PRELIMINARY MINERALOGICAL AND PETROGRAPHIC STUDY OF LA TÈNE HOUSEHOLD CERAMICS FROM BRATISLAVA'S OPPIDUM (SLOVAKIA)

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Abstract: *This paper presents the preliminary results of an ongoing study on La Tène household ceramics from the oppidum of Bratislava. This paper focuses mainly on the well-known, yet little-understood graphite-tempered vessels examined by the means of mineralogical and petrographic analysis. The possible similarities and differences of graphitic and non-graphitic wares are also examined in terms of raw material compositions in order to assess raw material provenance, and production technology used in particular firing conditions. The results suggest that one group of ceramics (group A) was made on the potter's wheel from local clays or from local alluvial-deluvial deposits. The firing temperature for this group is estimated between 600 and 900 °C. Another group of pottery (group B) was tempered with graphite. The graphite raw material originate either from Southern Bohemia or Moravia (Czech Republic). Graphite-tempered ceramics were hand-made and were fired at 500 - 600 °C, and only occasionally at over 900 °C.*

Keywords: *La Tène household ceramics, granulometric analysis, firing temperature, forming techniques, raw material provenance*

INTRODUCTION

Apart from the works by Cumberpatch and Pawlikowski (Cumberpatch & Pawlikowski, 1988; Cumberpatch, 1993) the mineralogical and petrographic examination of La Tène ceramics is generally understudied in Slovakia. Although these works cover a huge database on mineralogical and petrographic composition, the results were used only for the determination of the main ceramic groups and to assess questions on the circulation or exchange of slip decorated pottery in Slovakia, Moravia, Bohemia (Czech Republic), Poland and Hungary. Firing conditions or manufacturing technology was studied only sporadically (Cumberpatch & Pawlikowski, 1998; Cumberpatch, 1993). As opposed to this mineralogical and petrographic studies of La Tène, ceramics in the Czech Republic were presented systematically in 1992 by Waldhauser and later by Hložek & Gregerová in 2002. These studies were devoted mainly to the petrographic analysis of graphite-tempered ceramics in order to assess the provenance of the graphite. Graphite-tempered ceramics were also studied in Austria by Sauer (1994). He provides the results of his mineralogical and petrographic analyses and also on firing conditions, although in his study the possible provenance of graphite is not discussed. Celtic graphitic wares are understudied although their spatial distribution is well documented. Graphitic wares are widespread in a large geographical area. They are present at many archaeological sites in Central Europe from Northern Switzerland to Transsylvania (Rustoiu 1993), from Lower Bavaria to the *scordiscus* oppida along the river Danube in Serbia (Sladić 1986). At the present state of research the most western centre of production seems to have been at Manching (Germany), from where graphitic wares were transported in large numbers as far as the river Rhine. There is even one rare example found at Aulnat (France) (Collis 1976).

The aim of this paper is to provide archaeometric data on La Tène ceramics. In this study 23 vessels are examined. Although the data presented is preliminary, it was felt necessary to provide the results of a basic research on these little-understood vessel types in terms of technological practices since this study deals not only with the mineralogical and petrographic characteristics of La Tène ceramics from Bratislava, but also discusses production technology, firing conditions and temperature, and the possible source of the raw materials.

SAMPLES AND METHODS

Twenty-three sherds from two important archaeological sites in the inner part of the oppidum of Bratislava were used for this study. Bratislava – Kooperatíva (BA/K) represents the industrial part of the oppidum (presence of forge) and Bratislava – Hrad (BA/H) represents the fortified acropolis of the oppidum (**Fig. 1**.). The samples represent the most characteristic ceramic types. For this analysis mainly rims were chosen because the typological groups of the vessels they belong to can be distinguished. The analysis of different vessel types makes it possible to assess technological similarity or difference between similar vessel types. The selected samples include the most common vessel types at the oppidum of Bratislava such as bowls (V/2), bottles (II/3 red ware with decorations and grey ware without decoration), pots (type I/1a) and tripods (type IV).

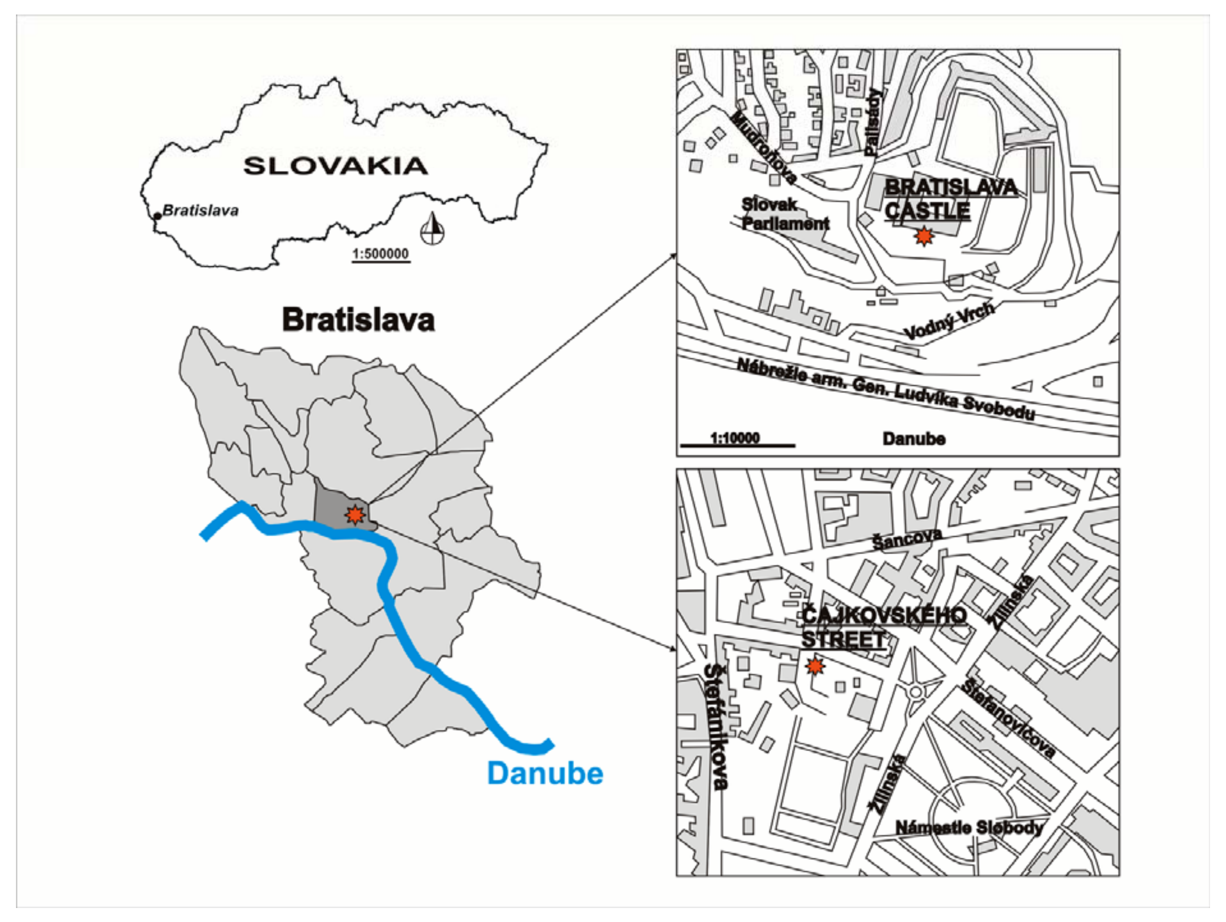

Fig. 1 Geographical position of studied archaeological sites in Bratislava (marked with stars). Archaeological site on Bratislava castle correspond to late La Tène fortified acropolis and archaeological site at Čajkovského Street correspond to industrial part of oppidum.

The sherds came to light from houses and none of them could be directly associated with one specific kiln. From each sherd, two slides were cut both across and parallel to the ceramic wall in order to prepare thin sections for the mineralogical and petrographic observations in polarized light. Optical microscopy (OM) was performed using an Olympus BX51 petrographic microscope. The granulometric characterisation of the sherds was obtained by planimetric measurements in thin sections using an Eltinor IV counting device with 1000 points per sample. One gram from each ceramic fragment was milled in an agate mortar and measured with X-ray powder diffraction (PXRD) at room temperature using a Dron-3 diffractometer (Geological institute, Faculty of Natural Sciences, Comenius University) operating at 40 kV and 15 mA using Co Kα radiation at scan speed of 0,02 °2Θ in range of 4 – 74 °2Θ.

The study of the ceramic fragments focuses on the mineralogical and petrographic study of thermally altered clay matrix, non-plastic inclusions and granulometric composition of the sherds, in order to estimate the grain size distribution in the ceramics, infer the firing conditions and assess the manufacturing technology of the vessels and to solve the question of raw material provenance. The manufacturing technology of the vessels was assessed from vessel fabrics. The grain size and orientation of vessel fabrics were processed using ImageJ software to obtain the graphical and numerical data needed for evaluating the directions of the matrix. The numerical data are represented by a Rose diagram, which expresses the main directions of grains orientation graphically.

ARCHAEOLOGICAL BACKGROUNDS

During the La Tène C2 – D2 periods the rise of Celtic fortified centre – oppidum in the surrounding of Bratislava was related to the migration of Celtic tribes to the Central Danubian area. The establishment of an oppidum on the crossroads of trade routes crossing the Alps and the Carpathians was of great strategic and economic importance.

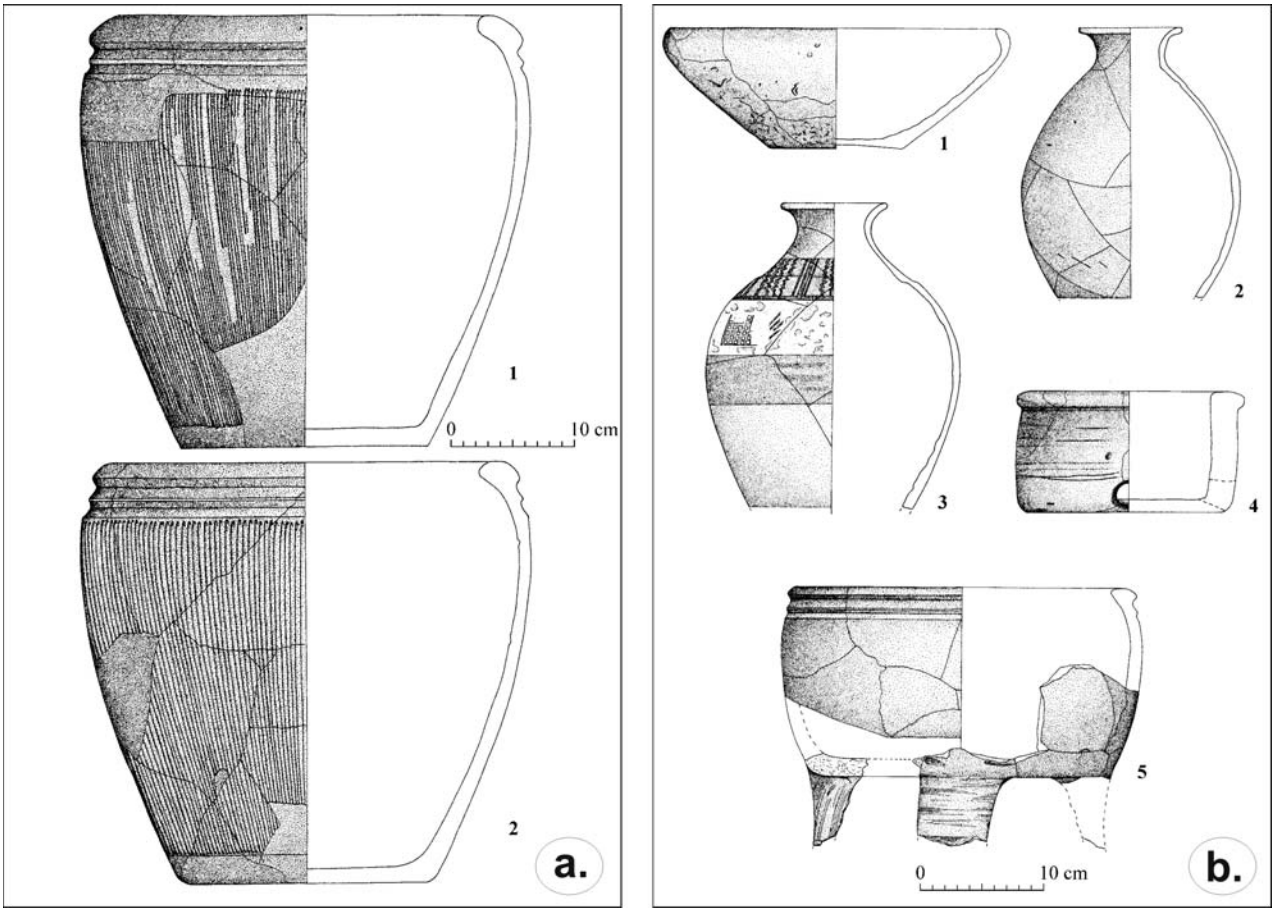

Fig. 2 a. pots with characteristic carved decoration so called comb decoration (Kammstrichware). The pots (1,2) include the type I/1a. **b.** characteristic ceramic inventory from Bratislava's oppidum. 1. bowl type V/2; 2. bottle type II/3 (grey ware); 3. bottle type II/3 (red ware with horizontal red and white painting); 4. technical ceramics (air blower); 5. tripod

This importance is documented by discovering numerous artefacts associated with craftworks. Apart from pottery kilns and ceramic fragments, numerous fragments of metal-working and a coinage industry has also been found (Pieta & Zachar, 1993; Čambal, 2004). Characteristic ceramic types of La Tène ceramics are various kinds of situlas and pots with vertical comb decoration (Kammstrichware) (**Fig. 2a-1,2**), various types of bottles with narrow neck and characteristic horizontal red and white painting (**Fig. 2b-2,3**), conical bowls (**Fig. 2b-1**) and tripods (**Fig. 2b-5**). Bowls of type V/2 are conical with inverted rims. The size of the bowls is variable (both large and small vessels were identified) and their surface was polished or occasionally roughened. Macroscopic observation suggests that all bowls were made from a fine, possibly levigated raw material. Bottles of type II/3 have narrow necks and ovoid body. Their exterior surface is often well treated by polishing, on the interior thin striations were observed. Bottles are either grey or red and especially red wares are covered with horizontal red and white strips. Pots of type I/1a are usually black in colour with the presence of graphite temper. These pots have a wide mouth, an everted or swollen rim, accentuated shoulder and a wide, flat bottom. Their surface is roughed and the vessels exhibit characteristic vertically arranged comb decoration. Tripods of type IV are usually dark brown kettle-like vessels with attached handle and three small legs. The tripods, their handle and also their legs were probably wheel thrown as thin striations were observed either on their interior of the vessel or on the surface of handles and legs. The surface of the tripods is usually not treated or occasionally it is roughed.

RESULTS

Macroscopic observations and granulometric composition

Macroscopically, the samples show different colours and they can be divided into two groups according to the wall thickness and metallic lustre.

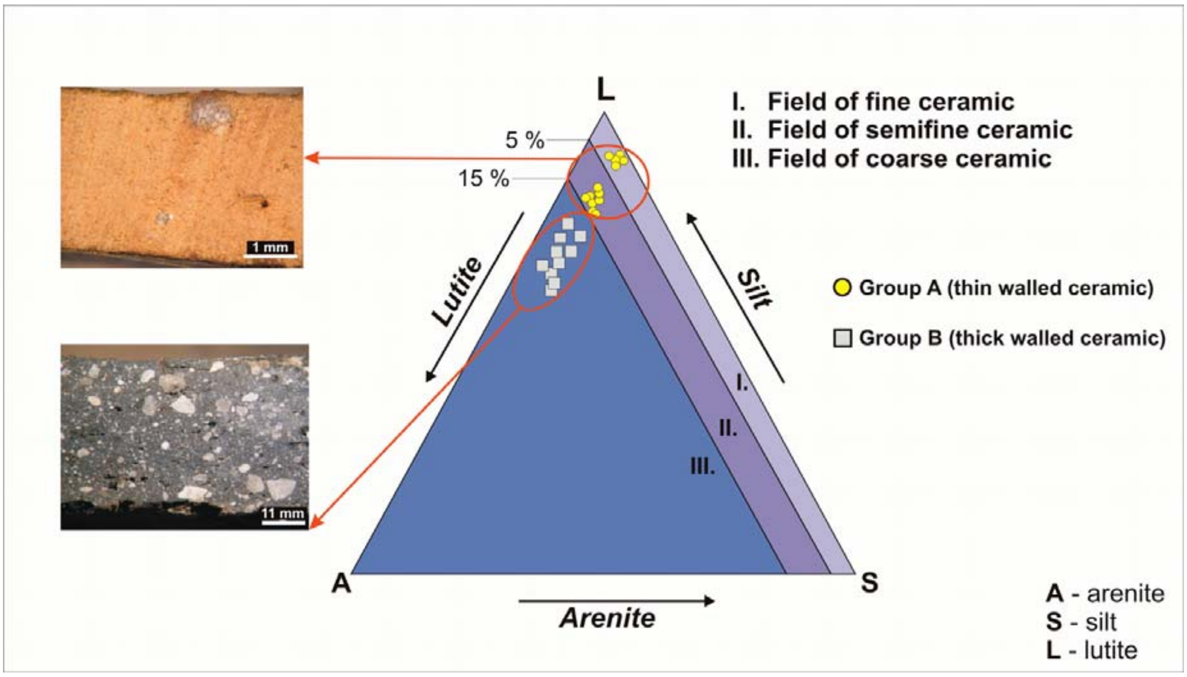

Fig. 3 Modified Wenthwort`s granulometric classification diagram according to Ionescu & Ghergari (2002).
A – arenite, S – silt, L – lutite.

Group A includes thin-walled ceramics (4 – 6 mm) with reddish or occasionally with greyish colour of ceramic body. The surface of the vessels in this group is often polished and covered with horizontal white, red or black painting. Some samples show typical sandwich structure with black core grading to the light reddish zones towards the margins. The matrix is homogeneous as no large non-plastic inclusions were observed (**Fig. 3**). In this group a very fine horizontal striations were observed on the interior of all the vessels.

Group B includes thick-walled (9 – 12 mm) ceramics with black colour and metallic lustre. The graphite temper responsible for the metallic lustre is easily observable (**Fig. 3**). The vessels in this group exhibit typical vertical comb decoration. Occasionally horizontal thick stripes were observed on the interior of the vessels. According to a modified Wentworth`s granulometric classification diagram (Ionescu & Ghergari, 2002) all samples from group A belong to semi-fine to fine ceramics, whereas the samples from group B belong to coarse ceramics (**Fig. 3**).

Mineralogical and petrographic composition

Sherds from group A

The samples in this group have a serial fabric and no observable tempering material could be detected or identified. The thin-walled ceramics from group A were further divided into four subgroups according to the presence of significant crystaloclasts and lithoclasts (**Table 1**.). Subgroup A1 shows the presence of limestone lithoclasts. Occasionally also microfossils as foraminifera were identified in thin sections (**Fig. 4a**). Subgroup A2 is characterised by granitic lithoclasts with biotite (**Fig. 4b**), whereas in subgroup A3 granitic lithoclasts were not present but crystaloclasts of biotite and well rounded amphibole (**Fig. 4c**) were observed. In the case of subgroup A4 no significant crystaloclasts or lithoclasts were observed. All samples from group A showed unimodal distribution of non-plastic inclusion (**Fig. 5a**) but they showed great diversity in matrix birefringence, which points towards differences in firing temperatures. Samples from subgroup A1, A2 and A3 showed near isotropic to isotropic matrix (**Figs. 4a, 4b, 4c**). Samples from subgroup A4 showed only strongly anisotropic and microcrystalline matrix typical for illitic clays (**Fig. 4d**) (Ionescu et al., 2007). In all the samples in group A the fabric is strongly oriented parallel to the ceramic wall (**Fig. 5a**). This observation is in good correlation with calculated main directions easily seen on the rose diagrams (**Fig. 5b**). Very rarely prolonged pores were identified in thin sections. Voids were randomly distributed in the ceramic body and these were created during the modelling process, when thin films of water or air were trapped between the clay layers during the kneading of the clay (Shepard, 1975; Ionescu et al., 2007).

Table 1 Overview of mineralogical and petrographic compositions of selected samples. Abbreviations: near isot. – near isotropic, gneiss* - graphite bearing gneiss.

Sample	**BA/K-1**	**BA/K-2**	**BA/K-3**	**BA/K-4**	**BA/K-5**	**BA/K-6**	**BA/K-7**	**BA/K-8**
Ceramic group	**A4**	**A4**	**A4**	**B3**	**A4**	**A4**	**A4**	**A4**
Matrix color	reddish	reddish	reddish	black	reddish	reddish	reddish	reddish
Character of matrix	anisotropic	anisotropic	anisotropic	isotropic	anisotropic	anisotropic	anisotropic	anisotropic
Fabric	oriented	oriented	oriented	chaotic	oriented	oriented	oriented	oriented
Quartz	+	+	+	+	+	+	+	+
K - feldspar	+	+	+	+	+	+	+	+
Plagioclase	–	+	–	–	+	+	+	+
Muscovite	+	+	–	–	+	+	+	+
Biotite	–	–	–	+	–	–	–	–
Calcite	–	–	–	–	–	–	–	–
Graphite	–	–	–	+	–	–	–	–
Sillimanite	–	–	–	–	–	–	–	–
Amphibole	–	–	–	–	–	–	–	–
Granite	–	–	–	–	–	–	–	–
Quartzite	–	–	–	–	–	–	–	–
Gneiss*	–	–	–	–	–	–	–	–
Sandstone	–	–	–	–	–	+	+	–
Limestone	–	–	–	–	–	–	–	–
Silicite	–	–	–	–	–	–	–	–
Fossils	–	–	–	–	–	–	–	–
Sample	**BA/K-9**	**BA/K-10**	**BA/K-12**	**BA/K-14**	**BA/K-15**	**BA/BH-1**	**BA/BH-2**	**BA/BH-3**
Ceramic group	**A4**	**B1**	**B1**	**B1**	**B3**	**A1**	**A2**	**A2**
Matrix color	greyish	black	black	black	black	reddish	reddish	reddish
Character of matrix	isotropic	isotropic	isotropic	isotropic	isotropic	isotropic	isotropic	near isot.
Fabric	oriented	chaotic	chaotic	chaotic	chaotic	oriented	oriented	oriented
Quartz	+	+	+	+	+	+	+	+
K - feldspar	+	+	+	+	+	+	+	+
Plagioclase	–	+	–	+	+	–	–	+
Muscovite	+	+	+	–	–	+	+	+
Biotite	–	+	+	+	+	–	+	+
Calcite	–	–	–	–	–	+	–	+
Graphite	–	+	+	+	+	–	–	–
Sillimanite	–	+	+	+	–	–	–	–
Amphibole	–	–	–	–	–	–	–	–
Granite	+	–	–	+	–	–	+	+
Quartzite	–	+	–	–	–	–	–	–
Gneiss*	–	+	+	+	–	–	–	–
Sandstone	–	–	–	–	–	–	–	+
Limestone	+	–	–	–	–	+	–	–
Silicite	–	–	–	–	–	–	–	+
Fossils	–	–	–	–	–	+	–	–

The PXRD analysis showed great diversity. X-ray analysis obtained from powdered samples from group A1 showed the presence of thermally unchanged minerals such as quartz, feldspar, mica and calcite. In the case of samples from subgroup A1 and A2 the diminishing of 0,1 and 0,45 nm diffraction lines of illite was observed. This is due to the partial collapse of crystalline structure of clay minerals, mostly illite during the firing (Maggetti, 1982; Herz & Garisson, 1998). The mineralogical composition of subgroup A2 is similar to subgroup A1 except of calcite. The mineralogical composition of subgroups A3 and A4 are also similar to the subgroup A2 but the diminishing of illite diffraction lines was not noticed.

Sherds from Group B

The samples in this group have a hiatal fabric suggesting a deliberate addition of graphite temper to the raw materials. According to the mineralogical and petrographic composition of the sherds group B was divided into three subgroups (**Table 1** and **Table 2**).

Table 2 Overview of mineralogical and petrographic compositions of selected samples, continued.

Sample	**BA/BH-4**	**BA/BH-5**	**BA/BH-6**	**BA/BH-7**	**BA/BH-8**	**BA/BH-9**	**BA/BH-10**
Ceramic group	**A3**	**A2**	**B2**	**B2**	**A4**	**A3**	**A3**
Matrix color	reddish	reddish	black	black	reddish	reddish	reddish
Character of matrix	near isot.	isotropic	isotropic	isotropic	anisotropic	anisotropic	near isot.
Fabric	oriented	oriented	chaotic	chaotic	oriented	oriented	oriented
Quartz	+	+	+	+	+	+	+
K - feldspar	+	+	+	+	+	+	+
Plagioclase	+	+	–	–	+	+	–
Muscovite	+	+	–	+	–	+	+
Biotite	+	+	+	–	–	+	+
Calcite	–	–	+	+	–	–	–
Graphite	–	–	+	+	–	–	–
Sillimanite	–	–	–	–	–	–	–
Amphibole	+	–	–	–	–	+	+
Granite	–	+	–	–	+	–	–
Quartzite	–	–	–	–	–	–	–
Gneiss*	–	–	–	–	–	–	–
Sandstone	+	+	–	–	+	+	–
Limestone	–	–	–	–	–	–	–
Silicite	–	–	–	–	+	–	–
Fossils	–	–	–	–	–	–	–

The presence of graphite temper was typical for all subgroups, but according to the presence of specific lithoclasts and crystaloclasts each subgroup was unique. Subgroup B1 is characterised by the presence of biotite, sillimanite and graphite bearing gneisses (**Fig. 4e**). Graphite occurs mainly in flakes often associated with other minerals such as quartz or biotite and occasionally in angular clasts. The size of the graphite is quite variable as submicroscopic graphite clasts (fine powdered graphite) colouring the matrix as well as flakes and clasts with 500 µm main size were also identified. Samples from subgroup B2 contained thermally unchanged calcite (**Fig. 4f**). In the case of subgroup B3 apart from graphite no significant crystaloclasts or lithoclast were identified. The graphite temper occurs in groups B2 and B3 in angular clasts or occasionally in flakes with main size of 400 µm. In these groups ubmicroscopic graphite clasts also colour the matrix.

For all three subgroups the black and isotropic matrix was typical. This could be due to the fine powdered graphite that colours the matrix and it was not possible to estimate the real optical character of the matrix (**Fig. 4e, 4f**). The distribution of non-plastic inclusions was bimodal and the fabric was either chaotic (**Fig. 5c**) or loosely circular. The chaotic fabric was in good correlation with calculated orientation using rose diagrams, where no prevailing direction was observed (**Fig. 5d**). Identified pores were mainly elongated and randomly distributed in the ceramic body. These pores could be described as primary. Secondary pores were observed in thin sections, which were similar to the primary ones, but they were oriented parallel to the ceramic wall. Such pores could originate in drying and shrinkage processes that accompanied the firing (Shepard, 1976; Magetti, 1982; Velde & Druc, 1999).

The PXRD analysis of subgroups B1 and B2 shows similar mineralogical composition, they only differ in the presence of thermally unchanged calcite. The mineralogical composition consists of quartz, feldspar, mica / illite, chlorite and graphite. Only in samples from subgroup B3 were the diminishing of illite diffraction lines observed.

DISCUSSION

Raw material provenance

The raw material provenance was inferred from the mineralogical and petrographic composition of non-plastic inclusions. Although the ceramics from group A, according to the granulometric classification, belong to the fine or semi-fine ceramics, and bigger clasts are very rare, it is possible to asses the possible origin of the raw material. The ceramics from subgroup A1 with limestone lithoclasts and with fossils (foraminifera) were probably made from marine clays of Studienske formation (Late Badenian) that outcrops 9 km out of Bratislava. The ceramics from subgroup A2 and A3 with the presence of granite or biotite were probably made from local deluvial or deluvial-fluvial sediments.

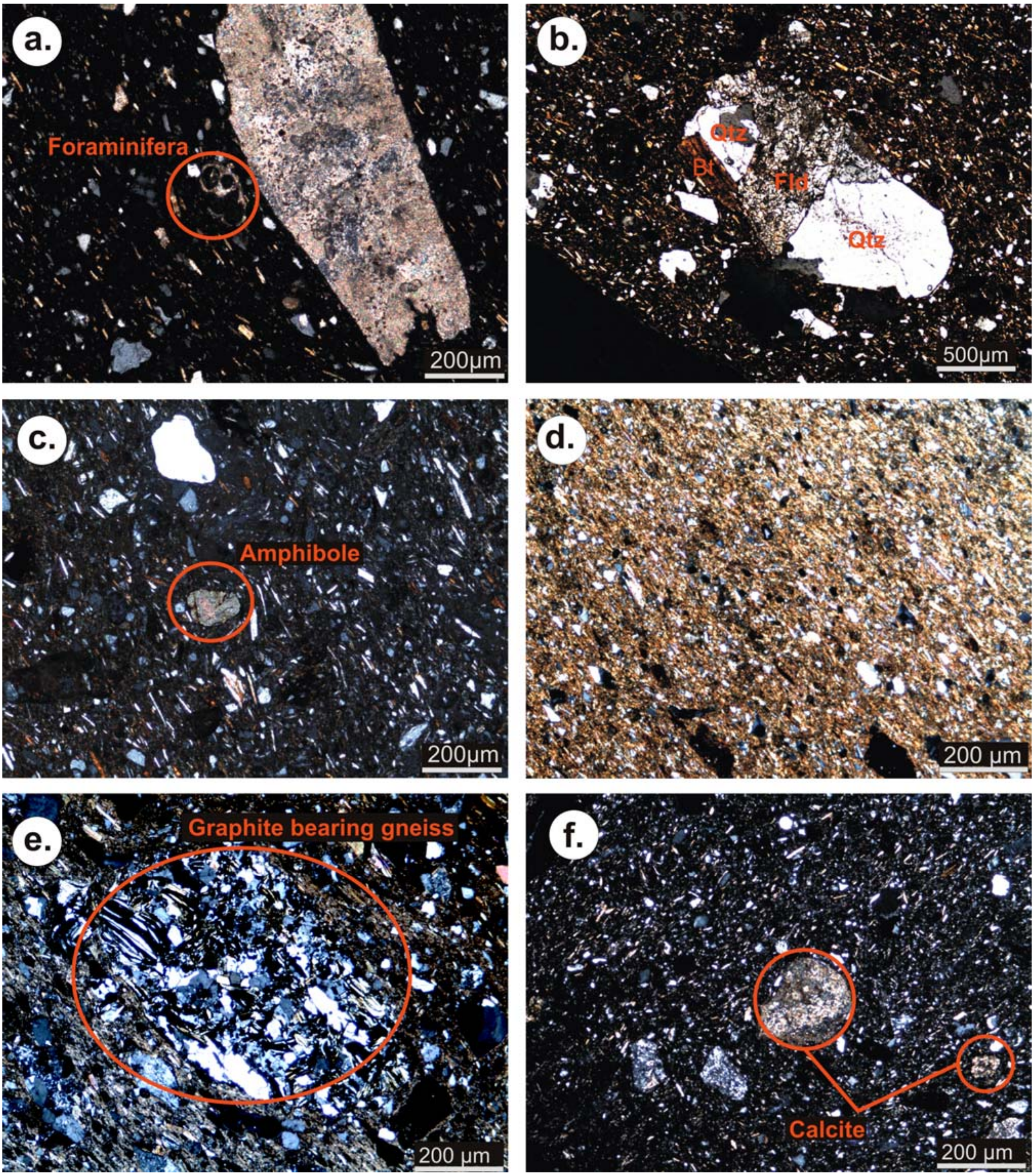

Fig. 4 ***Group A.:*** **a.** subgroup A1: isotropic matrix with well preserved limestone and foraminifera, strongly parallel oriented fabric (XPL) **b.** subgroup A2: isotropic matrix with granitic lithoclast (XPL) **c.** subgroup A3: crystaloclasts of amphibole, isotropic matrix with strongly parallel oriented fabric (PPL) **d.** subgroup A4: anisotropic and microcrystalline matrix with very weak sintering process (XPL). ***Group B.:*** **e.** subgroup B1: lithoclast of graphite bearing gneiss typical for graphite raw material from Southern Bohemia (XPL) **f.** subgroup B2: presence of calcite crystaloclasts suggest the Moravian graphite deposits as source for graphite temper (XPL).

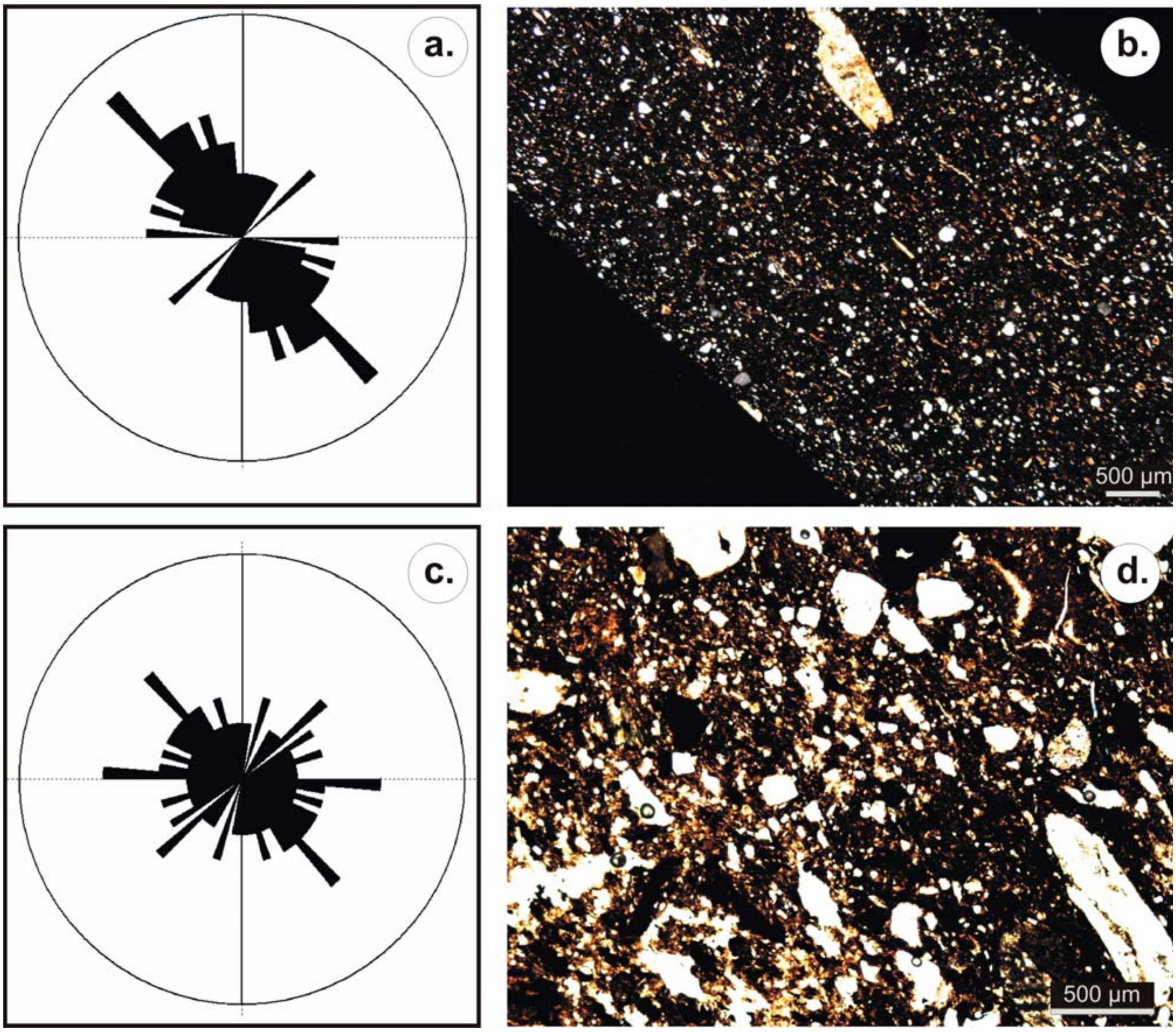

Fig. 5 a. The estimated main direction from rose diagram is in good correlation with proposed strongly oriented matrix in ceramics from group A **b.** thin section of group A (subgroup A1) ceramic (BA/BH-1, bottle II/3) with strongly orientated fabric; **c.** no main direction could be estimated in ceramics from group B as can be seen on the rose diagram what is in good correlation with estimated chaotic fabric; d. thin section of ceramics (BA/K-10, pot I/1a) from group B with chaotic fabric (plain polarized light).

The biotite and two micas granite (hercynian) outcrops directly within the city of Bratislava and well rounded amphibole also occurs in fluvial sediments of the river Danube. The alluvial sediments of the Danube are rich in clay minerals. In the case of group A the use of local raw materials can be assessed when potters collected clay from the vicinity of Bratislava.

The question of origin for the graphite-tempered ceramics in Bratislava’s oppidum is rather interesting as there are no suitable graphite deposits in Slovakia. The subgroup B1 with identified sillimanite, biotite and graphite bearing gneisses correspond to the Southern Bohemian deposits (Czech Republic). One of the characteristics of this graphite deposit is that it exhibits various types of gneisses (Tichý & Voda, 1983). The surrounding rocks of Moravian graphite deposits (Czech Republic) are mainly marbles (Tichý & Voda, 1983), therefore the graphite from group B2 with the presence of calcite possibly came from these deposits. In the case of subgroup B3 it was not possible to assess the provenance of graphite since no significant crystaloclasts or lithoclast were observed in this group. The presence of fine-powdered graphite and also angular clasts reflects the crushing of graphite to obtain suitable temper size. The angular clasts and the bimodal distribution of clasts argue against the possibility of making the vessels from sediments with naturally present graphite (e.g. Kappell, 1969). Such sediments are known to appear near graphite deposits (Kodym, 1957) but in these raw materials the graphite clasts are much finer and are usually oval.

Forming techniques

The fabric from group A is strongly oriented parallel to the ceramic wall as can be seen in the thin sections (e.g. **Figs. 4a, 4b**) and also on the rose diagram (**Fig. 5b**). Also very fine striations were observed on the inner part of the vessels. All these features are typical for wheel-thrown vessels.

Chaotic fabrics are noted in the thin sections from group B (e.g. **Figs. 4e, 5c**) and also in the rose diagrams suggesting that vessels in this group were handmade (**Fig. 5d**) (Shepard, 1976; Velde & Druc, 1999). The modelling techniques most expected are slab building and pinching. The loosely circular fabric and thick horizontal stripes observed on the inner part of the vessels corresponds to a fashion-wheel technique (Roux & Courty, 1998).

Firing condition

The optical and X-ray analysis allowed the identification of thermal processes, which mainly affected the clayish matrix. Data obtained were compared with various reference data (Shepard, 1976; Maggeti, 1982; Herz & Garisson, 1998; Duminico et al., 1998; Velde & Druc, 1999; Maritan et al., 2006). By comparing these observations with the reference data, the firing temperatures for the ceramics could be inferred. Thermally untouched calcite, variable optical character of matrix and observed diminishing of illite diffraction lines suggest that the firing temperature ranged from 700 °C to 800 °C but not higher then 850 °C in the case of ceramics from subgroup A1. Similar firing conditions were achieved in the case of ceramics from subgroup A2 and A3 but the upper limit of firing temperature did not exceed 900 °C. Samples from subgroups A4 show reddish colour of matrix and anisotropic matrix with very weak sintering process. The illite diffraction lines are also well preserved suggesting that the ceramics were fired at 500 – 600 °C. The presence of submicroscopic hematite colouring the matrix of sherds in groups A1, A2 and A3 (**Table 1** and **Table 2**.), reflects oxidizing conditions during the firing process. In the case of sample BA/K-9 (sherd from grey ware of II/3 type) the matrix varies from grey to black and the submicroscopic hematite is not present suggesting a reduced firing conditions for the grey ware of II/3 type.

Estimating the firing temperature for graphite wares from group B is rather difficult as the matrix is coloured with fine powdered graphite. The presence of chlorite in subgroup B1 and the presence of chlorite and thermally untouched calcite in subgroup B2 suggest temperatures ranging from 500 – 600 °C. In subgroup B3 the illite diffraction lines are very weak indicating that the temperature exceeded 900 °C. The black matrix, absence of submicroscopic hematite and well preserved graphite suggests reducing conditions during the firing. Experiments show that the graphite is stable up to about 600 °C in oxidizing conditions and for this reason in cases when the firing temperatures are low (500 – 600 °C), the vessels with purposefully added graphite could have been fired at oxidizing conditions without burning out the graphite (Attila Kreiter pers. com.). Sherds from group B3 were fired at a temperature exceeding 900 °C. At oxidizing conditions the graphite is stable up to about 600 °C but in reduced conditions it remains stable to a much higher temperature. Graphite is one of the most stable minerals under high temperatures, it does not melt but sublimates only at ca. 3500 °C (Martinón-Torres – Rehren 2005, 142). The high firing temperature and the presence of thermally untouched graphite reflects the reducing conditions during the firing for group B3.

CONCLUSION

Even though this is a preliminary study it still offers a valuable insight into the manufacture of La Tène pottery and the provenance of raw materials, in particular for graphite-tempered vessels. Graphite-tempered pots are ubiquitous in La Tène settlements although their technological characteristics and the provenance of graphite are understudied. Moreover, since multidisciplinary investigations of La Tène ceramics in Slovakia are lacking. This study provides basic mineralogical and petrographic data on late La Tène ceramics. Nevertheless, the presence of graphitic wares implies exchange, complex social networks, communication of ideas and spread of knowledge about the suitability of graphitic wares for use. The graphite in the examined vessels is associated with different minerals (groups B1-B3) suggesting that graphite was imported from sources situated in different directions. Thus by this study different directions of trade networks can be identified possibly towards Bohemia and Moravia. It is clear that the data is partial and further research is needed widening the spectrum of the analysed vessel types and also to compare the composition of ceramics with potential raw material sources, the results of this study offers fundamental information on raw material provenance, manufacturing technology and firing conditions of La Tène ceramics.

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