Pedregales: a coarse ware workshop in the Celtiberian tradition at the Roman town of Clunia (Peñalba de Castro, Burgos, Spain)

J. BUXEDA I GARRIGÓS[1] ▮ J. GARCÍA IÑAÑEZ[1] ▮ F. TUSET I BERTRAN[1, 2]

ABSTRACT Clunia was an important Roman town in the Duero valley. It was the capital of the *Conventus Iuridicus* of the same name in the Roman *Tarraconensis* province. Though there is evidence of Late Hispanic Terra Sigillata (LHTS) production at Clunia during the fourth and fifth centuries AD, the only pottery production conclusively identified is the Los Pedregales painted ware workshop, active during the Early Empire. This production was studied archaeometrically using X-Ray Fluorescence (XRF) and X-Ray Diffraction (XRD) in order to characterize its chemical and mineralogical composition. The microstructure, sintering state and decoration were analysed by means of Scanning Electron Microscopy (SEM).
The results reveal the use of two slightly different calcareous pastes, both of which give light-buff colors when fired; the black decoration, made out of manganese oxides, is highlighted.

1. Introduction

The Roman town of Clunia, *Colonia Clunia Sulpicia*, was the capital of the *Conventus Iuridicus* of Clunia, in the Roman province of *Tarraconensis* (Palol, 1994). It was located in the Duero valley, at the site of the modern-day village of Peñalba de Castro (Burgos, Spain) (Fig. 1).

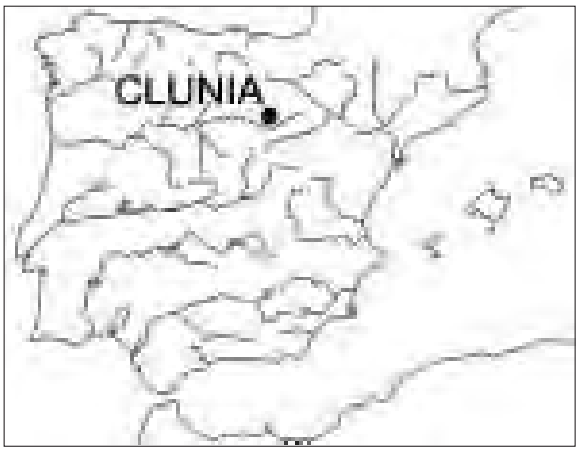

FIG. 1 – Map showing the location of the Roman town of Clunia.

The town was probably founded during the Augustan period, at the end of the first century BC. However, the earliest archaeological remains can be dated back only to the first half of the first century AD. Clunia was declared a *Colonia*, possibly under the rule of Galba (AD 68), and it was active until the sixth century AD.

The archaeometric study of the Hispanic Terra Sigillata (HTS) (second half of the first century AD and first half of the second century AD) and Advanced Hispanic Terra Sigillata (AHTS) (second half of the second century AD and third century AD) in this important town has demonstrated the existence of imports from the Tricio area in the Ebro valley. The research has also shown that Terra Sigillata was most probably produced in the Duero valley, if not in Clunia itself, since moulds used in Late Hispanic Terra Sigillata (LHTS) (fourth-fifth century AD) production have been recovered at this site (Buxeda, 1995; Tuset and Buxeda,

1995). During the Early Empire, and indeed throughout the period that the town was active, the only local pottery production that has been conclusively identified is the Los Pedregales painted ware workshop. We decided to study this production in order to characterize its reference group, to improve our understanding of the technology used and to obtain supplementary information on Hispanic Terra Sigillata production in the Duero valley.

The production at Los Pedregales from the first to the third centuries AD reflects the local development of pre-Roman Celtiberian pottery. The activity was discovered in 1915--1916, when a kiln dump was found at the site of Los Pedregales. The site was excavated in 1958 and in 1967-68, and its period of activity was dated to the first and second centuries AD. The vessels found in Los Pedregales are tableware, mostly cups and jars. The clay has a general buff/pale color. The vessels exhibit black painted decoration that is influenced by Terra Sigillata, since the decoration motifs, mainly fishes, birds, hares and floral motifs, are separated by metopes.

2. Sampling and analytical routine

To obtain an archaeological characterization of the local production of Celtiberian pottery found at Clunia, thirty-three individuals of common ware found at the Los Pedregales kiln dump were taken and analysed by X-ray fluorescence (XRF) and X-ray diffraction (XRD). Three items were then selected for study by scanning electron microscopy (SEM) in order to estimate their sintering state and to identify the pigments used for the decoration.

Fifteen grams of each individual were taken and powdered in a Spex Mixer (Mod. 8000) tungsten carbide cell mill, after mechanical removal of the outer surfaces. XRF analysis was performed using a Phillips PW 2400 spectrometer with an Rh excitation source. A portion of specimens was dried at 100°C for 24 h. Major and minor elements were determined by preparing duplicates of glassy pills using 0,3 g of powdered specimen in an alkaline fusion with lithium tetraborate at 1/20 dilution. Trace elements and Na_2O were determined by powder pills made out of 5 g of specimen mixed with Elvacite agglutinating placed over boric acid in an aluminum capsule and pressed for 60 s at 200 kN. Concentrations were quantified using a calibration line performed with 60 standards (International Geological Standards). The elements determined comprised Fe_2O_3 (as total Fe), Al_2O_3, MnO, P_2O_5, TiO_2, MgO, CaO, Na_2O, K_2O, SiO_2, Ba, Rb, Mo, Th, Nb, Pb, Zr, Y, Sr, Sn, Ce, Co, Ga, V, Zn, W, Cu, Ni and Cr. The loss on ignition (LOI) was determined by firing 0.3 g of dried specimen at 950°C for 3 h.

XRD measurements were performed on the above specimens using a Siemens D-500 diffractometer working with the CuKα radiation (λ=1.5406 Å), at 1.2 kW (40 kV, 30 mA), and using a graphite monochromator in the diffracted beam. Spectra were recorded from 4 to 70°2θ, at 1°2θ/min (step size=0.05°2θ; time=3 s). Crystalline phases were evaluated using the DIFFRACT/AT program by Siemens, which includes the Joint Committee of Powder Diffraction Standards (JCPDS) data bank.

The SEM study was conducted on a fresh fracture (transverse to the wall and parallel to the vertical dimension of the vessel) obtained from each of the three pieces. The samples were carbon coated and examined under a Jeol JSM-840 SEM coupled to an energy dispersive X-ray analyzer (EDX).

3. Results and discussion

For the analysis of the chemical concentrations, Aitchison's observations on compositional data were used (Aitchison, 1986, 1992; Buxeda, 1999; Buxeda and Kilikoglou, 2003) and the raw data were logratio transformed. The results showed an unexpectedly complex structure of three groups (Fig. 2).

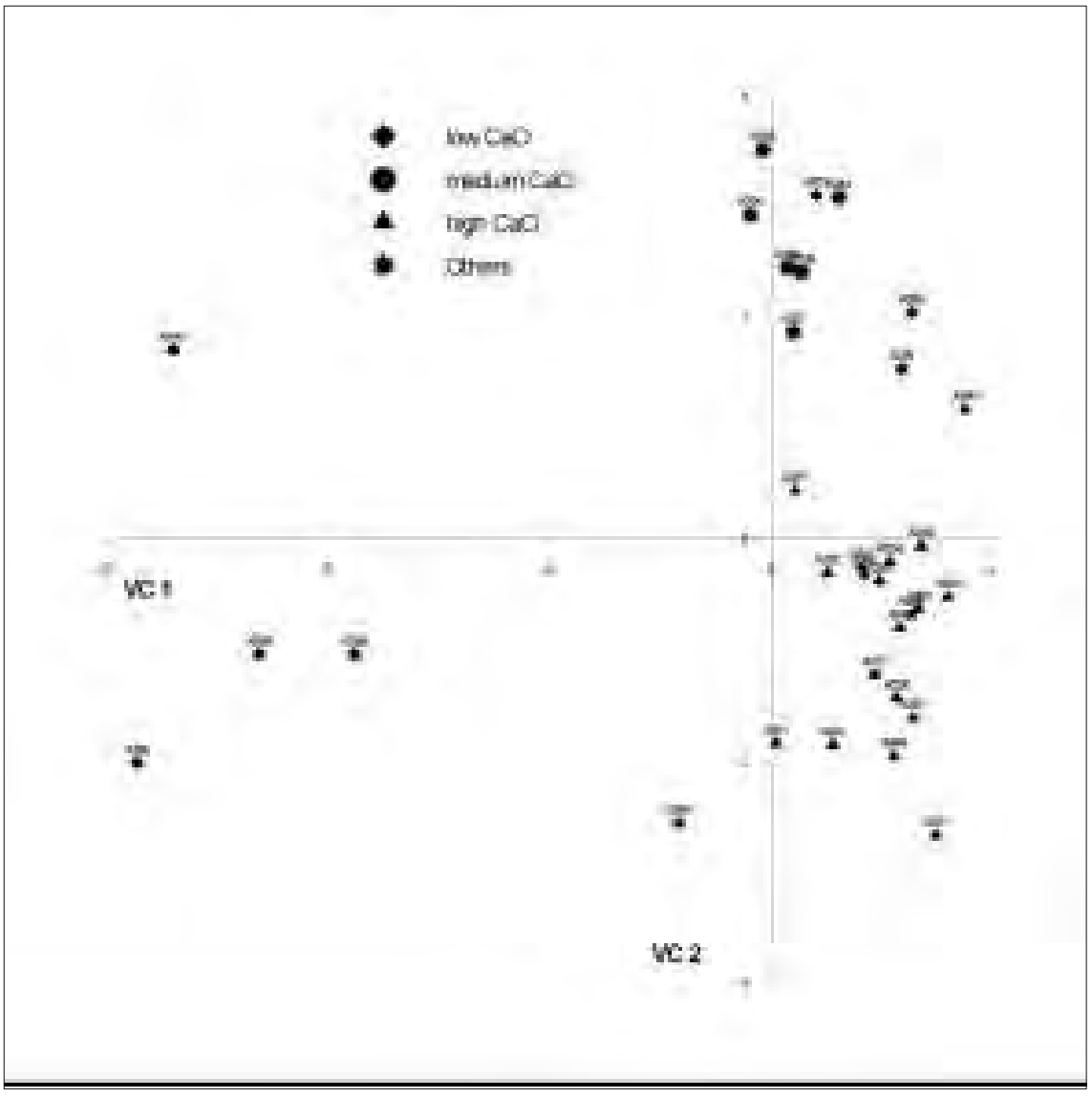

FIG. 2 – Stepwise discriminant analysis with the three groups identified at Los Pedregales on the logratio transformed data using TiO_2 as divisor. The variables with the highest discriminatory power were the transformed Fe_2O_3, CaO and SiO_2. The two canonical variables (CV) explain 100% of the total dispersion.

The main difference between the groups was the relative value of CaO. The group with the lowest relative CaO content (8,74 ± 1,91%, in normalized concentrations) is labelled PL; the one with the intermediate level (15,69 ± 1,11%) PM, and the one with the highest level (24,25 ± 2,47%) PH. Five items were considered outliers due to small chemical differences which could not be fully evaluated because of the small number of indi-

viduals in the studied sample. The data obtained were compared with the Hispanic Terra Sigillata and the Dorada ware (TSHD) characterized at Clunia (Buxeda, 1995; Tuset and Buxeda, 1995). In the previous studies, the Hispanic Terra Sigillata from the first to third centuries AD at Clunia was found to belong to the production at Tricio (groups E2/E4 and E1/E3) in the Ebro valley. However, from the end of the second century AD onwards two groups were being produced, most probably in the Duero valley, if not at Clunia itself (groups D1 and D2). The comparison shows that none of the Terra Sigillata production mentioned above can be identified with the local production at the site of Los Pedregales at Clunia (Fig. 3).

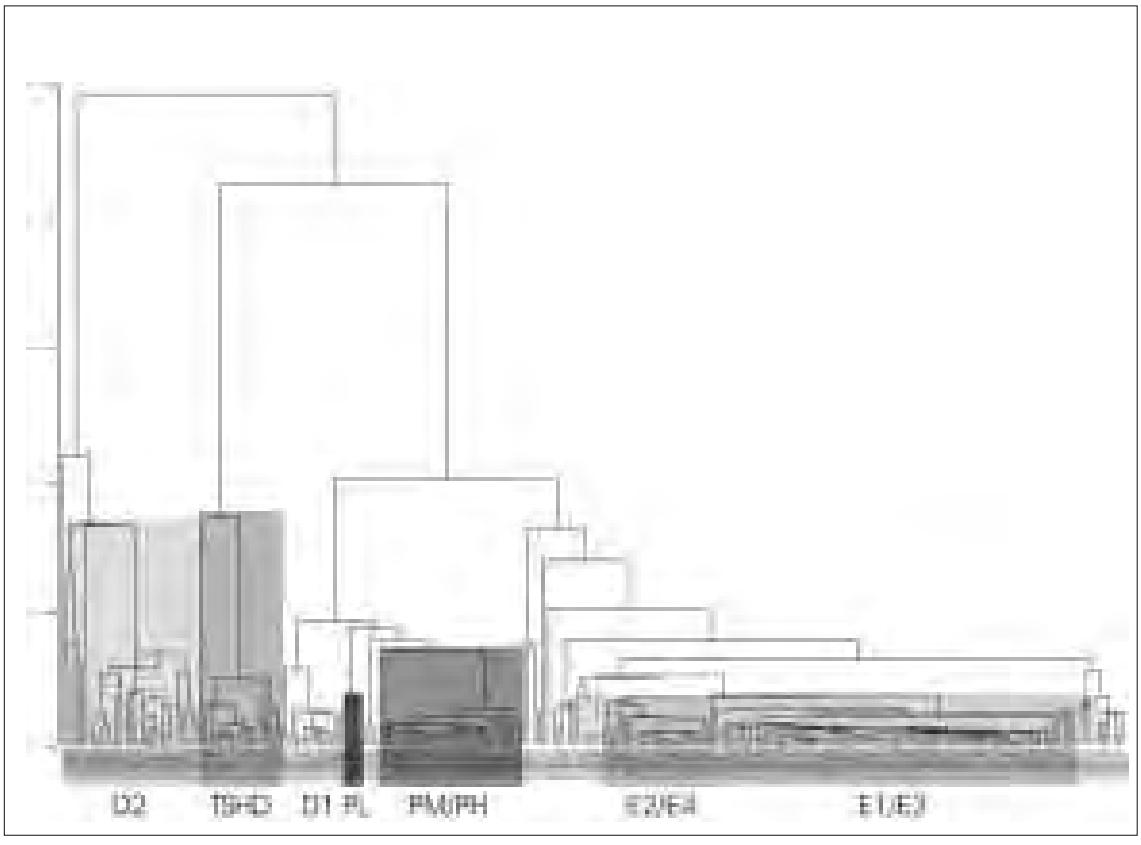

FIG. 3 – Dendrogram resulting from the cluster analysis using the squared Euclidean distance and the centroid agglomerative algorithm on the sub-composition Al_2O_3, MnO, TiO_2, MgO, Na_2O, K_2O, SiO_2, Ba, Rb, Nb, Zr, Y, Ce, Ga, V, Zn and Ni, using Fe_2O_3 as divisor in the logratio transformation.

However, it is clear that chemical similarities can be established with the D1 group, lending further support to a possible origin in the Duero valley.

As regards clay composition, all the Los Pedregales individuals can be considered calcareous. The Equivalent Firing Temperatures (EFT) estimated by X-ray diffraction analysis (Fig. 4 and Table 1) clearly point to a typical range of firing temperatures between 850 and 950/1000°C.

At these firing temperatures, calcareous pottery develops a typical buff/pale colour which allows a good contrast with the decoration. These estimated EFT are consistent with those calculated by SEM on fresh fractures (Fig. 5, right). Moreover, the SEM study permitted the characterization of the black decoration through an energy dispersive X-ray fluorescence microanalysis (Fig. 5, left).

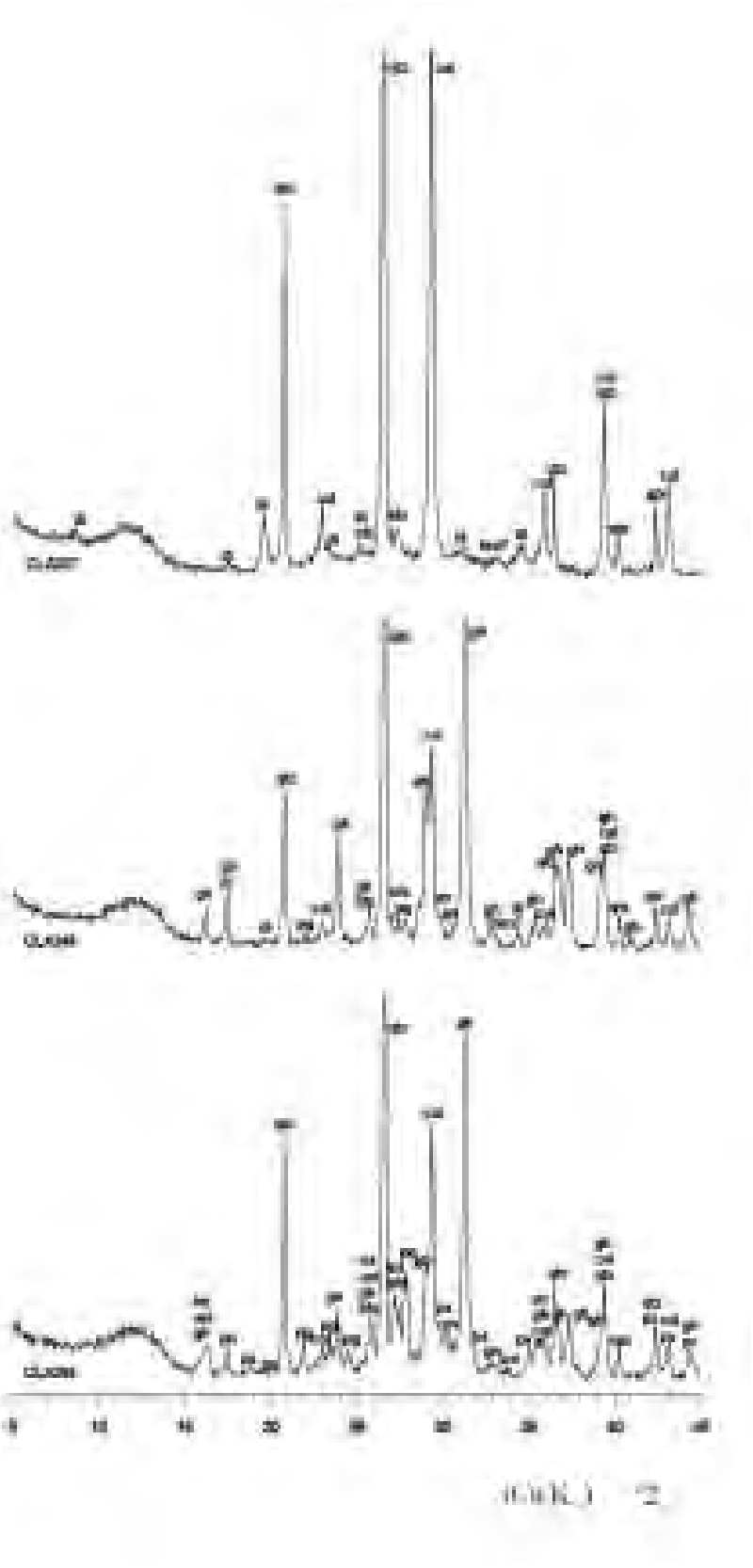

FIG. 4 – Characteristic diffractograms of the three broad ranges of estimated equivalent firing temperatures (EFT) defined at Los Pedregales (from top to bottom: <800-850°C, 850-950/1000°C, 1000-1050/1100°C). ill: illite-muscovite; qtz: quartz; cal: calcite; hm: hematite; kfs: alkali feldspar; pg: plagioclase; gh: gehlenite; px: pyroxene; lct: leucite; anl: analcime.

TABLE 1

Classification of the 33 individuals from Los Pedregales in relation to their chemical group and the range of estimated equivalent firing temperature (EFT).

EFT range	PL	PM	PH	Others	Total
<800-850°C		(1) CLA267		(2) CLA237, 265	3
850-950/1000°C	(3) CLA243, 258, 259	(5) CLA239, 240, 244 254, 263	(15) CLA238, 241, 242 245, 246, 247, 248, 249, 250, 252, 256, 257, 261, 262, 266		23
1000-1050/1100°C	(1) CLA260 (hr)		(3) CLA253, 255, 264 (anl)	(3) CLA251(anl), 268 (anl), 269 (anl)	7
Total	4	6	18	5	33

anl: individuals exhibiting analcime; hr: individual exhibiting hercynite.

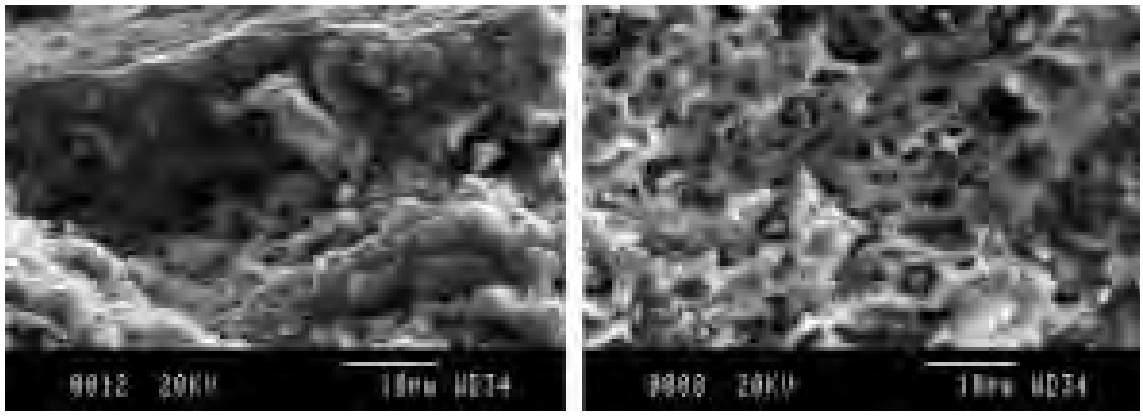

FIG. 5 – SEM microphotographs at 2000X magnification of individual CLA248 (group PH). Left: view of the black decoration on top of the body. Right: body exhibiting the typical cellular microstructure and a Vc vitrification state.

This decoration is based on manganese oxides, which were mixed in a clay suspension before painting. The decoration exhibits a poorly vitrified structure with an uneven composition.

4. Conclusions

This study of common ware at Los Pedregales reveals the existence of three production groups at Los Pedregales, with no direct relation to the contemporary Hispanic Terra Sigillata found at Clunia. The black decoration, based on the use of manganese oxides, seems to be related to the pre-Roman Celtiberian tradition. Though research of this type of pottery is limited, the use of MnO to obtain a black colour in Celtiberian decorated ceramics has been identified by Garcia-Heras and Vendrell (2000) in the polychrome pottery produced in Numancia, the most important Celtiberian walled town in the Upper Duero Valley. Therefore, this pottery could be considered as a distinctive element of the Celtiberian tradition adapted to the Roman world.

Acknowledgements

One of the authors, J. García Iñañez, received a research training scholarship (FI) from the Departament d'Universitats, Recerca i Societat de la Informació of the Generalitat de Catalunya. The authors are indebted to the Diputación Provincial de Burgos for financial support. The analyses were performed at the Scientific and Technical Services of the University of Barcelona.

NOTES

[1] Equip de Recerca Arqueomètrica de la Universitat de Barcelona (ERAUB), Dept. de Prehistòria, Història Antiga i Arqueologia, Universitat de Barcelona, C/ de Baldiri Reixac, s/n, 08028 Barcelona (Catalonia, Spain) eraub@trivium.gh.ub.es

[2] Yacimiento Arqueológico Colonia Clunia Sulpicia, Diputación Provincial de Burgos, 09454 Peñalba de Castro (Burgos) (Spain) tuset@clunia.eurart.es

REFERENCES

AITCHISON, J. (1986) - *The statistical analysis of compositional data*. London: Chapman and Hall.

AITCHISON, J. (1992) - On criteria for measures of compositional difference. *Mathematical Geology*. New York. 24, p. 365-379.

BUXEDA I GARRIGÓS, J. (1995) - *La caracterització arqueomètrica de la Terra Sigillata Hispanica Avançada de la ciutat romana de Clunia i la seva contrastació amb la Terra Sigillata Hispanica d'un centre productor contemporani, el taller d'Abella*. Col·lecció de Tesis Doctorals Microfitxades, UB 2524. Barcelona: Universitat de Barcelona.

BUXEDA I GARRIGÓS, J. (1999) - Alteration and contamination of archaeological ceramics: The perturbation problem. *Journal of Archaeological Science*. Amsterdam. 26, p. 295-313.

BUXEDA I GARRIGÓS, J., KILIKOGLOU, V. (2003) - Total variation as a measure of variability in chemical data sets. In VAN ZELST, L., ed. - *Patterns and Process. A Festschrift in honor of Dr. Edward V. Sayre*. Suitland, Maryland (USA): Smithsonian Center for Materials Research and Education, p. 185-198.

GARCIA-HERAS, M.; VENDRELL, M. (2000) - Late Iron Age Spanish Celtiberian polychrome pottery: identifying the nature of the black, red and white decorative pigments. In *32nd International Symposium on Archaeometry*. Mexico City: Mexico.

PALOL, P. DE (1994) - *Clunia. Historia de la ciudad y guía de las excavaciones*. Burgos: Diputación Provincial de Burgos. Junta de Castilla y León.

TUSET I BERTRAN, F.; BUXEDA I GARRIGÓS, J. (1995) - La cerámica Terra Sigillata Hispanica Avanzada (TSHA) de Clunia: segunda mitad del S. II – S. III d.C. *Trabalhos de Antropologia e Etnologia*. Porto. 35, p. 355-367.