VESSELS: INSIDE AND OUTSIDE

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A PRELIMINARY APPROACH FROM MATERIAL SCIENCE TO COPPER AGE FUNERARY POTTERY IN SOUTHERN IBERIA: THE PALACIO III (SEVILLA, SPAIN) THOLOS TOMB

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Abstract: *This paper proposes a material science-based study to the ceramic assemblage from the Palacio III (Sevilla, Spain) Copper Age* tholos *tomb, which is part of a larger prehistoric funerary complex that also includes a passage grave and a cremation cairn. This study examines the existence of relationships between the chemical composition of the vessels, their morphology and stratigraphic context, looking at the use of ceramics as votive offerings and their change over time.*
Keywords: *Copper Age, pottery, grave goods, compositional data, statistical modelling*

INTRODUCTION

Within Southern Iberia, the ceramics used as grave goods in Copper and Bronze Age funerary contexts are still poorly understood in all the four main dimensions of artefactual variability: technology, morphology, functionality and symbology. A recent bibliometric analysis (*Cordero Ruiz et al 2006*) has shown that ceramics used within funerary contexts have been comparatively less studied than those recorded in settlement sites. As part of a larger research project aimed at studying of Copper Age ceramic productions in SW Iberia, currently under way (*Odriozola & Hurtado, 2007; Odriozola & Martínez Blanes, 2007; Taylor, 2007;* etc.), this paper examines an assemblage of funerary ceramics found within the Palacio III *tholos*-type tomb.

The Palacio III funerary complex (Almadén de la Plata, Sevilla, Spain) (**Fig. 1**) was excavated by the universities of Sevilla and Southampton between 2001 and 2002, yielding a rich set of evidence that is currently under study. A full monograph with the results of this work is currently being put together, but some preliminary reports have already been published – see for example *García Sanjuán 2005; García Sanjuán & Wheatley, 2006; García Sanjuán et al 2006; Taylor 2007; Forteza González et al 2008; Díaz-Zorita Bonilla et al 2008.*

As a burial place, the Palacio III site was in use for a very long period of time. Three main structures, corresponding to as many stages in its biography as a monument, have been recorded (**Fig. 2**). The first is a passage grave that was found in a poor state of preservation as several of its uprights had been removed in the past for re-use by local farmers, and no *in situ* prehistoric deposit was found.

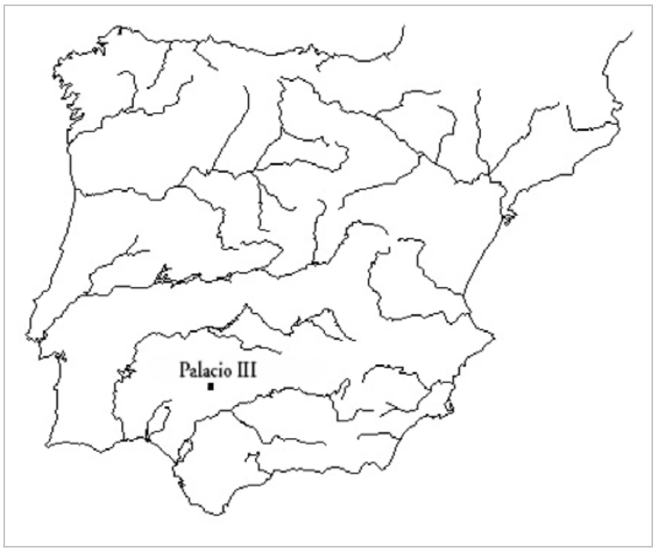

Fig. 1 Location of the Palacio III funerary complex within the Iberian peninsula.

Although no firm evidence exists for the dating of this monument, its architecture suggests a Late Neolithic chronology. The second is a Copper Age *tholos* tomb that was built only a few meters away from the entrance of the passage grave.

The excellent state of preservation of this construction has made possible a detailed recording of its main mortuary level (*c*. 200 artefacts, including ceramic vessels, lithic tools, personal objects, etc.) as well as the remarkable remains of the iconographic program that once decorated its uprights (**Fig. 3**). The third main structure identified at this site, exactly between the passage grave and the *tholos* tomb, is a small cairn that covered the remains

Fig. 2 general view of the Palacio III funerary complex from the East, with the Copper Age *tholos* at the forefront

of a cremation deposit of Iron Age date – see further details in *García Sanjuán, 2005*.

The concentration of constructions of several varying dates within the same space, as well as various other kinds of evidence, suggest that the Palacio III site acted as a true "cultural memorial" for successive generations of people living in the surrounding highlands.

This is also reflected in the ceramic assemblage recovered from the *tholos* tomb, which includes more than 60 different vessels, some are in a very good state of preservation, and others are in a highly fragmented condition (**Fig. 4**). From a contextual viewpoint, this ceramic assemblage can be divided in two main subgroups. The first of these two subgroups (the earliest and the largest in size), refers to vessels found on the rocky floor (or base) of the chamber and are clearly part of the primary collection of grave goods deposited within it. The second subgroup represents smaller number of ceramic vessels deposited at different stratigraphic levels above the rocky floor of the chamber. One interpretation of this is that the second subset of vessels may have been deposited after the roofing of the chamber had already collapsed and the chamber of the monument had already been covered by filling.

Fig. 3 Primary/Early depositional level of the Palacio III *tholos* tomb, at the very base of the chamber.

If so, then the time elapsed between the early/primary and the late/secondary deposition events are unknown yet. At the present time, however, thermoluminiscence analyses are being carried out in order to investigate the possibility to clarify this particular point. Preliminary results suggest that the time span separating the early/primary depositional phase from the late/secondary phase could be of *c.* 200 years.

Therefore, the archaeometric study of the Palacio III *tholos* ceramic assemblage has three main objectives.

Firstly, at a general level, it is aimed at advancing in the technological characterisation of Southern Iberian Copper Age funerary ceramics. From a comparative point of view, it is necessary to compare this with the technological characterisation of the ceramic assemblages used within settlement contexts. Secondly, the compositional analysis of the Palacio III *tholos* tomb funerary pottery assemblage is aimed at exploring the technical choices made along the *Chaîne Opératoire* followed by the craftsmen who produced them. Compositional grouping is therefore assessed against the background of vessel morphology (shape). Thirdly, this study will compare the technology of the ceramics deposited in the early/primary and late/secondary depositional phases of the *tholos* chamber in order to investigate the existence of significant changes in the use of this remarkable funerary complex through time.

SAMPLING AND ANALYTICAL METHODS

Compositional data has been recorded from 31 of the *c.* 60 vessel recovered at the Palacio III *tholos* tomb. Following a vessel minimum damage policy, only non fully preserved vessels were sampled. Although this policy has caused some specific items to remain outside this study (which is therefore not strictly representative of the full morphological variability of the assemblage at hand),

Table 1 Tabulation of the PC coefficients on each element for the first three Principal Components in the Palacio III funerary pottery assemblage.

Element	PC1	PC2	PC3	Element	PC1	PC2	PC3
Si	0,01	-0,03	0,00	**Ba**	-0,01	-0,03	0,34
Al	0,01	0,01	-0,03	**Co**	0,04	0,38	0,11
Fe	0,03	0,18	-0,02	**Cr**	-0,02	0,21	0,01
Mn	-0,12	0,38	0,31	**Cu**	0,01	0,14	0,10
Mg	0,04	0,21	-0,01	**Ni**	0,05	0,28	0,02
Ca	-0,03	0,28	0,06	**Pb**	-0,13	-0,38	0,45
Na	0,04	0,09	-0,08	**Sn**	0,92	-0,05	0,30
K	-0,00	-0,35	0,20	**Sr**	0,02	0,25	0,28
Ti	-0,01	0,13	-0,01	**V**	-0,02	0,14	-0,00
P	-0,30	0,04	0,54	**Zn**	-0,13	-0,11	0,19
				Zr	0,03	0,09	0,11

Table 2 Mean values for elemental concentration (%, ppm) in the compositional groups (mean value ± standard deviation)

Element	1	2	3	Element	1	2	3
Si	53,34±3,14	56,98±3,86	55,22±4,29	***Ba***	535,54±295,30	582,00±189,67	691,67±248,87
Al	19,64±1,90	19,01±0,99	17,82±2,40	***Co***	39,09±10,75	36,00±8,38	29,11±12,82
Fe	9,87±1,91	9,16±2,00	7,56±1,85	***Cr***	280,90±112,88	228,36±47,27	252,56±102,82
Mn	0,21±0,15	0,13±0,10	0,15±0,10	***Cu***	36,18±12,51	36,91±12,97	34,78±16,48
Mg	2,52±0,97	2,47±0,57	2,01±0,76	***Ni***	100,54±47,88	86,73±26,92	63,33±24,56
Ca	2,68±1,21	2,57±1,40	2,62±1,51	***Pb***	3,82±2,18	5,16±2,31	15,78±10,66
Na	1,42±0,62	1,45±0,40	1,24±0,40	***Sn***	1,00±0,00	27,91±21,57	1,00±0,00
K	1,25±0,80	1,71±0,85	2,15±0,67	***Sr***	189,73±74,43	229,73±86,08	213,56±111,53
Ti	1,12±0,30	1±0,28	0,95±0,20	***V***	200,18±51,52	168,10±55,22	187,22±150,04
P	0,37±0,17	0,31±0,24	1,01±0,58	***Zn***	67,18±15,66	57,27±8,83	117,33±70,01
				Zr	147,82±56,57	180,00±108,46	142,44±59,23

Fig. 4 Selection of well-preserved ceramic vessels from the Palacio III *tholos* tomb. Photo: M.A. Blanco de la Rubia © Consejería de Cultura de la Junta de Andalucía

nevertheless, a representative number of vessels and vessel types have been analysed.

In terms of analytical methods, Wavelength Dispersive X-Ray Fluorescence Spectroscopy (WD-XRF) was used in order to determine the elemental composition of the samples and draw compositional groups. Data were collected using a Panalytical Axios analyser equipped with a Rh tube. Calibration of the instrument was carried out using a set of Geological mineral standards (Geostandars). The samples were ground in an agate planetary mill to a 50 µm particles size, diluted with powder wax (0,1:0,061 ratio), and pressed at 40 Tm to prepare a pellet.

On the other hand, height, maximum diameter and rim thickness correlation were used to examine morphological (shape) classes.

For the statistical processing of the data, the elemental values were first $\log_{10}$ transformed to normalise data and compensate the differences in magnitudes between the major and trace elements (*Glascock 1992*). The first multivariate procedure involved in order to establish grouping tendencies of the data set is Cluster Analysis. The specimens are merged into clusters by comparing the sample-to-sample relationships based on sequential, agglomerative, hierarchical, non-overlapping clustering procedures (*Glascock 1992*), and of this we prefer Ward's method (*Baxter 1994, 2003*), carried out on a matrix of squared Euclidean distance.

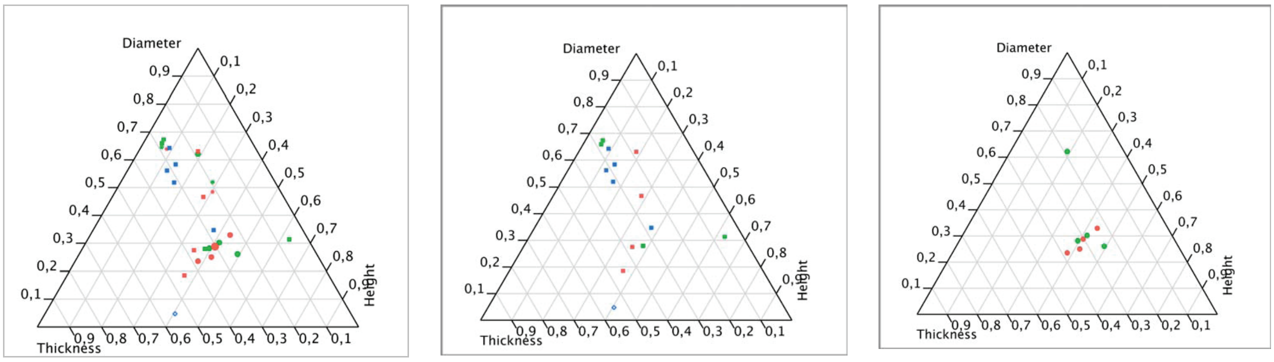

Fig. 5 (a) Ternary diagram showing vessel morphology for all the items included in this study (maximum height, maximum diameter and rim thickness). (b) Ternary diagram showing vessel morphology for the items recorded in the primary/early depositional level (maximum height, maximum diameter and rim thickness). (c) Ternary diagram showing vessel morphology for the items recorded in the secondary/late depositional level (maximum height, maximum diameter and rim thickness).

Factor analysis was then used to reduce the dimensionality of the data set using the principal component approach (*Baxter 1994, 2003, Glascock 1992*) and to corroborate tendencies observed on cluster analysis.

As it was stated before, the relationship between morphological and compositional patterns, and its variation through time, is one major objective of this study. If sherds belonging to vessels of different shapes cluster together compositionally, then it seems plausible to assume that the potters used raw materials that were geochemically similar (*i.e.* from the same sources), and prepared the paste in similar ways, regardless of vessel shape. On the contrary if morphologically similar vessels also cluster together chemically, this might suggest that craftsmen were using geochemically similar raw materials, as well as preparing their pastes in similar ways, constrained by vessel shape. Finally if vessels of a same shape comprise a unique compositional group, this perhaps could imply that people from nearby settlements could have been taking pottery into the Palacio III tomb, possibly as a part of a community network relationship, whereby different human groups follow varying votive patterns within the same "cultural memorial" space. This is precisely what has been found at the Copper Age site of Perdigões (Reguengos de Monsaraz, Portugal) (*Dias et al. 2006*).

RESULTS

Morphometric variables recorded in order to explore shape variability among the 31 items selected from the general ceramic assemblage include maximum height, maximum rim diameter and rim thickness (*Taylor, 2007*). These data are shown in ternary diagrams that suggest the existence of three basic shape patterns (**Figs. 5a, 5b, 5c**) – all three variables were recordable only for 25 of the 31 sampled items. The grouping displayed on **Fig. 5a** reflects the basic morphological types identifiable within the ceramic assemblage Palacio III: shallow containers with a large diameter and thick walls (plate type), vessels of small to medium height, large diameter and medium rim thickness (shallow bowls), and higher vessels with a smaller rim diameter and thinner walls (deeper bowls). Clustering in three basic types is fairly robust, with only two items appearing as outliers. **Fig. 5b** shows the ternary diagram for those vessels recorded at the primary/early depositional level, including all three morphological groups. **Fig. 5c**, in turn, shows the grouping of the vessels attributed to the secondary/later depositional phase of the *tholos*, which is formed almost exclusively by higher vessels with a smaller rim diameter and thinner walls (deeper bowls). Morphological variability seems to have been higher during the primary/early stage of the utilisation of the *tholos*.

Cluster analysis of compositional data (**Fig. 6**) identifies three significant groups in the compositional variation of this pottery assemblage. However, these three compositional groups do not match with any of the three morphological groups outlined above.

PCA was done on the covariance matrix of the normalised data. The first two principal components account for over 59.8% of the variation of the data (details of the PCA loadings can be seen in **Table 2**), no outliers emerging when using the Mahalanobis distance method (*Baxter 2003*) (**Fig. 7**).

Factors characterise the sample chemical variability (**Table 1**) used to differentiate between pottery groups, thus the 1st factor group contains acid ceramics, the 2nd factor groups has ceramics rich in ferro-magnesian and calcium plagioclase minerals, while the 3rd factor group comprised of K-feldespar rich ceramics.

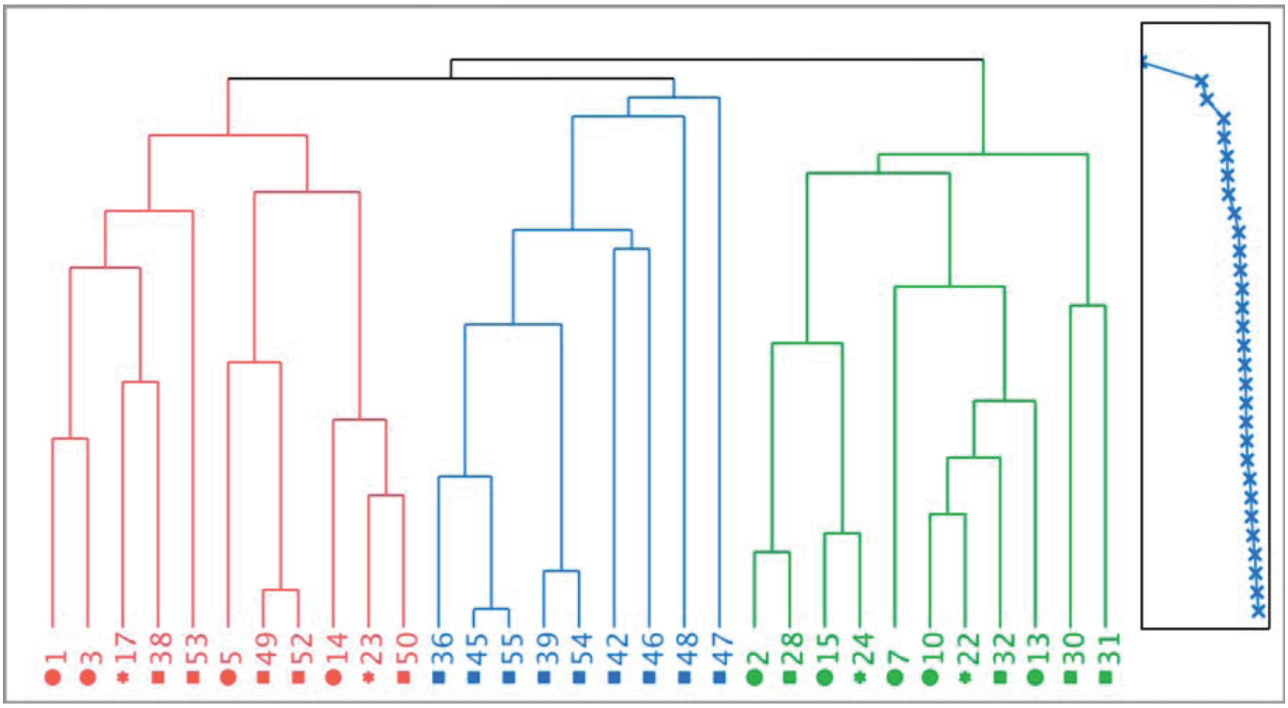

Fig. 6 Ward's method dendrogram showing the clustering of compositional data.

PCA corroborates the three compositional groups observed in the cluster analysis. Each group displays distinct geochemical fingerprints, perhaps reflecting differences in the geology of the clay sources or in the processing of clays prior to modelling and firing. Clay sources in the vicinity of the Palacio III funerary complex are few and poor, which perhaps implies that local potters may have resorted to mixtures of clays in order to obtain desired material in terms of workability. Therefore, it does not seem to be a clear correlation between the compositional and morphological clusterings. Different clay mixtures seem to have been used within each of the three basic morphological categories that have been distinguished.

An indication of the geochemical differences between the three compositional groups observed is provided by the tabulated mean elemental concentrations for each group (**Table 2**). The sherds in group 1 have conspicuously higher mean concentration for Al, Fe, Mg, Ca, P, Co, Cu and Ni than the sherds in the other groups, and compositionally more similar to group 2, than to group 3. We believe that the variability observed between cluster groupings of Palacio III funerary pottery assemblage is due to differences in the mixture process of clays from different local sources.

DISCUSSIONS

As it was stated at the beginning of this paper, Southern Iberian Copper Age funerary ceramics have never been studied. Our previous approach to Copper Age ceramics in the Spanish SW has focused on settlement materials from sites such as La Pijotilla or San Blas and has taken only compositional variability into consideration (*Odriozola Lloret & Hurtado Pérez, 2007; Odriozola Lloret & Martínez Blanes, 2007*). Furthermore, these studies have centred exclusively on decorated ceramics. Therefore, our approach to the Palacio III funerary pottery, combining the morphometric/morphological and achaeometric / compositional variability, lacks any previously settled knowledge to draw from.

In principle, the statistical evidence suggests the existence of three main groups within each of these two dimensions of variability, but these groups do not overlap. This is consistent with the results of the petrographic study of this assemblage that showed no simple or straightforward overlapping between the main textural and morphological types (*Taylor 2007*). This petrological study was based on the sampling of 40 of the 48 ceramic vessels recorded as part of the main ceramic record of this tomb, and its main conclusion suggest, first, the predominance of fabrics of fine matrix with moderate quantities of inclusions (of fine size); second, the existence of an ample variability of fabrics, suggesting the use of a relatively high number of sources for clay supply; third, the likely "local" character of all studied samples; fourth, the limited preparation of the clays before firing took place (no clear cases of added inclusions have been detected), and, fifth, the lack of obvious direct correlations between the characteristics of the fabrics and the morphology of the recipients (*Taylor, 2007: 191*)

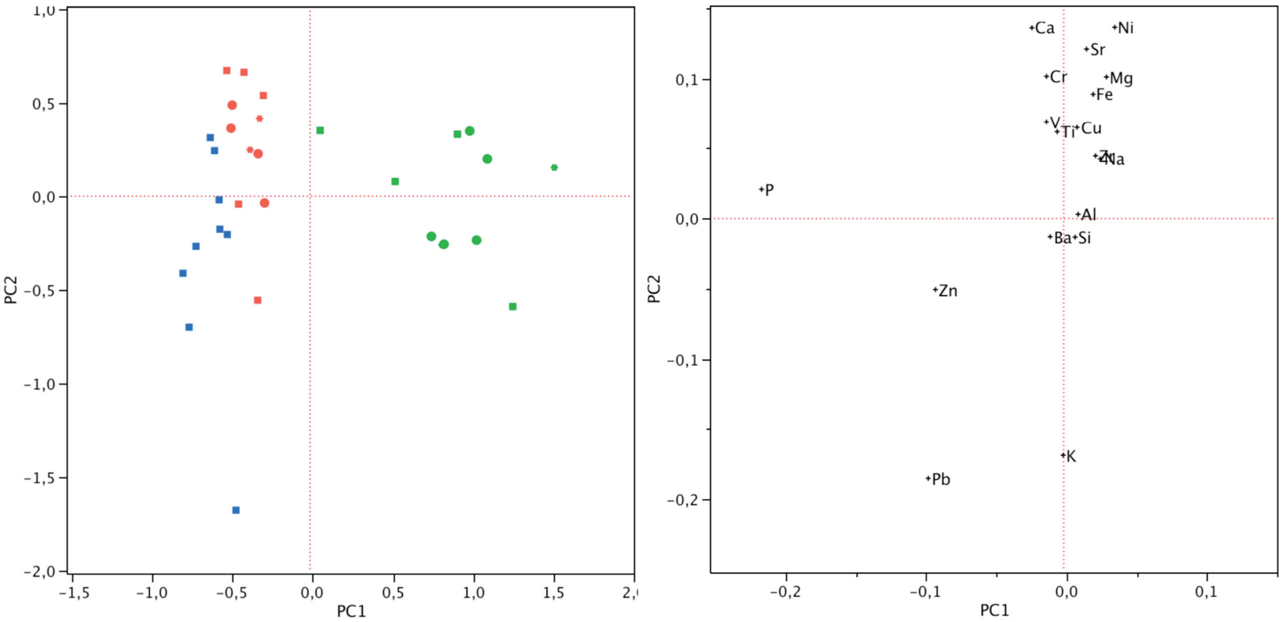

Fig. 7 PCA scores and loading plots.

The Palacio III funerary pottery has not yet been compared with ceramics from neighbouring contemporary settlements, but in principle it seems acceptable to assume that the three compositional clusters identified in the PC scores and on the hierarchical cluster of the data reflect the use of different clay deposits or different mixture process of clays by the manufacturers. The compositional data illustrate specific conditions of clay formation as well as the repeated utilisation of these specific resources along time.

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