Ceramic production in Monte da Pata 1 and Castelo das Juntas Late Iron Age sites (Guadiana Basin, southern Portugal): some archaeometric results

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ABSTRACT Within the Alqueva dam impact project (Guadiana basin, Portugal) an archaeometric approach has been done to several sites of various chronologies. This work presents results obtained for the chemical and mineralogical characterization of ceramics of two sites belonging to an Iron Age settlement network — Monte da Pata 1 (third-second century BC) and Castelo das Juntas (fourth-first century BC). Also potential local/regional raw materials were analysed. Ceramics from M. Pata 1 generally points to a local/regional production both the coarse ware (“local tradition”) and the grey ware. In the first case exists a better correlation with clays resulting from the weathering of schists, located closer to the site, and grey wares are more related with more basic rocks. Results obtained for ceramics from C. Juntas also indicates a local/regional production, especially clay materials resulting from the weathering of schists, also located very close to the site; in addition some pots point to the use of clays resulting from weathered basic rocks, such as diorites, gabbros and quartz-diorites. Thus, a continuity in ceramic production within the so called “local/regional pottery tradition”, both spatially and chronologically occurred.

1. Archaeological framework and research aims

Archaeological research undertaken in the Portuguese Guadiana Basin has identified several Late Iron Age sites (roughly, the second half of the 1st millennium BC). Selected sites were integrated in the Alqueva dam impact project aiming to investigate the settlement network of that period.

The present study deals with an archaeometric approach of ceramics of two site — Monte da Pata 1 (third-second centuries BC) and Castelo das Juntas (fourth-first centuries BC) — selected due to their larger ceramic assemblages and better-preserved archaeological contexts. This approach consists of technology production and provenance studies for both sites at two scales of analysis (intra-site and inter-site), addressing issues of exchange and possible local/regional imitation of exogenous pottery categories and types.

In the case of Castelo das Juntas large containers were found, particularly one “Iberian Barrel”. The “Iberian barrels” have been regarded as the product of local re-creations of southeastern shapes (Gamito, 1983, p. 204) on the basis of the restricted distribution of this ceramic type in western Iberia, and its scarcity within each site. The discovery of “barrels” in southwestern settlements, particularly in the Guadiana Basin, has contributed to rethinking the social relations and mechanisms underlying this shared material culture. Local production has been assumed generally for the Portuguese exemplars, but some authors have suggested that either pots or ideas may have been imported to the area under study (Fabião,
However, previous approaches to these issues have been built upon typological characterisation only. In this way, for Castelo das Juntas site issues of inter-regional exchange of items and/or “prototypes” within a shared “cultural world” were also addressed by contributing to establishing provenance of Castelo das Juntas “Iberian Barrel”, in comparison with three “Iberian barrels” from other regional late Iron Age settlements — Azougada, Segóvia and Vaiamonte.

At an intra-site level, the characterisation of ceramic production intends to determine provenance of coarse ware pottery; to define raw material resource strategies; to establish technological processes underlying the production of particular ceramic categories (such as the grey wares); and to estimate aspects of ceramic manufacture, namely, firing temperatures.

At an inter-site level, this work intends to explore ceramic interchange between sites; to investigate whether the longer occupation of Castelo das Juntas, and the role it may have played in the organisation of the local settlement network, have expression in a higher diversity in pottery production/consumption.

2. Materials and methods

Coarse ware sherds from Castelo das Juntas (34 samples) and Monte da Pata 1 (16 samples) were selected according to technological criteria, since a connection between forming techniques and “clay recipes” had been suggested by macroscopic observation of fabrics. Hand made and wheel thrown potteries were differentiated. Grey ware and storage pots were considered separately. Four “Iberian barrels” from Castelo das Juntas, Azougada, Segóvia and Vaiamonte were also analysed.

Geological survey was undertaken for the identification of potential sources of raw materials. Clay materials from the main regional geological contexts, including quartz diorites, diorites and associated gabbros, metabasite schists, vulcanites, schists, dolerite veins, as well as tertiary clay deposits were sampled.

Chemical analysis of ceramics and clays was done by instrumental neutron activation analysis (NAA), obtaining the concentration of 30 major and trace elements: Na, K, Fe, Ca, Sc, Cr, Mn, Co, Zn, Ga, As, Br, Rb, Zr, Sb, Cs, Ba, La, Ce, Nd, Sm, Eu, Tb, Dy, Yb, Lu, Hf, Ta, W, Th, U. Details concerning the measurement and processing of gamma spectrum can be found elsewhere (Prudêncio et al., 1986; Dai Kin et al., 1999).

Chemical data was treated using Statistica software (StatSoft, Inc., 2003; STATISTICA data analysis software system, version 6), with the performance of a multivariate analysis. A detailed study of the element distributions was also done.

Mineralogical composition of clays and ceramic samples from Castelo das Juntas was obtained by X-ray diffraction. Bulk material was prepared as non-orientated aggregate, and <2μm fraction was prepared as orientated aggregate under ambient conditions, after solvating with ethylene-glycol, and after heating to 500°C. Heating experiments were performed on ceramics with increasing temperatures of 600°C, 800°C and 1000°C.
3. Results and discussion

3.1. Monte da Pata 1 (MP 1)

Two major groups were defined by cluster and principle component analysis of artefact compositional data of pottery from MP 1. One outlier (grey ware) was established by UPGMA, using Euclidean distance as similarity coefficient.

Similar results were obtained using K-means cluster analysis, differences in chemical composition between the two groups being very clear (Fig. 1). Cluster 1 present higher level of rare earth elements (REE) and other elements connected to materials derived by weathering of acid rocks, whereas Cluster 2 is characterised by higher levels of Ca, Fe, Sc, Cr, Co and Zn, related to more basic clay materials. The outlier stands out due to much higher concentrations of REE, Zr, Fe and Na.

Cluster 2 is mainly composed of grey ware recipients (wheel-thrown pottery), which are macroscopically characterised by homogeneous texture, and overall low frequency of non-plastic grains, mainly composed by carbonates and traces of quartz, micas and ferruginous grains. The only exception belongs to hand-made pottery, also characterised by homogeneous texture, and small sized grains. On the light of these results, intentional choice of specific raw materials for the production of grey ware ceramic can be suggested, although a larger number of samples need to be analysed in the future and complemented with petrographic analysis.

Cluster 1 includes all the other types of ceramics, which present macroscopically larger and abundant non-plastic grains of quartz, micas, and carbonates. It should be noticed that the nature of the aplastic inclusions agrees with the chemical composition determined for each cluster.

Comparison between ceramics from MP 1 and regional clay samples generally points to a local/regional production both the coarse ware (“local tradition”) and the grey ware.
In fact, chemical data obtained so far seem to indicate the use of clays resulting from the weathering of schists, located closer to the site, in the case of cluster 1, and the preference for materials associated to diorites, gabbros and quartz-diorites for the production of cluster 2. It should be noted that this group is mainly composed by grey ware recipients with thinner non-plastic grains. These similarities are well observed in Fig. 2 which represents the projection of the samples in the factors 1 x 2 plane.

**FIG. 2** - MP 1 ceramic samples and regional clays projected in the first and second factor-plane.

**FIG. 3** - Means for each cluster of ceramics from MP 1 and regional clays, after applying the K-means clustering method.
In both cases, temper must have been added, particularly quartz grains, when clay materials resulting from schists were used (cluster 1). In cluster 2, non-plastic grains are significantly less frequent, partially being natural constituents of the clay matrix (e.g. ferruginous grains), and added as temper (micas, quartz, and carbonates).

Again, ceramic outlier stands out from the overall assemblage, no similarity having been found with the clay samples analysed. Furthermore, this ceramic outlier does not overlap with the only clay outlier detected (Fig. 3).

3.2. Castelo das Juntas (CJ)

Ceramics from CJ can be divided in two groups based on cluster analysis. Differences between these groups are visible in the plot of means for each cluster obtained by k-means clustering method (Fig. 4).

![Means for each cluster of ceramics from CJ after applying the K-means clustering method.](image)

Within cluster 1, a few samples including the CJ “Iberian barrel” (sub-group 1A, Fig. 5) stands out as a result of much higher levels of K and REE, specially the heavy REE (HREE), and lower levels of Ca, Fe, Sc, Cr, and Co (Fig. 5). A more pronounced negative Eu anomaly is one of the parameters that best differentiates sub-group 1A from both clusters 1 and 2.

Cluster 1 integrates mainly samples macroscopically characterised by fine textures. However, its chemical composition agrees with the abundance of felsic minerals probably present in microscopic grain size. Also, cluster 1 appears to relate to wheel-thrown pottery, which frequently presents slips.

Cluster 2 includes mainly samples characterised by high frequency of large non-plastic grains, and seems associated to wheel-thrown pottery, smoothing being the predominant finishing technique used.
Comparison between ceramic and regional clay samples indicates a local/regional production for the pottery analysed. Clay materials resulting from the weathering of schists, located very close to the site, appear to have been used to produce ceramics of cluster 1; whereas pots clustering within cluster 2 were manufactured probably using clays resulting from weathered basic rocks, such as diorites, gabbros and quartz-diorites (Fig. 6). In both cases, temper was most probably added to the natural clay matrix, the addition of quartz being particularly clear when materials resulting from weathered schists were selected.
Regarding other aspects of technology, the mineralogical characterisation by XRD did not show high-temperature phases for the majority of the pottery analysed. The presence of smectite (and/or ilite-smectite interstratified) was identified in some samples indicating firing temperatures below 600°C. In other cases, illite predominates, and a sharp peak of phyllosilicate minerals occurs. In a few samples maximum diffraction peaks are almost absent (only a low illite peak was recorded), probably due to vitrification during firing, indicating temperatures above 800-900°C. Furthermore, the vestigial presence of mullite in two samples should be noted, suggesting temperatures above 1000°C.

Thus, four ranges of firing temperature can be pointed to the CJ pottery: below 600°C; 600°C-700°C; 700°C-800°C; and above 800°C. The majority of the samples fit the 600°C-700°C interval.

The mineralogical characterisation of CJ samples also shows a closer affinity between the ceramics from this site, and the siliciclastic and illite-kaolinite clays. This agrees with the chemical composition obtained by INAA, which revealed the use of clay materials resulting from acid rocks in the production of the larger group of recipients analysed. We highlight, however, the need for additional studies in order to evaluate the effect of post-depositional phenomena in the ceramic mineralogical composition.

3.3.1. “Iberian barrels”

As discussed above, CJ “barrel” clusters within ceramic chemical sub-group 1A (Fig. 5), which can be associated to the use of materials resulting from weathering of acid rock located close to the site. The higher concentrations of some chemical elements found in this sample would reflect probably the addition of larger amounts of temper. We are therefore looking at local production of this pottery type at CJ.

CJ “barrel” was then compared to similar recipients from other regional late Iron Age settlements — Segóvia (SEG), Vaiamonte (VTE), and Azougada (AZ). Within these three samples, SEG and VTE present a geochemical similarity with the regional basic rocks, clustering with ceramic cluster 2 from CJ. Thus, a probable local production can be suggested for these two “barrels” in each corresponding site with similar raw materials. The third barrel (AZ) differentiates from the previous ones, mainly due to much lower concentration of Fe, Sc, U, Co, Cr, and Ca, and much higher contents of light REE (LREE).

The mineralogical composition of these samples also shows a tighter correlation between SEG and VTE recipients, which present similar mineralogical associations such as amphiboles, plagioclase, quartz, and micas. AZ barrel is different due to lower frequency of micas and plagioclase, and absence of amphiboles. In all cases, minerals related to temperatures higher than 800°C are not present.

In conclusion, the data obtained for the regional “Iberian barrels” point to a local production for the CJ exemplar, and suggest a very probable local production for the remaining cases (Dias et al., in press). However, these results must be confirmed by comparative study with the remaining coarse ware of each site, judgment on their implications in terms of pottery exchange being reserved until then.

3.4. Provenance: Comparison between MP 1 and CJ ceramics and regional clays

Chemical similarity between ceramics and geological materials may result both from the use of clays resulting from the alteration of particular types of rocks, or from the addi-
tion of variable amounts of temper, especially if it represents the addition of different proportions of ferromagnesian minerals (e.g., ferruginous grains), or silicates (e.g., quartz, and k-feldspars), often identified macroscopically.

Grey wares from MP, which seem more closely related with basic rocks, are characterised by fine fabrics, only a few non-plastic grains being macroscopically visible. These are mainly ferruginous grains, and quartz is very rare. In the case of CJ, fabrics with higher frequency of small size, non-plastic grains can be associated to acid rocks.

In Fig. 7 ceramics of both sites and regional clays are plotted in a diagram Fe+Sc+Cr+Co+Zn vs REE+Hf+Ta+Th+U showing similarities between some CJ samples and regional schists and between some MP 1 samples and basic rocks.

Concerning provenance of pottery from CJ and MP 1, local/regional production can be drawn, using weathered schists and in some cases clays derived by weathering of diorites and gabbros. Chemical differences found can be explained by add of different amounts of non-plastic grains (such as ferruginous grains, quartz, micas, carbonates). The exploitation of Tertiary clays is probable, but in this case also the addition of temper should be considered. Further characterisation of fabrics and “clay recipes” will require the petrographic examination of these ceramics for a more complete clarification of provenance and production technologies.

4. Final remarks and archaeological implications

The results obtained reveal continuity in ceramic production within the so called “local/regional pottery tradition”, both spatially and chronologically.

In synchronic terms, the same strategies of source exploitation seem to have been practiced throughout Late Iron Age in the area under study. In fact, chemical similarity between ceramic and regional clays indicates that coarse ware pottery from both MP 1 and CJ would have been produced locally, clay sources closest to each site being used preferably. The
higher chemical heterogeneity found in CJ ceramics may result from a longer period of occupation with a larger number of potters and diversified clay extraction.

Grey ware ceramics from MP 1, standing out from the overall wheel-thrown ceramics, points to the preferable use of clays resulting by weathering of basic rocks, rather than clays from weathered schists, located at a shorter distance from the site. This suggests that specific technological procedures/exploitation strategies were practiced in the production of grey wares. In CJ, the number of grey ware samples analysed is too small to allow for differentiation within the ceramic assemblage. Storage pots and the CJ Iberian barrel also cluster within local production.

In the case of the “Iberian barrels”, the samples analysed are chemically different, suggesting that no regional production centre would have been responsible for supplying the local communities with these ceramic items. The local production of storage pots is not surprising. They are highly represented in all Late Iron Age regional settlements, where they seem to have been the most common way of storing food (Fabião, 1998, p. 61). These containers do not seem to have been used for long-distance transportation, as previously equated. As a result, the analytical data obtained so far do not contest the traditional interpretation of the southwestern “barrels” (Gamito, 1983, p. 206) as being produced locally, their singularity being “constructed” in this process.

This archaeometric approach is essential for the understanding of issues of ceramic exchange in the Late Iron Age and the social relations underlying them at an inter-regional scale of analysis.

Acknowledgements

We would like to thank the Portuguese National Museum of Archaeology, for authorising access to, and sampling of, the “Iberian barrels” from Vaiamonte, Azougada and Segóvia for both mineralogical and chemical analysis.

NOTES

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