



The combined use of petrographic, chemical and physical techniques to define the technological features of Iberian ceramics from the Canto Tortoso area (Granada, Spain)

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Abstract

Thirty-two ceramic fragments dating from the Early Iberian Age were collected in Canto Tortoso, an archaeological site located about 100 km from the city of Granada (Spain). The site is on a hill bordered by two rivers, the Fardes and the Guadiana Menor.

The ceramics are divided equally into amphorae and vessels and half of them have black cores. The samples are rich in SiO₂ and Al₂O₃, with varying amounts of CaO, Fe₂O₃, MgO and K₂O. The most common mineral is quartz and almost all the samples have muscovite-type phyllosilicates. Calcite appears as small grains dispersed in the matrix and sometimes also of secondary origin covering the surface of samples or filling the pores. One ceramic was richer in calcite grains than quartz. An incipient decomposition of this carbonate is detected even at low firing temperatures. Samples fired at high temperatures are characterised by the presence of mullite or gehlenite and/or diopside phases. These silicates are also accompanied by a vitreous phase that increases the interlocking between the particles and changes the morphology of the pores from angular to round. The precipitation of phases of secondary origin on the surface of the ceramics may have minimised the chromatic differences between Ca-rich and Ca-poor samples. The combined use of chemical, petrographic and physical techniques allowed us to estimate the firing temperature of the ceramic samples (most samples were well-fired) and to discover the provenance of the raw material (a clayey material found near a kiln located just 3 km away from the settlement has a mineralogical composition compatible with that of the ceramics).

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1. Introduction

The Iberian people lived in settled communities in the East and South of the Iberian Peninsula from the VII to the end of III century BC when the Romans conquered the region. They shared a number of common features such as language, art, urban planning and religious rituals, while diverging in other typical aspects of a larger, more established state government such as politics and the economy [1].

The settlement of Canto Tortoso belonged to Bastetania, a region of the southern Iberian Peninsula, and the surviving archaeological remains are today located within the municipal

borders of Gorafe (Granada, Spain) in an area of 1.4 ha. This site was discovered during archaeological excavations in 1992 and the findings were described in a monographic work [2].

The settlement was founded on a hill with steep sides that overlook the confluence of two rivers, the Guadiana Menor and the Fardes (Fig. 1) and appears to have gone through three different chronological phases: the first settlement located at the eastern end dates from the Early Calcolitic Age; the second about which we have scant information is from the End of the Bronze Age; and the third and most important from the Early Iberian Age covers almost all of the site and contains the only architectural structures identified. These structures include a wall with a perimeter of 840 m, which has collapsed in many places due to the erosion of the hillside. There are also the remains of several rectangular-shaped houses. A path to the

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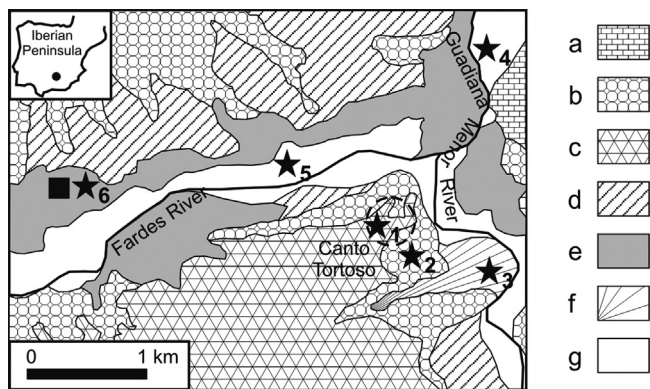


Fig. 1. Geological map of the Canto Tortoso area (Granada, Spain): (a) bioclastic limestones from the Turolian Age; (b) grey, white and ochre clays with levels of conglomerates, silts and carbonates from the Upper Turolian-Pliocene Age; (c) salmon-red clays with conglomerates, silts and carbonates from the Plio-Pleistocene Age (Guadix Formation); (d) depositional pediments composed of clayey-silt sediments with dispersed carbonates from the Middle Holocene Age; (e) present day alluvial fans from the Holocene Age; (f) talus cone from the Holocene Age; and (g) floodplain from the Holocene Age. From Roldán García et al. [51], modified. The perimeter of the settlement is marked with a dashed line. Stars followed by numbers 1–6 represent the location of the raw materials (RAW1–RAW6) we collected, while the square indicates the position of the kiln.

fortified area (about 3 m wide which narrows as it approaches the settlement) is still visible and is unique in the archaeological context of other contemporary settlements.

The recovery of Iberian Age ceramic fragments on Canto Tortoso hill suggests that this fortified settlement was a staging post on the trade route between the northern Guadalquivir (*Castulo*) and the coast of Almeria (*Baria*) [3]. The lack of any direct data from the archaeological excavations prevents us from specifying what goods were being traded. Adroher Auroux and López Marcos [4] suggest that wine and salted fish from the coast were exchanged for beer from more inland areas, all products likely to have been transported in amphorae and similar containers.

Although no previous archaeometric studies have been carried out on the ceramics from Canto Tortoso, there is an extensive bibliography dealing with ceramic artifacts from the Iberian Age, which provides compositional, technological and provenance information. As examples, several studies have been conducted on the ceramics discovered in the South [among others, 1,5,6] and North-East of the Iberian peninsula as well as on trade with neighbours [7–9]. Ceramics were one of the most significant elements of Iberian culture [10] and research has shown that potters had acquired a certain degree of skill not only in the manufacture of more elaborate products [1,11], but also in their knowledge of the raw materials. They learned for example how to prevent “lime blowing” in ceramics made with carbonate-rich clays [12], a skill they were perhaps obliged to attain due to the limited choice of raw materials in the area. The use of one type of raw material rather than another was dictated by the position of the settlement since clays tended to be quarried somewhere in the vicinity [13]. Hence, potters had to use forcedly local clays to make different types of products by varying the proportion of clay, silt and sand fractions and changing the firing temperature and/or the atmosphere [14].

The purpose of our research was to make an initial mineralogical and textural characterisation of the ceramics from Canto Tortoso, to investigate the provenance and the types of raw materials used in their production and to establish the range of firing temperatures. We began by conducting a petrographic study which we then complemented and completed with a series of physical tests. Given that ceramics can provide an insight into the society that manufactured and used them, an accurate characterisation of these materials can contribute to a better understanding of this ancient period of our history.

2. Materials and methods

2.1. Description of the samples

Thirty-two fragments of amphorae and vessels from the Early Iberian Age (VI century BC) were collected in the archaeological settlement of Canto Tortoso. They were selected after an archaeological survey of a larger group of fragments according to their archaeological significance and function. Macroscopically they are red-brown to pale-yellow coloured (Table 1). However, the original colours of ceramics may have been altered by the long exposure to the environmental conditions in the archaeological site. In some cases, the surface is covered by a discontinuous thin white patina. About half of the ceramics have a black core 2–4 mm thick measured on cross-sections (Table 1). Previous authors have attributed the presence of this dark level, sandwiched between the red (or yellow) surfaces, to the use of too fine ceramic body that have after firing a too fine porous texture [15], and the presence of organic matter or other reducing substances in the raw material [16–18]. In this case the poor oxidation of the core of ceramics caused the incomplete burning of organic matter, which was carbonized, and the reduction of iron compounds [19].

Six clayey materials outcropping in the vicinity of the settlement were collected for comparison with the ceramics in order to identify, if possible, the provenance of the raw materials used by the Iberian potters: two of the clays were found close to the settlement, one of these was from the Upper Turolian-Pliocene Age and the other was from the Guadix Formation from the Plio-Pleistocene Age; one was located in the talus cone just below the settlement and another in the sediments of the Guadiana Menor River; the last two were from the Holocene sediments (alluvial fans and floodplain) in the Fardes River. One of these last two sediments was collected near an Iberian Age kiln situated about 3 km away from the settlement, which is thought to date from the VI century BC (Fig. 1 and Table 1).

2.2. Analytical techniques

Major elements of the ceramic samples were determined by X-ray fluorescence (XRF) on fused Li-tetraborate beads using a Philips MagiX PRO model PW2440 spectrometer with Rh 4 kW tube. Prior to the analysis, 5 g per sample was finely milled in an agate mortar. The white patina, observed on the surface of some samples, was removed before milling. The accuracy of our analytical results was evaluated by comparison

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