The "non vitrifiable red slip" ware found in Braga (northwest of Portugal): a mineralogical and chemical characterization

F. OLIVEIRA[1] M. A. SEQUEIRA BRAGA[2] M. I. PRUDÊNCIO[3] M. DELGADO[4] M. A. GOUVEIA[3].

ABSTRACT "Non vitrifiable red slip" ware was found in the roman town of *Bracara Augusta* (northwest Portugal) in different types that lasted from the first to the middle of the fifth century. In this work two main groups of this ceramic were studied: imitations of "Pompejanish-roten" slip (Group I), and imitations of forms of "*Terra Sigillata* Hispanica" and forms and decoration of "African Red Slip Ware" (Group II). Mineralogical and chemical analyses of the pastes by means of X-ray diffraction, optical microscopy and neutron activation analysis were done in order to contribute to identify the production centers of these imitations. The results mainly reveal that the technique of manufacture of "non vitrifiable red slip" ware was used in *Bracara Augusta* to produce imitations of "Pompejanish-roten slip" and "*Terra Sigillata* Hispanica" and "African Red Slip Ware" forms."Pompejanish-roten slip" imitations produced in *Lucus Augusti*, and Italic "pompejanish-roten" production (Campania) were also imported.

1. Introduction

"Non vitrifiable red slip" ware is frequent in Braga (northwest of Portugal) where some thousands of fragments were found scattered all around the area once occupied by *Bracara Augusta*.

The same technique of manufacture and the typical non vitrifiable red slip occurred in different types that lasted from the first to the middle of the fifth century. This large span of time can explain the significant particularities of the fabric and shapes which determined their inclusion in different groups, according to well defined criteria (Delgado, 1993/94).

In this work two main typological groups were studied: Group I — imitations of "pompejanish-roten" slip, and Group II — imitations of "*Terra Sigillata Hispanica*" and "African Red Slip Ware" forms. Mineralogical and chemical analyses of the pastes were performed to complement the archaeological research and contribute to identify the production centers of these imitations. In order to know if those imitations were produced in this town "Common Ware" found in *Bracara Augusta* was also analyzed. The results obtained in this work were compared with results referred by Oliveira, 1997 and Gaspar, 2000, concerning ceramics from *Lucus Augusti* (Galicia, Spain).

Thus, this work aims the mineralogical and chemical characterization of roman pottery found in *Bracara Augusta* in order to improve the knowledge of the structure of different ceramic types and establish the local/regional production of imitations as well as to know the source of importation of the different imitations.

2. Materials and methods

The location of *Bracara Augusta* (nowadays Braga) is shown in Fig. 1.

The sherds analyzed can be macroscopic divided as follows:

(*i*) *non vitrifiable red slip wares*:

- Typological Group I – five sherds with a slip similar to "pompejanish-roten" slip (IP-2 to IP-6), imitations of the plate Oberaden 21 are the most frequent (Fig.2, ex:1,4).
- Typological Group II – sixteen samples of imitations (IS) of "*Terra Sigillata* Hispanica" forms (Fig.2, ex: 10,12,14); imitations of "African Red Slip Ware" forms and stamp-types (Fig.2, ex: 17, 21, 27, 28, 29, 31, 36, 39).
- Two samples of Italic production, one found in *Bracara Augusta* (IP-30) and one found in Beirut, Lebanon (IP-1).

(ii) common wares: twenty five samples of common wares produced in *Bracara Augusta* (C).

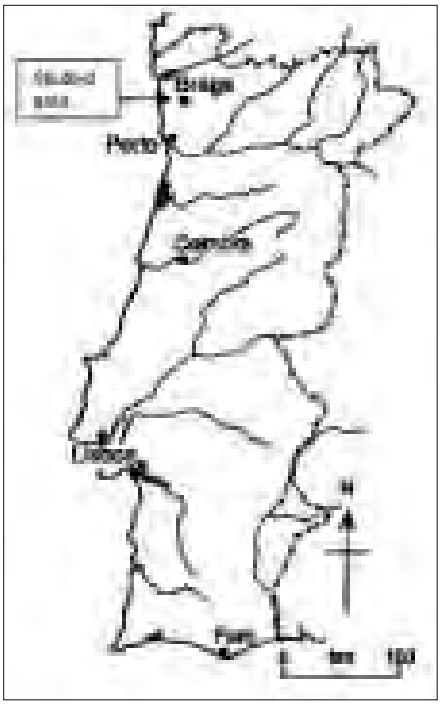

FIG. 1 – Map of Portugal showing the location of the studied area (Braga).

The powder X-ray diffraction (XRD) patterns of the non vitrifiable red slip ware samples were obtained in the bulk sample after grinding at 63 Bm, for the mineralogical characterization of the different ceramic fabrics. When clay minerals are present, oriented XRD patterns were obtained in the <2 μm fraction. To confirm the presence of iron oxides, selected powder samples were submitted to heating (300°C and 900°C) during 1 hour, and then, XRD patterns carried out.

Estimations of the mineral quantities in the bulk sample were obtained by the relative intensity of diagnostic reflections of each mineral in the X-ray diffractograms. The XRD patterns were obtained using a Philips PW1710 (APD) diffractometer with Cu-Kα radiation at 40Kv and 30mA, with a step size of 0.02° 2θ and counting time of 1.250 s.

Petrographic studies of the red slip wares were performed by optical microscopy in polished thin sections.

Chemical analysis was performed by instrumental neutron activation analysis (INAA). Samples and standards (sediment GSD 9 and soil GSS 1) were irradiated together in the core grid of the Portuguese Research Reactor (Sacavém) at a flux of 4.4×10^{12} n cm^{-2} s^{-1} for seven hours. Details concerning the measurement and processing of the gamma spectra can be found in Prudêncio et al. (1986) and Dai Kin et al. (1999). The concentration of the following elements was obtained : Na, K, Fe, Sc, Cr, Co, Zn, Ga, As, Br, Rb, Zr, Sb, Cs, Ba, La, Ce, Nd, Sm, Eu, Tb, Dy, Yb, Lu, Hf, Ta, Th, U.

Multivariate statistical methods were employed by using the Statistica program (StatSoft, Inc., 2003; STATISTICA data analysis software system, version 6), particularly cluster analysis, using the chemical elements contents as variables.

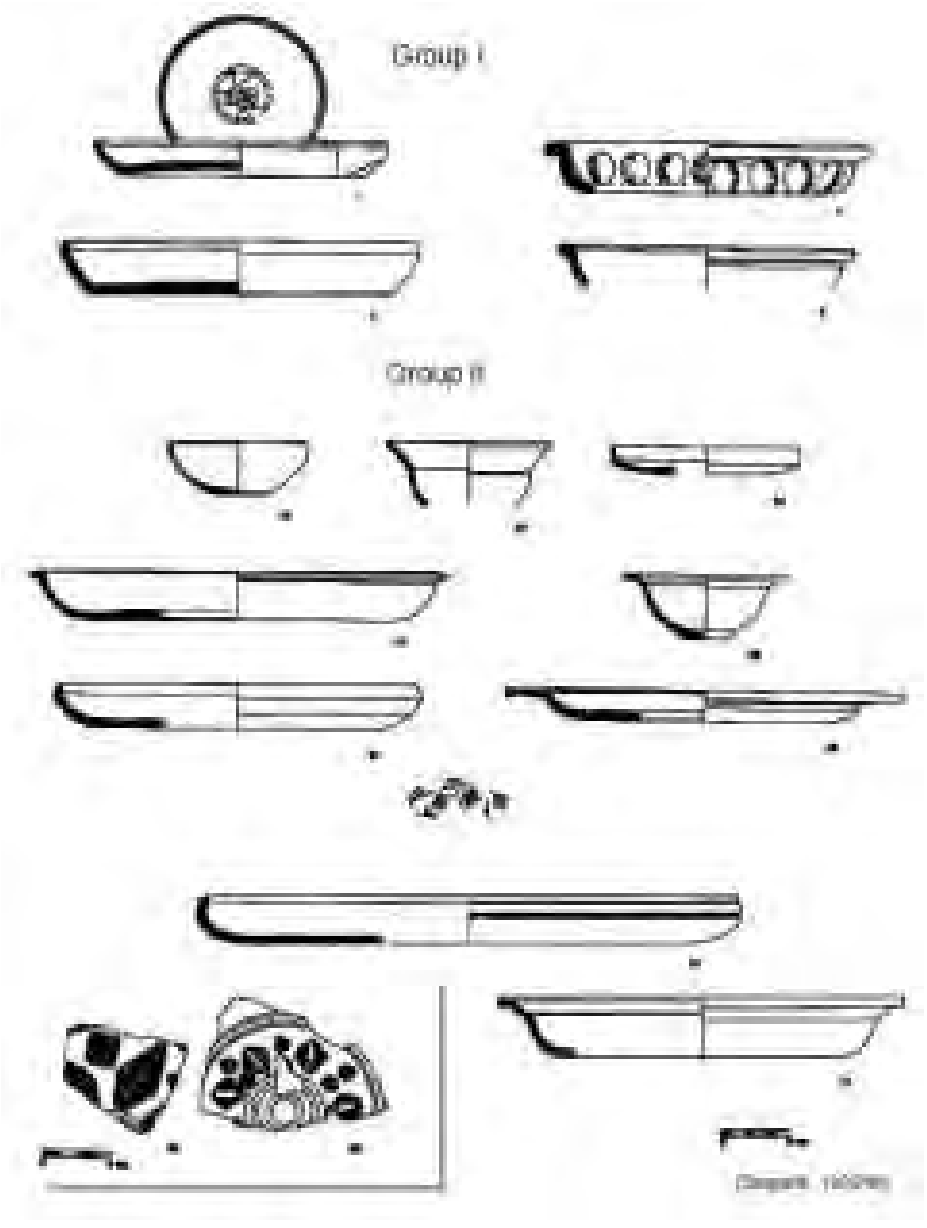

FIG. 2 – Shapes of non vitrifiable red slip ware (according to Delgado, 1993/94).

3. Results and discussion

Mineralogical results (estimations of each mineral proportion by XRD in the different samples) of the bulk samples can be found in Table 1.

Four samples characterised by a slip similar to "pompejanish-roten slip" (IP-3,4,5,6 - Group I) have quartz as dominant mineral, associated to low amounts of plagioclase, and mica. K-feldspar is also present in one sample, while hematite occurs as traces in most of the samples. IP-2 differs mainly due to the absence of plagioclase and mica. In the Italic productions samples (IP-1 and IP-30) quartz and plagioclase or K-feldspar are the dominant minerals; pyroxene, amphibole and mica are also present in very low quantities. Vestigial goethite and disordered hematite are the iron oxides present. Vestigial quantities of clay minerals (broad band at 11-13 Å) were identified, probably corresponding to mixed-layer and smectite.

As far as Group II is concerned, quartz is the dominant mineral followed by mica; K-feldspar and plagioclases are vestigial in most samples. Hematite occurs in most of the samples. Concerning clay minerals, kaolinite is present in two samples (IS-2, IS-10) and one broad reflection centred at 14Å occurs in four samples but in trace amounts.

According to mineralogical composition one sample of typological Group I (IP-2) is similar to typological Group II (Table 1). Typological Group II presents in general higher proportions of K-feldspar, mica and occurrence of clay minerals and anatase, while typological Group I has higher quantities of plagioclase. The Italic samples (IP-1 and IP-30) differ clearly due to the presence of pyroxenes and amphiboles and clay minerals (10-14 Å).

TABLE 1

Estimation of the mineralogical composition by XRD of ceramics.

	Samples	Py	Amp	Qz	Fk	Pl	Mica	Clay	Hem	Anat
Group I	IP-2	-	-	+++	++	-	+	-	-	-
	IP-3	-	-	++	+	+++	+	-	-	-
	IP-4	-	-	++	-	++	+	-	+	-
	IP-5	-	-	+++	-	++	+	-	-	-
	IP-6	-	-	+++	-	+	-	-	+++	-
Italic	IP-1	+	-	++	+++	tr	+	tr	+++	-
	IP-30	+	+	++	-	+++	+	+	+++	-
Group II	IS-1	-	-	+	+++	-	++	-	+++	+++
	IS-2	-	-	+++	+	+	+	+	-	-
	IS-3	-	-	+	-	-	+++	tr	+	+
	IS-4	-	-	++	+++	-	-	-	tr	+++
	IS-5	-	-	+	+	+	+++	tr	++	++
	IS-6	-	-	+++	++	-	-	-	+	-
	IS-7	-	-	++	++	-	+	-	tr	tr
	IS-8	-	-	++	++	-	+	-	++	-
	IS-9	-	-	+	+	+++	++	tr	-	-
	IS-10	-	-	++	+	-	++	+	+	-
	IS-11	-	-	+	+	-	+++	-	+	+
	IS-12	-	-	+	++	+	++	-	tr	++
	IS-13	-	-	++	++	+	+	tr	++	+
	IS-14	-	-	++	+	+	+	-	++	+
	IS-15	-	-	+++	+	-	+	-	-	++
	IS-16	-	-	+++	+	-	+	-	+++	-

(+++ very frequent; ++ frequent; + rare; tr- traces; - not detected). Py - pyroxene; Am- amphibole; Qz- quartz; Fk- k-feldspar; Pl- plagioclase; Mic- mica; Clay- clay minerals; Hem- hematite; Ana- anatase.

Petrographic analysis showed that both typological groups have a heterogeneous grain size distribution and the slip is similar to the paste but with less non plastic grains. In general it is darker than the paste, being thicker in typological Group I and covering the inner part of the piece. Typological Group II is characterized by a reddish-brown to yellowish-brown and pale brown paste; pores are abundant and usually stretched and some fissures are also present. The non plastic grains are quartz, K-feldspars, muscovite, and biotite, pla-

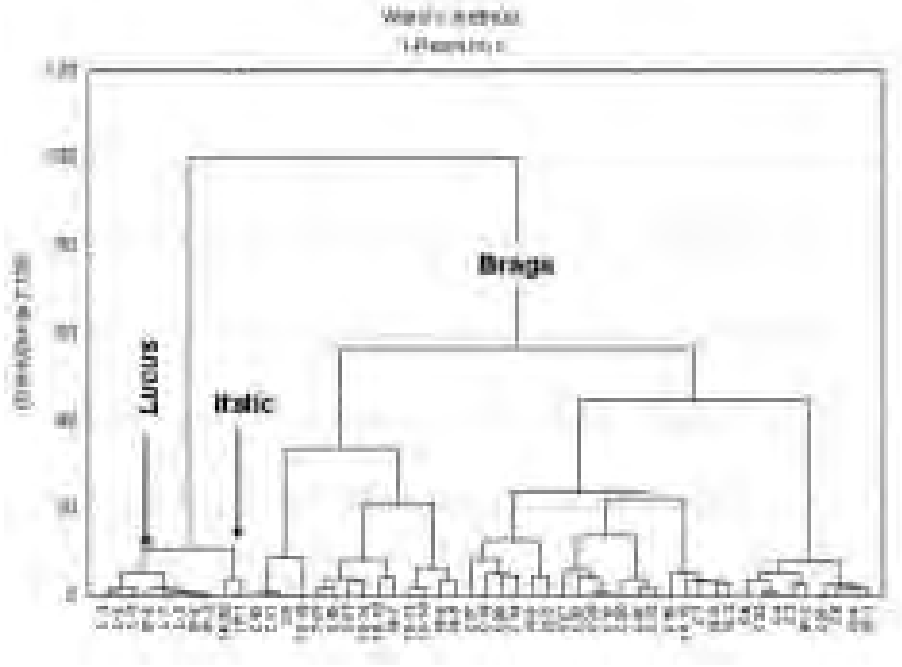

FIG. 3 – Phenogram obtained by cluster analysis using the Pearson correlation coefficient (*Lucus Augusti*: Oliveira, 1997; Gaspar, 2000; Italic imports: Prudêncio et al., 2003).

gioclase, grog and ferruginous grains. IP-2 sample (typological Group I) is similar to *typological* Group II as already seen by XRD.

The paste of ceramics of typological Group I (IP-3 to 6) is brown to greyish-brown in colour. Pores are abundant and usually in the shape of channels. Some voids are due to the organic matter loss during firing. Quartz, plagioclase, K-feldspars, muscovite and some biotite, rock fragments and clay nodules are the non plastic grains.

Italic ceramics (IP-1 and IP-30) present a matrix with a dark reddish-brown colour and coarse grain texture. The slip colour is similar to the one of the paste, but darker. Elongated pores of different sizes are abundant and stretched. The non-plastic inclusions differ clearly from the other samples studied, in particular due to the presence of pyroxene and amphiboles, both green in colour.

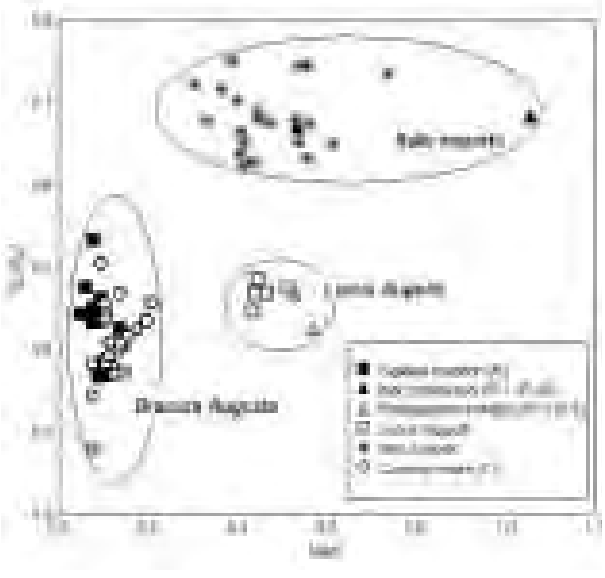

FIG. 4 – Diagram Na/K vs. Eu/Eu* (Italic imports data from Prudêncio et al., 2003).

The chemical results of the sherds, and their comparison with ceramics of well established provenance (Figs. 3 and 4), showed that: (1) the *terra sigillata* imitations (IS-1 - 15) were most probably manufactured in *Bracara Augusta*, taking into account the similarity to common ware produced in this town; (2) among the "pompejanish-roten slip", one imitation was manufactured in *Bracara Augusta* (IP-2), and three appear to have been made in *Lucus Augusti* and imported to *Bracara Augusta*; (3) the "pompejanish-roten slip" found in *Bracara Augusta* (IP-30) is similar to the one found in Beirut (IP-1), and also to

Italic imports found in other archaeological sites in Portugal (Prudêncio et al., 2003). Among the chemical elements analysed, sodium vs. potassium clearly distinguish the *Lucus Augusti* and *Bracara Augusta* productions, which is in agreement with the higher proportion of plagioclases/K-feldspars found in *Lucus* ceramics. The Italic productions differ mainly due to a smaller Eu anomaly (Fig. 4) and lower contents of Th and U.

4. Conclusions

The study confirmed:

- the importation of "Pompejanish-roten Platen" from Italy (Campania) as well as imitations of this production made in *Lucus Augusti*; and
- production, in Bracara Augusta, of imitations of "Pompejanish-roten Platen" and mainly of forms of "*Terra Sigillata* Hispanica" and "African Red Slip Ware".

NOTES

[1] Gabinete de Arqueologia, Câmara Municipal, 4760-110 Vila Nova de Famalicão, Portugal.

[2] Depart. de Ciências da Terra, Universidade do Minho, Campus de Gualtar 4710-057 Braga, Portugal.

[3] Instituto Tecnológico e Nuclear, Apartado 21 2686-953 Sacavém, Portugal.

[4] Unidade de Arqueologia, Universidade do Minho, Largo do Paço 4700-320 Braga. Portugal.

REFERENCES

DAI KIN, F.; PRUDÊNCIO, M. I.; GOUVEIA, M. A.; MAGNUSSON, E. (1999) - Determination of rare earth elements in geological reference materials: a comparative study by INAA and ICP-MS. *Geostandards Newsletter*. Nancy. 23, p. 47-58.

PRUDÊNCIO, M. I.; DIAS, M. I.; ARRUDA, A. M. (2003) - Amphorae in Sellium (Portugal) from 1st century to 5th century – importation and regional production. In *7th European Meeting on Ancient Ceramics*, Lisboa, Portugal.

DELGADO, M. (1993-94) - Notícia sobre cerâmicas de engobe vermelho não vitrificável encontradas em Braga. *Cadernos de Arqueologia*. Braga. 10/11, p. 113-149.

PRUDÊNCIO, M. I.; GOUVEIA, M. A.; CABRAL, J. M. P. (1986) - Instrumental neutron activation analysis of two French geochemical reference samples - Basalt BR and Biotite Mica-Fe. *Geostandards Newsletter*. Nancy. 10:1, p. 29-31.

OLIVEIRA, F.M.S. (1997) - *Contribuição para o estudo da cerâmica fina de Braga. A cerâmica "dita bracarense"*. MSc thesis, University of Minho, Braga, Portugal.

GASPAR, A. (2000) - *Contribuição para o estudo de cerâmicas dos séc. V-VI DC de Brag*a. MSc thesis, University of Minho, Braga, Portugal.