal of Archaeological Science*, but in archaeological and historical based journal and periodicals as well. Although the collaboration between scientists of natural sciences and archaeologists has been established, the nature of this collaboration has long been subject of discussion (Maggetti 2000: 3–5; Martínón – Torres &

¹ Archaeological science (archaeometry) refers to development and application of techniques and concepts drawn from the natural science and engineering (Martínón-Torres & Killick 2015: 1-17 with detailed discussion about archaeological science and scientific archaeology).

Killick 2015: 1–4). Often can be noticed that either archaeologists are not familiar with archaeometric methods or archaeometrists, or archaeological scientist don't see the necessity of archaeological analysis. So, before setting the goal of research precedes getting acquainted with all methods and analysis, which depend on types of archaeological artefacts. This only can be achieved in close collaboration of archaeometrists and archaeologists from the beginning of research. Although, various archaeometric methods may offer answers on pottery production; where and how it is made and how old it is, it is important to stress that these questions are becoming too narrow for archaeologists (Martinón – Torres & Killick 2015: 9). The questions about potters activities; gathering of the raw material – clay and temper, which temper they used, how did they overcome the modelling obstacles, maintenance of the fire in the kilns, function of vessels, functions of the vessels in different archaeological contexts, distribution and reconstruction of ancient trade, reconstruction of the ancient landscapes and finally the transfer of knowledge of pottery production more and more preoccupy contemporary archaeologists. Archaeometry looks as appealing tool for solving many problems, it does not offer answers to all above mentioned questions. Sillar and Tite have stressed out the importance of including the overall context, such as environmental, technological, economic, social, political and ideological aspects in research that have influenced the technological choices in production (Sillar & Tite 2000: 2–20). However, the technological choices also depend on “artefacts physics” (Martinón – Torres & Killick 2015: 8). To achieve the maximum functionality of vessels, such as less porosity for vessels containing liquids or greater resistance to high temperature for cooking vessels, the ancient potters certainly must have been familiar with the practical advantages and disadvantages of different technologies. Today, we can understand the changes in technologies by analysing the physical properties of potsherds through archaeometric analysis and therefore the changes in technology. This shows how much archaeology and natural science depend on each other in the interpretation of the ancient pottery production. Other important methods, which often are erroneously overlooked, are ethno-archaeological comparisons, for understanding the influence of socio-political and cultural-ideological factors on technological choices (Tite 1999: 225), and experimental archaeology in understanding the techniques of modelling (Martineau 2003: 209–216) and firing (Cuomo Di Caprio 2007; Lipovac Vrkljan *et al.* 2012: 149–154). Although archaeometry has many challenges, here

I will focus on the current state of research of Hellenistic ware on the East Adriatic coast.

POTTERY PRODUCTION ON EAST ADRIATIC IN THE HELLENISTIC PERIOD

During the Iron Age the indigenous communities on the East Adriatic coast were familiar with pottery production. They produced coarse household ware fired in the open fire (Gabrovec & Mihovilić 1987, 293–338; Batović 1987, 339–390; Barbarić 2011), but they were also familiar with the fine ware through imports of Attic and south Italian figured vases (Lisičar 1973: 3–29; Miše 2012: 231–241) and Apulian Geometric ware (Batović 1987, 339–390; Barbarić 2011; Mihovilić 2013). The productions of fine table ware in pottery kilns begin after the establishment of Greek colonies. Since the eastern Adriatic area underwent Greek colonisation in different periods, hence establishment of workshops in different periods. In *Dyrrachion*, colony established as Epidamnos in 627 BC in today's Durrës in Albania, the pottery production begun in the 6th c. BC (Hidri 2005; 2011: 843–848). Later, in the 4th c. BC, the Greeks settled on Central Dalmatian islands in *Pharos* at the island of Hvar and in *Issa* on the island of Vis. The archaeological evidence, presented



Map. 1: Workshops and settlements on the East Adriatic coast mentioned in the text (by M. Miše, 2015)

below, suggest that both Greek settlements in Central Dalmatia produced first, during the second half of the 4th c. BC, household and transport ware and later, towards the mid-3rd c. BC fine table ware. Although, there are some indications of the pottery production in settlement Resnik (ancient *Siculi*) on the Dalmatian coast, but for now we cannot determine with certainty whether it was in operation and when (more in the discussion below). (Map. 1)

ISSA

The archaeological evidence strongly supports the existence of two pottery workshops in ancient *Issa* that is from second half of the 4th c. BC to the 1st c. AD. Near the eastern Issaeen necropolis, on Vlaška njiva, misfired fragments of *amphorae* and *pithoi*, and remains of kiln were found, and on Martvilo – near the western Issaeen necropolis, misfired vessels with painted decoration, suspensors for kiln, elements of the kiln, moulds for relief ware and terracotta figurines were found. This indicates that two specialized workshops operated in *Issa*: one on Vlaška njiva for *amphorae* – Lamboglia 2 type and another on Martvilo for fine Hellenistic table ware production – *Gnathia* ware, Relief Hellenistic ware, Grey ware and probably Red-coated Hellenistic ware (see more in Čargo & Miše 2010: 9). Identifying all aspects of local production and its intensity is not an easy task for archaeologists, especially for fine table ware. Rarely the waste of fine vessels can be found in archaeological context as undoubtedly evidence of local production, like fragments of misfired table ware inside the kiln in *Heraclea Lucania* and in Metaponto (Lanza 2006: 115) or in Rocavecchia in southern Italy (Giannotta 1996: 453). Misfired or poorly fired vessels with decoration, like *oinochoai* and *pelikai* found on Martvilo (Miše 2015: cat. nos. 97, 106, 111, 113, 115, 131–133, 138–139, 146–148), are good evidence for local fine ware production, if we consider Lanza's suggestion that poorly manufactured vessels were not exported because they represent bad publicity for the workshop (Lanza 2006: 114–115 and 117). However, if the misfired vessels still retains their original function – to hold liquids or food – than their exports as a second-rate goods need to be considered. In *Issa*, on Martvilo necropolis, some poorly manufactured vessels, like *oinochoe* (Miše 2015: 66, cat. no. 3) that according to archaeological criteria can be considered imports from Apulia, were found.² This raises three possibilities,

(i) Issean market was less demanding and imported less artistically valued products, (ii) potters that moved from Apulia to Issa used the same technology and some of the misfired vessels found in Issa are locally made, but with “imported” craftsmen, and (iii) these vessels were imported in Issa as cheap by-products of trade or archaeological invisible goods. Here there is no “right” or sole answer, and that is why it is difficult to identify fine pottery production (only) by archaeological analysis. To identify the local production of the fine table ware archaeologists use comparative stylistic and morphologic analysis, preferably and, if it is available on the entire pottery assemblage. These analyses enable determining the local characteristics and singling of homogeneous groups. The identification of local production of fine ware in *Issa* was made on the *Gnathia* ware. There are several reasons for choosing this type of ware. Firstly, the *Gnathia* ware was the first type of southern Italian ware that had wide distribution; second, the painted decoration distinguishes *Gnathia* vessels from contemporaneous Black-glazed ware³, which was the most common among fine table ware, third, the current level of research of *Gnathia* ware in Apulia allows discussion of all aspects of its production; and fourth, *Gnathia* ware on the Eastern Adriatic coast has been found at many sites and in large numbers, especially in *Issa*, which facilitated a comparative analysis with Apulian production. (Re-david 2010: 170–187; Miše 2013: 99–130).

After above-mentioned archaeological analyses were conducted, the first archaeometric analysis of potsherds from *Issa* were made in 2008 at Faculty of Mining, Geology and Petroleum Engineering at University of Zagreb on two groups; the local Issaeen and imported southern Italian *Gnathia* ware (Miše 2013: 99–130). All 9 samples were analysed together with samples of local raw clay and quartz sand. The preliminary results of thin-section and XRD analysis show some differences in ration of hematite and magnetite between potsherds of local and southern Italian *Gnathia* ware (Glavaš 2008; Mileusnić *et al.* 2010: 372–372; Čargo & Miše 2010: 7–40⁴). These results are not conclusive and further

² On the other hand, so far none of the poorly manufactured Issaeen vessels were found outside of Issa, that is on the sites that imported Issaeen vessels. (Miše: 2015: 41, map 7).

³ Different names are used for this type of ware. In Italian publications, the *vernice nera* is equivalent to French *vernis noir*, or German *Glanztönfilm*. In some English-language publications, there are different terms, such as *slip* or *gloss*, but the widely accepted term is *glaze*. Although, the archaeometry analysis have shown that it is not a glaze, and the more convenient name would be *coating* or *Black-coated ware* (see below), the term *Black-glaze ware* stayed in the archaeological dictionary and will be used in this paper as well.

⁴ The results are also presented in poster section in 37th International Symposium on Archaeometry in Siena, Italy in May 2008 and at Mineralogy conference in Zakopane, Poland in September 2008.

investigation needs to be conducted, but certainly bring us one step closer to understand the Hellenistic fine ware production in ancient *Issa*.

More recently three samples from Vis, two potsherds of coarse ware (*pithoi*) and one potsherd of fine Hellenistic Grey ware (plate/bowl) were analysed (Šegvić *et al.* 2012: 63–87). Unfortunately, the insufficient numbers of samples hamper any conclusions, as well as analysis of two different types of ware; coarse/storage ware and fine table ware. The coarse and fine ware had different modelling and firing technique, and used different clay paste preparation. So, the interpretation of the results should be taken with caution.

PHAROS

During the archaeological excavation of the Department of Cultural Monument Conservation in Split the remains of dislocated kiln were found near the southern wall of the ancient *Pharos*. These are bricks made of red clay mixed with straw, and some of them have 3 mm thick ochre coating (Katić 2000: 49–50). The wastes of transport *amphorae* were found in the same Hellenistic context, together with moulds for terracotta figurines and ceramic coasters. Also, M. Katić inform us of a large amount of pottery waste found all over *Pharos*, but with more concentration near, above-mentioned southern wall and in south-eastern part, concluding that at least two workshops were active (Katić 2000: 54). From this information we can assume that workshop/s in *Pharos* produced *amphorae*⁵, but for the fine table ware production the evidences are not clear. According to so far published fine table ware from *Pharos*, unearthed during excavations in the residential complex (*Pharos* 1996; Kirigin *et al.* 2002: 246–254) or published as a part of different museum collections (Miše 2005: 25–48; Vallicelli 2006: 247–261), it is difficult to identify the local production. Probably the archaeological analysis of vast amount of potsherds unearthed in the residential complex during the excavations of Department of Cultural Monument Conservation in Split and excavations of *Adriatic Island Project*, and more recently excavations conducted by the City Museum of Stari Grad will give us more insight into all assemblages of pottery material in *Pharos*.

⁵ Although M. Katić discusses about the typology of *amphorae* produced in *Pharos* – naming them *Faros 2-4* – it can be noticed that author's typology was based on fragments of *amphorae* waste, rejected and misfired *amphorae* fragments that cannot be representatives for shape nor for typology.

RESNIK (ANCIENT *SICULI*)

During the archaeological analysis of the *Gnathia* and related Hellenistic ware on the East Adriatic coast, the group of vessels with characteristic brown coating and fine beige fabric (body of the vessels) were singled out in Resnik, a Hellenistic port settlement near today town of Kaštela, between Split and Trogir (Miše 2013: 123, no. 8; 2015). Some of these vessels have ribbing on the surface in *Gnathia style* and some of them have no other decoration except brown coating. Similar potsherds were also found in *Issa*, but their number, so far, is significantly smaller than in Resnik. Also, it was argued that relief decorated bowls, craters, articulated and thorn *kantharoi* from Resnik, compared to vessels of similar shape that were found on the other sites on the East Adriatic, have different fabric and decoration, a therefore belong to local production (Šešelj 2005: 381–400; 2008: 105–112). Other archaeological evidences of pottery production in Resnik are scarce. Also, in the previous publications it is remarked that moulds for relief ware found in Resnik indicate the existence of the Hellenistic Relief ware production (Šegvić *et al.* 2012: 66). However, the archaeological context of the above-mentioned moulds is not so straightforward in identifying the pottery production. Namely, the moulds were found in the shipwreck in *Siculi's* harbour, in the seashore in front of the settlement, suggesting that they were transported, and whether they were intended for a workshop at *Siculi* or elsewhere, remain as open question. Furthermore, the remains of the pottery kiln are not/not yet found as well as pottery waste of coarse and/or fine ware (personal communication with Ivanka Kamenjarin⁶).

Within abovementioned recent archaeometric analysis of potsherds from Vis, the 12 potsherds of fine Hellenistic ware from Resnik and 21 potsherds of fine Hellenistic ware from sanctuary on Cape Ploča (located on peninsula 35 km north from Resnik), were also analysed (Šegvić *et al.* 2012: 63–87, tab. 1). The aim of these analyses was, probably, to determine whether the potsherds found at sanctuary came from Resnik or from *Issa*. The potsherds were examined by microscopy and inductively coupled plasma mass spectrometry (ICP-MS), and 24 potsherds were examined by X-ray diffraction (XRD), scanning electron microscopy (SEM), and electron microprobe analyses (EMPA). The results show

⁶ I would like to thank to colleague Ivanka Kamenjarin, senior curator and head of the archaeological department of City Museum in Kaštela, for kindly allowing me to examine the excavated material from Resnik and for providing me necessary information about excavations.

relatively similar archaeometric properties for potsherds from Cape Ploča and Resnik, whereas potsherds from Vis differ in terms of composition and firing technologies; the potsherds from Cape Ploča and Resnik were fired at lower temperature than potsherds from Vis and, in supporting the Resnik pottery production, most of analysed fine ware “exhibits exceptional geochemical individuality, which tends to agree with the ceramic typology” (Šegvić *et al.* 2012: 84). From this conclusions it is not clear which analyses potsherds from Vis, two potsherd of coarse or one potsherd of fine ware, show such results, since the coarse ware were usually fired at lower, and Hellenistic fine ware at higher temperature (forthcoming Miše *et al.*) However, the chemical composition of analysed potsherds from Resnik and Cape Ploča (analyses conducted by Šegvić *et al.*) show good match with analysed reference group from Vis (analyses of Miše *et al.*), but we are still far from making any conclusion and further investigations and analysis can bring us more closer to identifying the Dalmatian workshops in Hellenistic period.

RISAN (ANCIENT RHIZON)

In 2004 the archaeometric analyses were conducted on *amphorae* and *Gnathia* ware unearthed in ancient *Rhizon* or *Rhizinium*, indigenous settlements near today Boka Kotorska in Montenegro (Daszkiewicz *et al.* 2007: 85). According to the excavations report the potsherds of Hellenistic ware, dated from 4th to the 2nd c. BC, were found (Dyczek 2005: 115–118), but they are, as far I am aware, unpublished. The thin section analysis, XRF (X-ray fluorescence) and MGR (Matrix Group by Referring) were carried out on 14 fragments of different types of *amphorae* (Greco-Italic, Lamboglia 2 and Dressel type⁷) and on 11 *Gnathia* potsherds from which five of them differ from each other and six are from a homogeneous group, and on the samples of local clay taken from sediments during the excavations (Daszkiewicz *et al.* 2007: 86, 89 and 92, tab. 2). The preliminary results have shown that analysed potsherds have different composition than local clay, and that excluded the local production in Rhizon. However, the interpretation of the results is somewhat unclear. Although, the authors stated that provenience of the analysed *Gnathia* ware and *amphorae* remain an open issue, they still suggest that *amphorae* were probably made somewhere in

Adriatic region (Daszkiewicz *et al.* 2007: 92). This is not surprising since the trade between west and east Adriatic coast in Hellenistic period was very intensive. However, more confusing is that a large part of analysed potsherds of *Gnathia* ware represent, according to the authors, product that are probably imported from workshops in the eastern Mediterranean (Daszkiewicz *et al.* 2007: 92). The *Gnathia* ware originates in the workshops of Greek colony of *Taras* (today Taranto) on the coast of Ionian Sea in southern Italy and its main production area were *Apulia* (today Puglia in east-southern Italy). The vessels of this type of ware were exported in the East Mediterranean, but not to the extent that we could assume the establishment of local workshops there (Miše 2010; 2013: 101). Concurrently to *Gnathia* ware in southern Italy, in the Eastern Mediterranean another type of ware – the West Slope ware, similar in black coating and decorative style, were more popular, with established workshops in mainland Greece and costal Asia Minor (*Agora* XXIX; Rotroff 1991: 14-46; 2002: 97–115; 2004: 657–662). Furthermore, no direct trade or at least not in high level and intensity that can be seen in the archaeological material, was established between indigenous communities on the East Adriatic with East Mediterranean, neither such trade was documented in other Eastern Adriatic colonies and settlements (Miše 2015). If we assume that the authors confused *Gnathia* with West Slope ware, the results of imported West Slope ware in *Rhizon* are worth of detailed attention. So far, only 6 vessels of West Slope ware were found on East Adriatic; 4 in *Issa* (Miše & Touloumtzidou 2015: 337–386), one from sanctuary at island of Palagruža (Kirigin *et al.* 2010: 65–92) and one on Kopila hill fort on the island of Korčula (personal communication with Igor Borzić⁸). They all show characteristics of Attic or north-western Greece productions (Miše & Touloumtzidou 2015: 348–358), and not of East Mediterranean. The authors do state that some analysed *Gnathia* potsherds could be produced somewhere in the Adriatic coast (Daszkiewicz *et al.* 2007: 92), what is more likely the place of origin. It would be useful to compare the *Gnathia* ware from *Rhizon* with Issaeon *Gnathia* ware, or with vessels from *Dyrrachion*. In this case, were archaeological analyses were not conducted and the background theory is lacking, good descriptions and illustrations of analysed samples are necessary. Although the preliminary results of archaeometric analysis of

⁷ The author of the cited papaer Daszkiewicz *et al.* 2007 did not offer anyl precise typology of the vessels.

⁸ I thank to Dr. Igor Borzić for showing me the fragments of West Slope ware unearthed on necropolis of settlement on Kopila hillfort.

fine ware and *amphorae* from *Rhizon* is vague and need to be updated and integrated with archaeological analysis, still give us information about local clay and imported *amphorae*.

DYRRACHION

An intense pottery production in *Dyrrachion* has been documented, according to the archaeological analysis from the 6th to 2nd c. BC with production of Red-figure vases, Hellenistic relief ware and Grey ware (Hidri 1986: 99–112 and 2011: 843–848). Additionally, a pottery kiln was found in the clay hill area of Curilla (Shehi 2010: 56–58). These are evidence for the local production. We still cannot talk about the characteristic of this production, for any type of ware, since the studies of large amount of potsherds excavated in *Dyrrachion* (personal communication with Eduard Shehi⁹) were not yet conducted, not did the archaeometric analysis. However, looking at the whole assemblages of the Hellenistic ware on the East Adriatic coast, certain differences can be noticed between assemblages from southern – east Adriatic and Central Dalmatia. These differences are observed in shape of vessels and performance of decorations, suggesting that two different productions were active on the East Adriatic during this period; one in Central Dalmatia and other in southern-east Adriatic region (more detail about types of Hellenistic ware on the East Adriatic and the difference between them in Miše 2013: 99–130 and 2015).

DISCUSSION

Archaeological evidences clearly indicate existence of production of coarse ware – *amphorae*, *pithoi* and kitchenware, and fine table ware on the East Adriatic coast during the Hellenistic period. However, the characteristics and type of specialized production – coarse and/or table ware, the organisation of production, the technology of production which is different among the different types of Hellenistic ware, the changes in technology and the distribution patterns are still unknown. The main reason for this lay in mostly unpublished material from excavations, but also in handling the vast amount of potsherds and the amount of information that can be obtained through their analysis. Identifying the pottery production as mentioned before, is interdisciplinary research and has to combine archaeological

⁹ I thank to Dr. Eduard Shehi for the information on Hellenistic ware from *Dyrrachion*.

and archaeometric analysis. With the comparative stylistic and morphological analyses, it is possible to identify homogeneous groups, but to obtain articulate and clear results, these analyses have to be included the entire pottery assemblage. The high degree of homogeneity or standardization of vessel shapes, decorations, manufacturing technologies is assumed to reflect specialized production, whereas variation or relative heterogeneity is taken to indicate household production (Tite 1999: 192).

Another aspect that also needs to be included in the archaeological and archaeometric analysis is the technology of production of Hellenistic ware. Covering the surface of the vessel with black coating was well known in the Classical and Hellenistic period. Coated ware, besides being the name of ware, Black-, Grey-, Brown- glazed/coated ware, it also refers to the technique of applying the coating on the surface of the vessel. The black colour on the vessels is a result of the application of a thin, diluted layer of clay rich in mineral elements; fine grained suspension of an illitic, non-calcareous clay, that was spread on a dry surface of the vessel by brush or dipping the vessel into suspension, which was richer in SiO₂ and CaO, and poorer in Fe₂O₃ and K₂O and was fired in oxidizing – reducing – oxidizing firing circle. The coating was obtained through simple sedimentation of illitic clay or iron oxides may have been added as colouring agents, and boron and potassium carbonate as fluxes. The vessels underwent single firing with transformed iron oxide and sintered the matrix: in the first oxidizing phase the clay body is red and hematite appears, in the second, the reducing phase sintering of clayey matrix made the gloss layer impermeable to oxygen, whereas the formation of magnetite results in black colour, and in the final re-oxidizing phase, no changes appear on vitrified coated layer, but previous reduced iron oxide in vessel body reverted to red colour (Maggetti *et al.* 1981, 199–207; Gliozzo *et al.* 2004: 227–246; Perez & Estevez–Tébar 2004: 607–614). Taking into consideration described process within the kiln, the Grey-ware that was common in the late Hellenistic period of 2nd and 1st c. BC, probably did not undergo the third or re-oxidizing phase. It would be also interesting to investigate the technological process of firing brown and red coatings that also appear on Hellenistic ware, since they indicated changes in technology production. However, these analyses are not yet, at least according to my knowledge, conducted.¹⁰ Besides coating, painted decoration

¹⁰ Marzec stressed the same problem of gap in our knowledge about production of colour coated ware in Hellenistic Period, on the examples of pottery from Cyprus, at ISA 2016 Conference in Kalamata in Greece.

was also popular on Hellenistic ware (*Gnathia* and West Slope). The study of N. Cuomo di Caprio provided good insights into ancient crafts; techniques of modelling, decorating and firing (Cuomo Di Caprio 2007). Employing different methods, including chemical and physical analysis and archaeological experiments, the author has shown that the firing technique for Black-glazed ware, Black- and Red-figure vases, and *Gnathia* ware was the same, and suggested maximum temperature of 900-950°C. The coating on the surface of the vessel, together with the added red, yellow and white colours for decoration, was applied before firing. The colour of the coating and decoration were formed during the firing process, and differences in colours depended on chemical composition of the diluted clay of which they were made. It took a skilled potter/painter to ensure that all applied coatings on the vessels did not mix in order to achieve desired polychrome effect after firing. The complexity of this process lies in the “behaviour” of clays used to make the body of the vessel, coating and decoration. The archaeometry analysis conducted on the Apulian Red-figured vases confirmed this technique (Mangone *et al.* 2008: 1533–1541; Mangone *et al.* 2009: 97–102; Giannossa *et al.* 2014: 347–352), as well as analysis of the *Gnathia* ware from Egnazia (Redavid 2010: 166–187). Even more, the analyses have shown that between body of the vessel and black coating is intermediate layer – red engobe – 35 to 100 µm thick, and that the coating was applied on engobe, not on the surface of the vessel, while decoration was applied over the black coating (Redavid 2010: 180). This shows that potters, in addition of being careful about the appearance of the vessels, were aware of the need to prevent porosity.

CONCLUSION

Considering complexity of Hellenistic fine ware production not only in the technological aspects (balance between body of the vessel – engobe – coating – decoration), but also in the diversity of shapes, coatings and decorations, identifying the local production is not an easy task. Necessary step need to be taken; archaeological analysis, geological and ethno-archaeological surveys together with archaeometric analysis, in order to obtain clear interpretation not only of all aspects of production, but also in reconstruction of ancient trade. The perspective of archaeometric analysis on the Hellenistic ware on East Adriatic, despite initial ramblings, looks promising since numerous archaeological evidences indicate existence of several local productions.

ABBREVIATIONS

<i>BAR Inter. Ser</i>	British Archaeological Reports International Series, Oxford
<i>VAHD /VAPD</i>	Vjesnik za arheologiju i historiju dalmatinsku / Vjesnik za arheologiju i povijest dalmatinsku from 2005, Split

BIBLIOGRAPHY

- Agora XXIX* S. Rotroff, "Hellenistic Pottery: Athenian and imported wheel made table ware and related material", *The Athenian Agora XXIX*, Princeton, 1997.
- Barbarić 2011 V. Barbarić, *Tipologija lončarje iz kasnog brončanog i željeznog doba s područja Dalmacije* (unpublished PhD thesis, University of Zagreb), Zagreb, 2011.
- Batović 1987 Š. Batović, "Liburnska grupa", in: A. Benac (ed.), *Praistorija jugoslavenskih zemalja V*, Sarajevo, 1987, 339–390.
- Cuomo Di Caprio 2007 N. Cuomo Di Caprio, *La ceramica in archeologia 2. Antiche tecniche di lavorazione e moderni metodi d'indagine*, Roma, 2007.
- Čargo & Miše 2010 B. Čargo & M. Miše, "Lončarska proizvodnja u Isi (Pottery Production in Issa)", *VAPD* 103, Split, 2010, 7–40.
- Daszkiewicz *et al.* 2007 M. Daszkiewicz, P. Dyczek, G. Schneider & E. Bobryk, "Preliminary results of archaeometric analysis of amphorae and Gnathia-type pottery from Risan, Montenegro", in: S. Y. Waksman (ed.), *Archaeometric and Archaeological Approaches to Ceramics. Papers presented at EMAC '05, 8th European Meeting on Ancient Ceramics, Lyon 2005*, BAR Inter. Ser 1691, Oxford, 2007, 85–93.
- Dyczek 2005 P. Dyczek, "Rhizon, 2001-2003. Preliminary report on the excavations of the Centre for Archaeological research- Novae, Warsaw University", *Archeologia* LV, 2004, Warszawa, 2005, 101–118.
- Gabrovec & Mihovilić 1987 S. Gabrovec & K. Mihovilić, "Istarska grupa", in: A. Benac (ed.), *Praistorija jugoslavenskih zemalja V*, Sarajevo, 1987, 293–338.
- Giannossa *et al.* 2014 L. C. Giannossa, G. Giannelli, F. Mastrorocco. I. M. Muntoni, R. Laviano & A. Mangone, "An overview on Apulian Red-figured pottery: from manufacturing process to provenance issues", *6th International Congress on "Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin", Proceeding, Vol. II – Session B, diagnostics, restoration and conservation, Athens Greece, 22.-25. 10. 2013*, Roma, 2014, 347–352.
- Giannotta 1996 M. T. Giannotta, "La ceramica sovraddipinta policroma: l'area messapica", in: E. Lippolis (ed.), *Arte e artigianato in Magna Grecia*, Napoli, 1996, 453–468.
- Glavaš 2008 I. Glavaš, *Sirovine i tehnologija izrade keramike* (unpublished Ma thesis, University of Zagreb), Zagreb, 2008.
- Gliozzo *et al.* 2004 E. Gliozzo, I. W. Kirkman, E. Pantos & I. Memmi Turbanti, "Black gloss pottery: production sites and technology in northern Etruria, Part II, Gloss technology", *Archaeometry* 46/2, 2004, 227–246.
- Hidri 1986 H. Hidri, "Nekropoli antiki i Dyrrahut (Rezultatet e gërmimeve të viteve 1973 dhe 1980)", *Iliria* 2, Tiranë, 1986, 99–112.
- Hidri 2005 H. Hidri, *Vazot antike të Dyrrahut*, Tiranë, 2005.
- Hidri 2011 H. Hidri, "Red-figured Pottery, Pottery with Relief Decoration and Gnathia Ware of Dyrrachion", *Z' Επιστημονική Συνάντηση για την Ελληνιστική Κεραμική*, Athens, 2011, 843–848.
- Katić 2000 M. Katić, "Uvod u proučavanje keramičkih radionica Farosa", *Opvscvla Archaeologica* 23-24, Zagreb, 2000, 49–58.

- Kirigin *et al.* 2002 B. Kirigin, J. Hayes & P. Leach, "Local pottery production at Pharos", in: N. Cambi, S. Čače & B. Kirigin (eds.), *Grčki utjecaj na istočnoj obali Jadrana, Zbornik radova sa znanstvenog skupa, 24. do 26. rujna 1998. g. u Splitu*, Split, 2002, 241–260.
- Kirigin *et al.* 2010 B. Kirigin, M. Miše & V. Barbarić, "Palagruža-the Island of Diomedes. Summary excavation report 2002-2008", *Hesperia* 25, Roma, 2010, 65–92.
- Lanza 2006 E. Lanza, "La tecnica della decorazione sovraddipinta: analisi di alcuni vasi in stile di Gnathia del Museo di Antichità di Torino", *Antenor* 5, Padova, 2006, 113–125.
- Lipovac Vrkljan *et al.* 2012 G. Lipovac Vrkljan, B. Šiljeg, I. Ožanić Roguljić & A. Konestra, "Eksperimentalna arheologija - gradnja replike rimske keramičarske peći u Crikvenici (Experimental Archaeology - a replica of a Roman pottery kiln)", *Annales Instituti Archaeologici* VIII, Zagreb, 2012, 149–154.
- Lisičar 1973 P. Lisičar, "Cenni sulla ceramica antica", *Archaeologia Iugoslavica* 14, Beograd, 1975, 3–29.
- Maggetti *et al.* 1981 M. Maggetti, G. Galetti, H. Schwander, M. Picon & R. Wessicken, "Campanian Pottery: The Nature of the Black Coating", *Archaeometry* 23/2, 1981, 199–207.
- Maggetti 2000 M. Maggetti, "Is there (still) a future for archaeometry in the 21st century?", in: D. Rammlmair, J. Mederer, Th. Oberthür, R. B. Heimann und H. Pentinghaus (eds.), *Applied Mineralogy in Research, Economy, Technology and Culture" Proceeding of the 6th Int. Conference of Applied Mineralogy*, Balkema, Rotterdam 2000, 5–6.
- Mangone *et al.* 2008 A. Mangone, L.C. Giannossa, A. Ciancio, R. Laviano & A. Traini, "Technological features of Apulian red figured pottery", *Journal of Archaeological Science* 35, 2008, 1533–1541.
- Mangone *et al.* 2009 A. Mangone, L.C. Giannossa, G. Colafemmina, R. Laviano & A. Traini, "Use of various spectroscopy techniques to investigate raw materials and define processes in the overpainting of Apulian red figured pottery (4th century BC) from southern Italy", *Microchemical Journal* 92, 2009, 97–102.
- Martinón – Torres & Killick 2015 M. Martinón – Torres & D. Killick, "Archaeological Theoris and Archaeological Science", in: A. Gardner, M. Lake, U. Sommer (eds.), *The Oxford Handbook of Archaeological Theory*, Oxford, 2015, 1–17.
- Martineau 2003 R. Martineau, "Methodology for archaeological and experimental study of pottery forming techniques", in: S. Di Pierro, V. Serneels & M. Maggetti (eds.), *Ceramic in the Society, Proceedings of the 6th European Meeting on Ancient Ceramic, Fribourg, Switzerland, 3-6 October 2001*, Fribourg, 2003, 209–216.
- Mihovilić 2013 K. Mihovilić, *Histri u Istri*, Pula 2013.
- Mileusnić *et al.* 2010 M. Mileusnić, I. Glavaš, M. Miše & B. Čargo, "Mineralne sirovine i helenističko lončarstvo otoka Visa, (Raw materials and hellenistic pottery, island of Vis)", in: M. Horvat (ed.), *Hrvatski geološki kongres. Šibenik, Hrvatska, 14.-16. listopada 2010, Knjiga sažetaka*, Zagreb, 2010, 372-372.
- Miše 2005 M. Miše, "Grčka i helenistička keramika iz Farosa u Arheološkom muzeju u Splitu (stari fond)", *VAPD* 98, Split, 2005, 25–48.
- Miše 2010 M. Miše, *Keramika tipa Gnathia na istočnoj obali Jadrana (od 4. do 1. st. pr. Kr.)*, (unpublished PhD thesis, University of Zagreb), Zagreb, 2010.
- Miše 2012 M. Miše, "Trgovački kontakti dvaju jadranskih obala krajem 4. i u 3. st. pr. Kr. na primjeru slikane keramike", *Histria Antiqua* 21, Pula, 2012, 231–241.
- Miše 2013 M. Miše, "Prilog proučavanju isejske keramike tipa Gnathia (A contribution to the study of Gnathia ware from Issa)", *VAPD* 106, Split, 2013, 99–130.

- Miše 2015 M. Miše, *Gnathia and Related Hellenistic ware on the East Adriatic coast*, Oxford 2015 (in print).
- Miše & Touloumtzidou 2015 M. Miše & A. Touloumtzidou, "Hellenistic Tomb in Stonca bay near Issa on the island of Vis, Croatia: new evidence on imports from Sicily and mainland Greece", *Hesperia* 32, Roma, 337–386.
- Miše *et. al* (forthcoming) M. Miše, I. Katona Serneels & V. Serneels, *Ancient Ceramic production on Central Dalmatian islands, southern Croatia: raw material, kilns and fine ware*, 13th European Meeting on Ancient Ceramic, Athens 2015.
- Perez & Estevez-Tébar 2004 J. M. Perez & R. Estevez – Tébar, "Pigment identification in Greek pottery by Raman microspectroscopy", *Archaeometry* 46/4, 2004, 607–614.
- Pharos* 1996 J. Jeličić Radonić, B. Rauter Plančić (eds.), *Pharos, antički Stari grad*, Zagreb, 1996.
- Redavid 2010 V. Redavid, *La ceramic 'di Gnathia' nella 'necropoli occidentale' di Egnazia*, Fassano, 2010.
- Rotroff 1991 S. Rotroff, "Attic West Slope vase painting", *Hesperia* 60, 1, New Jersey, 1991, 14–46.
- Rotroff 2002 S. Rotroff, "West Slope in the East", in: F. Blondé, P. Ballet, J.-F. Salles (eds.), *Céramiques hellénistiques et romaines, Productions et diffusion en Méditerranée orientale (Chypre, Égypte et côte syro-palestinienne)*, Lyon-Paris, 2002, 97–115.
- Rotroff 2004 S. Rotroff, "Attic West Slope Ware", in: *ΣΤ' Επιστημονική Συνάντηση για την Ελληνιστική Κεραμική*, Athens 2004, 657–662.
- Sillar & Tite 2000 B. Sillar & M. S. Tite, "The challenge of technological choices for material science approaches in archaeology", *Archaeometry* 42/1, Oxford, 2000, 2–20.
- Shehi 2010 E. Shehi, "Kilns in Albania", *Acta RCRF* 41, Bonn, 55–59.
- Šegvić *et al.* 2012 B. Šegvić, L. Šešelj, D. Slovence, B. Lugović & R. Ferreiro Mählmann, "Composition, Technology of Manufacture, and Circulation of Hellenistic Pottery from the Eastern Adriatic: A Case Study of Three Archaeological Sites along the Dalmatian Coast, Croatia", *Geoarchaeology: An International journal* 27, 2012, 53–87.
- Šešelj 2005 L. Šešelj, "Utjecaji dirahijskih keramičkih radionica na području srednje Dalmacije", *VAPD* 98, Split, 2005, 49–61.
- Šešelj 2008 L. Šešelj, "The influence of the Dyrachium pottery workshops in central and south Dalmatia", *Acta RCRF* 40, Bonn, 2008, 105–112.
- Tite 1999 M. S. Tite, "Pottery Production, Distribution, and Consumption – the Contribution of the Physical Science", *Journal of Archaeological Method and Theory*, vol. 6, no. 3, 1999, 181–233.
- Vallicelli 2006 M. C. Vallicelli, "Un gruppo di ceramiche sovraddipinte di tipo gnathia del Museo Archeologico Nazionale di Venezia: considerazioni preliminary", in: D. Morandi Bonacossi, E. Rova, F. Veronese, P. Zanovello (eds.), *Tra Oriente e Occidente. Studi in onore di Elena Di Filippo Balestrazzi*, Padova, 2006, 247–264.