16 THE CLAY PASTE FOR VUČEDOL CERAMIC VESSELS

MINERALOGICAL-PETROGRAPHIC ANALYSIS AND X-RAY POWDER DIFFRACTION

In the first part of the book, we were already acquainted with the development, subject matter and main goals of archaeometry, and its importance for the analysis and interpretation of archaeological artefacts. As far as pottery goes, the aim of archaeometric analysis is to identify production technologies (paste recipe, method of preparation of raw material and its shaping, firing and decoration), the raw material's origin and the function of the pottery products. The analysis of sherds from both investigated sites has attempted to provide answers to some of these questions. Although the number of sherds that have been analysed and are presented here is relatively small, the results obtained provided some guidelines for further analyses to be performed on a much bigger number of samples, and in view of a more extensive array of questions which have been raised as a consequence of the results obtained (Mileusnić & Miloglav 2015).

The sampling of pottery sherds from both sites has been done in line with research questions which sought information on: a) differences in tempers added to various functional shapes; b) firing method and temperature; c) composition of and recipe for clay pastes. Thus, the sherd samples have been classified into three categories: a) sherds of various functional shapes (bowl, pot, cup etc.); b) various colours of cross-section; c) various surface treatments (polishing, burnishing and barbotine treatment).

After the research questions were posed, 17 pottery sherds were sent for analysis – 7 from the site at Ervenica, and 10 from the site at Damića Gradina.

The mineral composition of the raw materials, the texture of the paste and the type and quantity of temper in it, were established by mineralogical-petrographic analysis under an optical microscope (OM), and X-ray powder diffraction (XRD). The analyses were done at the Department of Mineralogy, Petrology and Mineral Resources of the Faculty of Mining, Geology and Petroleum Engineering of the University of Zagreb. In addition, 8 sherds from various Vučedol sites (Ervenica, Tržnica Tell, Borinci, Vučedol) were subjected to Fourier-Transform Infrared Spectrometry (FT-IR), with a view to identifying the composition of the incrustation. Those analyses were performed at the University of Natural Resources and Life Sciences in Vienna. At this moment, only preliminary results are available, and those indicate that the incrustation paste was made only of freshwater shells.

X-ray powder diffraction is the main method of analysing the mineral composition of pottery and clay samples. This analysis has the advantage of identifying clearly and directly specific clay minerals, which cannot be identified using other physical methods, especially in the case of polyphase pastes.

The optical microscopy and X-ray analysis have established the following mineral composition of the pottery: quartz, a mineral from the mica group (muscovite/sericite), K-feldspar, plagioclase, fine crystalline aggregate grains and possibly clinopyroxene. Particles of rock (quartzite/chert) have also been found sporadically. In addition, medium- to large-grained grog and some rounded organic grains have also been observed in the sherds.

The sherds' core ranges from dark brown and grey to black, with some samples displaying light-brown to orange-red external and/or internal walls. Such structures can be a result of reduction firing with the final cooling phase in an oxidizing atmosphere.

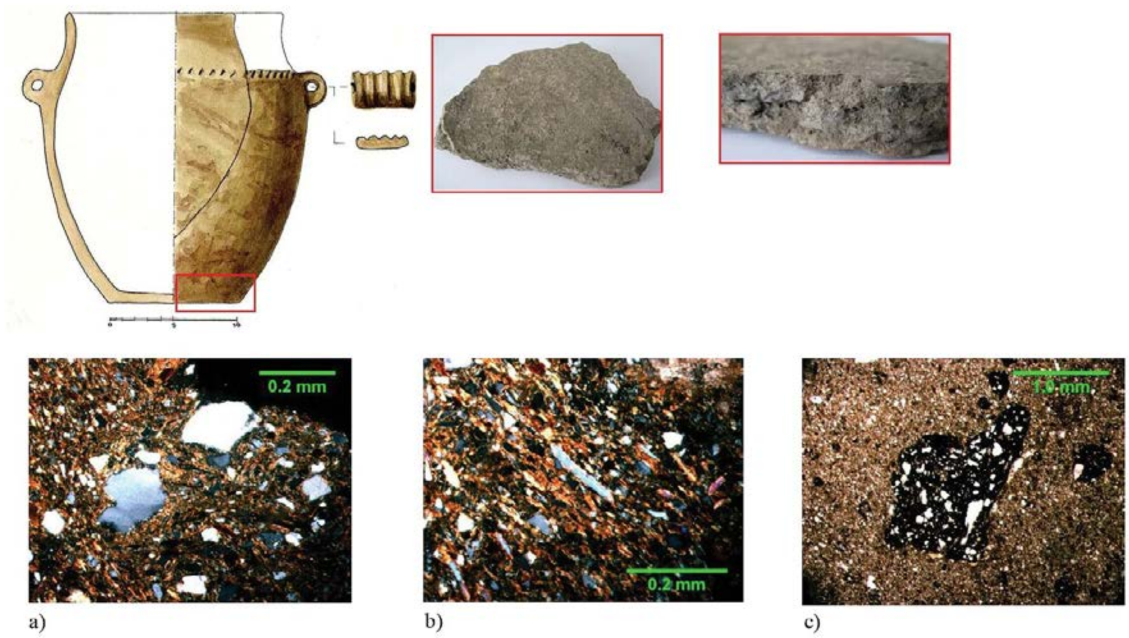

Fig. 78 – Pot of type B 1a: a (crossed nicols) – the microphotograph shows two relatively large grains of quartz with typical undulose extinction; b (crossed nicols) – elongated muscovite with high interference colours; c (parallel nicols) – grog with embedded quartz.

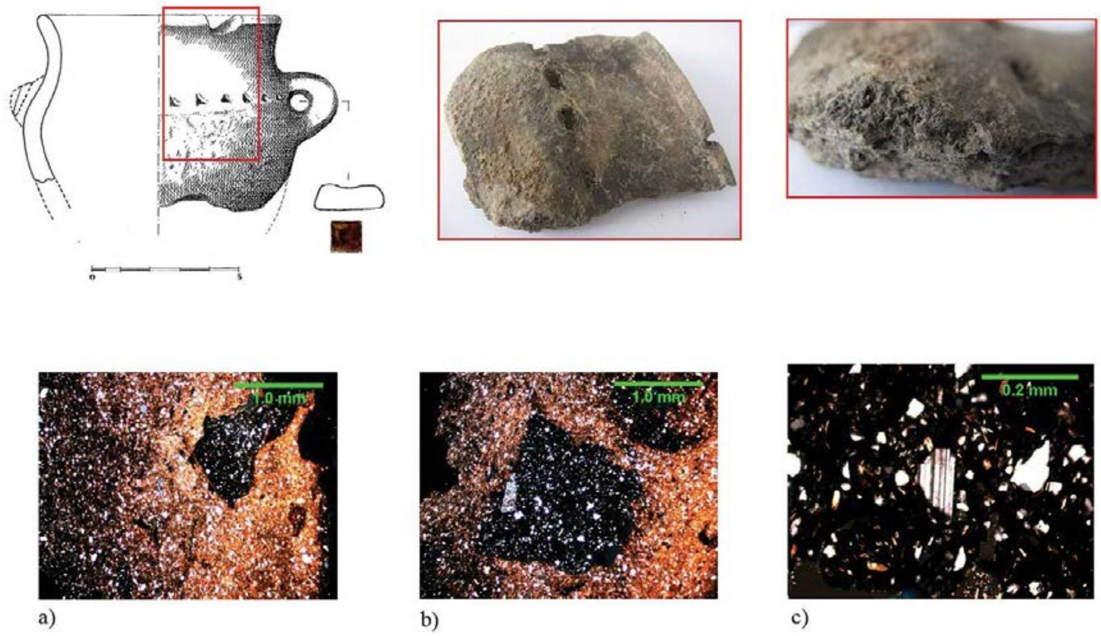

Fig. 79 – Pot of type B 1b: a (crossed nicols) – external oxidized wall of a sample with embedded angular, black fragment of grog, located in the upper right corner; b (crossed nicols) – a large grain of grog, with embedded elongated fragment of chert at the left edge of the grog; c (crossed nicols) – plagioclase with polysynthetic twinning.

The petrographic analysis of pottery samples from the sites of Ervenica and Damića Gradina has not resulted in a separation of samples into groups based on different textural, structural and mineral properties, because samples originating from the two sites do not display any significant differences. The matrix contains abundant homogeneously-distributed fine-grained subangular to angular quartz and a flaky mineral from the mica group. The unimodal distribution of quartz and mica particles, silt to sand in size, present in the matrix, suggest that the minerals are natural ingredients of the raw material (Velde & Druc 1999).

The only difference observed among the pottery sherds analysed regards different quantities of grog tempering. It has been established that shapes which belong to the functional group of pots (vessels for thermal processing of food) contain higher quantities of large-grained grog in their clay paste.

Although grog is present in large amounts in all the sherds processed, the size of the grog particles present in pots ranges between coarse (1–3 mm, 85.71%) and very coarse (> 3 mm, 14.29%), while the grog temper in bowls is medium-grained (0.2–1 mm, 100%). There is no correlation between the observed differences in tempers and vessel dimensions, given that pots can be smaller and larger (as are, in this case, types B 1a and B 1b, fig. *78* and *79*), and thus, in this case, the hypothesis that size of particles varies with size of vessel and thickness of walls has not been confirmed (Rye 1981).

The importance of adding temper to the clay paste, especially for vessels intended for thermal processing of food, has been discussed in the first part of the book. The properties of grog have also been described in chapter 4, with an overview of its positive and negative features relevant to the thermal and physical properties of the vessel. Therefore, we should not disregard the differences observed in adding substantial quantities of coarse-grained grog to the clay paste for the production of pots, irrespective of the small number of analysed samples. Tempering clay paste with grog is one of the oldest technological choices. Broken and crushed pottery sherds were always available in settlements, so its preparation did not require any additional engagement, on behalf of the potter, relating to the search for and procurement of temper. In addition to reducing the thermal stress in cooking pots, tempering with grog also provides the clay with plasticity necessary for its shaping. The majority of grog present in the pottery samples analysed consists of angular grains, whose size varies between 0.25 and 6.56 mm. Pieces of recycled grog can also frequently be observed in the sherds, consisting of smaller grains of older grog embedded in a larger grain of newer grog (*Fig. 80*).

Fig. 80 – Pot of type B 3a: a (crossed nicols) – rounded organic grain; b (parallel nicols) – grog which contains, in the lower right section of its large grain, two smaller angular grains of grog which are older than that in which they are embedded.

The analyses performed allow the conclusion that the clay pastes used to produce these vessels do not display any significant differences in their structure. The pottery's mineral composition corresponds to the mineral composition of loess – the natural geological base of the location of the two sites investigated. Given that the main ingredients of loess are quartz, feldspar and minerals of the mica group, as discussed in detail in chapter 10, the presence of these minerals in the clay paste of the analysed pottery was expected. Therefore, we can assume that local raw material was used for the pottery's production. With a view to establishing the location of potential raw material in the vicinity of both sites, clay samples have been collected, and they are currently being analysed.

The potters used fine-textured clay and tempered it with grog for the production of all types of vessels (bowl, pot, cup, jug). In an attempt to improve the physical properties of cooking vessels, they added increased quantities of coarse grog grains to their clay paste. In the first part of the book, we have already learned that various kinds of temper were used for diverse types of vessels, so tempering cooking pots with larger quantities of grog can be associated with the vessels' function, in that they had to sustain the thermal stress to which they were exposed on a daily basis. The choice of temper added by the potter to his clay paste is also linked to the vessel's resilience to such stress.

Although the sample was relatively small, the differences observed in tempering pots with higher quantities of grog have prompted additional sampling and analyses, currently under way, whose aim is to confirm the relevance of the data on a bigger sample from both sites.

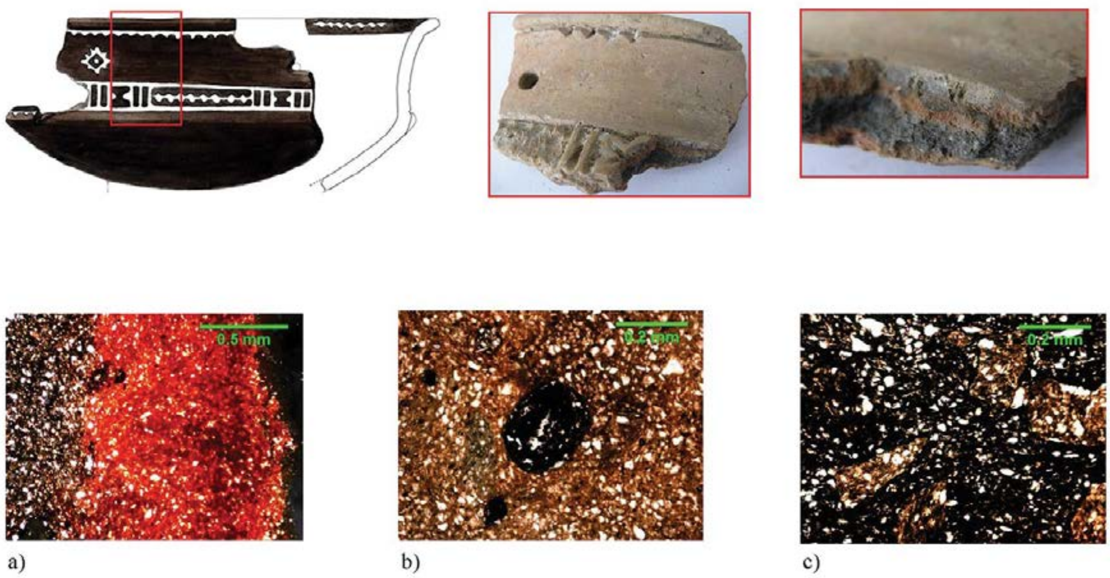

Fig. 81 – Bowl of type A 4c: a (crossed nicols) – interference colours of the external edge of the wall are covered by its own bright orange-red colour; b (parallel nicols) – well-rounded black organic grain; c (parallel nicols) – grains of grog that can be identified in the black matrix by their light colour and angular edges.