Journal of Archaeological Science: Reports 21 (2018) 166–174

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com/locate/jasrep

Spectroscopic characterization of amphorae from the 8th to the 7th c. BCE found at the Almaraz settlement in Almada, Portugal

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ARTICLE INFO

Keywords:
Phoenician amphorae
Almaraz at Tagus Estuary
XRD
XRF
Micro-Raman

ABSTRACT

The archaeological site of Almaraz is located in the old part of the city of Almada, in the south shore of Tagus River, region of Lisbon. The excavated findings and the radiocarbon dating of the contexts where these were found show an occupation that can in fact be dated from the 8th to the 7th c. BCE period, thus a very early stage of the Phoenician occupation in the Iberian Peninsula. Numerous amphorae sherds were found at Almaraz. A spectroscopic characterization of those ceramics was made and is presented here, to help us understand if they were produced locally, in Lisbon workshops, or imported.

Sixteen sherds representative of the thousands found at Almaraz were studied with the use of non-invasive spectroscopies, namely by crossing information from micro-Raman and X-ray fluorescence emission data. X-ray diffraction experiments were also performed.

In spite of the fact that no ceramic kilns were found at Almaraz until now, the results point to two major groups of amphorae of local origin: one which used clays of Miocene origin, found on the southern shores of the Tagus River, very close to the Almaraz site, at Palença (with quartz, anorthite, diopside and hematite). Another group, remarkably different, made use of clays of Pliocene origin also from the Tagus Estuary, the Fontaínhas clay source (where quartz, anorthite, muscovite and hematite were found).

1. Introduction

Based on the archaeological investigation the human occupation of Almaraz site started in the Late Neolithic (4th Millennium BCE). Excavation findings described below, associated to radiocarbon dating (Barros and Soares, 2004) indicate that the Almaraz settlement had an extensive occupation since the Late Bronze Age (9th to the early 8th c. BCE). Its first contacts with Phoenician settlers, possibly originating in southern Iberia or even far away, seems to have started in the 8th century, the moment when they seem to reach the Tagus Valley (Arruda et al., 2017), making it an important site in the history of Iron Age settlement. However, we should take into account that one iron knife has been recovered in a nearby context associated to Late Bronze Age site known as Quinta do Marcelo (Vilaça, 2006) an artefact which may indicate some sort of early contacts with people from the Mediterranean. These objects have also been found in other northern Portuguese Late Bronze Age sites which attest for some sporadic interaction at least since the 9th century BCE.

The amount of material recovered, with very rare imported objects such as alabaster vases and an Egyptian faience scarab, thus unique in the Tagus Valley, as well as Corinthian pottery, reveal the importance of this settlement with permanent contacts with the Mediterranean, most likely the home of the political elites which were responsible for the control of trade in the River Tagus Valley and with close relations with Lisbon since both settlements were in privileged areas and controlled the entrance in the Tagus mouth and the inland access through the river, a recurring occupation and geostrategic model observed in other areas of Portugal (Aubet, 2002; Arruda, 2005). The exploration of

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https://doi.org/10.1016/j.jasrep.2018.07.005
Received 21 March 2018; Received in revised form 15 June 2018; Accepted 7 July 2018

the Tagus River as source of metals such as gold may in fact justify the strong defense of its entrance (Sousa, 2014). Other products such as salt, fundamental in the conservation of food and its transport, were also exploited.

The archaeological site of Almaraz is a large and rocky strip of land hanging over the Tagus River, in an area located between the Castle of Almada and Cacilhas. On its North side, a huge cliff can be seen, while the South side was defended by two lines of walls and one ditch. The site is located in the old part of the city of Almada, on the Southern shore of the Tagus River, in the region of Lisbon.

Originally this archaeological site had an area of approximately 6 ha, but it has been reduced to about 4 ha due to urban expansion, although just a small fraction has been excavated. *Archaeological excavations* in this settlement were made from 1988 (the site was discovered in 1986) with archaeologists going back frequently until 2012, providing numerous examples of artisanal activities, namely potter trivets from pottery workshops, crucibles for melting metals such as gold, silver, tin, lead, copper, bronze and iron (Melo et al., 2014; Valério et al., 2003), loom weights, fishing accessories, etc. (Barros, 1998; Olaio, 2015). Thousands of amphorae sherds were found in the archaeological site, in spite of the small excavated area (< 5% of the total), suggesting a local production. On the other hand dozens of tripods, of prismatic shape (triangular cross-section) were found, used as kiln furniture to separate objects during the fire process. Similar objects have been found in other Phoenician archaeological sites associated to pottery production. Numerous remains of amphorae sherds were found, associated to these older contexts, although other contexts, especially habitation structures and domestic waste pits, can be related to other chronologies ranging from the 7th to 4th century BCE, since the site only declines after the Punic wars and the Roman occupation (Barros, 1998; Barros et al., 1993). The amphorae discovered at the site indicated that most probably these objects came from a local/regional production, within about 10 km distance (Olaio, 2015). The production of amphorae in the Tagus Valley during the Iron Age had already been suggested by Ana Margarida Arruda (1999) and at least two areas of production confirmed based on the visual characteristics of these artefacts. Sousa and Pimenta (2014) identified these two types of production. One of them is found mostly in the mouth of the Tagus River which the authors believed to be made in the Lisbon or Almaraz area and a second type, usually found slightly upriver. The description of objects provided by these authors correspond to the amphorae collected from Almaraz, including a white slip covering the external walls and with, at least seven different morphological types (Sousa and Pimenta, 2014), ranging from the 8th to the 4th century BCE.

These earliest regional objects where found in sites such as the Rua de São Mamede ao Caldas in the Lisbon Castle Hill, dated from the mid-8th century BCE, as well as in Vila Franca de Xira where deformed objects may indicate the proximity of a production site (Pimenta and Mendes, 2011). The present state of knowledge concerning the production of transportation jars in the Tagus Valley does not permit to conclude the existence of other production centres although this hypothesis cannot be discarded, especially for more recent chronologies (5th–4th centuries). All of these older shapes find similarities with southern Iberian productions revealing permanent contacts since these objects were frequently traded and travelled long distances carrying food supplies (Ramon Torres, 1995).

On later chronologies Lusitanian amphorae were also produced in the kilns located at the Tagus Estuary (Porto dos Cacos and Quinta do Rouxinol), in a later period, from the 1st to the 5th c. CE. A detailed elemental composition study of amphorae fragments was performed with the use of instrumental neutron activation analysis (INAA), to access the differences between the amphorae produced in these two workshops (Dias et al., 2010). About 40 km South of Lisbon (see Portugal map included as an inset in Fig. 1A), in the Sado river estuary, numerous amphorae fragments were also found at six archaeological sites, including the kilns of Herdade do Pinheiro. Those remains were studied with the use of INAA and XRF techniques (Prudêncio et al., 2009; Dias and Prudêncio, 2007), and were organized into two groups, Sado 1 and Sado 2, based on the proximity of the producing kilns to the clay sources. These Sado productions date from the 1st c. BCE to the 5th c. CE.

Sixteen sherds representative of the thousands found at Almaraz were studied with the use of non-invasive spectroscopies, namely crossing information from micro-Raman and X-ray fluorescence emission (XRF) data. X-ray diffraction (XRD) experiments were also performed. For this study, only sherds found in two well characterized pits were used. Four samples were from the 8th c. BCE (ALZ103, ALZ111, ALZ247 and ALZ419), while the remaining samples were from another pit with an archaeological context of the 7th c. BCE. The amphorae of more recent origin (6th, 5th and 4th c. BCE) were not studied.

The samples correspond to the types found in the Almaraz. The objects were selected from the collections found in well dated and secure archaeological contexts. The earlier examples, possible to date from the late early 8th century till mid-7th century, a chronology obtained from C14 determination, were found inside a pit filled with domestic garbage (Barros and Soares, 2004). This context is dated from the moment when Phoenician settlers were reaching the Iberian Peninsula. Although the lower layers of this pit provided this earlier date, the upper layers were dated from the 5th and 4th centuries. As for the other samples these were found inside the filling of the defensive wall, a structure that was presumably abandoned and filled in the 7th century. Although this chronology was also obtained via radiocarbon dating, the authors suggest that this date is not as viable as the one from the domestic pit since the filling of the defensive pit may have been made in different moments and with objects and garbage retrieved from zones where it was deposited earlier (Barros and Soares, 2004). Recently the C14 determinations from these contexts in Almaraz were reviewed and in spite of the doubts that emerged from the sample collection it is still possible to secure a settlement with at least an early 8th century occupation (Soares and Arruda, 2017), based in some artefacts. Together with some contexts found in Lisbon, Santarém and Moura, the Almaraz is still one of the oldest sites where the contact between West and Eastern populations is documented, a moment when Phoenician settlers were entering the Iberian Peninsula (Soares and Arruda, 2017).

A spectroscopic comparison with the well characterized ceramics found in the south shore of the Tagus River, either at Santo António da Charneca (SAC) (Barros et al., 2012), and Mata da Machada (MM) (Carmona and Santos, 2005), or in Lisbon archaeological contexts, (attributed to Lisbon workshops) was performed (Vieira Ferreira et al., 2015a; Mangucci 1996; Vieira Ferreira et al., 2015b; Vieira Ferreira et al., 2016). Local clays were also included for provenance studies' comparisons, and were collected both in the north and south shores of the Tagus River, as indicated in Fig. 1, using as much as possible the same clay sources as those used in the older workshops (Vieira Ferreira et al., 2015a; Lepierre, 1899; Matos Sequeira, 1917).

The main objectives of our study are: 1) the spectroscopic characterization of the pastes of Almaraz amphorae (to the best of our knowledge, the oldest amphorae found and produced in our country until now); and 2) and the mineralogical identification of the clays used by potters to manufacture them. The chemical composition of the ceramic pastes and clays (as raw materials) will be compared by using different temperatures for firing the clays in the laboratory, with the aim to distinguish which productions came from Almaraz or Lisbon. One should emphasize that this is the first complete archaeometric study performed for a Phoenician site in the region of the great Lisbon.

1.1. Raw materials and geological context

The studied area belongs to distal sector of the Lower Tagus Basin (LTB) that occupies a large area in Portugal, from the littoral region of Lisbon-Setubal Peninsula, to beyond Spanish border near Castelo Branco (Beira Baixa). The LTB is a symmetrical western counterpart of