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Bell Beaker pottery from Galicia (NW Spain): An archaeometric characterization and provenance study of some representative sites

Cerámica campaniforme de Galicia (NW de España): Caracterización arqueométrica y estudio de procedencia de algunos yacimientos representativos

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Resumen

Se describen los resultados del estudio arqueométrico (composición mineral y elemental) de 55 muestras de recipientes campaniformes recuperadas en 8 yacimientos arqueológicos del NW de la Península Ibérica. Las muestras son representativas de la variación formal de la cerámica (tanto lisa como decorada) y del tipo de contextos (ceremonial, doméstico y funerario) donde las cerámicas campaniformes fueron encontradas en la región. Las composiciones mineral y elemental mostraron un alto grado de coherencia. La mayor parte de los recipientes tenía composiciones con proporciones variables de feldespato potásico y plagioclasa, o de plagioclasa y anfíbol, coherentes con la litología local. También se encontraron composiciones mezcla de feldespato potásico y anfíbol, que no se encuentran de forma natural en los materiales geológicos del entorno, lo que apunta a una mezcla intencional de materias primas.

La cerámica campaniforme, comparada con la de otros períodos previos, muestra fuertes cambios en relación con el estilo, pero mantiene una continuidad en cuanto al uso de los recursos de materia prima. No se encontró relación entre aspectos formales y la composición de la cerámica. La mayor parte de la cerámica estudiada procede probablemente del entorno de los yacimientos. Un análisis de distancias a las áreas potenciales para los materiales, empleando un sistema de información geográfica, sugiere que prácticamente todas pueden encontrarse en un radio de 16 km (la mayoría entre 2 y 5 km), lo que implica una a dos horas. Parece que el esfuerzo asociado a las cerámicas de contextos ceremoniales fue mayor que el de la cerámica de contextos funerarios y de asentamiento.

Palabras clave: Campaniforme, NW de España, Mineralogía, Composición geoquímica, Procedencia.

Abstract

We describe the results of an archaeometric study (mineral and elemental composition) of 55 samples from Bell Beaker vessels recovered from 8 archaeological sites in the northwest of the Iberian Peninsula. The samples are representative of the formal variation of the pottery (both decorated and undecorated) and type of contexts (ceremonial, domestic and funerary) in which Bell Beaker pottery is found in the region. Both, mineral and elemental composition were found to be highly consistent. Most of the vessels had compositions resulting from mixtures of potassium feldspar and plagioclase or plagioclase and amphibole, which are coherent with the local lithology. A few pottery samples showed a mixed composition of potassium feldspar and amphibole, which is not found naturally in the surrounding geological materials, indicating an intentional mixing of different raw materials.

Compared to previous periods, Bell Beaker pottery represented a significant change in terms of style but continuity in terms of the use of raw materials. No relationship was found between the formal aspects and the composition of the pottery. Most of the samples we studied were probably manufactured with materials obtained from the area around the sites. An analysis of distances to potential source areas for the materials, using a geographical information system, indicates that almost all can be found within a radius of 16 km (most between 2-5 km), implying between one and two hours walk. A greater effort seems to have been associated to pottery of ceremonial sites compared to funerary and settlement sites.

Keywords: Bell Beaker, NW Spain, Mineralogy, Geochemical composition, Provenance.

1. Introduction

Bell Beaker pottery is a type of prehistoric pottery that has received much attention from archaeologists in Galicia (NW Spain). Since the late 1980s, a number of studies have been published with different objectives (e. g. Criado and Vázquez, 1982, Prieto, 1999a, Suárez and Lestón, 2005, Prieto and Salanova, 2011, etc). Nevertheless, there are only three studies concerned with the regional characterization of Bell Beaker pottery from NW Spain (Prieto, 1999a, 1999b, 2011a). Since the publication of the last study, research has focused on extending our knowledge of the formal, contextual, spatial and functional aspects of the pottery (e. g. Prieto 2002, 2011a, 2011b), and on finding relationships with other possible regions of influence, based on studying decorations made using shells (Prieto and Salanova 2009). Archaeometric studies have only recently begun to appear (Lantes-Suárez et al., 2010, 2015, Martínez-Cortizas et al. 2008, 2010, 2011, Prieto-Lamas et al., 2011, Prieto-Martínez et al., 2008, 2009a). So, in order to fill this gap, we carried out a study of the mineral and elemental composition of Bell Beaker pottery from NW Spain. This preliminary archaeometric characterization was aimed at increasing our knowledge of the 'chaînes opératoires'. The main aims of the study were: (1) to characterize the Bell Beaker pottery from Galicia (NW Spain) using archaeometric techniques; (2) to establish trends in mineral and geochemical composition; (3) to study the variability between archaeological sites; (4) to obtain insights into how the raw material was processed (temper mixing); (5) to evaluate provenance by comparing pottery composition with that of local lithology; (6) to compare the composition of Bell Beaker pottery to that of previous periods, and (7) to apply a Geographic Information System (GIS) to identify the possible source areas of the raw materials used for the pottery from the studied sites.

2. Sites context and analysed samples

We selected eight archaeological sites distributed throughout the region with Bell Beaker pottery or which are associated with its contexts: Devesa do Rei and Forno dos Mouros in the province of A Coruña; Zarra de Xoacín, Monte de A Romea and San Cosme in the province of Pontevedra; Roza das Aveas II in the province of Lugo and Cameixa and A Forxa in the province of Ourense (Fig. 1). Although the selection of samples was

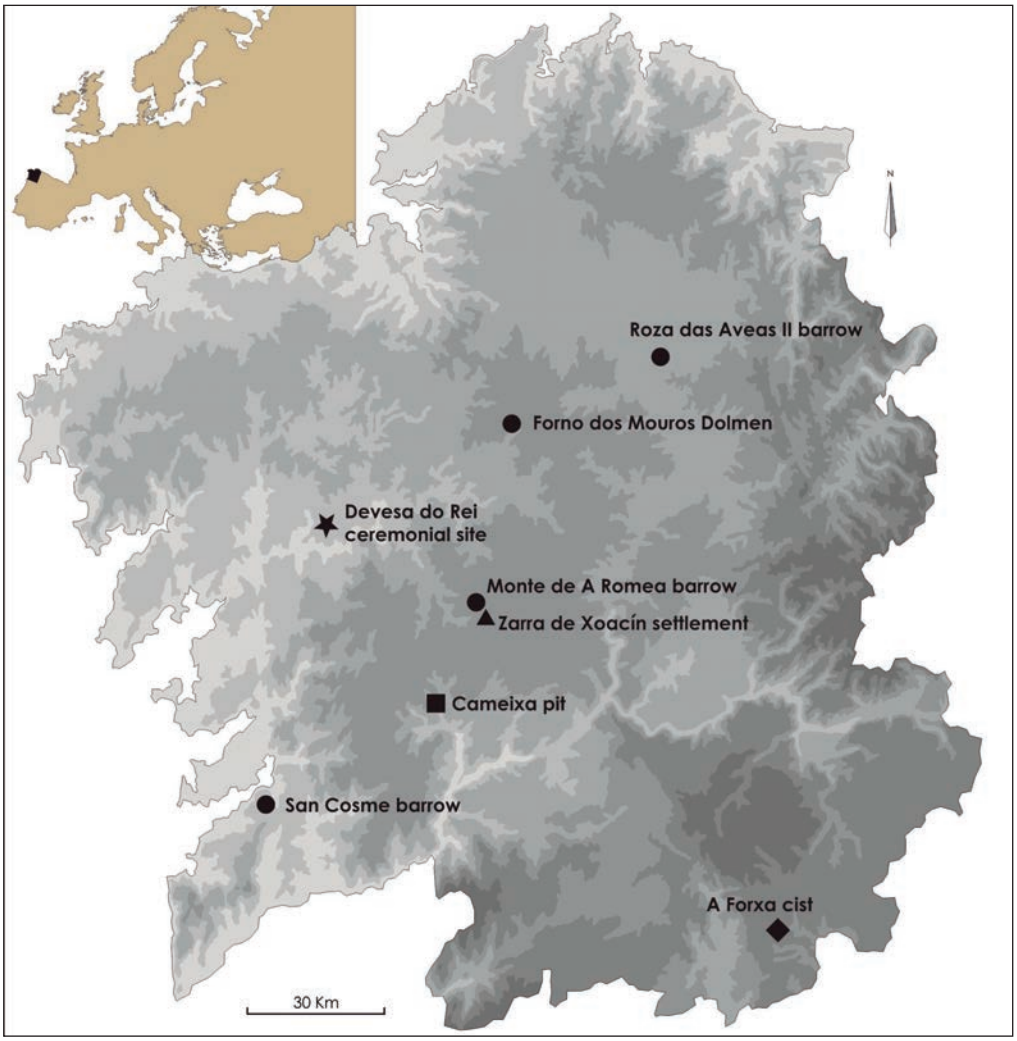

Fig.1. Location of the studied sites.

somewhat biased by the availability of Bell Beaker pottery, we chose ceramics from sites with well-known contexts, where we had carried out the archaeological study. The samples were selected to be representative of the variability of the context of the site – domestic, funerary and ceremonial – and also of the variability of the pottery within the site. A total of 55 samples were analysed: 23 plain pots (3 with horizontal plastic cordons in the edges), 28 Bell Beakers and 4 non-Bell Beaker decorated pots. Most of the samples that were analysed belonged to Devesa do Rei (37 of the 99 Bell Beaker pots recovered in this site) followed by Zarra de Xoacín (7 pots) and Monte de A Romea (4 pots). The other sites were represented by two (A Forxa, San Cosme) or one (Forno dos Mouros, Cameixa, Roza das Aveas II) sample (Fig. 2).

Sample Code	Morphology	Decoration Type	Type	Dec. Techniques	Dec. Tools	Global Colour	Temper: Abundance	Temper: Texture	Temper: Grain size
De001	Bowl	Bell-beaker	Herringbone Decoration	Impression	Shell (clam)	Black	Very scarce	Compact	Fine
De002	Beaker	Bell-beaker	Linear Variety	Incision	Punch	Red	Scarce	Compact	Fine
De003	Plate	Bell-beaker	Geometric Decoration	Incision, Impression	Punch	Black	Scarce	Compact	Fine
De006	Beaker	Undecorated	-	-	-	Brownish	Scarce	Compact	Fine
De008	Beaker	Undecorated	-	-	-	Brownish	Scarce	Compact	Coarse
De009	Beaker	Bell-beaker	Geometric Variety	Incision	Punch	Red	Scarce	Compact	Fine
De010	Undefined	Relief	-	Cordon	Clay addition	Brownish	Abundant	Compact	Coarse
De011	Beaker	Bell-beaker	Herringbone Decoration	Impression	Shell (scallop)	Brownish	Scarce	Compact	Medium
De013	Bowl	Impression	-	Impression	Punch	Brownish	Scarce	Compact	Fine
De017	Beaker	Ungulated	Rusticated Ware	Impression	Nail	Black	Scarce	Compact	Medium
De018	Beaker	Ungulated	Rusticated Ware	Impression	Nail	Black	Scarce	Compact	Medium
De022	Beaker	Bell-beaker	Geometric Decoration	Impression	Shell (scallop), Punch	Black	Scarce	Compact	Fine
De025	Bowl	Undecorated	-	-	-	Brownish	Scarce	Compact	Medium
De026	Beaker	Bell-beaker	Linear Variety	Impression	Comb	Brownish	Scarce	Compact	Medium
De027	Beaker	Bell-beaker	Herringbone Variety	Impression	Shell (clam)	Brownish	Scarce	Porous	Fine
De030	Undefined	Undecorated	-	-	-	Brownish	Scarce	Compact	Medium
De031	Beaker	Undecorated	-	-	-	Red	Very scarce	Compact	Fine
De032	Undefined	Undecorated	-	-	-	Brownish	Scarce	Compact	Fine
De035	Bowl	Undecorated	-	-	-	Red	Scarce	Compact	Medium
De038	Undefined	Relief	-	Cordon	Clay addition	Black	Scarce	Compact	Fine
De041	Bowl	Undecorated	-	-	-	Black	Scarce	Compact	Fine
De043	Pot	Undecorated	-	-	-	Brownish	Scarce	Compact	Medium
De044	Bowl	Relief	-	Cordon	Clay addition	Brownish	Scarce	Compact	Fine
De046	Beaker	Undecorated	-	-	-	Black	Very scarce	Compact	Fine
De055	Bowl	Undecorated	-	-	-	Brownish	Scarce	Compact	Medium
De057	Beaker	Undecorated	-	-	-	Red	Scarce	Compact	Fine
De081	Beaker	Bell-beaker	Linear Decoration	Impression	Shell (scallop)	Red	Abundant	Compact	Medium
De086	Beaker	Bell-beaker	Geometric Variety	Impression	Comb, Punch	Brownish	Scarce	Compact	Fine
De098	Beaker	Bell-beaker	Linear Decoration	Impression	Shell (scallop)	Red	Abundant	Compact	Medium
De099	Beaker	Undecorated	-	-	-	Red	Scarce	Compact	Medium
De102	Bowl	Undecorated	-	-	-	Brownish	Scarce	Porous	Medium
De109	Bowl	Undecorated	-	-	-	Red	Abundant	Compact	Coarse
De121	Beaker	Bell-beaker	Linear Decoration	Impression	Shell (scallop)	Black	Scarce	Compact	Fine
De122	Beaker	Bell-beaker	Linear Variety	Impression	Comb	Red	Scarce	Compact	Medium
De126	'Barrel'	Undecorated	-	-	-	Black	Scarce	Compact	Medium
De132	Undefined	Undecorated	-	-	-	Brownish	Scarce	Compact	Medium
De136	Beaker	Bell-beaker	Linear Variety	Impression	Comb	Brownish	Scarce	Compact	Fine
Za02	Beaker	Bell-beaker	Geometric Decoration	Impression	Comb	Brownish	Scarce	Compact	Fine
Za29	Beaker	Bell-beaker	Linear Variety	Impression	Comb	Red	Scarce	Compact	Fine
Za35	Beaker	Bell-beaker	Linear Variety	Impression	Comb	Brownish	Scarce	Compact	Fine
Za44	Beaker	Bell-beaker	Linear Decoration	Impression	Shell (scallop)	Red	Scarce	Compact	Fine
Za54	Beaker	Bell-beaker	Linear Decoration	Impression	Shell (scallop)	Brownish	Scarce	Compact	Fine
Za59	Beaker	Bell-beaker	Linear Decoration	Impression	Shell (clam), Comb	Brownish	Scarce	Compact	Fine
Za99	Beaker	Bell-beaker	Linear Variety	Impression	Comb	Red	Scarce	Compact	Fine
Ro31	Beaker	Bell-beaker	Herringbone Variety	Impression	Comb	Red	Scarce	Compact	Fine
Ro32	Beaker	Bell-beaker	Herringbone Variety	Impression	Comb	Red	Scarce	Porous	Fine
Ro33	Bowl	Bell-beaker	Geometric Variety	Impression	Comb	Red	Abundant	Porous	Fine
Ro42	Undefined	Undecorated	-	-	-	Red	Abundant	Compact	Medium
Fm01	Beaker	Bell-beaker	CZ/M	Impression	Cord, Shell (coquille fine)	Red	Abundant	Compact	Medium
Fx01	Straight-wall beakers	Undecorated	-			Brownish	Scarce	Compact	Fine
Fx03	Straight-wall beakers	Undecorated	-			Brownish	Scarce	Compact	Fine
Cx1	Urn	Decorated	Hilversum	Clay adition	Cordon, mamilon	Brownish	Abundant	Compact	Medium
Rz1	Beaker	Bell-beaker	Geometric Decoration	Impression	Comb, Punch	Brownish	Very scarce	Compact	Fine

Fig. 2. Synthetic archaeological description of the samples analysed. De: Devesa do Rei; Za: Zarra de Xoacín; Ro: Monte de A Romea; Fm: Forno dos Mouros; Fx: A Forxa; Cx: Cameixa; Rz: Roza das Aveas II, Sc: San Cosme.

Devesa do Rei (Aboal et al., 2005, Prieto, 2011c) is a ceremonial site containing four types of ceramics: Bell Beaker pottery, non-Bell Beaker decorated pottery, undecorated pottery with cordons and plain pottery (Fig. 3)[1]. For the Zarra de Xoacín settlement (Aboal et al., 2004-5, Prieto, 2011d) we only included Bell Beaker pottery, because the plain pots seemed to be associated to a previous Late Neolithic phase of occupation, some two hundred years earlier than the Bell Beaker phase (Fig. 4).

Finally, all the analysed pots from the funerary contexts were representative of this kind of site in Galicia

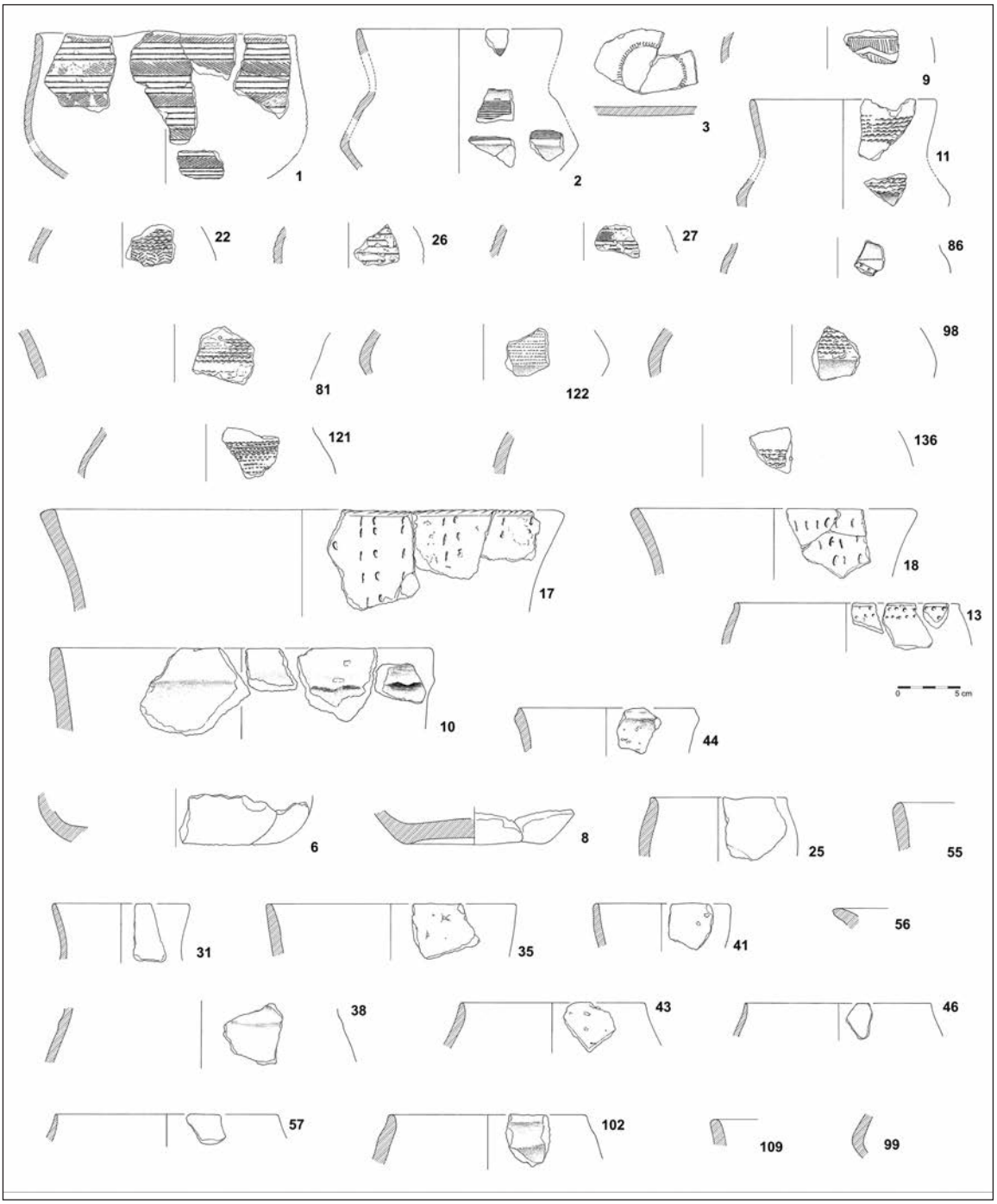

Fig. 3. Schematic drawings of pots from the ceremonial site of Devesa do Rei.

1 Despite the presence of burials may be associated to ceremonial contexts, here we consider ceremonial and funerary as separate contexts. The archaeological remains belonging to the Bell Beaker phase of Devesa do Rei are of "ceremonial" functionality but do not correspond to a type of funerary deposition, as it has already been discussed in a previous paper (Prieto, 2011c).

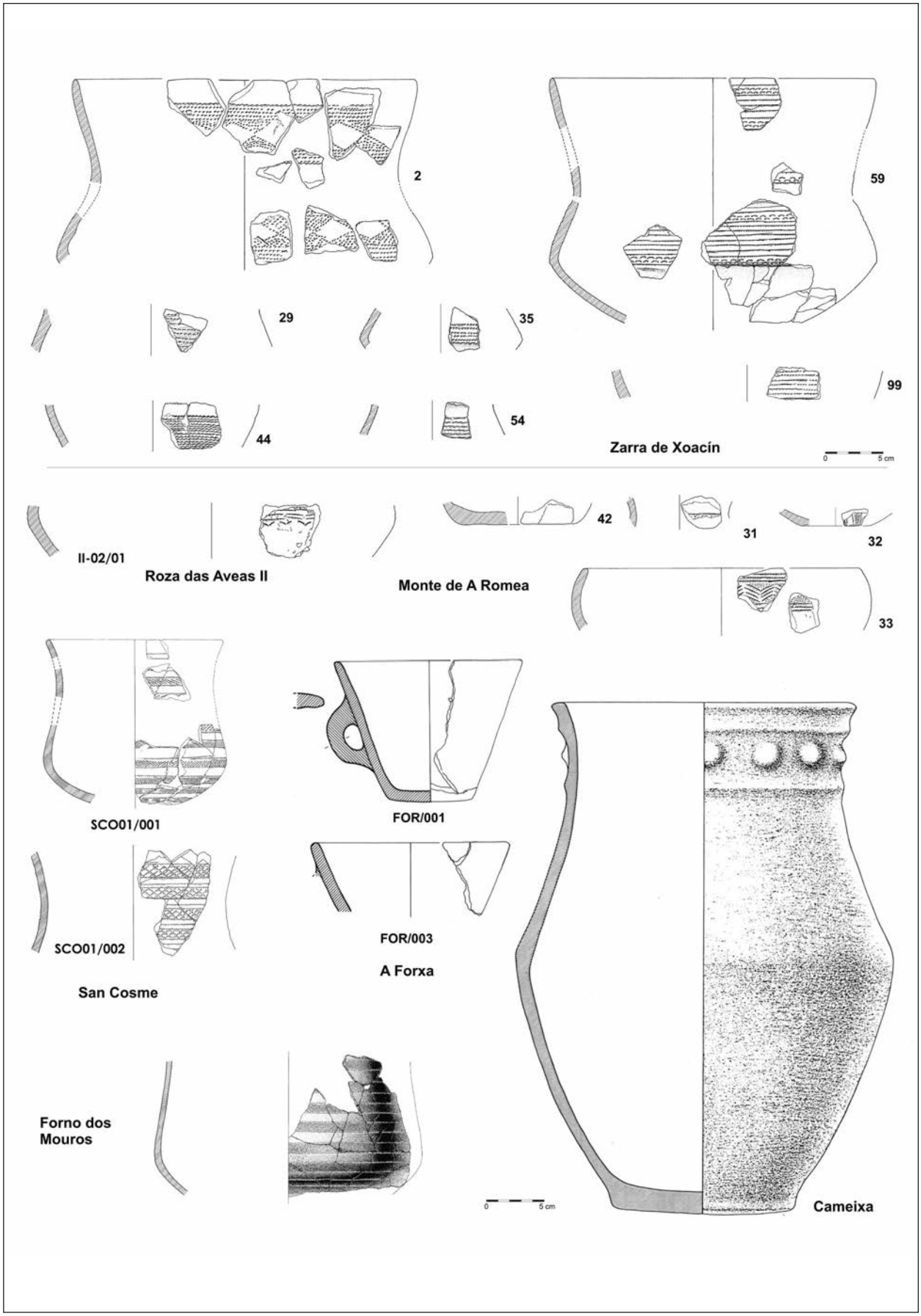

Fig. 4. Schematic drawings of pots from the domestic and funerary sites.

(Fig. 4). In this case, most of the Bell Beaker pottery was found in megaliths: Roza das Aveas II (Prieto et al., 2010), Monte de A Romea (Prieto, 2007), San Cosme (Parcero, 1998, Prieto, 2011e) and Forno dos Mouros (Prieto et al., 2008, Prieto, 2011e). Only two of the pots were found in a cist (A Forxa) and one in a pit (Cameixa), both sites dated to the Bell Beaker period (Prieto et al., 2009a, Prieto, 2011f, Prieto, 2011g).

This study was carried out in six main phases, based on a schedule developed in previous research programmes (Martínez-Cortizas et al., 2008, for the first five phases): 1) a detailed archaeological study, 2) a morphological characterization of the pots, 3) the preparation and processing of the samples, 4) mineral (by X-ray diffractometry) and elemental analyses (by X-ray fluorescence; elements determined: Si, Al, Ti, Fe, Mg, K, Ca, Rb, Sr, Ba, Ga, Y, Zr, Nb, Cr, Mn, Ni, Cu, Zn, Pb), 5) a multivariate statistical analysis of the data (principal components analysis, PCA), and finally 6) identifying the geographical source areas of the raw materials and modelling the possible routes used to obtain them by means of a Geographic Information System (Guimarey et al., 2014).

3. RESULTS

3.1 Mineralogical composition

We identified eleven minerals in the crystalline phase of the samples. These minerals can be grouped into three main categories (Fig. 5) depending on their frequency (percentage of pots in which the mineral was found): a first group of very frequent (frequency >75%) minerals which includes quartz, plagioclase and mica; a second group of frequent (frequency 75-15%) minerals which includes K-feldspar, amphibole and halloysite; and a third group of occasional (frequency <15%) minerals, which includes anatase, chlorite, hematite, kaolinite and bernalite. These minerals represent a wide range of compositions, from felsic (as K-feldspar-rich) to mafic (with chlorite and amphibole). The abundance (average concentration in the pots containing the mineral) of the different minerals was variable. Very high variations (coefficient of variation, CV>75) were found for K-feldspar, mica, amphibole, chlorite, kaolinite and anatase; high variation (CV 50-75) for plagioclase and halloysite; and moderate to low variation (CV <50) for quartz, hematite and bernalite.

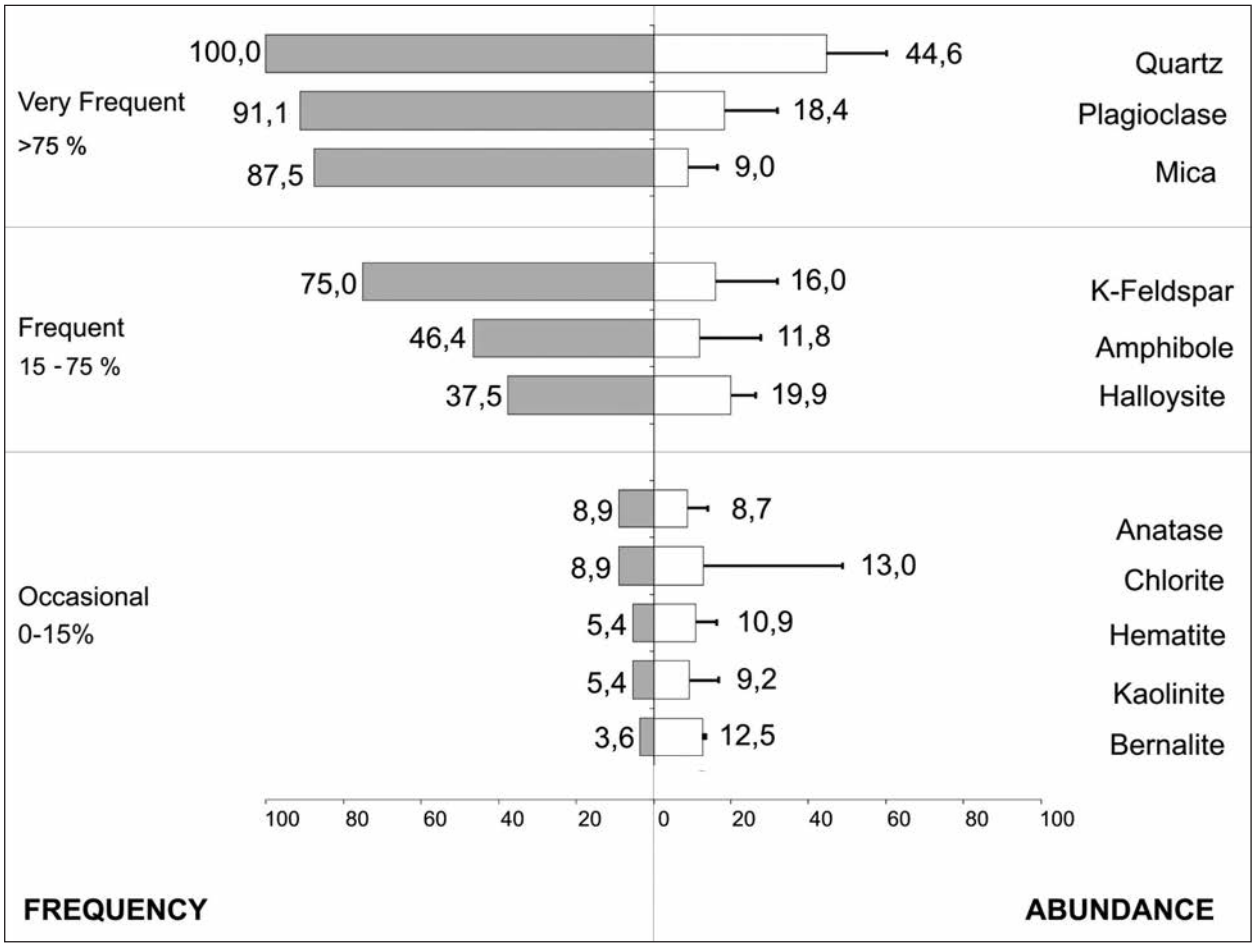

Fig. 5. Frequency (proportion of pots in which the mineral was present) and abundance (average content of the mineral in the pots in which it was present) of the minerals found in the Bell Beaker pots from NW Spain analysed in this study. Lines in the bars of the right-hand panel indicate one standard deviation.

3.2 Elemental composition

Figure 6 shows the average, maximum and minimum concentrations for the elements analysed in our study. The lowest variation in concentrations was found for Si, Al, Ga, Y, Zr and Nb (CV<40). Moderate variation (CV 50-70) was found for Ti, Fe, K, Rb, Sr, Pb and Zn. Very high variation (CV>70) was observed for most of the metallic elements, especially for Cr, Ni and Mn; as well as for Ca and Mg.

3.3 Statistical analysis

PCA allowed us to identify the main trends in both the elemental and mineralogical composition. The first principal component (F1, accounting for 27.0 % of the total variance, Fig. 7) is characterized by large positive loadings of metallic elements (Fe, Ti, Zn, Mn, Ni and Cr) and some alkaline earth elements (Ca and Mg), as well as the minerals chlorite, amphibole, anatase and hematite. Silicon, Rb, K, Pb, Sr and Al, and the K-feldspar show negative loadings. Therefore, this factor accounts for the major transition from felsic to mafic compositions.

The second principal component (F2, 15.5% of the total variance, Fig. 7) is characterized by positive loadings of Y, Ga, Nb, Zr, Ti, Zn, Cu, anatase, quartz and hematite, and negative loadings of Ni, Cr, Mg, Ca and chlorite. Therefore, this factor is related to two different compositional groups in the mafic side and, apparently, a certain separation in the felsic component. Although the quality of the data for the elemental and the mineral composition is not the same (because the latter is mostly semi-quantitative), the results show consistency between the two data sets, since the alkaline/felsic mineralogy is associated with higher contents of elements that are characteristic of acid rocks (Si, Al, K, Rb, Sr and Pb), while minerals indicative of mafic compositions correlate with higher concentrations of metallic and alkaline earth elements. Only one of the metallic elements (Pb) plots opposite to the other metals (Fig. 7). This is due to the fact that the main hosting major mineral for Pb is K-feldspar.

The projection of the samples scores (Fig. 7) shows that the Bell Beaker pottery from Devesa do Rei has the greatest variability in terms of composition. Most of the samples from this site range between an almost pure K-feldspar, to plagioclase and plagioclase-amphibole composition, although it also includes four shards that are responsible for the variation in the mafic side of the F1-F2 projection: two samples rich in anatase and hematite and two chlorite-rich samples. The samples from Zarra de Xoacín spread in a similar way to the pots from Devesa do Rei, which is also indicative of a significant variability in composition. For the rest of the sites it is not possible to establish compositional trends, due to the small amount of pots analysed. In any case, the shards from Monte de A Romea and the one from Forno dos Mouros are richer in plagioclase, while those from the other sites also contain significant amounts of K-feldspar (San Cosme, Roza das Aveas II and A Forxa) or are represented almost exclusively (Cameixa) by this latter mineral.

3.4 Compositional trends and local lithology

As previously mentioned, excluding the four samples with extreme composition (anatase-hematitic and chloritic), the results indicate that the variation in mineralogy involves three main minerals: K-feldspar, plagioclase and amphibole. The ternary diagram in Figure 8 shows the distribution of the samples analysed in the re-scaled plane represented by these three minerals. It indicates the presence of two main transitions: from K-feldspar to plagioclase

	Si	Al	Ti	Fe	Mg	K	Ca	Ga	Y	Zr
unit	%	%	%	%	%	%	%	µg/g	µg/g	µg/g
avg.	**19.4**	**10.4**	**1.4**	**8.6**	**1.4**	**2.0**	**0.7**	**26**	**30**	**212**
max.	26.2	15.4	4.6	22.3	6.2	4.4	3.2	47	115	468
min.	12.1	5.7	0.2	1.3	0.3	0.7	d.l.	13	12	71

	Nb	Rb	Sr	Ba	Cr	Mn	Ni	Cu	Zn	Pb
unit	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
avg.	**11**	**117**	**68**	**109**	**627**	**686**	**157**	**32**	**71**	27
max.	27	300	135	710	9937	4019	2597	133	345	80
min.	4	27	14	50	16	81	1	d.l.	33	9

Fig. 6. Average, maximum and minimum concentrations of the elements determined in the Bell Beaker pots analysed (avg: average, max: maximum, min: minimum; d.l.: concentrations lower than the detection limit).

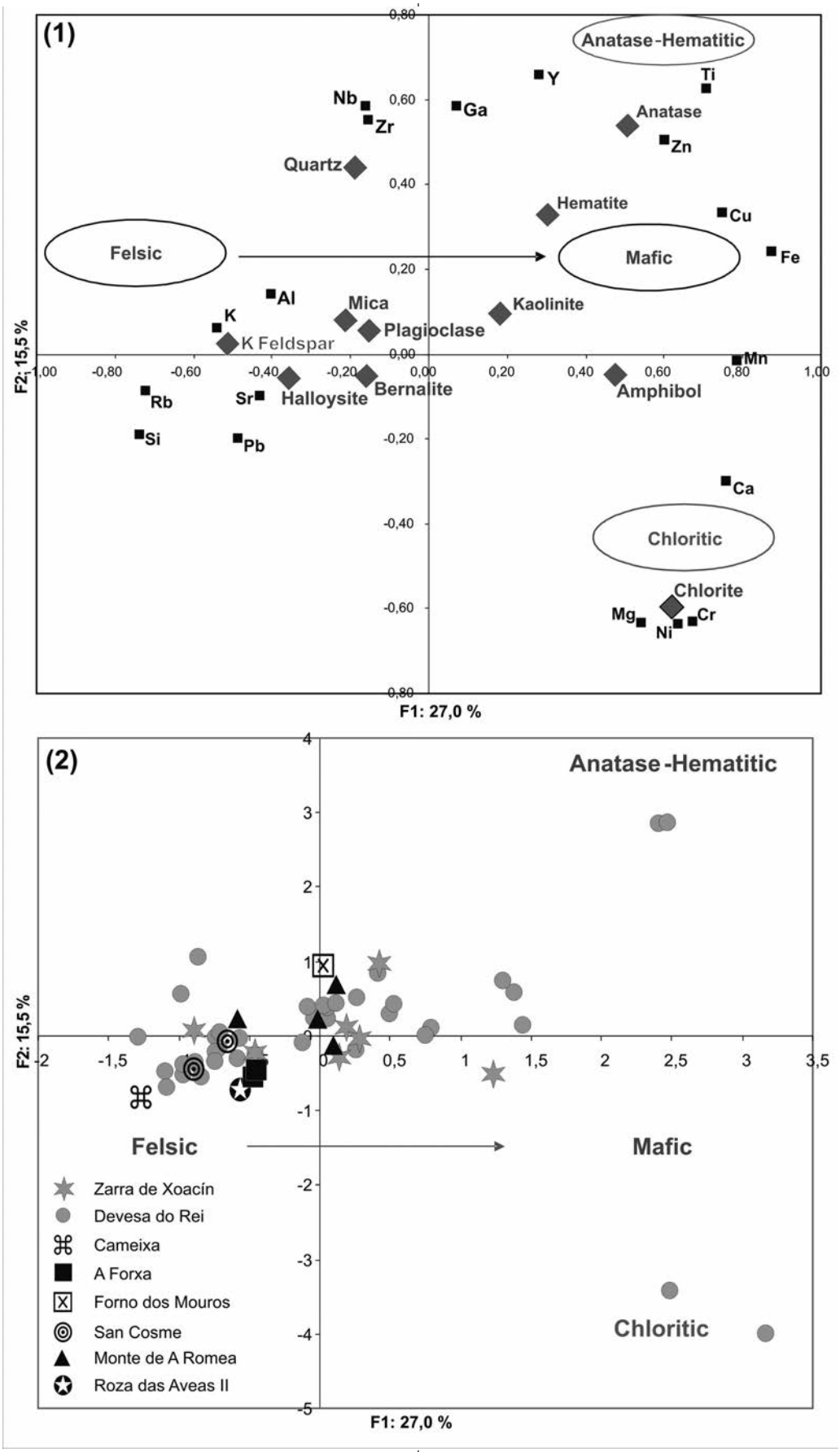

Fig. 7. Principal components analysis: (1) F1-F2 projection of factor loadings of minerals and elements. (2) F1-F2 projection of samples scores of the NW Spain Bell Beaker pottery.

and from plagioclase to amphibole (coded as Group 1 and Group 2 respectively), and a number of ceramics with variable proportions of the three minerals (Group 3). The two main transitions are typical of acid and basic lithology respectively, together with their weathering products. However, the compositions of the third group (which includes pots from Devesa do Rei, Zarra de Xoacín, Monte de A Romea and A Forxa) cannot be found in rocks of the area or their weathering products, suggesting that they are the result of an intentional mixing of minerals from quite different lithology source. This same conclusion cannot be drawn from the composition of the other groups, since K-feldspar and plagioclase co-exist in the rocks of the area, in the same way as amphibole and plagioclase.

For the four ceramics with more extreme composition it is not possible to determined whether it is related to a selective concentration of some minerals due to manipulation of the clays or to an accidental collection of particular raw materials. In any case, no pattern or tendency has been observed for the archaeological variables justifying their dissimilar composition.

The area we studied contains a diverse variety of rocks and primary minerals (Figure 9), although their weathering products have a quite similar mineral composition. Kaolinite is the main secondary phase (with interlayered phyllosilicates and gibbsite in some cases), while resistant minerals (like quartz) tend to concentrate in the weathering products.

For most of the sites and samples, the elemental and mineralogical composition of the pottery is coherent with the lithology of the area around the sites, suggesting that the raw materials were obtained from local sources. It is also important to note the virtual absence of kaolinite in the pottery (occasional in one pot and at trace amounts in two pots), which could be indicative of firing temperatures higher than 550 ºC and probably lower than 800-900 ºC, as no minerals that neoform above these temperatures (Linares et al., 1981; Eiland and Willians, 2000; Morales, 2005: 68-69) were detected.

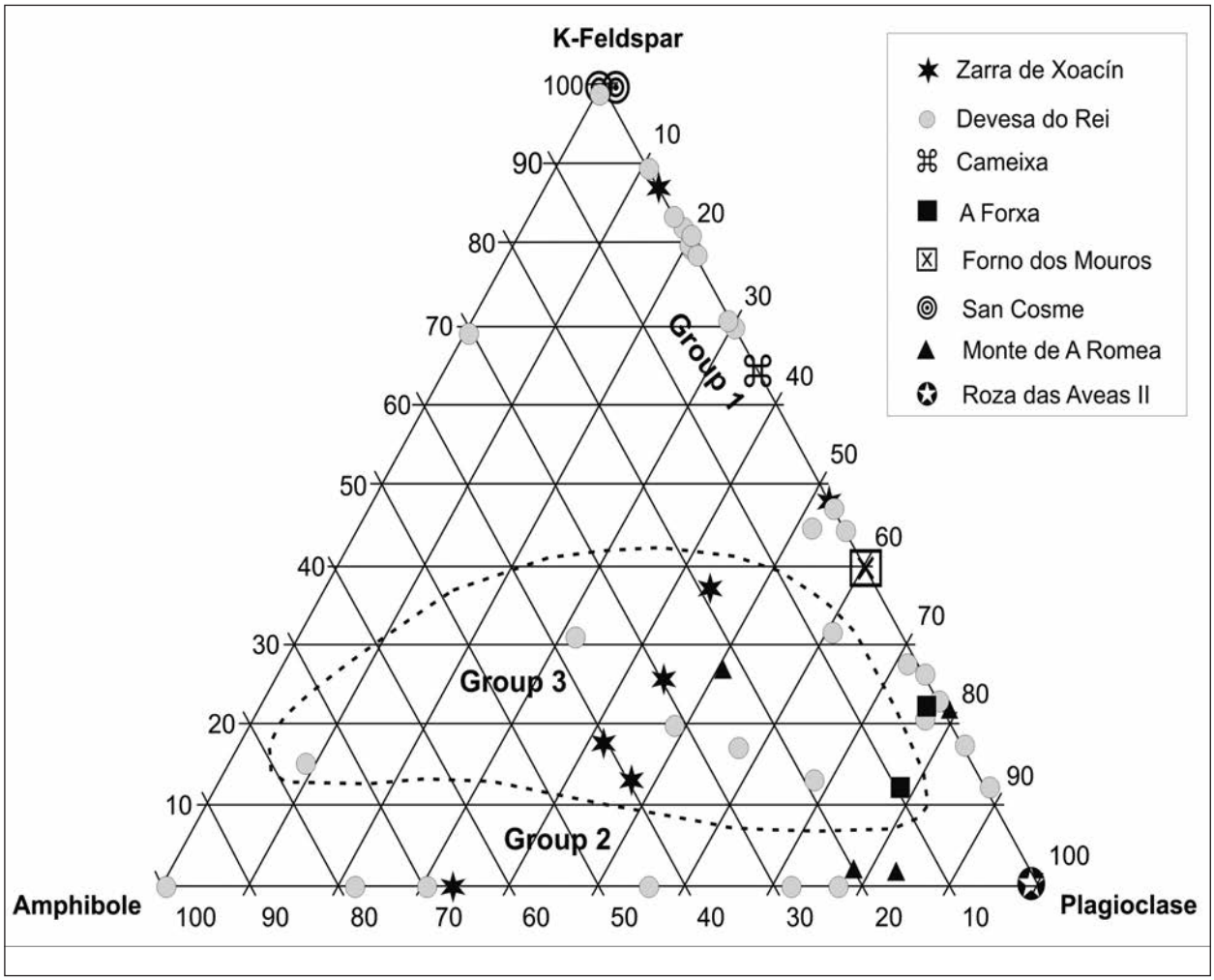

Fig. 8. Ternary diagram with the relative proportions of K-feldspar, plagioclase and amphibole in Bell Beaker pots from NW Spain.

Site	Site lithology	Main minerals	Weathering products
Devesa do Rei	Granitoids and granites	quartz, microcline, albite, biotite, muscovite, sillimanite	Residual minerals:
Monte de A Romea	Paragneis and amphibolites	biotite, muscovite, quartz, plagioclase, amphibole, garnet	quartz, muscovite
Zarra de Xoacín	Amphibolite mixed with paragneis	biotite, muscovite, quartz, plagioclase, amphibole, garnet	
Roza das Aveas II	Lake clay, arcose and conglomeratic rocks	clays from schists and granitic rocks	Secondary minerals:
Cameixa	Granite	quartz, K-feldspars, plagioclase, muscovite, biotite	mainly kaolinite,
A Forxa	Slates with Quartzites	quartz, mica, plagioclase, K-feldspars	interlayered phyllosilicates
San Cosme	Paragneis and amphibolites	quartz, plagioclase, biotite	and gibbsite
Forno dos Mouros	Ortogneis	quartz, K-feldspars, biotite, plagioclase	

Fig. 9. Mineral composition of the main rocks of the area and their weathering products. Compiled from the geological maps of the *Instituto Geológico Minero de España* (IGME): Devesa do Rei (Klein et al., 1982a), Zarra de Xoacín and Monte da A Romea (González et al., 1974b, Klein et al., 1982b), Forno dos Mouros (Pablo - Martínez 1981), Roza das Aveas (García et al., 1975), San Cosme (García et al., 1981a,b), A Forxa (Nuño et al., 1981), Cameixa (Monteserín - Pérez, 1981, González et al., 1974a).

4. Provenance study and calculations based on the mineralogical data

Based on the geological information integrated in the GIS and using techniques to simulate human movement through the area, we tried to identify the potential sources areas of the materials used to produce the pottery. To do so, "Cost analysis" algorithms were applied, which determine the effort involved in moving over a "Friction Surface". For travellers, these calculations are usually based on the orography and its conditioning factors, such as the slope, hydrography, plant cover or climate (Murrieta-Flores, 2012; Parcero Oubiña and Fábregas, 2010, Romero López, 2005). In our case we took into account the slope and hydrography, ruling out the other factors due to the lack of data for the studied period. The calculation was made using Naismith's algorithm (Fontanari, 2001), considering an average speed of 5 km/h that would vary locally depending on the direction of movement (anisotropic movement), applying different coefficients depending on whether this was uphill or downhill and considering the local slopes. The first result from these analytical techniques is an Accumulated Cost Surface, which indicates the amount of time taken to move on foot from the starting point (the site) to any part of the territory based on these variables. Therefore, by superimposing these cost layers on the geological map, we were able to obtain an initial idea of the effort involved in gathering materials, as it is possible to directly determine the distance (in time) to any geological unit (potential resource). We then traced the routes taken to gather materials, determining where people must have travelled between the site and the sources of raw materials that were identified. These tools used to trace routes identify the shortest distance between the starting point and destination, connecting the midway points along this line. This method is described in detail in a recent publication (Guimarey et al., 2014).

A preliminary analysis of distances indicates that almost all of the compositions of the ceramics can be found within a radius of 16 km, regardless of whether they can be interpreted as having been intentional or not. The majority of the minimum distances estimated to obtain the raw materials are less than 7 km, and are generally between 2 and 5 km, as shown in Fig. 10. Martínez Cortizas et al. (2011) also estimated distances to source materials, but in straight line and without taking the geographical conditioning factors into account. In general, the results of the present study coincide with the values provided by these authors, although they vary slightly as a result of refining a number of specific routes. The distances can then be calculated in terms of time needed to cover them, which are generally between one and two hours, and on many occasions even less.

Yacimiento	Contextos	grupo Lit	Longitud (m)	SEG	HORAS	Nº CERÁMICAS
DE	Ceremonial	aGr	5.326,64	3.708,48	1,03	11
DE	Ceremonial	Amp	3.456,78	4.154,22	1,15	2
DE	Ceremonial	aSch	11,72	0,00	0,00	1
DE	Ceremonial	bSch	7.240,01	5.802,96	1,61	6
DE	Ceremonial	cGr	6.161,95	4.665,46	1,30	16
DE	Ceremonial	D	237,12	182,76	0,05	1
ZA	Asentamiento	aGr	4.430,99	3.651,38	1,01	3
ZA	Asentamiento	Amp	95,71	93,10	0,03	1
ZA	Asentamiento	bSch	15.870,80	12.165,20	3,38	1
ZA	Asentamiento	cGr	1.591,63	1.351,53	0,38	2
FM	Funerario	cGr	603,52	433,49	0,12	1
RZ	Funerario	cGr	2.904,73	2.067,97	0,57	1
RO	Funerario	Amp	437,11	442,26	0,12	1
RO	Funerario	cGr	3.443,61	2.701,25	0,75	3
SC	Funerario	aGr	555,30	335,59	0,09	2
FX	Funerario	cGr	4.645,31	4.188,24	1,16	2
CX	Funerario	aGr	4.169,60	4.811,44	1,34	1

Fig. 10. Distances and access times to raw materials calculated using the GIS.

If we focus on the sites and their contexts, considering the minimum distances (and time taken to reach them) for the most likely sources of raw material, as deduced from the mineralogical study of the pottery and the mineralogical resources available in the area (Fig. 11), a number of trends can be deduced. The first general observation is that a greater effort to obtain raw materials seems to be associated to ceremonial sites compared to funerary sites and settlements. This can be seen in the variety of raw materials used and in the distances or times needed to obtain them. In A Devesa do Rei up to 7 different raw materials have been found which were gathered both *in situ* and in the local area, up to a maximum of 90 minutes from the site (for 6 of the 38 samples the raw material could have been obtained from a little further away).

This contrasts with the situation in the funerary sites in which, despite having pottery from up to 6 different locations, mainly two raw materials have been found –alkaline and calco-alkaline granites– and on rare occasions, raw materials with amphibole. There seems to be differences in terms of where these raw materials were obtained. In the megalithic funerary sites (Roza das Aveas II, Forno dos Mouros, San Cosme and A Romea) the raw materials were obtained *in situ*, while in the case of the non-megalithic funerary sites (the pit of Cameixa and cist in A Forxa) the radius extends to the local area, with raw materials from more than 4 km away, or one hour's walk. Nevertheless, the pottery from the cist of A Forxa does contain small amounts of amphibole and this mineral is not present in the calco-alkaline granites of the surrounding area. Apart from the fact that amphibole was not described for this type of rock in the geological literature (Nuño et al., 1981: IGME 303), neither was it identified in the analyses of geological samples taken on these materials. This indicates that amphibole-rich raw materials must have been included in the clays to some extent. And so, based on the available data, we support the hypothesis of a mixed or external source for this material, as initially suggested in Prieto-Martínez et al. (2009a). The closest areas of basic rocks with amphibole are 50 km to the south, in the basic complex of Bragança-Vinhais (in northern Portugal), and 100 km to the northwest in the Lalín unit (where the sites of Monte de A Romea and Zarra de Xoacín are located). The Portuguese area seems the most likely origin for the amphibole of these pots, not only because it is the shortest distance to the potential source area of the minerals, but also because of the type of pot (straight-wall plain beakers). From the north of Portugal to the south of the River Miño, there are abundant archaeological sites with this type of pottery in funerary contexts (e. g. Bettencourt, 1982, Bettencourt et al., 2004, Sanches, 1981 and 1982). In Fraga do Zorro (Verín), a necropolis located a few kilometres to the SW of A Forxa, pottery with a similar mineral composition to that found in the straight-wall beakers of A Forxa was also found (Prieto et al.,

2009a). A quarter of the 43 vessels from Fraga do Zorro, a nearby funerary site analysed in Prieto Martínez et al. (2009b), contained amphibole in the temper, and a wider variety of shapes that were different from those found in A Forxa. This suggests that the south of the province of Ourense was a very dynamic area, as it is the first one for which the composition of the ceramics provides evidence of intermediate regional distances (>10-15 km; Convertini and Querré, 1998).

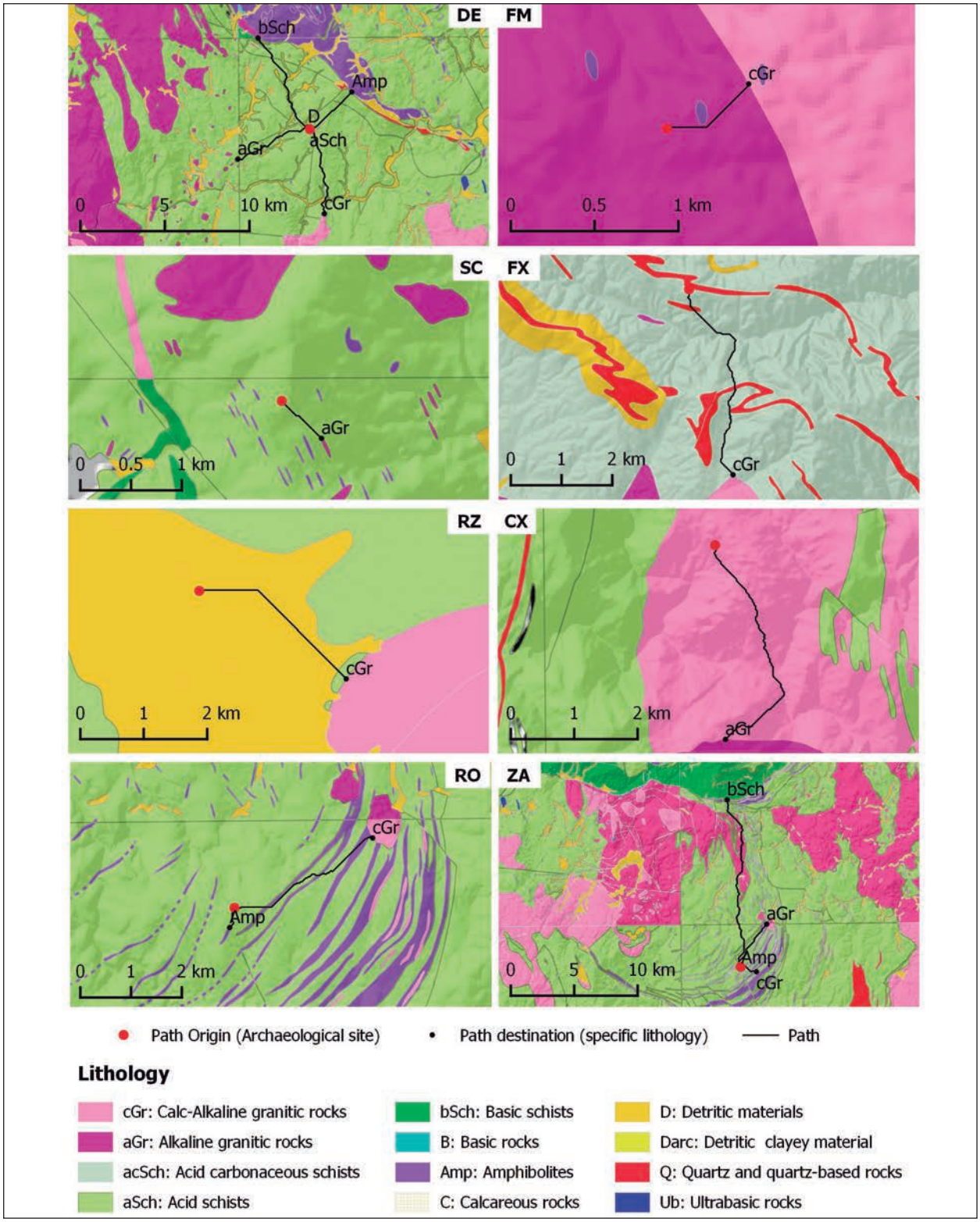

Fig. 11. Visualisation of distances for each studied site: DE: Devesa do Rei; ZA: Zarra de Xoacín; RO: Monte de A Romea; FM: Forno dos Mouros; FX: A Forxa; CX: Cameixa; RZ: Roza das Aveas II, SC: San Cosme.

In turn, in the settlement sites such as Zarra de Xoacín, although we found a smaller diversity of materials than in the ceremonial sites (4 different raw materials were found in the site that was analysed), the radii of action, mainly less than 1 hour, seem to have been extended in exceptional cases, reaching as far as nearly 16 km away to obtain basic schist.

5. Final remarks

The results of this study have several implications in terms of the composition, provenance, technology, ceramic typology, type of site context and chronology. In the case of composition, the results indicate that the Bell Beaker pottery of Early Bronze Age from NW Spain has a wide variety of mineral and elemental compositions, from those typical of acidic rocks (alkaline and calco-alkaline) to those that are characteristic of basic rocks. At site level, there was also a wide variability in the sites for which a relatively large number of samples were analysed. Variations in K-feldspar, plagioclase and amphibole content defined the three main trends in the crystalline phase (most probably the temper), while the mineral and elemental composition revealed a high degree of consistency (mafic mineralogy was associated to higher contents in Fe, Ti, Zn, Mn, Ni, Cr, Ca and Mg), while felsic mineralogy was associated to higher contents in Si, Rb, K, Pb, Sr and Al).

In terms of provenance, in all sites the composition of the pottery was consistent with the lithology of the surrounding areas. This suggests a local (<15 km) origin for the clays as found in other parts of Europe (Carmona et al., 2014; Clop, 2007; Convertini and Querré, 1998; Dias et al., 2000; Odriozola et al., 2008; Vander Linden, 2007; etc). The pottery had a low mobility, in contrast to the situation with other objects, people and ideas in the Bell Beaker period. Only two recipients from a cist in the south of the Ourense province have a composition that is indicative of longer distances (50-100 km), suggesting a probable connection with sites from northern Portugal; although we cannot rule out that there may be small veins of amphibole in the area that are not indicated on the geological maps, and which would have been known by the local inhabitants. Despite the vessels were manufactured using local raw materials the potter was definitely inspired by foreign designs.

Other aspects, apart from the composition, are important for the interpretation of a stable communication at longer distances. This is the case of the urn from Cameixa, whose morphology and decoration are reminiscent of the Hilversum Horizon in Belgium, defined by Fokkens (2005), which extends to the British Isles and Brittany (like the Saint-Just urn in Ille-et-Vilaine; Le Roux et al., 1989) (Prieto 2011g). The decorative technique is another element that helps to verify these distant relations. Decoration made using shells such as *Donax vitatus* or *Cerastoderma edule*, found in Forno dos Mouros and San Cosme, and in exceptional cases on Bell Beakers such as in Devesa do Rei, suggest a possible link with Brittany (Prieto and Salanova, 2009). Therefore, while the composition of the pots points towards a local origin of the clays used, certain stylistic aspects are shared with pottery from very distant areas, a situation that is becoming increasingly clear through recent research projects carried out in the region (i.e. Nonat et al., 2014, Salanova et al., 2015, López-Romero et al., 2015). Of the productive process, designs were probably the easiest to imitate between different communities, so the movement of a small number of people may have had a greater impact in design transmission, provided the imported designs had a meaning for the receptor communities.

In terms of the technology, the crystalline component of the clays (i.e. the temper) was found to follow three main different mineral mixtures. Two of them, with varying proportions of plagioclase/K-feldspar and plagioclase/amphibole, can be found in rocks and weathering products of the area around each site and cannot be directly interpreted as intentional. However, the third, which contains K-feldspar and amphibole, may be considered as indicative of intentional mixing, as there is no single source material in the area that could provide both minerals. The virtual absence of kaolinite also suggests firing temperatures higher than 550 ºC, and the absence of high temperature neoformation minerals would suggest firing temperatures of lower than 800-900 ºC.

As regards the typology, it bears no correspondence with composition. Both aspects were marked by a significant diversity, but responded to different patterns. Therefore, the composition is not associated with the archaeological types. In terms of context, despite the wide geographic distribution and the limited amount of samples analysed, a relatively higher homogeneity was observed for the pottery from funerary sites, which is highly coherent with the processing of the clays verified in the archaeological study. However, the compositional homogeneity did not reflect the morphological and decorative differences of the three types of burials (megaliths, with Bell Beaker pottery; cists and pits, with plain pottery; and non-Bell Beaker decorated pottery).

Despite A Devesa do Rei may represent a particular case regarding context in Galicia, its ceramic assemblage contains most of the types present in the region so, to the level of the study presented here, the results can be considered as representative. Regarding the context, it may be necessary to analyse more samples to confirm the trends identified and provide more robust conclusions.

Finally, in terms of chronology, the stylistic change that occurred throughout prehistory in NW Spain, especially between the Late Neolithic and Early Bronze Age with the introduction of Bell Beaker pottery, was quite dramatic. Nevertheless, the archaeometric study does not reveal such a dramatic change, as the composition of the pots point to a local origin of the raw material for at least four thousand years, and thus for continuity regarding its provenance. Our data only suggest a slightly higher degree of control in mixing the temper (mainly for plagioclase) in decorated Bell Beaker pottery, which is more obvious for sites located in areas with basic lithology (amphibolite, in Zarra de Xoacín and Monte de A Romea) than for the sites located in granitic areas.

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Bibliography

Aboal Fernández, R.; Ayán Vila, X.; Criado Boado, F.; Prieto Martínez, M. P.; Tabarés Domínguez, M. (2005): "Yacimientos sin estratigrafía: Devesa do Rei, ¿un sitio cultual de la Prehistoria Reciente y la Protohistoria de Galicia?". *Trabajos de Prehistoria* 62 (2), 165-180.

Aboal Fernández, R.; Baqueiro Vidal, S.; Castro Hierro, V.; Prieto Martínez, M. P.; Tabarés Domínguez, M. (2004-05): "El yacimiento del III milenio BC de Zarra de Xoacín (Lalín, Pontevedra)". *Lancia* 6, 37-58.

Bettencourt, A.M.S. (1982): "A propósito de um vaso tronco-cónico do Museu de Aveiro". *Arqueologia* 5, 40-43.

Bettencourt, A.M.S.; Dinis, A.P.; Silva, A.; Veiga, A.M.; Ribeiro, E.; Cardoso, H.; Boas, L.V.; Amorim, M.J. (2004): "A estação arqueológica das Boucinhas, Regueira, Vitorino de Piães, Ponte de Lima (Norte de Portugal)". *Portugalia* NS XXV, 2, 91-114.

Carmona Ballestero, E.; Palmero Díaz, S.; Arnaiz Alonso, M. A. (2014): "Análisis químico de cerámicas calcolíticas de la Cuenca Media del Arlanzón (Burgos): un medio para la valoración de la procedencia y el intercambio". *Boletín de la Sociedad Española de Cerámica y Vidrio* 53 (2), 81-92.

Clop, X. (2007): *Materia prima, cerámica y sociedad. La gestión de los recursos minerales para manufacturar cerámicas del 3100 al 1500 ANE en el nordeste de la Península Ibérica*, 1660. BAR International Series, Archaeopress, Oxford.

Convertini, F.; Querré G. (1998): "Apports des études céramologiques en laboratoire à la connaissance du Campaniforme: résultats, bilan et perspectives". *Bulletin de la Société Préhistorique Française* 95 (3), 333-341.

Criado Boado, F.; Vázquez Varela, J.M. (1982): *La cerámica campaniforme en Galicia*. A Coruña.

Dias, M.I., Prudêncio, M.I, Prates, S., Gouveia, M.A., Valera, A.C. (2000), "Tecnologias de produçâo e proveniência de materia-prima das cerámicas campaniformes da Fraga da Pena (Fornos de Algodres - Portugal)". In *Actas do 3¼ Congresso de Arqueologia Peninsular, 4 (Pré-História Recente da Península Ibérica)*, ADECAP, 253-268.

Eiland, M. L.; Williams, Q. (2000): "Infra-red spectroscopy of ceramics from Tell Brak, Syria". *Journal of Archaeological Science* 27, 993-1006.

Fokkens. H. (2005): "Le début de l'Âge du Bronze aux Pays-Bas et l'Horizon Hilversum ancien". In Bourgeois, J., Talon, M. (eds.): *L'Âge du Bronze du Nord de la France dans son contexte européen*, 11-33. Paris

Fontanari, S. (2001): *Svilluppo di metodologie GIS per la determinazione dell'accessibilità territoriale come supporto alle decisioni nella gestione ambientale*. M. Sc. Thesis, University of Trento, Italy.

García, F.; Abril, J.; Pliego, D.V.; Rubio, J.; Solar, J.B.; Coretge, L.G.; Floor, P. (1981a): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 261 (4-12, Tuy), 2nd serie, 1st edition (IGME publications).

García, F.; Abril, J.; Rubio, J.; Corretge, L.G.; Zapardiel, J.M.; Floor, P. (1981b): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 223 (4-11, Vigo). 2nd serie, 1st edition (IGME publications).

García, F.; Abril, J.; Tena-Dávila, M. de; Capdevilla, M.R. (1975): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 72 (7-6, Lugo), 2nd serie, 1st edition (IGME publications).

González, F.; Iglesias, M.; Martínez, J.R. (1974a): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 187 (6-10, Ourense), 2nd serie, 1st edition (IGME publications).

González, F.; Iglesias, M.; Martínez, J.R. (1974b): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 154 (6-9, Lalín), 2nd serie, 1st edition (IGME publications).

Guimarey B.; Lantes Suárez, O.; Cordero, M.; Prieto Martínez, M-P. (2014): "Integración de información geológica en un sistema de información geográfico con objetivos arqueométricos". *Gallaecia* 33, 7-37.

Klein, E.; Aldaya, F.; Arps, D.E.S.; González, F.; Hilgen, J.D.; Pablo, J.G. de; Huerga, A. (1982a): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 121 (5-8, La Estrada), 2nd serie, 1st edition (IGME publications).

Klein, E.; Hilgen, J.D.; Arps, D.E.S.; Calvo, B.; Huerga, A. (1982b): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº (153, 5-9, Cercedo), 2nd serie, 1st edition (IGME publications).

Lantes-Suárez, O.; Prieto, B.; Prieto-Martínez, P.; Ferro-Vázquez, C.; Martínez-Cortizas, A. (2015): The colour of ceramics from Bell Beaker contexts in NW Spain: relation to elemental composition and mineralogy. *Journal of Archaeological Science 54*, 99-109.

Lantes-Suárez, O.; Prieto-Martínez, M. P.; Martínez-Cortizas, A. (2010): Caracterización de la pasta blanca incrustada en decoraciones de campaniformes gallegos: Indagando sobre su procedencia. In Saiz Carrasco, M.ª; López Romero, R.; Cano Díaz-Tendero, Mª A.; Calvo García, J.C. (eds.): *Actas del VIII Congreso Ibérico de Arqueometría* (Teruel, 19-21 Octubre 2009). Ed. Seminario de Arqueología y Etnología Turolense: 87-100. Teruel.

Le Roux, C.T.; Lecerf, Y.; Gautier, M. (1989): "Les megalithes de Saint-Just (Ille-et-Vilaine) et la fouille des alignements du Moulin de Cojou". *Revue Archéologique de l'Ouest* 6, 5-29.

Linares, J.; Huertas, F.; Capel, J. (1983): "La arcilla como material cerámico. Características y comportamiento". *Cuadernos de Prehistoria de la Universidad de Granada* 8, 479-490.

López-Romero, E.; Güimil-Fariña, A.; Mañana-Borrazás, P.; Otero Vilariño, C.; Prieto Martínez, M.P.; Rey García, J. M.; Vilaseco Vázquez, X.I. (2015, in press): "Ocupación humana y monumentalidad durante la Prehistoria Reciente en el islote de Guidoiro Areoso (Ría de Arousa, Pontevedra). Investigaciones en el marco de las dinámicas litorales atlánticas actuales". *Trabajos de Prehistoria*.

Martínez Cortizas, A.; Lantes Suárez, O.; Prieto Martínez, M. P. (2010): Análisis arqueométrico de la cerámica de contextos campaniformes del Área Ulla-Deza. In Prieto Martínez, M. P. &. Criado-Boado, M. P. (coords.): *Reconstruyendo la historia de la comarca del Ulla-Deza (Galicia, España). Escenarios arqueológicos del pasado*. TAPA 41: 135-144. Instituto de Estudios Galegos Padre Sarmiento. CSIC. Madrid.

Martínez Cortizas, A.; Lantes Suárez, O.; Prieto Martínez, M. P. (2011): "Capítulo 33. Cerámica campaniforme del NW de la Península Ibérica. Indagando en sus materias primas, elecciones tecnológicas y procedencia". In Prieto Martínez, M.P.; Salanova, L. (coords.). *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*, 309-331. Pontevedra.

Martínez Cortizas, A.; Prieto Lamas, B.; Lantes Suárez, O.; Prieto Martínez, M. P. (2008): "Análisis mineralógico, elemental y cromático de cerámica prehistórica del área Ulla-Deza (Noroeste de la Península Ibérica)". In Rovira Llorens, S.; García Heras, M.; Gener Moret, M.; Montero Ruiz, I. (eds.): *Actas del VII Congreso Ibérico de Arqueometría*, Madrid, 250-64 (www.ih.csic.es/congreso_iberico/VII%20CIA.pdf). Madrid.

Monteserín, V.; Pérez, A. (1981): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 186 (5-10, Puente Caldelas), 2nd serie, 1st edition (IGME publications).

Morales Güeto, J. (2005): *Tecnología de los materiales cerámicos*. Ediciones Diaz de Santos. Conserjería de Educación, Comunidad de Madrid. Madrid.

Murrieta-Flores, P. (2012): "Understanding human movement through spatial technologies. The role

of natural areas of transit in the Late Prehistory of South-western Iberia". *Trabajos de Prehistoria* 69 (1), 103-122 (doi:10.3989/tp.2012.12082).

Nonat, L.; Vázquez Liz, P.; Prieto Martínez, M.P. (2015): *El vaso de largo bordo horizontal: un trazador cultural del noroeste de la península Ibérica en el II milenio BC*. British Archaeological Reports International Series 2699. Oxford: Archaeopress.

Nuño Ortea, C., López García, M. J.; Ferragne, A.; Ruíz García, C. (1981): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 303 (8-13, Verín). Segunda serie. Primera edición. Publicaciones del I.G.M.E.

Odriozola Lloret, C., Hurtado Perez, V., Dias, M. I. y Valera, A.C. (2008): "Produçao e Consumo de Campaniformes no Vale Do Guadiana: Uma Perspectiva Ibérica". *Apontamentos de Arqueologia e Património* 3, 45-52.

Pablo Maciá, J.G. de; Martínez Catalán, J.R. (1981): Mapa Geológico 1:50.000 y Memoria explicativa de la hoja nº 71 (6-6, Sobrado dos Monxes), 2nd serie, 1st edition (IGME publications).

Parcero Oubiña, C. (1998): *La arqueología de la gasificación de Galicia 3: Excavación del túmulo nº 3 del Alto de San Cosme*. TAPA 5. Santiago de Compostela.

Parcero-Oubiña, C.; Fábrega, P. (2010): "Una arqueología del movimiento: modelización de la evolución histórica del tránsito entre el Deza y Santiago". En M. P. Prieto-Martínez, M.P, F. Criado-Boado, Felipe (eds.): *Reconstruyendo la historia de la comarca del Ulla-Deza (Galicia, España). Escenarios arqueológicos del pasado*, Traballos de Arqueoloxía e Patrimonio. TAPA 41, CSIC, 145–157. Madrid.

Prieto Lamas, B.; Lantes Suárez, O.; Prieto Martínez, M. P.; Martínez Cortizas, A. (2011): Capítulo 33. Aspectos cromáticos de la cerámica campaniforme de Galicia. In Prieto-Martínez, M. P. & Salanova, L. (coords.): *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II Milenios BC en el NW de la Península Ibérica*. Diputación de Pontevedra, 333-343. Pontevedra.

Prieto Martínez, M.P. (1999a): "Caracterización del estilo cerámico de la Edad del Bronce en Galicia: cerámica campaniforme y cerámica no decorada". *Complutum* 10, 71-90.

Prieto Martínez, M.P. (1999b): *Forma, Estilo y Contexto en la Cultura Material de la Edad del Bronce Gallega: Cerámica Campaniforme y Cerámica No Decorada*, PhD Thesis, Universidad de Santiago (published edition in CD), (Santiago de Compostela).

Prieto Martínez, M.P. (2002): "A formal characterisation of ceramics in Galician Bell-Beaker contexts". In Gheorghiu, D.; Lungu, V. (eds.): *Studia Vasorum* 1, (www.vadastra.ro) (August 2002).

Prieto Martínez, M.P. (2007): "Volviendo a un mismo lugar. Recipientes y espacios en un monumento megalítico gallego (NW de España)". *Revista Portuguesa de Arqueología* 10 (2), 101-125.

Prieto Martínez, M.P. (2011a): "Unity and circulation. What underlies behind the homogeneity of Galician Bell Beaker style?". In Prieto, M.P.; Salanova, L. (Coords.), *Current researches on Bell Beakers. Proceedings of the 15th International Bell Beaker Conference: From Atlantic to Ural. 5th - 9th May 2011 Poio Pontevedra, Galicia, Spain*. Copynino, 209-250. Santiago de Compostela.

Prieto Martínez, M.P. (2011b): "Capítulo 35. La alfarería de las comunidades campaniformes en Galicia: contextos, cronologías y estilo". In Prieto Martínez, M.P.; Salanova, L. (Coords.). *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*. Diputación de Pontevedra, 345-361. Pontevedra.

Prieto Martínez, M.P. (2011c): "Capítulo 19. Devesa do Rei, contribución del estudio cerámico a la interpretación de la ocupación campaniforme". In Prieto Martínez, M.P.; Salanova, L. (Coords.). *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*. Diputación de Pontevedra, 163-169. Pontevedra.

Prieto Martínez, M.P. (2011d): "Capítulo 7. Zarra de Xoacín (Lalín, Pontevedra), la problemática de los yacimientos con estratigrafía horizontal". In Prieto Martínez, M.P.; Salanova, L. (Coords.). *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*. Diputación de Pontevedra, 67-72. Pontevedra.

Prieto Martínez, M.P. (2011e): "Capítulo 9. Poder y estrategias de apropiación del espacio en las comunidades campaniformes. Dos casos de estudio: el dolmen de Forno dos Mouros y el túmulo 3 del Alto de San Cosme". In Prieto Martínez, M.P.; Salanova, L. (Coords.). *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*. Diputación de Pontevedra, 85-94. Pontevedra.

Prieto Martínez, M.P. (2011f): "Capítulo 14. Vasos troncocónicos y cerveza en contextos campaniformes de Galicia: la cista de A Forxa como ejemplo". In Prieto Martínez, M.P.; Salanova, L. (Coords.). *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*. Diputación de Pontevedra, 119-125. Pontevedra.

Prieto Martínez, M.P. (2011g): "Capítulo 15. La urna de Cameixa ¿una influencia del *Horizonte Hilversum*?". In Prieto Martínez, M.P.; Salanova, L. (Coords.). *Las Comunidades Campaniformes en Galicia. Cambios sociales en el III y II milenios BC en el NW de la Península Ibérica*. Diputación de Pontevedra, 127-131. Pontevedra

Prieto Martínez, M.P.; Lantes Suárez O.; Martínez Cortizas, A. (2008): "O campaniforme cordado de Forno dos Mouros (Toques, A Coruña)". *Cuadernos de Estudios Gallegos* 121, 31-51.

Prieto Martínez, M.P.; Lantes Suárez O.; Martínez Cortizas, A. (2009a): "Dos enterramientos de la Edad del Bronce en la provincia de Ourense". *Revista Aquae Flaviae* 41, 93-105.

Prieto Martínez, M.P.; Lantes Suárez, O.; Vázquez Liz, P.; Martínez Cortizas, A. (2010): "La cerámica de dos túmulos de Roza das Aveas (Outeiro de Rey, Lugo): Un estudio diacrónico del estilo y la composición". *BSAA arqueología (Boletín del Seminario de Arte y Arqueología)* 76, 27-61.

Prieto Martínez, M.P.; Martínez Cortizas, A.; Lantes Suárez, O.; Gil Agra, D. (2009b): "Estudio de la cerámica del yacimiento de fosas de Fraga do Zorro". *Revista Aquae Flaviae* 41, 107-121.

Prieto Martínez, M.P.; Salanova, L. (2009): "Coquilles et Campaniforme en Galice et en Bretagne : mécanismes de circulation et stratégies identitaires". *Bulletin de la Société Préhistorique Française* 106 (1), 73-93.

Romero López, R.L. (2005): "Cálculo de rutas óptimas mediante SIG en el territorio de la ciudad celtibérica de Segeda: propuesta metodológica". *Saldvie: Estudios de prehistoria y arqueología* 5, 95-111.

Salanova, L.; Prieto-Martínez, M.P.; Clop-García, X.; Convertini, F.; Lantes-Suárez, O.; Martínez-Cortizas, A. (2015, in press): "What are large-scale Archaeometric programmes for? Bell Beaker pottery and societies from the third millennium BC in Western Europe". *Archaeometry (doi:* 10.1111/arcm.12173).

Sanches, M.J. (1981): "Recipientes cerámicos da Pré-história recente do Norte do Portugal". *Arqueologia* 3, 88-98.

Sanches, M.J. (1982): "Vasos da estaçao arqueológica do Corvilho-Santo Tirso". *Arqueologia* 5, 56-61.

Suárez Otero, J.; Lestón Gómez, M. (2005): "Un vaso con decoración cordada en Galicia y el problema de los orígenes de la cerámica campaniforme en el occidente ibérico". *Madrider Mitteilungen* 46, 1-21.

Vander Linden, M. (2007): "What linked the Bell Beakers in third millenium BC Europe? *Antiquity* 81, 343-352.