19th International Congress
of Classical Archaeology
Cologne/Bonn
22–26 May 2018

ICCA
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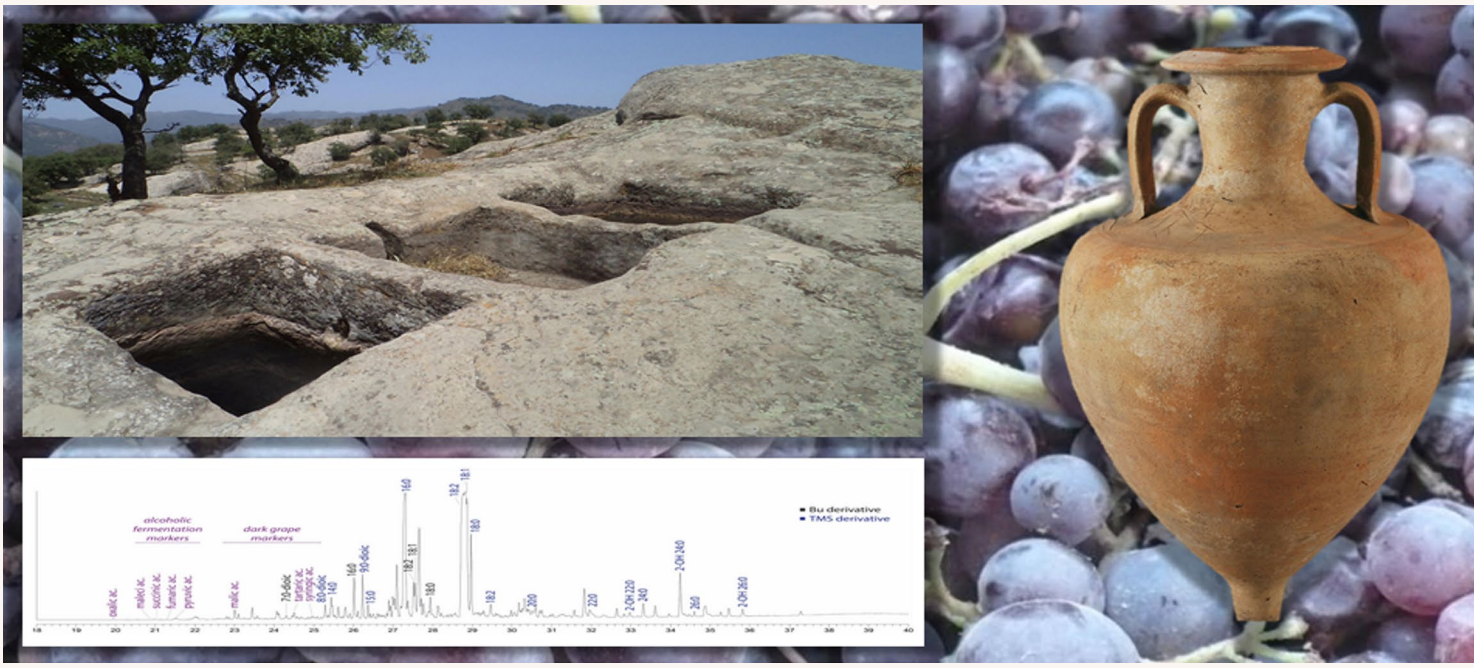
AIAC

Archaeology and Economy in the Ancient World



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A. Making Wine in Western-Mediterranean
B. Production and the Trade of Amphorae: Some New Data from Italy

Panel 3.5

Jean-Pierre Brun
Nicolas Garnier
Gloria Olcese

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Proceedings of the

19th International Congress of Classical Archaeology

Volume 9: Making Wine in Western-Mediterranean / Production and the Trade of Amphorae

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Edited by

Martin Bentz and Michael Heinzelmann

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Cover illustration: left: rock-cut unit from Monte Cucco and chromatogram from the residues of the rock-cut unit from Serramezzana; right: Graeco-Italic amphora from the Secca di Capistello shipwreck. (realization by D. M. Surace, foto by N. Garnier, images are property of Immensa Aequora project).

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CONTENTS

A. Making Wine in Western-Mediterranean

B. Production and the Trade of Amphorae: Some New Data from Italy

Posters

PREFACE

On behalf of the 'Associazione Internazionale di Archaeologica Classica (AIAC)' the 19th International Congress for Classical Archaeology took place in Cologne and Bonn from 22 to 26 May 2018. It was jointly organized by the two Archaeological Institutes of the Universities of Cologne and Bonn, and the primary theme of the congress was 'Archaeology and Economy in the Ancient World'. In fact, economic aspects permeate all areas of public and private life in ancient societies, whether in urban development, religion, art, housing, or in death.

Research on ancient economies has long played a significant role in ancient history. Increasingly in the last decades, awareness has grown in archaeology that the material culture of ancient societies offers excellent opportunities for studying the structure, performance, and dynamics of ancient economic systems and economic processes. Therefore, the main objective of this congress was to understand economy as a central element of classical societies and to analyze its interaction with ecological, political, social, religious, and cultural factors. The theme of the congress was addressed to all disciplines that deal with the Greco-Roman civilization and their neighbouring cultures from the Aegean Bronze Age to the end of Late Antiquity.

The participation of more than 1.200 scholars from more than 40 countries demonstrates the great response to the topic of the congress. Altogether, more than 900 papers in 128 panels were presented, as were more than 110 posters. The publication of the congress is in two stages: larger panels are initially presented as independent volumes, such as this publication. Finally, at the end of the editing process, all contributions will be published in a joint conference volume.

We would like to take this opportunity to thank all participants and helpers of the congress who made it such a great success. Its realization would not have been possible without the generous support of many institutions, whom we would like to thank once again: the Universities of Bonn and Cologne, the Archaeological Society of Cologne, the Archaeology Foundation of Cologne, the Gerda Henkel Foundation, the Fritz Thyssen Foundation, the Sal. Oppenheim Foundation, the German Research Foundation (DFG), the German Academic Exchange Service (DAAD), the Romano-Germanic Museum Cologne and the LVR-LandesMuseum Bonn. Finally, our thanks go to all colleagues and panel organizers who were involved in the editing and printing process.

Bonn/Cologne, in August 2019

Martin Bentz & Michael Heinzelmann

A. Making Wine in Western-Mediterranean

From Oil to Wine? A Balanced View on the Production of the Most Representative Agricultural Products of Antiquity

Jean-Pierre Brun

Olive oil and wine, which are considered as the two most representative agricultural products in the ancient Mediterranean, have been overvalued by archaeological studies because their production and trade leave lasting archaeological remains of presses, vats, jars and amphorae. In contrast, the archaeology of cereal has only produced a few granaries and millstones. However, the introduction of systematic sieving is now used to find the grains. Carpology is thus changing the outlook as its results now offer the opportunity to study the diffusion of precisely identified cereals and to quantify their proportions in agricultural areas.[1] For the study of wine and oil, we now have a wide range of indicators ranging from stone and masonry remains to grape seeds, pollen and biochemical analyses that provide accurate answers.[2] But to fully understand the issues faced by current research, we need to travel back in time to those early studies.

For a long time, historians and archaeologists have had only scattered, incomplete and biased written sources, representations of uncertain, polysemic or simply erroneous interpretations, heaps of amphorae sherds and remains of presses or vats at their disposal. The typological classification of amphorae has taken a long time to establish and remains incomplete and unsatisfactory. The study of amphorae was initiated by epigraphists of the late 19th century, who were interested in inscribed examples from Rome and Pompeii[3] but naturally, they only looked at those bearing inscriptions. These data took a long time to converge with those collected by field archaeologists; many wine amphorae types were attributed to oil and vice versa. It was not until the last quarter of the 20th century that we reached a more complete picture of the main amphorae types, thanks to underwater excavations.[4] Recent bio-chemical analyses show the complexity of commercial phenomena; besides the main trade flows – Italian wine to Gaul; Baetican oil to Rome, etc. – how much local trafficking was there? How did triangular businesses affect and complicate these network systems?[5] An isolated amphora, or even a short series, which is found on an archaeological site is not certain evidence of a commercial network as it could be reused several times. At most it could simply be an indication of trade or exchange that must be integrated within larger contexts.

With regard to the presses, their massive remains, highly visible in North Africa at the end of the 19th century, caused misinterpretations elsewhere: all press remains were systematically attributed to oil mills (fig. 1).[6] Northern Roman Syria is another classic example: G. Tchalenko[7] identified all the presses for oil processing and he reconstructed a more or less monocultural landscape of olive trees, while recent studies show that the majority of production facilities were actually for wine (fig. 2–3).[8] At the opposite end of the ancient world, in Lusitania, the large presses of the Roman villae of São Cucufate[9] or Torre di Palma[10] were first attributed to the production of oil while, in my opinion,

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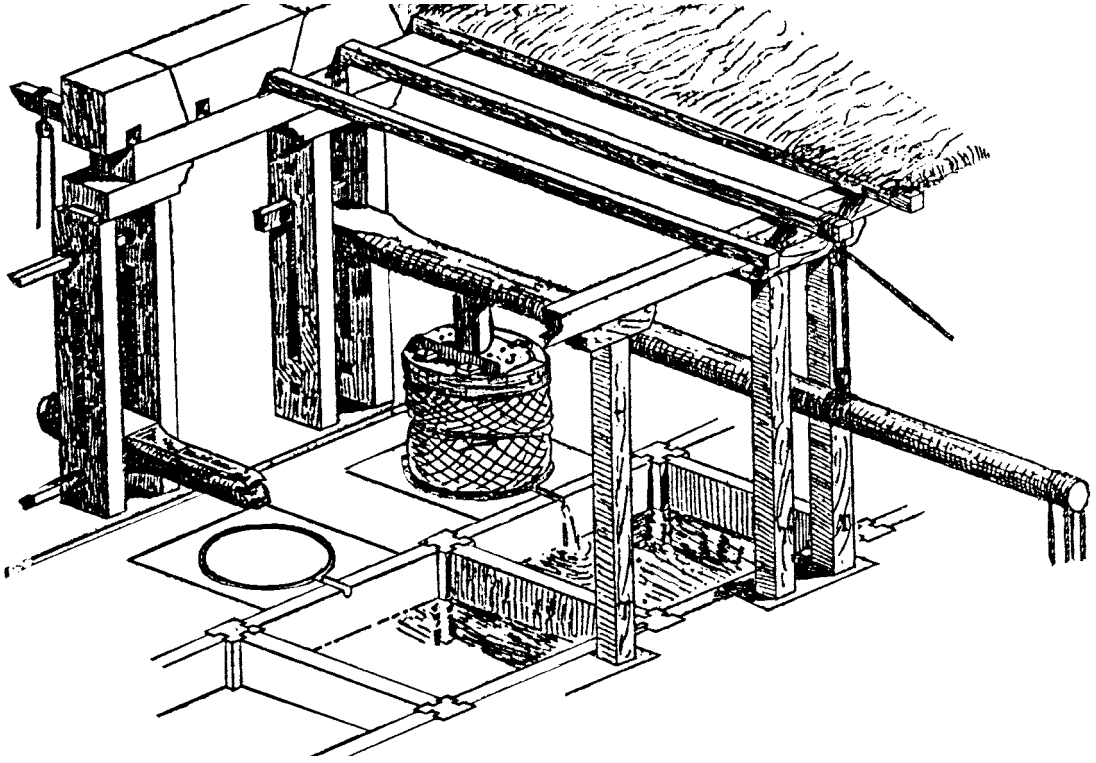

Fig. 1: An oil plant in Africa as interpreted by Saladin 1887.

they are actually wineries (fig. 4).[11] We can add the examples of the so-called huge olive oil factories in the region of Satafis in Mauretania Caesariensis, which are actually wine making plants (Khirbet Agoub) (fig. 5).[12] Recently, I revisited my conclusions about the villa of S. Michel at La Garde (Var, France), where, besides a production of oil ascertained by oil mills and olives stones, we are now able to identify wine-making tanks thanks to biochemical analysis by Nicolas Garnier (unpublished). They show that part of the pressing installations were used for making wine. A strange structure installed during the 3rd century AD in a vat built earlier could be interpreted as a cellar with supports for wooden casks (fig. 6).[13] Finally, the villa of S. Michel is coming back to a well documented series.

In addition, as early as the 2nd century BC, Cato, our most trustworthy and accurate guide, warns us that there is no difference between oil and wine presses except for the greater height of the latter (Agr. 18 and 19). In fact only the discovery of annex facilities helps to distinguish between the two productions: the presence or absence of olive mills, of decantation tanks or of pitched dolia.[14] Today, the determination is also based on the seeds gathered through systematic sieving and the bio-chemical analyses.

Carpology presents two major interests. On the one hand, the presence of grape seeds or olive stones indicates the nature of the production and on the other hand the shape of these seeds allows us to match the ancient varieties with current ones.[15] There

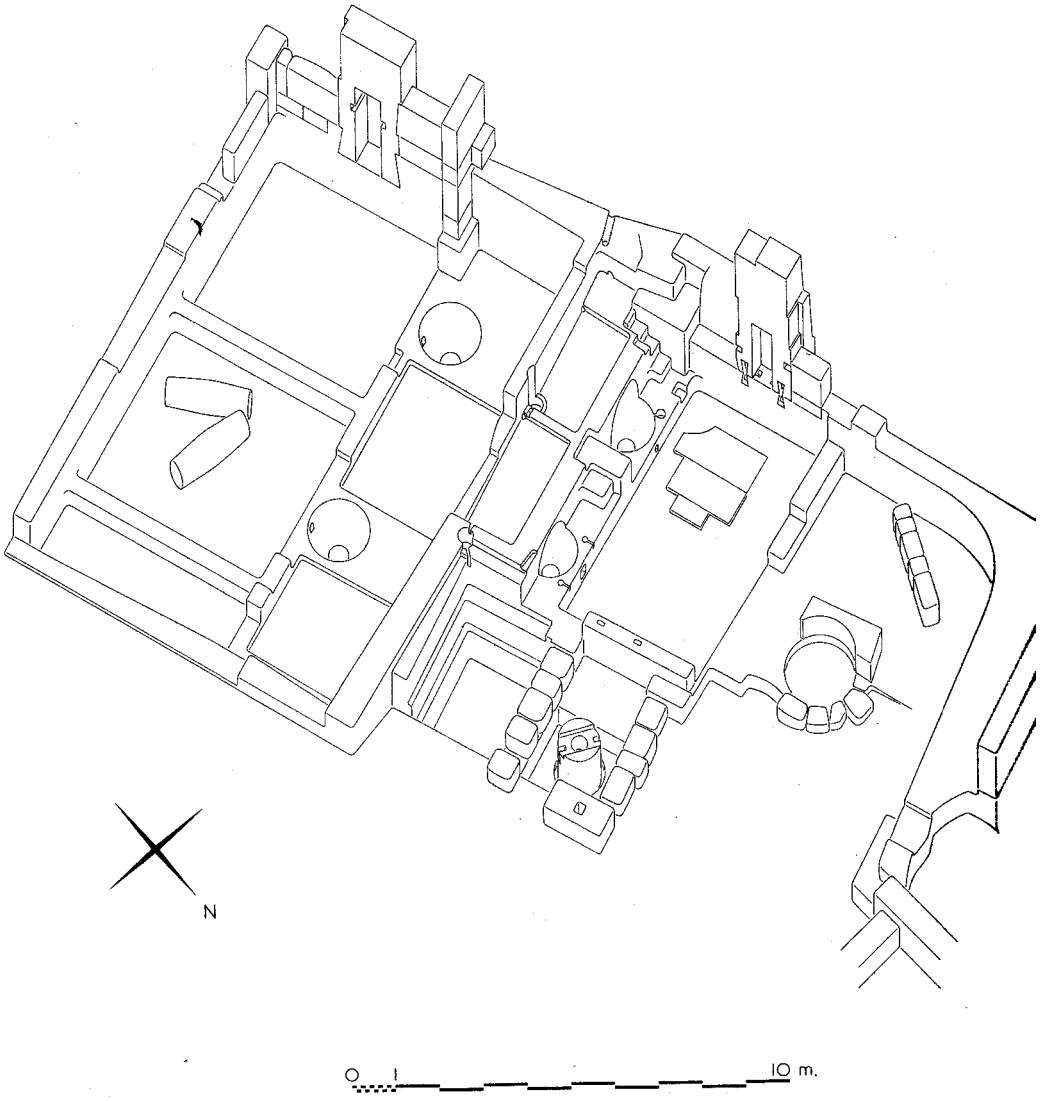

Fig. 2: Axonometry of presses at Behyo (Syria), interpreted as oil presses.

are many examples of the first use of this type of agriculture: at Dikili Tash in Greece during the Neolithic period;[16] at Longola (Poggiomarino) at the beginning of Iron Age in Italy;[17] at Alt de Benimaquia, Denia, in Iron Age Spain;[18] at the villa of Piriac-de-Mer in Roman Gaul,[19] or at Rirha in Morocco[20] where grape seeds support the interpretation of the remains as wineries; at Scaffa Piana in Corsica during the Neolithic period;[21] and in Palestine, olive pits indicate the production of oil. Carpology is now an indispensable partner in any interpretation.

In the last decade, biochemical analyses also provided significant contributions to the interpretation of production facilities and amphora contents. Nicolas Garnier has traced the history of this development from the pioneering 19th century works

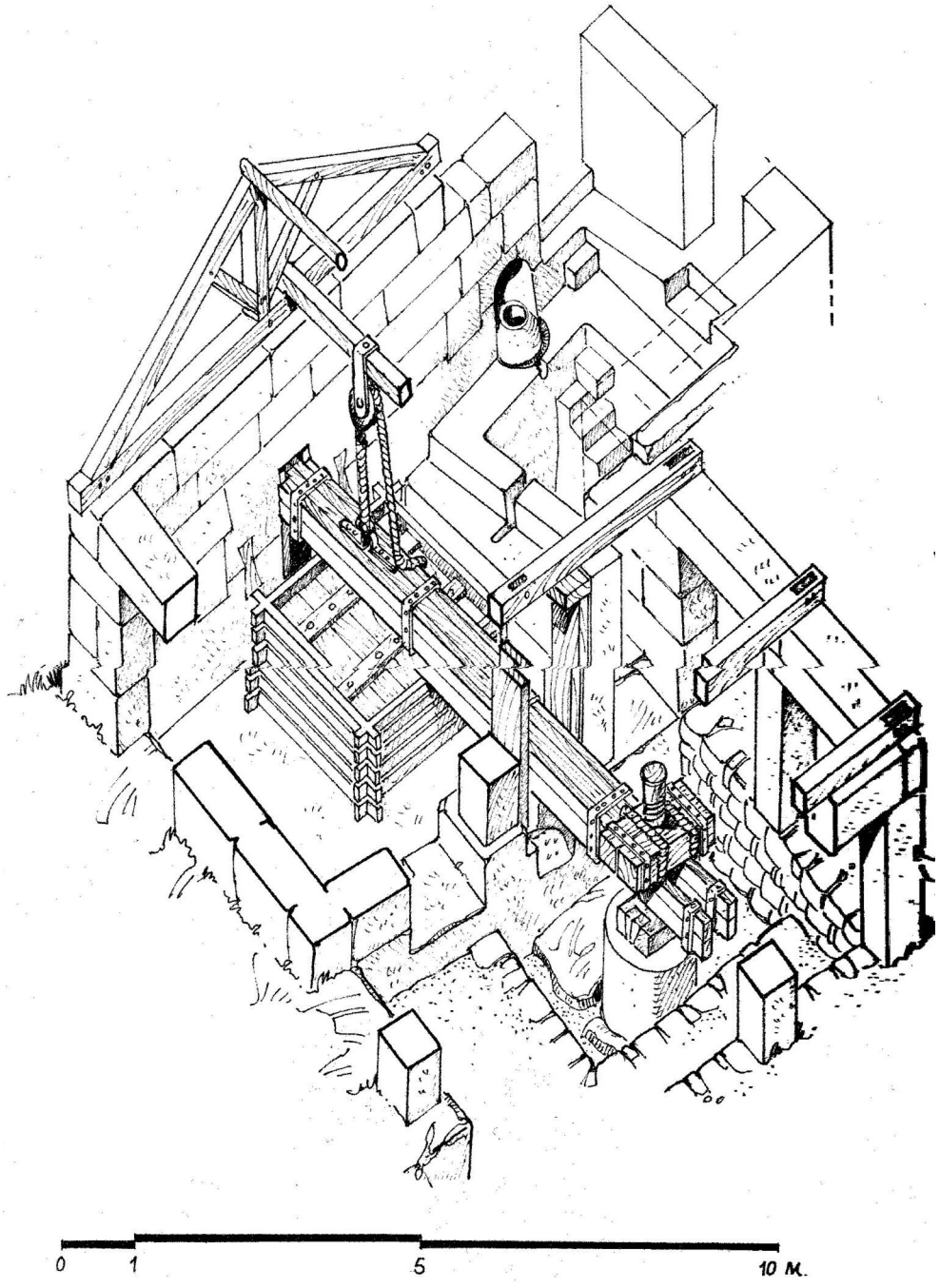

Fig. 3: The wine making plant n°3 of Dehes (Syria).

to the performance of modern instruments, such as GC-MS, and adapted extraction methodologies. This is one of the essential paths of progress in our understanding of technical and economic phenomena and one of the pillars of our work today.[22]

Fig. 4: Plan of the press complex in the villa of São Cucufate (Portugal).

We now have the technical means, though often not the financial resources, to revisit the very foundations of the development and decline of wine and oil production and to estimate their respective proportions by trying to detect the biases and the lacunas of the documentation. In terms of trade, the overwhelming domination of the Dressel 20 amphorae in Imperial Rome spread the idea of a strong production of olive oil widely marketed during antiquity. This observation, true for the first three centuries of the Roman Empire, has been abusively extended to other periods. Let us look at various problems researchers are facing, starting from the archaic period.

We suspect, and it is being increasingly corroborated, that the production of wine and oil began in various areas of the Mediterranean long before the arrival of Phoenician or Greek settlers from the east. The exploitation of the olive in the Iberian Peninsula began during the Neolithic and wine and oil were produced in Italy from at least the Bronze Age and probably the Neolithic. But the quantities were limited with little or no marketing.

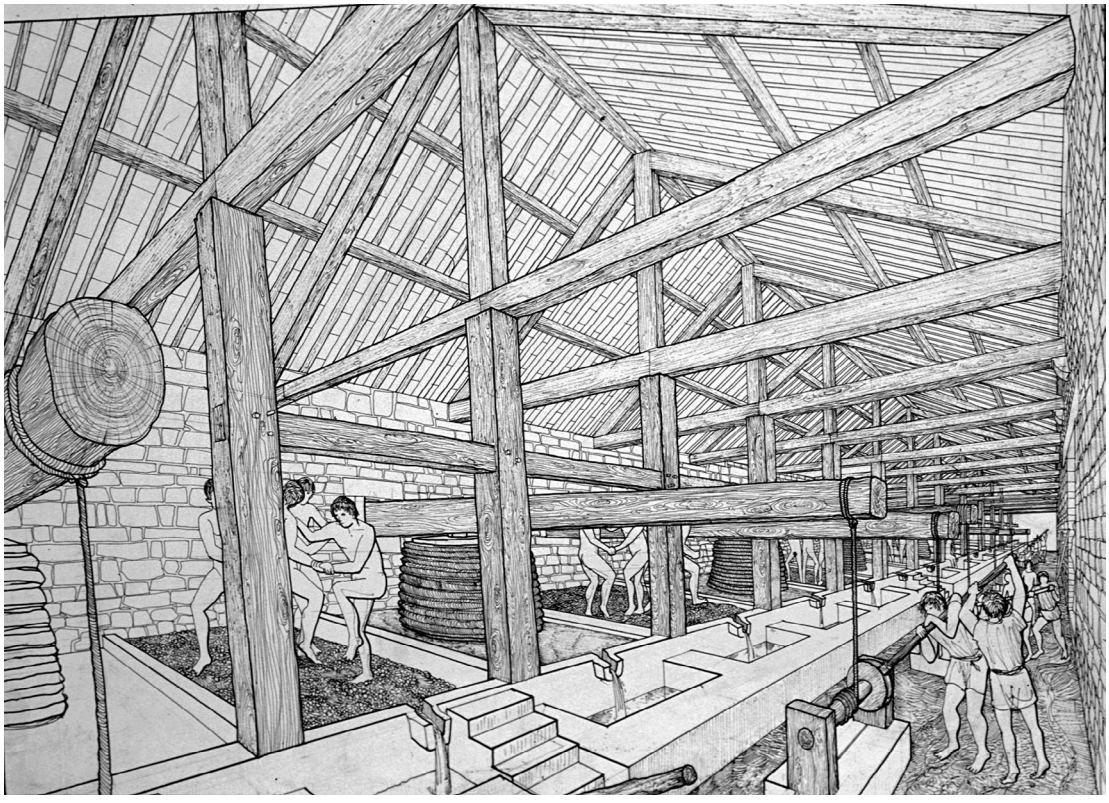

Fig. 5: Suggested reconstruction of the wine making plant at Khirbet Agoub (Algeria).

From the Archaic period, we can trace the emergence of commercial networks through amphorae. For a long time the allocation of the SOS and Corinthian A amphorae for the transportation of oil created an oil trade but this attribution was based on a methodologically unacceptable combination of material and literary sources, and these amphorae actually carried luxury wine for export.[23] Only expensive wines could pay for such long journeys from Greece to Italy and these luxury wines were buried in the graves of powerful people. For instance, a Corinthian amphora A was found in the tomb of Pontecagnano 926 and a SOS amphora in the tomb Artiaco 104 at Cumae, both tombs also contained precious metal vases used for drinking wine.[24] Consequently, all the theories developed about the supply of the newly founded colonies, about the slow growth of colonial viticulture and the alleged slow beginnings of the cultivation of the olive tree must be dramatically revised.[25] It is obvious that the Greeks brought with them their knowledge and their cultural needs that required, as soon as they seized the land, the cultivation of olives trees and vines in order to produce oil for external use and wine, considered as a basic drink, as a drug, as a necessary mediation with the gods and as a comfort beverage with a double purpose: psychotropic and convivial.

The production facilities of this early period remain poorly documented because they were often very simple and made of perishable materials (wooden treading floors, textile

Fig. 6: Two vats of the villa Saint-Michel at La Garde (France) transformed into a wine cellar during the 3rd c. AD. Note the small walls probably supporting wooden barrels.

torsion presses). However, stone-based presses are known through archaeology in Ischia, Lattes, Crimea, etc. and many rock installations date back to this period. I quote for example the case of the wine devices of Las Pillilas at Requena (Spain)[26] or the ones near Agrigento in Sicily, dated from the Classical and Hellenistic periods.[27] These facilities largely widespread in Greece, Sicily, Sardinia,[28] Malta,[29] Algeria,[30] Spain,[31] Portugal[32] were generally part of a domestic or local economy. The wine was stored in multipurpose jars, often amphorae reused several times,[33] and they were mainly transported in wineskins. These parameters distort our perception of domestic production and local consumption, which was the dominant model at all times. Archaeologists focus on what they can find and count, especially amphorae that highlight commercial phenomena, but these trade flows were often marginal in terms of volume, even if iconic. This remark can be applied to the entire ancient period, even more so when wooden barrels became widely used concurrently with ceramic containers.[34]

Before the development of the metropolises in the Hellenistic period, trade dealt only with luxury products like fine wines, perfumes, fabrics, jewels, slaves, etc., and rarely basic products, except during a food crisis or shortage.[35] But after the 3rd century BC, in cities such as Rome and Alexandria,[36] population growth meant that the surrounding countryside was no longer able to supply foods and it became necessary to import these goods in increasing quantities e.g. cereals, salted meat and fish, oil and common wines.

Large commercial networks were boosted by specific demands from powerful social elites living in regions deprived of vines, such as inland Gaul: Marseille and then Tyrrhenian Italy, then coastal eastern Spain made great profits from these needs created by a very specific cultural and political context.[37]

These two phenomena: the growth of capital cities of powerful states and strong socio-cultural demand from peripheral populations introduced major changes in production techniques, the specialization of agriculture and the geography of production. From the 2nd and 1st centuries BC, some regions began to specialize some of their productions: the Tyrrhenian coast, Sicily, and the Greek islands in viticulture and Apulia, Istria and Baetica in olive oil. Installations that were previously very artisanal, and archaeologically almost imperceptible, became massive, like the model farms proposed by Cato and illustrated by many villas like the villa Prato at Sperlonga amongst others (fig. 7).[38] The treading floors and the presses were, from this time, built of stone and wooden beams, the vats made out of masonry, and the cellars equipped with many dolia. Export trade was carried out by larger boats loaded with greater quantities of amphorae. But once again, archaeologists can only observe the main visible phenomena, those that F. Braudel rightly called "Les jeux de l'échange".[39] Indeed researchers attached great importance to urban development, but all local production and consumption continue to escape our perception, for the most part due to the lack of measurable indices. Local wine was still transported in skins, sometimes huge, like those carried by tank carts, and often it was poured into reused amphorae. As for oil, the study of its trade is focused on the supply of people with high purchasing power: urban populations, especially in Rome, and the

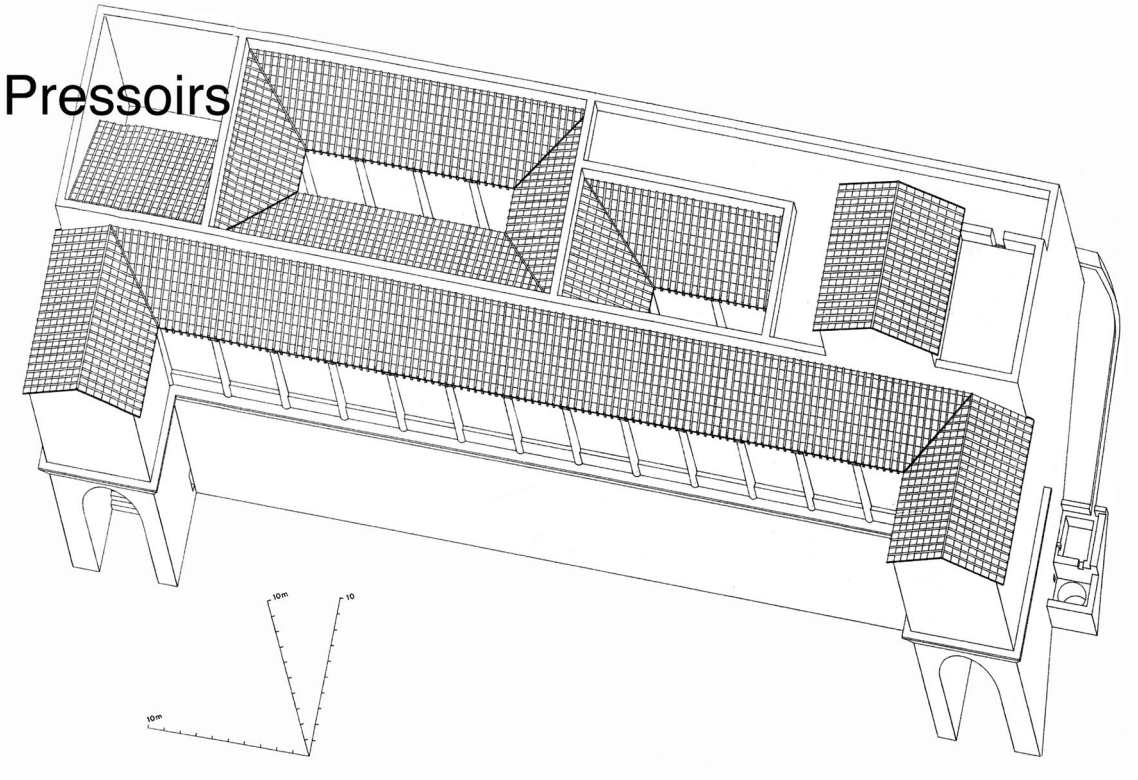

Fig. 7: Axonometry of the Villa Prato.

soldiers. Outside these privileged categories, the demand was satisfied with local olive oil but also with seed oils, in Egypt for example,[40] or walnut oil,[41] and mainly animal fat, which was readily available everywhere.

Even during the early Empire and the peak period of the production of wine and oil in the Mediterranean, we can detect commercial vineyards only through their production and diffusion of amphorae: Baetica, Tarraconnensis, Narbonnensis, Campania, Cilicia, Africa, in particular. These great networks are now well known thanks to the multiplication of studies, but the works of A. Tchernia, B. Liou, and A. Hesnard[42] have revealed that the production of some of these large vineyards can never be quantified because a significant part of the wine was shipped in bulk, transported in dolia secured in the hold of merchant ships. On the other hand, we should also consider smaller containers, flat-bottomed small amphorae or jugs, which were used for marketing prized wines, such as wines from the region of Ephesus[43] or those of northern Campania.[44] Work is needed to rehabilitate these small containers whose value could be equivalent to that of larger common wine amphorae.

Even with this advanced research, some commercial vineyards will continue to escape our notice, such as those of Western and Northern Europe. Since the origins of these productions, from at least the 1st century BC, the vineyards of the Po Valley, then a century later those of Lusitania, of Aquitania, of Lugdunensis, of Belgica, of Germania,

of Britannia and of Pannonia produced their wine in wooden devices (treading floors, presses, vats) and marketed it in barrels. The remains of these productions are limited to grape seeds, planting trenches, fragments of staves or trenches for wooden presses, like the one recently excavated at "Lieu-Dieu" (Boulazac, Dordogne) (fig. 8).[45] However, exports to the Roman forts of the limes, as early as the first century, were mostly in barrels. The illuminating works of E. Marlière on the fort of Vindolanda (Hadrian's Wall) show that, at the end of the 1st and beginning of the 2nd centuries AD, less than 1% of the wine supply reached this military post in amphorae.[46]

Of course, the situations vary greatly from one province to another. In the Eastern Mediterranean Basin, ceramic containers were still massively used for both production and marketing. However, in the Western Basin, probably as early as the end of the 1st century AD, the use of barrels spread in the Iberian Peninsula, in Italy and even in Africa.[47] The recent discovery at Arles of a an inscribed jug containing a sample of white wine from Alba near Rome (Albanum) proved that wine from Central Italy was marketed in barrels towards the end of the 1st century AD.[48] The diffusion of this technical innovation replaced the complex system of wine transportation in dolia installed in special ships.[49] These ships disappeared under the Flavian dynasty probably because the built-in dolia were replaced by the lighter and more versatile wooden barrels. And we should consider the hypothesis they were used to ship oils, as was done during the Middle Ages and the 16–18th century. We need to ask new questions: how widespread was the container revolution introduced by wooden barrels? We know that it touched wine and salted fish, so why not olive oil?

During Late antiquity, our understanding of viticulture is further distorted by the increasing use of all sorts of wooden devices, which deprives archaeologists of essential evidence. In Gaul, entire vineyards, for example those of the Loire valley known by Gregory of Tours or those of the region of Reims attested by the testament of Saint-Remy have so far not left little traces. We could multiply the examples.

In summary, new research, supported by carpological and biochemical analyses, offers a more balanced vision of wine and oil production. In the northern part of the western Mediterranean, presses are mainly devoted to wine production. In the south, in Spain, and in Africa, the remains seem mostly to be associated with olive oil production, with the notable exception of Egypt, which is almost exclusively devoted to wine. For trade, the overwhelming dominance of amphorae Dressel 20 in Rome led to the idea of a huge oil production widely marketed during antiquity. This observation, true for the first three centuries of the empire, has been erroneously extended; however, advances in amphorae typologies, mineralogical and biochemical analyses are re-establishing a more accurate picture of the chronological and regional dynamics of wine and oil production and trade. Here again, progress can be made. I pointed out that a major part of wine and oil productions escape the archaeologist: this includes family productions, almost undetectable in installations made of organic materials, local productions often performed in rock carved devices (the Italian palmenti or Spanish lagares) and marketed

Fig. 8: Recently excavated wine making installation of Le Lieu-Dieu (Boulazac, France). Note that the remains of the press, made entirely of wood consist only of a trench and post holes.

in skin containers (utres, cullei), and in certain regions (Alpes, Cisalpina, Lusitania, Tres Galliae, Germania, Britannia), all the wine was produced and marketed in wooden vats and barrels. As we improve our knowledge, we are able not only to clarify our positive knowledge, but also to identify the gaps, which are and will remain considerable.

We must be aware of these shortcomings in the construction of our reasoning on both technical and economic evolutions. Some gaps are structural. The general disappearance of wooden instruments forever deprives us of the majority of evidences on the vineyards where they were used. Other gaps may be partially filled. The biochemical analyses now identify the contents of ceramic containers, even if they were filled successively with different liquids. Carpological studies reveal the production of wine or oil in sites where the other remains are not characteristic. The archaeology of planting reveals vineyards even where there are no traces of winepresses such as in the region of Bourges.[50] New archaeological research on rock presses is gradually shedding light on their chronology.[51] Distinguishing areas of light and shadow in our knowledge already represent huge progress in our research, which is fed by the following papers.

Notes

[1] About Gaul, see Matterne 2001 and Ozoulias 2014.

[2] Pecci et al. 2013a; Pecci et al. 2013b; Garnier 2016.

[3] Dressel 1899; Mau – Schöne 1909.

[4] On the misidentifications in Gaul, see Laubenheimer 2016.

[5] For example, see the possible triangular commerce of olive oil from Africa to Alexandria and of ben oil (moringa peregrina) from Alexandria to Arles: Djaoui et al. 2015.

[6] For example: Saladin 1887; Cowper 1899; Gsell 1901, 30 f. For recent surveys: Leveau 1984; Ben Baaziz 2000; Sehili 2009; Hobson 2015; Ahmed 2018.

[7] Tchalenko 1953–1958 followed by Callot 2004. For similar errors concerning Gallia Narbonensis: Brun 1987 (but with nuances, 223–227).

[8] Brun 2004b, 111–123; Callot 2017; Limbergen 2017.

[9] Alarcão et al. 1990; *contra*: Brun 2005, 288–290.

[10] Heleno 1962; Maloney – Hale 1996, 275–294; *contra*: Brun 1997.

[11] Brun 2004b, 288–300.

[12] Brun 2004b, 233–238.

[13] Brun et al. 1989; Brun 2005, 88–92.

[14] These questions are checked in Brun 2004a, 5–36. The production and use of the dolia have been recently studied by Carrato 2017.

[15] Terral et al. 2004.

[16] Valamoti et al. 2015.

[17] Cicirelli et al. 2008.

[18] Gomez-Bellard et al. 1993.

[19] Hervé-Monteil et al. 2011, 197.
[20] Carrato et al. 2018.
[21] Magdeleine – Ottaviani 1983.
[22] Garnier 2012; Garnier – Valamoti 2016.
[23] Brun 2011a; Sourrisseau 2011.
[24] Pontecagnano: D'Agostino 1977; Cumae: Guzzo 2000, 135–147.
[25] On the beginnings of olive tree cultivation in Italy, see Brun 2011b.
[26] Martinez Valle in this volume.
[27] Olcese et al. in this volume.
[28] Rovina 2008; Loi 2017.
[29] Anastasi in this volume.
[30] Laporte 1975 interpreted as oil presses; *contra*: Brun 2004b, 238 f.
[31] For example at Kelin: Quixal et al. 2016 and more generally: Contreras – Vicente Elias 2015.
[32] For example in the Sierra di Estrela: 2007; at Valpaços: Medeiros Freitas 2017.
[33] Garnier – Pecci, Proceedings of the congress about amphora trade, Cadix, oct. 2015.
[34] Marlière 2002.
[35] The food crises were caused mainly by poor harvests of cereals caused by the weather or the pests and it was then necessary to import grain thanks to "low level connectivities" (Horden – Purcell 2000, 144 f.) but oil also could became scarce. An example of such a shortage, for which it is difficult to distinguish the needs for nutrition from the cultural needs of oil used for the care of the body, is given by the inscription IG, II-2, 903. In the 2nd century BC, a scarcity of oil occured in Athens because of a bad harvest; a generous trader having in his boat 56 000 litres of oil planned to sell in the Pont-Euxin, agreed to sell with a loss in the city and was honored with public recognition (Gauthier 1982).
[36] For Rome, the situation is now well known: see Morley 1996. Alexandria imports massively Greek and Mediterranean wines as well as African oil.
[37] On this question: see Tchernia 1986; Dietler 1992; Poux 2004.
[38] Broise – Lafon 2002.
[39] Braudel 1979.
[40] Sesame, castor, radish, etc. These oil seeds are well known thanks to papyrological documentation: Sandy 1989.
[41] It seems that the imitations of Dressel amphoras manufactured in northwestern Gaul were used to market walnut oil in this region: Baudoux 1996, 106–110.
[42]Corsi-Sciallano – Liou 1985; Tchernia 1986, 285 f.; Hesnard et al. 1988; Marlier 2008; Sciallano – Marlier 2008.
[43] Lemaître 1997.
[44] Brun 2011a.
[45] Bost – Bohny 2017.
[46] Marlière – Torres Costa 2005.
[47] Marlière – Torres Costa 2007.
[48] Djaoui – Tran 2015.
[49] Liou – Sciallano 1985; Hesnard et al. 1988.

[50] Dumasy et al. 2011.
[51] Olcese et al. in this volume; Depalmas et al. in this volume.

Image Credits

Fig. 1: after Saladin 1887. – Fig. 2: Tchalenko 1953–1958. – Fig. 3: Callot 2017. – Fig. 4: A. Alarcão – Étienne – Mayet 1990; B. Brun 2004b, 290. – Fig. 5: drawing by J.-Cl. Golvin. – Fig. 6: by the author. – Fig. 7: Broise – Lafon 2002. – Fig. 8: photo by C. Bost.

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Genomic Tools to Reconstruct the Grapevine Domestication and Evolution in the Western Mediterranean Basin

Gabriella De Lorenzis – Francesco Mercati – Carlo Bergamini – Maria Francesca Cardone – Maria Gabriella Barbagallo – Francesco Sunseri – Lucio Brancadoro – Attilio Scienza – Osvaldo Failla

Italy is one of the major wine producers, with the area under vine cultivation reaching 690,000 hectares in 2016. The most ancient archeological evidence of grape consumption in Italy dates back to the Epigravettian and Mesolithic periods, in Grotta del Romito (Cosenza, Calabria) and Grotta dell'Uzzo (Trapani, Sicilia), respectively, where seeds of wild grapevines have been identified.[1] Sicily, together with the other regions of southern Italy (Calabria, Campania, Basilicata and Puglia), played a key role in the introduction of new forms of viticulture to Italy during Greek colonization. The aim of this work was to identify the genetic relationships among southern Italy and eastern Mediterranean Sea countries germplasm by a SNP genotyping.

A total of 187 grapevine accessions, originating from Italy, Greece and the Eastern Mediterranean Sea were genotyped by Vitis18kSNP chip array (Illumina Inc., San Diego, California), containing 18 071 SNPs. The SNP polymorphisms have been used to identify synonymies/homonymies, calculate the genetic distances among the cultivars (clustering analysis), the genetic relationships (Principal component analysis, PCA), structure analysis and parentage analysis.

The SNP genotyping of 187 grapevine accessions from Italy, Greece and the Eastern Mediterranean Sea countries produced a dataset of polymorphic loci counting 11023 SNP loci. A dendrogram was built to investigate the genetic relationships among the genotypes. The range of similarity varied from 100 to about 83%. A total of 158 unique genotypes were detected, with the higher number of synonymies identified among Italian genotypes. Other synonymies were also noticed between genotypes from Italy and the Eastern Mediterranean Sea. Cluster analysis was not able to define groups based on the geographic origin. Indeed, samples coming from different Italian regions were clustered together with genotypes originated from the other countries. Nevertheless, the Greek genotypes were clustered in a group including the most part of the Eastern Mediterranean Sea samples.

PCA identified two main clusters: Cluster 1 grouped together mainly samples from eastern Mediterranean Sea countries (97%) and southern Italy (59%), together with northern Italy, and Cluster 2 comprised only samples coming from the south of Italy (31%). The first two principal components, representing the first uncorrelated variables in which the correlated variables (SNPs) were transformed, explained the 39% of total variability. The genetic clusters were not geographically restricted.

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Structure analysis identified two as the most likely number of ancestral genetic groups (K = 2). Only the 8% of genotypes showed a percentage of membership > 80%. Although the high number of admixed genotypes, the spatial interpolation of ancestry proportions inferred assigned genotypes from the Eastern Mediterranean Sea countries and southern Italy to the same cluster. In the second cluster, samples belonging to northern Italy were mainly included.

The grouping of Italian and Greek samples together in the same clusters are in agreement with the historical events joining these two areas.[2] These results supported the hypothesis that during Greek colonization, Calabria and Sicilia played an important role for evaluating the potential of varieties coming from the eastern Mediterranean and their spreading firstly in southern Italy and afterwards in Etruscan Italy (Central Italy) and France.[3]

The first (parent-offspring) relationships were detected to define a proposed pedigree of southern Italian samples. Up to 52 genotypes from southern Italy shared almost one PO relationship. Most relationships were identified between southern Italian genotypes. Interpopulation relationships were also identified. The cultivars with the highest number of relationships were Sangiovese (13) and Mantonico Bianco (10). Other genotypes showing a well-defined pedigree-network were Bombino bianco (7 PO relationships) and Aglianico (6). These results revealed the use of elite cultivars in grape breeding programs. These cultivars have shaped the grapevine ampelographic platform of southern Italy. The elite cultivars (such as Sangiovese and Aglianico) were varieties widespread in many important winegrowing areas or minor varieties but with large local interest (such as Mantonico Bianco and Bombino bianco).[4]

In conclusion, a significant degree of gene flow was observed in agreement with historical and socio-eco-political events that occurred in the Mediterranean Basin. These results highlighted the central role of southern Italian germplasm in the spread of grapevine through Western Europe. The uniqueness of this ampelographic platform was mainly an outcome of complex natural or human-driven crosses involving elite cultivars.

Notes

[1] Costantini 1982; Cattani et al. 2004.

[2] Buono – Vallariello 2002.

[3] Collesano 1998; Buono – Vallariello 2002.

[4] Cipriani et al. 2010.

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Investigating the Grape Varieties Cultivated by the Romans in Southern Gaul through Geometric Morphometrics and Palaeogenomics

Laurent Bouby – Jazmín Ramos-Madrigal – Anne Kathrine Wiborg Runge – Thierry Lacombe – Vincent Bonhomme – Sarah Ivorra – José Alfredo Samaniego Castruita – Roberto Bacilieri – Marcus Thomas Pius Gilbert – Jean-Frédéric Terral – Nathan Wales

Grape cultivation was a highly important and lucrative activity in the Mediterranean areas of Roman Gaul, especially during the 1st and 2nd c. AD.[1] Many aspects of wine production are nowadays well documented by archaeology. However, still little is known about the cultivated grape itself. Yet, grape cultivar is, together with soil, climate and human practices, one of the main factor for the quality of wine. Thousands of grape cultivars are described today, displaying a tremendous diversity for many phenotypic characteristics. But very few is known about the history of these cultivars and even less about their ancestors from Classical times. Latin writers, such as Columella and Pliny the Elder, reported about the already remarkable diversity of cultivated grapes in their times, giving the names of the most famous types, providing extensive information about their productivity, hardiness, adaptation to soil and climate conditions, areas of origin.[2] Several types are described as typical of the territory of Gaul (Allobrogica, Caburnica, etc.) but it is impossible to draw any relationship between the named ancient types and existing modern cultivars.

The archaeological excavations recently carried out on Roman sites in Languedoc provided significant numbers of well-preserved grape pips, due to waterlogged conditions prevailing in some deposits, especially in wells. Most of these sites were more or less involved in wine production and in many cases the recovered pips, together with pedicels and berry skins, belonged to wine making residues.[3] Consequently, the pips almost certainly came from locally cultivated grapes. We then decided to use the pips as a proxy to try to characterize the grape types cultivated in southern Roman Gaul, combining two approaches: geometric morphometrics and palaeogenomics.[4] Together or separately, these analyses were carried out on samples from seven Roman sites in Languedoc (200 BC – AD 400). The shape of ancient pips was quantitatively described using outline analysis, namely elliptic Fourier transforms performed on dorsal and lateral seed outlines. Ancient pips shapes can then be characterized by comparison with modern pips using discriminant and data analysis methods. This method is able to distinguish pips from wild or domesticated grapevines and, among them, 14 morphotypes composed of various cultivars.[5] A new palaeogenomic approach, based on targeted-high-throughput sequencing of ten thousand Single Nucleotide Polymorphisms, explored identities and genetic relationships of grape cultivars across time, by assembling a dataset of ancient and modern samples. Individually collected archaeological pips from waterlogged contexts were analyzed in a dedicated ancient DNA clean laboratory.[6]

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The combined results from these independent approaches are congruent and prove the cultivation of an important grape diversity, not only on a regional scale but also at the level of each individual farming site. Numerous morphotypes and several genotypes can be recognized on the majority of the sites. In general the grapes cultivated in Gallia Narbonensis during the Roman period were quite different from the varieties cultivated today. First, morphometrics show that pip shapes similar to those of modern wild grapes are very common on every site. However, ancient DNA suggests that all archaeological pips are genetically closer to modern domesticated grapevine than to its wild relative. The wild morphotype then most probably represents a part of the ancient cultivated diversity of grapes, with no modern equivalent, rather than collected wild grapes.[7]

Then, palaeogenomics identify no specific match between archaeological pips and any modern variety, but parental relationships exist in some cases with varieties regarded today as typical of the northern Alpine regions. The morphotypes acknowledged by morphometry include modern cultivars from various French wine regions. However, many pips are similar in shape to 'Mondeuse blanche', a white wine cultivar characteristic of the Savoie region, in the French Alps.

These results show that drastic changes affected the diversity of the grapes cultivated in southern France between antiquity and the present time. We still have to trace the origins of the ancient cultivated grape types and to determine how and when they have been replaced by new varieties.

Notes

[1] Brun 2005.

[2] Tchernia 1986.

[3] Figueiral et al. 2010.

[4] This project is supported by the French National Agency of Research (VINICULTURE project – ANR-16-CE27-0013), by the Danish Council for Independent Research (10-081390) and the Danish National Research Foundation (DNRF94).

[5] Terral et al. 2010.

[6] Ramos-Madrigal et al. 2019.

[7] Bouby et al. 2013.

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Ricerche multidisciplinari sui palmenti rupestri nell'Italia meridionale tirrenica

Gloria Olcese – Andrea Razza – Domenico Michele Surace
(con un contributo di Nicolas Garnier)

Obiettivi e fasi del progetto

La ricostruzione dell'economia antica può avvenire anche attraverso lo studio dei palmenti rupestri, gli antichi impianti di produzione del vino formati da vasche scavate nella roccia (fig. 1), oggetto della ricerca "Fare il vino nell'Italia antica",[1] nata nell'ambito del progetto *Immensa Aequora*.[2]

Nonostante alcuni studi recenti,[3] non esiste in Italia un lavoro d'insieme su queste strutture agricolo-produttive,[4] per cui ancora irrisolti sono alcuni quesiti che riguardano, ad esempio, la cronologia (spesso difficile in assenza di reperti datanti o per il riuso e le modifiche nel corso dei secoli) e la destinazione d'uso degli impianti.[5]

Il progetto è articolato in una serie di fasi, alcune ancora in corso:

- *mappatura regionale*, con ricognizioni in Toscana, Lazio, Campania e Sicilia, in zone selezionate per la cospicua attestazione di impianti rupestri (in blu nella fig. 2). I dati finora ottenuti sono confluiti in un *Atlante*,[6] strutturato in schede (fig. 3 A), in corso di completamento;
- *analisi e confronto delle caratteristiche strutturali* dei palmenti rupestri;
- verifica degli eventuali *rapporti tra impianti e paesaggio agrario*, contesti insediativi e fornaci ceramiche;
- *analisi dei residui* (GC-MS) per l'identificazione della destinazione d'uso dei palmenti rupestri campionati (in rosso nella fig. 2);
- *studio archeobotanico* e *biomolecolare* in alcune aree per riconoscere il paesaggio agrario antico sopravvissuto, particolarmente i relitti di antichi vigneti coltivati, e per analizzare le caratteristiche genetiche e morfologiche delle viti selvatiche.[7] Le analisi condotte sui vitigni moderni consentono, infatti, di ricostruire le caratteristiche dei vitigni antichi e della genesi della viticoltura nelle aree studiate.[8] L'indagine può, inoltre, riguardare non solo i vinaccioli antichi[9] ma, in loro assenza, gli esemplari moderni che ne conservano le caratteristiche genetiche: recenti lavori su vinaccioli moderni hanno, ad esempio, messo in luce il ruolo avuto dal germoplasma dei vitigni dell'Italia meridionale nella diffusione della vite verso Occidente.[10]

Ischia e la Sicilia: due aree di indagine

Nell'ambito delle ricerche effettuate sui palmenti rupestri, la Campania e la Sicilia, particolarmente rinomate per la produzione vitivinicola del passato, hanno offerto numerose indicazioni utili a una ricostruzione del paesaggio agrario delle due regioni.[11]

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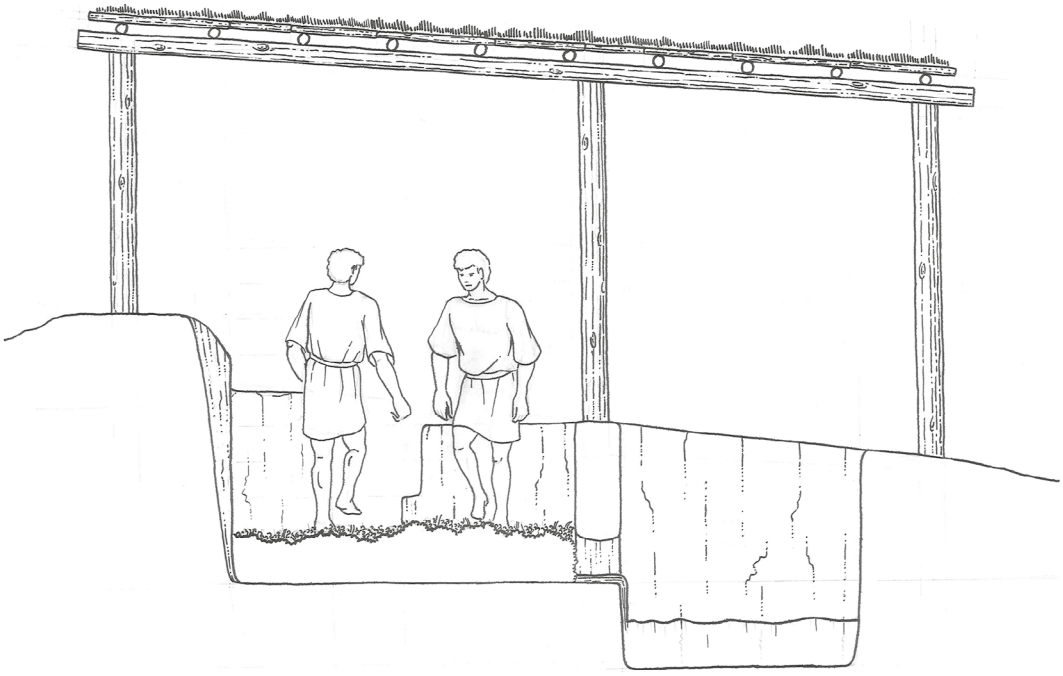


Fig. 1: Rappresentazione in sezione della fase di pigiatura in un palmento rupestre a doppia vasca (disegno E. Serafini, progetto *Immensa Aequora*).

In *Campania* la ricerca si è per ora concentrata a Ischia per la presenza di vigneti, di palmenti e di un pigiatoio "domestico" nel contesto arcaico di Punta Chiarito, oltre che per la produzione di anfore vinarie durante tutte le fasi di vita dell'isola.[12] Questi elementi rendono Ischia un'area adatta per lo studio dell'intero ciclo produttivo del vino, dalla coltivazione della vite alla produzione dei contenitori e al suo commercio, dall'epoca della colonizzazione fino al tardo antico.

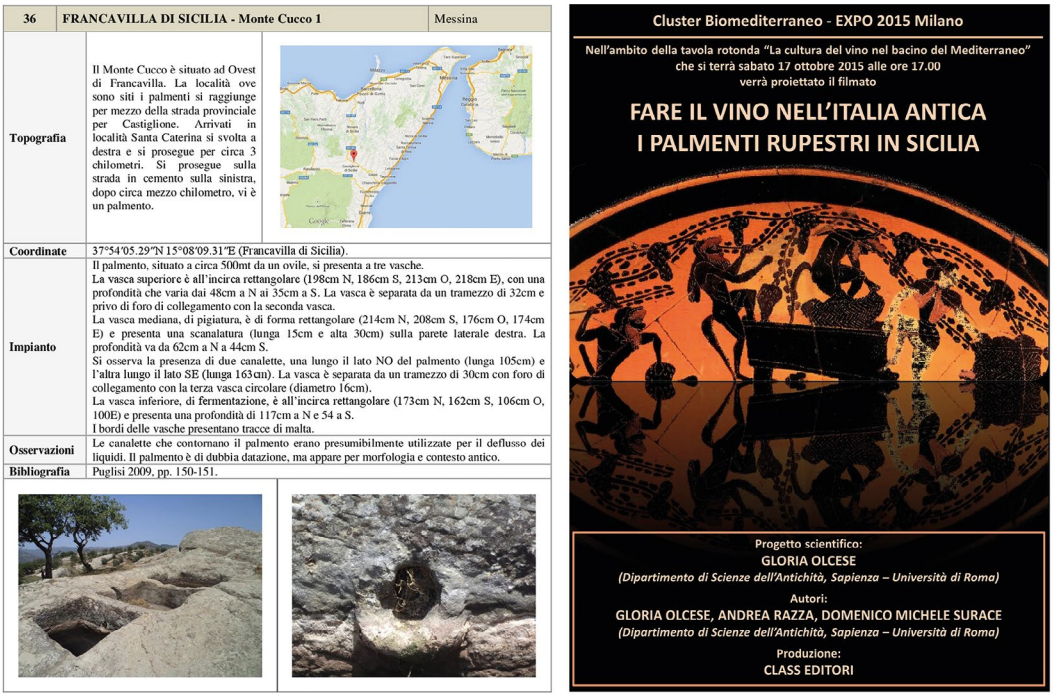
Numerosi sono gli impianti nel Bosco della Falanga (fig. 5), sul Monte Epomeo, nella zona centrale dell'isola. Altri palmenti si trovano a Monte Corvo (fig. 4), sopra Forio, in un'area ancora oggi ricca di vitigni, sulla costa occidentale. Queste strutture, considerate spesso di epoca moderna ma che in alcuni casi presentano caratteristiche comuni a impianti antichi di altre aree del Mediterraneo, rappresentano l'architettura rurale dell'isola.[13]

In *Sicilia*, regione caratterizzata da diverse *facies* culturali[14], i vitigni e gli impianti produttivi sono numerosi e distribuiti in gran parte del territorio. Nelle fasi iniziali del progetto, è stato effettuato un primo studio bibliografico dei palmenti dell'isola per sviluppare un modello di intervento, estendibile ad altre aree[15]. In seguito, sono state eseguite alcune ricognizioni in diverse zone, come quella del Ragusano, caratterizzata da palmenti rupestri disseminati fin a ridosso dell'ambiente cittadino (fig. 7 B),[16] e nelle aree particolarmente significative della Valle dell'Alcantara[17] (fig. 3 A), nell'entroterra della Sicilia orientale alle pendici dell'Etna, e del Bosco della Risinata, presso Sambuca di Sicilia nella Valle del Belice (AG)[18] (fig. 6).

Fig. 2: Carta di distribuzione dei palmenti indagati dal progetto: in blu le aree delle ricognizioni, in rosso i palmenti campionati.

Alcuni risultati preliminari dello studio sui palmenti rupestri

Lo studio condotto a Ischia e in Sicilia ha permesso di individuare alcune caratteristiche ricorrenti relative a topografia, struttura, cronologia e destinazione d'uso dei palmenti, che sono gli ambiti tematici che si ritiene utile indagare.



36	FRANCAVILLA DI SICILIA - Monte Cucco 1	Messina
Topografia	Il Monte Cucco è situato ad Ovest di Francavilla. La località ove sono siti i palmenti si raggiunge per mezzo della strada provinciale per Castiglione. Arrivati in località Santa Caterina si svolta a destra e si prosegue per circa 3 chilometri. Si prosegue sulla strada in cemento sulla sinistra, dopo circa mezzo chilometro, vi è un palmento.	
Coordinate	37°54'05.29"N 15°08'09.31"E (Francavilla di Sicilia).	
Impianto	Il palmento, situato a circa 500mt da un ovile, si presenta a tre vasche. La vasca superiore è all'incirca rettangolare (198cm N, 186cm S, 213cm O, 218cm E), con una profondità che varia dai 48cm a N ai 35cm a S. La vasca è separata da un tramezzo di 32cm e privo di foro di collegamento con la seconda vasca. La vasca mediana, di pigiatura, è di forma rettangolare (214cm N, 208cm S, 176cm O, 174cm E) e presenta una scanalatura (lunga 15cm e alta 30cm) sulla parete laterale destra. La profondità va da 62cm a N a 44cm S. Si osserva la presenza di due canalette, una lungo il lato NO del palmento (lunga 105cm) e l'altra lungo il lato SE (lunga 163cm). La vasca è separata da un tramezzo di 30cm con foro di collegamento con la terza vasca circolare (diametro 16cm). La vasca inferiore, di fermentazione, è all'incirca rettangolare (173cm N, 162cm S, 106cm O, 100E) e presenta una profondità di 117cm a N e 54 a S. I bordi delle vasche presentano tracce di malta.	
Osservazioni	Le canalette che contornano il palmento erano presumibilmente utilizzate per il deflusso dei liquidi. Il palmento è di dubbia datazione, ma appare per morfologia e contesto antico.	
Bibliografia	Puglisi 2009, pp. 150-151.	

Fig. 3: A) Esempio di scheda dell'Atlante dei palmenti rupestri (Monte Cucco, Francavilla di Sicilia); B) locandina documentario (Olcese et al. 2015).

Il contesto topografico

Il *contesto topografico* in cui i palmenti rupestri considerati si inseriscono appare costante: nella quasi totalità dei casi gli impianti sono posti su alture spesso ancora oggi ricche di vigneti; si nota inoltre la predilezione per la vicinanza a risorse idriche e a vie di comunicazione, come riscontrato anche in altri territori antichi a vocazione vitivinicola, tra cui, a titolo di esempio, la Tarraconense, la Narbonense o l'Anatolia.[19] Ciò suggerisce un'ottimizzazione degli spazi lavorativi volta a far sì che l'intero processo di vinificazione potesse compiersi secondo le modalità e le tempistiche più favorevoli.

La presenza di numerosi palmenti rupestri delinea un paesaggio caratterizzato da insediamenti rurali di varia estensione che, affiancando la viticoltura alle altre attività agricole, hanno determinato lo sfruttamento policolturale del territorio in cui sono inseriti.[20]

Il carattere isolato degli impianti in alcune zone indagate può essere indicativo di una produzione di vino orientata forse al soddisfacimento di piccole comunità. Un esempio di questa organizzazione socio-economica è rappresentato dalla Valle dell'Alcantara, caratterizzata da palmenti rupestri distribuiti a distanza gli uni dagli altri, in zone collinari interessate dalla presenza di vigneti, nelle vicinanze di un'importante risorsa idrica rappresentata dal fiume omonimo.[21]

In altre aree studiate, invece, la gran concentrazione ravvicinata di palmenti rupestri lascia immaginare una produzione più ampia e organizzata. Gli impianti del Bosco della

Fig. 4: Palmento di Monte Corvo, Ischia.

Falanga di Ischia (fig. 5) – purtroppo non datati – e l'imponente complesso del Bosco della Risinata (fig. 6) – per cui, invece, esiste qualche appiglio cronologico, si veda *infra* – sono inseriti in aree dove si riconoscono evidenze sia della produzione del vino che del suo stoccaggio nel corso dei secoli.[22] In particolare, il palmento del Bosco della Risinata è collocato in un'area caratterizzata da vasti vigneti[23] e di cui la rinomata qualità del vino *Inykos*, prodotto localmente già in epoca greca, testimonia l'importanza dell'industria vinicola antica.[24] La produzione nell'area di contenitori destinati proprio al trasporto del vino è suggerita, invece, dal rinvenimento nel vicino sito di Monte Adranone (fig. 2) di elementi riferibili a un'officina ceramica di età ellenistica.[25]

Le caratteristiche strutturali

Molti degli impianti mostrano *caratteristiche strutturali* comuni. La forma più frequente prevede bacini quadrangolari di varia grandezza (fig. 7 A). Altra combinazione, meno attestata, è composta da una o più vasche superiori quadrangolari e una vasca inferiore semicircolare (fig. 7 B). Impianti ancora più rari prevedono una vasca circolare (talvolta in associazione con vasche superiori quadrangolari) (fig. 7 C) o più vasche anche di diversa forma (fig. 7 D). I bacini sono sempre separati da un tramezzo con un foro per il deflusso del liquido o, più raramente, con un taglio ricavato nella roccia stessa.

Nei palmenti di Ischia e della Sicilia l'estensione delle vasche è variabile, così come la profondità.[26] Il pesante lavoro di scavo nella roccia era finalizzato ad assicurare il massimo della capacità di sfruttamento dell'impianto.[27]

Fig. 5: Palmento sito nel Bosco della Falanga, Ischia.

Tra gli esemplari più complessi, quelli del Bosco della Falanga (fig. 5) sono costituiti da vasche circolari e quadrangolari, in alcuni casi parzialmente coperte e collegate, canalizzazioni e fori riconducibili a strutture in materiale deperibile per la ripartizione funzionale degli spazi.

L'impianto del Bosco della Risinata (schedato da F. Lentini in *Atlante palmenti*), con i suoi tre palmenti a doppia vasca tra loro interconnessi, interessa una superficie di circa 110 mq ed è certamente uno dei più grandi della Sicilia (fig. 6). Non mancano nelle fonti antiche testimonianze di imponenti strutture per la produzione di vino, per cui un parallelo è offerto da Diodoro Siculo (XIII 83, 2–3) che descrive il noto impianto di Tellias, cittadino di Agrigento della fine del V secolo a.C., la cui capacità era pari a quella di ben 1000 anfore (ca. 20.000 litri).[28]

La cronologia

Come si è detto, fornire una *datazione* certa dei palmenti rupestri è spesso impossibile[29] ma dallo studio condotto sono emersi alcuni elementi utili.

La lettura trasversale dei dati ricavati dall'indagine sugli impianti della Valle dell'Alcantara con quelli del contesto datato all'età del Ferro in cui sono inseriti,[30] ad esempio, ha permesso di ipotizzare che la realizzazione originaria delle strutture risalga a questa fase, forse in connessione proprio con l'avvio della coltivazione della

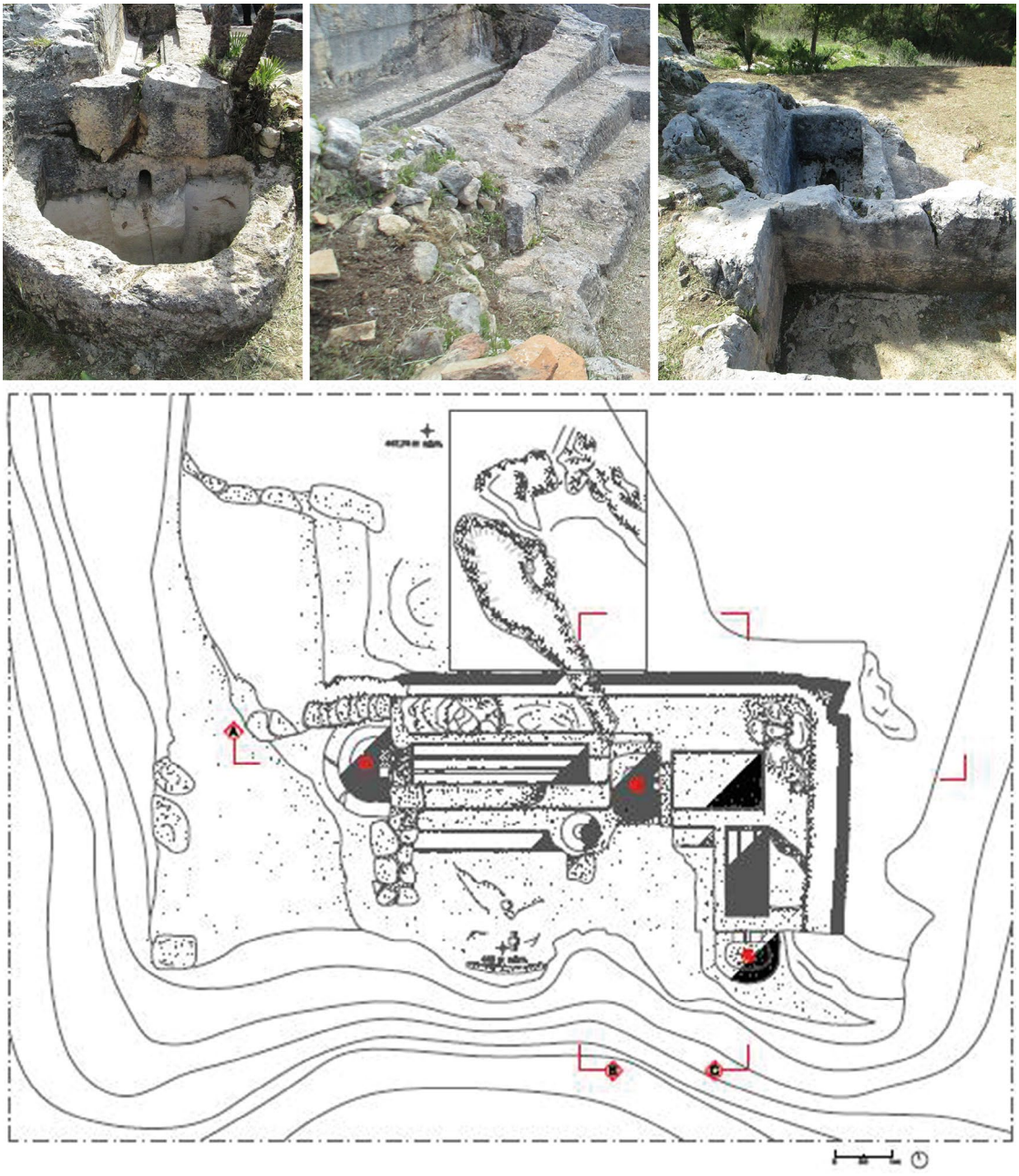


Fig. 6: Palmento del Bosco della Risinata presso Sambuca di Sicilia (rilievo planimetrico di E. Cucchiara inserito nella scheda a cura di F. Lentini in *Atlante palmenti*).

vite, prima della colonizzazione,[31] quando i popoli indigeni crearono una serie di piccoli insediamenti rurali destinati alla coltivazione.[32]

Con la conquista romana, invece, non si osservano tracce di insediamenti nella Valle, che, forse, ha rappresentato in quel periodo esclusivamente un'area di penetrazione e di

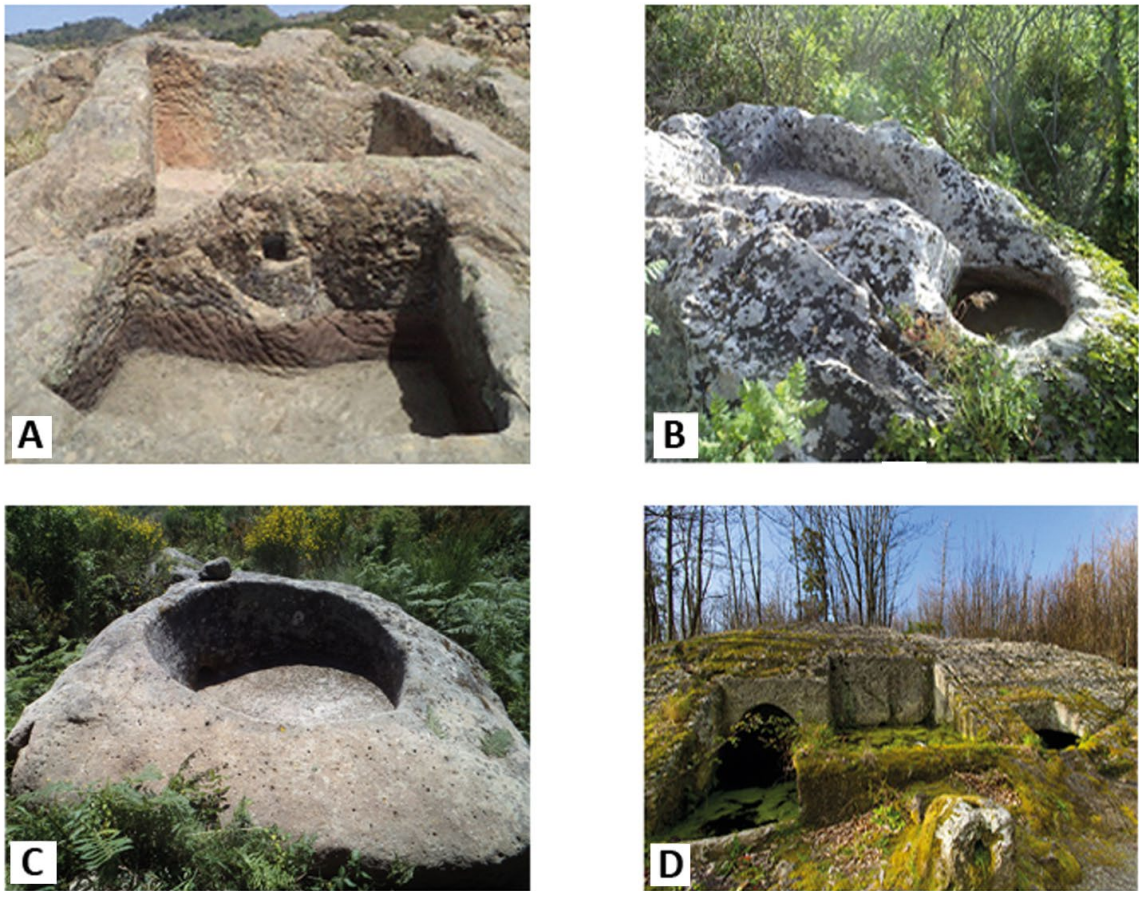


Fig. 7: Forme maggiormente attestate tra i palmenti rupestri delle aree indagate: A) vasche quadrangolari (nella foto, palmento di Gallodoro, ME); B) vasca di pigiatura quadrangolare e vasca di fermentazione semicircolare (nella foto, palmento di Ragusa, RG); C) vasche circolari (nella foto, palmento di Serramezzana, SA); D) impianti a più vasche (nella foto, palmento del Bosco della Falanga, Ischia).

passaggio verso la Sicilia centro-occidentale.[33] In epoca romana, il sistema e la scala di produzione aumentano, come indicato anche dalle diverse attestazioni di vini della zona nelle fonti[34] (come il *Tauromerianum* di Taormina,[35] l'*Haunintinum* e il *Mamertinum* del Messinese[36]), e i palmenti rupestri non sono forse più adatti alle nuove esigenze. L'ipotesi di un loro temporaneo abbandono trova ulteriore conferma nell'assenza, nelle vicinanze delle strutture, di ceramica di età imperiale, indicatore rilevante per determinare la cronologia di utilizzo di un sito e di solito onnipresente.

Gli impianti sembrano essere, invece, riutilizzati a partire dall'epoca bizantina, quando le dinamiche produttive cambiano nuovamente.[37]

Un ulteriore criterio datante potrebbe essere costituito dall'analisi delle presse per la spremitura, come gli studi della Peña Cervantes hanno mostrato per la Penisola Iberica.[38]

	Località	Contesto	Palmento	Forma	Risultato delle analisi (GC-MS)
Toscana	Castel del Piano - S. Biagio (GR)	Si trova nell'area della cappella di S. Biagio, dove sono state rinvenute ceramiche datate al IX-X sec. d.C. (Caprasecca 2004).	Palmento 1	*Forma A* Vasca unica: quadrangolare.	Vasca contenente tracce di resina: uva nera fermentata, molto inquinamento vegetale.
	Vitozza (GR)	Si trova in un insediamento rupestre fondato in epoca medievale in un'area frequentata fin dall'epoca preistorica (Parenti 1980; Feo 1998).	Palmento 3	*Forma B* Vasca di pigiatura: quadrangolare. Vasca di fermentazione: semicircolare.	Tracce di rivestimento della vasca poco conservate: uva nera fermentata, molto inquinamento vegetale e funghi, grassi vegetali.
Lazio	Norchia (VT)	Si trova in un'area le cui prime tracce di frequentazione risalgono al Paleolitico, ma che ha espansione massima dal IV sec. a.C. (Colonna Di Paolo - Colonna 1978). Una nuova fase di insediamento si registra dall'VIII sec. d.C. (Quilici 1990; Ambrosini 2016).	Vasca A	*Forma B* Vasca di pigiatura: quadrangolare. Vasca di fermentazione: semicircolare.	Tracce di rivestimento della vasca poco conservate: uva nera fermentata, altra frutta (acido malico), molto inquinamento vegetale e funghi.
			Vasca C	*Forma A* Vasca unica: quadrangolare.	Tracce di rivestimento della vasca poco conservate: uva bianca fermentata, altra frutta, molto inquinamento vegetale e funghi.
Campania	Ischia - Monte Corvo (NA)	Si trova sul Monte Corvo, sopra Forio. Sull'isola è nota l'attività di produzione ceramica testimoniata dalle fornaci di S. Restituta di Lacco Ameno, in funzione fin dall'VIII sec. a.C. (Olcese 2017).	Palmento 1	*Forma D* Impianto a 5 vasche di forma quadrangolare.	Tracce di rivestimento della vasca poco conservate: grassi vegetali, tracce di uva nera.
	Serramezzana - Antenna televisiva (SA)	Si trovano nell'area tra la Valle dell'Alento e il Monte della Stella, in Cilento. Le attività vitivinicole appaiono riferibili all'arrivo dei Focei nel VI sec. a.C. È nota, in zona, la produzione del vino *Βυξεντῖνος* in una vigna arcaica rinvenuta nella valle del Bussento. Apparentemente, non è attestata alcuna menzione di vini locali nelle fonti prima di Orazio (Ep. 15-20) (Botti et al. 2011).	Palmento 1	*Forma C* Vasca unica: circolare.	Scarse tracce di resina del rivestimento della vasca: uva nera fermentata (vino rosso), molto inquinamento vegetale e funghi.
	Novi Velia - Perato (SA)		Palmento 1	*Forma A* Vasca di pigiatura: quadrangolare. Vasca di fermentazione: quadrangolare.	Scarse tracce di resina del rivestimento della vasca: uva molto scura fermentata (vino rosso), molto inquinamento vegetale e funghi.
Sicilia	Francavilla di Sicilia - Monte Cucco (ME)	Si trova in un'area ricondotta dai rinvenimenti archeologici almeno alla prima Età del Ferro (Spigo et. al. 2008). Altra fase di intensa frequentazione è risalente al periodo bizantino (Privitera 2009).	Palmento 2	*Forma A* Vasca di pigiatura: quadrangolare. Vasca di fermentazione: quadrangolare.	Vasca priva di tracce di rivestimento: uva nera fermentata, molto inquinamento vegetale.

Tab. 1: Tabella di riepilogo dei dati relativi ai palmenti analizzati nell'ambito del progetto.

In base alle osservazioni della studiosa, la pressa manuale a leva, riconosciuta dai fori di alloggiamento osservati su molti palmenti rupestri della Sicilia, come i numerosi esemplari del Monte Cucco (fig. 3 A), nella Valle dell'Alcantara, corrisponderebbe al tipo più antico, in uso già dall'età del Bronzo.

Infine, il rinvenimento di ceramiche nei pressi dei palmenti, così come di segni epigrafici sulle vasche (che in Campania e in Sicilia non sono stati però fino ad ora individuati),[39] rappresenta un termine *post quem* per la cronologia di realizzazione.

Nell'ambito dello studio condotto, la datazione dell'imponente palmento del Bosco della Risinata (fig. 6) è stata riferita, se pur ipoteticamente, all'epoca punico-ellenistica grazie al rinvenimento di bacini e di frammenti di due grandi *pithoi*, la cui morfologia e, per uno dei due, l'impasto sono attestati nel sito di Monte Adranone (fig. 2).[40] Proprio in questa fase si sviluppa una politica di sfruttamento delle campagne dell'area promossa dall'oligarchia cartaginese,[41] che potrebbe giustificare la complessa articolazione e la grande capacità produttiva del palmento.

Altri esempi di palmenti datati sulla base del rinvenimento di reperti (tegole, ceramiche e anfore greco-italiche) sono documentati a Licata nell'Agrigentino[42] e nel territorio di Entella (rivestimento interno composto da ceramica frantumata delle vasche di un palmento),[43] e rappresentano una testimonianza della produzione vinicola nella Sicilia punico-ellenistica.

La verifica della funzione: le analisi dei residui

Per la prima volta è stata programmata ed effettuata nell'ambito del nostro progetto una serie di analisi sui residui organici conservati nelle vasche di otto palmenti, con il duplice scopo di testare il metodo della gascromatografia associata alla spettrometria di massa (GC-MS) applicato su queste strutture, e di verificare la *reale funzione* di alcuni impianti (tab. 1).[44] I risultati delle analisi sono riportati nel contributo di N. Garnier di seguito al testo.

I palmenti da cui sono stati prelevati campioni per le analisi (in rosso nella fig. 2) sono riferibili a contesti di diversa cronologia. La tabella 1 consente di confrontare i dati relativi ai palmenti, tra cui forma e funzione, sulla base dei residui analizzati. Nella totalità dei casi sono state riscontrate tracce di uva, pertanto i palmenti erano sicuramente utilizzati per la pigiatura di questo frutto.

Nell'antichità, come noto, sono attestati vitigni bianchi e rossi utilizzati per la produzione di vini di varia colorazione;[45] l'indagine effettuata ha dimostrato che, durante il periodo di utilizzo degli impianti, in tutti i siti campionati era coltivata uva nera. Per la varietà bianca, invece, l'unica attestazione certa riguarda l'area di Norchia (VT), frequentata fin dal Paleolitico ma le cui principali testimonianze sono etrusche (alcune tombe monumentali) e medievali (un insediamento dell'VIII sec.).[46] Questo risultato testimonierebbe quindi l'utilizzo in questo sito di vasche differenti a seconda del prodotto finale che si voleva ottenere.[47]

Un'altra osservazione è possibile in merito al palmento di Monte Corvo (fig. 4), l'unico in cui non sono stati rinvenuti marcatori della fermentazione: pertanto il mosto, a seguito della pigiatura avvenuta nell'impianto, era evidentemente destinato a recipienti appositi o, in alternativa, era trasportato in altro luogo.

Anche sul piano tecnologico sono emerse importanti indicazioni: le tracce di pece e resina rinvenute sulle pareti delle vasche analizzate (tranne che in quella di Francavilla) suggeriscono infatti che, nel processo di vinificazione, l'impermeabilizzazione dei bacini dovesse essere pratica usuale e diffusa.

Qualche osservazione conclusiva e alcune prospettive di ricerca

Il ruolo dei palmenti rupestri nella ricostruzione della produzione e dell'economia del mondo antico appare oggi molto rilevante in quanto, in alcuni casi, essi rappresentano una fondamentale testimonianza dei sistemi per la produzione del vino usati successivamente e meglio indagati, come quelli utilizzati nelle ville di età romana.[48]

Gli indicatori archeologici nello studio di certi palmenti rupestri - come la presenza di insediamenti nelle vicinanze degli impianti, alcuni elementi funzionali (i fori per le presse nelle vasche) o ancora i confronti con impianti di altre aree del Mediterraneo - sembrano confermare la loro "antichità", in particolare in alcune zone della Sicilia e della Campania, dove furono poi riutilizzati nelle epoche successive.[49] Le indagini di verifica continueranno sul campo seguendo i criteri considerati.

Studiare le caratteristiche delle viti selvatiche che popolano la prossimità di siti archeologici consentirà inoltre di indagare i meccanismi della domesticazione, mentre il confronto tra le viti selvatiche nei pressi di contesti archeologici e quelle distanti potrebbe fornire indicazioni circa la selezione operata dall'uomo. Oggi abbiamo a disposizione tecniche molecolari sofisticate che permettono di concentrare l'analisi della variabilità genetica solo su specifiche classi di geni,[50] per esempio quelli della domesticazione.[51] Nuove ricerche finalizzate allo studio dei vitigni e dei vinaccioli in relazione ai contesti archeologici sono già state pertanto programmate a Ischia.[52]

Lo sviluppo di un *network* mediterraneo di studiosi, che si occupano da più punti di vista della coltivazione e della produzione del vino nei palmenti rupestri, potrà favorire l'incrocio di dati e una migliore conoscenza dell'agricoltura del passato.

Attraverso l'opera di sensibilizzazione delle comunità locali sarà infine possibile realizzare attività volte alla conservazione, alla tutela e alla valorizzazione di queste importanti strutture che fanno parte del paesaggio agrario mediterraneo.

Analisi sui palmenti rupestri del progetto *Immensa Aequora*

Nicolas Garnier

Nell'ambito della ricerca denominata "Fare il vino nell'Italia antica", facente capo al progetto *Immensa Aequora* (www.immensaaequora.org), ideato e coordinato da G. Olcese e con la collaborazione di A. Razza e D.M. Surace, sono stati analizzati i campioni di otto palmenti rupestri per stabilire il loro contenuto.[53] I siti in cui si trovano gli impianti rupestri sono: località S. Biagio a Castel del Piano e Vitozza (GR) in Toscana, Norchia (VT) nel Lazio, Monte Corvo a Ischia (NA), località Antenna televisiva a Serramezzana e Novi Velia (SA) in Campania, località Monte Cucco a Francavilla (ME) in Sicilia.

Materiali e metodi di analisi di laboratorio

Di solito all'interno dei palmenti rupestri non si rinvengono testimonianze dell'alimento lavorato, tuttavia è possibile ottenere informazioni identificando i residui organici conservati nelle loro pareti.

I metodi di analisi organica, separativi (cromatografia) e strutturali (spettrometria di massa), consentono di identificare le molecole organiche che sono conservate in tracce, anche in matrici complesse. Pertanto, in combinazione con appropriati metodi di estrazione, queste tecniche di analisi consentono di identificare il contenuto di anfore che hanno trasportato vino o derivati dell'uva,[54] oli vegetali[55] o persino salse di pesce.[56] L'identificazione dei materiali biologici è possibile grazie all'individuazione di associazioni di marcatori che permettono di riconoscere fonti animali e vegetali, specie,[57]

e i marcatori della fermentazione alcolica delle uve nel vino[58] o della fermentazione del pesce mediante autoprotolisi.[59]

Le metodologie recentemente sviluppate per identificare tracce di uva e vino si sono dimostrate efficaci per i palmenti in muratura,[60] per le anfore da trasporto[61] e per i contenitori di liquidi,[62] ma nessun tentativo era stato finora effettuato sulle strutture rupestri, rimaste esposte all'aria aperta per decenni o addirittura per secoli.

Nei paragrafi a seguire si riassumono i risultati delle analisi effettuate sui campioni, con l'obiettivo di valutare l'efficacia della metodologia di analisi dei marcatori di uva e vino in strutture rupestri, e di identificare la destinazione d'uso degli impianti attraverso il prodotto in essi contenuto.

Preparazione dei campioni e analisi organica

In laboratorio, la superficie dei campioni è raschiata con un bisturi per eliminare al massimo i residui vegetali (muschi, licheni…) e i sedimenti. Una porzione del campione è selezionata e ridotta in polvere, e quindi estratta secondo un doppio protocollo.[63] La prima estrazione (1LE) permette di individuare i lipidi solubili, mentre la seconda (2LE) permette la dissoluzione dei marcatori insolubili caratteristici della frutta e della fermentazione. Ciascun estratto è analizzato dopo una derivatizzazione con il BSTFA/piridina e con la gascromatografia combinata con la spettrometria di massa (GC-MS).

Risultati delle analisi di laboratorio

Tutti i palmenti rupestri mostrano un primo estratto lipidico (1LE) costituito principalmente da zuccheri, mono e disaccaridi, di cui il micoso è lo zucchero di maggioranza (fig. 8). Essi provengono dalle pareti cellulari dei microrganismi del suolo e sono comunemente identificati nelle analisi ambientali dei campioni di suolo.[64] I muschi e i licheni, con la degradazione della loro cellulosa costitutiva, rilasciano i monosaccaridi, principalmente glucosio, e riducono i polioli glucitolo, ribitolo, inositolo, ecc. Vengono anche identificati gli acidi grassi (acido palmitico 16:0, 18:2 linoleico, 18:1 oleico e 18:0 stearico), ma il numero e l'alta concentrazione degli zuccheri impediscono una buona identificazione dei marcatori minori. La depurazione dell'estratto 1LE è quindi indispensabile. Gli zuccheri vengono rimossi mediante estrazione in fase solida su una colonna aminopropilica. La tecnica consente di ottenere tre frazioni, una contenente i componenti neutri (steroli di interesse), la seconda i composti acidi (principalmente acidi grassi) e la terza gli zuccheri. Solo le prime due frazioni, neutre e acide, sono di interesse e vengono analizzate da GC-MS dopo la derivatizzazione.

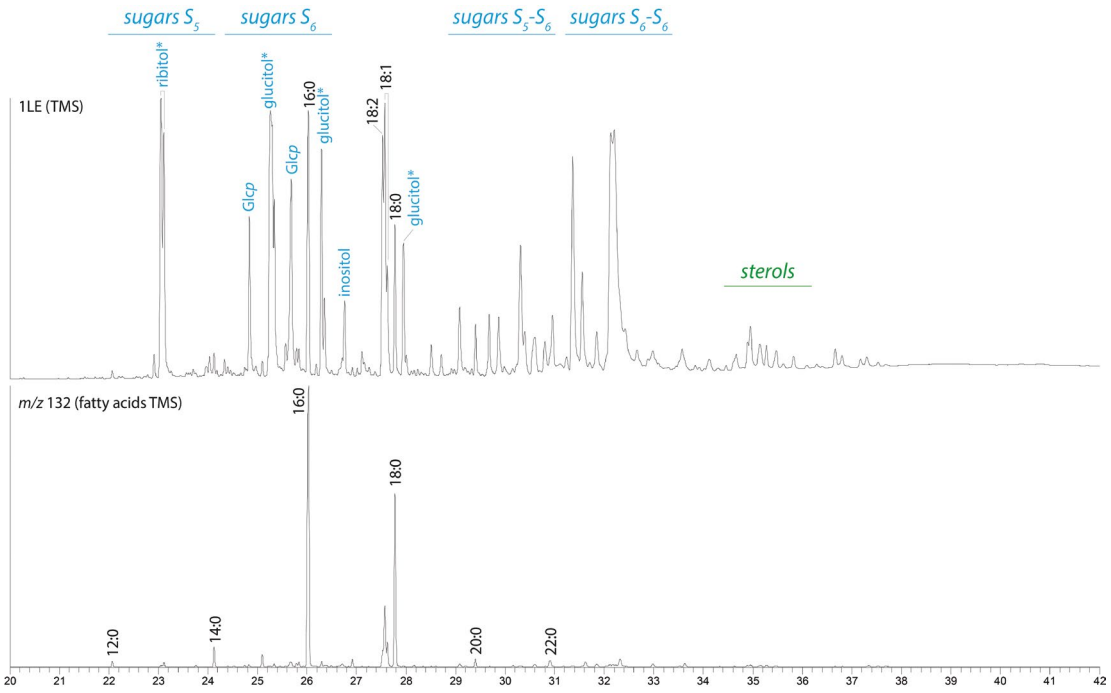


Fig. 8: Cromatogramma del primo estratto lipidico (1LE) ottenuto a partire dai residui conservati nelle pareti del palmento di Serramezzana (analisi GC-MS, colonna Zebron 5MSi 18 m × 0.18 mm i.d. × 0.1 µm fase sp.; rilevamento EI 70 eV, Thermo DSQII). In basso, il frammentogramma dello ione a m/z 132 permette di estrarre il profilo degli acidi grassi a partire dai risultati dell'analisi dell'1LE.

I cromatogrammi delle frazioni purificate neutre e acide dell'estratto 1LE mostrano steroli d'origine animale (colesterolo), fungini (9(11)-deidroergosterolo) e vegetali (stigmasterolo, sitosterolo) (fig. 9).

I triterpeni sono presenti anche in combinazioni complesse. Provengono dal degrado dei microrganismi del suolo e della vegetazione, dei muschi e dei licheni, che popolavano le pareti dei palmenti rupestri. La frazione acida mostra un ampio profilo di acidi grassi (12:0 – 28:0) provenienti da diverse fonti sovrapposte, anch'esse riconducibili a microrganismi del suolo e piante rampicanti. L'acido linoleico (18:2), particolarmente sensibile all'ossidazione, non dovrebbe essere individuato in materiali antichi. La sua forte concentrazione conferma allora l'importante presenza di vegetazione moderna, e quindi di inquinamento. I diacidi a catena corta (6: 0-dioici a 9: 0-dioici) derivano dall'ossidazione naturale degli acidi grassi polinsaturi, in particolare dell'acido oleico. Pertanto, l'analisi chimica non può essere utilizzata su questo tipo di campioni per individuare tracce di materiali vegetali identificati da marcatori comuni a muschi e licheni (acidi grassi, steroli vegetali, triterpeni) e quindi per identificare produzioni oleicole, a meno che il vegetale non abbia marcatori particolari, come il ricino caratterizzato da una quantità molto grande di acido ricinoleico.[65]

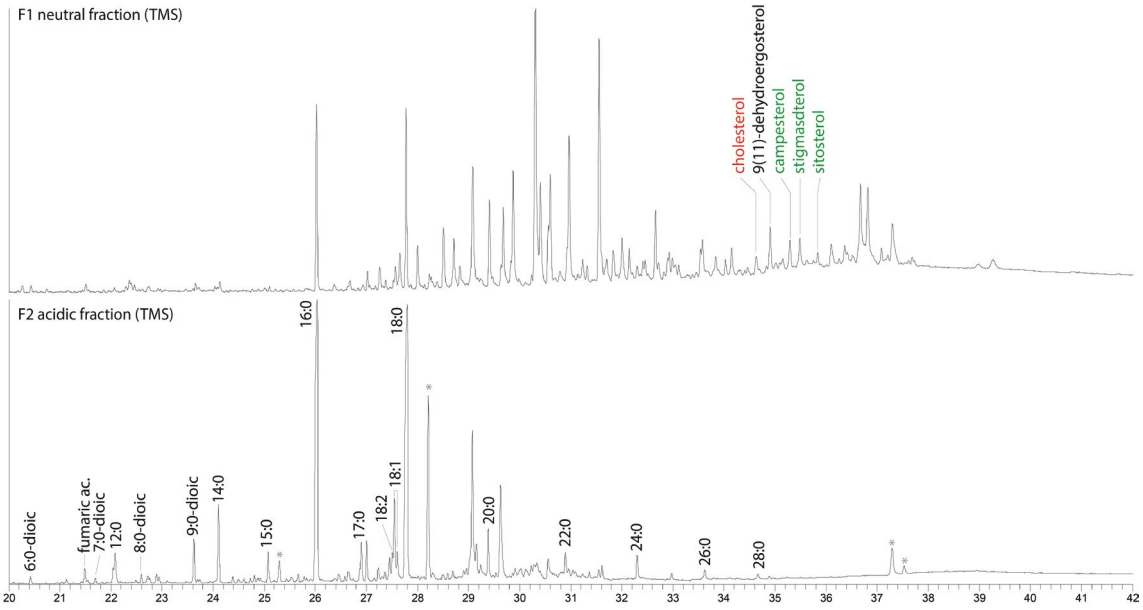


Fig. 9: Cromatogramma della frazione neutra (F1) e della frazione acida (F2) ottenuto attraverso SPE del primo estratto lipidico del palmento di Serramezzana.

La prima estrazione mostra anche la presenza di acidi diterpenici, a eccezione del palmento di *Francavilla*, presenti in forma libera ma anche, in alcuni campioni, di metilato. Questi sono marcatori di resina e pece di conifera. Possiamo quindi dedurre che le pareti dei palmenti rupestri erano rivestite con applicazioni di pece (*Norchia, Vitozza, Ischia*) o di resina di conifere (*Castel del Piano, Serramezzana, Novi Velia*). Solo due vasche mostrano tracce di grasso, di ruminanti (*Norchia vasca A*) e non ruminanti (*Serramezzana*). Tutti gli altri impianti hanno una netta prevalenza di grassi vegetali, legati principalmente ai moderni muschi e licheni (campesterolo, stigmasterolo, sitosterolo) ma anche ai funghi (ergosterolo = ergosta-5,7,22-trien-3β-ol, ergost-7-en-3-ol, ergosta-5,22-dien-3β-ol). Il palmento di *Vitozza* è stato probabilmente riempito di detriti o di piante, di specie a foglia ricca di amirine, lupeolo e idrossilupenone (specie non nota in letteratura).

La seconda estrazione mostra chiaramente la presenza dei marcatori dell'uva in tutti gli impianti in maggiore o minore quantità (in particolare la *vasca C di Norchia*), attraverso la combinazione di acido tartarico e malico (fig. 10).

Si tratta in tutti i casi di uve nere (acido siringico rilasciato dalla malvidina e dai suoi derivati, specifici di uva nera e *teinturier*[66]), tranne che per la *vasca C di Norchia* dove i marcatori sono riferibili solamente a uva bianca (senza acido siringico).

Ragionando sull'assenza/presenza del marcatore malvidina, se una vasca solitamente utilizzata per raccogliere mosto di uva bianca è riempita, anche solo una volta, di mosto di uva nera, la malvidina, marcatore specifico dell'uva nera, viene rilevata e la vasca classificata come contenente uva nera.

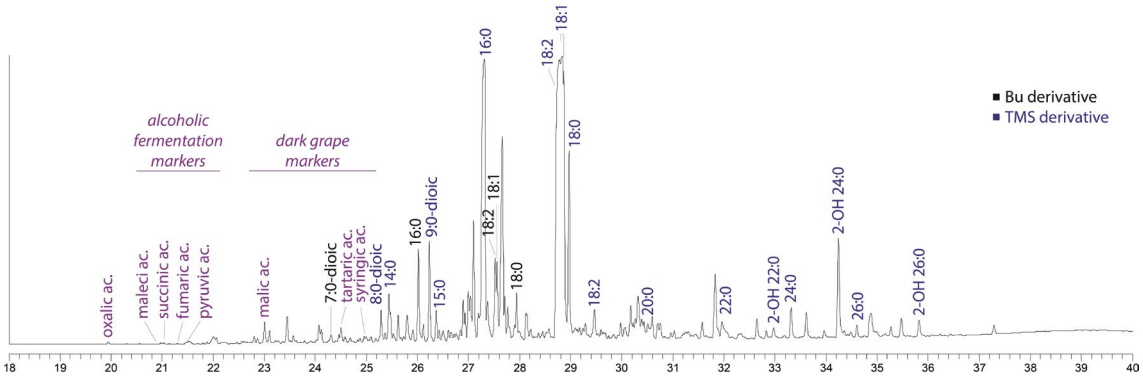


Fig. 10: Cromatogramma del secondo estratto lipidico (2LE) ottenuto a partire dai residui conservati nelle pareti del palmento di Serramezzana (analisi GC-MS, colonna Zebron 5MSi 18 m × 0.18 mm i.d. × 0.1 µm fase sp.; rilevamento EI 70 eV, Thermo DSQII).

L'assenza di malvidina, invece, permette di definire che il palmento è stato utilizzato solo per la raccolta di mosto d'uva bianca, o eventualmente di uva nera ma per la vinificazione in bianco. In questo caso, la vasca deve essere svuotata molto rapidamente dopo la pigiatura o la spremitura, prima che inizi la fermentazione e prima che la malvidina venga rilasciata dalle bucce nere. Tuttavia questa ipotesi non è concepibile. Possiamo quindi dedurre che in questo caso il palmento deve avere sempre raccolto solo mosto d'uva bianco.

A eccezione di *Ischia*, dove il profilo è dominato dagli zuccheri, tutte le vasche mostrano i marcatori della fermentazione alcolica (acido succinico, maleico, fumarico, piruvico). Ciò dimostra che tutti i palmenti indagati sono stati utilizzati per la raccolta del mosto d'uva fermentato subito dopo la pigiatura. L'assorbimento delle pareti indica anche che il liquido ha ristagnato nella vasca per un certo tempo, almeno per la durata della fermentazione.

Conclusioni sulle analisi chimiche

Sebbene i palmenti rupestri siano sempre rimasti all'aperto, esposti alle intemperie, le loro pareti popolate da muschi e licheni conservano ancora marcatori del contenuto originale. È stato possibile utilizzare metodi analitici della chimica organica per identificare questi contenuti e, quindi, la funzione dei palmenti. L'inquinamento ambientale, molto importante, non permette di identificare i contenuti antichi caratterizzati da marcatori comuni (ad es. oli vegetali). Al contrario, contenuti di origine animale o di frutti, con marcatori distinti in assenza di muschi e licheni moderni, sono identificabili. Il nostro studio mostra che gli otto impianti rupestri selezionati hanno contenuto uva e che ha avuto luogo una fermentazione alcolica. Quasi tutti presentano i marcatori dell'uva nera, che ne evidenziano la lavorazione. Al contrario, il palmento C di Norchia conteneva solo succo d'uva bianca, fermentata,

site	n°	corps gras animal						corps gras végétal							matériaux résineux					fruits						autres
		non-ruminant	ruminant	produit laitier	itaconic ac.	chauffage	cire d'abeille	sébum / olive (squalène)	corps gras végétal	chauffage	cires végétales	matière végétale	cendres végétales	cétones impaires (cuisson)	subérine (2-OH acides)	chol / sito	résine de conifère	poix de conifère	HPA diterpéniques	HPA triterpéniques	raisin	raisin blanc / noir	fermentation	autres	pollutions	
Norchia	vasca A	-	++	-	-	-	-	+	+	-	tr.	camp stigma sito ergost-7-en-3-ol ergosta-5,22-dien-3β-ol	-	-	-	1.20	-	+	-	-	+	noir	++	+ ox ++ succ pyr	+++ sucres	ac. gras insaturés abondants (16:2 16:1 18:2 18:1)
Norchia	vasca C	-	-	-	-	-	-	+	+	-	tr.	camp stigma sito ergost-7-en-3-ol ergosta-5,22-dien-3β-ol ergosterol	-	-	-	0.01	-	tr.	-	-	++	blanc	+	succ pyr + malic	+++ sucres	ac. gras insaturés abondants (16:2 16:1 18:2 18:1)
Vitozza	palmento 3	?	-	-	-	-	-	-	++	-	tr.	camp stigm sito amyrin OH-lupenone lupeol stigmast-4-en-3-one			+	0.24	-	tr.	-	-	+	noir	+	succ pyr + malic	+++ sucres	
Castel del Piano	palmento 1	-	-	-	-	-	-	-	-	-	tr.	-	-	-		n.d.	tr.	-	-	-	+	noir	tr.	maleic succ fum	+++ sucres	ac. gras insaturés abondants (16:2 16:1 18:2 18:1)
Francavilla	palmento 2	-	-	-	-	-	-	-	+	-	-	camp stigm sito				0.46	-	-	-	-	+	noir	+	++ ox + maleic succ fum pyr	+++ sucres	ac. gras insaturés abondants (16:2 16:1 18:2 18:1)
Ischia	palmento Monte Corvo	-	-	-	-	-	-	-	+	-	-	camp stigm sito			-	0.77	-	tr.	-	-	tr.	(noir, tr.)	-	-	+++ sucres	
Serra-mezzana	palmento 1	tr.	-	-	-	-	-	-	tr.	-	-	camp stigm sito ergosterol			+	1.55	tr.	-	-	-	+	noir	+	succ	+++ sucres	ac. gras insaturés abondants (16:1 18:2 18:1)
Novi Velia	palmento 1	-	-	-	-	-	-	-	+	-	-	camp stigm sito ergosterol lupeol	-	-	+	0.21	tr.	-	-	-	+	noir	+	succ fum maleic pyr malic	+++ sucres	

Tab. 2: Sintesi dei risultati ottenuti mediante l'analisi organica dei residui conservati nelle pareti dei palmenti rupestri.

una preziosa indicazione del fatto che nella zona della struttura durante il periodo di funzionamento dell'impianto erano coltivate varietà d'uva bianca (tab. 2).

Note

[1] La ricerca è in corso a cura di G. Olcese, A. Razza e D.M. Surace, a cui si devono anche l'indagine sul campo e i prelievi di campioni per le analisi chimiche (GC-MS). Le immagini del contributo sono coperte da copyright (progetto *Immensa Aequora*) e non sono riproducibili senza l'autorizzazione degli autori.

[2] <www.immmensaaequora.org>; per alcuni dati preliminari raccolti, Olcese – Soranna 2013; Olcese et al. 2015 (fig. 3 B); Olcese et al. 2017.

[3] In particolare Amouretti – Brun 1993; Brun 2003a; 2003b; 2004. Per la Spagna, Peña Cervantes 2010; 2019; Martinez Valle – Pèrez 2013; per la Grecia, Marangou 1993; Vogeikoff-Brogan – Apostolakou 2004; per la Turchia, Aydinoglu – Şenol 2010; per Israele, Frankel 1999; per il Nord Africa, Brun 2000; Mattingly 2009. Per l'Italia, l'importante lavoro di A. Zifferero e A. Ciacci (progetto *Vinum*, Archeologia della vite e del vino 2012) e lavori di natura locale come Sculli 2002 in Calabria, Vallelonga 2012 nel Lazio, Botti et al. 2011 in Campania, Puglisi 2009 e Amato 2012 in Sicilia, Loi 2017 in Sardegna.

[4] Si osservano tre categorie principali: pigiatoi lignei o ceramici, palmenti rupestri, impianti in muratura (Brun 2012, 73–76).

[5] Battistini 2011, 12–17; Masi 2012, 583–590; Peña Cervantes 2019.

[6] *Atlante palmenti*.

[7] In ambito mediterraneo, si ritiene che gli assortimenti varietali di vite vinifera si siano formati con l'introduzione di vitigni da Oriente che, sovrapponendosi al processo di incipiente domesticazione, avrebbero originato nuova variabilità genetica nelle viti domestiche, e forse selvatiche, in seguito a incroci spontanei tra le due forme (tra gli altri, Biagini et al. 2004).

[8] Un rilevante esempio è rappresentato dal lavoro svolto da A. Scienza sui vitigni moderni della Sicilia, che ha permesso di individuare due aree di coltivazione corrispondenti in antico a quelle controllate da Greci e Punici (Scienza et al. 2014). La distinzione tra le varietà della Sicilia occidentale e orientale è stata ottenuta mediante analisi PCR (*Polymerase Chain Reaction*) e relativa elaborazione PCA (*Principal Component Analysis*), effettuate su 48 campioni.

[9] Un rilevante caso di studio riguarda l'esemplare rinvenuto nel pigiatoio di Punta Chiarito a Ischia per cui le analisi paleobotaniche hanno permesso di identificare un vitigno locale (Coubray 1994).

[10] Si veda il contributo di De Lorenzis et al. pubblicato in questo stesso volume.

[11] Per un approfondimento sul popolamento rurale e la geografia viaria di queste due regioni si vedano, a titolo di esempio: per la Campania, Beloch 1879, Arthur 1991 e 1995; per la Sicilia, Marcone 1987, Wilson 1990 e 2000, AITNA 1992, Bejor 2007.

[12] Per il pigiatoio, De Caro – Gialanella 1998, Brun 2004, 162 seg. e 2012, 73; per i palmenti, D'Arbitrio – Ziviello 1982, 15; per i vitigni e il vino di Ischia, Scienza – Boselli 2003 e D'Ambra et al. 2006; per la produzione di anfore nel quartiere ceramico di S. Restituta, Olcese 2010 e 2017.

[13] Buchner Niola 1965, 88–90; D'Arbitrio – Ziviello 1982.

[14] Si vedano, ad esempio, Marcone 1987, Wilson 1990 e 2000, Cambi 2003 e 2005, Portale 2005.

[15] Olcese – Soranna 2013, 307.
[16] Anelli 2006; Di Stefano 2010.
[17] Un primo lavoro incentrato sui palmenti rupestri della Valle dell'Alcantara si deve a S.F. Puglisi (2009).
[18] Il palmento è stato oggetto di studio nell'ambito del convegno "Sur le traces de Magon" (Sambuca di Sicilia, 11 aprile 2015); F. Lentini in *Atlante palmenti*.
[19] I dati riscontrati confermano quanto già evidenziato, Brun 2003b e 2004 con bibliografia.
[20] Tale interpretazione sembra ben emergere, ad esempio, dai più recenti *surveys* condotti in Sicilia (Bejor 2007) e in altre regioni (ad esempio Attema 2017).
[21] Puglisi 2009, 98–100; Parasiliti 2014.
[22] Un sistema di produzione di questo tipo richiedeva un'attività di coordinamento e investimenti per strumentazione e spazi che fanno riferimento a complesse dinamiche economiche e sociali finalizzate allo sfruttamento massimale del territorio rurale (Forni – Marcone 2002, 112 seg.).
[23] Il palmento si trova nell'area di Monte Adranone, sito ellenizzato in età arcaica e parte del sistema difensivo creato da Cartagine per arginare l'avanzata di Siracusa nel IV secolo a.C., prima di essere distrutto probabilmente tra il 261 e il 260 a.C. Alla fase greca sono state riferite le imponenti mura, i due assi viari ortogonali centrali e rinvenimenti ceramici; a quella punica, due edifici nell'area sacra (Fiorentini 1995 e 2005 con bibliografia; De Vincenzo 2016; Caminneci – Di Carlo 2017).
[24] Plinio, NatHist XIV, 35; van der Mersch 1994, 51.
[25] Si tratta di una canaletta per la raccolta dell'acqua, vaschette per la lavorazione dell'argilla, elementi fittili e alcune anfore (Fiorentini 1995, 20–22 e fig. 65, 66; Atlante 2011–2012, 397).
[26] La vasca di pigiatura è in media lunga ca. 200 cm, larga 190 cm e profonda 50 cm; quella di fermentazione, lunga ca. 180 cm, larga 130 cm e profonda 60 cm.
[27] Il prelievo dei campioni per le analisi ha mostrato l'enorme fatica richiesta per intagliare la roccia e la necessità di strumenti particolarmente resistenti.
[28] van der Mersch 1994, 28; Brun 2011, 109.
[29] La stessa antichità dei palmenti rupestri è molte volte dubbia; in alcuni casi, però, la loro datazione è stata desunta dalle aree in cui essi sono inseriti, come per alcuni impianti della Sardegna, connessi da C. Loi (2017, par. III.6) già all'epoca prenuragica.
[30] Il rinvenimento a Francavilla di Sicilia di ceramica più antica rispetto alla fondazione dell'abitato greco lascia ipotizzare l'esistenza di un precedente insediamento indigeno (Spigo et al. 2008, 40 seg.). Le più antiche attestazioni dal territorio di Castiglione provengono, invece, dall'area del Castello di Lauria e consistono in tre sepolture "a grotticella" e in ceramica locale proprio dell'età del Ferro (Privitera 2009).
[31] Importanti ricerche attestano infatti che la coltivazione della vite fu introdotta in alcune aree già grazie ai contatti commerciali con i Micenei (Forni – Marcone 2002, 114; Brun 2011, 97).
[32] Spigo et al. 2008; Privitera 2009.
[33] Asheri 1980, 109; Martin et al. 1980, 751; Malfitana 2003, 41; Renda 2003, 61 seg.
[34] Per una panoramica si veda van der Mersch 1994, par. II.2–3.
[35] Varro I, 25; Plinio, NatHist XIV, 25 e 66.
[36] Plinio, NatHist XIV, 66 e 80.

[37] Santagati 2012; Valpreda 2017. Per quanto riguarda le aree dei palmenti, nel territorio circostante Francavilla sono state rinvenute sette tombe "a pseudo-grotticella", la cui datazione sembrerebbe rapportabile all'età bizantina dal confronto con le sepolture "a forno" iblee e dal ritrovamento di tegole striate (Privitera 2009, 528–540). A Castiglione si trova un insediamento riportabile alla fase di avvio dell'occupazione bizantina del V–VI secolo d.C. (Messina 2002); altre testimonianze archeologiche di epoca tardo-romana e bizantina provengono dal vicino Monte Balsamà (quattro sepolture "a forno" e "ad arcosolio", Privitera 2009, 540–542). Nell'area della vicina Randazzo sono state portate alla luce tombe "a pseudo-grotticella", simili a quelle di Francavilla (Privitera 2009, 542–547). La 'bizantinizzazione' dell'area trova ulteriore riscontro a Malvagna, dove sono state rinvenute una chiesetta di V secolo d.C. e tre sepolture protostoriche rimaneggiate proprio in epoca bizantina (Privitera 2009, 550 seg.; Magro – Scaravilli 2017, 359). Infine, anche nella necropoli di Rocca Pizzicata è stato ritrovato materiale sporadico di epoca bizantina (Magro – Scaravilli 2017, 358 seg.).

[38] Peña Cervantes 2010, 42 seg.; 2019.

[39] Noto è, invece, il caso di croci incise sulle vasche di alcuni impianti di Ferruzzano, in Calabria (Sculli 2002, 55 seg.).

[40] Fiorentini 1995, 12 e 18. Tale datazione è stata da noi proposta durante il convegno "Sur le traces de Magon" (Sambuca di Sicilia, 11 aprile 2015) e approfondita nella scheda a cura di F. Lentini in *Atlante palmenti*.

[41] Anello 1986, 169; Bondì 2006, 134 seg.

[42] Amato 2012.

[43] Canzanella et al. 1990; van der Mersch 1994, 35.

[44] Per ricerche simili precedenti e per la metodologia di analisi, a titolo di esempio, Garnier 2003 e 2015; McGovern 2004; Romanus et al. 2009; Pecci et al. 2013; Garnier – Valamoti 2016; Garnier – Olcese forthcoming. Per una panoramica sui metodi chimici applicati all'archeologia per lo studio dei residui e sulla loro evoluzione nel tempo, Garnier 2016 con bibliografia.

[45] Brun 2003a, 53.

[46] La collocazione dei palmenti lungo le strade verso il centro è stata ricondotta a una possibile proprietà pubblica degli impianti (Colonna Di Paolo – Colonna 1978, 63 nota 9). Per le tombe, Ambrosini 2016; per la frequentazione dall'epoca medievale, Quilici 1988 e 1990, Mercuri 2014.

[47] Va considerato che la lavorazione di uva bianca è riscontrabile dalle analisi di GC-MS solo nei casi in cui il palmento non abbia mai ospitato uva nera.

[48] Tra gli altri, Giardina – Schiavone 1981; Carandini 1989; Manacorda 1989.

[49] La viticoltura delle colonie sarebbe, in tal senso, stata facilitata proprio dall'esistenza di un impianto già presente sul territorio (Brun 2011).

[50] Thomson 2014.

[51] Iniziative in questa direzione sono già state avviate in collaborazione con colleghi del DiSAA dell'Università Statale di Milano, tra cui C. Pozzi, O. Failla e G. De Lorenzis.

[52] Queste attività saranno svolte con la collaborazione di A. Scienza, a cui si devono fondamentali lavori sui vitigni dell'area (Scienza – Boselli 2003). Per il potenziale informativo sul passato dei vitigni e dei vinaccioli moderni, si rimanda a Scienza et al. 2014 e al contributo di G. De Lorenzis in questo stesso

volume (si vedano le note 8–10). L'importante ruolo dell'archeobotanica nella ricostruzione del paesaggio agrario antico è testimoniato anche dalle ricerche effettuate in Italia centro-meridionale da L. Costantini (si vedano ad esempio Costantini – Costantini Biasini 1987, 1999 e 2012; Costantini in Roccagloriosa I, 323–328).

[53] Per il progetto e per i dati archeologici, si veda prima il testo di G. Olcese, A. Razza e D.M. Surace. I prelievi, effettuati durante le ricognizioni a cura degli autori del contributo archeologico, a cui si deve anche la traduzione del testo dal francese, sono stati effettuati alla base delle pareti verticali delle vasche usando un martello: il frammento litico è stato avvolto nell'alluminio fino al trattamento in laboratorio per evitare inquinamenti moderni dovuti al contatto con buste di plastica. Le analisi GC-MS di cui si presentano qui i primi risultati sono state finanziate dal progetto FIRB *Immensa Aequora* e con fondi di Ateneo Sapienza – Università di Roma, e dal Laboratoire N. Garnier.

[54] Garnier 2003; Garnier et al. 2003; Romanus et al. 2009; Pecci et al. 2013 e 2017; Djaoui et al. 2015.

[55] Condamin et al. 1976; Romanus et al. 2009; Pecci et al. 2010; Djaoui et al. 2015.

[56] Garnier 2006 e 2014; Smriga et al. 2010; Driard et al. 2017; Pecci et al. 2018; Garnier et al. 2018.

[57] Poynter – Eglinton 1991.

[58] Barnard et al. 2011; Pecci et al. 2013; Garnier – Valamoti 2016.

[59] Garnier et al. 2018.

[60] Pecci et al. 2013; Desrayaud 2015; Chapon – Abdelrhani 2016; Raux et al. 2017.

[61] Garnier – Olcese forthcoming; Garnier – Pecci forthcoming.

[62] Garnier 2015.

[63] Per i procedimenti, Garnier – Valamoti 2016.

[64] Rogge et al. 2006 e 2007.

[65] Pecci et al. 2010.

[66] Mazza – Francis 1995; Singleton 1995.

Indice delle figure

Fig. 1: disegno di E. Serafini (progetto *Immensa Aequora*). – Fig. 2. 4. 5. 7 e tab. 1: a cura degli autori (progetto *Immensa Aequora*). – Fig. 3a: *Atlante palmenti.* Fig. 3b: Olcese et al. 2015. – Fig. 6: rilievo planimetrico di E. Cucchiara inserito nella scheda a cura di F. Lentini in *Atlante palmenti.* – Fig. 8–10 e tab. 2: a cura dell'autore.

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Wine in Sardinia. New Archaeological Data and Research Methodology

Anna Depalmas – Cinzia Loi – Nicolas Garnier – Alessandra Pecci

Introduction

Vitis vinifera L. ssp. *vinifera* i.e. grapevine is one of the most ancient and precious fruit-bearing plants in the world. It played a prominent role in complex historical societies around the Mediterranean. Today, it is commonly accepted that the modern cultivars of *Vitis vinifera* are the result of the domestication of *Vitis vinifera* L. ssp. *Sylvestris,* i.e. wild vines. Wild vines are very common among the spontaneous plants of Sardinia. Recent research dates back the introduction of wine production and consumption in the region to the Early Bronze Age thanks to a combination of botanical finds and chemical residue analysis.

Carbonized grape pips have been found from the Early Bronze Age (2017–1751 cal. BC, 2 σ) site at Monte Meana, Santadi-CI,[1] while other evidence was discovered in the *domus* de Janas IV of S'Elighe Entosu, situated in the territory of Usini (Sassari) in northern Sardinia.[2] About this context, a recent anthracological study revealed the presence of a large amount of charred *Vitis vinifera* wood associated with grape pips in a hearth dated to the beginning of the Middle Bronze Age (ca. 1780–1630 BC).

An important quantity of *Vitis vinifera* grape seeds (7616 pips) has been found in the well of the San Marco nuraghe in Genuri; unfortunately the mineralization of the pips does not allow to determine the subspecies.[3]

During the Late Bronze Age (12th–10th cent. BC), different contexts have yielded evidence of the presence of *Vitis,* though not wine. In the Duos Nuraghes Nuragic settlement, the grape seeds found in the Late Bronze Age and Early Iron Age levels are pertaining to the squat type with short stalk which are characteristic of *Vitis vinifera* L. var. *sylvestris*. This is a wild species, which was often used in this period. According to the first analysis carried out by Corrie Bakels,[4] these grape seeds belonged to the wild subspecies or *Vitis vinifera* L. var. *sylvestris* but, according to Philippe Marinval, who made a re-examination of the samples, they would belong to an previous stage of domestication.[5] Charred grapes were also found in hut 5 of the village built around the nuraghe Adoni in Villanovatulo.

The investigations carried out in the village of nuraghe Bau Nuraxi in Triei (NU) discovered pollen from *Vitis Vinifera* ssp. *Vinifera* associated with a fragmentary askoide jug in a layer of inside room 7 dated by radiocarbon around 1000 BC.[6]

Charred grape pips found in various rooms of the Nuragic village at Genna Maria in Villanovaforru (Early Iron Age) show cultivated vines alongside wild species pips.[7] This site is also equipped with a basin and a spouted tank that are interpreted for pressing grapes.

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Generally speaking, remains of winemaking process and instruments are scarce, with the exception of the presumed Nuragic press and basins found in the settlement of Monte Zara in Monastir Cagliari, in a hut dating back to 800 BC.

Many more seeds of *Vitis* are mentioned, for example from the Nuraghe Ortu Comidu, in the central southern part of the island and from the Nuraghe Toscono in central Sardinia, both dating to the Punic period, others dating to the Roman period (300 BC – AD 500).[8]

For the late prehistoric period, while the aforementioned discoveries are quantitatively or qualitatively little relevant, an extraordinary case is provided by the Bronze Age settlement of Sa Osa (Cabras). It is one of the few Sardinian archaeological sites that allow the reconstruction of a complete picture of the development of the exploitation of natural resources and agricultural technologies, such as wine production. During the archaeological excavations carried out in 2008–2009 near the village of Cabras, (Or), the Nuragic settlement of Sa Osa was discovered. Several small and medium-sized oblong pits and cylindrical deep wells dug into the underlying sandstone were filled with various sediments. These cavities originally had different functions (e.g. dwelling, quarry, water supply) but, at some point, they were used either as rubbish dumps or for storing foodstuffs. Plant remains, charred cereals (hulled barley, wheat), legumes and few waterlogged macro-remains, mostly fig and grape remains, were found inside two Middle Bronze Age wells (well-V and well-U). Well N, excavated in sandstone sediments to a maximum depth of 4.35 m, was filled by several stratigraphic units, containing abundant organic material including wood, charcoal, cork, seeds (mostly of *Vitis*), animal remains and pottery sherds, which date the backfilling to the end of the Late Bronze Age.[9] Most seeds and fruits from Well-N were found in excellent state of preservation due to water logging. A total of 35 taxa were identified including fruits and berries. Radiocarbon dating of two grape pips collected at the depth of 1.40 and 2.15 m area indicates respectively 1286-1115 2σ cal. BC and 1276-1088 2σ cal. BC (OxA-25106, OxA-25107).[10] The number of *Vitis vinifera* (ca. 0.8 litres for ca. 15,400 pips) and *Ficus carica* (ca. 4 litres for ca. 5 millions achenes) was very large, representing more than 90% of the total number of remains. For this reason, the number of these two taxa has been estimated according to the corresponding volume of thousand items of each taxon.[11]

Previous research on seed morphology of the Sa Osa specimens showed a close relationship between the Sa Osa grape pips and some modern Sardinian varieties, probably both belonging to white grape varieties.[12] This could be considered as evidence for the domestication of grapes because these varieties would have been intentionally selected.

The discovery of wild and domesticated grape seeds in the same wells of Sa Osa suggests that wild and domesticated grapes were mixed together to prepare beverages. Moreover, traces of wine have been found also in cultic contexts, for examples at Abini (Teti).

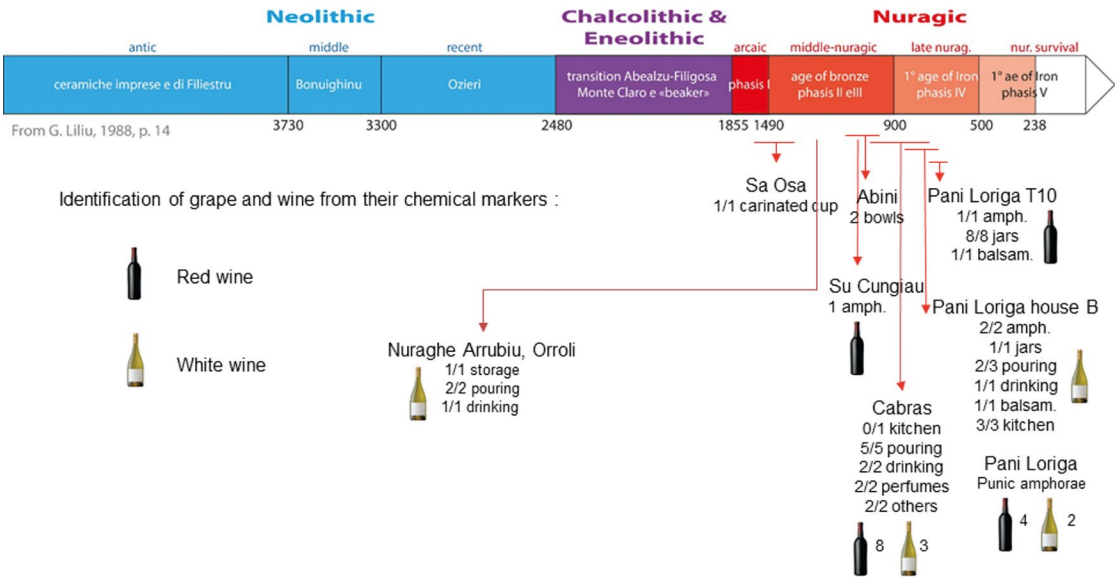

Fig. 1: Summary scheme relating to the documentation of wine in Sardinian later Prehistory.

The Organic Residue Analysis

Although some substances are difficult to identify and although there are risks of contamination both on the archaeological site and in the laboratory, reliable data can be obtained through biochemical analysis of ceramic vessels and their organic coatings. Recently, wine residues have been detected using specific extraction methods and analyses.

The presence of fermentation markers and of tartaric acid – which, albeit not exclusively produced by grapes, can be considered as characteristic of this fruit in this area and during this period — indicates that wine was poured into various vases. These analyses, we carried out in Sardinia by Nicolas Garnier using the protocol developed by Garnier and Valamoti,[13] and by Alessandra Pecci using the protocol developped by Pecci and collegues in 2013.[14]

In the first case they detected red and white wine residues in different vessels from the Bronze Age and from later periods at Nuraghe Arrubiu,[15] Sa Osa,[16] Pani Loriga[17] on vessels found in funerary and in domestic contexts (fig. 1). In the nuraghe Arrubiu, a vase linked to a foundation ritual performed in the Torre A (beginning of the Late Bronze Age) and an askos found in the courtyard B (BF/PF1) contained white wine. Data from ceramic studies and from biochemical analyses suggest that the wine drunk during rituals might be locally produced following the white wine making process.[18] At the end of the Bronze Age, a series of culinary pots reveals that wine was also commonly used for cooking.[19]

Wine making processes are detectable in Pani Loriga thanks to a series of Bartoloni D3 and D4 amphorae from the end of the 6th–5th c. BC. In one of these, a flat amphora

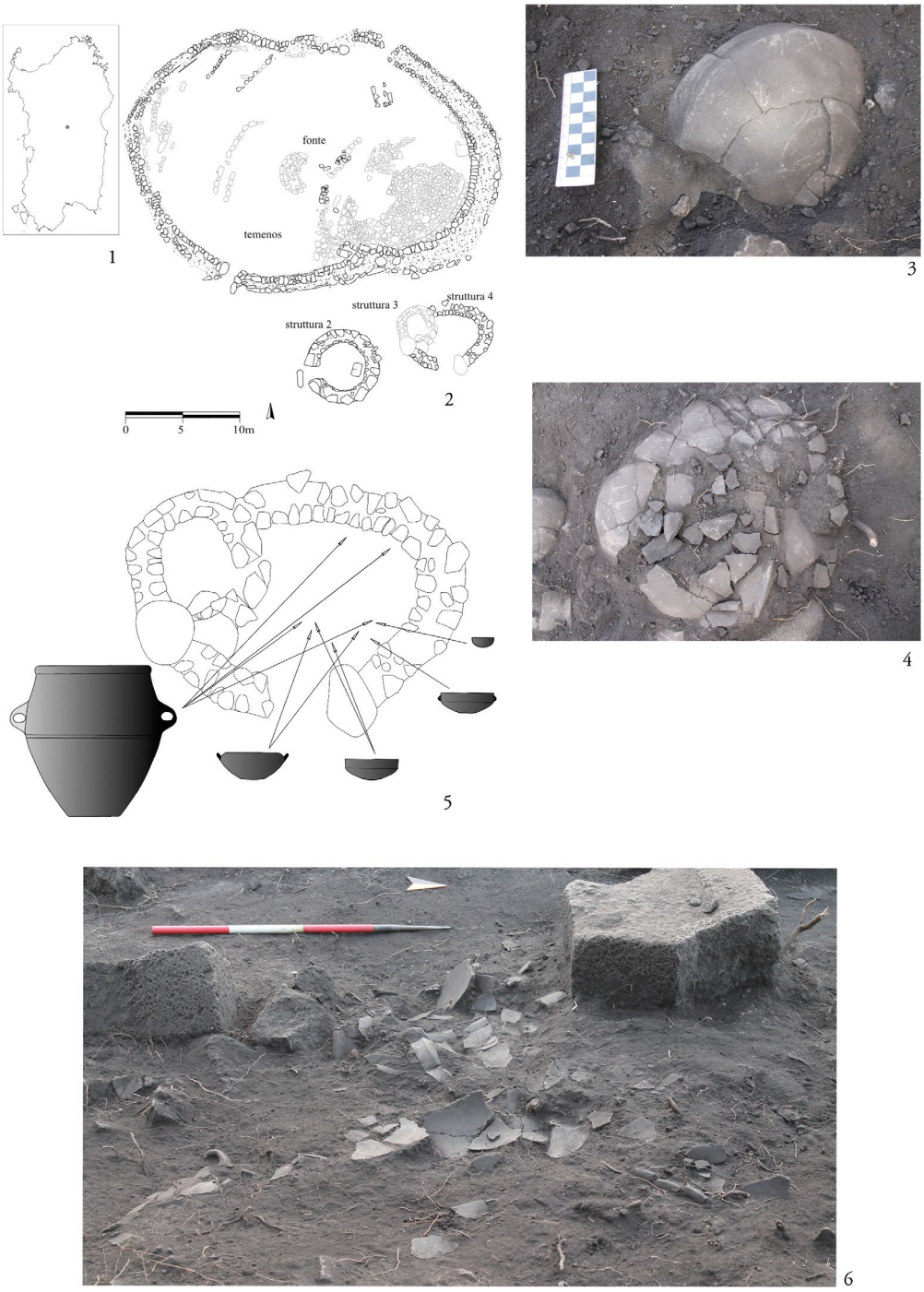

Fig. 2: Abini, Teti: 1. Localization of the archaeological complex; 2. Plan with the sanctuary' structures so far excavated. – Structure 4: 3. Carinated bowl found during the excavation; 4. Amount of sherds within the structure; 5. Spatial distribution of the main pottery shapes; 6. High concentration of pottery and bones at the center of the room.

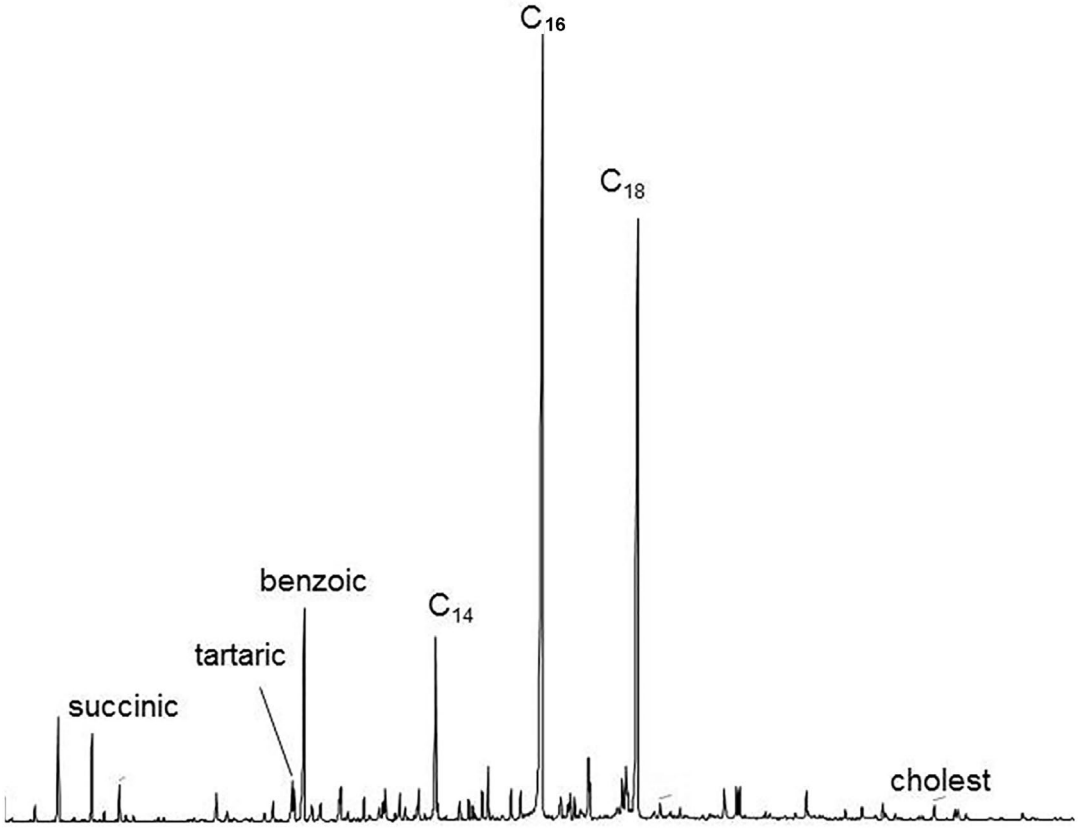

Fig. 3: Chromatogram of the extract (ii) from the carinated bowl from Abini, where wine residues were identified.

sherd was used as pallet for skimming the mixture of foam and yeasts produced during the fermentation process.[20] The study of a large series of storage and consumption vases suggests that the Pani Loriga settlement was producing and exporting white and red wines during the Punic era.

At the Nuragic sanctuary of Abini, the University of Sassari excavated a 12–11th c. BC burnt structure possibly related to the sanctuary. Among the materials found in situ (fig. 2), five vessels were sampled and analyzed by Alessandra Pecci at the University of Barcelona, following the method developed in Bristol for the lipid extract and the method developed by Pecci et. al. for the identification of wine markers.[21] These analyses identified markers of wine residues and animal products in a bowl and in a carinated bowl (fig. 3). Another carinated bowl from Sa Osa, dated to the 14th–12th c. BC, revealed markers of wine, which match with the great quantity of pips discovered in the aforementioned pit/well.

The identification of wine residues in a carinated cup found in the Terramara di Pilastri di Bondeno (northern Italy) suggests that this type of vase could have been used for wine consumption at that time.[22]

The Production Facilities

The rock-cut presses are of significant interest due to their historical and archaeological value. These facilities were long neglected, probably because they could not be securely dated. Those already known are of doubtful and mysterious origin and it is difficult to interpret their typology and age. Our research project aims to clarify this topic through a corpus of rock-cut devices organized by type and function.[23]

A recent study established a typologically organized gazetteer of the rock-cut devices surveyed in central-west Sardinia. This area, about 650 sq km wide, corresponds to the historical regions of Guilcer and Barigadu, in which 103 devices have been identified so far: 11 in the Guilcer territory and 92 in the Barigadu territory (to which we should add 55 mobile tanks).

Outside the surveyed area, analogous structures probably connected with wine making have been identified in some Nuragic settlements and in sites from the Punic and Roman periods (Genna Maria-Villanovaforru[24], Monte Zara-Monastir[25], Truncu ʻand Molas-Terralba[26], s'Abba Druche[27], Arrubiu-Orroli[28], S'Imbalconadu-Olbia[29]; other installations are reported in northwestern Sardinia).

The basic type includes two tanks – a treading basin and a collecting vat – excavated in the bedrock and linked by a hole or by an open channel. The treading floor presents a large flat surface, more or less deeply cut in the bedrock, sometimes delimitated by a series of orthostats. These treading floors do vary in shape and dimensions, more than the collecting vats, and they present a slope towards a hole or drip that allowed the must to flow into the lower tank. On the pressing surface, the presence of drainage channels carved into the rock can be observed, especially when the slope is insufficient. The collecting vats, of various shapes, are placed at a lower level than the treading floors. Their bottom presents a carved depression used for collecting liquid and solid residues.

Five classes of rock-cut facilities have been defined:

Type I presents a rectangular treading basin with rounded corners. The collecting vat, generally of semi-circular form, is located at a lower altitude.

Type II is slightly carved in rocky areas where pressing basins usually have a semi-circular shape and a low depth. In some cases, probably to avoid problems caused by the little depth, the basin is bounded by a series of orthostats, a stone wall or a combination of both.

Type III is characterized by the presence of rectangular or sub-rectangular pits, excavated more or less deeply into the bedrock.

Type IV includes mixed installations, those where the treading basin is carved in the bedrock, while the collection tank is mobile, being carved in a single boulder.

Type V groups all other installations combining some of these characteristics randomly.

The mobile tanks can be classified in two clusters: those carved in "erratic" large-medium blocks with the inner face uniquely carved and those finely carved in smaller blocks outside and inside. In the survey area, a total of 55 tanks were registered.

We have learnt up to now that there is a considerable quantity of production facilities and structural differentiations, which do not simply depend on local differences. The archaeological picture is much less homogeneous than previously thought, due to different cultural roots and distinct traditions of life and work. In order to deepen these issues, an area of 1 km radius has been delimited around each device. The choice of the size of the area was intended to better focus the archaeological context. From the study of the *palmenti* in relation to the closest dated archaeological site, we observed that the situation varies according to the type of device -immovable or mobile-. The 29% of the immovable plants fall close to archaeological evidence dating back to pre-Nuragic times; 9.7% near a settlement referable exclusively dated form the Nuragic era; 3.8% are close to Nuragic contexts also frequented in later periods; 34% are near Roman settlements or necropolis.

The analysis of the relationship between mobile devices and other archaeological evidences has shown that as many as 20 vats (equal to 36.36%) fall close to a site frequented exclusively during the Nuragic era; 7 tanks (12.72%) are located near a pre-Nuragic site; 9 near a Nuragic site reoccupied in the Roman period and early Middle Age (16.36%).

In these conditions, we suggest that at least a part of the surveyed artefacts cannot be attributed a priori to the Roman or medieval periods. It seems that the *palmenti* were in use from at least the Bronze Age to very recent times.

Conclusion

The evidence currently available confirms that vine cultivation was a fundamental agricultural activity of Sardinia since the Early Bronze Age. The combination of botanical and biochemical analyses suggests that wine was consumed before the arrival of the Phoenicians but we are still waiting for identifying the origin of the vines (local vs. imported). Recent analyses of plaster sampled in production vats distinguish between installations used for wine or for oil.[30] Now, the *palmenti* can also be studied with the same methods;[31] that will provide new data improving our knowledge of the wine culture in Sardinia.

Notes

[1] Ucchesu et al. 2015a.

[2] Celant 2010.

[3] Cocco et al. forthcoming.

[4] Bakels 2002.

[5] Perra et al. forthcoming.

[6] Sanges 2010.
[7] Bakels 2002.
[8] Sanges 2010.
[9] Sanna 2011; Usai 2011.
[10] Sabato et al. 2015.
[11] Sabato et al. 2015, 9.
[12] Lovicu et al. 2010; Ucchesu et al. 2015a, 2015b.
[13] Garnier – Valamoti 2016.
[14] Pecci et al. 2013b.
[15] Perra et al. 2015; Garnier 2015, pers. comm.
[16] Garnier – Usai forthcoming.
[17] Botto 2016.
[18] Botto 2016.
[19] Gradoli – Garnier 2017.
[20] Botto – Oggiano 2012.
[21] Pecci et al. 2013b; Pecci – Cau unpublished report.
[22] Pecci et al. 2017.
[23] Loi 2017.
[24] Badas 1995.
[25] Ugas 1999.
[26] Van Dommelen et al. 2010.
[27] Satta 1996.
[28] Lo Schiavo – Sanges 1996.
[29] Sanciu 1997.
[30] Pecci 2007; Pecci et al. 2013a, 2013b; Garnier – Valamoti 2016.
[31] Esteve Gracia et al. 2018; see other articles in this volume.

Image Credits

Fig. 1. 3: by the authors. – Fig. 2: 1.–4. by the authors; 5. drawn and elaborated by A. Gallo; 6. by C. Bulla.

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Wine Making in the Iberian Peninsula during the Roman Period: Archaeology, Archaeobotany and Biochemical Analysis

Yolanda Peña Cervantes

Both wild grapevines and olive trees have been recorded by archaeologists in the Iberian Peninsula from a very early date, going back to the Neolithic period. Many different types of evidence have been found for the presence of both cultivations throughout prehistory, especially from the Chalcolithic.[1] However, according to the information we have available, we cannot yet confirm the existence of exploitations of these species for wine or oil production before the Phoenician presence. At the same time, domesticated varieties of grapevines and olive trees have not been recorded prior to the 9th century BC.[2]

Data currently available confirms that viticulture was introduced to the Iberian Peninsula by Phoenician colonists. Recorded evidence for domesticated grapevine comes from the site of Castillo de Doña Blanca, during the 8th century BC.[3] Before this date, the site of La Orden-Seminario in Huelva shows rectangular-shaped rows of holes which prove grapevine cultivation in Iberia, at least in the 9th century BC (fig. 1, a).[4]

Type R-1 wine amphorae, produced in the Cadiz area from the 8th century BC, suggest, in parallel with the evidence above, the development of significant wine production from the beginning of Phoenician colonization.[5] However, the first wine production plant identified in Iberian contexts comes from the 7th century BC. This suggests that perishable materials were used for the first winemaking activities in the Iberian territories.[6]

On the one hand, one of the earliest examples of wine production is evidenced at the Iberian settlement of La Font de la Canya in Barcelona. Remains of pressed grapes (seeds, stems and branches) dated between 650 and 600 BC were found inside a silo, as well as R-1 wine amphorae (fig. 1, d).[7] On the other hand, by the end of the 7th century or the beginning of the 6th century BC, major wine production occurred in Las Pilillas, Requena (Valencia), where rock-cut platforms and vats were used for treading and pressing the grapes with lever presses (fig. 1, b, c).[8]

Additionally, another notable example of winemaking at that time is the well known site of Alt de Benimaquía, a fortified Iberian *oppidum* on the Mediterranean coast, where four treading vats, amphorae R-1 (both Phoenician and local replicas) and thousands of *vitis vinifera* pips were discovered (fig. 1, e).[9] Moreover, the most ancient presence of biochemical markers of wine has been located in the winery of Coll del Moro de Gandesa (Tierra Alta, Tarragona). These analyses by A. Pecci are not yet published.[10]

During the Roman period, a significant increase in wine and oil production takes place. Together with the three major production lines (wine from Tarraconensis; wine and oil from Baetica), aimed at interprovincial trade, a high volume of production of wine and oil in nearly every region of the Iberian Peninsula has recently been recorded. At present we know more than 700 sites containing evidence of pressing facilities (fig. 2).

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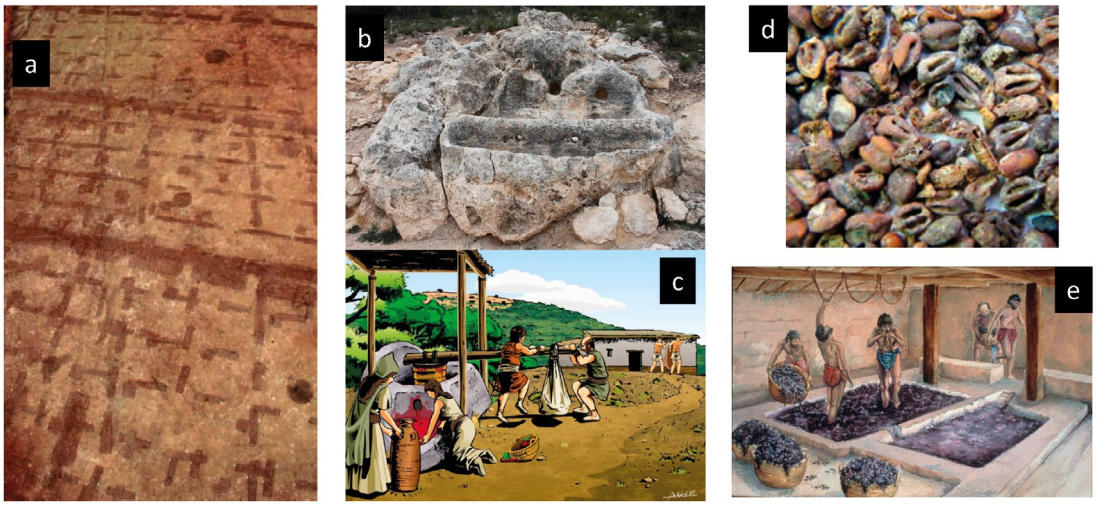

Fig. 1: Sites with evidence of wine production in pre-Roman times. a: vineyard trenches at Orden-Seminario, Huelva; b: View of one of the rock cut treading vats at Las Pilillas, Requena; c: Reconstruction of the activities in the winery of Las Pilillas; d: Remains of pressing found at the site of Font de la Canya, Barcelona; e: Cellars of Alt de Benimaquia, Alicante.

More than 250 of them are known through excavations,[11] whose results do not solve the main interpretive problem, which is, in many cases, distinguishing which product was being processed – oil or wine.

The difficulty of distinguishing between oil and wine making installations was highlighted in the article by J.P. Brun in 1993.[12] Although the ability to identify specific devices for either product have greatly improved, the contribution of archaeobotany and archaeobiochemistry are now crucial to achieve more accurate results. These types of analysis are more suitable for smaller exploitations since devices made of perishable materials do not leave clear remains and are very hard to identify. Fortunately, in recent years these methods have been applied more frequently in the Spanish-Portuguese archaeology; providing fresh data on winemaking in ancient times. Archaeobotany and archaeobiochemistry also contribute to improve the ability of researchers to discriminate winemaking facilities from oil mills.

We will begin with the most important wine area in Hispania: Tarraconensis. This production is now well known thanks to the study of the containers and of the winemaking plants. The wine produced in the coastal area of Catalonia was exported from the second half of the 2nd century BC until the end of the 2nd century AD.[13]

The recently excavated site of La Sagrera, located in the current urban area of Barcelona, illustrates this production model. The excavation of this suburban villa showed that three successive wineries were built.[14] Biochemical analyses carried out by Nicolas Garnier in 2016, not yet published, on behalf of the Servei d'Arqueologia of

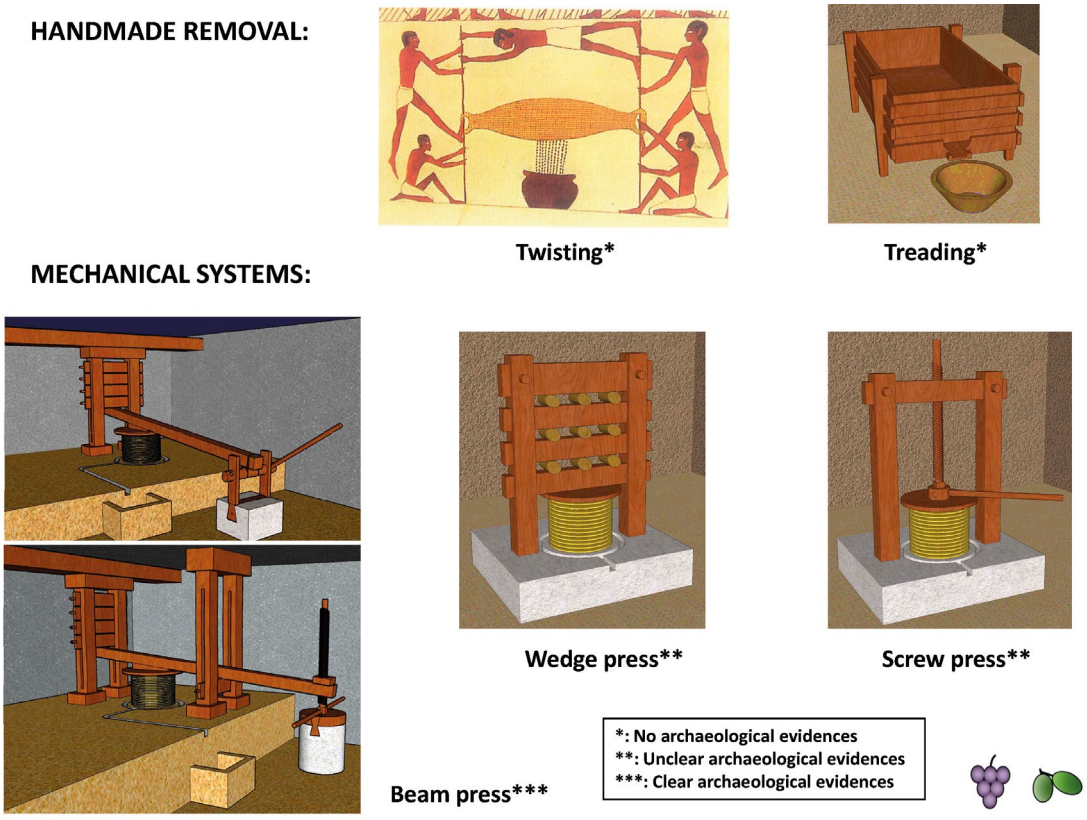

Fig. 2: Devices used for wine and oil making, showing their potential archaeological remains.

Barcelona, provided interesting data about the organization of production at four stages and helped to revise the identification of a late phase of the wine production. The wine presses used the *arca lapidum* system. The lever press is weighted by a wooden box filled with stones and rubbles. This type of press is characteristic of major Tarraconensis production plants. Well known today by archaeologists, it remained unnoticed in previous excavations.[15]

Although the wine production of Tarraconensis is well known, it would be interesting to carry out analysis on the remains of a group of sites such as the sites of Olivet d'en Pujol and Tolegassos, in Girona, whose productions are debated. These two rural settlements present large open-air storage areas with *dolia defossa* that were originally interpreted by their excavators as cereal warehouses,[16] but the *dolia* were probably uses as winemaking containers, as everywhere else.

Biochemical analyses have been carried out at the site of Fonte do Milho, in Portugal, in order to answer the old debate on the functionality of the press. The pressing structures of this Lusitanian site were traditionally interpreted as for oil production, following the long historiographic tendency to identify any press as for oil. In fact, in the area with

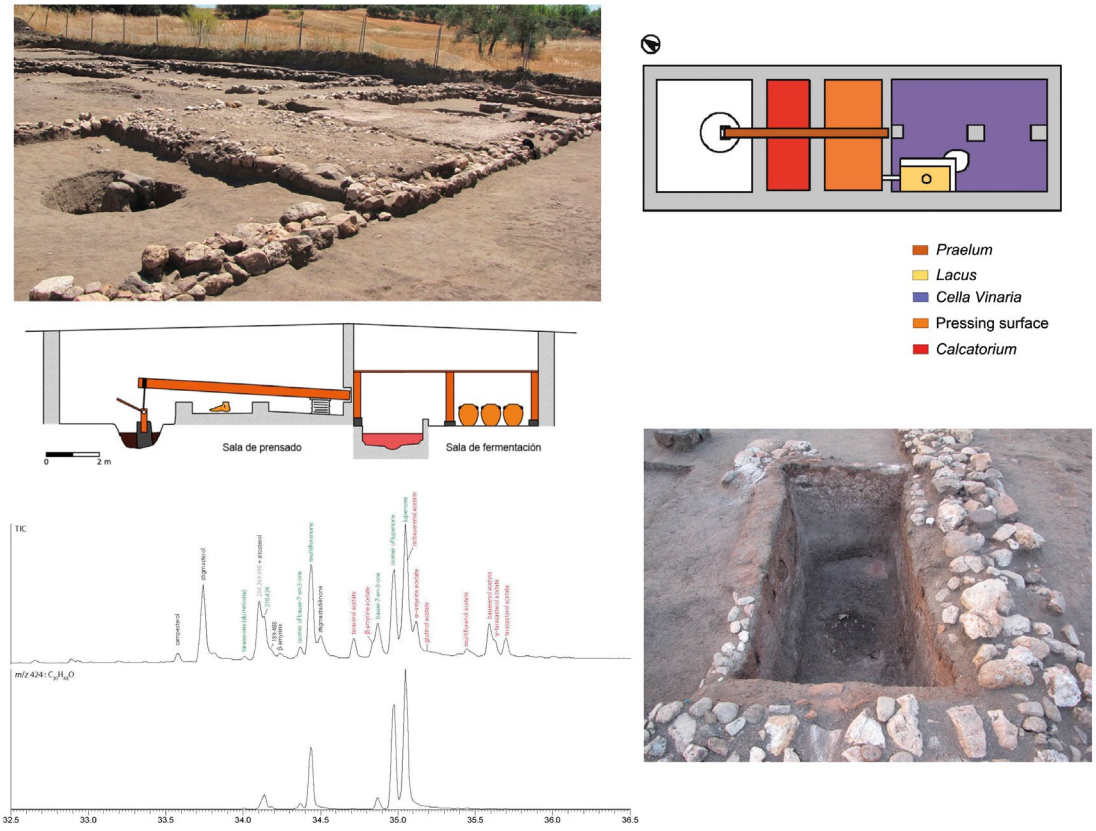

Fig. 3: General view, plan, section, detail and chromatogram of the *lacus* of Los Palacios in Madrid.

dolia defossa located in this fortified village, we know that red wine was produced in Roman times, but the precise chronology is not yet known.[17]

The interpretation of the rural site of Los Palacios, near Madrid[18] also relies on biochemical analysis of residues. In this case, the plan of the installation with a double treading floor and a large cellar with central pillars led to identification of a *calcatorium* and a *cella vinaria* (fig. 3). This preliminary interpretation has been confirmed by the analyses carried out by N. Garnier, who detected fermentation processes of white wine in the *lacus*. This structure, dated at the end of the 1st century AD, was later reused to store *asteraceae* herbs.[19]

Analytical techniques have also been essential to interpret the *pars fructuaria* of the Roman villa of Carranque near Toledo. This site is famous for its mosaics and for the existence of a large manorial-type building. An area originally interpreted as a kitchen was reinterpreted as a productive sector composed of an oil mill and a winery, occupied throughout the 4th century AD (fig. 4, a).[20] To the east of the central patio, which forms the core of the buildings, installations linked to olive oil production were found. Due to the state of preservation, we obtained few clues for identifying the product except for the presence

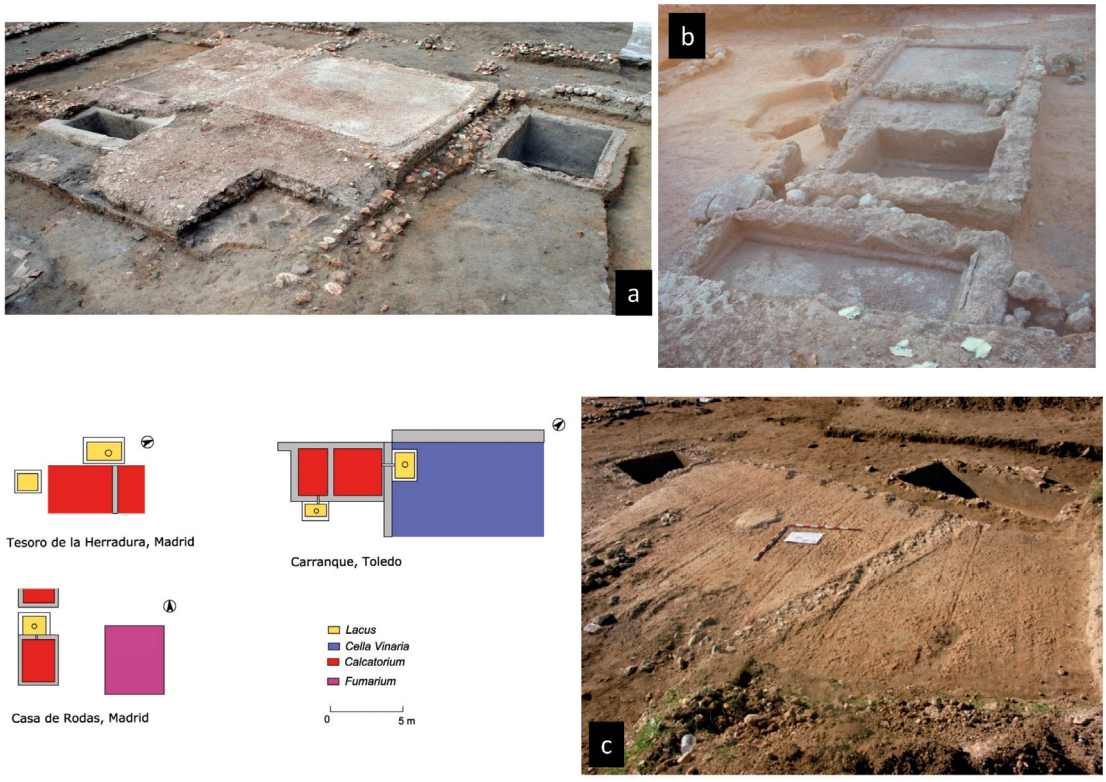

Fig. 4: Treading floors possibly used as bases of central screw presses. a: Carranque, Toledo; b: Casa de Rodas, Aranjuez; c: Tesoro de la Herradura, Madrid.

of a double vat, which was thought to represent evidence of decantation structures. The biochemical analysis detected the traces of animal fat that was mixed with the plaster for waterproofing the floor and the presence of vegetal oil.[21] In the buildings located to the west of the patio, seed flotation and carpological analysis helped the functional interpretation of two *opus signinum* floors connected with two vats. The remains of carbonized *vitis domestica* pips, found inside one of the tanks confirmed the production of wine in this sector of the *villa*. Although we thought originally that the two floors were used for treading the grapes, the difference in size between them and the capacity of the vat (*lacus*) suggest the use of a wooden central screw press in the northern structure.[22]

The identification of these devices at Carranque, simpler in structure, allows to characterize a specific model for wineries in the central part of the Iberian Peninsula. These are small facilities without beam presses, in which the grape juice is obtained by combining foot treading and pressing, possibly with screw presses. Other examples similar to Carranque are found at the sites of Tesoro de la Herradura and Casa de Rodas, in the Madrid region (fig. 4).[23]

In the interior of the Peninsula, the wineries are not equipped with *dolia defossa* (albeit with some exceptions), but with small free-standing containers similar to those

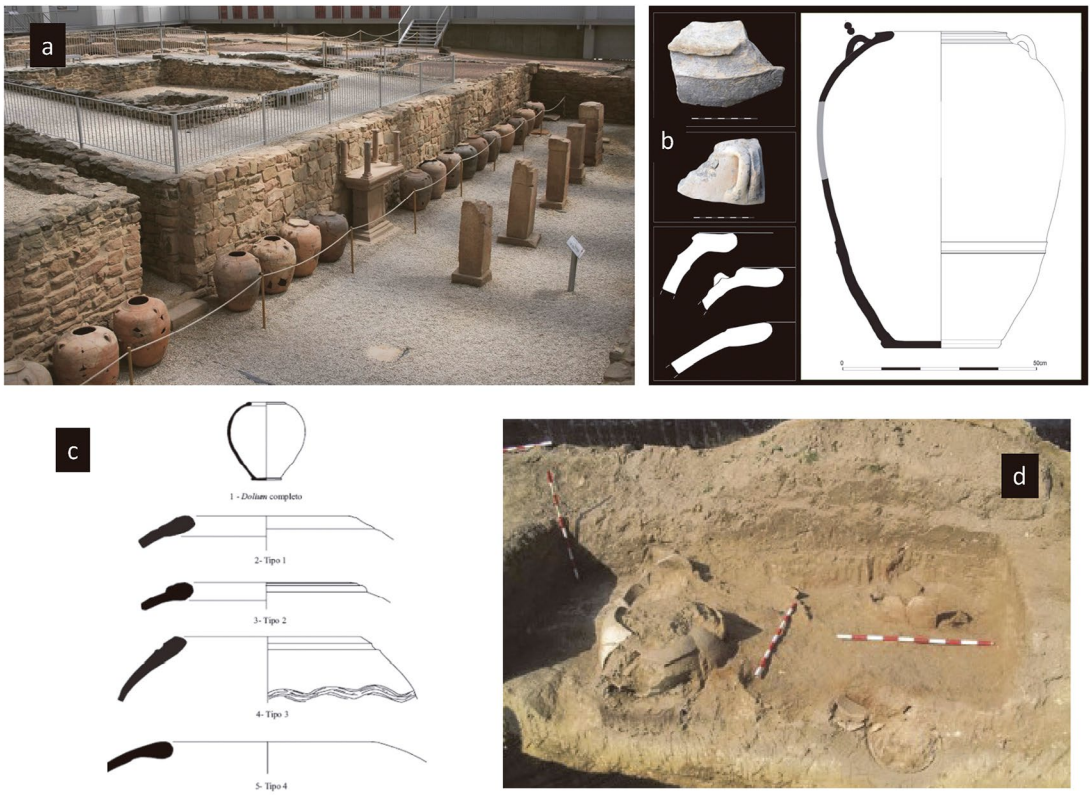

Fig. 5: Free-standing ceramic containers for winemaking (*orcae*). a: *Cella vinaria* of Las Musas, Navarra; b: Rasero de Luján, Cuenca; c: Rumansil, Murça do Douro; d: Cortijo de la Marina, Sevilla.

located in the paradigmatic winery of Las Musas villa in Navarra (fig. 5, a). As they are free standing and easily removed, these containers, called *orcae* in Latin literature are difficult to use for identifying winemaking processes since, unlike *dolia defossa*, they do not leave holes or many remains. That is why it is so important to carry out carpological and biochemical analyses of these ceramics and tanks. The use of these *orcae* follows a local tradition in the Ebro Valley, the interior of the Peninsula and in the regions of Baetica and Lusitania (fig. 5).[24]

These containers are displayed in long buildings, covered with gable roofs and divided into two or three naves which are separated by rows of pillars. In this building, it is common to find a tank intended for liquid transfer. Although we cannot rule out other interpretations about the uses of these containers, such as storage of agricultural yields, we tend to interpret this rural building type as characteristic for winemaking.

This model was also used at the site of Prazo, in the northern part of inland Lusitania:[25] biochemical analyses identified a coating made of conifer pitch in the *lacus* discovered in the building, proven to be a *cella vinaria* (fig. 6). Although the use of wooden barrels cannot be dismissed, free-standing containers were more likely to be used in

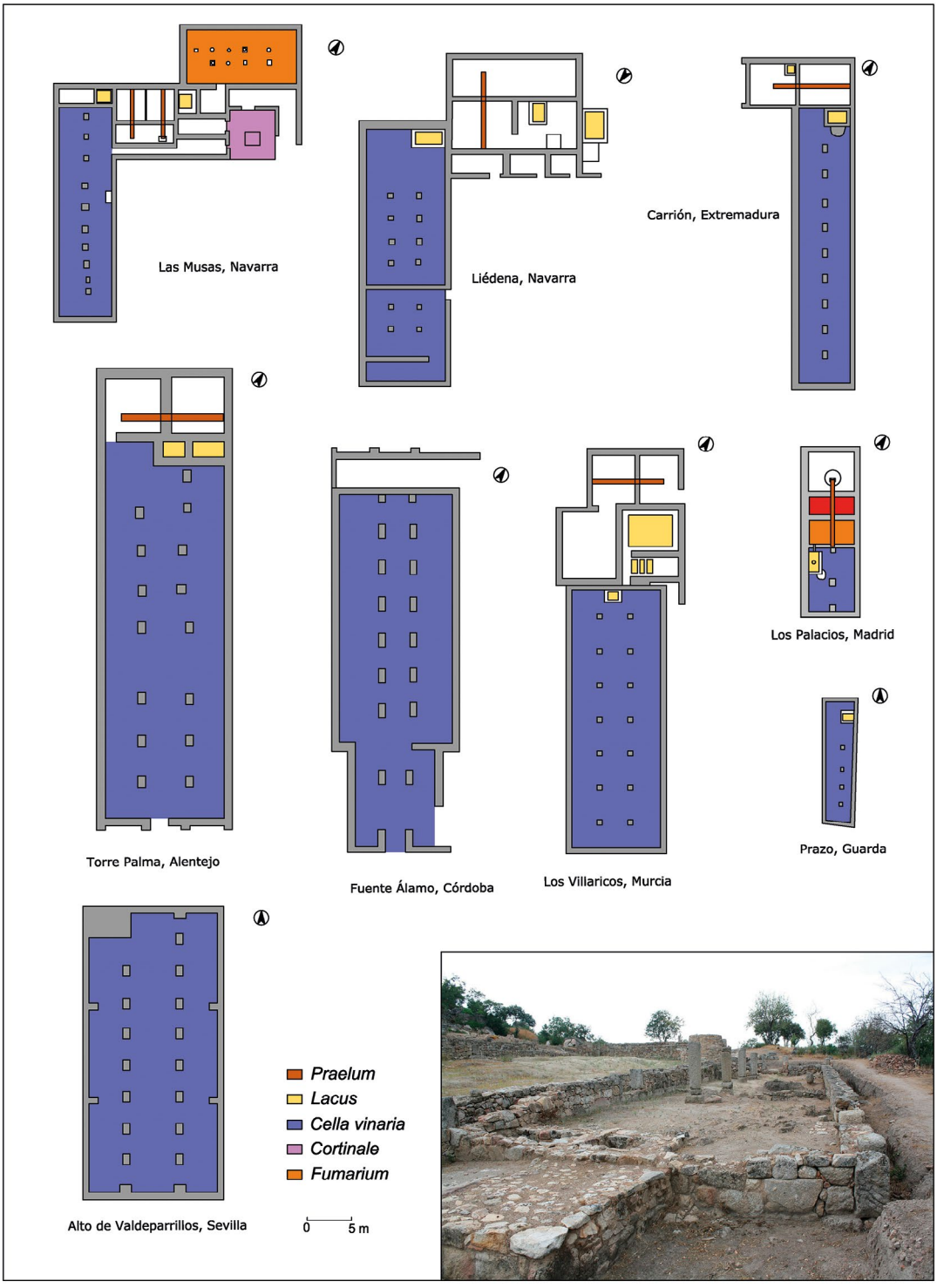

Fig. 6: Plans of long buildings divided into naves and a general view of the *cella vinaria* at Prazo.

Fig. 7: General view, plan and chromatogram of Late Antique site of Son Peretó, Mallorca.

these buildings. In Lusitania, these containers linked to wine fermentation have been discovered at Rumansil II, Carrión, Aldea do Grilo and Vale do Mouro, among others.[26]

In turn, these types of analysis also should play an essential role in the identification and study of Late Antique wine and oil production. These products were still largely consumed by the Hispanovisigothic and Byzantine population of the Iberian Peninsula.[27] However, we lack substantial data about oil and wine making and commercialization, due to the small scale of production and trade. We imagine that the extraction system obtained crushed grapes by treading and pressing with central screw presses made entirely out of wood. These methods were probably applied at the site of Son Peretó in Majorca. In this rural settlement, occupied between the 5th and 8th centuries AD, which had a religious building, the only evidence of wine production is a vat whose functionality would have been unnoticed without biomolecular archaeology (fig. 7).[28]

The same is true for Pla de Ses Figueres, on the island of Cabrera, dated to the 5th and 6th centuries AD.[29] In this site, a vat located in an area surrounded by heaps of *murex* was originally thought to produce purple dye. However, the sediments containing tartaric

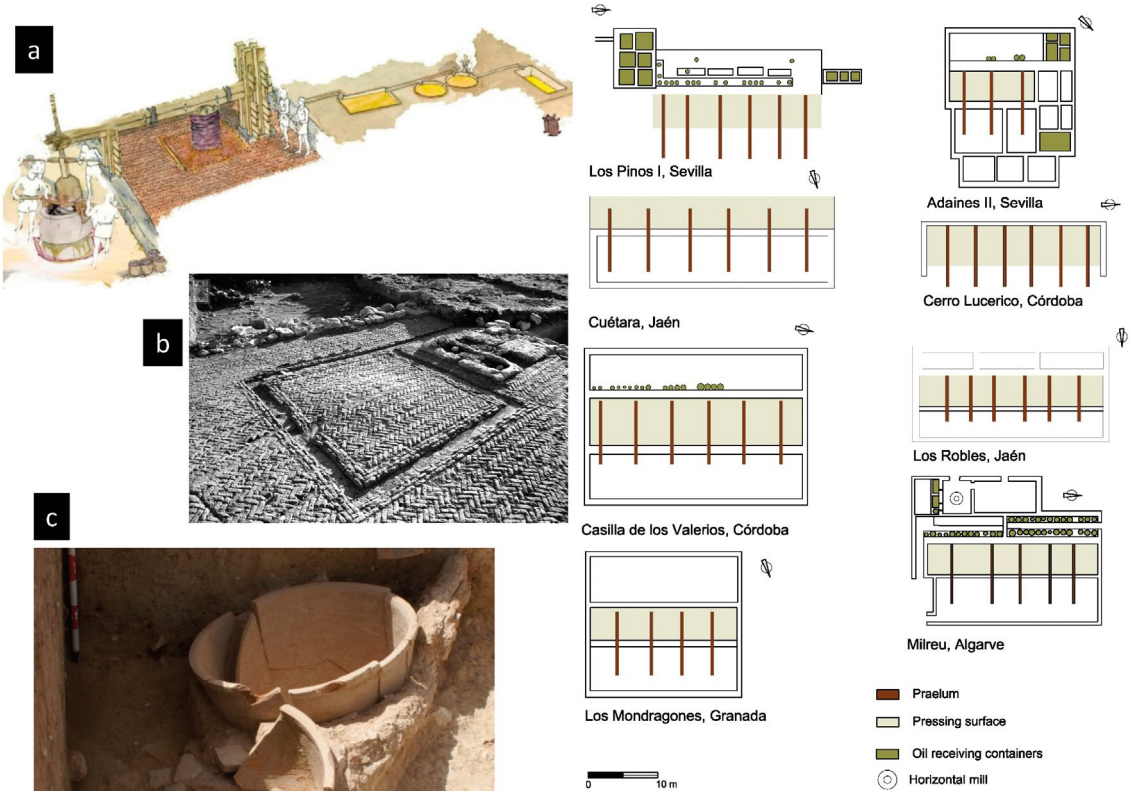

Fig. 8: Plans of oil mills from Baetica. a: Reconstruction of the oil mill of Gallumbar, Antequera; b: Pressing room of Gallumbar, Antequera; c: *Dolia* of Adaines II, Sevilla.

and hydroxycinnamic, acid, discovered through biochemical analysis, proved that this space was related to winemaking.[30]

We should also briefly mention the current state of research about oil mills in Hispania: firstly, because of the relevance of this production throughout the Roman period and across the peninsular territory; and secondly, because a better knowledge of these remains improves our capacity to distinguish oil mills from wineries.

In the last decade there has been a revolution in our knowledge of the oil processing facilities in the southern area of Hispania. Numerous oil plants have been excavated and published providing technical guidelines for further studies. From the Augustan period, we detect a dominant productive and technological model for the oil mills in this region: 1. they are equipped with lever and screw presses; 2. they are mostly horizontal mills; 3. they use decantation devices using gravity; 4. wide-mouth *dolia* are used for decantation and storage; 5. the floors are made in *opus latericium* (fig. 8).[31] This model continued during the period of peak production of Baetic oil, until the Late Empire.

During the last few years, carpological and biochemical analyses have also became more common, further developing this scientific revolution. For example, carpological studies were carried out in the recently excavated site of Las Delicias, in the Genil river

Valley. The study of 335 carbonized olive stones, mostly used for fuelling amphorae kilns located nearby, uncovered a great variety of olive varieties, including wild olives.[32] The future will surely bring even more exciting results.

Notes

[1] Reference to Buxó 1997; Pérez-Jordá 2013 and a summary in Peña Cervantes 2010, 152.

[2] L. Chocarro and G. Pérez-Jordá point out this issue in their very recent review on carpological studies in the Iberian Peninsula (Chocharro – Pérez-Jordá 2018, 21). In relation to the impact of the Phoenician colonization, we also refer to Buxó 2008; Peña Cervantes 2010, 152–158; Pérez-Jordá 2015 and Pérez-Jordá et al. 2017.

[3] Ruiz Mata 1995.

[4] Echeverría – Vera 2015.

[5] Reference to Ramón 1995, 2006 and 2010 and Sáez Romero 2018, amongst others.

[6] In previous publications, we have emphasized on the importance of using components made of perishable materials to produce wine and oil. The use of this type of tools creates a 'silent production', which is conditioning our knowledge on ancient productive processes. See Peña Cervantes 2010, 21–40 and 2014, 218–228.

[7] López et al. 2015.

[8] Martínez Valle 2014; Quixal et al. 2016.

[9] Gómez Bellard – Guérin 1993.

[10] Jornet et al. 2016.

[11] Reference to Peña Cervantes 2010 and 2014 on the study of productions premises; and to Peña-Chocarro et al. 2017 in relation to available carpological studies.

[12] Brun 1993, 511–537.

[13] The bibliography that is available about Tarraconensis wine is extremely large. We can refer, among many works, to Revilla 2006; López Mullor – Martín 2008; Prevosti – Martín i Oliveras 2009; Martín i Oliveras et al. 2017. For a comprehensive summary, reference to Peña Cervantes 2014, 239–241.

[14] Alcubierre et al. 2014.

[15] On this recently discovered system, we refer to Martín i Oliveras 2012 and Peña Cervantes 2011–2012, 49 f.

[16] Casas 1989.

[17] Garnier 2017, 104–105.

[18] Major et al. 2014.

[19] Garnier 2017, 108.

[20] García-Entero et al. 2011–2012.

[21] Garnier 2017, 107.

[22] Peña Cervantes 2017, 61.

[23] Peña Cervantes 2017.

[24] On these types of containers, see Peña Cervantes 2011–2012, 51–53. About the central part of the Peninsula, see Peña Cervantes 2017 and about Andalusia: Peña Cervantes 2016, 308–311.

[25] Pereira – Silvino 2015.

[26] Peña Cervantes 2014, 232.

[27] Peña Cervantes 2005–2006 and 2008.
[28] Pecci et al. 2013.
[29] Riera 2013.
[30] Pecci et al. 2013.
[31] Peña Cervantes 2016.
[32] Bourgeon et al. 2017.

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Fig. 1a: Echeverría – Vera 2015; b: by the author; c: Quixal et al. 2016; d: López et al. 2014; e: Gómez Bellard – Guérin 1993. – Fig. 2: by the author. – Fig. 3: Major et al. 2014; Garnier 2017. – Fig. 4a: García-Entero et al. 2011–2012; b: Oñate – Penedo 2012; c: Vega et al. 2017. – Fig. 5a: by the author; b: Urbina – Morín 2013; c: Silvino et al. 2017; d: Castro et al. 2004. – Fig. 6: by the author. – Fig. 7: Cau et al. 2012; Pecci et al. 2013. – Fig. 8a, b: Romero – Vargas 2016; c: Corzo 2016.

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From Vine to Vat and Beyond: the Case of Ancient Malta

Maxine Anastasi

In a paper published in the mid-1980s, the late scholar of Punic studies Antonia Ciasca identified a small number of what she claimed to be Maltese-manufactured pottery vessels from sites located in the central Mediterranean.[1] Based on the then available evidence, Ciasca suggested that these Maltese amphorae were remnants of the distribution of foodstuffs travelling alongside Maltese migrants.[2] Since then, several more of these pottery containers have been discovered across the central Mediterranean prompting a re-evaluation of Ciasca's Maltese migrant hypothesis. This is especially pertinent if we also consider the new evidence available in Malta for a product that could have been exported in antiquity. The first part of this paper will explore the new results of the University of Malta's excavation of a vineyard in Malta.[3] This will then be viewed in the context of an ongoing research project currently being carried out on Maltese table amphorae,[4] and evidence of a shipwreck that carried a similar cargo off the coast of Gozo. The intention is to highlight new evidence for viticulture on the islands, and go on to suggest, by way of hypothesis, that wine was a possible export from Malta, carried in those very container types that aroused Ciasca's interest more than thirty years ago.

The Vineyard

In 2006, the Department of Classics and Archaeology, at the University of Malta undertook the first season of what became a ten-year research and training excavation of a Roman villa in the village of Żejtun, in the south of Malta (fig. 1). The site was accidentally discovered in the early 1960s during construction works for a new village school, and was subsequently excavated over the course of the following decade. This investigation uncovered a series of connecting rooms with tiled floors, several cisterns, and most importantly, a separate room reserved for the pressing of olive oil.[5] This specific function is clear from the presence of three oil-settling vats and a large stone counterweight block, modified to secure a screw mechanism—a familiar layout for scores of other olive pressing sites across the island.[6]

It is not the olive press that is of interest here, but a series of 'channels'—as described in the only surviving sketch plan from the 1970s—which were discovered in different areas of the site.[7] It only became clear in 2013, that these 'channels' belonged to an extensive system of long and narrow vine trenches cut into the soft limestone bedrock (fig. 2). These vine trenches preceded the construction of the villa, as most of the trenches continue beneath the many floors and walls, as well as the Roman-period pressing equipment. At least four 'systems' of trenches have been traced. Two continuous sets run parallel to each other following a north-south axis (fig. 3); whilst a third system is made up of much shorter trenches. These shorter vine trenches cross-cut the longer

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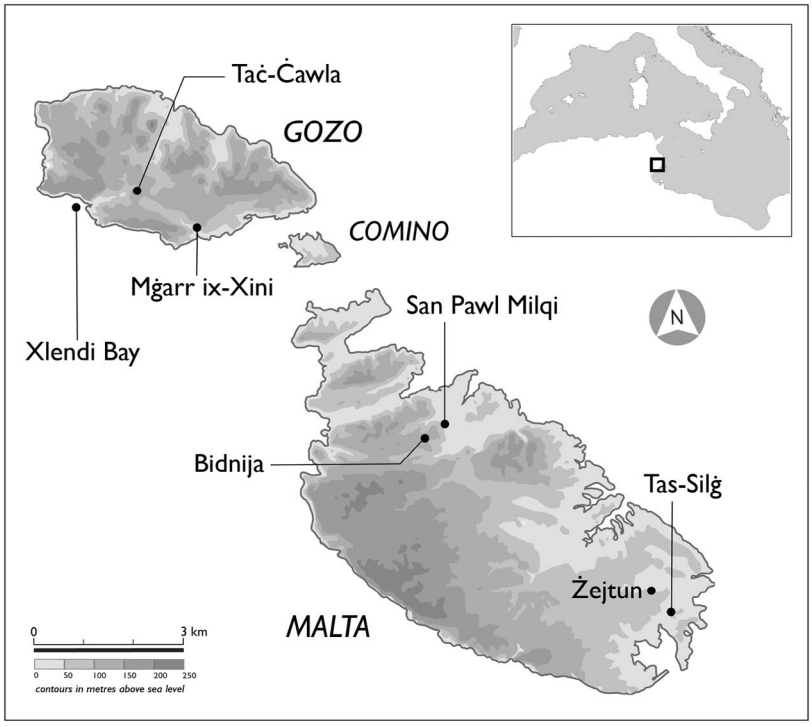

Fig. 1: Location map of the Maltese islands showing the places mentioned in the text.

ones, thus clearly post-dating them.[8] A fourth system follows an east-west axis, where some of the southern-most trenches are thought to mark a change in direction, where the trenches stop short of a large cistern. The significance of this will be discussed below.

Several segments of these trenches escaped excavation in the 1970s, especially the parts sealed by floors and walls belonging to the Roman-period villa. Where possible, environmental samples of the deposits contained within these trenches were taken for analyses. To date, no grape seeds were recovered in the samples that were studied, nor was there any reliable pollen count as the pollen was far too degraded. Despite this, the study demonstrated the methodical manner in which the trench fills were prepared, ready for cultivating in an otherwise challenging desiccated and rocky landscape.[9] The pottery found within the fills was used to date the final use of the trenches to the late 2nd/1st century BC, when the vineyard was abandoned, and the area taken over to make way for the building of the Roman villa soon after.[10]

The only part of the site where no vine trenches were uncovered is restricted to the south-eastern quarter of the existing building, directly north of a large cistern in Area D (fig. 3). It is here that a building that stood adjacent to the vineyard, and which was fitted with a wine press, is thought to have existed. A series of masonry walls and the cistern's opening were both dated by pottery to the late 5th and 4th century BC. No direct physical relationship could be traced between the vineyard and the structure, but a GPR survey, followed by excavation, successfully traced the limit of the vine trenches and

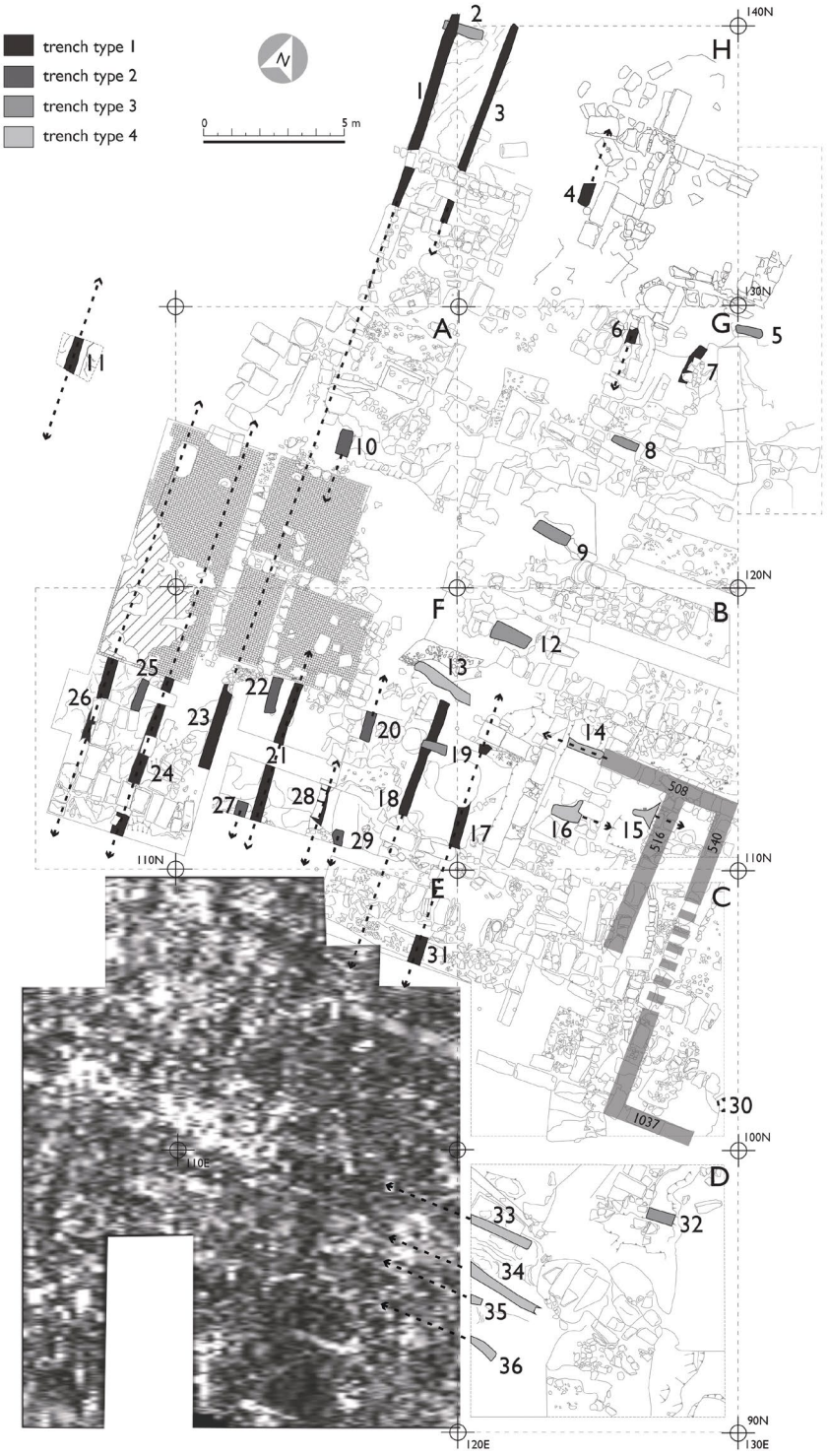

Fig. 2: Site plan of the Żejtun villa complete to the 2016 excavation campaign with the vine trenches marked out by type, and the unexcavated area surveyed by GPR.

Fig. 3: Trench in Area F at the Żejtun villa with type-1 vine trenches cut into the bedrock.

showed a return of the north-south aligned trenches, which deliberately terminated a short distance from the entrance to the cistern. This leads us to believe that the vineyard was planned to accommodate an existing feature.[11]

The site underwent a radical period of rebuilding shortly after the 1st century BC, which as mentioned earlier, resulted in the abandonment and partial destruction of the vineyard, and the construction of the large building housing the olive press. The villa was built using a large number of reutilized stone blocks, many displaying clear traces of working, resizing and modification. The clearest example of this came with the discovery of a perfectly preserved limestone pressbed, forming part of the foundation courses of the villa's south-facing perimeter wall. Samples of the pressbed's surface were tested for traces of lipids and tartaric residues, in the hope that the type of fruit that was once pressed could be detected. Unfortunately, the results obtained were inconclusive. However, a distinctive pitted surface concentrated in the centre of the pressbed is believed to be use-wear related to its use in the past.[12]

A short distance away, lay a pair of disused stone uprights—one now broken in two and incorporated into a Roman-period wall; the other one complete, but forming part of the adjacent levelling fill. Each one displays carved notches as is often found on the *arbores*, those stone piers designed to secure a wooden press beam, common on many Roman-period wine presses across the Mediterranean. A third reutilized block,

also found incorporated into the Roman-period structure, was found to be hollow, and belonged to an upturned rectangular limestone trough with a simple lateral spout. A large fragment of mortar lining, which was discovered still stuck to the interior surface of the trough's spout, would have made the container impervious, and more suited to hold liquids. Taken altogether, this concentration of reutilized stone features may have belonged to a press that existed alongside the 5th/4th century BC building and cistern, and which was skirted by a vineyard. It would also suggest that the grapes cultivated were intended for wine rather than table grapes.

The investigation of the Żejtun vineyard and possible winery constitutes important new data that showcases the existence of organized viticulture on the islands in antiquity. It has not been possible to determine a period of use for the vineyard, but if we consider the dates attributed for the building of the winery structure just discussed, it is probable that the vineyard was in use from at least the 5th/4th century up until the late 2nd/1st century BC, before the vineyard was abandoned and destroyed. Similar configurations of Hellenistic and Roman-period vine trenches cut into rock to increase soil depth are known elsewhere in the Mediterranean.[13] Indeed, rock-cut vine trenches, some of which have been dated to the 5th–4th century BC, are also documented in Ibiza, attesting to the establishment of similar cultivation practices in the Punic period.[14] Lastly, the discovery of the Żejtun complex has now raised the possibility that several other sites across the Maltese islands, which were adapted with olive pressing facilities in the Roman period, may also yield clues to earlier occupation phases linked to grape cultivation and wine production. Until further villa sites are subjected to similar systematic archaeological investigations, we can only speculate on the extent of this trend.

As for other vine trenches, scores of similar rock-cut trench systems have been revealed by developer-funded excavations over the last ten years in other parts of Malta and Gozo. Unfortunately, all of these remain unpublished and are only known through short notes and newspaper reports.[15] Many of these trench systems, however, have either been claimed to be of more recent date using unknown criteria, or have not been dated at all. More recently, the discovery of the only example of trenches cut into (prehistoric) soil deposits (rather than rock) was made at the site of Taċ-Ċawla, in Gozo. The trenches were excavated by members of the ERC-funded FRAGSUS project, as part of the targeted investigation of the prehistoric remains at the site.[16] Pottery within these trenches has been dated to the 1st century BC, potentially making them contemporary with the Żejtun examples, and indicating that Żejtun is not an isolated example of ancient viticulture.

The Vats

Like many other areas in the Mediterranean, the Maltese islands are also home to a number of *palmenti*—the rock-cut treading pans and collecting vats associated with wine production (fig. 4). The largest concentration of these pans, consisting of at

Fig. 4: Google Earth images showing location of known rock-cut treading pans in Malta (top) with an inset of the recorded treading pans in Mġarr ix-Xini, Gozo.

least 17, dot the top and bottom of the ancient river valley of Mġarr ix-Xini, on Gozo. Their shape and composition ranges from simple rectangular or square shallow treading floors, connected to a deeper vat, to more complex systems consisting of multiple vats and interconnecting depressions, some of which are even sheltered beneath fallen boulders.[17] One of the more elaborate sheltered ones, located on the valley floor, even bears two pairs of rock-cut notches in the vertical rock-face, most certainly meant to accommodate a press beam, a feature also found on a number of the isolated *palmenti* found in Malta.[18]

In 2005, the treading pans from Gozo were surveyed as part of the largescale Mġarr ix-Xini Regional Park's project, initiated by the local council of the region and the state's Superintendence of Cultural Heritage, with the aim of studying the ecological

and archaeological potential of the valley and the surrounding landscape. It was through this project that a number of areas were earmarked for excavation. The outcome of these archaeological investigations remain to be published, however, recent doctoral research by one of the project's co-directors remarked on the association of one of these treading pans with an agricultural terrace wall provisionally dated to the 6th/5th century BC by the pottery.[19] This date would tie in nicely with the evidence for wine production believed to have existed at Żejtun in Malta.

The Amphorae

With increasing evidence for wine production in antiquity, it is pertinent to explore the amphorae, to determine whether at least one type of container can be identified, which could be a possible contender for the purpose of storing and transporting some of the wine being produced. Here we may consider one of the classes of amphorae identified by Ciasca as one form that could have transported Maltese wine overseas. The remainder of this short paper will briefly examine what is known about this form, and explore whether there is a link between local wine production and these forms.[20]

The group of table amphorae Ciasca originally identified is well-recognized in the local literature because of the Greek-inspired form and characteristic cream-slipped surface with red-painted linear decoration.[21] Their distinctiveness is primarily one of the reasons behind their identification outside of the Maltese islands.[22] However, despite the class being well-known locally, many gaps remain in what we know about these containers. Their typology has remained very generic, and there is no clear-cut distinction between the many variants identified both in local and foreign excavations. This fuzziness has affected the chronology too, as all the variants are very often bundled together in the period between the 4th and mid-2nd century BC.[23] In Malta, they are best represented in funerary contexts,[24] but are also found, although not common, at several sites across the Maltese islands, including the sanctuary of Tas-Silġ[25] and rural villa sites, such as at Żejtun,[26] San Pawl Milqi[27] and Bidnija.[28] Unfortunately, there is still no archaeological evidence of a production site for these containers.[29] What is apparent, however, is that to date, more examples have been traced from non-Maltese contexts, than locally, possibly implying that their production could have been export-oriented. Alternatively, however, this could be a reflection of the under-representation of these forms within the published literature available.

These table amphorae are important for studying local Maltese production and export because they represent concrete examples of the physical exchange of Maltese-made goods in the Late Punic and early Roman periods. Contemporary Phoenician and Punic forms are also found outside of Malta, but unless subjected

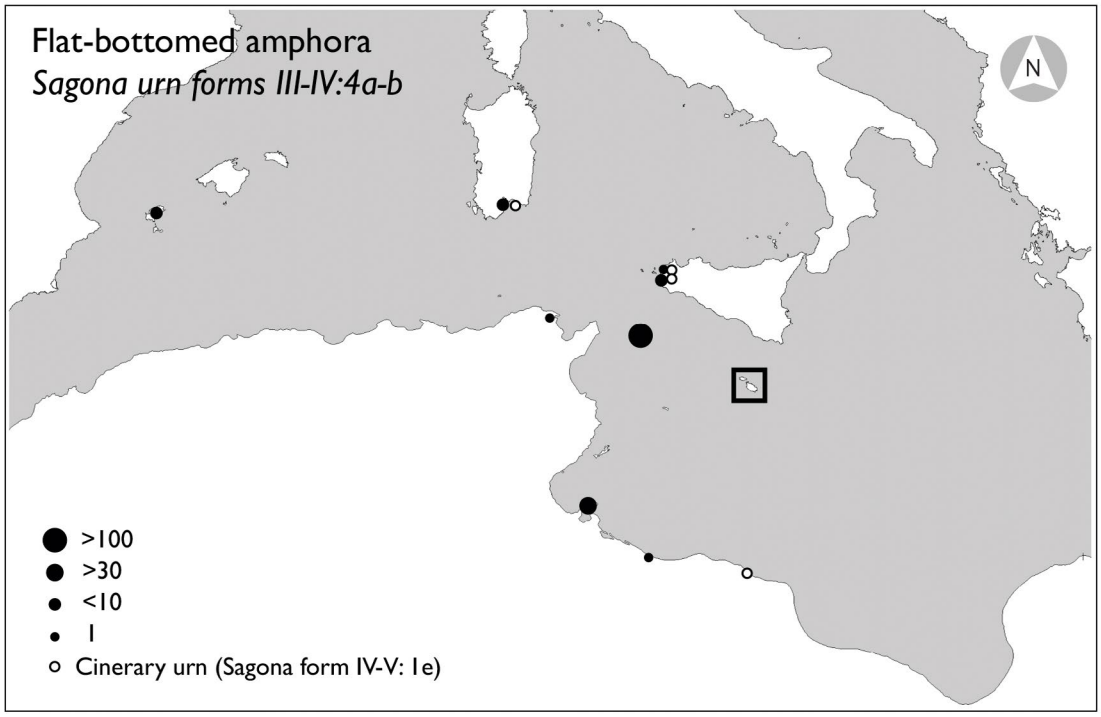

Fig. 5: Quantitative distribution of known Maltese flat-bottomed amphorae in the central Mediterranean.

to detailed fabric analyses it can be difficult to identify them, especially since far fewer examples tend to be found and several other central Mediterranean sources produced the same form.[30]

Ciasca's original migrant hypothesis was inherently flawed if we consider that it is based on the erroneous 'pots as people' fallacy.[31] In spite of this her ideas were shaped on the basis of the scant evidence available at the time. Fortunately, recent surveys and excavations in Pantelleria, Jerba and elsewhere, combined with searches through old excavation reports and Ciasca's research, have now made it possible to plot the distribution of all the Maltese objects known in the central Mediterranean, including these table amphorae forms (fig. 5).[32] The spread is generally limited to other islands and coastal areas within the central Mediterranean, but what is much clearer now are the higher concentrations found in places like Pantelleria and Jerba. Indeed, more familiarity with the form's characteristics is certain to ensure more examples are identified when assemblages are in the process of being studied. This denser distribution of tangible evidence is also indicative of greater economic connectivity between the Maltese islands and the central Mediterranean than originally thought.

In addition, further evidence that will cause us to reconsider Ciasca's hypothesis are the results of a recent underwater survey of the seabed off the coast of Xlendi

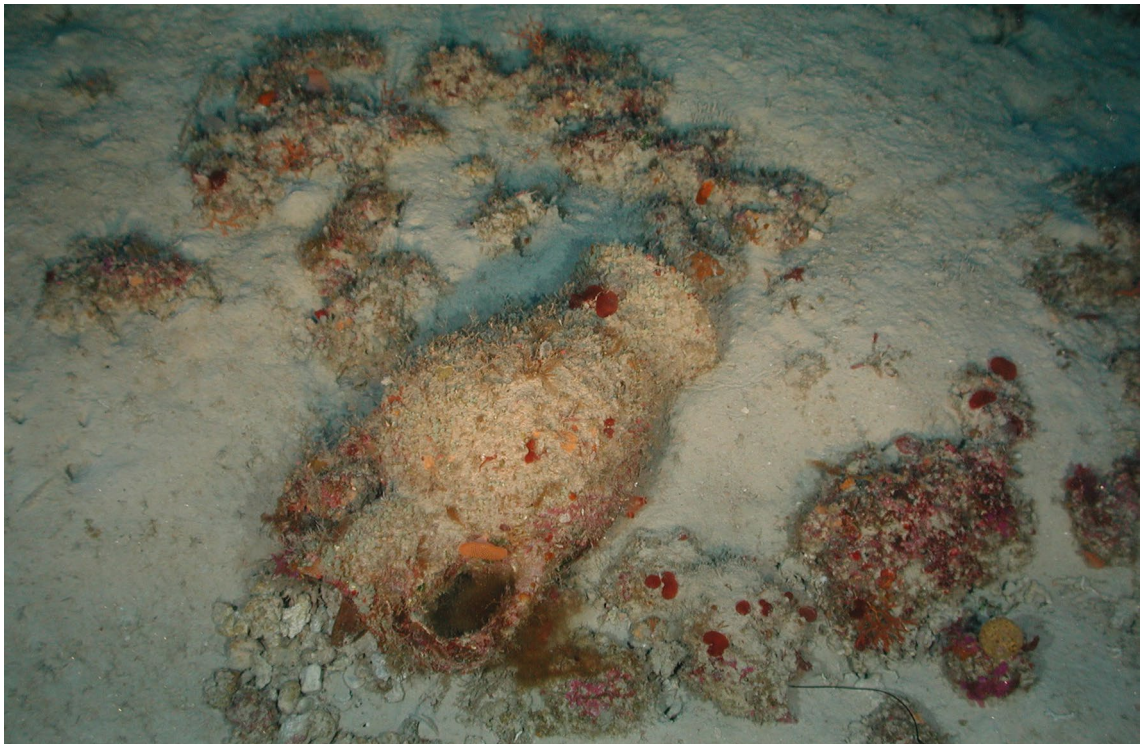

Fig. 6: Example of a possible Maltese flat-bottomed amphora from the Xlendi Bay wreck, Gozo.

Bay in south-west Gozo—incidentally not too far from the concentration of *palmenti* mentioned earlier. Ceramic vessels, presumably originating from several shipwrecks are known to litter the seabed, however, recent systematic sonar scanning of the area and high-resolution imaging has revealed the full extent of an underwater site covering an area of around 1600 m^2.[33] A handful of the amphorae and other objects were raised to the surface in the 1960s, and are being used to aid the identification of the thousands of amphorae visible on the sea floor (fig. 6). Those raised generally consist of 3rd/2nd century BC North African and Italian forms, but also hundreds, if not more, of these characteristic Maltese flat-bottomed and egg-shaped forms. The identification of the amphorae visible on the seabed is currently being carried out, and is already indicating that the amount of Maltese amphorae present is consistent with a far more organized system of export than was previously considered.[34]

With regards to the possible content of these containers, there is currently little evidence to date. Traces of what appear to be a pitch lining were reported on the interior of one of the flat-bottomed forms raised in the 1960s.[35] But this remains to be confirmed scientifically. Morphologically, it is possible to link the form with the classic Greek amphora tradition, which is more commonly associated with carrying wine. Along with a typological study of the variants we know exist, the opportunity to accurately

survey, excavate and examine the cargo itself will be crucial to our understanding of Maltese exports, and these forms in particular. Plans are afoot to carry out a battery of petrographic, chemical and residue analyses in order to put the question of source and contents to rest.

In conclusion, more compelling archaeological evidence for viticulture and wine production on the Maltese islands is now available. When viewed alongside a clearer distribution map of Maltese pottery containers, which in themselves potentially carried wine, it is now more possible to think of a Maltese vintage that was produced on the islands and then exported, at least in part, overseas. This evidence also brings us to a point where we can begin exploring more challenging questions about ancient Maltese connectivity within a wider regional context. For decades, the concept of ancient Maltese production and exports has always been heavily circumscribed by the limited archaeological evidence at hand, where connectivity was very often cautiously inferred, rather than supported by archaeological evidence in the ground.

Notes

[1] Ciasca 1985.

[2] Ciasca 1985, 23 f.

[3] Vella et al. 2017.

[4] Anastasi 2015; 2018.

[5] Bonanno – Vella 2012.

[6] Bonanno 1977; Anastasi – Vella 2018.

[7] Bonanno – Vella 2012, fig. 4.

[8] Vella et al. 2017, 117–120 fig. 2.

[9] Vella et al. 2007, 120.

[10] Vella et al. 2017, 119.

[11] Vella et al. 2017, 119 f.

[12] Spiteri Debono et al. 2016; Vella et al. 2017, 120–122. A new series of tests are scheduled to be carried out on the sample of the pressbed using a new method that only became available after this analysis was conducted (pers. comm. Cythianne Spiteri Debono, October 2018).

[13] See Megara in Attica (Pikoulas 2012), Antiparos in the Cyclades (Renfrew 1982, 157) and Megara Hyblea in Sicily (Boissinot 2009).

[14] Marlasca Martín – López Garí 2006.

[15] For instance, Times of Malta, 6th August 2016 <https://www.timesofmalta.com/articles/view/20160806/local/no-phoenician-ruins-just-recent-vineyard-trenches-in-madliena.621172> (accessed October 2018).

[16] Pers. comm. Nicholas C. Vella, May 2018.

[17] Jaccarini – Cauchi 1999; Bonanno 2008.

[18] Bonanno 2008.

[19] Azzopardi 2014, 234 f.

[20] This topic has been partly discussed in Anastasi 2018.
[21] Sagona 2002, 103 f.
[22] Anastasi 2018, 131.
[23] Bruno 2009, 101.
[24] Sagona 2002, 104.
[25] Sagona 2015, 56 fig. 1.39–42; Cagiano de Azevedo et al. 1965, fig. 7.1–4.
[26] Anastasi 2012, fig. 2.3–4.
[27] Busuttil et al. 1969, fig. 8.16, 22, 24–26.
[28] Docter et al. 2012, fig. 27.39.
[29] Little evidence of production sites is available for the Maltese islands. The evidence currently available for local production comes from fabric characterisation analyses and a repertoire of forms that are only found on the islands (Anastasi 2019).
[30] Anastasi 2018, table 1. The discovery of a 7th century BC shipwreck off the south-west coast of Gozo has revealed a cargo of Maltese amphorae alongside North Tunisian amphorae and Pantellerian millstones. The sources of the cargo are supported by petrographic analyses (see the latest results of the underwater survey from the Project's website <http://www.lsis.org/groplan/article/art_Xlendi.html>. The petrographic results will be published shortly).
[31] Cruz 2011, 120.
[32] Anastasi 2018, fig. 38.
[33] For an overview of the amphorae retrieved in the 1960s, see Azzopardi 2013. This project was carried out as part of a survey of Maltese territorial waters in 2007, directed by Timmy Gambin and his team from the Aurora Trust, and in collaboration with the Superintendence of Cultural Heritage, Malta.
[34] This identification process is part of a larger project being planned to explore and document this underwater site. This project is being directed by Timmy Gambin, from the Department of Classics and Archaeology of the University of Malta.
[35] Azzopardi 2006, 46.

Image Credits

Fig. 1 and 5: by the author. – Fig. 2: site plan digitised by D. Nigro; the final plan was put together by M. Anastasi; Vella et al. 2017, fig. 2. – Fig. 3 and 6: University of Malta. – Fig. 4: Google Earth.

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B. Production and the Trade of Amphorae: Some New Data from Italy

On Land and Sea. Production and Trade of Wine from Campania (3rd BC – 1st AD): Some New Archaeological and Archeometric Data about Amphorae

Gloria Olcese

The *Immensa Aequora* Project: Aims

This contribution looks at certain aspects of the production and trade of wine-bearing amphorae from Campania in the Hellenistic and Roman periods.[1] These aspects were studied as part of the *Immensa Aequora* Project (www.immensaaequora.org), which consists of a series of interconnected sub-projects; their purpose is to study the production centres and the distribution of ceramics made in south-central Tyrrhenian Italy between the 4th century BC and the 1st century AD, using archaeological, epigraphic and archaeometric methods.[2]

Due to the scope of the research and the inherent difficulty in summarizing many different data sets, this paper offers a preliminary and limited synthesis of the amphorae considered here, without an exhaustive review of the numerous data points and the research carried out previously by other authors. Moreover, for details and, above all, laboratory data, this contribution refers to forthcoming and existing publications, which are cited here.[3]

Campania: Ongoing Research on Production Centres, Amphorae and Wine

The map in fig. 1 highlights some of the principal sites of ceramic production in Campania. It is certainly incomplete, and in particular lacks a full picture of the amphora production centres, which are indicated in red; the ongoing project has only looked at some of these.

The area that stretches from Mondragone and Capua, down to the Gulf of Naples is where forms of agricultural development emerged very early on that led to the systematic production of wine.[4] While Rome turned her path of conquest southward, already in the 3rd century BC the products from the Gulf of Naples and Campania were making their way to the markets of the southern and even northern Tyrrhenian region.[5]

The areas chosen for the project were all important centres of wine production, in some cases since the period of Greek colonisation. Wine, together with ceramics, plays a central role in our research, thanks also to the study of systems of production such as the rock-cut units, widely attested in Campania and the Mediterranean, which are important indicators of wine production.[6] A recent line of research is also concerned with the analysis of amphorae and rock-cut units using the GC-MS method.[7] By verifying the substances contained within them, alongside laboratory tests to determine the origin of the container on a consistent number of amphorae from multiple shipwrecks, we

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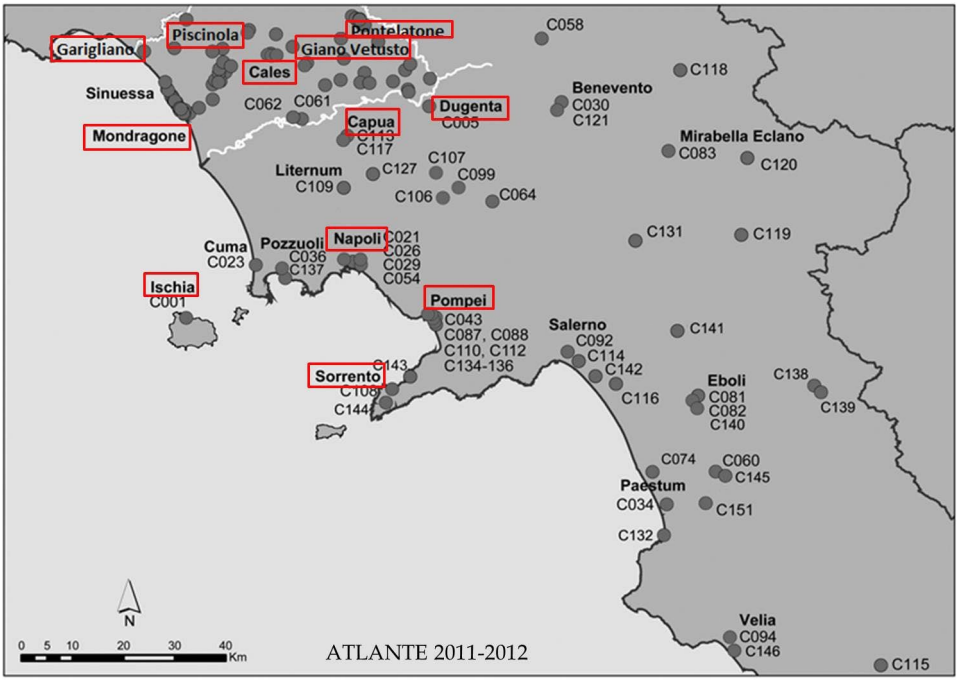


Fig. 1: Map of the ceramic production sites in Campania (indicated in red the amphora workshops) (Atlante 2011–2012, 256 Carta 3).

are able to reconstruct the trade networks between centres of production and sites of consumption more completely.

In this paper, we will only briefly present some data related to certain contexts in three key areas: *Ischia and the Gulf of Naples, Northern Campania,* and *the area of Mt. Vesuvius,* limited to some stamped amphorae traditionally attributed to Pompeii. Additionally, the aim is to summarize several preliminary results, including those from the laboratory, on the distribution of amphorae from these areas.

Ischia / Gulf of Naples: Production and Circulation of Graeco-Italic Amphorae and Wine (3rd century BC)

Beneath the modern Basilica of Santa Restituta in Lacco Ameno (Ischia),[8] only a short distance from the sea, seven kilns have been discovered (from mid-late 8th to 3rd–2nd century BC). The best documented phase coincides with the Hellenistic period, when the kilns produced Graeco-Italic amphorae (types van der Mersch III, IV, V, V/VI, and possibly VI) many of which were stamped.

Among the Graeco-Roman amphorae found at Ischia, at least two chemical groups have been identified, and four mineralogical groups that have already been described and published; these groups are in part local, and in part imported from other centres on the Gulf of Naples, perhaps Naples herself.[9] Ancient Graeco-Italic amphorae from Ischia and Naples are important indicators of the economic and commercial conditions

between the end of the 4th and the beginning of the 3rd century BC, in which Rome turned its attention towards the South and extended its influence to *Neapolis* and the Gulf of Naples, acting as a stabilizing force in the Tyrrhenian Sea. During this period, the area, taking advantage of the alliance with Rome following the *Foedus Aequum* of 326 BC, saw its foreign trade relations expand remarkably, a fact evidenced also by coinage and by an increase in activity at the Neapolitan mint.[10]

The exportation of wine from the Gulf, and more generally from Campania, and the need to normalise/standardise the container that it was packaged in, can perhaps explain the appearance of new types of containers – the Graeco-Italic amphorae – and the stamping in Greek adopted in this area between the end of the 4th and beginning of the 3rd centuries BC. The epigraphic stamps on the Ischia amphorae are of great interest, since they inform us about the organisation of production and the economic and social realities on the island during the Hellenistic period. More than three hundred stamps have been identified that bear Greek and Oscan names, written in Greek.[11] The situation is in some ways analogous to that found in the Aegean area from the end of the 4th century BC when new forms of amphorae similar to the Graeco-Italic ones also appeared ("mushroom rims") and on which the stamps sometimes use the same iconography or names that appears on coins.[12]

Occasionally, the names on the amphora stamps of Ischia are the same as those found on bricks, sometimes preceded by the abbreviation *ΔH* (*demosios o demosia*);[13] open letters and monograms in some cases seem to correspond to those that appear on coins from Naples between the end of the 4th and beginning of the 3rd centuries BC, and involved the same figures, perhaps public ones: further research is needed.

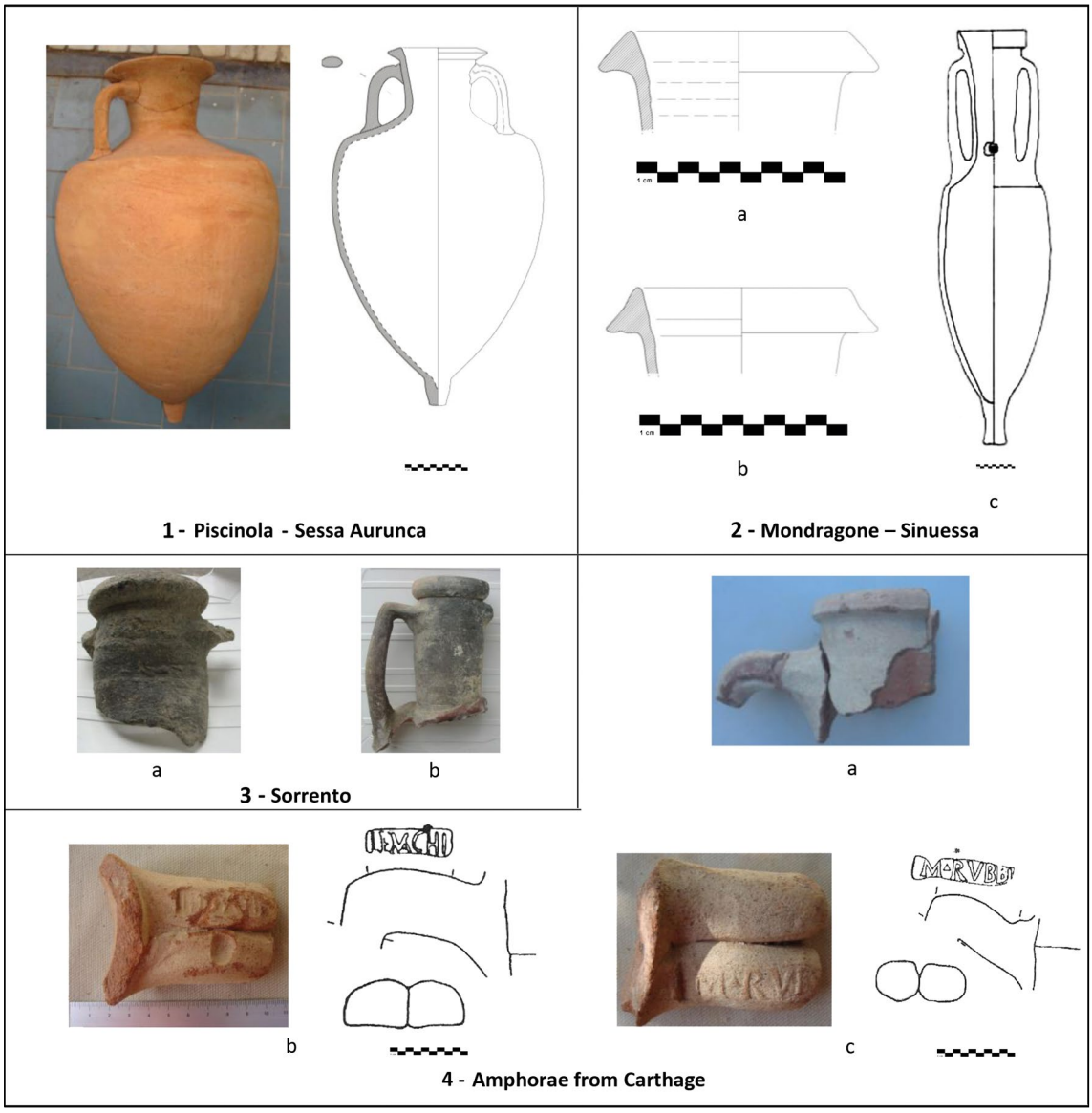
The data from Ischia has recently been integrated with that related to Graeco-Italic amphorae from Naples, which are in some cases similar or identical, thus possibly of local production,[14] which seems to confirm the hypothesis already used for Ischian material: that of a "system" of production in the Gulf of Naples, which was regulated by the Roman state.[15]

The production of Dressel (from now on "Dr.") 1 and Dr. 2–4 amphorae, both at Naples and in the Gulf, requires further study. These types have been recognized by their fabrics at various consumption sites around the Mediterranean and beyond, but their compositions have not yet been characterised in the areas of production.

Sorrento

Sorrento is known from literary sources for its production of *Surrentinum* wine, which was stored in amphorae, and of fine pottery also produced in the city.[16] The distribution of Sorrentine production centres is largely unrecorded. However, one of these, during the Roman period, was located south of the Forum (1st century BC). Remains of a large kiln and dumps filled with numerous fragments of Dr. 2–4 amphorae were found near Villa Fiorentino and in Corso Italia (tab. 1.3).[17]

Amphorae from Sorrento can be distinguished by their fabric and in the laboratory. Mineralogically they are compatible with the local geology; the three



Tab. 1: Amphorae from production/consumption sites studied within the *Immensa Aequora* Project: 1) Piscinola – Sessa Aurunca area; 2) Mondragone – Sinuessa workshops; 3) Sorrento workshop; 4) amphorae from Carthage (Rakob excavations).

most important contents are volcanic rocks, clinopyroxene and feldspars (sanidine and plagioclase).[18]

Area around Mt. Vesuvius: Dr. 2–4 Amphorae with and without Stamps

Another area well-known for producing amphorae that travelled widely is that around Mt. Vesuvius, where the cultivation of grapes and wine production has been attested since the 9th century BC.[19]

Fig. 2: Map of the distribution of the Dr. 2–4 amphorae stamped by *L. Eumachius*.

The production of Dr. 1, Dr. 2–4 and, most likely, of Graeco-Italic amphorae is generally attributed to the area around Mt. Vesuvius, though workshops where they were produced have not been found. The fabric of these amphorae, which were widely traded, has been called "*Black sand fabric*"[20] from its characteristic aspect of being dark red with numerous volcanic inclusions.

This fabric also appears in the francophone bibliography as "*à pate rouge et minéraux noirs*" or "*Eumachi*", since it is a characteristic of amphorae stamped with *Eumachi* (L.EVMACHI, pointing to *L. Eumachius*, Augustan-era producer of amphorae as well as father of *Eumachia*, the public priestess of Venus, who built a public building in the Forum of Pompeii).[21] The amphorae have been attributed to Pompeii/the area around Mt. Vesuvius,[22] also because of the abundance of attested bricks in the area with the stamp L.EVMACHI EROT(IS),[23] and because it is a fabric known in other amphorae (for example Dr. 1) and is broadly compatible with the geological characteristics of the Somma-Vesuvius area.[24]

The distribution of the amphorae with the stamp L.EVMACHI (fig. 2) concerns numerous sites in the Mediterranean and some shipwrecks, including the Grand Ribaud D,[25] from the end of the 1st century BC.

In addition to a few examples of Dr. 2–4 unstamped amphorae from the urban area of Pompeii, some amphorae from Carthage have also been sampled within our project among the materials from excavations carried out by F. Rakob and M. Vegas: a Dr. 1 with a *titulus pictus* and two Dr. 2–4, stamped EVMACHI and L.EVMACHI[26] (tab. 1.4b).

Another example of Dr. 2–4 from the same context in Carthage, subjected to mineralogical analysis, is stamped with the mark M.RVBBI/M.RVB BL – ?– (tab. 1.4c):[27] the final part of the stamp is not very legible and refers to a *M. Rubellius Blandus*, of the *Rubelli* family, according to Martin-Kilcher.[28] The amphora from Carthage with this stamp, documented at Alesia and on the Grand Ribaud D[29], has a comparable mineralogical composition and probably the origin as the amphorae stamped *L.Eumachi* from the same context. Another unmarked Dr. 2–4 amphora from Pompeii, subjected to mineralogical analyses, also belongs to this group.[30]

The amphorae from Carthage and the one from Pompeii have a similar composition, whose characteristics fully correspond to the definition of *Black sand* in the bibliography: elongated pores, orientated parallel to the external surface, and several, almost-exclusively volcanic inclusions, particularly volcanic rocks, which represent around the 30–35% of the inclusions.[31]

Another unstamped example of Dr. 2–4 has a different composition (tab. 1.4a). Further laboratory investigation could clarify if the Dr. 2–4 amphorae that do not fall into the mineralogical *Black sand/Eumachi* belong to the chemical group known as "*Eumachoid B*", noted in the bibliography and frequently attested in Gaul, whose origin is unknown, but could not be Pompeii. The amphorae from this group, found at different sites around Gaul,[32] are only distinguishable from the *Black sand/Eumachi* group thanks to chemical analyses: in fact, they have lower K_2O values and higher CaO.

Northern Campania (Province of Caserta)

Northern Campania (in particular, the *ager Falernus*), a subject of research as part of the *Immensa Aequora* Project, is an important area for wine production; over the course of the centuries, the region produced various types of amphorae, including Graeco-Italic, Dr. 1 and 2–4, and even later.[33] The characteristics of the fabrics of the types produced in this area are not well known. Often, they have not even been characterised in the lab, except for some cases noted in the bibliography, such as the case of Mondragone, which is discussed below.

Piscinola – Sessa Aurunca

Archaeological investigations carried out in the territory of Sessa Aurunca, along the strip between the base of the Roccamonfina massif and the Garigliano, led to the discovery of a necropolis at Piscinola. 59 tombs have been found (dating to between the 5th century and the late 4th century BC).[34]

The materials include a Graeco-Italic wine amphora, similar to type van der Mersch IV (end of the 4th century BC) (tab. 1.1), grouped with black figured or glazed drinking vessels. Mineralogical analyses conducted on a sample of Graeco-Italic amphorae in this context display a composition that is compatible with local geology.[35] Graeco-Italic amphorae type IV and V, similar but distinct from the Gulf amphorae because of their different fabrics, have also been documented in the area around *Cales* and Capua.[36]

Mondragone

The area of Mondragone has been the focus of excavations and surface surveys over the years, which have contributed to identifying structures in some areas, and concentrations of ceramic materials in others, often related to manufacturing activities.[37] In this area, Graeco-Italic and Dr. 1 amphorae have been found, which, on the basis of laboratory data, could have been exported during the Late Republican period to Gaul and Switzerland, where the first chemical (XRF) and mineralogical analyses were carried out.[38]

Different clays were used in the manufacturing of Graeco-Italic and Dr. 1 amphorae from Mondragone. These clays are distinguishable by different amounts of CaO and, in general, by a high proportion of sanidine, glass and volcanic rock fragments;[39] three principal petrographic groups are known: the first two contain almost exclusively Graeco-Italic amphorae (including some wasters) (tab. 1.2a–b), and a few Dr. 1 (tab. 1.2c). The third group, on the other hand, includes only amphorae Dr. 1 B, of which a few are stamped (with the stamp HI).

The amphorae that have been studied in our project have a petrographic composition compatible with the geological formations that populate the area of Mondragone itself.[40]

Rocca d'Evandro

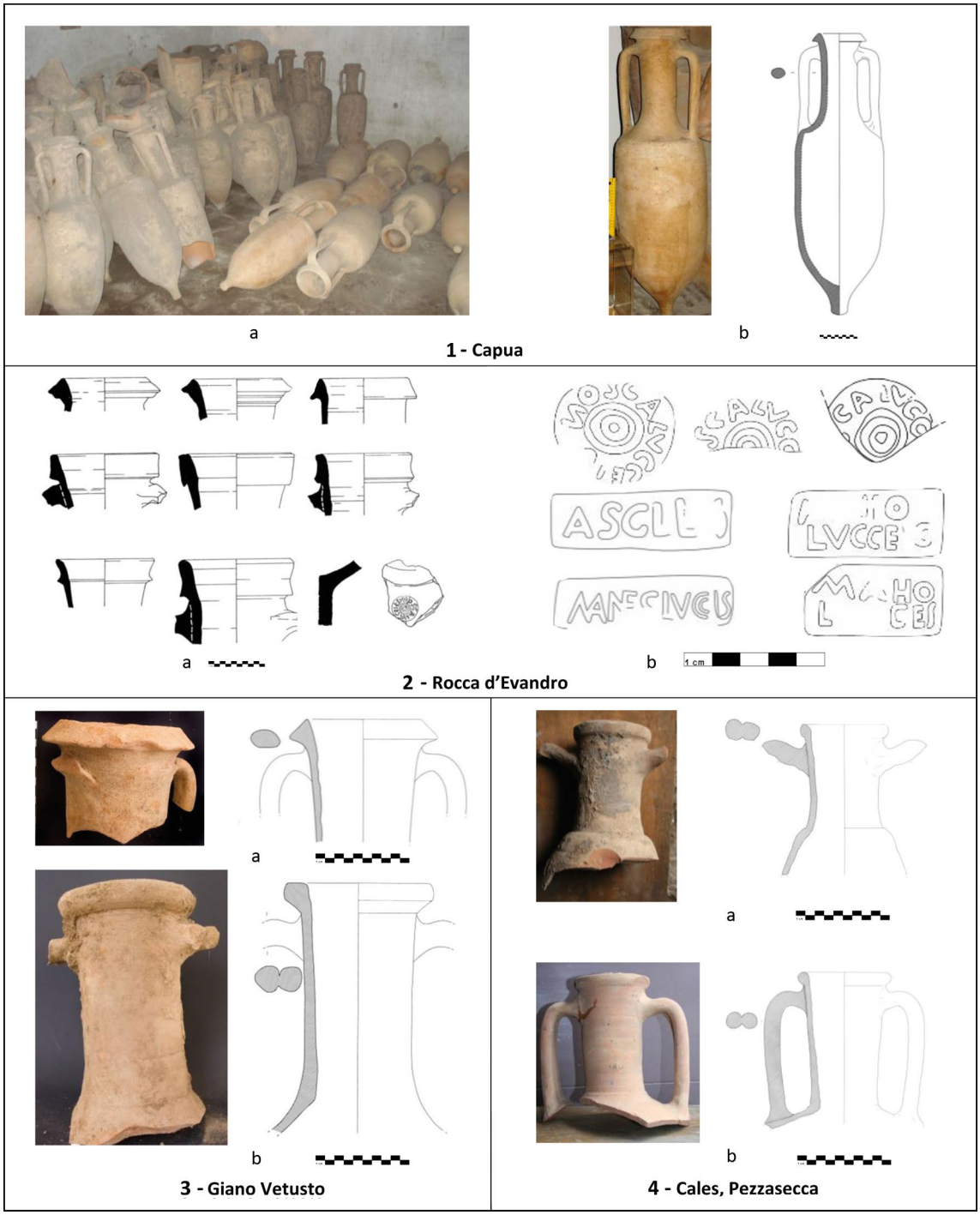
Studies on the Rocca d'Evandro site, situated on the edge of the Liri Valley, have allowed us to identify a concentration of archaeological materials on the surface, related to four furnaces, and other evidence pertinent to the production of Graeco-italic amphorae, Dr. 1 A, B and Dr. 2–4 (between the 2nd century BC and the start of the 1st century AD), which would have been used to hold Falernian wine and were possibly traded through the port of Minturno.

The site has been interpreted as a settlement held by the *gens Luccei*, whose name is present on the stamps of amphorae recovered here.[41] The stamps on Dr. 1 amphorae are MOSCA LVCCEI [S?] (circular stamp), ANTIOC/ANTIOCVS LVCCEI, ASCL [LS?], MAHO LVCCE[I] S, MANES LVCCIS, MELII LVC (rectangular stamps) (tab. 2.2), often with an abbreviated S (*servus*) at the end. The amphorae analysed within the *Immensa Aequora* Project are Dressel 1 B.[42]

Cales Pezzasecca

Cales, a Latin colony (334 BC), is primarily associated with the production of black glaze pottery, which was widely exported even beyond the Italian peninsula.[43] The excavations carried out on the site of ancient *Cales* have yielded traces of pottery workshops, dating from the Hellenistic period to Late Antiquity.

A project to study ceramic production at *Cales* has been underway for several years, in collaboration with the relevant Superintendency. The project also looks at the production site on the edge of Via Casilina, at the Pezzasecca site, surveyed by J.-P. Morel, bringing to light structural elements, kiln dumps and rejected pieces.[44]



Tab. 2 : Amphorae from production sites in the province of Caserta studied within the *Immensa Aequora* Project: 1) Capua workshops; 2) Rocca d'Evandro workshops; 3) Giano Vetusto workshops; 4) *Cales*,Pezzasecca workshop.

The workshop, active from the end of the Republican to the early Imperial periods, also produced Dr. 2–4 amphorae of a type already found in other Campanian centres (tab. 2.4); their fabric, a calcareous one rich in crypto-crystalline calcite, has a composition pertinent to the local geology of the Roccamonfina Volcanic system.[45]

Giano Vetusto

The site,[46] close to *Cales*, is probably linked to a large rural villa, and includes a craft production centre (dated from the second half of the second century BC to the third century AD). During the second half of the first century BC a kiln was constructed for the production of Dr. 2–4 amphorae: some fragments show a stamp on the neck that bears a *cognomen* of servile condition, the genitive CRESCENTIS, likely the slave who was in charge of the pottery workshop.

On the basis of the mineralogical analyses, all samples of Dr. 2–4 amphorae (tab. 2.3b) studied as part of the project are compatible with the local geology of Giano Vetusto and are different from those at other centres of production of Dr. 2–4 studied as part of the project.

Capua

We know from ancient sources that Capua produced high quality wine, called *Anadendrite*.[47]

No workshops producing amphorae have been found in the area. In the depot of Porta Roma, a homogenous group of about 150 Dr. 1 amphorae was discovered, apparently without any stamps and mostly in good condition (tab. 2.1).

The shape of the amphora is similar to the type defined as Dr. 1 G, which combined the rim of the Graeco-Italic amphora and the body of the Dr. 1, identified in contexts from Gaul, and which circulated between the second half of the 2nd century BC and the beginning of the first, as some shipwrecks attest, such as S. Tropez and Cap Roux.[48]

Even though the find context is probably not that of a production site, the mineralogical analysis performed suggests that their composition is compatible with the geology of Capua.[49]

The Trade of Campanian Wine: Some Data from Cargoes of Shipwrecks and from Consumption Sites

The trade in ceramics and amphorae from different centres in Central South Italy and, particularly in Campania, is the focus of a new phase of the *Immensa Aequora* Project,[50] which is still on-going; it concerns the comparative and multidisciplinary study of cargoes from 32 shipwrecks of Italian origin (3rd century BC–1st century AD) found in the western Mediterranean, by over 140 mineralogical analyses on Graeco-Italic, Dr. 1 and Dr. 2–4 amphorae (fig. 3).

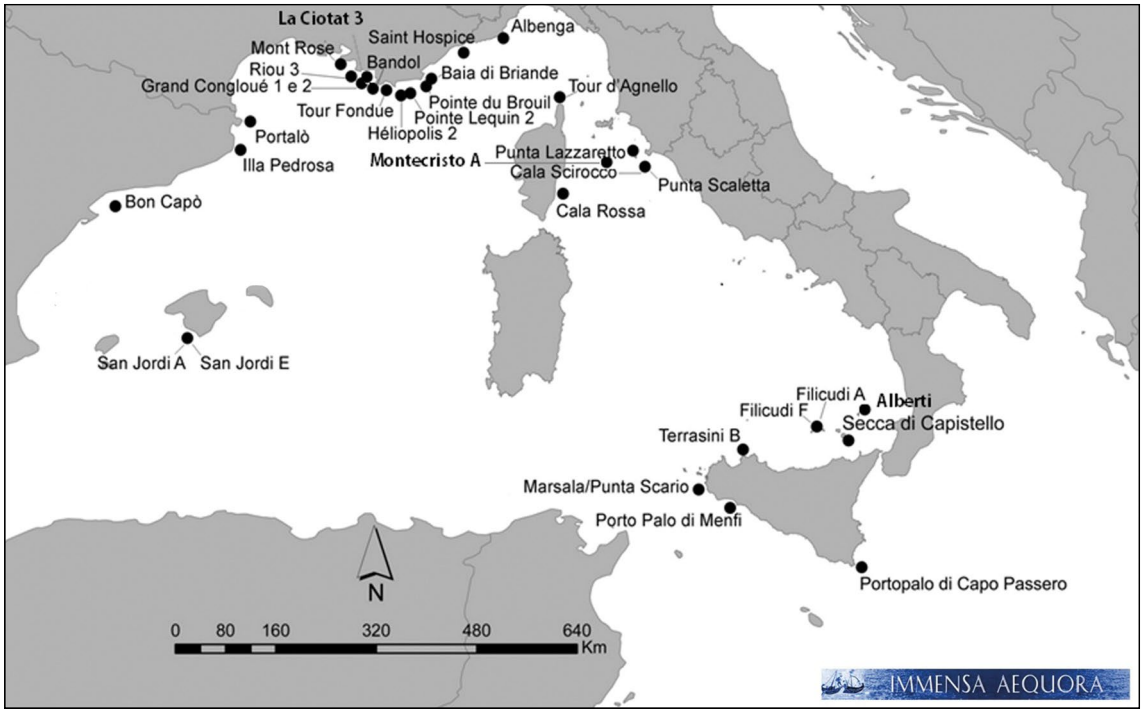


Fig. 3: Map of the sampled shipwrecks with amphorae of Tyrrhenian origin (Olcese 2020, 159 fig. 2).

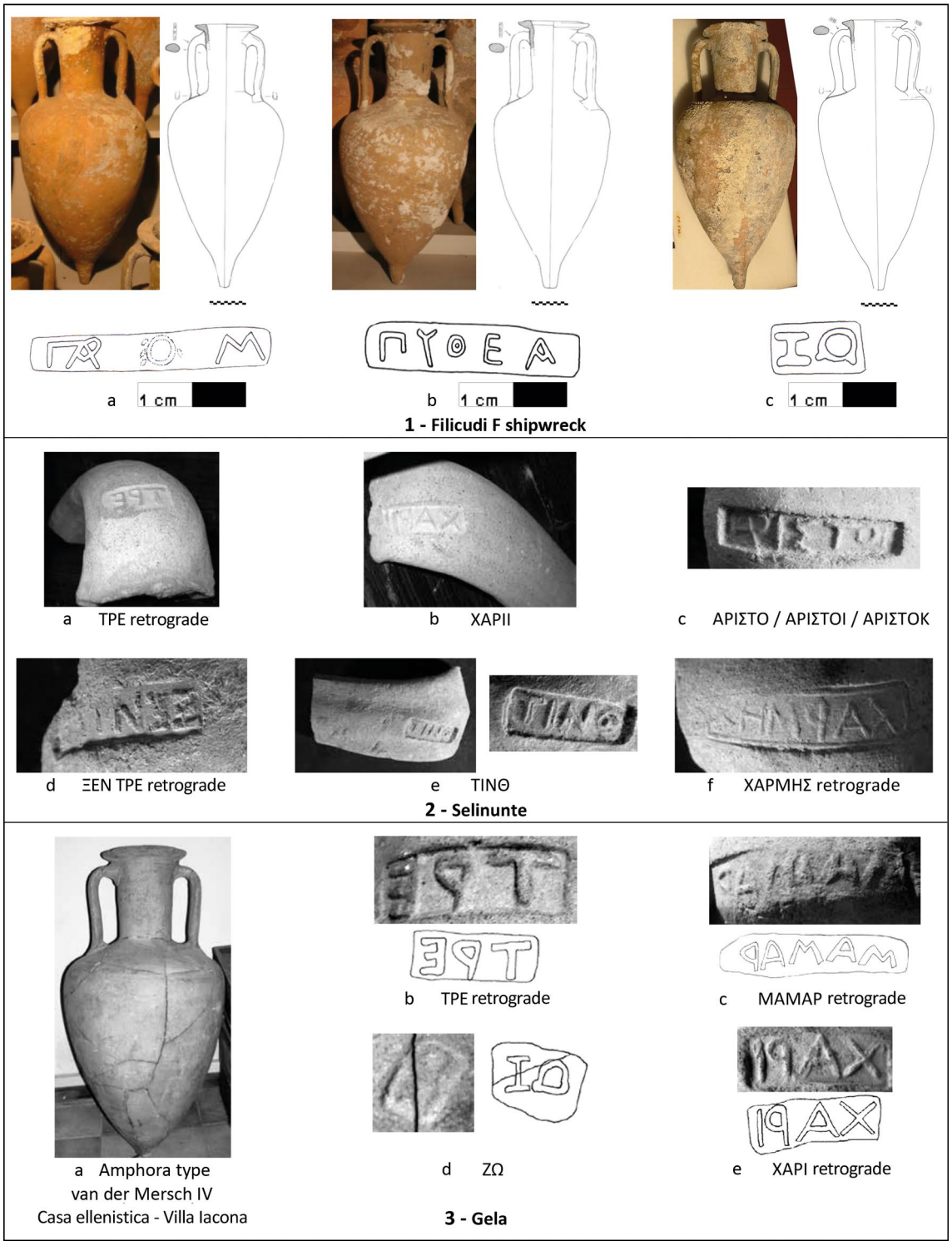
Mineralogical analyses of the amphorae from the shipwrecks and sites of consumption revealed the existence of groups and subgroups, in addition to a series of samples that could not be attributed to the principal identified groups. Mineralogical data, compared with those obtained from production centres in the course of the project, support the connection between the amphorae and their possible sites of origin.[51]

Even with the necessary caution, Campania's predominant role in the production of containers that were widely traded, and therefore also the foods contained within them, has been confirmed over the course of the centuries.

Wine and Graeco-Italic Amphorae from the Gulf of Naples in Sicily (and elsewhere) in the 3rd century BC

The first half of the 3rd century BC saw trade in products from Ischia/Gulf of Naples (and perhaps from some sites in northern Campania), from which come types van der Mersch IV and V amphorae stamped in Greek, recovered from the cargo of the Filicudi F wreck (tab. 3.1), from Secca di Capistello wreck and from some sites in Sicily.[52] GC-MS analysis was used for the first time to identify their contents that consists of red wine.[53]

Stamps known on Graeco-Italic amphorae from Ischia/Gulf of Naples were identified among materials found at Palermo, Selinunte and various centres in south-central Sicily, including Monte Adranone, Caltabellotta, Selinunte (tab. 3.2), Gela (tab. 3.3) and



Tab. 3: Amphorae and stamps from a shipwreck and production sites studied within the *Immensa Aequora* Project: 1) Filicudi F shipwreck; 2) Selinunte; 3) Gela.

Licata,[54] between the end of the 4th and the 3rd centuries BC (tab. 4.4), although the extent of the phenomenon is not known.

In the most ancient phase of distribution of ceramics/amphorae from the Gulf of Naples, it seems that the route that led to Sicily, and perhaps also North Africa, went through Capo Lilibeo.

In light of data from material culture, the third Romano-Carthaginian treaty (306 BC) can perhaps be better understood.[55] Sicilian markets were closed to Rome, and there was a desire to limit the distribution of products – perhaps even those from the Gulf of Naples and from Campania – in general by businessmen who were pushing for an invasion of the markets controlled by Carthage.

Some amphorae from 3rd century BC shipwrecks (i.e. the Tour Fondue and Bon Capò wrecks),[56] and from more recent shipwrecks, of the middle and second half of the 2nd century BC, can also be ascribed to the Gulf of Naples. Trade in Campanian products in the most ancient phases included, as is known, also other types of ceramics, such as black glaze pottery of the 3rd century BC, and has been confirmed by the chemical analyses carried out by M. Picon on the black glaze pottery from Olbia de Provence.[57]

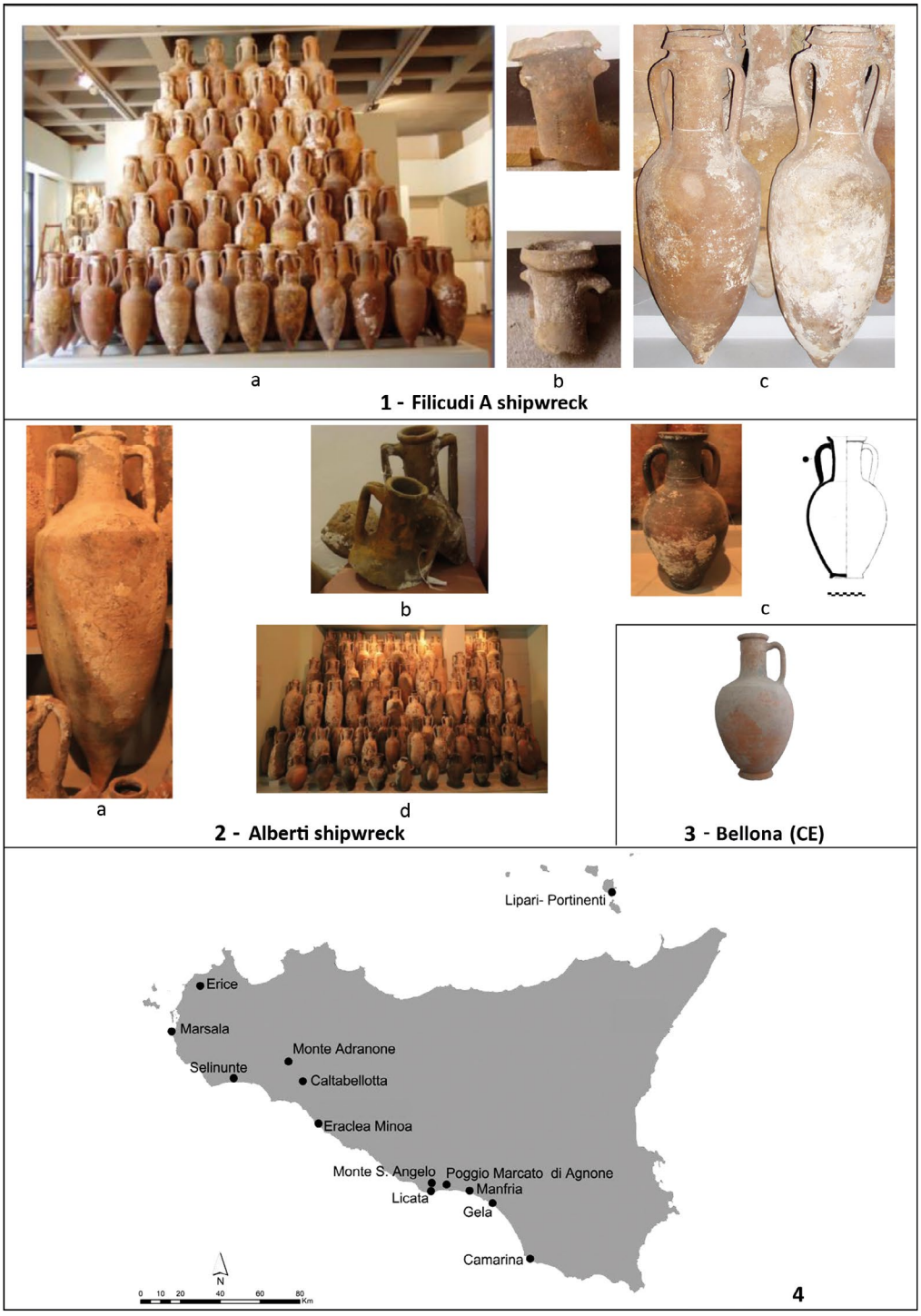
The Increase in the Distribution of Campanian Wine: 2nd and 1st centuries BC

In the 2nd century, within the sample-set of the shipwrecks under consideration, some cargoes have been found to consist of amphorae whose mineralogical compositions are close to those of ceramics produced in the area of Vesuvius, such as in the case of many of the transport amphorae from the Filicudi A (tab. 4.1).[58] In other cases, the compositions of the amphorae are similar to those of ceramics produced in the coastal zone between Mondragone and Sinuessa, or inland northern Campania.

Although amphorae with *Black sand fabrics* have been easily identified even before by their characteristic aspects, the amphorae from northern Campania and the area of Mondragone, connected to well-known wines such as Falernian, nevertheless until recently have only rarely been identified at sites of consumption, unless mineralogical analyses have been carried out. Thanks to the mineralogical study of the amphorae found in Gallic sites of the 2nd and 1st centuries BC on the Rhine valley, in the area of Basilea,[59] a greater percentage of amphorae is attributed to the area of Mondragone (about 20%), alongside containers from other, unidentified sites along the Tyrrhenian coast. Archaeological contexts at Lyon, dated to between 160 and 140 BC, reveal the presence of amphorae from the region of Mondragone at a similar percentage.[60] On the other hand, the situation is different at some sites in the south of France, such as Aix and Martigues, where the *Black sand* amphorae account for almost 40%.[61]

A subdivision of the market and areas of preferred contact is beginning to take shape and should be studied in detail.

The intensification of viticulture and the production of wine in northern Campania in the 2nd century, where vine cultivation began early, has been documented by a high



Tab. 4: Amphorae from shipwrecks and production sites studied within the *Immensa Aequora* Project: 1) Filicudi A shipwreck; 2) Alberti shipwreck; 3) Dr. 2–4 from Bellona; 4) map of the Graeco-Italic amphorae from the Gulf of Naples found in Sicily and analysed in laboratory.

density of amphorae workshops,[62] which is probably connected to the creation of plantations that was allowed by the division of the *ager publicus* by a programme of military and economic control of the southern part of the Tyrrhenian coast, and by the foundation of the colonies of 194 BC (such as *Volturnum* and *Liternum*).[63]

In the 1st century AD, which has only been marginally considered in our project, the presence of Campanian amphorae (perhaps northern) is attested on the basis of mineralogical analyses on some shipwrecks such as the *Alberti shipwreck*, dated to the middle of the 1st century AD, recovered at Panarea (Aeolian Islands), currently under revision.[64] On this shipwreck, in addition to Dr. 2–4 amphorae (tab. 4.2a–b), Cretan amphorae type 4 were found. Also on part of the wreck there were numerous two-handled *amphorettes* (*lagynoi*) with flat bottoms (tab. 4.2c). These containers, which are also documented at Pompeii and *Camolodunum* and on the *limes* of the Rhine (Hofheim and Vindonissa), and in forts in the desert of eastern Egypt, were possibly used to contain and export wine of quality originating from inland Campania, as has been proposed recently.[65]

Archaeometric studies are underway on examples from the Alberti wreck, but it is still interesting to presuppose that similar *lagynoi,* although up to now with only one handle, have been found during our studies between *Cales* and Capua (for example at Bellona, in the modern province of Caserta – tab. 4.3), an area in which it is possible that they were produced.[66]

Notes

[1] Olcese 2007, 2015, 2017a, 2017b and 2020; Olcese et al. 1996, 2013a and 2013b, to whom reference is made for the previous bibliography. The new phase of the *Immensa Aequora* Project has as its goal the publication of the volume *Atlas* – Roman Ceramic Production Sites and Shipwrecks of Tyrrhenian Italy: Fabrics and Mineralogical Analyses. *Immensa Aequora* Fabrics Atlas (in preparation), comprising the analyses carried out on the ceramics of the production sites and wrecks. Thanks to D.M. Surace, collaborator of the project, for the editorial revision and the creation of the tables.

[2] For the purposes of the project and the first results, *Immensa Aequora Workshop* 2013. The archaeometric methods used for the ceramics from the production sites are chemical (XRF) and mineralogical ones; only mineralogical for the ceramics from underwater contexts, to avoid problems due to alterations. For the chemical analyses the collaborations of M. Picon (†) first, and of V. Thirion-Merle in a successive phase, were fundamental. For the mineralogical part, the main contribution was that of I. Iliopoulos and, for many shipwrecks, of C. Capelli.

[3] For the objectives underlying the creation of the ceramics database see Olcese – Picon 2002 and Olcese 2013a.

[4] On these issues see, by way of example, Tchernia 1986 and 2011; Arthur 1982, 1991 and 1995; Crimaco 2009; Brun 2011.

[5] For the data already published, Olcese 2010, 2015, 2017b and 2020.

[6] Brun 2011; Olcese – Soranna 2013; Olcese et al. 2015 and 2017, as well as the additional contribution presented in this same session, AIAC 2018.
[7] Garnier – Olcese forthcoming.
[8] Olcese 2004, 2010, 2015 and 2017a; Olcese et al. 1996.
[9] Olcese 2010; Pugliese 2014.
[10] Olcese 2010, 76 f. and 293, with previous bibliography; Olcese 2017b. On the social and economic history of the territory of Naples, Lepore 1952, on its coinage, Cantilena et al. 1986.
[11] Olcese 2010, 2017a and 2019.
[12] Finkielsztejn 2006; Lawall 2011.
[13] Olcese 2010, 73–76.
[14] Pugliese 2014.
[15] Olcese 2010, cap. IX; Olcese 2015; 2017b, 305–309.
[16] Tchernia 1986, 344–347; Atlante 2011–2012, 369, with previous bibliography.
[17] For the sources Tchernia 1986 [edition 2016], 334 f. and 344–347. For a summary on the Sorrento kilns, Atlante 2011-2012, 369-370; for the first archaeometrical data on the Dr. 2–4 of Sorrento, Olcese et al. 2013a, 55 f.
[18] Iliopoulos in Olcese et al. 2013a, 55 f.
[19] At Poggiomarino, Longola (Na), for example, Cicirelli et al. 2008; for the "*pompeianum*" vine, Pliny, HN XIV, 38; for Pompeii, Toniolo – Pecci in this volume.
[20] For example, Peacock 1977.
[21] Tchernia – Zevi 1972; Panella – Fano 1977; Tchernia 1986; Hesnard et al. 1988; Zevi 1995; Freed 2000; Williams – Peacock 2005; Peña – McCallum 2009b; Iavarone 2012–2013; Iavarone – Olcese 2013. For the *gens Eumachia*, Castrén 1975, 165; Zevi 1995; lastly Nonnis 2015, 199, with previous bibliography. The "*Eumachi* type" definition has recently been questioned, especially when used for containers prior to the Augustan era, but also because this fabric appears to be attested in other production areas too (Martin-Kilcher et al. 2013, 392 f.); for this reason it is called "*Black sand (A and B) fabrics*".
[22] Tchernia – Zevi 1972, 40.
[23] CIL X, 8042, 48; Steinby 1979, 268; De Caro 1994, 84.
[24] Peacock - Williams 1986, 86–88; Hesnard et al. 1989, 29 and 38.
[25] For the distribution of the stamps on amphorae and bricks, van der Werff 1989, Appendix II and Iavarone – Olcese 2013, 222–224; for the shipwreck Grand Ribaud D, Hesnard et al. 1988, tav. XXII. For Ephesus, Bezeczky 2010, 86. A review of the Dr. 2–4 from Pompeii is currently underway within the *Immensa Aequora* Project (in collaboration with S. Iavarone and A. Razza).
[26] For the excavation, Karthago I (1991). The amphorae, sampled within the *Immensa Aequora* Project in collaboration with the DAI of Rome (Dr. P. von Rummel) and Dr. M. Vegas (excavation of Dr. F. Rakob), have the inventory numbers K79/277 and K90/75 (Martin-Kilcher 1993). Delattre already pointed out the recurrence of more than 40 L.EVMACHI stamps, with variants (Delattre 1894, 113).
[27] M.RVBB, inv.n. K79/108 (inventary project, CAR15), Martin-Kilcher 1993, 313, no. 101.
[28] A graffito from Pompeii names a *Rubellius Blandus* as *consul suffectus* of the year 17/18 AD (CIL IV, 1552).
[29] For Alesia, Callender 1965, 191, no. 1172; for the Grand Ribaud D shipwreck, Hesnard et al. 1988, tav. 22.

[30] Iavarone – Olcese 2013; Iavarone 2014. The Dr. 2–4 come from Forum Granaries and the garden of Domus IX.

[31] I. Iliopoulos did the reading of the sections, in *Atlas*. The amphorae stamped with EVMACHI are distinguished by rather high chemical values of MgO and FeO, of K_2O e Al_2O_3 (see also Thierrin-Michael 1992, 70–72).

[32] Hesnard et al. 1989, 41 and following; Thierrin-Michael 2007, 123 f.

[33] Arthur 1982, 1987 and 1991; Hesnard et al. 1989; De Caro – Miele 2001. For centres of ceramic production in northern Campania, cf. Atlante 2011–2012. Studies have been underway for a few years at *Cales* and Capua (Olcese et al. 2013a), in collaboration with the relevant Superintency (see *infra*).

[34] For materials sampled as part of the project on Graeco-Italic amphorae (Olcese 2010, 36 f., 42, 277 f.) see Arthur 1991; De Filippis et al. 2013.

[35] For analysis of the Graeco-Italic amphorae, see Iliopoulos in Olcese 2010, 277 f.

[36] Data from on-going studies at contexts in *Cales* and Capua.

[37] For archaeological data on contexts in Mondragone, see Atlante 2011–2012, 306–323, with previous bibliography.

[38] The Graeco-Italic amphorae include multiple fabrics, from the fine variety with small white granules (carbonates) up to the coarse one rich in sanidines and volcanic rocks (Hesnard et al. 1989; Thierrin-Michael 1992, 63–66, and 2007, 123 f.; Thierrin-Michael – Picon 1994).

[39] Iliopoulos in *Atlas*.

[40] Iliopoulos in *Atlas*. This production is not very distinctive from the chemical point of view, because it is similar to reference groups of amphorae from different sites of production, such as Fondi and Cosa; distinguishing parameters are the two chemical elements K_2O and Fe_2O (Thierrin-Michael 2007, 123).

[41] Chiosi – Gasperetti 1994; Atlante 2011–2012, 326–328 with bibliography; for the *Luccei* family, Nonnis 2015, 251.

[42] According to I. Iliopoulos (in *Atlas*), near the site of Rocca d'Evandro, there are not many volcanic formations and this explains the presence of terminal grade volcanic minerals, while the fragments of volcanic rock are rare.

[43] De Caro – Miele 2001, 543–545. For the ceramics of *Cales*, Pedroni 2001, with previous bibliography.

[44] Morel 1989; a joint publication of the work is foreseen.

[45] Olcese et al. 2013a; Iliopoulos in *Atlas*. See also Guarino et al. 2011.

[46] Proietti – Crimaco 1991; Crimaco et al. 1994; Atlante 2011–2012, 304 f.; for the analyses, Iliopoulos in *Atlas*.

[47] Athenaeus (I, 31, d) that attributes the information to Polibio (XXXIV, 11.1).

[48] Loughton 2003. For this type (described in bibliography as *Black sand/falso Eumachi*) the production centres are unknown.

[49] Iliopoulos in *Atlas*.

[50] For the work program about shipwrecks, Olcese 2013b and 2020, 158–160; Olcese et al. 2013b; *Per incerta maris* forthcoming. For data regarding other wrecks, Cibecchini – Capelli 2013.

[51] Iliopoulos in *Atlas*.

[52] For the first data regarding the Eolian wrecks, Olcese 2010, 231–248, with previous bibliography.

[53] Garnier – Olcese forthcoming.

[54] Olcese 2010, cap. VIII, 265–276, and 2015, 192.
[55] For the Roman – Carthage treaties, Scardigli 1991. See also Bechtold 2007.
[56] Olcese 2010, chapter VII, with previous bibliography; *Per incerta maris* forthcoming.
[57] Picon 1988: the chemical analysis (XRF) have confirmed that the black glaze ceramics of the middle and second half of the 3rd century BC have the same compositions of those from the Gulf of Naples.
[58] Olcese et al. 2013b, 85–87; Iliopoulos in *Atlas*.
[59] Thierrin-Michael 2007; Martin-Kilcher et al. 2013.
[60] Thierrin-Michael 2007, 125.
[61] Thierrin-Michael 2007, 125, with previous bibliography. For the circulation of Campanian Dr. 2–4 amphorae in the East, Lavall 2006 and Bezeczky 2010; for Arabia and India, Davidde et al. 2004 and Tomber 2012.
[62] See the location cards of the production sites, Atlante 2011–2012, 256.
[63] For the workshops between Mondragone and Sinuessa, Atlante 2011–2012, 255 and following, with previous bibliography; Pagano 1990; Crimaco 1991 and 1993; De Caro – Miele 2001.
[64] In collaboration with the Aeolian Museum Bernabò Brea of Lipari; for the shipwreck, Archeologia Subacquea 1985, 71–74.
[65] Brun 2007 and 2011. Thanks to J-P. Brun for the note about the amphorettes in the eastern desert of Egypt.
[66] The amphorette shown in tab. 4.3, next to those of the Alberti shipwreck, comes from Bellona, between *Cales* and Capua. The hypothesis that these containers were produced locally (and perhaps in other sites of Campania, for example in the Pompeian area), which could soon be verified by on-going laboratory analyses, does not exclude the possibility, but rather reinforces that of J-P. Brun, who maintains that small-scale amphorettes, connected to the export of *aminaia*, were produced in the middle valley of Volturno and at *Alifae*, Brun 2011, 113 f.

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Fig. 1: Atlante 2011–2012, 256 Carta 3. – Fig. 2: *Immensa Aequora* Project. – Fig. 3: Olcese 2020, 159 fig. 2. – Tab. 1.1; 1.2a-b; 1.4; 2.1; 2.2b; 2.3-4; 3.1b; 4.1-3: *Immensa Aequora* Project. – Tab. 1.2c: Atlante 2011–2012, 308 tav. 3.XXI.6. – Tab. 1.3: Atlante 2011–2012, 369 foto 3.29. – Tab. 1.4b-c: stamps drawings by Martin-Kilcher 1993, 313 and 319. – Tab. 2.2a: amphora drawings by Chiosi – Gasperetti 1994. – Tab. 2.4b: drawing by Olcese et al. 2013a, 67. – Tab. 3.1: Olcese 2010, 233 f. – Tab. 3.2: Olcese 2010, 268 fig. VIII.2. – Tab. 3.3: Olcese 2010, 290 f. – Tab. 4.1b: Olcese et al. 2013b, 86 fig. 13. – Tab. 4.2c: drawing by Brun 2011, 120. – Tab. 4.4: Olcese 2015, 193 fig. 16.

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Il ciclo di vita del vino. Casi studio dall'area vesuviana

Luana Toniolo – Alessandra Pecci

La "micro-regione" vesuviana si pone come un fortunato campione di indagine non solo per l'eccezionale stato di conservazione del sito stesso e l'enorme mole di dati offerti, bensì soprattutto per la sua peculiare posizione all'interno della geografia fisica ed economica regionale. Pompei, infatti, era ben inserita all'interno di un articolato sistema di viabilità secondaria che la collegava direttamente ai vicini centri della piana nocerino-sarnese quali Nocera e Nola. Inoltre Pompei poteva usufruire per il collegamento con questi centri anche del ruolo connettivo svolto dal corso del fiume Sarno, come ci informano le fonti.[1] Questi fattori permisero alla città di interagire sia con il suo retroterra produttivo, in quanto le vie fluviali costituivano una sorta di estensione della navigazione a cabotaggio marina[2] all'interno dei territori coltivati dell'area sarnese e Nocerina, sia di inserirsi in un *network* commerciale regionale grazie ai collegamenti con il porto di *Puteoli*.

Con la definizione di 'micro-regione' pompeiana si intende qui l'area strettamente connessa a livello economico a Pompei e che vedeva nella città vesuviana il principale mercato di distribuzione dei prodotti dell'*hinterland* rurale.[3] Stando alle fonti,[4] questo ruolo di redistribuzione era in parte svolto anche dal porto della città vesuviana che può essere interpretato come un vero e proprio '*node of density*'[5] all'interno della rete connettiva micro-regionale.

L'*ager pompeianus*, in particolare, offre cospicue evidenze di una notevole produzione agricola finalizzata principalmente alla viticoltura e da localizzare in diverse zone dell'antico territorio di pertinenza della città. La vite non costituiva sicuramente l'unica cultura praticata nell'area ma senza dubbio i dati archeologici a nostra disposizione sembrano indicare come all'interno del sistema produttivo delle *villae rusticae* la viticoltura abbia svolto un ruolo cardine tra le varie attività agricole.[6] Le numerose scoperte che a partire dall'800[7] si sono susseguite nell'agro vesuviano hanno permesso di identificare sia nell'area collinare a nord[8] vicino all'odierna Boscoreale che nell'area a sud[9] lungo il corso del Sarno oltre che nella zona pianeggiante a est[10] i resti di più di 150 *villae* in cui la presenza di *torcularia* e *cellae* vinarie con *dolia* (fig. 1) per la conservazione del vino sembrano suggerire che la produzione vinaria abbia costituito la principale risorsa economica di queste unità produttive.

Recenti studi condotti sulla capacità produttiva di queste ville[11] ritengono che la produzione annua si aggirasse intorno all'altissima cifra di 131.100 *cullei*, quindi 103 milioni di litri di vino all'anno, corrispondenti a 3,4 milioni di Dressel 2–4. Per capire il peso economico di questa produzione si deve considerare che secondo Catone[12] il consumo annuo procapite doveva essere di circa 250 litri. Se ci si attiene alla stima sulla popolazione di Napoli, Nola e Pompei e del loro *hinterland* la produzione vesuviana di vino non solo era in grado di soddisfare la domanda locale, ma addirittura produceva un *surplus* quattro volte superiore.[13]

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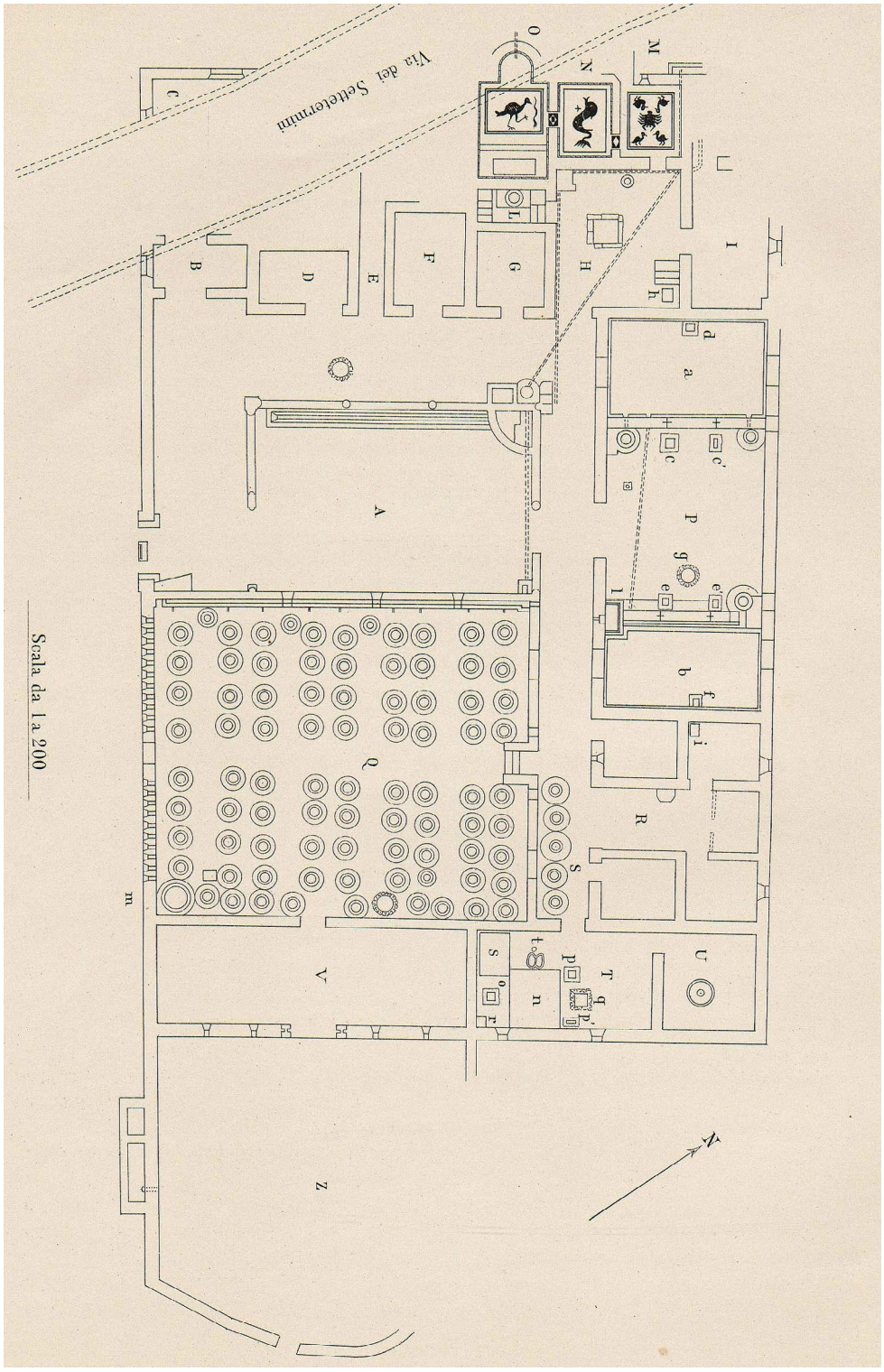

Fig. 1: Pianta della Villa della Pisanella.

Il notevole volume di questa produzione vinaria comportava la necessità di poter disporre di contenitori ceramici utilizzabili non solo per lo stoccaggio del vino ma anche per la sua redistribuzione sia al minuto che su larga scala che si accompagnava alla sua vendita "sfusa" impiegando altri mezzi come il *culleus*[14] (fig. 2). Dovette quindi svilupparsi in parallelo anche un'attività artigianale finalizzata alla produzione di anfore per la commercializzazione di questi prodotti.

I risultati delle analisi dei residui condotti in area vesuviana dagli autori permettono di ottenere informazioni sulle diverse fasi del ciclo di vita del vino nella zona ed in particolare di mostrare esempi della produzione, stoccaggio e trasporto e consumo di vino.

Le analisi dei residui hanno avuto un grande avanzamento negli ultimi trent'anni: sebbene vi siano ancora problemi nell'identificare numerose sostanze e nel controllare la contaminazione, è ormai possibile ottenere dati affidabili sul contenuto delle ceramiche e sui loro rivestimenti organici.[15]

Un risultato importante ottenuto negli ultimi anni nello studio dei residui organici nei materiali archeologici è stato lo sviluppo di metodi adatti ad identificare i residui di vino. Per molto tempo, infatti, la presenza di un rivestimento a base di pece è stato considerato l'indicatore di un contenuto vinario.[16] Le ricerche condotte da McGovern sull'origine del vino, oggi in parte riviste, hanno introdotto una nuova fase nella ricerca, ed hanno aperto la strada allo sviluppo di metodi sempre più precisi per l'identificazione di questa sostanza, i più recenti dei quali possono essere applicati utilizzando la gas cromatografia insieme alla spettrometria di massa.[17] E' necessario sottolineare che, sebbene sia sempre necessario controllare la possibile contaminazione da parte del contesto di giacitura, fino ad ora chi scrive non ha mai riscontrato contaminazione derivata da presenza di acido tartarico nel terreno in nessuno degli esperimenti e studi archeologici condotti negli ultimi quindici anni, pertanto riteniamo questo acido un indicatore affidabile della presenza di succo d'uva, o eventualmente di altri frutti, come il tamarindo, o forse il melograno, nei campioni. Infatti, l'acido tartarico è presente nell'uva e in altri frutti, come il tamarindo.[18] Quindi l'affermazione della presenza di succo d'uva/vino o dei derivati del vino, come l'aceto, nelle anfore deve sempre essere in accordo con il contesto studiato ed essere compatibile con i dati botanici dei luoghi di produzione, dato che per l'area vesuviana non costituisce un problema.

Di seguito mostriamo esempi di residui di vino (o derivati) identificati in materiali archeologici della zona vesuviana analizzati seguendo il metodo proposto in Pecci et al. (2013a) per l'identificazione dei residui di vino ed il metodo sviluppato da Evershed per l'estratto lipidico totale. In particolare, mostriamo che l'applicazione dell'analisi dei residui ha permesso di identificare diverse fasi del ciclo di vita del vino: quello della produzione, attraverso lo studio degli impianti di produzione (ed in particolare l'analisi di vasche e *dolia*), lo stoccaggio e il trasporto (attraverso l'analisi di anfore e *dolia*), la preparazione e il consumo attraverso l'analisi di ceramiche da fuoco.

Un esempio di produzione di vino confermato dall'analisi dei residui è una villa tardo-romana, la cosiddetta Villa di Augusto a Somma Vesuviana, dove sono state effettuate

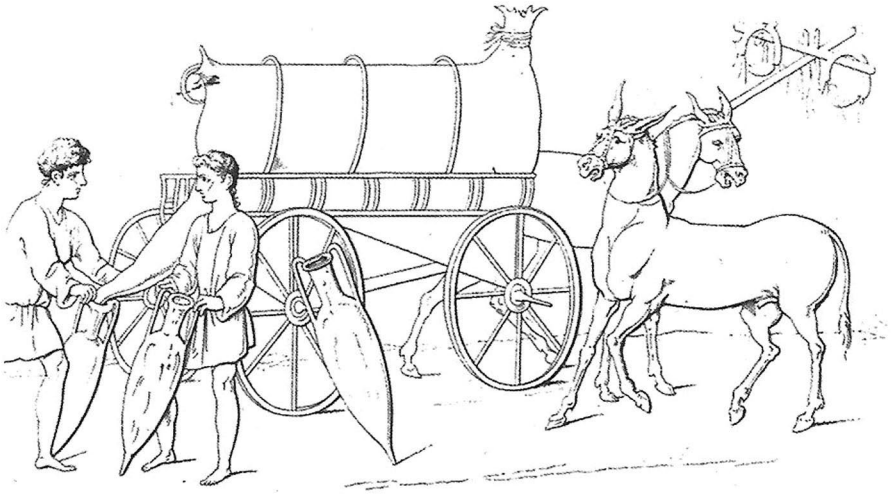

Fig. 2: Graffito con *culleus* dalla *caupona* VI, 10, 1.

analisi sui depositi rivestiti di malta e sui *dolia*. Le analisi hanno permesso di confermare che l'installazione produttiva era finalizzata alla produzione di vino.[19] Anche l'analisi in corso dei *dolia* della cosiddetta taverna della Regio V 4, 6–8 di Pompei, condotta in collaborazione con Daniela Cottica, Silvia Ritondale e Simona Mileto, sembra poter confermare la produzione di vino nella cella vinaria qui identificata anni fa da Jean-Pierre Brun e Dorothee Neyme.

Per quanto riguarda lo stoccaggio ed eventualmente il trasporto di vino, un esempio è fornito dai *dolia* della Bottega del *Garum* di Pompei, dove i cinque *dolia* analizzati dal cortile centrale contengono i resti di pesce ad indicare la produzione di salse di pesce, ma l'analisi chimica ha permesso di identificare anche i residui di vino e di abbondante pece.[20] Il vino identificato potrebbe quindi essere collegato al condimento delle salse di pesce o ad un riutilizzo dei *dolia*, che erano precedentemente utilizzati per la conservazione del vino.

Per quanto riguarda il trasporto del vino (e la sua produzione locale), abbiamo tracce di residui di vino in anfore vesuviane Dressel 2–4, come mostra l'analisi di dieci anfore ed un tappo di sughero dalla Villa B di *Oplontis* analizzate nell'ambito dell'*Oplontis Project* diretto da J. Clarke e M. L. Thomas.[21] Qui il fatto che le anfore siano state rinvenute capovolte suggerisce che le anfore fossero già state utilizzate, ed i residui di vino al loro interno lo confermano indicando che probabilmente le anfore erano conservate nella Villa B per essere poi nuovamente riempite con vino proveniente dalla zona circostante. Analisi in corso presso l'università di Barcellona indicano che vi è polline di uva in un blocco di pece rinvenuto nel sito, mentre questo è assente nel rivestimento delle anfore.

Il vino veniva anche importato a Pompei, come sappiamo dai numerosi rinvenimenti di anfore (teoricamente) vinarie nel sito. Un esempio di possibile importazione di vino

(o derivati) a Pompei proviene dall'analisi di anfore africane scavate durante il progetto Impianto Elettrico 1980–'81, dove lo studio dei materiali è stato diretto da Daniela Cottica e Darío Bernal Casasola. Le analisi condotte in collaborazione con Dario Bernal mostrano che alcune delle anfore africane analizzate hanno residui di vino, anche se numerose sembrano essere state riutilizzate a causa della presenza nella stessa anfora di residui di vino e olio vegetale, e quindi non è possibile sapere quale sia stato il primo/principale contenuto dei recipienti. Infatti, la matrice ceramica assorbe tutte le sostanze con cui viene a contatto e non è possibile fare una stratigrafia dei residui assorbiti. Questi dati sono importanti tra l'altro perché mettono in luce la possibilità di confermare la produzione africana di vino suggerita da Michel Bonifay.

Altri esempi di analisi dei residui utili per stabilire la produzione vesuviana di vino e l'importazione di vino a Pompei vengono dalla Casa di Championnet (VIII 2, 1–2), che offre un piccolo spaccato anche sul consumo di questo vino. Gli scavi condotti dal Parco Archeologico di Pompei in occasione di interventi di progettazione e restauro[22] hanno portato alla luce nella Casa di Championnet e nei vicini edifici meridionali del foro nuovi assemblaggi che permettono non solo di ricostruire la storia più antica del sito, ma anche di applicare dei metodi analitici, spesso non possibili sui materiali nei depositi per successivi inquinamenti. Gli interventi di restauro della Casa di Championnet, ad esempio, sono stati accompagnati da scavi stratigrafici volti sia a risolvere problematiche puntuali connesse alle esigenze dei lavori di restauro, ma anche ad indagare un complesso in gran parte sconosciuto. Di particolare interesse è lo scavo dell'ambiente collocato nell'angolo sud-occidentale del porticato del piano inferiore,[23] accessibile direttamente dal criptoportico e realizzato probabilmente prima del terremoto del 62 d.C. Al momento dell'eruzione tale ambiente doveva essere probabilmente in disuso in quanto la volta era quasi completamente crollata; l'eruzione del 79 d.C. riempì completamente l'ambiente di materiale vulcanico. Al momento dello scavo si rinvennero anfore, alcuni esemplari di ceramica comune da fuoco e di ceramica comune al centro dell'ambiente e a ridosso del muro perimetrale meridionale, in frammenti non sempre ricomponibili e insieme a resti ossei di animali non in connessione che sembrerebbero suggerire che l'ambiente sia stato utilizzato come deposito di materiale/immondezzaio, probabilmente della vicina cucina che si apriva sul criptoportico.

Questo contesto, sigillato, offriva la possibilità di condurre analisi dei residui per comprendere cosa era stato cucinato nel vasellame qui rinvenuto e verosimilmente impiegato nella vicina cucina e come era stato cucinato, ricostruendo così la dieta del gruppo domestico che qui risiedeva. Si sono analizzati 6 contenitori che costituivano il *set* da cucina tipico del I sec. d.C.: una pentola con orlo a tesa,[24] un'olla,[25] un'anforetta,[26] un tegame a orlo indistinto[27] e due anfore, un'anfora vinaria locale Dressel 2–4 ed una Agorà G198 dalla Cilicia.

Entrambe le anfore studiate presentano residui di vino. Nel caso della Dressel 2–4 questi dati confermano quanto già ipotizzato a livello storico e archeologico sul contenuto di questo tipo e già confermato dallo studio delle anfore di Oplonti. Interessante è il

dato sulle Agorà G198, un'anfora poco nota prodotta in Cilicia e per la quale non erano state prima condotte analisi sui residui. Le analisi hanno confermato che il prodotto trasportato fosse vino, contenuto prima solo ipotizzato sulla base dei pochi *tituli picti* noti e sulla specificità produttiva dell'area.

L'anforetta domestica era invece rivestita con pece estratta direttamente dal legno, utilizzata sia per impermeabilizzare che per favorire la conservazione del contenuto, ma non presenta resti di vino o derivati, come attestato anche da un noto quadretto dai *Praedia* di Giulia Felice, dove queste anforette contenevano frutta. In questo caso conteneva grassi di ruminanti, come il tegame e la pentola. Particolarmente interessanti sono i risultati dell'olla in quanto, oltre a grassi animali, presentava anche tracce di acido tartarico e acido succinico, cioè di vino, suggerendo quindi che il vino (o i suoi derivati) non venisse usato solo come bevanda ma anche per condire le carni cotte nell'olla. È interessante notare che il vino è presente nella parte finale del recipiente, ma non nella parte superiore dell'olla: tale differenza può corrispondere all'assorbimento di sostanze in diversi momenti di uso del recipiente. Probabilmente la presenza di vino sul fondo dell'olla dipende dalla preparazione di una salsa, come le varie salse con vino di cui parla Apicio come la salsa bianca per la carne bollita, oppure di pietanze che implicavano l'uso di una scarsa quantità di liquido, che non ha mai raggiunto la parte alta del recipiente. Questa differenza nell'assorbimento dei residui tra il fondo e la parete è molto interessante anche dal punto di vista metodologico e si inserisce in un dibattito in corso, in questo ambito di studi, sulla necessità di campionare più punti dello stesso recipiente per ottenere una ricostruzione affidabile delle modalità di consumo. L'analisi dell'olla permette di evidenziare una fase successiva del ciclo di vita del vino, quello della sua preparazione per il consumo, testimoniando l'uso del vino – o dell'aceto, dato che per il momento non è possibile distinguere tra i due – come condimento per il cibo preparato o riscaldato nel'olla. L'analisi dei residui ha permesso di rintracciare questa pratica dall'Età del Bronzo al periodo medievale: dalla ceramica da fuoco della Terramara di Pilastri di Bondeno (Ferrara) alla ceramica tardoantica catalana e delle Baleari a quella medievale toscana.[28]

Conclusioni

Le fonti e l'evidenza archeologica (*villae*, anfore, impianti produttivi) hanno contribuito a rafforzare l'immagine di Pompei come una città "vinaria". L'analisi dei residui organici dei materiali archeologici volte ad identificare la presenza di vino nei recipienti o nelle strutture produttive aiuta ad approfondire la conoscenza del ciclo di vita del vino in area vesuviana. In particolare è stata utile per confermare la produzione di vino nella regione attraverso l'esempio di una installazione produttiva, la sua esportazione e l'importazione della bevanda. Inoltre ha fornito alcune indicazioni sul contenuto delle

anfore, in particolare confermando il contenuto vinario delle Dressel 2–4, segnalando la presenza di vino in anfore africane antiche e fornendo i primi dati sulle Agorà G198 ed ha permesso di apprezzare l'uso del vino per il condimento dei cibi. In tutti questi casi non sappiamo se si tratta di vino o di derivati, perché al momento le analisi non sono in grado di differenziarli.

Note

[1] Si veda come mero esempio Strabone, 5, 4, 8.

[2] Vd. Horden – Purcell 2000, 140.

[3] Quest'area è stata spesso definita facendo ricorso a metodi desunti dalle scienze geografiche quali i poligoni di Thiessen, cfr. Peña – Mc Callum 2009, 165 seg.

[4] Vd. Strabo 5, 4, 8.

[5] Vd. Horden – Purcell 2000, 393.

[6] La bibliografia sulle produzioni agricole del territorio vesuviano e sul loro peso economico è vastissima; questo dibattito è iniziato nei primi decenni del '900 con il contributo di Frank su Classical Philology (Frank 1918); si veda inoltre Sievers 1938 e il fondamentale volume di Jongman 1988. Per uno *status quaestionis* su questo tema si veda Flohr – Wilson 2017.

[7] Per i numerosi scavi privati in quest'area che dall'800 misero in luce varie strutture produttive si veda Garcia y Garcia 2017. Per uno studio geo-archeologico e un modello predittivo sulla distribuzione delle ville nella piana del Sarno si veda Vogel et al. 2013; 2016.

[8] Nell'area settentrionale dell'*ager vesuvinus* sono state individuate varie *villae rusticae* tra cui: una villa nel fondo Antonio Prisco con *torcularium* e *dolia* interrati, villa in proprietà D'Acunzo con *torcularium* e *horreum* per il grano, Villa Imperiali in località Civita, vd. Stefani 1994, con ampio *torcularium*. Quest'ultima villa è al momento in corso di scavo dal Parco Archeologico di Pompei che ha riportato in luce parte del quartiere servile di un complesso che sembra di enormi dimensioni. Si veda inoltre la villa in località Villa Regina cfr. De Caro 1994, con cella vinaria contenente 18 *dolia* interrati e *torcularium* con vasca di pigiatura; la villa di *Publius Fannius Synistor* con *torcularium* e *trapetum*, la villa della Pisanella con *torcularium* con vasche in cocciopesto per la pigiatura e *dolia* interrati (si rinvennero anche macine per olive); la villa di *Numerius Popidius Florus* con cella vinaria e *torcularium*; la villa in proprietà Risi Di Prisco, la villa in proprietà Greco con *torcularium* e *dolia* interrati. Per un commento critico delle *villae* individuate cfr. Stefani 1994 e Senatore 1998.

[9] Nell'area meridionale sono stati identificati i seguenti complessi produttivi: la villa n. 32 (vicino al santuario dionisiaco di S. Abbondio) con cella vinaria di dimensioni non chiare e *dolia* infissi nel terreno; villa n. 33 con ampia cella vinaria con 34 *dolia*, villa n. 34 con una cella vinaria di notevoli dimensioni che non pone dubbi sulla sua vocazione produttiva. Possibili strutture produttive sono inoltre da individuare in Località Ponticello di Mariconda (in prossimità del fiume Sarno) con numerosi *dolia*, sempre in Località Ponticello di Mariconda ma più a ovest (fondo Piscicelli) in prossimità del fiume Sarno con decine di dolia e sempre in Località Ponticello di Mariconda nella zona del Polverificio (in prossimità del fiume Sarno) sono stati recuperati numerosi dolia. Infine dolia indicanti lo svolgersi di attività produttive sono stati

identificati in Contrada Iossa e in Contrada Mesigno. Per un elenco critico delle *villae* individuate cfr. Senatore 1998.

[10] Tra le *villae rusticae* individuate nell'area orientale dell'agro vesuviano si segnalano: la villa n. 52 con *dolia* interrati, la villa n. 35 con cella vinaria e *torcular*, la villa n. 19 con cella vinaria e *torcular*, la villa in contrada Monacelle con cella vinaria e *dolia*, la villa in contrada Ventotto, la villa in proprietà Buccino, la villa in proprietà Giarretta, la villa in contrada Spinelli fondo Sangiovanni, la villa in località Bernardinetti in proprietà Venuti, la villa nella strada per S. Antonio Abate, la villa a Scafati nei giardini Petrarca con cella vinaria e *torcular*; la villa in Via Nolana, nell'area a nord del cimitero, è di notevoli dimensioni ma solo parzialmente scavata; sempre in Via Nolana un'altra villa fu identificata in proprietà Cirillo, una presso il canale Conte di Sarno con cella vinaria e *torcular*. Inoltre: la villa in contrada Crapolla proprietà Arpaia solo parzialmente scavata, la villa in via Lepanto proprietà Vitiello e campo sportivo V. Bellucci con il piano antico coltivato a vigneto. A Scafati, via Passanti, traversa Cesarano, proprietà Cascone-Sorrentino fu identificata una villa di notevoli dimensioni con torcularium e cella vinaria. Nel territorio dell'odierna Scafati alcune villae di notevoli dimensioni vennero identificate in via Tricino, proprietà Acanfora, nell'area del Cimitero nel Fondo Prete in contrada Castagno con cella vinaria contenente 61 *dolia*, in Località Castagno, in via Poggiomarino, in via Passanti, in località San Pietro con *torcular*, in via della Resistenza, località Cartucciera, in via Montegrappa "*…si è portato alla luce un ambiente per la lavorazione del vino, relativo ad una villa rustica*", cfr. De' Spagnolis – Conticello 1994, 31 e in via Vicinale Iossa, Proprietà Iovane e infine in località Bagni con torcular. Le ville nn. 36, 37, 38, 39 sono state scavate solo parzialmente e non sembra possibile determinarne con sicurezza la funzione produttiva, cfr. Senatore 1998.

[11] Si veda De Simone 2017.

[12] Cato, Agr. 57.

[13] De Simone 2017, 40.

[14] Il Digesto 8, 3, 6 ricorda come gli strumenti impiegati per *deportare, exportare, evehere, vectare* le derrate agricole fossero anfore, botti, otri, animali da traino, carri e battelli.

[15] In particolare, lo studio dei residui organici nelle anfore (soprattutto romane, ma anche medievali) ha permesso di confermare l'esistenza di contenuti che ci si aspettava in base allo studio tipologico - formale e l'esistenza di contenuti diversi da quelli che ci si aspettava in base al tipo. Inoltre, ha permesso di mettere in luce la pratica del riuso delle anfore per il trasporto di merci uguali o diverse da quelle utilizzate per il primo contenuto (riuso "*Type* A" di Peña 2007; si veda Pecci et al. 2017a; Garnier – Pecci c.s.).

[16] Heron – Pollard 1989.

[17] Guash Jané et al. 2006; Barnard et al. 2011; Pecci 2005; Pecci et al. 2013a; Garnier, Valamoti 2016; McGovern et al. 2017.

[18] Barnard et al. 2011.

[19] Allevato et al. 2012; Pecci et al. 2013a.

[20] Pecci et al. 2018.

[21] Pecci et al. 2017b.

[22] Per i contesti archeologici e gli interventi di restauro si veda Cicirelli 2017.

[23] Si veda nel dettaglio Masseroli – Giglio 2017, 41.

[24] Tipo Di Giovanni 1996, F2211b.

[25] Tipo Di Giovanni 1996, F2323.

[26] Tipo Schöne-Mau I.

[27] Tipo Di Giovanni 1996, F2210.

[28] Pecci 2009; Pecci et al. 2018; Inserra et al. 2015; Mas Florit et al. c.s.

Indice delle figure

Fig. 1: Pasqui 1897, tav. XIV. – Fig. 2: Stefani 2005, 96.

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Importazioni ispaniche di generi alimentari trasportati in anfora ad Ostia nella prima età imperiale: nuovi dati

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Rome was an extraordinary centre of consumption, which attracted an incredible amount of goods arriving through its ports (Ostia and *Portus*). One of the first peripheral regions to undertake the distribution of its agricultural surplus to the capital was *Hispania*, especially the *Baetica* province, which underwent a radical transformation in the organisation of the exploitation and commercial trade of the resources from the Second Punic War to the Augustan age. After drawing up a comprehensive balance of Hispanic imports transported to Ostia by amphorae (wine, oil, *salsamenta* and fish sauces), the focus will be on a case study. An important sample area in the region of Ostia is the context of Binario Morto (about 50 BC–50 AD), where remains of a wooden waterwheel and a structure with amphorae used to drain the groundwater have been found. The study of 335 amphorae shows a significant majority of Hispanic productions. Petrological and chemical analyses permitted to determine the origin of the amphorae from specific workshops located in the areas of the Guadalquivir Valley and around Cádiz, and on the northern coast of Catalonia.

Introduzione

Il presente contributo intende analizzare le premesse storiche ed economiche che innescarono, nella *Hispania* Betica e nella Tarraconense, lo sviluppo di un'agricoltura intensiva i cui prodotti – essenzialmente olio, vino e pesce – vennero progressivamente inseriti nei circuiti commerciali mediterranei e giunsero a Ostia. L'entità di tali flussi può essere misurata attraverso l'analisi della presenza delle anfore ispaniche nel mercato di Ostia e di Roma, particolarmente diffuse tra l'età augustea e la prima età imperiale, come anche testimoniato dal caso-studio delle anfore rinvenute a Ostia Antica nel contesto del Binario Morto.

La produzione nelle province dell'*Hispania*

Roma, centro di consumo di una grandissima quantità di prodotti alimentari di importazione, fu punto d'arrivo privilegiato del *surplus* agricolo dell'*Hispania* fin dall'inizio dell'età imperiale, generando un imponente flusso commerciale, come provato dalle anfore che compongono il Monte Testaccio.

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Le province dell'*Hispania* furono tra le prime a esportare le proprie merci verso l'Urbe, sfruttando rotte e orientamenti commerciali già attivati per i metalli[1] e in risposta alla necessità di rifornimento di Roma, specialmente in relazione alle campagne militari. Potendo contare su una struttura amministrativa e commerciale già esistente, questo sfruttamento sistematico e fortemente intensivo non impiegò troppo tempo a coinvolgere anche il mercato degli alimenti. La posizione geografica e le potenzialità produttive dell'*Hispania*, assieme alle condizioni politiche e sociali che avevano determinato le iniziative commerciali delle *élites* locali, furono i principali motivi del successo di queste nuove dinamiche di mercato, come dimostrato dall'importante ruolo giocato dalla valle del Guadalquivir e dalla baia di Cadice per l'approvvigionamento delle truppe sia durante la conquista della *Lusitania Transtagana* e del nordovest della penisola iberica che, in seguito, della *Germania*.[2]

Il momento chiave che segnò la creazione delle strutture economiche necessarie allo sviluppo dell'*Hispania* romana come area di esportazione è collocabile già sotto Cesare; esse poi si svilupparono straordinariamente dopo l'età augustea. Ad eccezione di alcune aree peculiarmente legate al commercio interregionale già durante l'Età del Ferro (come la fascia costiera sud mediterranea, il Levante o il circolo di *Gadir* e lo Stretto di Gibilterra), infatti, in gran parte della penisola le reti commerciali erano, fino all'età cesariana, locali e di natura autarchica, basate sullo sfruttamento estensivo dei territori. Proprio in questo periodo furono riorganizzate sotto l'impronta romana in funzione dei nuovi interessi italici, favorendo un ambiente economico molto più dinamico e accessibile su scala internazionale.

In tal senso, si può riconoscere una prima fase, tra il II e la metà del I secolo a.C., in cui si registrano l'ingresso di prodotti italici nel mercato ispanico e i relativi primi scambi commerciali. In seguito, tra la metà del I secolo a.C. e il periodo augusteo, a Roma si verifica una crescita delle importazioni provinciali e principalmente dei prodotti ispanici. In questa fase cambiano anche i modi dello sfruttamento agricolo, con un ampliamento delle coltivazioni dell'ulivo e della vite e l'avvio del fenomeno di incremento delle *villae*. Una loro vera e propria diffusione in Betica, fuori dalle rive del *lacus Ligustinus*,[3] si osserva, infatti, dall'ultimo terzo del I secolo a.C., contemporaneamente alla standardizzazione del repertorio dei contenitori in forme ormai romanizzate[4] e all'aumento dei contenitori ispanici in arrivo nella zona di Ostia-Roma.

Le principali aree di produzione ispaniche, per quanto riguarda le anfore attestate nei siti italici durante i primi secoli dell'Impero, furono la Betica e la Tarraconense (fig. 1).

La Betica, a sud della penisola iberica, fu area di notevole peso economico, culturale e politico durante l'età repubblicana e alto-imperiale,[5] grazie a importanti centri economici e commerciali, quali *Corduba*, *Hispalis*, *Obulco* o *Castulo*, mentre gli insediamenti costieri, principalmente l'antica *Gades*, regolavano l'accesso e la distribuzione commerciale nell'entroterra.

Sin dall'inizio della dominazione romana la Betica risultò molto attiva nel panorama commerciale. La regione, in epoca repubblicana, fondava il proprio commercio su

Fig. 1: Province dell'*Hispania* nel I–II secolo d.C. (Rodriguez Gutierrez 2011, fig. 20).

un'antica rete di esportazione del *surplus* locale, ma è solo in età augustea che si venne a delineare un repertorio anforico indipendente dalla tradizione punica. In questo senso, l'importanza della Betica come regione esportatrice raggiunse il culmine nel I e nel II secolo d.C., fino alla metà del III secolo d.C.

Già dalla fine del II secolo a.C., e in particolare durante la seconda metà del I secolo a.C. e la prima metà del I secolo d.C., la viticoltura e le attività artigianali erano particolarmente sviluppate nella regione della Tarraconense,[6] nel nord-est della penisola iberica, soprattutto nell'area litorale e pre-litorale, favorite dall'ingente domanda romana dovuta all'espansione bellica. In particolare, in epoca alto-imperiale si osserva una diversificazione nelle dinamiche commerciali di questa provincia, che iniziò a importare prodotti da diverse aree. Contestualmente, le officine tarraconesi raggiunsero un successo commerciale che interessò, oltre alla Gallia, anche l'Italia e altre province dell'Impero, come quelle africane. Sebbene in un primo momento sono le anfore betiche a godere di maggior successo a Roma, come emerge dalla minore attestazione delle produzioni tarraconesi per tutto il I secolo d.C., il commercio di questi prodotti persistette fino al II secolo d.C.

Le importazioni di prodotti ispanici a Roma e Ostia-*Portus*

Buona parte del quadro dei commerci interprovinciali che coinvolsero le derrate alimentari prodotte in *Hispania* è stata nel tempo ricostruita anche e soprattutto grazie alla documentazione archeologica restituita da Roma, che fu rifornita da una rete di porti che ne assicurarono gli approvvigionamenti. Ostia e *Portus* ebbero certamente un ruolo di primo piano in questo *port network* e per questa ragione la documentazione delle anfore rinvenute a Ostia ha una duplice valenza: in primo luogo essa illustra i consumi degli abitanti di Ostia, ma in qualche modo riflette anche il flusso delle derrate alimentari dirette verso Roma attraverso i suoi porti. Di conseguenza, la documentazione delle anfore rinvenute ad Ostia deve essere in parte interpretata in relazione con quella di Roma.

A Roma le importazioni dei generi alimentari trasportati in anfora dall'*Hispania* si sono materializzate soprattutto nel Monte Testaccio, il *terminal* dell'olio sotto il controllo dell'annona: formatosi tra l'età augustea e il principato di Gallieno, è composto prevalentemente dagli scarti delle Dressel 20 prodotte lungo la valle del Guadalquivir e del Genil sbarcate nel vicino porto fluviale di *Emporium*, che formarono una collina indagata a più riprese dai ricercatori spagnoli.[7] Si tratta dunque di una discarica "tematica" ed organizzata, in quanto formatasi prevalentemente dall'accumulo dei frammenti di anfore olearie betiche (circa l'85%): di conseguenza, essa non fornisce un quadro esauriente dei generi alimentari trasportati in anfora consumati dagli abitanti di Roma, che invece emerge più chiaramente da una serie di contesti urbani e ostiensi, nei quali il materiale scartato e non selezionato riflette più fedelmente il consumo di vino, olio e prodotti derivati dal pesce provenienti dall'Italia e dalle province.

Il primo arrivo a Roma di generi alimentari dall'*Hispania* si registra in un contesto degli *Horti Lamiani*, sull'Esquilino, datato tra l'80 e il 50 a.C.:[8] si tratta di testimonianze ancora episodiche, che comprendono meno del 10% della anfore raccolte, e che riguardano alcune forme betiche probabilmente da identificare con i tipi Ovoide 4 e 5; non risultano ancora documentate le anfore della Tarraconense e questa assenza ha probabilmente una valenza cronologica.

Alcuni contesti romani di età augustea documentano un fondamentale cambiamento (fig. 2):[9] le anfore betiche sono molto più attestate e compaiono per la prima volta le anfore vinarie tarraconesi (Pascual 1, Dressel 2–3), anche se in scarsa quantità, mentre le anfore betiche da pesce (Dressel 7–13) sono ora piuttosto numerose, circa un quarto delle anfore utilizzate per il trasporto di queste derrate alimentari.

Nel I e nel II secolo le anfore vinarie tarraconesi diminuiscono progressivamente, mentre gli indici delle anfore olearie betiche (Dressel 20) si impennano vertiginosamente, raggiungendo nel corso del I e dell'inizio del II secolo percentuali comprese tra l'80 e il 90% delle anfore olearie; dalla metà del II secolo, invece, risultano dimezzate e diminuiscono progressivamente fino alla fine del III – inizio del IV secolo d.C.

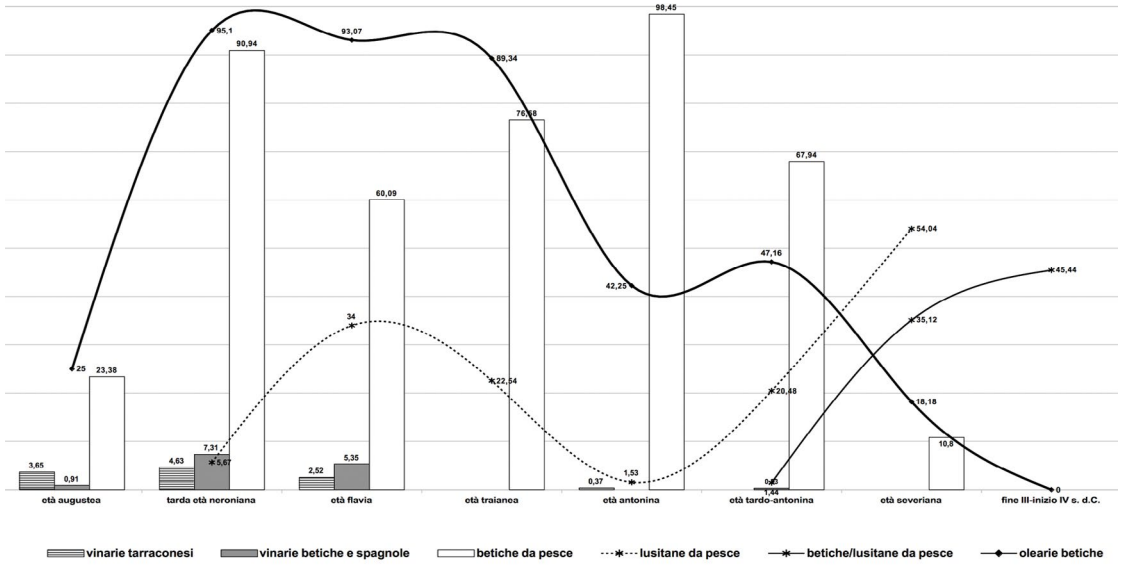

Fig. 2: Roma. Attestazioni delle anfore ispaniche distinte per contenuto tra l'età augustea e la fine del III – inizio del IV secolo d.C. (Rizzo 2018b, fig. 2).

In età giulio-claudia crescono anche gli indici delle anfore ispaniche da pesce, che raggiungono complessivamente oltre 90% delle anfore da pesce (Dressel 7–13, 14A–B, 17, Beltrán II A–B): nella seconda metà del I e nel corso del II secolo le percentuali di attestazione dei contenitori betici da pesce tendono dapprima a diminuire e, in un secondo momento, ad aumentare, intrecciandosi con quelli delle anfore lusitane da pesce (Dressel 14B, fig. 2), coprendo fino all'età severiana quasi tutto il fabbisogno del mercato.

Anche ad Ostia si registrano alcuni fenomeni già evidenziati in relazione al mercato di Roma, sebbene le percentuali risultino in alcuni casi piuttosto diverse (fig. 3).[10] Anche in questo caso la documentazione archeologica presenta alcuni limiti, in quanto nella fase più antica – contesti di *Domus* del Protiro, La Longarina 1–2 e Binario Morto – risulta costituita solo da anfore riutilizzate in interventi di bonifica, drenaggio e impermeabilizzazione del terreno.

Le analogie con il mercato romano possono essere sintetizzate come segue.

1) Anche ad Ostia le anfore ispaniche risultano ancora scarsamente documentate in età tardo-repubblicana: nel contesto del terzo quarto del I secolo a.C. della *Domus* del Protiro sono stati identificati pochissimi esemplari, riferibili alla forma Ovoide 1 e probabilmente ad alcune anfore da pesce betiche, e mancano, come nel contesto romano tardo-repubblicano degli *Horti Lamiani*, le anfore tarraconesi.

2) Come a Roma, gli indici delle anfore ispaniche si innalzano vistosamente in età augustea: nei contesti di La Longarina 1–2 e del Binario Morto l'incremento più evidente riguarda le anfore betiche Haltern 70 (13,65%) e Dressel 7–13 (22,9%), accanto alle quali fanno la loro comparsa anche le anfore vinarie e da pesce tarraconesi (anfore ovoidi, Dressel 9, Pascual 1, Oberaden 74, Dressel 2–3).

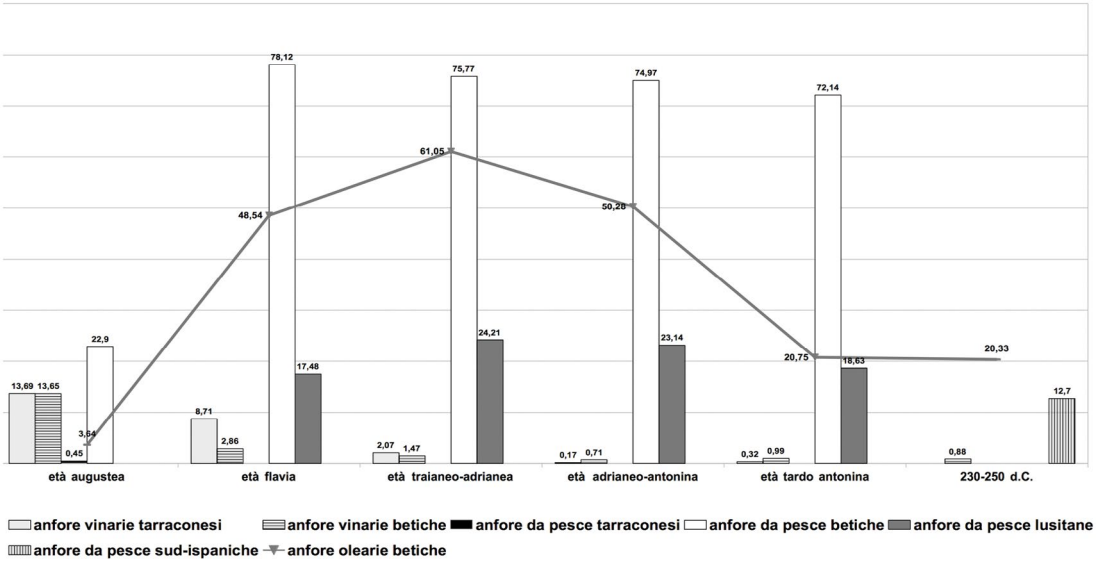

Fig. 3: Ostia. Attestazioni delle anfore ispaniche distinte per contenuto tra l'età augustea e il 230–250 d.C. (grafico di G. Rizzo).

3) Le anfore olearie della Betica (Dressel 20) aumentano vistosamente nel corso del I e della prima metà del II secolo d.C., e diminuiscono nella seconda metà del II secolo, mantenendosi ad Ostia stabili durante l'età severiana: esse tuttavia non raggiungono quasi mai gli altissimi indici percentuali registrati a Roma, che evidentemente fu la loro destinazione principale a causa dei privilegi annonari accordati alla popolazione della capitale dell'Impero.

4) Nei limiti della documentazione presa in esame, da cui esulano le testimonianze dei vini trasportati in *dolia* e botti, sembra emergere il panorama di un mercato ostiense in cui le anfore vinarie betiche e tarraconesi sono sempre poco presenti, sebbene in maggior quantità che a Roma, e tendono a scomparire nel corso del II secolo d.C.

5) Le anfore da pesce betiche (Dressel 7–13, 14A, 17, Beltrán II A–B, fig. 3) assorbono circa i tre quarti del fabbisogno del mercato e risultano presenti, diversamente che a Roma (fig. 2), con indici piuttosto costanti nel corso della seconda metà del I e del II secolo d.C., affiancate, come a Roma, da quelle lusitane da pesce (Dressel 14B).

Oltre alle evidenti analogie con Roma, i contesti ostiensi restituiscono l'immagine di un mercato caratterizzato anche da differenze, alcune delle quali riguardano anche il commercio delle derrate alimentari, provenienti dal nord Africa, e dei vini, italici e dell'area egeo-microasiatica. Tuttavia una delle più evidenti peculiarità ostiensi rientra proprio nel campo delle importazioni delle anfore olearie betiche, che risultano complessivamente molto meno diffuse che a Roma, primaria destinazione per i già citati privilegi annonari concessi ai suoi cittadini.

Le anfore ispaniche a Ostia: il contesto del Binario Morto

Il caso-studio delle anfore del contesto del Binario Morto a Ostia Antica,[11] scavato da Angelo Pellegrino e Andrea Carbonara del Parco Archeologico Ostia Antica tra il 1998 e il 2002,[12] risulta particolarmente emblematico ai fini dell'indagine sull'attestazione di materiale ispanico a Ostia offrendo diretto riscontro delle dinamiche di importazione durante la prima età imperiale.

Nell'area indagata sono emerse strutture funerarie, collegabili alla vicina necropoli di Pianabella, e una fossa circolare sul cui fondo sono stati recuperati i resti di una ruota idraulica.[13]

La fossa, larga circa 15 metri e profonda 3, era rivestita lungo le pareti di contenimento da un doppio filare di anfore: quelle dell'ordine inferiore sono state rinvenute ancora *in situ* nei settori E e O, e adagiate sul fondo nel settore N; quelle dell'ordine superiore, invece, risultavano tutte scivolate sul fondo e frammentarie.

Le anfore rinvenute nel contesto del Binario Morto sono 335, tra esemplari interi e frammentari.

Le principali attestazioni si riferiscono prevalentemente ai tipi Dressel 2–4 italiche e tarraconesi (rispettivamente 57 e 61 esemplari), Haltern 70 (55 esemplari), Dressel 7–11 (43 esemplari), Dressel 6A e B (21 esemplari) e Dressel 20 (18 esemplari), provenienti quasi totalmente dall'US 35 (strato di fondazione e rivestimento della fossa); i tipi meno documentati, invece, provengono per la maggior parte dagli strati che colmavano la fossa (fig. 4 e fig. 5).

La realizzazione della struttura è stata datata all'età tardo-augustea, sulla base del periodo di attestazione comune delle anfore provenienti dall'US 35, collocabile tra la seconda metà del I sec. a.C. e la prima metà del I sec. d.C. Il periodo di produzione degli esemplari rinvenuti negli strati di riempimento si riferisce, invece, a una datazione che arriva fino alla metà del II sec. d.C., suggerendo quindi che la struttura sia stata utilizzata durante il I sec. d.C. e fino a tale cronologia (fig. 6).

Alcuni frammenti (pertinenti principalmente ad anfore tardo puniche), inoltre, si discostano del tutto dalla datazione proposta per la fossa ma, in virtù dell'esigua quantità, si possono considerare materiali residuali o fuori contesto.

Attraverso l'analisi macroscopica è stato possibile identificare 21 impasti principali riconducibili a tre aree di origine: betica, tarraconese e italica. Al fine di individuare con maggiore precisione le officine produttrici, si è ritenuto opportuno verificare tale risultato con analisi mineralogiche e chimiche[14]. Dall'incrocio dei dati archeologici con quelli archeometrici è stato pertanto possibile identificare tre principali gruppi di produzione, di cui soltanto uno non pertinente a officine ispaniche, in quanto relativo all'area italica (fig. 7).[15]

In conclusione, lo studio compiuto sugli esemplari del contesto di Binario Morto ha permesso di aggiungere dati nuovi alla conoscenza delle produzioni delle anfore ispaniche in epoca augustea e alto-imperiale.

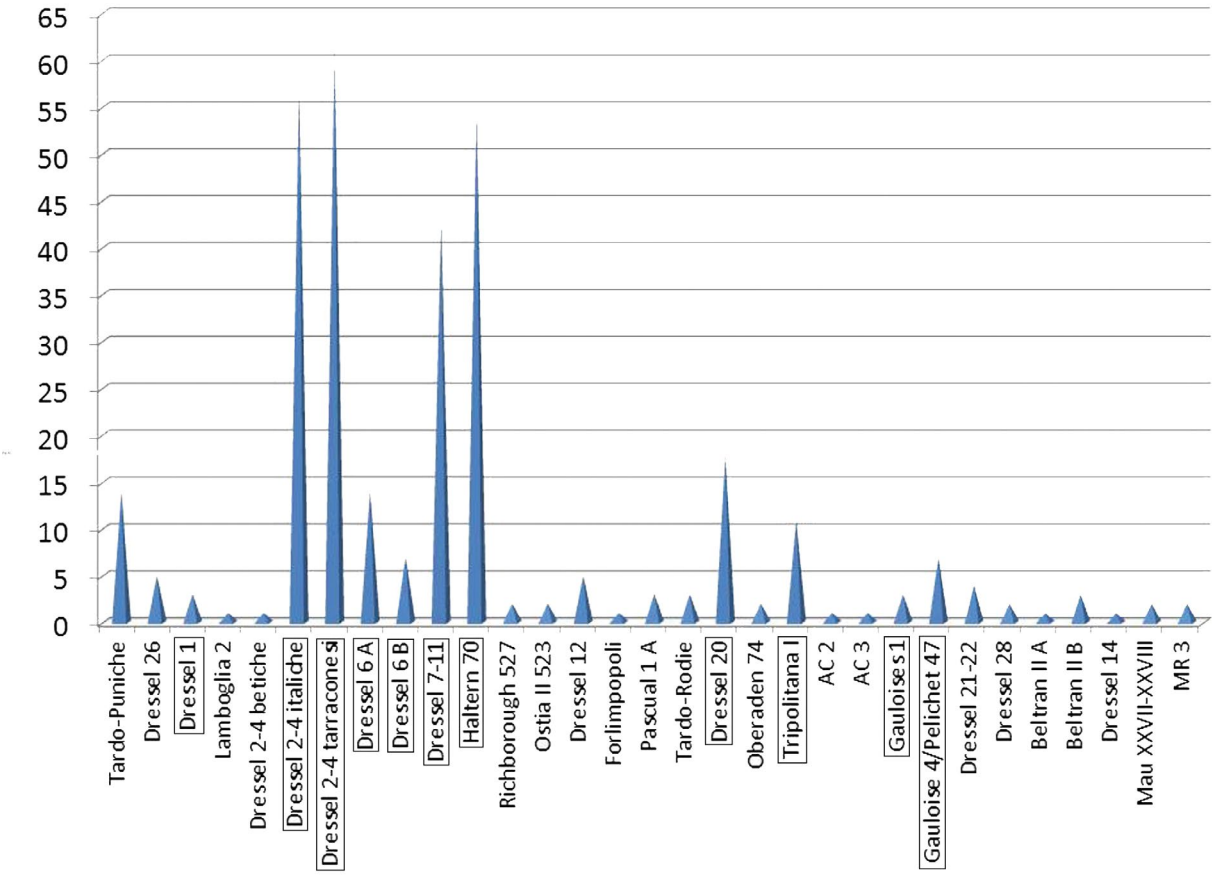

Fig. 4: Istogramma quantitativo dei tipi anforici del contesto del Binario Morto (NMI), con evidenziati (inseriti in un riquadro) quelli pertinenti la fase di realizzazione della fossa (rielaborazione da Olcese et al. 2017, 200 fig. 3).

I dati relativi all'ampia attestazione e alla varietà dei tipi anforici di origine provinciale nel Binario Morto (72% del totale delle anfore rinvenute) rappresentano, infatti, un importante indicatore della situazione dell'area ostiense nell'epoca indagata. In particolare, risulta evidente la netta maggioranza delle produzioni ispaniche (58%), confermata dai risultati delle analisi di laboratorio, e tra l'altro anche confrontabile con quanto già emerso dallo studio archeologico delle anfore del vicino contesto di La Longarina 1–2 (57%).[16]

Lo studio delle anfore del Binario Morto contribuisce, dunque, a una migliore definizione delle presenze anforiche nel territorio ostiense tra I sec. a.C. e I sec. d.C. e, contemporaneamente, a un incremento delle informazioni in merito alla caratterizzazione chimico-mineralogica delle anfore analizzate. L'attribuzione di alcuni campioni a officine che, pur presentando affinità con aree di origine note, non sono attualmente conosciute, offre, infine, nuovi elementi utili per lo studio delle aree di produzione in area iberica.

Fig. 5: Principali tipi anforici attestati nel contesto del Binario Morto (rielaborazione da Razza – Surace 2016, tavv. X e XI).

Osservazioni conclusive

Pur non essendo in grado di dar conto di quel flusso di vino trasportato dall'*Hispania* non attraverso le anfore (*dolia* e botti), le statistiche precedentemente illustrate, alla luce di quanto emerso anche dal caso-studio del contesto del Binario Morto, sono comunque in

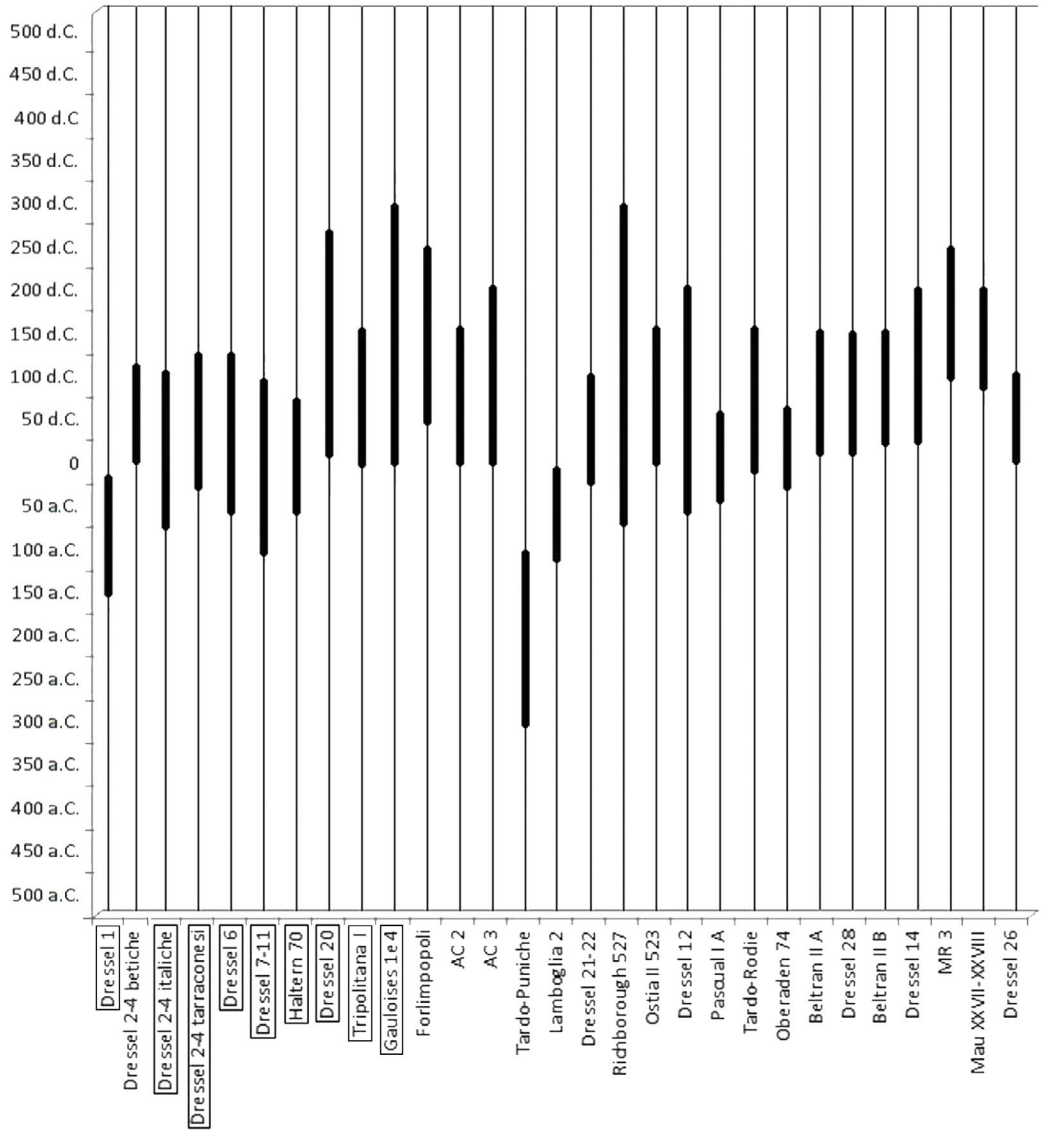

Fig. 6: Diagramma cronologico dei tipi anforici del contesto del Binario Morto, con evidenziati (inseriti in un riquadro) quelli pertinenti alla fase di realizzazione della fossa (rielaborazione da Razza – Surace 2016, 510 fig. 14).

grado di documentare, per l'età augustea, una serie di contatti commerciali di entità non indifferente con la Betica (soprattutto derivati dalla lavorazione del pesce e poi olio e vino) e, in misura molto minore, con la Tarraconense (vino). Tale panorama risulta confermato nelle sue tendenze generali anche dal confronto con il contemporaneo mercato di Roma, dove l'unica sostanziale differenza è costituita dalla maggiore presenza di anfore olearie betiche (25%, contro il 3,64% dei contesti ostiensi, figg. 2–3), molto probabilmente dirette soprattutto a Roma, come si è visto, a causa dei privilegi annonari di cui godette la sua popolazione.

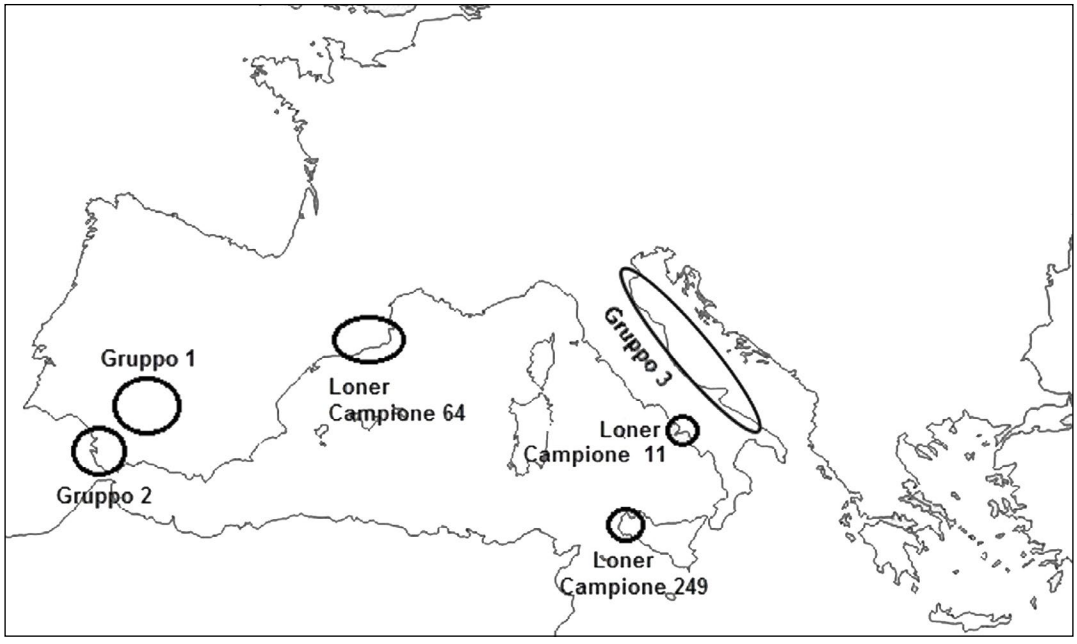

Fig. 7: Aree di origine delle anfore analizzate del contesto del Binario Morto (Olcese et al. 2017, 214 fig. 8).

Note

[1] Domergue 1990.

[2] Remesal Rodríguez 1986.

[3] Gorges 1978.

[4] García Vargas et al. 2011.

[5] Chic García 1997.

[6] Prevosti – Martín Oliveras 2009.

[7] Blázquez Martínez et al. 1994; Monte Testaccio I–VI.

[8] Ferrandes 2014.

[9] Il grafico di fig. 2 è tratto da Rizzo 2018b, fig. 2, cui si rimanda per la lista dei contesti e relativa bibliografia. I dati sono espressi in percentuale rispetto al totale delle anfore rinvenute nei periodi presi in considerazione, distinte per contenuto: così, per l'età augustea, le anfore vinarie tarraconesi e betiche sono rispettivamente il 3,65 e lo 0,91% delle anfore vinarie di quel periodo, e le anfore olearie betiche e da pesce rispettivamente il 25% e il 23,68% delle anfore olearie e da pesce.

[10] I dati della fig. 3 sono tratti da Rizzo 2018a, figg. 4.6; 12.13.

[11] I dati relativi alle anfore del contesto sono presentati in Razza – Surace in Olcese – Coletti 2016 e in Olcese et al. 2017. Il lavoro sulle anfore del contesto è stato, in una prima fase, condotto nell'ambito dei seminari di studio presso il Castello di Giulio II del Corso di Metodologie della ricerca archeologica e archeometrica della Sapienza – Università di Roma (Prof.ssa G. Olcese), coinvolgendo gli studenti di

Laurea Magistrale e Scuola di Specializzazione, quindi è stato riesaminato e completato da A. Razza e D. M. Surace.

[12] Pellegrino – Carbonara 2016.

[13] Olcese 2016, 505 e nota 2.

[14] Le analisi sono state effettuate dall'Equip de recerca arqueológica i arqueométrica de la Universitat de Barcelona diretto dal Prof. Miguel Ángel Cau Ontiveros; Olcese et al. 2017.

[15] Olcese et al. 2017. Il gruppo 1, infatti, include esemplari di Haltern 70, Dressel 2–4 betiche e Dressel 20 ricondotti a più centri di una stessa area di origine, localizzata nella valle del Guadalquivir tra Siviglia e Cordova, e più precisamente nell'area paleozoica della Sierra Morena.
Il gruppo 2, invece, è composto da anfore Dressel 7–11, Dressel 9, e ancora Haltern 70 e Dressel 20, riconducibili all'area di Cadice, probabilmente presso la foce del Guadalete.
Altri 4 campioni sono stati riconosciuti, inoltre, come *loners*, non pertinenti cioè ai gruppi identificati. Tra questi, uno, rappresentato da un esemplare di Dressel 2–4, presenta caratteristiche d'impasto che ne suggeriscono un'origine dal centro/nord della costa catalana.

[16] Secondo le più recenti riflessioni, i contesti di La Longarina 1 e 2 appartengono ad un intervento di bonifica prevalentemente unitario, databile in età augustea, e trovano pertanto un parallelo con la datazione proposta per la realizzazione della fossa del Binario Morto. Anche il numero di anfore contenute nei due contesti è simile: 335 nel Binario Morto e 294/8 ne La Longarina 1–2. In particolare, le anfore italiche de La Longarina sono 114 (38%), le ispaniche sono 168 (57%); nel Binario Morto le anfore di produzione italica sono 93 (28%) e quelle di produzione ispanica sono 195 (58%); Razza – Surace 2016, 510 seg. Per La Longarina 1–2: Rizzo 2018a, 234 seg. nota 41, con bibliografia; un lavoro di revisione del materiale anforico del contesto è attualmente in corso ad opera di A. Razza e D.M. Surace nell'ambito del progetto *Immensa Aequora* diretto da G. Olcese (Olcese et al. 2019).

Indice delle figure

Fig. 1: Rodríguez Gutiérrez 2011, fig. 20. – Fig. 2: Rizzo 2018b, fig. 2. – Fig. 3: grafico di G. Rizzo. – Fig. 4: rielaborazione da Olcese et al. 2017, 200 fig. 3. – Fig. 5: rielaborazione da Razza – Surace 2016, tavv. X e XI. – Fig. 6: rielaborazione da Razza – Surace 2016, 510 fig. 14. – Fig. 7: Olcese et al. 2017, 214 fig. 8.

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Posters

Dynamique de la production vinicole en Gaule Narbonnaise à l'époque romaine à partir de l'étude des capacités de stockage (I^er s. av. – V^e s. ap. J.-C.)

Charlotte Carrato

La place prépondérante de la production vinicole dans l'économie de la Gaule Narbonnaise à l'époque romaine n'est aujourd'hui plus à démontrer. En effet, les recherches archéologiques de ces 40 dernières années ont parfaitement établi la forte densité des installations de production vinaires et la vaste extension du vignoble sud-gaulois durant le Haut-Empire et, dans une moindre mesure le Bas-Empire.[1] Les modalités et la chronologie de la spécialisation économique de la Narbonnaise ont déjà fait l'objet de synthèses sur la base des données archéologiques. Une montée en puissance de la viticulture a été identifiée durant les I^er et II^e s., suivie par une première crise dans la seconde moitié du II^e s. puis une chute progressive des activités vinicoles dans le courant du III^e et le début du IV^e s.

S'appuyant sur une récente synthèse des données sur les établissements agricoles ayant livré des *dolia*,[2] nous proposons dans ce travail de préciser les différentes étapes d'essor, d'apogée et de déclin de l'économie vinicole sud-gauloise précédemment définies. Les chais à dolia occupent en effet une place prépondérante dans le processus de production vinicole antique et témoignent de l'évolution des capacités de stockage et donc de production. Leur étude diachronique livre des données chiffrées qui traduisent la dynamique de la production vinicole à travers le temps, mais présente aussi certaines limites que nous discuterons à l'issue de cette contribution.

Les outils de l'analyse

Soixante-six installations de productions vinicoles ont été prises en compte dans le cadre de cette étude (fig. 1). Tous les sites du corpus sont situés sur la frange littorale de la Narbonnaise, et s'étendent depuis les abords de Perpignan jusqu'à Fréjus, mais également le long de la vallée du Rhône jusqu'à Lyon. Ils sont datés entre le I^er s. av. J.-C. et le V^e s. ap. J.-C. La fonction vinicole de ces installations a été validée au cas par cas sur la base de divers arguments archéologiques (structures de production vinicole, traces de plantation de vignes, traces de poix dans les *dolia*, …). En plus des sites dont la fonction vinicole est assurée par les espaces de stockage en *dolia*, au nombre de 62, 4 sites probablement munis d'espace de stockage en tonneaux ont été intégrés à l'étude.

Afin de mesurer l'évolution des capacités de stockage des installations vinicoles au cours du temps, un examen minutieux de l'évolution de chacun des sites du corpus a été

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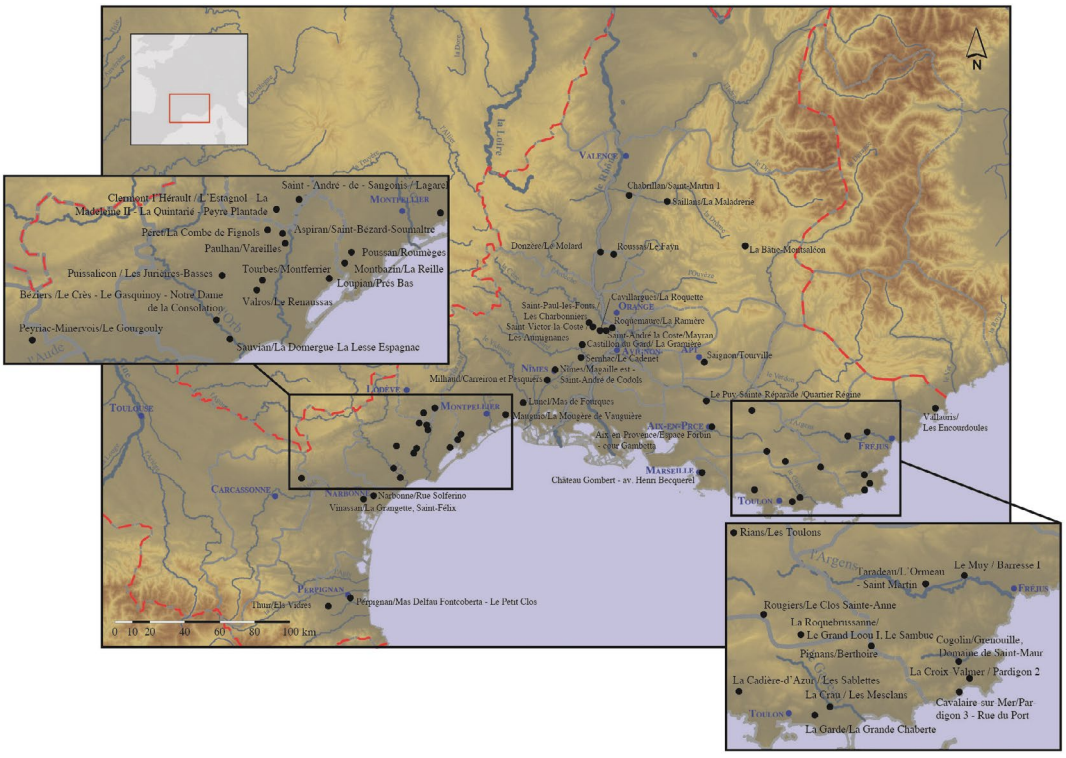

Fig. 1: Carte de répartition des installations vinicoles de Gaule Narbonnaise utilisées pour l'étude (66 sites).

réalisé. La chronologie considérée (I^er^ s. av.–V^e^ s. ap. J.-C.) a été divisée en phases d'un demi-siècle. L'ensemble de ces données chiffrées est rassemblé dans un tableau (fig. 2) et synthétisé par un diagramme (fig. 3). Pour évaluer les capacités de production par phase (en bleu), des estimations du nombre d'établissements en activité, du nombre global de *dolia* employés ainsi que de la capacité de stockage maximale ont été proposées. Afin de rendre compte de la dynamique des investissements dans les infrastructures de production vinicole (en orange), le nombre de nouveaux établissements, de nouveaux *dolia* et, de fait, l'augmentation ou la baisse des capacités de stockage ont été pris en compte. Pour évaluer enfin la taille des espaces de stockage par phase, le nombre maximal de *dolia* installés a également été renseigné et un indice de la capacité de stockage des nouvelles installations calculé (nouvelles capacités de stockage / nombre de nouvelles exploitations) (en vert).

La lecture de ces phénomènes économiques s'appuie également sur la cartographie des indicateurs précédemment définis (fig. 4). Ces cartes rendent d'abord compte des dynamiques économiques différentielles micro-régionale phase par phase. Complétées de symboles figurant l'augmentation ou la réduction des capacités de stockage en *dolia*, mais également la création d'espaces potentiels de stockage en tonneaux, elles permettent finalement d'affiner la lecture des indicateurs de développement.

Phases	Capacités de stockage			Dynamique d'investissement			Taille des exploitations
	Installations vinicoles actives	Nombre de *dolia* total	Capacité de stockage globale (en hl)	Nouvelles installations vinicoles	Nombre de nouveaux *dolia*	Nouvelle capacité de stockage (en hl)	Nombre maximum de *dolia* par site
Première partie du I^{er} s. av. J.-C.	1	27	486	1	27	486	27
Deuxième partie du I^{er} s. av. J.-C.	4	179	3,222	4	152	2,736	83
Première partie du I^{er} s. ap. J.-C.	16	1,482	26,676	14	1,347	24,246	340
Deuxième partie du I^{er} s. ap. J.-C.	53	4,236	76,248	42	2,754	49,572	412
Première partie du II^{e} s. ap. J.-C.	53	4,463	80,334	10	305	5,490	469
Deuxième partie du II^{e} s. ap. J.-C.	52	4,300	77,400	11	299	5,382	469
Première partie du III^{e} s. ap. J.-C.	36	2,720	48,960	3	32	576	300
Deuxième partie du III^{e} s. ap. J.-C.	21	1,843	33,174	1	23	414	300
Première partie du IV^{e} s. ap. J.-C.	10	876	15,768	0	0	0	362
Deuxième partie du IV^{e} s. ap. J.-C.	6	355	6,390	0	0	0	161
Première partie du V^{e} s. ap. J.-C.	2	70	1,260	0	0	0	47
Deuxième partie du V^{e} s. ap. J.-C.	1	47	846	0	0	0	47

sur la base de 18hl par *dolia*

Fig. 2: Table de quantification des capacités de stockage des installations vinicoles de Gaule Narbonnaise entre le I^{er} s. av. J.-C. et le V^{e} s. ap. J.-C.

Chronologie évolutive de l'économie vinicole sud-gauloise

La première phase de montée en puissance, qui s'étend du I^{er} s. av. J.-C. au I^{er} s. ap. J.-C., est marquée par une forte augmentation de tous les indicateurs. En l'espace de deux siècles, le nombre d'installations de production vinicole connu est multiplié par plus de 50 et les capacités de stockage par près de 160. L'investissement dans le domaine est plus fort à partir du changement d'ère et surtout dans la seconde moitié du I^{er} s. ap. qui voit la création de plus de 40 établissements, dont la majorité sont de grandes dimensions comme le montre l'indice de taille. De fait, le nombre d'installations en activité ne cesse de croître tout comme les capacités de stockage globales. On remarquera enfin que cette dynamique est accompagnée d'une augmentation de la taille des plus grandes exploitations qui atteignent plus de 400 conteneurs. La cartographie proposée pour cette première phase montre le développement précoce de l'économie vinaire en Languedoc rattrapé un demi-siècle plus tard, à partir de la seconde moitié du I^{er} s. ap. J.-C., par la Provence et la moyenne vallée du Rhône. À cette époque, les créations de nouveaux établissements sont majoritaires, même si ce phénomène est parfois accompagné d'une augmentation des capacités de production des chais existants.

Le II^{e} s. ap. J.-C. bénéficie des forts investissements antérieurs, mais atteste également des premiers signes d'une crise. Cette seconde phase correspond en effet à l'apogée de la viticulture sud-gauloise lors de laquelle le nombre d'installations connues ainsi que les capacités de stockage atteignent leur maximum. On connait en effet plus d'une cinquantaine d'établissements en activité à cette époque dont les capacités de stockage cumulées dépassent 80 000 hl. À cette époque, tout comme durant le siècle précédent, la viticulture constitue l'une des sources principales de l'enrichissement des élites.

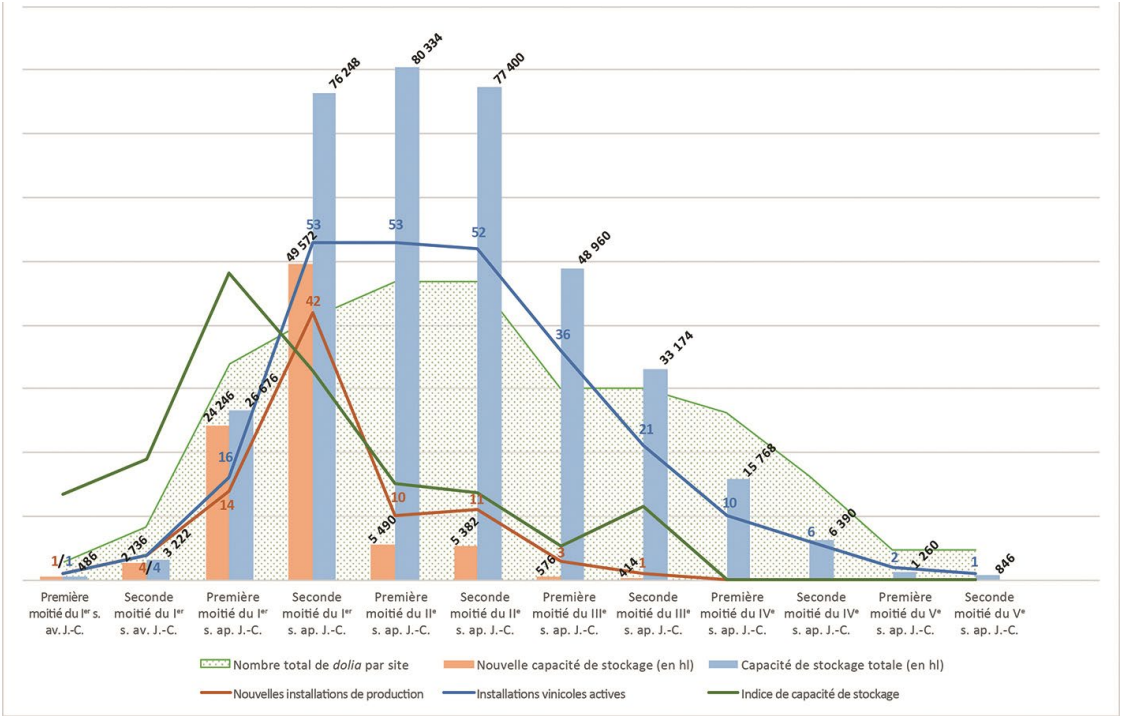

Fig. 3: Graphique de quantification des capacités de stockage des installations vinicoles de Gaule Narbonnaise entre le I^er^ s. av. J.-C. et le V^e^ s. ap. J.-C.

Ce secteur économique témoigne en outre d'une production de masse à destination commerciale à l'échelle de l'Empire, comme le confirment la multiplication des ateliers d'amphores et la large diffusion de ces emballages.[3]

Pourtant, la chute des investissements dans le domaine de la production vinicole est nettement perceptible dès le début du II^e^ s. En effet, le nombre de nouveaux établissements est divisé par 4 par rapport à la fin du siècle précédent et la taille des espaces de stockage nouvellement édifiés nettement réduite. Les prémices d'une crise se traduisent d'abord par la réduction des capacités de stockage de certaines exploitations, phénomène qui s'observe en tous points de la Province et touche tous les types d'établissements. Les signes avant-coureurs d'une mutation technologique semblent apparaître également à partir de la seconde moitié du II^e^ s., à travers la création de quelques exploitations qui n'ont pas livré de *dolia* et pourraient avoir été équipées de tonneaux.

Le déclin de la production vinicole de masse, distinctement entériné à partir du début du III^e^ s., est marqué par une chute du nombre d'exploitations en activité et, de fait, des capacités de production. Entre les charnières des II^e^–III^e^ s. et des III^e^–IV^e^ s., les capacités de stockage en *dolia* sont divisées par 2,5. Encore un siècle et celles-ci avoisinent les valeurs observées pour le changement d'ère. Durant cette ultime phase, l'investissement en nouveaux espaces de stockage en *dolia* est quasi nul.

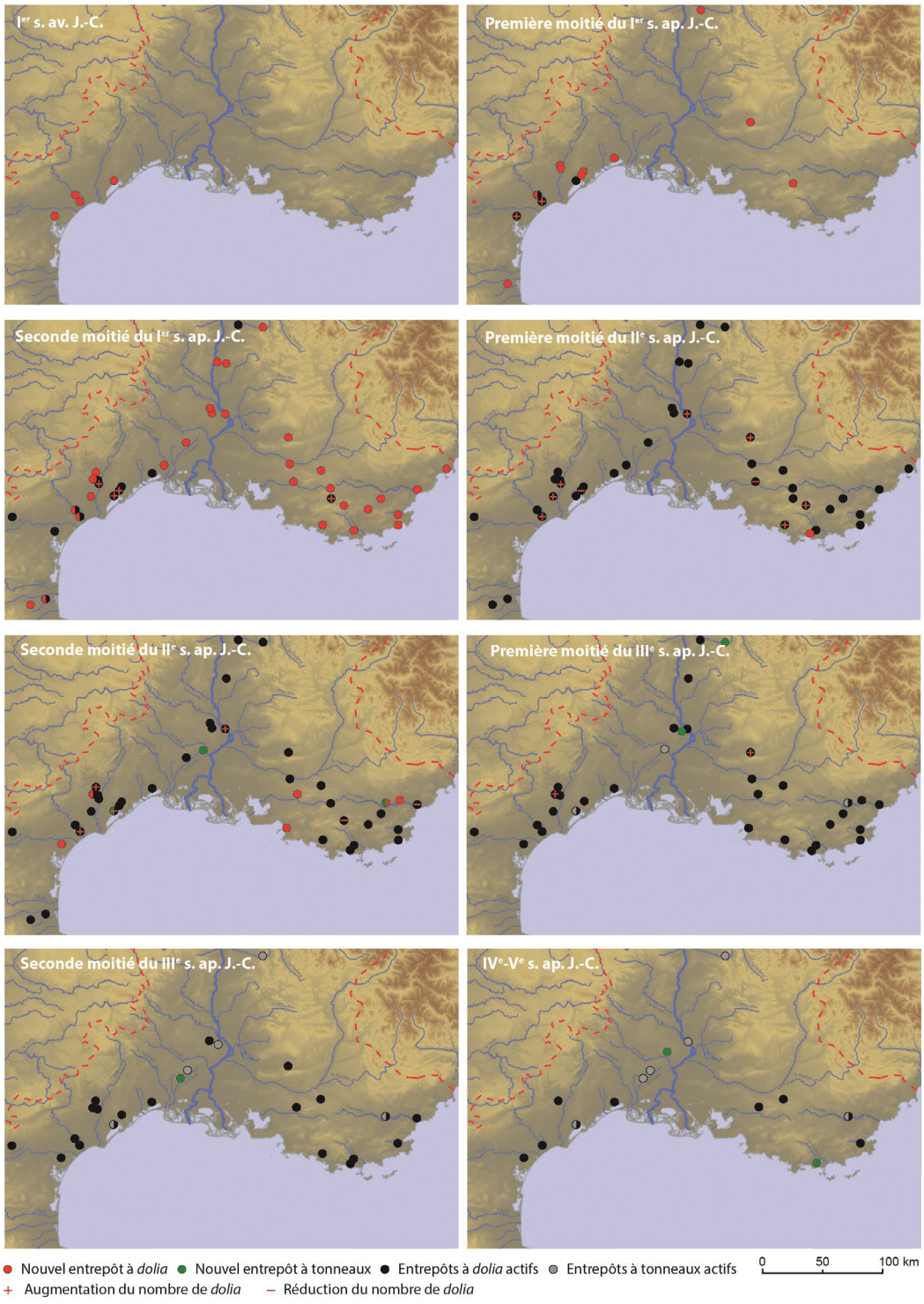

Fig. 4: Cartographie évolutive des installations vinicoles de Gaule Narbonnaise entre le Ier s. av. J.-C. et les IVe–Ve s. ap. J.-C.

Les mutations de l'économie vinicole à partir du III^e s. : disparition des indices de production ou réduction réelle ?

Les difficultés inhérentes à la définition de la fin de l'occupation des sites de production constituent un écueil que l'archéologie à elle seule ne permet pas de résoudre. En effet, s'il est aisé de déterminer l'augmentation des capacités de production avec l'ajout de nouveaux *dolia* au sein de chais existants ou de nouveaux établissements, il est souvent impossible de percevoir une baisse de la production n'entrainant qu'un abandon partiel de l'espace de stockage. Les *termini ante quem* des chais ne sont en effet définis qu'à partir de la récupération des *dolia* ou de l'abandon du site qui peut intervenir des années après la baisse ou l'arrêt de la production. Cette méthode de datation conduit de fait à sous-estimer la réduction progressive des capacités de stockage en *dolia* et bien souvent à rallonger la durée de fonctionnement des sites.

À partir du III^e s., la réduction progressive du stockage en *dolia*, principal marqueur de la production vinicole, est visible à travers l'abandon de nombreuses exploitations agricoles. Face à la réduction du stockage en *dolia*, on a souvent tendance à s'appuyer sur le développement providentiel du tonneau pour soutenir l'hypothèse d'une continuité de la viniculture régionale, comme le montre la cartographie de la Figure 4.[4] La restitution de tonneaux dans des espaces vides, anciennement occupés par des *dolia*, est vraisemblable dans certains cas, mais doit être basée sur des arguments solides, ce qui ne nous semble pas toujours être le cas. De surcroit, l'augmentation de l'usage du tonneau est en contradiction avec les attestations de son usage, majoritaires aux I^er et II^e s.[5] Pour être validé, un réexamen de l'ensemble des chais à tonneaux supposés nous semble nécessaire, tout comme la mise en place d'une méthodologie de fouille adaptée à ces espaces apparemment vides de tout aménagement, ou munis de bases maçonnées – prélèvements micromorphologiques, analyses chimiques. Enfin, des comparaisons architecturales seront à envisager pour évaluer la possibilité d'autres types de bâtiments agricoles, en particulier de greniers.[6]

En dépit de la difficulté d'identification des chais à tonneaux, qui pourraient avoir tenu une place importante dans l'économie vinicole du Bas-Empire, les structures de production vinaires (fouloirs, cuves de réception) sont aujourd'hui bien identifiées et laissent peu de doute sur la baisse réelle des capacités de production en vin de la Narbonnaise à partir du III^e s.[7] Il en est de même des indications fournies par l'étude des productions amphoriques qui témoignent d'une réduction progressive de la fabrication et de l'exportation sud-gauloise[8], parallèlement à une hausse des importations d'amphores vinaires venues de Tripolitaine ou de Maurétanie césarienne à partir du III^e s. L'ensemble de ces arguments milite en faveur d'une production réduite à diffusion régionale durant les III^e–V^e s. qui traduit également une réorientation économique de l'ensemble de la Narbonnaise au profit de la viticulture africaine[9] dont les modalités et la chronologie restent encore à étudier…

Notes

[1] Brun – Laubenheimer 2001; Brun 2005.

[2] Cette synthèse est une extension inédite de nos travaux récemment publiés (Carrato 2017a et b).

[3] Mauné 2013; Bigot 2017, 188–192.

[4] Selon les fouilleurs, 8 sites ont livré des espaces de stockage qui devaient accueillir des tonneaux.

[5] Marlière 2002, 175–179.

[6] Pellegrino 2018.

[7] Brun 2005, 74 s.

[8] Corbeel 2012, 105 s.; Bigot 2017.

[9] Bonifay 2004; Brun 2004 et 2019.

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Toutes les images sont de l'auteur.

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Recent Discovery of an Urban Winery in Rirha (Sidi Slimane, Morocco), 2nd–3rd Century CE

Charlotte Carrato – Abdelfattah Ichkhakh – Mohamed Kbiri Alaoui – Elsa Rocca – Marie-Pierre Ruas – M'Ahmed Alilou – Véronique Mathieu – Séverine Sanz-Laliberte – Nicolas Garnier – Jean-Baptiste Pineau

The Rirha site, in the fertile plain of Gharb, 8 km north of the present-day town of Sidi Slimane, lies along the right bank of a bend in the Beth wadi, a tributary of the river Sebou (fig. 1). The site was occupied continuously from the Mauretanian period (from the 6th/5th c. BCE) until Roman times (up to the 3rd–4th c. CE), then later after a hiatus, throughout the Middle Ages (from the 8th/9th c. to the 14th/15th c.).[1]

At the eastern end of the site, bordering a thick skirting wall – and what was probably a monumental gate – the first remains connected to a Roman artisanal winery were discovered.[2] It is located in a quarter that has yielded a Volubilitan peristyle *domus* and a thermal complex. Built in the last quarter of the 2nd c., it has been exceptionally well preserved thanks to a fire around the mid-3rd century.

In this study we present the preliminary findings of an ongoing study, detailing the remains uncovered, the traces of winemaking, and in general the importance of this discovery for our knowledge of the economy of Roman Africa.

The Winemaking Facilities in Rirha Unit 1

The winemaking facility covers an area of at least 250 m² (fig. 2a). On the eastern side it opens on to an alley, which may have run into a main street. Here there is a monumental entranceway, 2.5 m wide, framed by sculpted pilasters.

This gateway opens on to a "work room", comprising two areas (A and B): two flagged pressing rooms, raised above the earth floor and reached by at least one stairway (7) (southern press). They are marked by a sculpted cornice, probably once topped by a detachable wooden balustrade and high brick vaulting (fig. 2b). Crushing (1) and pressing (2) took place in the same areas. The grapes were presumably crushed in wickerwork filters or vats made of perishable materials, next to the press' bottom. The press was square-shaped and operated by a lever press[3], as indicated by the presence of a double anchoring block and a cylindrical counterweight (3).[4] The useful length of the *praelum* in the Rirha presses varies between 10 and 10.20 m, which makes them among the largest examples found in the region (fig. 3a).[5] The exceptional discovery of charred remains of a *praelum* in the southern press indicates that this was at least 0.58 m wide (4).[6]

Returning to the central corridor (C), this leads to the "processing room" (D), which runs behind the press areas. Only the southern half of this space, linked to the southerly press, has been explored. It was equipped with 4 wide-mouthed *dolia* (8), each with a

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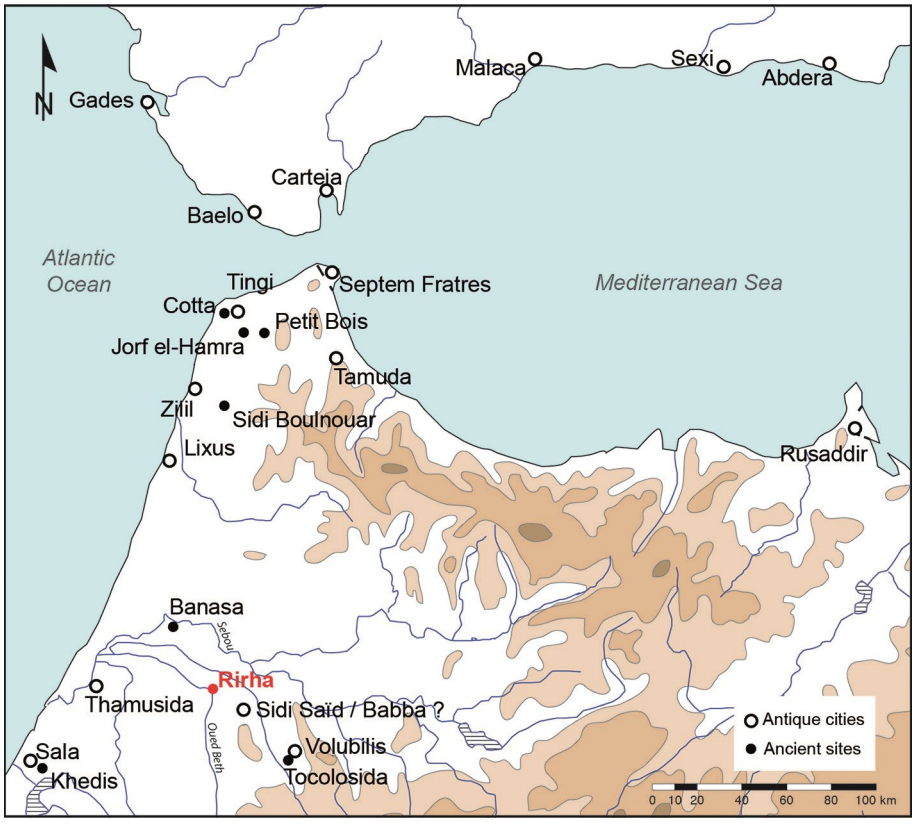

Fig. 1: Principal deposits in ancient Morocco and location of the Rirha site.

capacity of 170 l., enclosed in a brickwork skirting (fig. 3b).[7] Two other complete *dolia* backing on to the western wall suggest that this area could also have been used for storage (9), and perhaps also fermentation. The arrangements that have been uncovered include a water supply directly connected to a cistern (E), emphasising a concern to keep the production facilities clean.

Evidence of Wine Production

The fact that this was a winemaking facility was first evidenced by the discovery of large numbers of charred remains of grape pips, and then confirmed by chemical analyses.

Three primary deposits of charred grape residue were found on the floor of the "processing room" –one beneath the southerly press, and the others in circular patterns (0.9 m diameter) in the centre of the room. One of them was dry-sieved on 0.3 mm meshes to limit dissociation of the fruit parts and collect the smallest ones. This provided a total of 1877 remains with 94 % grape components mixed with seeds

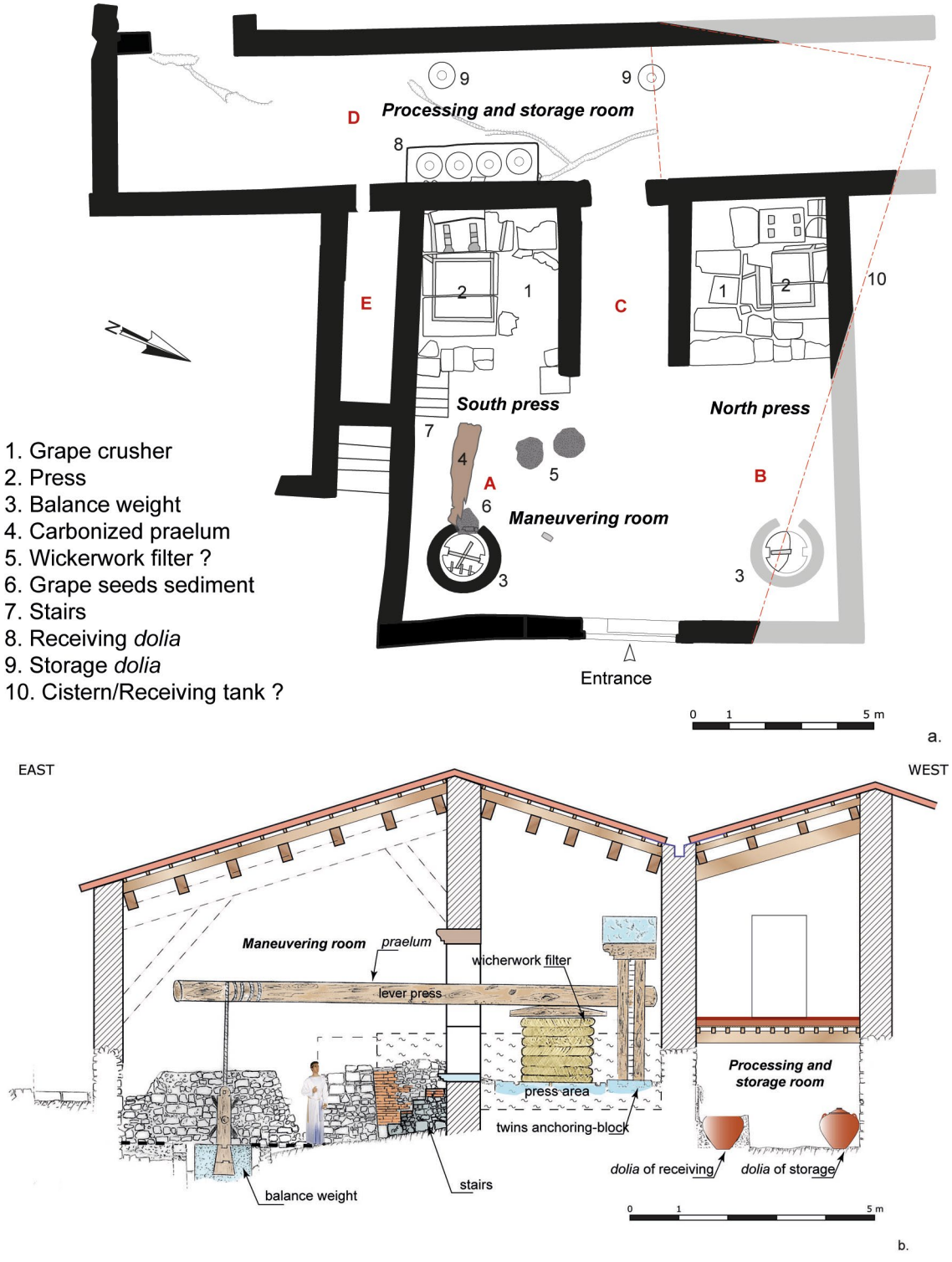

Fig. 2: Remains of winery at Rirha: (a) Explanatory ground-plan of production facility; (b) 2D hypothetical reconstructions of the southerly press.

Fig. 3: Detailed view of production equipment: (a) The southerly press with the counterweight in the forefront, the charred *praelum* and a cluster of grape pips in the centre, and the press area in the background (b) The row of *dolia* and the drains are in the centre, and the cistern on the right.

of cereals, pulses, a wild plant and fragments of grass stems. The grape residue consisted mainly of whole pips (87 %), pips with attached pulp or skin, folded berry skin, broken flattened berries, fruit pedicels and stem fragments (fig. 4.2–5). Some pedicels adhered to grass stems indicated that the fruit was thoroughly crushed. Ethnoarchaeological experiments suggest that the composition of the carbonized grape residues in the concentration studied closely resembles the grape by-products from the final pressing stage.[8] The lack of press basket traces (often made of doum palm) suggests that only its content was discharged. Ethnographic examples show that straw can be mixed in with these residues when the juice is poured into the containers. This straw thus serves to filter out solids: stalks, pips and tissues of the crushed fruit.[9]

In addition to these discoveries, analyses have been run on invisible impregnations on the walls of the four collecting *dolia* in the southerly press (tab. 1). All show markers of black (syringic acid from malvidin) grape (tartaric and malic acids) and alcoholic fermentation (succinic and fumaric acids), in addition to animal (ruminant) and vegetable (oleic, linoleic, sitosterol, stigmasterol) fatty acids, plus conifer seeds. These results indicate that the *dolia* were sealed with a mixture of conifer pitch and animal fat for easier application, and that they were filled with fermented black grape juice i.e. wine.

An Improved Characterisation of the Viticultural Economy of the Province of Tingitania

The reliable identification of a winemaking facility at Rirha is of great importance in that it provides a foundation for a better understanding of viticulture in Africa, where the ancient economy is mostly considered to be oil-based.[10]

In Roman Africa there would seem to have been less winemaking, despite numerous written[11] and pictorial sources[12], which could indirectly support the importance of wine in the economy of this part of the empire. Unlike the northwestern Mediterranean, where semi-interred *dolia* vaults are the principal signs of wine-making, in Africa such remains are rare. In fact, excepting the coastal part of Caesarean Mauritania,[13] wine seems rather to have been stored in amphorae or in small *dolia* placed directly on the ground.[14] This makes it difficult to distinguish between oil- and wine-making facilities, which can be done *"only on the basis of architecture and chemical or carpological analyses"*.[15]

In Tingitania, there are records of three oil-producing zones, and to a lesser extent wine producing, in the Tangiers region,[16] the Sala region,[17] and the Sebou basin.[18] These include 120 facilities largely interpreted as having been oil mills. However, there are certain indications in a dozen or so cases suggesting that some of them may have been used to produce wine. Northward, sites at Cotta,[19] Jorf el-Harma,[20] Petit-Bois,[21] and more recently Sidi Boulnouar,[22] seem to present characteristics of winemaking facilities.

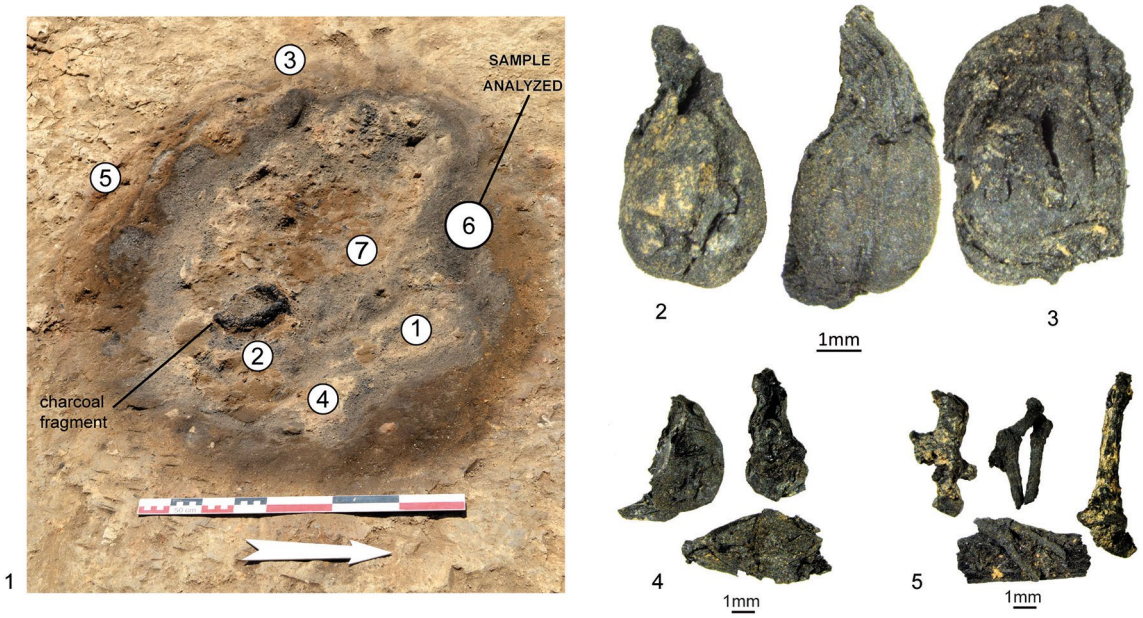

Fig. 4: Components from processed grape residue: 1. sampling in the circular concentration of carbonized grape waste (no. 6: sample analyzed); 2. charred grape seeds; 3. chared pressed grape seed covered by a fragment of the berry skin; 4. charred pressed berry skin; 5. charred grape stalk and pedicels.

n°	objet	animal fats						vegetable oils									resinous material					fruit		
		non ruminant	ruminant	milk product	itaconic ac.	heating (cholestadiénone)	beeswax	sebum / olive (squalène)	vegetable oils	heating (stigmastadiénone)	vegetable waxes	vegetable material	vegetable ashes	odd cétones (cooking)	subérine (2-OH acides)	chol / sito	coniferous resin	coniferous pitch	HPA diterpéniques	HPA triterpéniques	other resin	grape fruit	white/black grape	fermentation
1750	dolium	-	+	-	-	-	-	++	+	-	tr.	-	-	-	+	2.76	-	++	-	-	-	+++	black	+
1751	dolium	-	+	-	-	-	-	+	+	-	tr.	-	-	-	+	3.34	-	++	-	-	-	+++	black	+
1763	dolium	-	+	-	-	-	-	++	+	-	tr.	-	-	-	+	4.87	-	+	-	-	-	+++	black	+
1835	dolium	-	+	-	-	-	-	+	++	-	tr.	Fuco	-	-	+	0.89	-	+	-	-	-	+++	black	+

Tab. 1: Summary of the analyses of organic content in *dolia*.

In the Sebou basin, some installations at *Volubilis*[23] raise similar doubts. It might be worth reviewing the identification of the presses at Sala as oil mills, given that the locally made Sala 1 amphorae might not have contained oil as originally supposed.[24] All these facilities differ very little from oil factories, apart from the absence of mills and collecting basins. On the other hand, they exhibit some similarities, which seem to be characteristic to this province, such as the use of the same type of lever press,[25] or again the use of small Iberian-style *dolia*.[26]

This brief overview demonstrates the importance of a detailed study of wine producing equipment, thanks to the particularly well-preserved state of the excavation of the Rirha winery. Thanks to its exceptional state of preservation and the multidisciplinary approach that has been adopted, this major discovery will undoubtedly inspire advances in our knowledge of the wine producing economy of Roman Africa.

Notes

[1] The Rirha archaeological programme has been co-directed since 2005 by Mohamed Kbiri Alaoui and Abdelfattah Ichkhakh on the Moroccan side, and on the French side, from 2005 to 2012 by Laurent Callegarin (Casa de Velázquez, Madrid), from 2012 to 2016 by Claire-Anne de Chazelles (CNRS, UMR5140, ASM, Montpellier), then by Elsa Rocca and Charlotte Carrato since 2017. This research has always been supported by the French Ministry for Europe and Foreign Affairs, the National Institute of Archaeology and Heritage in Rabat, Casa de Velázquez and the Moroccan Ministry of Culture. Since 2013, the LabEx Archimede (programme "Investing in the future" of the Université Paul Valéry, ANR-11-LABX-0032-01) has played a central role in funding the research through the programme entitled "Gharb. Cultural identity in the Mauretanian area, from the Gharb to Morocco".

[2] We wish to thank Laurent Callegarin and Claire-Anne de Chazelles, French directors of the archaeological project during the first six years of the clearing of the complex, and Corinne Sanchez, director of the TP2C team of the ASM laboratory, UMR5140, Montpellier, for financing the English translation.

[3] This is a type Cc 311/12 press (Brun 1986, 86 fig. 28 and 100–103), the most common at Volubilis.
[4] The two counterweights (diameter 1.12 m) correspond to type 12 (Brun 1986, 120).
[5] At Volubilis, the arbores are between 4.70 and 9.20 m long (Akerraz – Lenoir 1981, 82).
[6] These are currently being researched by J. Ros (CNRS, UMR 5554, ISEM, Montpellier) and C. Vaschalde (UMR 5554, ISEM Montpellier).
[7] The grape juice was funnelled into one of the four *dolia* via a pipe placed after the press area drain.
[8] Margaritis – Jones 2006; Ros 2013.
[9] Ros 2013; Ros et al. 2016.
[10] Camps-Fabrer 1953; Brun 2004; Leveau 2005; Leveau 2008; Leveau 2011; El Bouzidi – Ouahidi 2016.
[11] Herodotus (IV, 195), Strabo (XVII, 3, 4) and Pliny (N. H., V, 1, 3).
[12] Leschi 1957; Rebuffat – Gabard 1990; Balmelle – Brun 2005.
[13] Amraoui 2017, 283.
[14] Brun 2003, 24; Brun 2004, 203.
[15] Brun 2003, 11.
[16] There are 31 known establishments in this region, among sites at Tangiers, Cotta, Jorf el-Hamra, Petit Bois, Daïat, Dchar Jdid/Zilil, Tamuda, Lixus and Sidi Boulanouar.
[17] There is evidence of two production facilities in this last location, plus four more in the hinterland.
[18] 11 in Banasa (Alaioud 2010), one in Rirha and 70 in Volubilis (Étienne 1960; Akerraz – Lenoir 1981; Es-Sadra 2010; Alaioud 2016).
[19] Ponsich – Tarradell 1965, 55–68; Ponsich 1970, 276 pl. LXXXVII; Brun 2004.
[20] Ponsich 1964, 243–252; Brun 2004.
[21] Ponsich 1964, 237–243; Brun 2004.
[22] Proceedings of the Tetuan conference (24–26 November 2016) "Mauritania and the Mediterranean World".
[23] Particularly considering certain facilities in the north-east quarter described by Étienne 1960: Maison au Bain des Nymphes, Maisons des Fauves, Maison de la monnaie d'or, Maison aux deux pressoirs, Maisons aux demi-colonnes, Maison à la bague d'or.
[24] Boube 1987.
[25] Type Cc311/12 (Leveau 2011, 62 f.), which could have had a screw during the 2nd c. on an original and specific type to Tingitania (Brun 2004, 257 f.).
[26] Carrato forthcoming.

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The Agricultural Territory of La Solana de las Pilillas (6th–5th centuries BC)

Asunción Martínez Valle

The Requena-Utiel Plain is located in the West of the Valencia province (Spain). Oriented northwest to southeast, this plain covers a 2,100 km^2 area between 600 to 900 metres above sea level. This area marks the contact between the southern foothills of the Iberian System and the northeastern slopes of the southern sub-plateau. A river called Cabriel, tributary of the Júcar River, delimits its southern border having deeply carved the terrain.

The plain forms a geographical entity, which has been, since antiquity, a cultural and administrative unit. Its characteristics derive from its border location on the route leading from the Mediterranean coast to the interior of the Iberian Peninsula. Its climate is broadly Mediterranean but with some transitions to continental marked by cold winters and short hot summers that restrict farming possibilities but offer better chance of success for vine cultivation.

The Cabriel river created abrupt cliffs in a mountainous morphology furrowed by numerous dry rivers and deep valleys. Along two of these furrows, Los Morenos and Alcantarilla, several settlements dedicated to the production of wine were established from 6th century BC onwards (fig. 1). They are characterized by the adaptation of the natural rocky environment for carving treading floors, presses and vats used for crushing and pressing the grape and make wine.

The Origin of Wine Production at La Solana de Las Pilillas

Wine consumption in the Requena-Utiel Plain has been documented as far back as the 7th century BC, and the beginning of local production dates from the 6th century BC.

La Solana de las Pilillas (Requena, Valencia) is an Iberian tower-farm that started the production of wine in the early 6th century BC.[1] The site is located at 65 km from the Mediterranean coast in the ravines of Los Morenos, next to the Cabriel river. This area is covered by limestone soils; the local microclimate is ideal for vine cultivation, sunny and not too dry thanks to the water of the ravine. The site is exclusively dedicated to wine production and commercialization, where wine was fermented in amphorae produced in the area.[2] This seasonal settlement consists of four rock-cut wine presses, a cellar and a tower, displayed on terraces maintained by walls. The platforms are linked by passages that facilitated access to the different areas (fig. 2).

On the slope of the hills, intense erosion detached large blocks of limestone that rolled down and are now situated far from their original location. The presses are carved in these blocks; they usually present an upper platform, rectangular in shape, surrounded by a rim with postholes and grooves used for covering the structure. This

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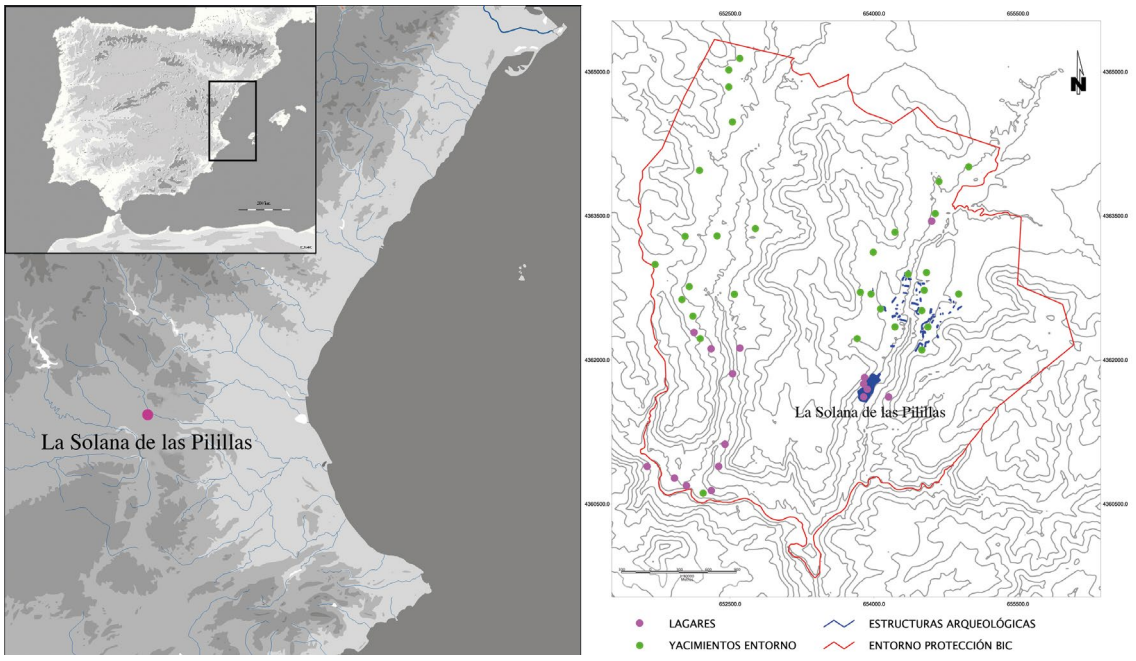

Fig. 1: Location of La Solana de las Pilillas and its territory.

platform is connected through holes to a vat carved at a lower level. The must flew from the trodden grapes into the lower basin. It was then poured into amphorae and taken away in order to proceed with the subsequent production process.

Detailed analysis of these wine presses allows to propose a hypothetical reconstruction. Holes and marks carved in the rock reveal the pressing systems. The capacity of the lower basins gives us an idea of the quantity of must gathered in one load. In the four presses excavated at Solana de las Pilillas, one load could produce approximately 2,000 liters of must.[3]

Next to the wine presses, a building containing amphorae and stone stoppers can be interpreted as a wine cellar with a storage capacity higher than other contemporary wineries in the Iberian territory. Such a capacity suggests that a part of the wine was intended for trade.

The excavations of the site were coupled with survey of the surrounding area in order to discover other wine presses and other settlements connected to this place dedicated to wine production. Twelve rock-cut wine presses in use during the 5th century were found along the ravines of La Alcantarilla. La Solana de las Pilillas site was part of an agricultural territory covered partially by vineyard and exploited from several settlements. This territory was thus organized around settlements mainly dedicated to the production of wine.

These settlements were connected by tracks, which were certainly used by the wine trade. The remains of these narrow tracks and paths are enough numerous for partly reconstructing the road network (fig. 3).

Fig. 2: Aerial photo of La Solana de las Pilillas.

Las Pilillas winery is linked to two pottery workshops, where amphorae and tableware were manufactured. Both, pottery and wine production show a significant Phoenician influence.

The Potters Kiln El Nacimiento

The potter's kiln El Nacimiento (Requena) can be detected by the abundant Iberian ceramics scattered in surface and by over fired sherds; it can be dated from the 7th–6th centuries BC. The ceramic production included pithoi, amphorae, plates and gray ceramic. The production of typical tripods and mortars is linked to the Phoenician influence. From the beginning of the excavations of Phoenician sites in the Iberian Peninsula, tripods were identified as a specific type introduced by them. The tripod does not derive from any local production of the Late Bronze Age and it is considered as a Phoenician import into the western Mediterranean from the second half of the 7th century BC. Besides the local wares, fragments of amphorae R1 made in the southern part of the peninsula prove the import of Phoenician wine; some fragments of pithoi are also imported.

The ceramic production of El Nacimiento is related to the consumption of wine. The Iberians adopted the Phoenicians drinking behavior. The locally made tripods and mortars (in gray ceramic and class A) were used for crushing substances added to the preparation of the beverages.[4]

This production of tripods in a kiln near the Early Iron Age site of Requena suggest narrow contacts between the local population and the Phoenicians who transmitted the know-how of the ceramic and wine making.

Fig. 3: Ancient track probably related with wine trade.

Casillas del Cura Archaeological Site

Towards the beginnings of the 6th century BC, the pottery workshop of Casillas del Cura began to produce ceramics at commercial scale near the Cabriel River. The excavations carried out on this site showed a large pottery workshop equipped with four kilns and surrounded by over fired scattered vases. Fourteen discarded amphorae were found in one of the kilns. All of them were broken and 3500 fragments[5] had to be assembled in order to obtain complete profiles and to measure their capacity; the typology of these amphorae shows that they derive from Phoenician prototypes.[6] The Casillas del Cura workshop consolidated the technology of ceramic production. According to the dimensions of the kilns and the volume of pottery, this workshop was more important than the El Nacimiento one. The forms made in this workshop are often more evolved even if some of them are similar in both deposits. Containers of Phoenician influence, such as jars and small jars, dominate at Casillas del Cura. They constitute more than 50 % of the output, the plates and the amphorae around 15 % each. The potteries made at Casillas del Cura are largely present in the warehouse of La Solana de las Pilillas.[7]

Rock Cut Wine Presses of the Ravine of La Alcantarilla

In the 5th century BC, the production of wine increased and the occupation of the ravine of La Alcantarilla began to condense. Wine making is associated to scattered farming settlements, located next to rock cut wineries. The growing production implicates a greater control of the territory with new settlements up the hills, next to the main communication and trade routes.[8] Concentrations of these wine presses have been discovered on the edges of the ravine of La Alcantarilla. For example, la Solana de Cantos includes four wine presses and a cellar, which was used during two phases between 5th and 3rd century BC. This occupation was not permanent and we interpret the remains as shelters used for housing the work force during the harvest and for storing the amphorae during the process of fermentation.[9]

Another archaeological zone at the Rincon de Herreros was occupied from the 5th century BC: three wine presses and two displaced fragments of another one were found. Remains of wine presses are also visible at El Saltadero and at Solana de las Carbonerillas.

The permanent settlement village is located at Casa de la Alcantarilla. Here lived the population who exploited the agricultural territory between the 5th and the 4th centuries BC.

Conclusions

The wine production began in the Requena area under the influence of eastern Mediterranean populations towards the beginnings of the 6th century BC starting vine cultivation, which was maintained in the Requena-Utiel plain for centuries.[10]

Through contacts with Phoenicians not only the vine cultivation and the production techniques were transmitted, but also cultural elements that the Iberian people assimilated and adapted to its own idiosyncrasy. The dynamics of occupation of the territory created a new agricultural landscape.

Direct connection with the Mediterranean wine cultures has been proven by the excavation of the rock cut presses and the fermentation processes in clay vessels often made in local kilns since the 6th century BC.

The wineries of La Solana de Las Pilillas and other ones along the ravine of La Alcantarilla are examples of the capacity of the Iberian societies to organize themselves collectively and to build infrastructures technically adapted albeit in remote areas. The construction of the presses, of the terraces, of the cellars required a great investment of time and effort; their maintenance was also difficult given the seasonality of their use.

These settlements are integrated into the territory and are related to other Iberian sites through a wide network of roads, some of them paved in order to facilitate the circulation of carts and, thus, the transport of wine.

Las Pilillas archaeological site is part of a cultural heritage shared with others Mediterranean countries. There have been many documented discoveries regarding wine culture influenced by Mediterranean cultures, such as an Iberian goblet locally

made that bears a picture of a Dionysian myth often represented on Greek vases dated from the 5th to the 4th centuries BC (fig. 4).[11]

Fig. 4: Iberian goblet with representation of a Dionysian myth.

Notes

[1] Excavation of the site started in 2009 with the purpose of creating a museum. The following institutions are cooperating in this project: Valencian Institute of Conservation and Restoration of Cultural Heritage and Requena's Town Council.
[2] Martínez Valle et al. 2013a.
[3] Pérez Jordá 2000.
[4] Martinez Valle 2017.
[5] UPV (Universidad Politécnica de Valencia) students doing their specialization on conservation and restoration of cultural heritage have managed to complete some of the amphoras in summer working campaigns.
[6] Martínez Valle et al. 2001.
[7] Martínez Valle et al. 2013b.
[8] Martinez Valle 2017.
[9] Mata et al. 1997.
[10] Brun 2013.
[11] Martínez Valle 2014.

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Fig. 1. 3: by the author. – Fig. 2: Territorio Bobal. – Fig. 4: P. Más.

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The aim of this volume is to present new data and current multi-disciplinary projects on viticulture in antiquity, on the production and circulation of wine, and on the containers that held the wine, involving archaeology, archaeometry, archaeobotany and molecular-archaeology.
The studies in this volume focus on Italy, and its relations to other areas (Spain, Malta), to deepen our knowledge of the transformations in the agricultural landscape. Another focus are wine production facilities, which have until now remained under-studied, such as rock cut vats.
The advancement of technical knowledge is gradually answering the old question of differentiating between wine and olive oil production facilities. We knew that the same presses were used for both products, but now, systematic floatation can turn up olive stones or grape seeds, and biochemical analyses in gas-chromatography or liquid-chromatography coupled with mass-spectrometry now provide very reliable results on the remains in vats.
The second part of the volume presents some new archaeological and archaeometric data related to the production and distribution of wine amphorae – coming from the Tyrrhenian coast of Italy, Spain and Africa – in Italy and the western Mediterranean, the study of which was also carried out using laboratory methods.

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