Přehled výzkumů 63/2, 2022 ● 61–109

Analysis of pottery from Žďár nad Sázavou – Staré město with a focus on the technology of the assemblage

Analýza keramiky ze Žďáru nad Sázavou – Starého města se zaměřením na technologii souboru

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KEYWORDS

Pottery technology – pottery analysis – Žďár nad Sázavou – Staré město – pottery production of the 13th century – pottery kilns

ABSTRACT

The study focuses on ceramic production from Žďár nad Sázavou – Staré město, an agglomeration that formed in the third quarter of 13th century and was abandoned after the founding of the 'new' town in the early 14th century. The large pottery collection is well dated and captures changes in pottery production during the medieval transformation, tightly connected with the colonisation of the Bohemian-Moravian Highlands. The pottery assemblage from the 2004 excavation season was processed in this study. Material from the pottery kiln discovered in 2006 and found during the review of the research documentation was supplemented afterwards.

The main part of study evaluates ceramic production technology, which was rapidly changing during this period. Pottery fragments were divided into ceramic classes according to the properties of the ceramic mass and firing. The descriptive system of technological marks is a part of the study, but it could be used for other medieval pottery collections. Detailed attention was paid to pottery-forming technique marks: coiling, wheel forming and wheel throwing. The analysis of pottery technology is based on the chaîne opératoire of medieval ceramic production. The macroscopic analysis of pottery-making technology is connected with the conclusions of natural science analyses. Their aim was to validate and specify the macroscopic description of ceramic classes and also detailed information about pottery provenance and technology. The analysis of the pottery provides information for the future production-distribution model of pottery production in the area.

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https://doi.org/10.47382/pv0632-01

Received 12 March 2022; received in revised form 27 July 2022.
Available online 25 October 2022.

Competing interests: The authors have declared that no competing interests exist.

1. Introduction

The Žďár region ranks among those whose settlement began to increase more significantly only in the 13th century, much the same as in other parts of the Bohemian-Moravian Highlands, such as the Havlíčkův Brod, Jihlava and Pelhřimov regions. In contrast, the Třebíč and Telč regions were part of the earlier settlement area (Těsnohlídková 2021, 293–297). The current state of knowledge of medieval pottery in the Bohemian-Moravian Highlands has been processed in a forthcoming monograph (Čapek et al. 2022).

Based on the results of the author's dissertation (Těsnohlídková 2021, 203–255), this study focuses on the characteristics of pottery production in Žďár nad Sázavou – Staré město. A large, high-quality and well-dated assemblage would capture one of the phases of pottery changing under the influence of the medieval transformation of society, in this part of the Bohemian-Moravian Highlands directly associated with the colonisation of the area (Těsnohlídková 2021, 206–208). The population of this market settlement peaked in the third quarter of the 13th century. Due to the scope of excavations at the site, the amount of pottery material and its availability, attention was focused on material from the 2004 excavation season. It was only later during a revision of the documentation that the pottery kiln investigated in 2006 was identified and its evaluation was attached separately to the processing.

The core of this article is a detailed evaluation of the technology of pottery production, which was undergoing a major change in the studied period. The analysis of technological traces was based on a specially created typology (see Appendix) based on traces identified on archaeological pottery, the results of the experimental production of pottery, ethnographic sources and foreign work focused primarily on the description of the technology of protohistoric pottery (e.g. Hołubowicz 1950; Roux, Courty 1998, Roux 2019). The work is a case study of the analysis of pottery technology based on the *chaîne opératoire* of medieval pottery production. A detailed analysis of the technological side is often neglected in evaluations of medieval pottery in favour of a detailed analysis of morphological features. More detailed studies dealing with the technology of medieval pottery have only appeared in recent years (e.g. Čapek et al. 2018; Hlavica et al. 2016; Běhounková 2015). One exception from earlier studies is the processing of pottery from the Hradištko site near Davle (Richter 1982).

The macroscopic analysis of the technology was supplemented by the findings of scientific analyses carried out in cooperation with K. Slavíček and J. Petřík from the Department of Geological Sciences in the Faculty of Science at Masaryk University (Těsnohlídková 2021, Annex 30). The goal of this work was

to validate and supplement the macroscopic description of pottery classes, with the technology and provenance of the pottery being the subject of interest. The first analyses of the pottery material at the site were also expected to provide basic information for the future production-distribution model of pottery in the area.

2. Characteristics of the settlement of the site and archaeological excavations

The site is located at the northern edge of the built-up area of today's town in the field lines along the sunken lanes from the Klafar springs towards Starý dvůr. The site is known by the toponym 'Staré město' (Old Town). The elevation of the site is 575–590 m above sea level (Fig. 1).

The market settlement of Žďár situated near a provincial road existed before the middle of the 13th century. It is typically localised near a ford across the River Sázava in the area of its confluence with the Stržský and Staviště streams. M. Richter assumed that the original Žďár is under today's Branský Pond. Archaeological evidence for the original settlement is still missing (Richter 1974, 239–240).

The transfer of this original settlement to locations called 'Na Starém městě' was to have occurred in connection with the founding of a Cistercian monastery, which is dated by information in *Chronica domus Sarensis* to the years 1252–1257. The residents were to have been people from the original village of Žďár and members of the building lodges with their families, as well as other craftsmen. The village was to have moved to the left bank of the River Sázava as early as in 1262–1276, to the centre of today's town of Žďár nad Sázavou. Following the abandonment of the settlement, the site was gradually converted into cultivated fields. Today, most of the former settlement is buried beneath development. A sunken lane running through the site has been preserved (Ludvikovský at al. 1964, 188–194; Richter 1974, 236; Zatloukal 1999, 201–203).

An analysis of the soil profile from the vicinity of the settlement produced new information and documents that the landscape around the site was being cultivated by man by the beginning of the 1220s at the latest, a period that would have witnessed deforestation and the burning of clearings, which were characteristic for colonisation. The distinctive iron-making precinct at the site could perhaps indicate the link between settlement and the extraction and processing of iron ores (Hrubý et al. 2014, 27–28).

The first interest in the site is documented by an entry in the town chronicle from the year 1929 (Richter 1974, 233). The attention of the Institute of Archaeology of the Czechoslovak Academy of Sciences was focused on the site in the 1970s. Small-scale trenching was followed by extensive excavations carried out by Miroslav Richter (Richter 1974, 233). A plan to build a satellite settlement brought the location to the forefront of interest in the 1990s. The first rescue archaeological excavations were conducted in 1996–1999 under M. Geisler and R. Zatloukal from the Institute for Archaeological Heritage in Brno (hereinafter referred to as ÚAPP Brno) (Zatloukal 2000, 193). These were followed by excavations of large parts of the settlement in 2004–2006 under M. Geisler from the ÚAPP Brno, during which the remaining areas of the settlement were investigated (Geisler 2004; 2005; 2006). Smaller excavations in the outlying parts of the site in connection with the continuing construction of residential buildings were conducted in recent years by the firm Pueblo o. p. s. R. Zatloukal processed the excavations of M. Richter and those from 1996–1999 (Zatloukal 1999; 2000, 88–113).

The settlement was located on both sides of the sunken lane running from Klafar springs to the Starý dvůr homestead in an estimated length of 200–250 m on a gentle southeastern slope that ends at a natural edge dropping to the River Sázava (Geisler 2004, 4–5). The buildings formed a street line slightly deviating from the direction of the contemporary sunken lane. R. Zatloukal presumed a spool-shaped village green with a width of 60–70 m. The residential development is documented by sunken cellars with entrance alcoves (Fig. 2). The question is their interpretation – whether they were residential or were cellars beneath wooden residential buildings; alternatively, they could have been residential in the first phase and above-ground structures were subsequently built (or were to have been built) over them (on this issue, e.g. Holub et al. 2005, 44–101; Hejhal, Hrubý 2005, 126–147). Many buildings at the site were wooden and were documented only by the presence of postholes.

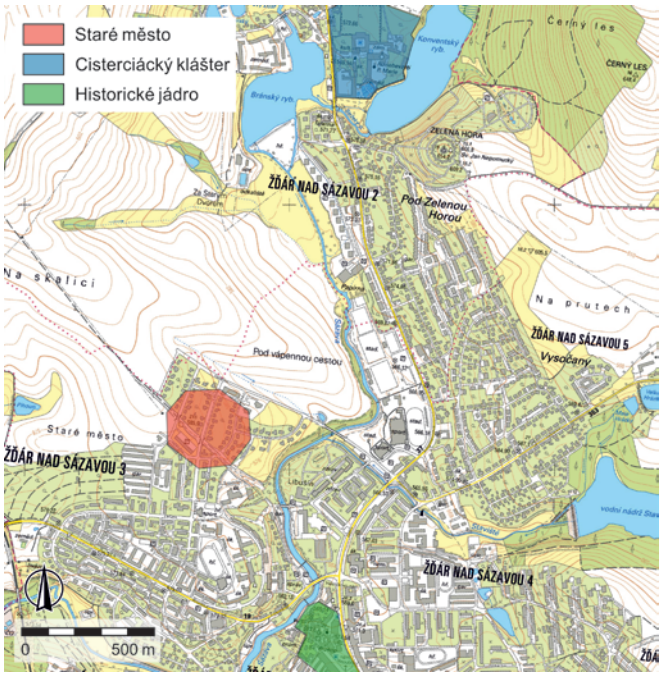


Fig. 1. Location of Staré město site in the area of Žďár nad Sázavou – the later city centre and Cistercian monastery are marked. Map ČUZK, designed by K. Slavíček.

Obr. 1. *Umístění lokality Staré město na katastru Žďáru nad Sázavou – vyznačení pozdějšího centra a cisterciáckého kláštera. Mapa ČUZK, vyznačení K. Slavíček.*

Fig. 2. Cellar (context 252) investigated in 2004. After Geisler 2004, Tab. 66.

Obr. 2. *Zahloubený suterén (kontext 252) zkoumaný v roce 2004. Podle Geisler 2004, tab. 66.*

Fig. 3. Relic of likely partially roofed stonemasonry workshop during archaeological research; semi-finished stone moulding for the monastery and production waste are visible. After Geisler 2005, Tab. 53.

Obr. 3. *Relikt patrně částečně zastřešené kamenické dílny během archeologického výzkumu; patrné polotovary kamenických článků pro klášter a výrobní odpad. Podle Geisler 2005, tab. 53.*

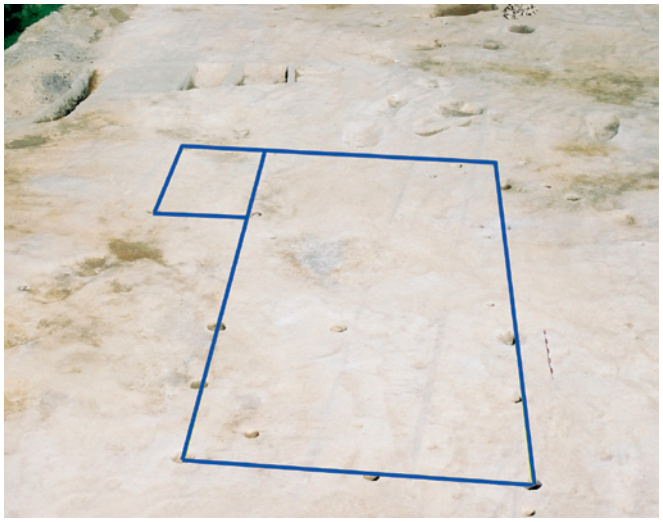


Fig. 4. Probable plan of the church at the site. After Geisler 2005, Tab. 38.

Obr. 4. *Pravděpodobný půdorys kostelíka na lokalitě. After Geisler 2005, tab. 38.*

In terms of craft operations, iron ore processing, a blacksmith's precinct with the preserved destruction of stone furnaces and what appears to be evidence of blacksmith's forges were documented at the site (Richter 1974, 236; Zatloukal 2000, 197). Furthermore, a partially roofed stonemason's workshop related to the construction of the monastery was investigated (Fig. 3). Stone working is also documented by the occurrence of stone mouldings, including waste (Geisler 2005, 57–60; 2006, 74–78). A pottery kiln testifies to ceramic production (Geisler 2006, 35–36). Written sources mention the existence of a small wooden church at the site, a rectangular 16 × 6 m post-built structure with a rectangular extension in the west corner that was perhaps investigated in 2005 (Fig. 4; Geisler 2005, 37–39).

No two or more features were found in superposition, thus confirming the theory of the short existence of the settlement. After the site was abandoned, it was probably left deserted for several years before being adapted for agricultural use. Large features were filled with stones and soil (Richter 1974, 236; Zatloukal 2000, 197–198).

3. Basic characteristics of assemblage from the 2004 excavation season

The processed pottery assemblage from the 2004 excavation season was composed of 4,201 fragments with a weight of roughly 129 kg (nearly 69 kg of which were fragments of storage vessels). The pottery from the 2004 excavation season comes from 134 features/contexts. The assemblage can be regarded as relatively compact and created in the short horizon of the settlement's existence.

During processing, it should be taken into account that the assemblage shows signs of a high degree of fragmentation with isolated occurrences of fragmented vessels (49% of fragments up to 4 cm^2, 45% in the range of 4–8 cm^2, in detail in Těsnohlídková 2021, 209–212). As such, most of the assemblage provides only detailed information on the morphological and technological qualities of the fragments, which cannot always be associated with the qualities of the entire vessel. The possibilities of monitoring metric properties or the overall profiling of vessels as well as a comprehensive evaluation of the technology are limited.

The pottery came from subsurface features, while no significant concentration of vessel remains or large fragments was documented in any of the features. Here we can expect more comprehensive findings only after the entire site has been processed. No feature that could be related to pottery production was uncovered. Large features produced the greatest number of finds. Two features contained over 500 potsherds: one cellar (766 fragments) and a production/farming feature (context 206, 687 fragments). Six other contexts contained more than 100 fragments, i.e. another cellar and settlement pits. Of the other features with less than 100 fragments in the fill, a furnace with a pit in front of it probably related to iron production, the remains of two other unspecified furnaces, settlement pits, postholes and a gutter were examined in the 2004 season (for details, see Těsnohlídková 2021, 209–212).

4. Technology

4.1 Ceramic classes and their validation

Ceramic class (CC) was followed as a quality determined on each fragment and generally used when processing the medieval pottery. The classes were primarily determined on the basis of macroscopically observable qualities of the ceramic fabric and its firing, which can be observed on all fragments. Traces of shaping preserved on only a smaller part of the assemblage were later discussed within the framework of classes and pottery groups (in detail in Čapek, Těsnohlídková 2020, 39–45).

A total of 13 ceramic classes identified at the site can be attributed to three basic categories of medieval ceramics: sandy, graphite and micaceous (Tab. 1). CC 11 (storage vessels) was evaluated separately. According to the processed assemblage, the basic ratio of sandy, graphite and micaceous pottery at the site is 55 : 41 : 4. The representation of ceramic classes was compared on the basis of three different criteria, namely the number of fragments (before fitting), weight and, for comparison, the sum of estimated vessel equivalent (EVE) values for all rims in the given ceramic class (Graph 1). The results show that quantification by the number of fragments correlates relatively well with the quantification by the vessel equivalent obtained on the basis of the 425 fragments of vessel rims. Graphite pottery is overestimated when weight is used due to the fact that graphite vessels tend to have a thicker wall and an overall higher robustness of form. Storage vessels (ceramic class 11) were treated separately due to having entirely different qualities than common ware. With a total of 667 fragments, they represent 16% of the assemblage, though their overall weight of nearly 69 kg makes up 54% of the assemblage.

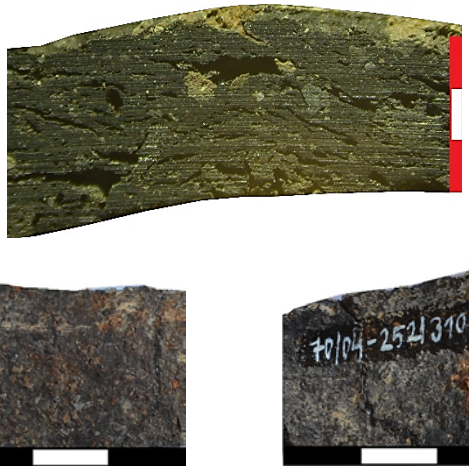
CC 1 – sandy and matte (61 sherds)

Fabric: small amount or uncombusted organic charcoal, small amount of mica, fine or medium grained

Firing: mostly reduction, may be oxidation biscuit firing on one or both surfaces, medium hard

Surface: smooth to mildly rough

Colour: dark grey to black, oxidation biscuit firing: beige, ochre, orange to shades of brown



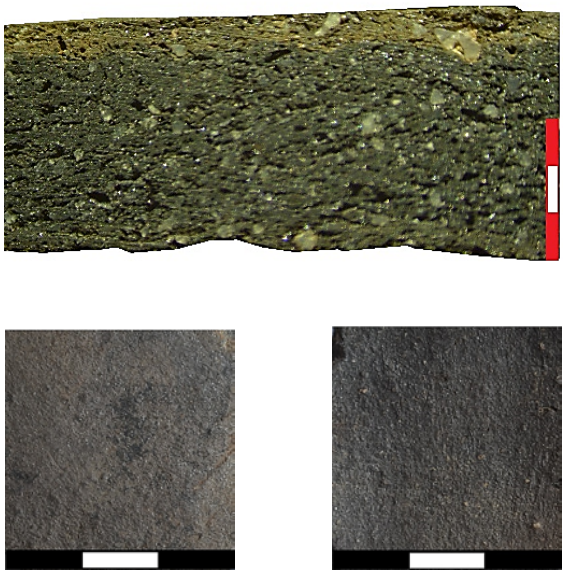
CC 2 – sandy fine and shiny (263 sherds)

Fabric: small amount or uncombusted organic charcoal, mica: small amount or medium to large amount (grains 1 mm), medium-grained

Firing: mostly oxidising biscuit firing, may be reduction, medium hard

Surface: smooth to mildly rough

Colour: dark grey, oxidation biscuit firing: beige, ochre, orange to shades of brown



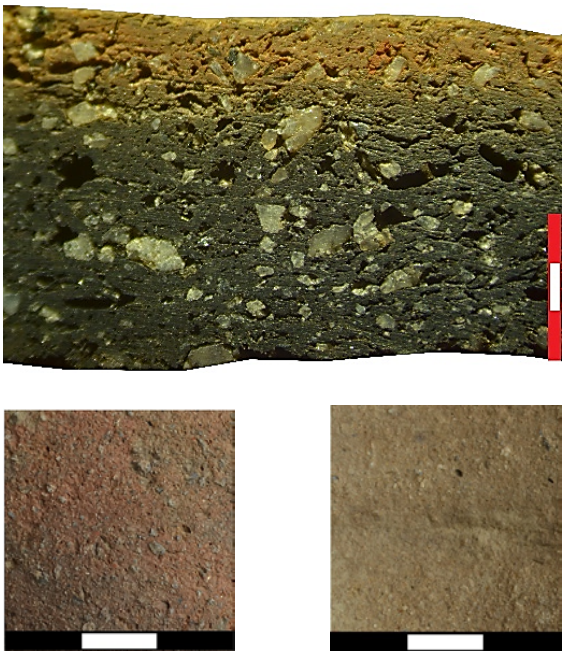
CC 3 – sandy coarse and shiny (1,416 sherds)

Fabric: small amount or uncombusted organic charcoal, mica: small amount or medium to large amount (grains 1 mm), medium-grained

Firing: mostly oxidising biscuit firing, may be reduction or mixed, medium hard

Surface: smooth to sandy

Colour: dark grey, oxidation biscuit firing: beige, ochre, orange to shades of brown



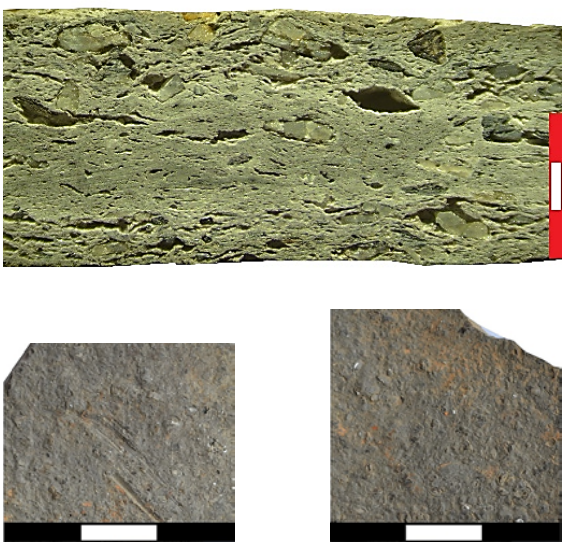
CC 4 – sandy and light (107 sherds)

Fabric: oxidation (in cases of oxidation firing, the graphite/organic temper can combust completely), mica: small amount or medium to large amount (grains 1 mm), medium-grained

Firing: mixed, oxidation, may be white core or light over-fired, medium hard

Surface: smooth to sandy

Colour: medium to light grey, oxidation – ochre to orange



CC 5 – glazed pottery (4 sherds)

Fabric: oxidation (in cases of oxidation firing, the graphite/organic temper can combust completely), mica: without or small amount, fine-grained

Firing: oxidation, mixed, medium hard

Surface: very smooth to smooth, glaze on inner surface

Colour: sherd – beige to light grey, glaze – yellow, green, green-brown

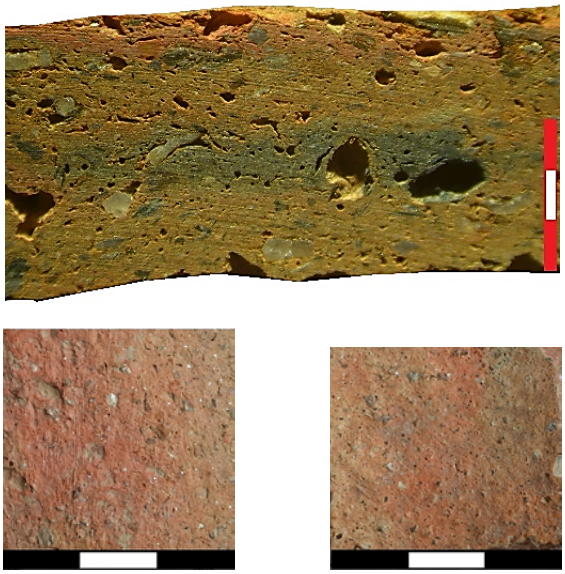
CC 6 – micaceous oxidation (15 sherds)

Fabric: oxidation (in cases of oxidation firing, the graphite/organic temper can combust completely), medium to large amount – coarse – flakes (ca. 2 mm), medium-grained

Firing: oxidation, may be mixed, rest of clack core or light over-fired

Surface: smooth to sandy

Colour: ochre to orange, could be brick red



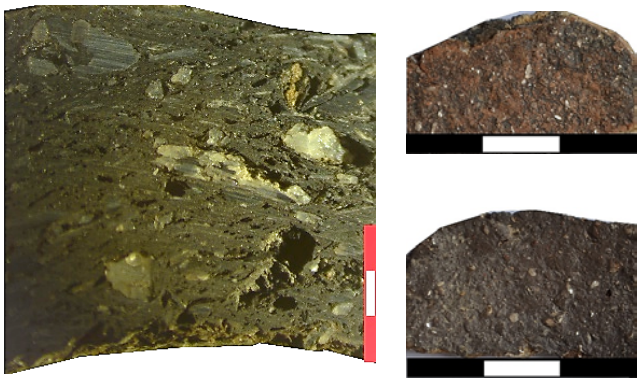
CC 7 – micaceous reduction (95 sherds)

Fabric: small amount or uncombusted organic charcoal, mica: medium to large amount – coarse – flakes (ca. 2 mm), medium grained

Firing: reduction, may be oxidation biscuit firing, medium hard

Surface: smooth to mildly rough

Colour: dark grey, oxidation biscuit firing: beige, ochre, red or shades of brown



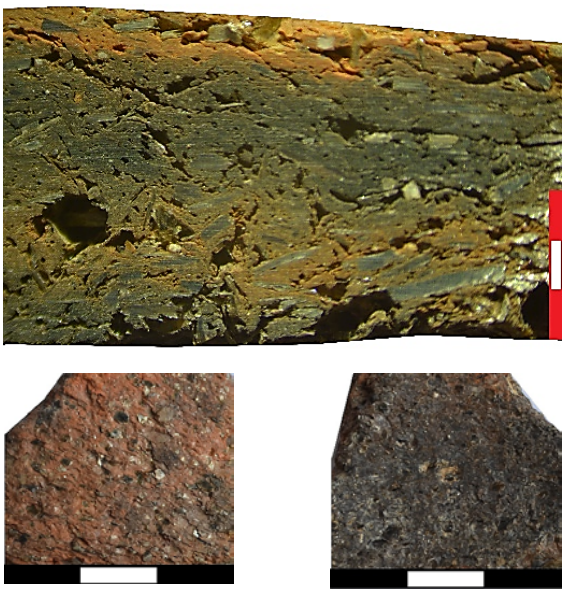
CC 8 – extra micaceous (21 sherds)

Fabric: small amount or uncombusted organic charcoal, mica: extreme amount (fabric crumbles, flakes), medium to coarse grained

Firing: mixed, oxidation biscuit firing, reduction, oxidation, soft to medium hard

Surface: smooth to sandy, inclination to abrasion

Colour: medium to dark grey, oxidation or oxidation biscuit firing: ochre, brisk red or shades of brown



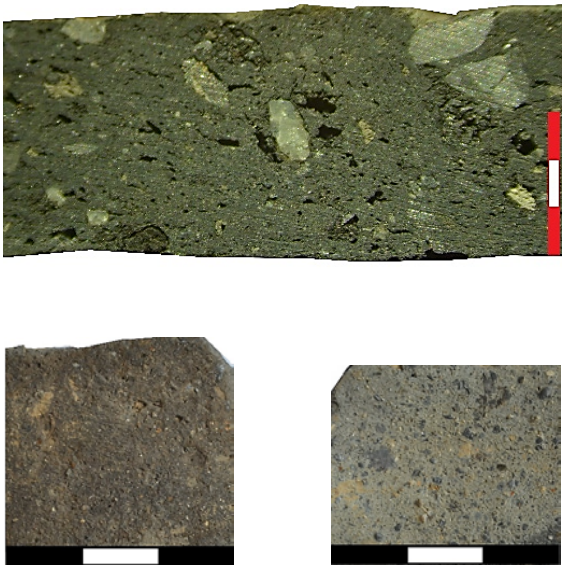
CC 9 – graphite matte (471 sherds)

Fabric: medium to large amount – macroscopically visible grains, mica: small amount or medium to large amount (grains 1 mm), medium-grained

Firing: mostly reduction and oxidation biscuit firing, may be black core or mixed firing, rarely light over-fired, mostly soft, may be medium hard

Surface: smooth to sandy, inclination to abrasion

Colour: medium to dark grey, matte graphite grains, oxidation biscuit firing: colour of surface from beige, ochre to reddish and shades of brown



CC 10 – graphite shine (390 sherds)

Fabric: medium to large amount – macroscopically visible grains, mica: small amount, medium to large amount (grains 1 mm), medium-grained

Firing: mostly reduction and oxidation biscuit firing, may be black core or mixed firing, rarely light over-fired, mostly soft, may be medium hard

Surface: smooth to sandy, inclination to abrasion

Colour: medium to dark grey, shiny graphite grains, oxidation biscuit firing: colour of surface from beige, ochre to reddish and shades of brown

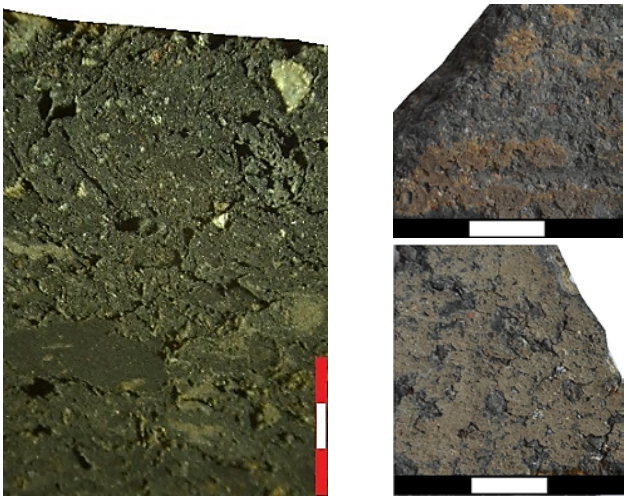
CC 11 – storage vessels (667 sherds)

Fabric: medium to large amount – macroscopically visible grains (up to 0.5 cm), mica: small amount or medium to large amount (flakes 2 mm), reddish inclusion, coarse grained

Firing: reduction or oxidation biscuit firing, mostly soft, may be medium hard

Surface: majority sandy, could be mildly rough to smooth, inclination to abrasion

Colour: medium to dark grey, shiny graphite grains, oxidation biscuit firing: colour of surface from beige, ochre to reddish and shades of brown



CC 12 – oxidation shiny (32 sherds)

Fabric: oxidation (the graphite/organic temper can combust completely), for graphite, it is not possible to determine its presence (oxidation firing), mica: medium to large amount – fine – grains (ca. 1 mm), medium-grained

Firing: oxidation or black core, medium hard

Surface: smooth to mildly rough

Colour: ochre to orange, black core – black to dark grey

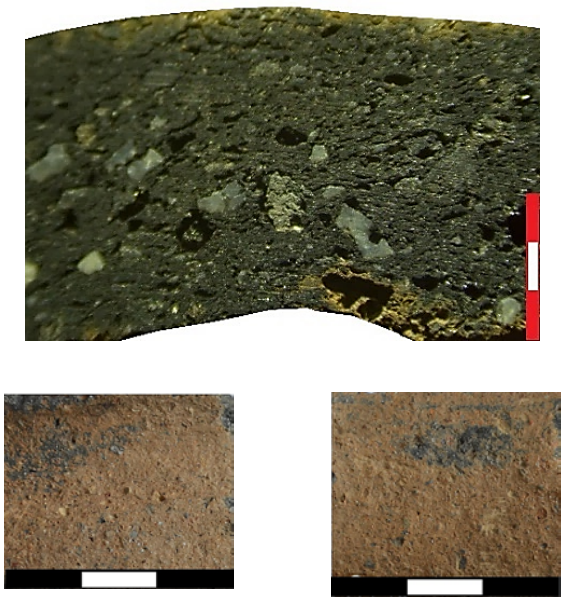
CC 13 – graphite fine (609 sherds)

Fabric: medium to large amount – powdered graphite, medium grained

Firing: reduction or oxidation biscuit firing, may be mixed, soft or medium hard

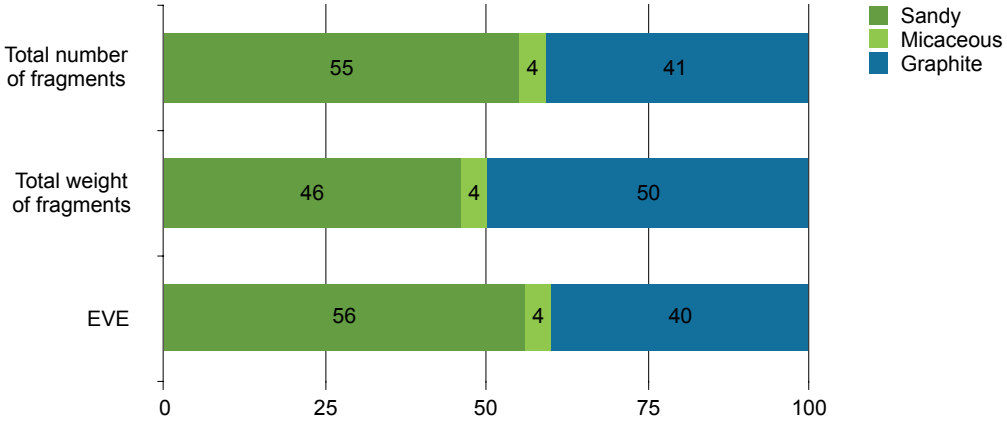
Surface: smooth to mildly rough

Colour: dark grey, colour of oxidation biscuit firing – ochre, shades of brown, could be beige, orange or brick red



Tab. 1. List of ceramic classes in pottery production from Žďár – Staré město. Left photo – vertically cut, above – outer surface; middle photo – outer surface; right photo – inner surface, Photo by K. Těsnohlídková, K. Slavíček (black scale in cm, red scale in mm).

Tab. 1. *Seznam keramických tříd v hrnčířské produkci ze Žďár nad Sázavou – Starého města. Foto vlevo – nábrus; řez kolmo, nahoře vnější povrch; foto uprostřed – vnější povrch; foto vpravo – vnitřní povrch. Foto K. Těsnohlídková, K. Slavíček (černé měřítko v cm, červené v mm).*



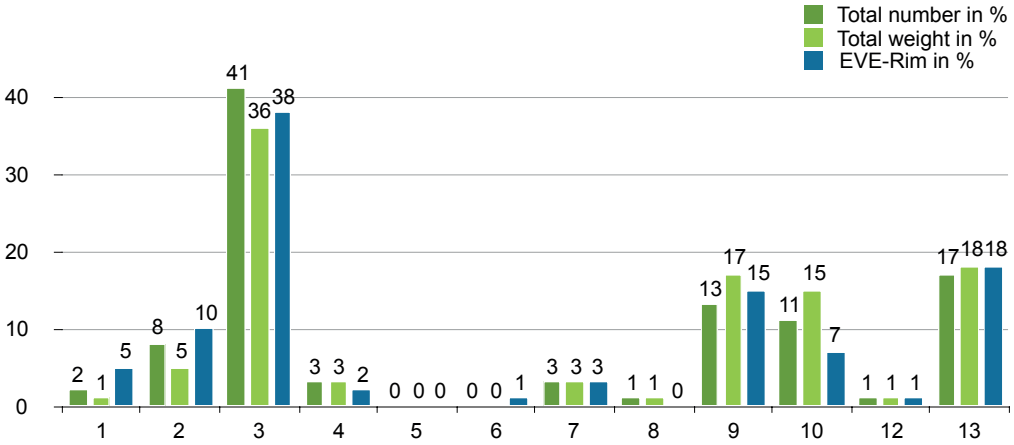
Graph 1. Share of basic pottery groups based on various quantifiers.

Graf 1. *Procentuální zastoupení základních skupin keramiky na základě různých kvantifikátorů.*

The largest, CC 3, which forms 41% of the assemblage, is characterised as sandy, coarse and shiny. Other sandy CC have a lower representation: sandy, fine and shiny CC 2 makes up 8%; sandy and light CC 4 – 3%; sandy and matte CC 1 – 2%; oxidation light CC 12 – 1% of the assemblage. The smallest class of glazed pottery (CC 5) with just four fragments and a share of nearly 0% is also grouped among the sandy classes. The three graphite classes have a similar ratio: fine graphite CC 13 makes up 17%, matte graphite CC 9 has a share of 13%, shiny graphite CC 10 a share of 11%. Micaceous pottery has a low representation: 3% of the assemblage is micaceous reduction CC 7, 1% is extra micaceous CC 8, and less than 1% is micaceous oxidation CC 6 (Graph 2; in detail in Těsnohlídková 2021, 212–214).

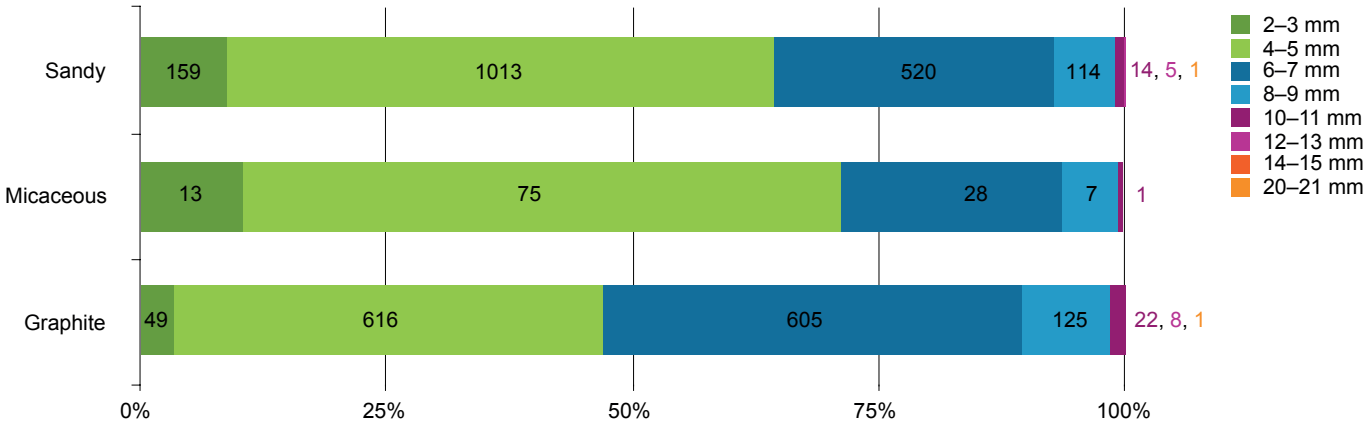
Fragment thickness, ideally from the body of the vessel, was followed as a special indicator. The results show that graphite pottery had thicker walls, which is consistent with its overall robustness compared to sandy pottery. Micaceous pottery has thinner walls (Graph 3). The same was confirmed with the measured thickness of bottoms. The wall thickness of storage vessels was most typically in the 12–20 mm range.

An analysis that involved over-firing to various temperatures was conducted in an attempt to verify the accuracy of the created ceramic classes. This analysis confirmed the appropriateness of separating the pottery into groups of graphite, sandy and micaceous classes. A more detailed classification in which firing qualities were also taken into consideration could not be



Graph 2. Graph with a comparison of the share of classes within individual quantifiers (0 in the graph indicates that the share in the assemblage approaches 0).

Graf 2. *Graf s porovnáním procentuálního zastoupení tříd v rámci jednotlivých kvantifikátorů (0 v grafu znamená, že se podíl v souboru blíží 0).*



Graph 3. Thickness of potsherd from vessel wall in pottery groups.

Graf 3. *Síla střepu stěny nádob u keramických skupin.*

confirmed using this method. The behaviour of all over-fired samples demonstrated that these are 'brick-making' non-loess materials containing iron oxides and a relatively low content of clay minerals, which have a relatively high thermal resistance but low sintering (Těsnohlídková 2021, 253–255).

Likewise, the results of scientific analyses confirmed the correctness of the macroscopic division of pottery into graphite, sand and micaceous, which, with only a few exceptions, basically respected the results of the macroscopic description. These groups could be broken down even further, but they correlated with the macroscopic ceramic classes only in some cases (in detail in Slavíček et al. 2021). This is mainly related to the different parameters used to distinguish various categories. Here we focus mainly on the testimony of analyses of production technology.

4.2 Variability in ceramic material

The description of ceramic material focused on three basic criteria: the content of graphite and its form, the content of mica and its form and the granularity of sandy inclusions (Fig. 5). Other specific inclusions were followed.

Sandy ceramic classes are characterised by fine to medium granularity (Tab. 1). Sandy inclusions are a natural component of the ceramic material, apparently 'brickmaking' (non-loess) clay. The intentional addition of sandy temper was documented in some of the analysed samples (Slavíček et al. 2021). A small to medium inclusion of fine mica can be distinguished, though it is highly likely that it is also a natural component of the ceramic material. Although these classes do not contain macroscopically discernible graphite, a certain graphite component or uncombusted organic inclusions can be present. CC 5 is the only ceramic class in the assemblage that also includes surface treatment (glazing). The fabric is fine, with a low content of fine mica and without a graphite inclusion.

The ceramic material of graphite classes contains a medium to large amount of graphite with or without macroscopically observable grains (Tab. 1). It contains natural mica, in smaller or larger amounts. Nevertheless, even in the case of a higher amount of fine mica, this is most likely not an intentional inclusion. A medium granularity of the ceramic material is dominant. Analyses revealed grog in samples of CC 9, 10 and 13 (Slavíček et al. 2021).

Micaceous pottery classes 6 and 7 can be evaluated as medium-grained without graphite or with a graphite component or a small amount of graphite and with a medium to large amount of mica flakes (size around 2 mm); they are only differentiated by their firing (Tab. 1). The last ceramic class, CC 8, is characterised by a high amount of coarse mica, which can cause the fabric to crumble.

The ceramic material of storage vessels (CC 11) can be characterised as coarse-grained with a natural content of mica and a high content of graphite, including grains (Tab. 1). A temper in the form of red clumps with a size of 1–5 mm was described for some storage vessels in CC 11. These were ferrous clayey grains that occur commonly in clay. Others contained a high amount of coarse mica. One analysed sample contained a macroscopically unidentified slag inclusion (Slavíček et al. 2021).

4.3 Forming technology

4.3.1 Traces on vessel bodies

Production traces were visible on 636 inner walls of fragments (i.e. 17% of the total number of body fragments). Traces related to the thinning of walls were described on 48 fragments. Production defects related to the forming of the vessel body were not identified. The number of traces on sandy, micaceous and graphite pottery roughly corresponds to the ratio of these classes at the site. Traces documenting the forming technique were preserved on only a small number of storage vessel fragments.

On 298 fragments, this involved traces documenting the presence of coils; on 233 fragments, these were traces documenting the use of fast rotation; and on 105 fragments, there was a combination of traces documenting coils and fast rotation (Fig. 6). It is only possible to assign 105 fragments with certainty to the technique of a lower degree of wheel forming with the use of fast rotation, though the coils are not entirely smoothed out. We can assume that at least some of the fragments where only evidence of coils or only traces of rotation were described will also belong to pottery produced using the profiling turning technique. Moreover, it is possible to count on the use at the site of slower rotation to turn vessels from coils as well as the formation of vessels from one piece of clay using rotational kinetic energy or combining multiple techniques on one vessel.

Traces documenting the use of fast rotation slightly prevailed among sandy pottery (44%); the number of fragments with evidence of coils was somewhat lower (40%), while in the remaining cases (16%) a combination of traces of coils and fast rotation was documented, i.e. a lower degree of profiling turning (Tab. 2–4).

Ceramic class 1 can be regarded as probably wheel-thrown; of the 13 described marks, 12 document fast rotation (grooves, rings) and only one could be related to the presence of coils in the wall of the vessel (depressions). As such, this class differs from the other sandy classes in the forming technique.

In CC 2, there is a predominance of fragments documenting the use of coils in combination with rotation (24 from a total of 60 case), followed by evidence of coils (20 fragments) and the

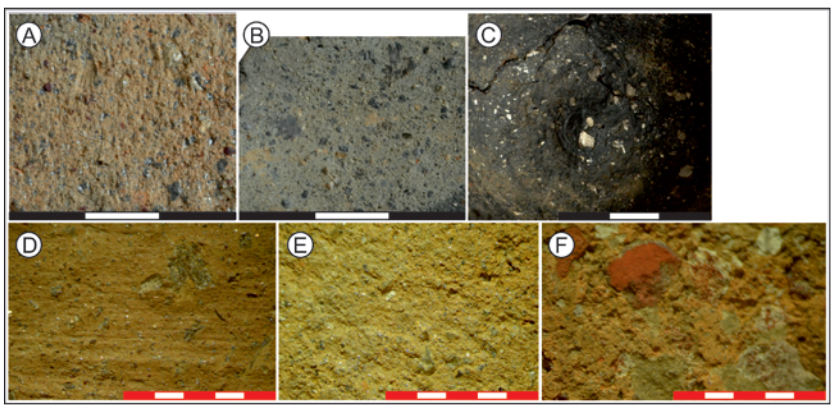


Fig. 5. Examples of characteristic nonplastic inclusions in the ceramic material of pottery from Žďár nad Sázavou – Staré město. A – Shiny grains of graphite; B – matte grains of graphite; C – flakes of mica; D – sandy pottery with visible fragments of rock and mica; E – fine quartz and graphite; F – likely ferrous temper in fabric of storage vessel. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 5. *Příklady charakteristických neplastických příměsí v keramické hmotě na keramice ze Žďáru nad Sázavou – Starého města. A – Lesklá zrna grafitu; B – matná zrna grafitu; C – lupínky slídy; D – písčitá keramika s patrnými úlomky hornin a slídou; E – jemný křemen a grafit; F – patrně železité ostřivo v zásobnici. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

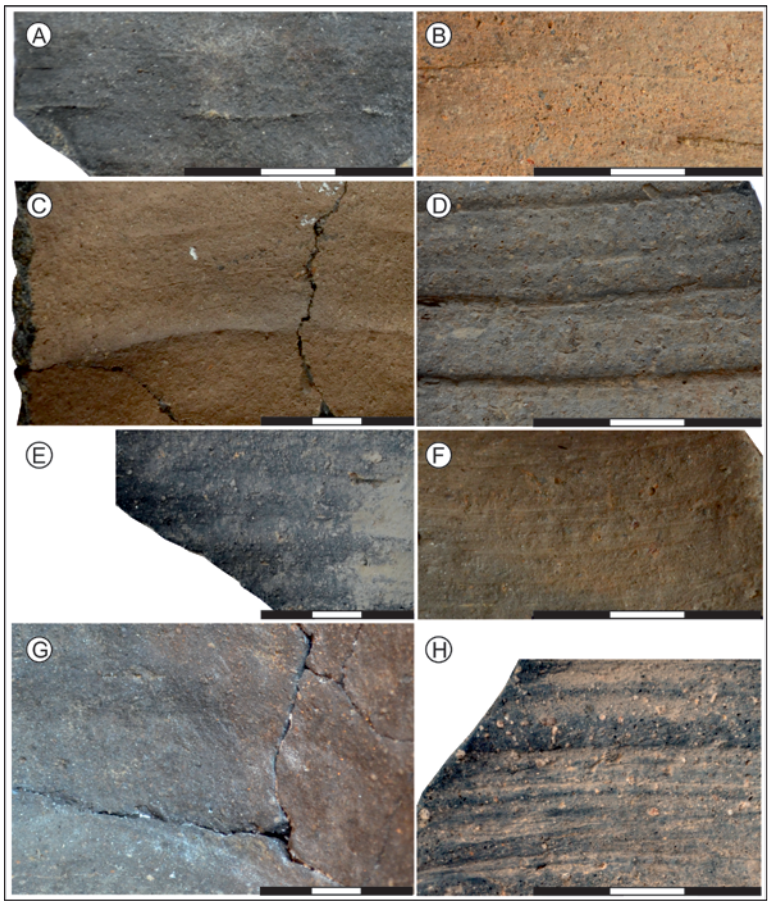


Fig. 6. Characteristic traces from forming on the inner walls of vessels from Žďár nad Sázavou – Staré město. A–D – Various manifestations of coil evidence, depressions, lines and dents; E – rings and grooves; F – even wall and grooves from papillary lines or tools; G – traces of squeezing, depressions and dents from coils in the lower part of the vessel; H – thinning of the wall in the lower part under slow rotation/'lathe-like' turning. Photo by K. Těsnohlídková (scale in cm).

Obr. 6. *Charakteristické stopy po formování na vnitřních stěnách nádob ze Žďáru nad Sázavou – Starého města. A–D – různé podoby dokladů válků, deprese, linie a prohlubně; E – prstence a drážky; F – rovnoměrná stěna a drážky po papilárních liniích či nástroji; G – stopy vymačkávání, deprese a prohlubně po válcích ve spodní části nádoby; H – zeslabování stěny ve spodní části pomocí ořezávání při pomalé rotaci/soustružení. Foto K. Těsnohlídková (měřítko v cm).*

CC	Total	Depressions	Depressions + dents	Depressions + lines	Depressions + dents + lines	Lines	Irregular decreases	Dents	Vacuoles
1	1	1							
2	20	11				6		1	2
3	89	43		1		29		12	4
4	5	4				1			
12	2	2							
8	1					1			
9	48	19	1			5	2	20	1
10	45	16	2		1	13		10	3
13	85	17		1	1	15	3	47	1
11	2	1				1			

Tab. 2. Marks documenting the presence of coils in the body of vessels in individual pottery classes. Yellow – sandy classes (light – fine-grained, dark – medium-grained); orange – micaceous classes; grey – graphite classes (light – fine-grained, dark – medium-grained); blue – storage vessels.

Tab. 2. *Znaky dokládající přítomnost válků v tělech nádob u jednotlivých keramických tříd. Žlutá – písčité třídy (světle – jemně zrnité, tmavě – středně zrnité); oranžová – slídové třídy; šedá – grafitové třídy (světle – jemně zrnité, tmavě – středně zrnité); modrá – zásobnice.*

CC	Total	Grooves	Grooves + temper movement	Grooves + rings + temper movement	Temper movement	Regular wall	Regular wall + grooves	Rings	Rings + grooves
1	12	11						1	
2	16	12			1			2	1
3	91	52		1	1	2	4	25	6
4	6	3							3
12	4	4							
7	18	1						15	2
8	1							1	
9	20	14			1			5	
10	20	13	2					5	
13	43	33	2	1	1			3	3
11	2	2							

Tab. 3. Marks documenting the use of fast rotation in forming vessels in individual pottery classes. Yellow – sandy classes (light – fine-grained, dark – medium-grained); orange – micaceous classes; grey – graphite classes (light – fine-grained, dark – medium-grained); blue – storage vessels.

Tab. 3. *Znaky dokládající využití rychlé rotace při formování nádob u jednotlivých keramických tříd. Žlutá – písčité třídy (světle – jemně zrnité, tmavě – středně zrnité); oranžová – slídové třídy; šedá – grafitové třídy (světle – jemně zrnité, tmavě – středně zrnité); modrá – zásobnice.*

CC	Total	Depressions/ rings	Depressions + grooves	Depressions + grooves + vacuoles	Depressions/ rings + grooves	Depressions + dents + grooves	Grooves + lines	Grooves + dents	Dents + rings	Rings + vacuoles	Vacuoles + grooves	Vacuoles + grooves + lines
2	24	2	21				1					
3	21	10	6	1	1	1	1				1	
6	1					1						
9	13	3	3				7					
10	29	3	9		10	1	3		1		2	
13	17	7	6		1			1		1		1

Tab. 4. Marks documenting the combination of coils and fast rotation in connection with pottery class. Yellow – sandy classes (light – fine-grained, dark – medium-grained); orange – micaceous classes; grey – graphite classes (light – fine-grained, dark – medium-grained).

Tab. 4. *Znaky dokládající kombinaci válků a rychlé rotace v závislosti na keramické třídě. Žlutá – písčité třídy (světle – jemně zrnité, tmavě – středně zrnité); oranžová – slídové třídy, šedá – grafitové třídy (světle – jemně zrnité, tmavě – středně zrnité).*

use of fast rotation (16 fragments). The uniform occurrence of marks and the low occurrence of rings indicate the use of various stages of profiling turning on the pottery in this ceramic class.

The largest ceramic class, CC 3, has a similar share of evidence of coils and fast rotation (91 and 89 fragments), a combination of both in 21 cases. In the case of coils, these are depressions, vacuoles, dents and lines; in the case of rotation, they are grooves and also a relatively frequent occurrence of straight walls or rings, which should document forming from a single piece of clay. In the case of CC 3, the use of different stages of profiling turning is certain, and the use of rotation for forming from one piece of clay for the whole vessel or its part can also be considered probable.

Five fragments with coils (depressions, lines) and six with traces of fast rotation (rings, grooves) were documented in CC 4, while two fragments with coils (depressions) and four with traces of fast rotation (grooves) were recorded in CC 12. As such, this would have been pottery produced by various degrees of profiling turning.

Evidence of coils predominates on graphite pottery, appearing on 56% of fragments. Traces of the use of fast rotation were found on 26% of fragments, a combination of coils with fast rotation on 18% of fragments (Tab. 2–4). A highly similar ratio of these marks is found in all three graphite classes; only in CC 10 were there generally more fragments (31%) with evidence of coils and fast rotation (compared to 16% in CC 9 and 12% in CC 13).

Traces of coils were most often in the form of dents, depressions and lines, followed by vacuoles and irregular decreases in the thickness of the vessel wall and the combination of 2–3 of these marks. In terms of evidence of the use of fast rotation, these were most often grooves, in several cases also rings and the displacement of temper or a combination of these marks. With respect to marks documenting the presence of coils and the use of fast rotation, these were depressions, lines, vacuoles or dents in combination with grooves, in rare cases dents or vacuoles in combination with rings or marks on the border between depressions and rings.

As the range of traces on graphite pottery was the most variable, it is possible to count on less stable forming techniques and a higher share of turning and lower degrees of profiling turning, during which the coils are not rubbed away to such an extent by fast rotation. Unlike sandy pottery, the technology used to form graphite ware can be described as more archaic.

Dominating micaceous pottery classes are traces documenting its turning with fast rotation (rings, grooves and their combination; Tab. 2–4). Evidence of forming was present on 21 fragments, of which 18 belonged to CC 7. Lines described in one case could document coils, while one questionable case was classified under rings/depressions. Based on these marks, it can be assumed that micaceous pottery was produced by turning a single piece of clay. Given its low representation at the site, it is possible to consider the theory that it is not a local product or is more technologically advanced ware. Scientific analysis confirmed that the provenance of the ceramic material differed from the other pottery groups (Slavíček et al. 2021).

A small number of traces are preserved on storage vessels. Marks related to the presence of coils – depressions and lines – were described in two cases, in another two grooves testifying to the use of a faster degree of rotation.

Depressions and rings occurring over the surface and which can therefore not overlap or accompany one another are conclusive marks for differentiating pottery from coils (without distinguishing whether this involved turning or profiling turning) and wheel-thrown pottery from a single piece of clay. These marks were positively identified on 246 fragments. The ratio of pottery produced from coils and wheel-thrown vessels from a single piece of clay was roughly 70 : 30 for coarse sandy pottery and 80 : 20 for graphite pottery. Micaceous pottery could then be attributed to the technique of wheel-thrown vessels from a single piece. Depressions from coils were identified on only one storage vessel.

Traces of the secondary thinning of walls were documented on the lower parts of the inner walls in the sandy and graphite pottery classes. More of these traces occurred in classes with medium granularity than those with a fine-grained fabric. Three marks were described and the frequency of their representation in the assemblage on 48 fragments does not rank them among commonly used techniques. Traces of squeezing with the intention of thinning and lightly expanding the lower parts of vessels (10 cases of sandy pottery and 19 of graphite pottery) were found on 29 fragments. Based on accompanying marks from the primary forming, the technique can be connected with a lower degree of profiling turning. 'Lathe-like' turning was described in 17 cases, i.e. shaving the inner wall of the final pottery form with the aim of thinning at slow rotation (of which 13 were cases on sandy pottery, four on graphite pottery). Traces of eversion under slight rotation were documented on two fragments of sandy pottery.

4.3.2 Traces on the bottoms of vessels

Traces of formation on bottoms were identified on 172 fragments (i.e. 39% of fragments of all bottoms). They were observed at three locations (inner – 67 cases, outer side – 86 cases, transition from body to bottom – 70 cases). Their mutual occurrence, link to traces on vessel walls and connection to pottery classes were recorded.

Most often encountered on the inner sides of bottoms are rings, which are preserved in the greatest numbers on graphite pottery. The second most frequent mark is a *navel* in the middle of the bottom, which occurred most often on the bottoms of

CC	Grooves	Incisions	Circle	Slightly rippled	Rings	Rings + grooves	Navel	Navel + grooves	Scroll	Dents
1			1							
2				2						
3	1	2	1	3	2		9		4	1
4					3				1	
7					4					
8							1			
9		2			2		1	1	5	
10	2		1	1	9	1				
13		2			2	1			1	
11					1					

Tab. 5. Preserved macroscopic traces of forming on the inner sides of vessel bottoms. Yellow – sandy classes (light – fine-grained, dark – medium-grained); orange – micaceous classes; grey – graphite classes (light – fine-grained, dark – medium-grained); blue – storage vessels.

Tab. 5. *Dochované makroskopické stopy po formování na vnitřních stranách den nádob. Žlutá – písčité třídy (světle – jemně zrnité, tmavě – středně zrnité); oranžová – slídové třídy; šedá – grafitové třídy (světle – jemně zrnité, tmavě – středně zrnité); modrá – zásobnice.*

medium-grained sandy pottery. Both of these marks belong to bottoms made from a single piece of clay with the use of rotation, as do other marks occurring in smaller numbers: grooves, incisions, circle, slight rippling, the combination of rings with grooves and a navel with grooves. Appearing in several cases are scrolls, which are also apparently related to production from a single piece of clay; however, the winding of the bottom from coils cannot be ruled out. Dents observed in one case document production or thinning of the bottom by squeezing (Tab. 5).

Marks from the outer side of the bottom are related to the type of forming device and the method of placing the clay on it (Tab. 6). The most common mark is a potter's mark. Here we deal only with their technological side (on their significance, e.g. Varadzin 2005). The negative relief of the potter's mark in the surface of the forming device created a positive relief imprint on the vessel. As such, the bottom was not attached completely firmly to the device surface during the production of the vessel or was removed, e.g. after the partial drying of the vessel. Of the 30 cases of preserved potter's marks and their parts, five belonged to bell-shaped lids, while the other cases most probably involved the bottoms of pots. Potter's marks were present on sandy pottery in 16 cases, on graphite pottery in 14 others. The motifs are similar in both groups, though the potter's marks are preserved only in fragmented form in the majority of cases; the motifs cannot be determined in a third of cases (summary of motifs in Těsnohlídková 2021, tab. 50).

An imprint of the wooden surface was preserved in 14 cases (Tab. 6). It can be deduced from this potter's mark that the bottom was not cut off from the surface of the forming device in any special way, since the structure of the imprint would not be preserved; the vessel may have been removed from the surface after partial drying.

The dusting of the board was clearly documented on seven fragments (Tab. 6) and was to have been evidence of the turning of the vessels from coils or profiling turning of lower degrees, since an incompletely attached bottom prevented the full use of rotational kinetic energy. Although domestic and foreign literature has addressed this mark with the use of experimental pottery, its interpretation for high medieval production still remains partly unexplained. Although original opinions attributed it with confidence to turned pottery, its possible use in profiling turning was later accepted and experiments also point to its possible use with wheel-thrown pottery. New information could come from the processing of assemblages of intact dusted vessels with a detailed analysis of technological traces supported by ethnographic and experimental data (e.g. Nekuda, Reichertová 1968, 37; Richter 1982, 97; Procházka 2007, 245; Orna et al. 2011, 67–75; Bočková et al. 2014, 124–128; Roux, Courty 1998, 748–749; Roux 2009, 197–198).

CC	Potter's mark	Impression of wooden board	Dusting
1			
2	2		
3	12	6	4
4	2		
6			
7			
9	1		
10	3	8	2
13	10		1

Tab. 6. Preserved macroscopic traces of forming on the outer sides of vessel bottoms. Yellow – sandy classes (light – fine-grained, dark – medium-grained); orange – micaceous classes; grey – graphite classes (light – fine-grained, dark – medium-grained).

Tab. 6. *Dochované makroskopické stopy po formování na vnějších stranách den nádob. Žlutá – písčité třídy (světle – jemně zrnité, tmavě – středně zrnité); oranžová – slídové třídy; šedá – grafitové třídy (světle – jemně zrnité, tmavě – středně zrnité).*

As the described marks appeared in a similar ratio on sandy and graphite pottery, the use of the same forming device can be assumed for both. No traces are documented on the outer sides of the bottoms of micaceous pottery. The described marks document that the bottoms were not firmly attached to the surface of the forming device and subsequently cut off; they were either dusted or removed even despite full attachment by pulling from the board after production or partial drying. The conclusions of experimental pottery production should be mentioned here, namely that ceramic material corresponding to 13th-century pottery has different properties during forming than the clay used today to throw pottery (Těsnohlídková 2021, 111). Similar evidence comes from intact pot bottoms from a pottery kiln batch at the site investigated in 2006 showing a stronger representation of dusting in combination with traces of the attachment and removal of the vessel from the edges of the bottom.

A slight border, a coil above the bottom or evidence of the gluing of the bottom could be found at the transition from the bottom to the body. Borders were linked to sandy and graphite pottery. A distinctive coil above the bottom was observed in all three groups. A glued bottom appeared most often on micaceous pottery; it occurred on sandy and graphite pottery in only one case (Tab. 7). These three marks cannot be attributed to a specific forming technique. The border is apparently related to the method of attaching the bottom to the surface of the forming device. In many cases, a coil above the bottom documents the use of coils to build the walls of the vessel with supplemental forming with slow or fast rotation, though it could also have been created during turning from a single piece of clay as a reinforcing segment for the vessel body. A glued bottom could also be related

CC	Border	Border + coil above bottom	Coil above bottom	Glued bottom
2			1	1
3	8	3	11	
4	3		2	
7			4	2
8			1	1
9	1	1	5	1
10	4		6	
13	4	2	9	

Tab. 7. Preserved macroscopic traces of forming on the transition from the bottom to the body. Yellow – sandy classes (light – fine-grained, dark – medium-grained); orange – micaceous classes; grey – graphite classes (light – fine-grained, dark – medium-grained).

Tab. 7. *Dochované makroskopické stopy po formování na přechodu dna a těla. Žlutá – pískové třídy (světle – jemně zrnité, tmavě – středně zrnité); oranžová – slídové třídy; šedá – grafitové třídy (světle – jemně zrnité, tmavě – středně zrnité).*

to a production defect: after supplemental forming, the bottom was too weak or damaged after removal from the board and was therefore cut off and a new one was inserted.

The heavily fragmented assemblage made it possible to follow combinations of production traces on the bodies and bottoms of vessels in a relatively limited number of cases – on only 45 potsherds. This small sample is not conducive to strong conclusions and its size is not large enough for any more detailed analyses. During the future processing of intact vessels from the site, it could perhaps serve as a comparative sample (in detail in Těsnohlídková 2021, 226–227).

4.4 Firing technology

No connection between any of the basic groups – sandy, micaceous or graphite – and the specific type of firing was observed (Fig. 7, Graph 4). There is a broader range of firing with sandy and micaceous pottery, which can also be subjected to oxidation firing. Oxidising biscuit firing of one or both surfaces is predominant in all three groups (i.e. an oxidation fired layer on dark ceramic fabric), and other variants also occur, testifying to mixed fast firing (black core, mixed firing). Reduction firing is the second most common. A larger share of reduction firing is observed on micaceous pottery, where it is used on roughly one-third of vessels. Reduction firing occurs less often on sandy and graphite pottery. The share of purely oxidation pottery is very low. The sandwich effect, false smoking or a white core appear only on several fragments of sandy and micaceous ware. The last two marks could be connected with firing at higher temperatures and appear only secondarily as a side effect of the firing (e.g. in the core).

The sandy classes include three classes with predominant reduction firing and the same number with mostly oxidation marks (Graph 5). The only class with a different composition is CC 1. It differs from the others with the highest share of purely

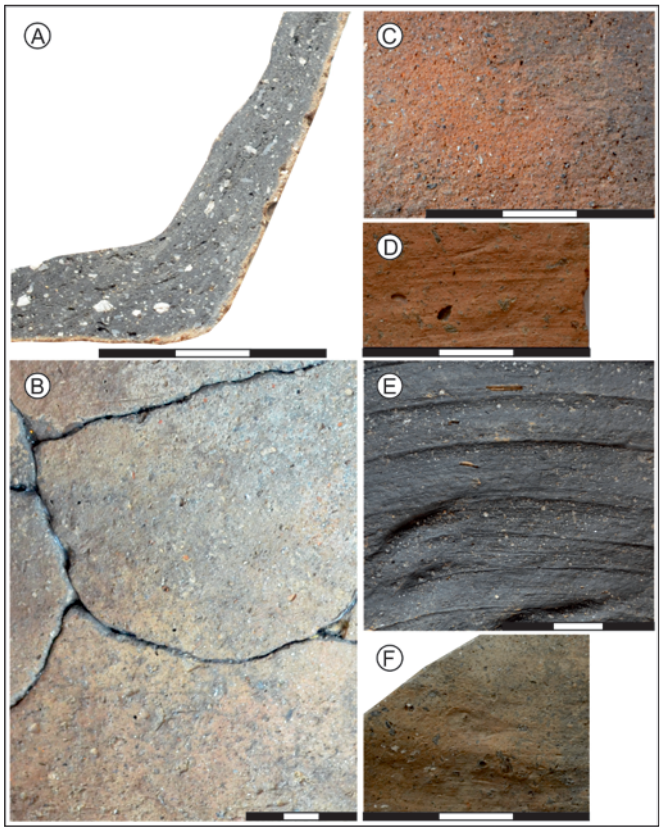
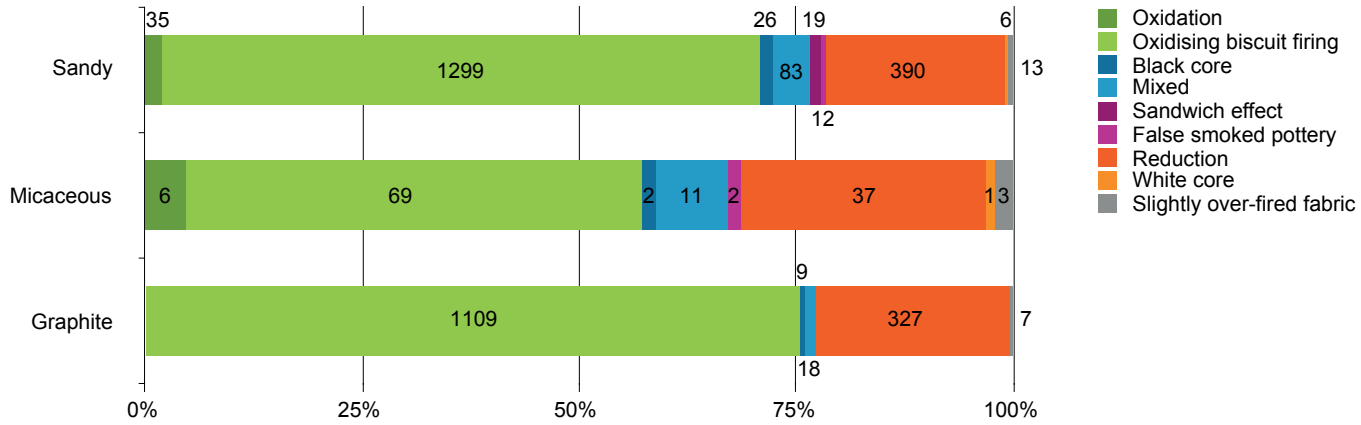


Fig. 7. Range of firing types on pottery from Žďár nad Sázavou – Staré město. A–C – Oxidising biscuit firing of surface; D – oxidation firing; E – reduction firing; F – mixed firing. Photo by K. Těsnohlídková (scale in cm).

Obr. 7. *Škála typů výpalu na keramice ze Žďáru nad Sázavou – Starého města. A–C – Oxidační přežah povrchu; D – oxidační výpal; E – redukční výpal; F – smíšený výpal. Foto K. Těsnohlídková (měřítko v cm).*



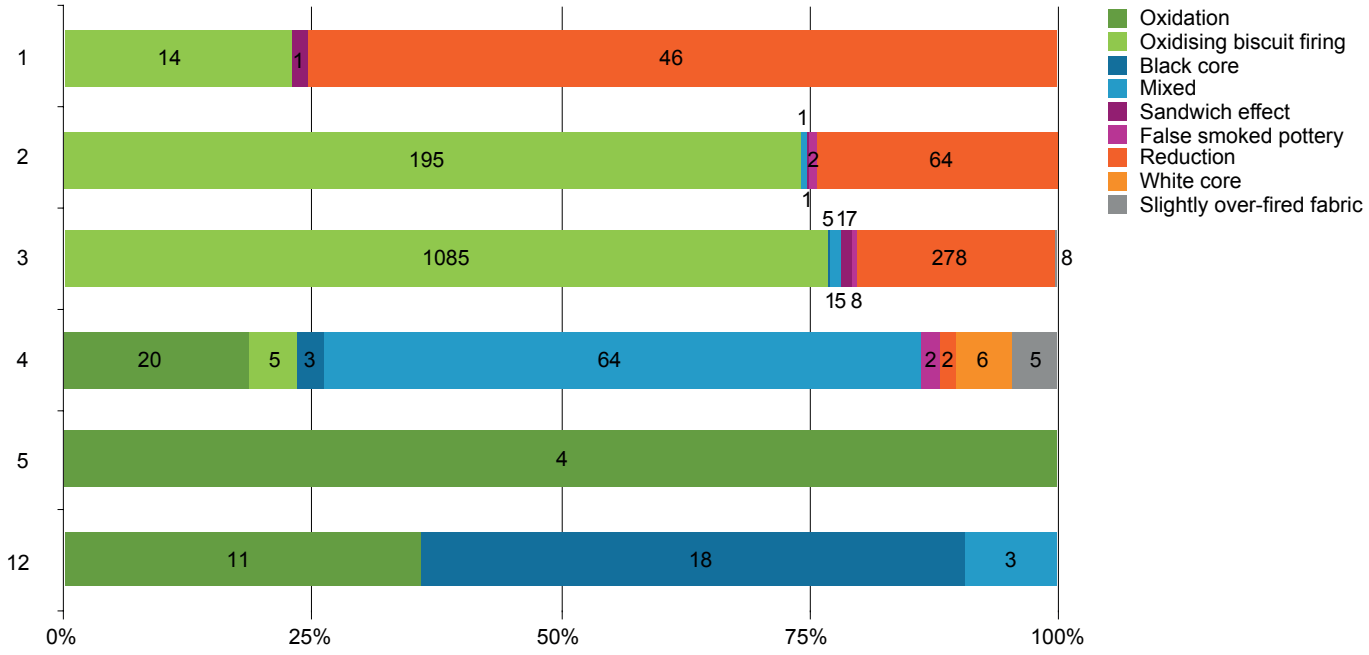
Graph 4. Range of firings in basic pottery groups.

Graf 4. *Škála výpalů u základních skupin keramiky.*

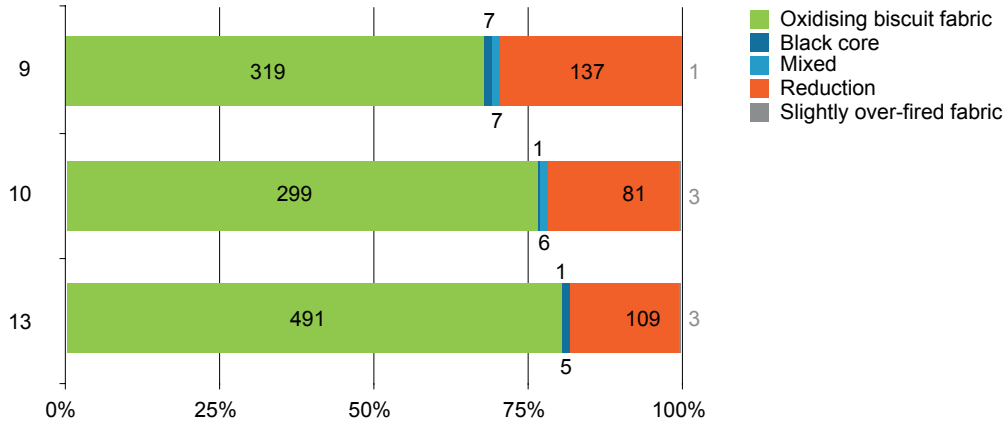
reduction pottery (over three-quarters of the assemblage) and a lower share of oxidising biscuit firing and mixed firing, and it was also different in terms of forming technology. Other sandy classes already contain the firing type in their definition. CC 2 and CC 3 represent standard local production. Due to the small size and identical characteristics of the ceramic fabric, the predominantly oxidation-fired CC 4 and CC 12 can be considered not as having a different firing technology, but that they were in exposed places during firing or secondary post-firing occurred. Exclusively oxidation firing with a light-coloured ceramic fabric was identified on glazed vessels, which were evidently imports.

In graphite classes, the relative representation of firings is similar in all three classes (Graph 6). Oxidising biscuit firing is predominant on roughly 70–80% of all fragments; 20–30% of cases have a reduction firing. A dark core, mixed firing or light post-firing is found in a small number of cases. Marks from the firing on micaceous pottery show that there is no sharp border between the reduction and oxidation class (Graph 7). Ceramic fabrics appear with transitional marks and it is apparently possible to speak in all three classes of micaceous ware of the same firing strategy which, depending on the type and occurrence of represented marks, evidently did not differ from the firing of sandy and graphite ware. A similar representation as with graphite pottery occurs among storage vessels, which were most likely fired in the same way as kitchenware (Graph 8).

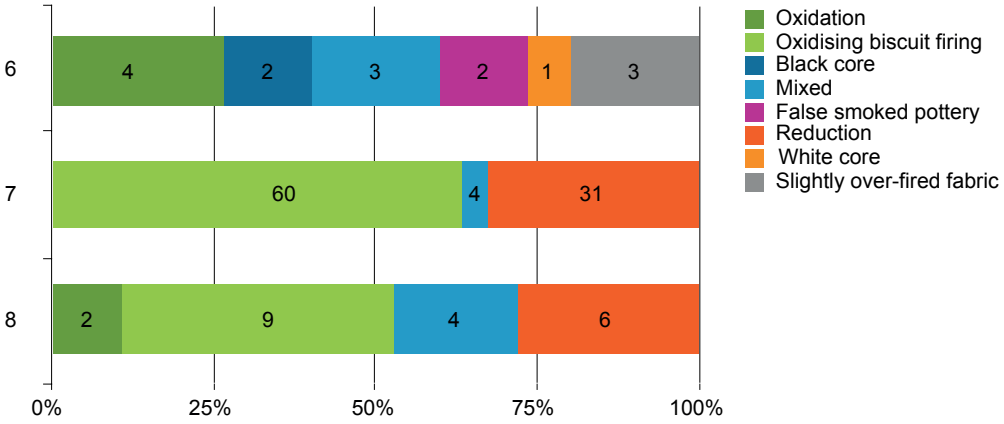
The colour of oxidising biscuit firing ranged from beige to cream, ochre, orange, red and various shades of brown. The firing colour wasn't tied to pottery classes and was probably related to the firing intensity – temperature and atmosphere. The biscuit firing was found on both sides of fragments in 50% of cases, on the outer surface in 46% of cases, on the inner surface on only 4% of fragments.



Graph 5. Range of firing in individual sandy ceramic classes.
Graf 5. *Škála výpalu v rámci jednotlivých písčitých keramických tříd.*

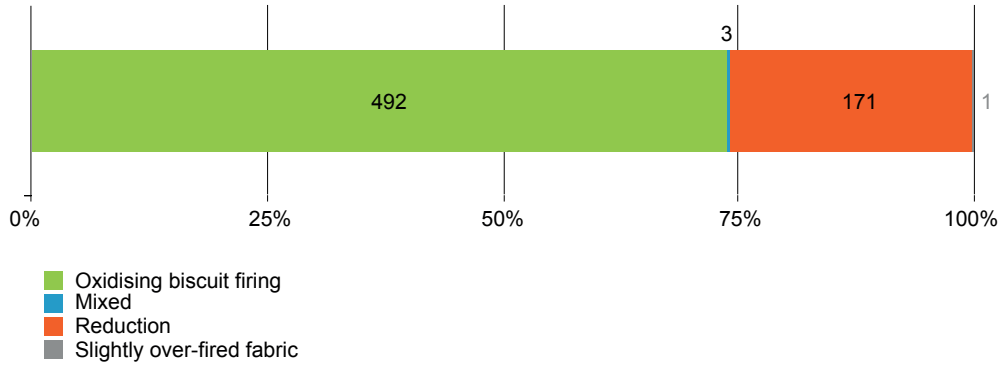


Graph 6. Range of firing in individual graphite ceramic classes.
Graf 6. *Škála výpalu v rámci jednotlivých grafitových keramických tříd.*



Graph 7. Range of firing in individual micaceous ceramic classes.

Graf 7. *Škála výpalu v rámci jednotlivých slídových keramických tříd.*



Graph 8. Type of firing on storage vessel fragments (CC 11).

Graf 8. *Druh výpalu u fragmentů zásobnic (KT 11).*

Oxidising biscuit firing documents the effects of an oxidising atmosphere in the final phase of firing. The experiments that were conducted demonstrate that its presence is linked primarily to fast firing at lower temperatures or a short duration of higher temperatures (Těsnohlídková 2021, 172–174). Nearly half of the fragments with oxidising firing only on the outer surface of fragments could be related to the placement of vessels in the kiln during firing, with the neck of the vessel being covered in some way, or with the vessels being stacked such that the necks were facing downwards, thus limiting the amount of air reaching the interior of the vessel, where the final oxidation phase thus did not occur, or the mouths of the vessels remained closed in the remaining fuel.

The even distribution of the oxidising biscuit firing on fragments from various parts of vessels and its high occurrence on storage vessels confirms that this is truly a mark resulting from firing and not, e.g. during cooking or secondary post-firing. Mainly with graphite storage vessels it is also possible to consider partial intentionality – during oxidising biscuit firing the graphite burns off the surface and the vessel does not get dirty.

The conclusions of scientific analyses supplementing firing technology information with the temperature are similar. The majority of sandy and graphite pottery was fired in the same way: reduction firing with an oxidising conclusion manifested in a light layer on the potsherd. The firing temperature was determined on a majority of samples in the 700–900°C range (graphite pottery and sandy classes 2 and 3). Some of the samples in these classes contained uncombusted biomass, which confirms a prevailing reduction atmosphere and a low firing temperature, in some cases even a graphite content, which helped maintain the reduction environment longer in the ceramic fabric. In sandy classes 4 and 12, the firing temperature was higher and reached c. 1000°C. This higher temperature could have resulted from the fragments of vessels or their parts being in an exposed location. A higher firing temperature in a context with additional marks of more advanced technology was confirmed on micaceous and glazed pottery, i.e. a temperature of around 1000°C (Slavíček et al. 2021).

Of the manifestations that can be regarded as certain firing defects, only two oblique cracks were identified in the entire assemblage (in CC 12 and 13). In several cases there were remnants of combusted grains of graphite on the surface of potsherds with an oxidising biscuit firing (KT 9 –11) and imprints of a combusted organic component on the inner or outer surface (KT 3, 9, 13).

The hardness of fragments was followed in connection with the quality of firing, and it was found that hardness was related more to the composition of the ceramic fabric than marks from firing. Soft fragments (could be scratched with fingernail) made up more than 90% of storage vessel fragments, 60% of graphite classes with grains, over 50% of crumbling CC 8 and 40% of graphite classes without grains. Ceramic fabrics with a medium hardness (could be scratched with iron) dominated (88–100%) the remaining two micaceous classes (CC 6 and CC 7) and all of the sandy classes.

4.5 Surface treatment

Surface treatment was not documented on fragments. The macroscopically described possibility of engobe on several fragments (KT 3 and KT 10) was ruled out by scientific analysis and identified as 'false' engobe or oxidising biscuit (Fig. 8a, b; Slavíček et al. 2021).

The assemblage also contained four fragments of glazed pottery with beige ceramic fabric (CC 5). These were a rim fragment from a miniature vessel (beige), the handle of possibly an alembic (yellow-brown) and an additional fragment of a rim and bottom (light green; Fig. 8c). The glaze was on the inner part of the vessels in all cases. With the use of a pXRF device, the glaze on the potsherd from the alembic was determined to be a lead glaze with an admixture of sulphur (Slavíček et al. 2021).

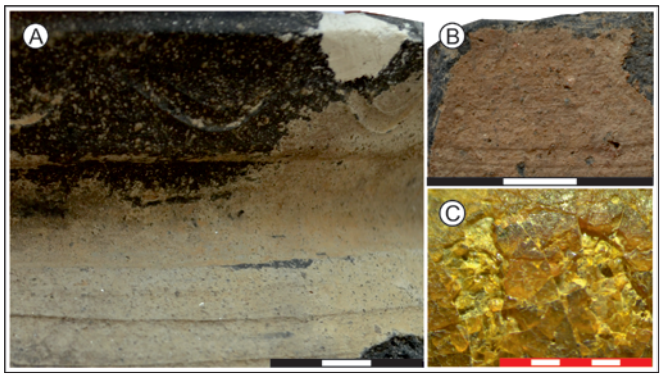


Fig. 8. Evidence of the surface treatment on pottery from Žďár nad Sázavou – Staré město. A, B – Cases of 'false' engobe; C – detail of lead glaze containing sulphur. Photo by K. Těsnohlídková (black scale in cm, red scale in mm).

Obr. 8. *Doklady povrchových úprav na keramice ze Žďáru nad Sázavou – Starého města. A, B – Případy tzv. nepravé engoby; C – detail olovnaté glazury s obsahem síry. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

4.6 Evidence of the use of vessels and post-depositional processes

The main evidence of use was carbonised food remnants (a dark coating) on vessels, which were found on 55 fragments of kitchen pottery (Fig. 9). These were 34 fragments of pots, one miniature vessel and 20 potsherds that could not be identified more closely. The traces occurred on the rims and necks of vessels (29 cases) on the inner side of the body (17 cases) and on the inner sides of vessel bottoms (9 cases). The occurrence of this mark on storage vessels is unusual in that their use in the heating of food is not commonly assumed (in 48 cases – 41 on the inner side of the body, 6 rims and 1 bottom). More detailed analyses would be needed to determine if the mark was related to the use of the storage vessels or to post-depositional processes.

The analyses below provide proof of this. It needs to be reformulated, as the use of these vessels in heating food is not considered, but the mark could be a secondary trace associated with post-depositional processes.

Other possible traces related to the use of pottery vessels included hairline cracks on the inner side of a CC 13 vessel, which could be related to cooking.

In collaboration with J. Pavelka (Department of Archaeology in the Faculty of Philosophy and Arts and the Centre of Biology, Geoscience and Environmental Education at the University of West Bohemia), analyses of food macro-remains were conducted on seven samples of pots and two storage vessels. Analyses for casein, gliadin (cereals), proteins, cow milk and lipids were performed. Detection was based on tests for the analysis of food allergens and mass spectrometry (Pavelka et al. 2016, 25–35). Only on two samples from fragments of pots was it possible to demonstrate traces from the cooking of meat; the other samples were negative or contaminated with manure (Pavelka 2019).

Evidence of the secondary repair of broken vessels was found on 16 fragments, of which 14 cases involved repair holes bored on storage vessels (7 fragments, in 2 cases with a metal clip), pots (2 fragments) and on a miniature vessel (1 fragment). This perforation of lids (3 fragments) could have been related to the release of steam.

The recycling of broken vessels was documented in three cases – a low bowl created by grinding the edges of an apparently broken CC 3 pot and two disks with a perforation (diameter 30 mm, hole 5 and 6.5 mm) made by grinding the edges of the body of decorated and undecorated CC 3 vessels. These disks could have been used, e.g. as spindle whorls or buttons.

The categories of the coarseness of the surface and abrasion of fragments are also closely related to post-depositional processes. Both were determined using generally applied criteria (Čapek, Těsnohlídková 2020, 81; Procházka 2007, 241). They are also related to the characteristics of the ceramic fabric and the quality of firing, and they could reflect the use of the vessels. The surface could also have been damaged during the washing of the pottery in the course of laboratory processing.

Specific marks that can be connected with post-depositional processes were described on 36 fragments. Most often this involved post-firing on the fractured edges of fragments documenting the presence of the fragment in the fire (heating, blaze...). Post-firing was identified in 31 cases. A light stage of over-firing was observed in four cases. In one case, traces of rust on the outer side of a fragment are apparently related to the proximity of a metal artefact in the find context. Of the other marks influenced by post-depositional processes, the surface coarseness and abrasion of fragments were also followed. In this case, these categories reflected more the composition of the ceramic fabric and the quality of the firing and testify less to the find context.

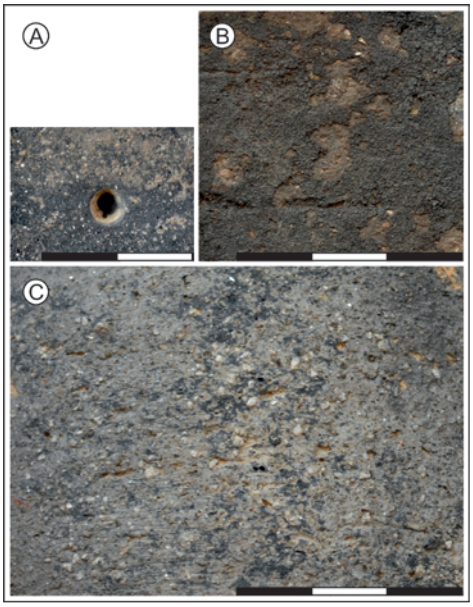


Fig. 9. Traces related to the use of vessels and post-depositional processes on pottery from Žďár nad Sázavou – Staré město. A – Secondary perforation in lid; B – organic carbonised food remnants on vessel walls; C – worn surface. Photo by K. Těsnohlídková (scale in cm).

Obr. 9. *Stopy související s používáním nádob a postdepozičními procesy na keramice ze Žďáru nad Sázavou – Starého města. A – Sekundárně vyvrtaný otvor v poklici; B – organické příškvarky na stěně nádoby; C – omletý povrch. Foto K. Těsnohlídková (měřítko v cm).*

4.7 Provenance

Based on the petrographic composition of pottery, the provenance of defined groups of ceramic fabrics were followed (in detail in Slavíček et al. 2021). The main sources of information were used to analyse samples of clay from four locations by surrounding watercourses and the geological map.

Graphite and sandy pottery verifiably used local sources. The composition of graphite pottery corresponds to the geological subsoil of the site located in the 'variegated series' of the Strážov Moldanubian Zone, which is also documented by concurrence with the rock types of sandy Sázava sediment, which represents transported material from the area north of Žďár. Although lenses of graphitic rock are relatively common for the variegated series of the Moldanubian Zone, their occurrence is not yet proven directly in the immediate vicinity of Žďár. The composition of the sandy pottery corresponds to the granitoid subsoil near the site, which runs from the western edge of Žďár nad Sázava all the way to the Sázava. It is possible to expect more granitoid grains in the Sázava river sediment in Hamry nad Sázavou and further downstream. Additional nearby outcrops of granitoid rock are found to the north, upstream of the Sázava near Polnička. The fine granularity of the glazed pottery does not permit an interpretation of the provenance based on petrography (Slavíček et al. 2021).

The distinct fabric of micaceous pottery points to a possible origin near the Svratka Crystalline of the Kutná Hora – Svratka area, which is located in a strip from Škrdlovice through Cikháj, Fryšava pod Žákovou horou and further to the east and south, i.e. in a radius of at least 8 km northeast of the site. It is possible here to consider the import of raw material or finished vessels from another site. Micaceous pottery has a different technology than sandy and graphite pottery. A macroscopic description almost exclusively captured traces of wheel-thrown pottery and marks connected with firing are slightly different, including higher firing temperatures in general. Given the short existence of the site, the different production technology could suggest that these were vessels made at a different centre. On the other hand, the source is not so distant that the production of micaceous pottery can be ruled out, e.g. in the final phase of the settlement's existence. The further study of pottery in the region could help shed light on this issue (Slavíček et al. 2021).

5. Pottery morphology

The pottery form to which potsherds belonged was directly determined for 1,857 fragments. Of the identifiable fragments, 60% of the assemblage was pots, 33% storage vessels, and roughly 5% bell-shaped lids. No other form exceeded 1% with the number of fragments in the assemblage (Fig. 52). The high share of storage vessels is also a result of the fact that all of the characteristic fragments have the vessel body. With standard kitchenware, neither the actual vessel body nor the bottom were automatically attributed to pots, despite the fact that the absolute majority of fragments actually belong to this form. In this case, the share of pots would rise to 82%, with a concomitant decrease in the share of other types of vessels – storage vessels to 15% and bell-shaped lids to 2%. Miniature vessels, flat lids, flagons with stirrup handles, flasks, bowls and apparently an alembic represent less than one percent (i.e. several fragments). Technical pottery included tuyères related to iron production at the site (these were not included in the processing).

Rim type in combination with pottery class and quantification using estimated vessel equivalent (EVE) were used to express the minimum number of vessels in the assemblage. Based on rims, the minimum number of vessels was established at 266. Pots were represented by a minimum of 236 individuals (127 from sandy pottery classes, 98 graphite and 11 micaceous); there were also at least 14 bell-shaped lids, six storage vessels, four flat lids, two miniature vessels, one jug, one flagon and two individuals in the flask/jug/flagon category.

This representation can be compared with the results of the evaluation of pottery from the site from earlier excavations, where R. Zatloukal reports from the total number of fragments 82% pots, 8% storage vessels, 4% bell-shaped lids and 2% beakers. Other forms make up less than 1% – flagons, jugs, flat lids, bowls and small lamps; a pan on feet, an aquamanile and a ceramic horse figurine were represented by a single fragment (Zatloukal 2000, 88–113). The difference in the occurrence of bowls is apparently the result of the fact that these are forms with broadly bell-shaped mouths that could also be classified among bell-shaped lids. Several intact vessels from additional excavation seasons, including the excavation of a well and a pottery kiln, were included in the summary of forms.

5.1 Pots

The highly fragmented assemblage with a single intact vessel is not optimal for a general evaluation of pot forms and dimensions (Fig. 10–12). A review of all pottery assemblages from the site and the processing of intact vessels and those in a better state of preservation would be ideal for creating a detailed typology and more precise pot metrics. Although R. Zatloukal proposed a basic typology of pots at the site, it cannot be used for this assemblage (Zatloukal 2000, 102–104).

5.1.1 Forms and dimensions of pots

Pots were dominated by those with a neck diameter of 120–140 mm and 140–160 mm, with both categories having a 28% share of these vessels. Pots with diameters of 160–180 mm (18%), 180–200 mm (9%) and small pots with a rim diameter of 100–120 mm (13%) also had a higher representation.

It was only possible to compare the diameters of pots in the sandy and graphite group; those with a micaceous fabric lacked sufficient representation. Among pots with a sandy fabric, nearly 50% are in the group with a rim of up to 140 mm; only 26% of graphite pots fall into this group. Among pots with a sandy fabric, 27% have rims with a diameter of 140–160 mm, whereas this figure among graphite pots is 30%, i.e. their share is nearly equal. A total of 23% of pots with a sandy fabric are larger vessels with a diameter over 160 mm, while 44% of graphite pots are in this group. As such, in general more pots with a greater diameter were made from a graphite fabric than from a sandy fabric. Pots with a micaceous fabric evidently had smaller necks. The diameter could be determined in only 12 cases, half of which had a diameter of 120–140 mm, a quarter 140–160 mm, and in two cases the diameter was either greater or smaller than these two ranges.

In terms of other dimensions, it was possible in a greater number of cases to record the height of the mouth of the vessel, from the transition of the neck and the body to the edge of the vessel. Nearly a third of the vessels had a mouth height of 30 mm. This dimension was higher in 32% of cases (9% 31–35 mm, 14% 36–40 mm, 6% 45 mm), lower in 35% of cases (21% 25–29 mm, 11% 20–24 mm). We do not have a sufficiently more representative sample to determine the dependence on pottery groups, but the results show a slight tendency of graphite pottery to have a lower vessel mouth height.

The diameter of the bottoms of pots was most frequently (38%) in the 100–120 mm range, while another 28% were 120–140 mm. These categories are followed by smaller bottoms with a diameter of 80–100 mm (19%) and a larger diameter of

140–160 mm (11%). Pots with the same bottom size were represented among sandy and graphite fabrics. Significantly fewer graphite vessels had a small bottom diameter. A total of 71% of identified bottoms of sandy fabric belonged to pots with bottoms up to 120 mm, whereas only 47% of those with a graphite fabric belonged to this category. This is similar to the situation with rims, where graphite pottery had a greater occurrence among vessels with a larger rim diameter. Micaceous bottoms could be measured in only 11 cases, suggesting that a higher share of pots with a larger flat bottom were made with a micaceous fabric.

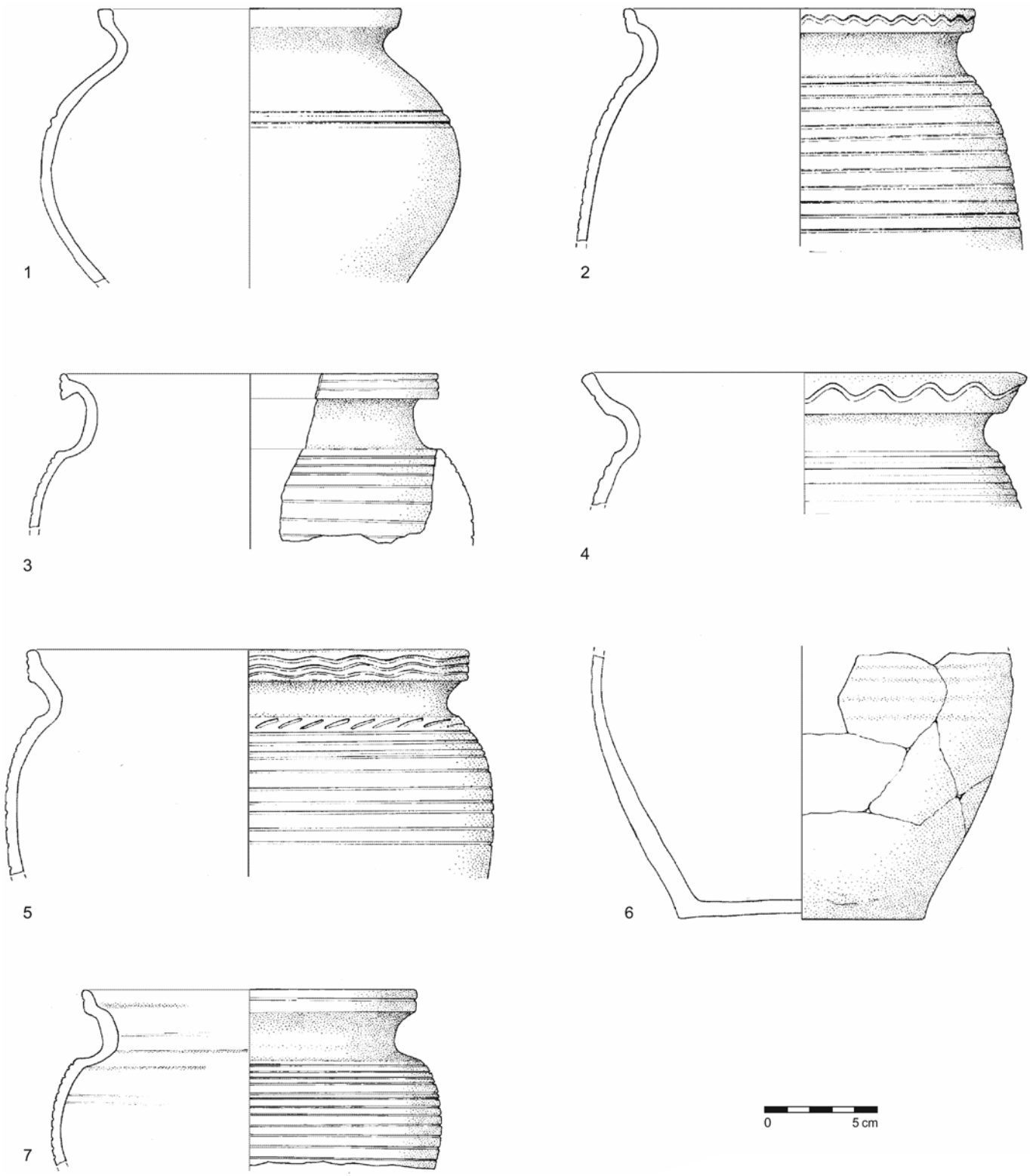


Fig. 10. Pots with material from ceramic class 3 from Žďár nad Sázavou – Staré město (Inv. No.: 1 – 70/04-10/16; 2 – 50/05-206/17; 3 – 70/04-234/7; 4 – 70/04-117/1; 5 – 70/04-252/186; 6 – 70/04-252/239; 7 – 70/04-312/1). Drawing by S. Plchová.

Obr. 10. *Hrnce keramické třídy 3 ze Žďáru nad Sázavou – Starého města (Inv. č.: 1 – 70/04-10/16; 2 – 50/05-206/17; 3 – 70/04-234/7; 4 – 70/04-117/1; 5 – 70/04-252/186; 6 – 70/04-252/239; 7 – 70/04-312/1). Kresba S. Plchová.*

In the case of pots, the mouth curve, the neck curve and the method of offsetting the neck at the shoulder were also followed (Těsnohlídková 2021, příloha 23). In 51% of cases, the neck curve was S-shaped, in 47% of cases segmented concave, while the other types appeared only rarely. A concave curve dominated among necks (90%), while the share of funnel-shaped and rounded necks approached 5%. The differences between pottery groups here were slight, and perhaps it can only be said that a rounded bottom was typical for pots with a sandy fabric. The offset of necks and shoulders of pots was described – in 50% of cases fluid, in 28% rounded, 21% with a break and only in one case by a rib. Vessels with a sandy fabric most often had a fluid

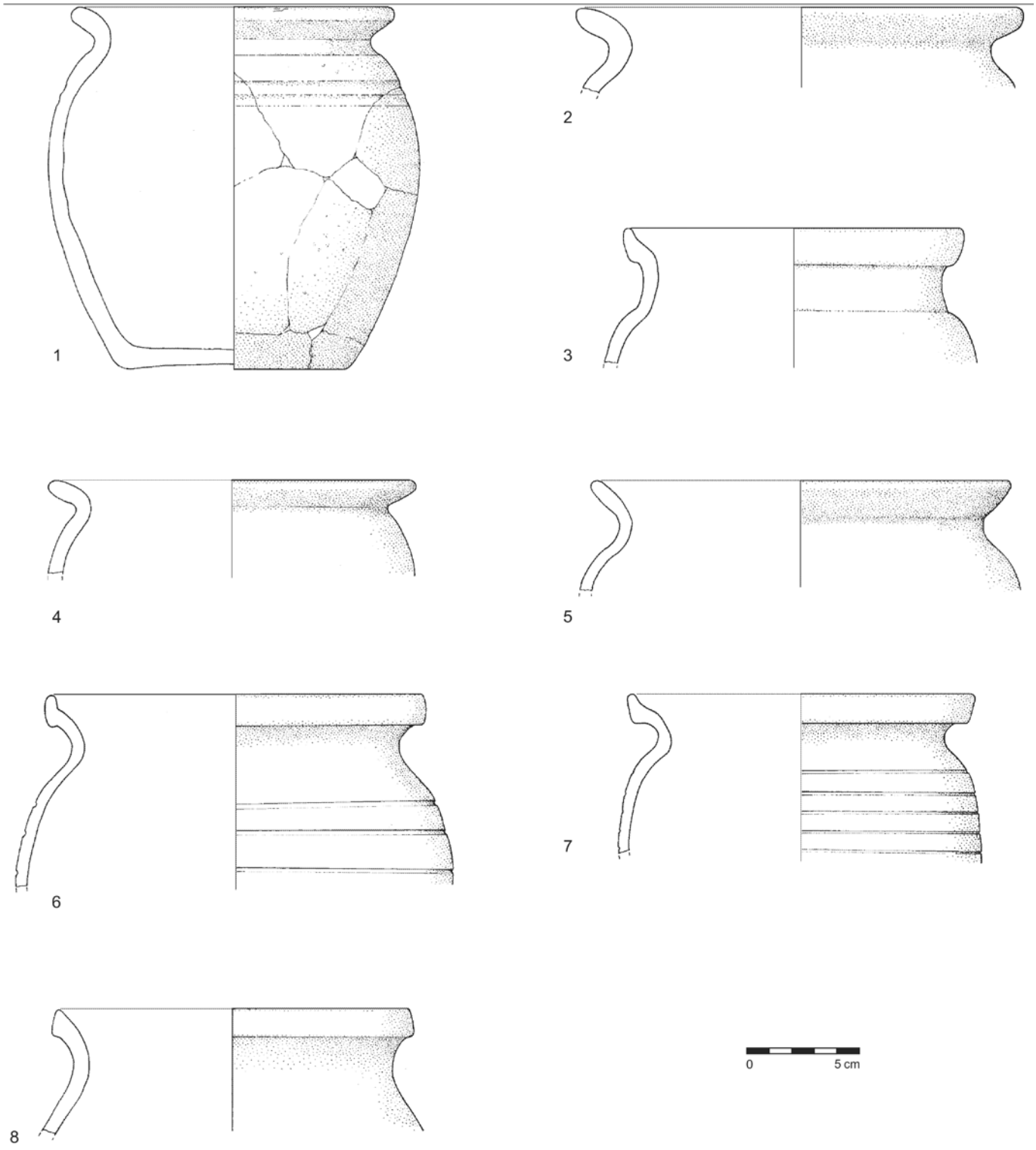


Fig 11. Pots with material from ceramic classes 9, 10, 12 from Žďár nad Sázavou – Staré město. 1–3 – CC 9; 4–6 – CC 10; 7, 8 – CC 12 (Inv. No.: 1 – 70/04-784/1; 2 – 50/05-252/29; 3 – 70/04-252/10; 4 – 70/04-252/184; 5 – 70/04-124/7; 6 – 70/04-234/8; 7 – 70/04-154/4; 8 – 70/04-154/5). Drawing by S. Plchová.

Obr. 11. *Hrnce keramických tříd (dale KT) 9, 10, 12 ze Žďáru nad Sázavou – Starého města. 1–3 – KT 9; 4–6 – KT 10; 7, 8 – KT 12 (Inv. č.: 1 – 70/04-784/1; 2 – 50/05-252/29; 3 – 70/04-252/10; 4 – 70/04-252/184; 5 – 70/04-124/7; 6 – 70/04-234/8; 7 – 70/04-154/4; 8 – 70/04-154/5). Kresba S. Plchová.*

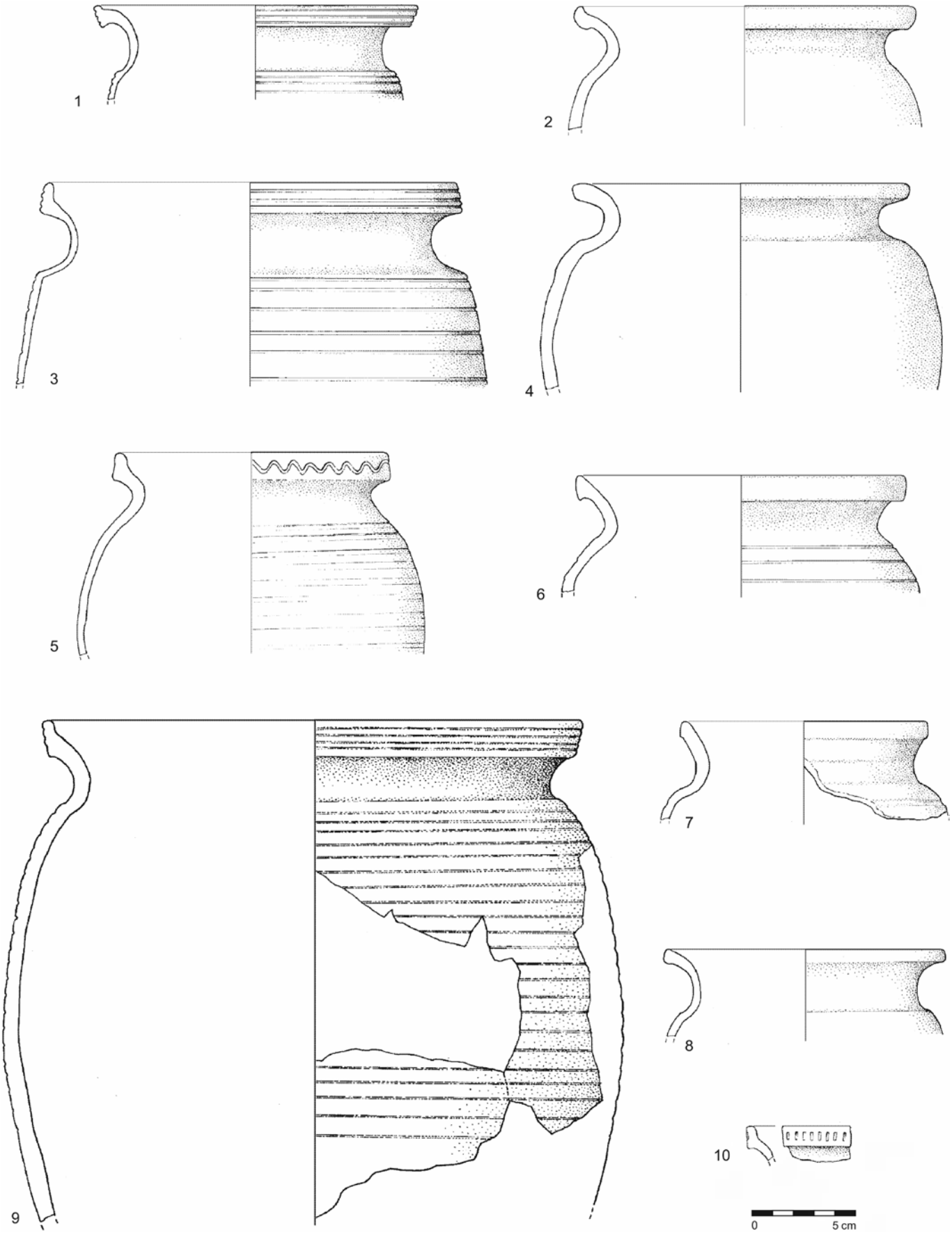
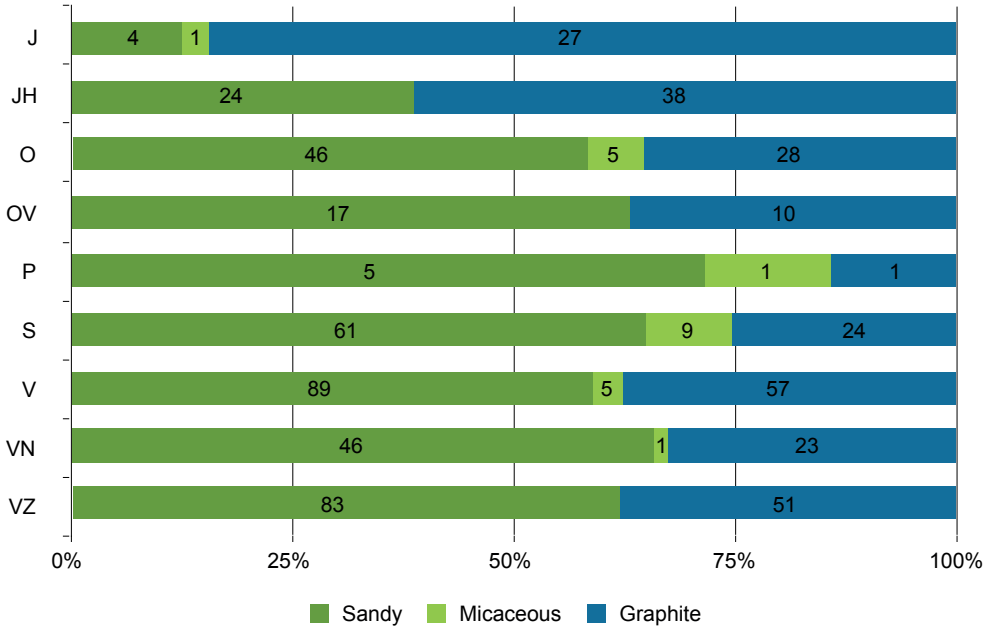


Fig. 12. Pots with material from ceramic class 13 from Žďár nad Sázavou – Staré město (Inv. No.: 1 – 70/04-154/7; 2 – 50/05-154/3; 3 – 70/04-124/16; 4 – 50/05-312/3; 5 – 70/04-236/1-3; 6 – 70/04-154/6; 7 – 70/04-198/4; 8 – 70/04-206/52; 9 – 70/04-169/1; 10 – 70/04-190/3). Drawing by S. Plchová.

Obr. 12. *Hrnce keramické třídy 13 ze Žďáru nad Sázavou – Starého města (Inv. č.: 1 – 70/04-154/7; 2 – 50/05-154/3; 3 – 70/04-124/16; 4 – 50/05-312/3; 5 – 70/04-236/1-3; 6 – 70/04-154/6; 7 – 70/04-198/4; 8 – 70/04-206/52; 9 – 70/04-169/1; 10 – 70/04-190/3). Kresba S. Plchová.*



Graph 9. Representation of pottery groups among rim types (data in %, for descriptions see typology in Fig. 13).

Graf 9. *Zastoupení keramických skupin v rámci typů okrajů (údaje uvedeny v %, popisky viz typář obr. 13).*

offset (42%), a break (29%) and rounding (29%). In the case of graphite pottery, a fluid offset was most common (63%), followed by rounding (22%), a break (14%) and a rib (1%). As such, the transition from the body to the neck was more commonly of a more fluid type on graphite pottery. The offset was rounded on four fragments of micaceous pottery.

5.1.2 Pot rims

A total of 656 rim profiles were identified. These were divided into nine basic types, which were then divided into subtypes and variants. The system was created on the basis of the code of Brno pottery and partially south Bohemian typologies and was adapted to local conditions with a presumed use for pottery in the region of the Bohemian-Moravian Highlands in the period from the 13th century to the first half of the 14th century (Fig. 13; Čapek 2010, 162–165, Procházka 2007, 248–254). The classification of rims used by R. Zatloukal during the processing of an earlier assemblage in 2000 was also taken into consideration. However, due to its breakdown into only several basic types, it is not suitable for a comprehensive comparison with other typologies and was therefore not used as the foundation for a new classification (Zatloukal 2000, 92–94; in detail in Těsnohlídková 2021, 241–242).

Represented in the greatest numbers are various types of everted rims (a total of 54%), including basic (23%), upwardly everted (20%) and low everted (11%). These are followed by roof-shaped rims (14%), collars (12%) and simple-edged rims (10%). Occurring in the fewest cases are simple rims (5%), oval rims (4%), while folded rims appear in only a few instances (1%). The nine rim types were broken down into 27 subtypes and 99 variants.

Simple and simple-edged rims appear predominantly on graphite pottery – 84% of simple rims are on graphite pottery, while 61% of simple-edged rims are on graphite vessels. The others appear more on sandy classes of pottery in the range of 58–66%. Folded rims are excluded from the analysis due to the fact that they appear on only seven specimens, a sample size that is not representative. Micaceous pottery is also left without commentary due to its low representation (Graph 9). More detailed links and a precise quantification of rim subtypes and variants to ceramic fabrics and groups are provided in the table in the annex (Tab. 8).

	Total number	Sandy	Micaceous	Graphite
J.1	32	4	1	27
JH.1	23	4		19
JH.2	4	3		1
JH.3	3	3		
JH.4	32	14		18
O.1	50	27	5	18
O.2	11	9		2
O.3	16	8		8
O.4	2	2		
OV.1	10	6		4
OV.2	17	11		6
P.2	4	4		
P.3	3	1	1	1
S.1	38	22	6	10
S.2	9	4	1	4
S.3	46	34	2	10
S.4	1	1		
V.1	59	41	1	17
V.2	61	29	3	29
V.3	31	19	1	11
VN.1	17	12		5
VN.2	16	8	1	7
VN.3	37	26		11
VZ.1	91	56		35
VZ.2	9	3		6
VZ.3	27	17		10
VZ.4	7	7		

Tab. 8. Quantification table of frequency of rim types and subtypes in pottery production from Žďár nad Sázavou – Staré město in basic ceramics groups.

Tab. 8. *Kvantifikační tabulka výskytu typů a podtypů okrajů hrnců v keramickém souboru Žďár nad Sázavou – Staré město v rámci základních keramických skupin.*

Simple rims

J.1

J.1.1 J.1.2 J.1.3

Simple-edge rims

JH.1

JH.1.1 JH.1.2 JH.1.3

JH.2

JH.2.1 JH.2.2

JH.3

JH.3.1 JH.3.2

JH.4

JH.4.1 JH.4.2 JH.4.3

Roof-shaped rims

S.1

S.1.1 S.1.2 S.1.3 S.1.4 S.1.5

S.2

S.2.1 S.2.2 S.2.3 S.2.4 S.2.5 S.2.6

S.3

S.3.1 S.3.2 S.3.3 S.3.4 S.3.5

S.4

S.4.1 S.4.2 S.4.3

Folded rims

P.1

P.1.1 P.1.2

P.2

P.2.1

P.3

P.3.1 P.3.2

Everted rims

V.1

V.1.1 V.1.2 V.1.3 V.1.4 V.1.5

V.2

V.2.1 V.2.2 V.2.3 V.2.4 V.2.5 V.2.6

V.2.7

V.3

V.3.1 V.3.2 V.3.3

Low everted rims

VN.1

VN.1.1 VN.1.2

VN.2

VN.2.1 VN.2.2 VN.2.3 VN.2.4 VN.2.5 VN.2.6

VN.3

VN.3.1 VN.3.2 VN.3.3 VN.3.4 VN.3.5 VN.3.6

Upwardly everted with tapering

VZ.1

VZ.1.1 VZ.1.2 VZ.1.3 VZ.1.4 VZ.1.5 VZ.1.6

VZ.1.7 VZ.1.8 VZ.1.9 VZ.1.10

VZ.2

VZ.2.1 VZ.2.2 VZ.2.3

VZ.3

VZ.3.1 VZ.3.2 VZ.3.3 VZ.3.4 VZ.3.5 VZ.3.6

VZ.4

VZ.4.1 VZ.4.2

Oval rims

OV.1

OV.1.1 OV.1.2 OV.1.3 OV.1.4

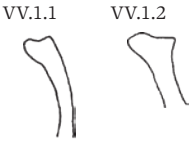
OV.2

OV.2.1 OV.2.2 OV.2.3 OV.2.4

Horizontally shaped rims

VV.1

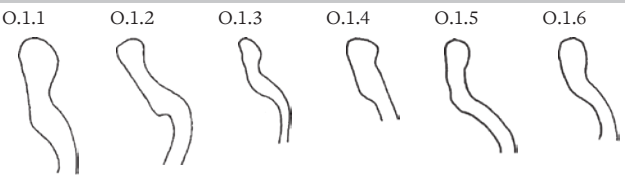
VV.1.1 VV.1.2



Collars - rims

O.1

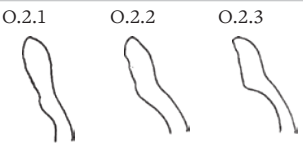
O.1.1 O.1.2 O.1.3 O.1.4 O.1.5 O.1.6



O.1.7

O.2

O.2.1 O.2.2 O.2.3



O.3

O.3.1 O.3.2 O.3.3 O.3.4

O.4

O.4.1 O.4.2

Flat collars - rim

OP.1

OP.1.1 OP.1.2

OP.2

OP2.1 OP.2.2

Fig. 13. Types of pots rims for pottery of 13th and first half of 14th century from Bohemian-Moravian Highlands. Created by K. Těsnohlídková.
Obr. 13. *Typář okrajů hrnců pro keramiku 13. a 1. poloviny 14. století z Českomoravské vrchoviny. Sestavila K. Těsnohlídková.*

5.1.3 Pot decoration

Decoration appeared on 653 body fragments, i.e. on roughly a quarter of preserved body fragments (Fig 14). A total of 612 of these potsherds had various versions of incisions and grooves. As such, this decoration represents nearly 94% of all decorative motifs on vessel bodies. Whirl decoration in the form of wide finger-pressed grooves (R.08.01-02) occurred on 20 fragments (3%). Wavy lines appeared in 15 cases (2%) and decoration other than incised ornament (fingernail nicks, rectangular or triangular wheel-pressed decoration) occurred on only six fragments (1%).

A connection between the ratio of incisions and grooves and the ceramic fabric is observed: on pottery with a sandy fabric, the ratio is roughly 1 : 1 and on graphite pottery 1 : 2, a dependency related to the aforementioned robustness of graphite pottery vessels. Otherwise, the share of individual decorative motifs is distributed similarly between graphite and sandy pottery. Sparse incisions/grooves (R.01.09, R.02.09) were probably more common on graphite pottery, on sandy pottery a motif of two and more regularly spaced incisions/grooves (R.01.02, R.02.02); however, the differences are not significant. Decoration with one incision/groove on the body occurred only on pottery with a sandy fabric (R.01.01 and R.02.01).

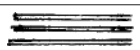
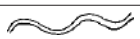
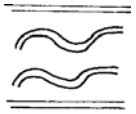
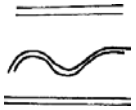
Simple wavy lines occurred on pottery with a sandy fabric in six cases, on graphite pottery in eight cases. The lone combed wavy line appeared on a graphite potsherd. Whirl decoration is predominant on pottery with a sandy fabric (17 out of 20 cases of whirl decoration appear on sandy ware, two on micaceous ware and one on graphite ware). Stamps and nicks occurred on pottery with graphite and sandy fabric.

Decoration appeared on 254 of 656 preserved pot rims, i.e. on 39%. Decoration was always found on the outer side of vessels. With the exception of one fragment of CC 13 with one row of rectangular wheel-pressed decoration, the decoration was always incised (Fig. 14).

Incisions and grooves in various forms and numbers appeared on 162 rims, and another 94 rims were decorated with wavy lines: on 43 specimens these were low wavy lines, on 38 specimens high wavy lines. Steep wavy lines appeared in nine cases, two wavy lines one above the other in five cases, and there was one case of overlapping wavy lines. The final two rims were decorated with a combination of incisions and wavy lines.

Wavy line decoration appears more often on the rims of graphite pottery, with 45% of decorated rims featuring this motif; on the other hand, only 32% of sandy pottery rims were decorated with this motif. High wavy lines are predominant on graphite pottery, low wavy lines on pottery with a sandy fabric. The rims of six fragments of micaceous pottery were decorated with incisions and grooves, while one featured wavy lines.

Rim decoration occurred in the greatest numbers on rims with an upwardly everted rim (66% of all upwardly everted rims, 49% of upwardly everted tapering rims and 39% of upwardly everted low rims were decorated). A high share of decoration also appeared on collar rims (recorded on 43% of collar rims). A total of 23% of simple-edged rims were decorated, while 14% of roof-shaped rims were decorated. Oval rims were decorated at the lowest rate – 7%. Decorative motifs are distributed relatively evenly within the types of rims and it is not possible to observe significant links between a certain decorative motif and a particular form of rim.

R.01	**Incisions (under 1 mm thickness)**	
R.01.00	Indeterminate number	
R.01.01	One incision	
R.01.02	Two and more incisions	
R.01.03	Densely thickness	
R.01.04	Bunch of incisions	
R.01.08	Irregular incisions	
R.01.09	Sparse incisions	
R.02	**Grooves (over 2 mm thickness)**	
R.02.00	Indeterminate number	
R.02.01	One groove	
R.02.02	Two and more grooves	
R.02.03	Densely grooves	
R.02.08	Irregular grooves	
R.02.09	Sparse grooves	
R.03	**Simple ripples (under 2 mm)**	
R.03.00	Indeterminate number	
R.03.01	Low ripple	
R.03.02	High ripple	
R.03.03	Steep ripple	
R.03.04	Overlaps ripples	
R.04	**Simple ripples (over 2 mm)**	
R.04.01	Low ripple	
R.04.02	High ripple	
R.04.05	Two and more high ripples	
R.05	**Lone combed ripples (under 2 mm)**	
R.05.00	Indeterminate number	
R.05.01	One line	
R.07	**Combination of ripples and incisions/grooves**	
R.07.00	Indeterminate number	
R.07.01	Incision/groove, under it ripple	
R.07.02	Grooves and under its ripple	
R.07.03	Ripple and under it grooves	
R.07.04	Incision – ripples – incision	
R.07.05	Ripple between grooves	

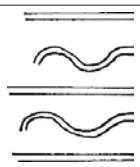
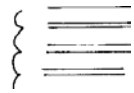
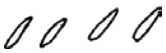
R.07.06	Groove between ripples	
R.07.07	Groove – ripple – groove – ripple – groove	
R.08	**Wide grooves dented by fingers**	
R.08.01	Densely	
R.08.02	Rarely	
V.02	**Scratched**	
V.02.01	Nails scratched	
V.03	**Arched scratched**	
V.03.00	Single	
V.03.01	Line	
K.02	**Rectangular stamps**	
K.02.02	2–4 lines	
K.03	**Triangle stamps**	
K.03.00	Indeterminate number	
K.03.03	Five a more lines	
Z	**Storagge vessels decoration**	
Z.01	Wide grooves	
Z.02	Squere stamps	

Fig. 14. Decorations types for pottery from Bohemian-Moravian Highlands in 13th and first half of 14th century. R – Engraved; V – scratched and injection; K –stamp or stamp wheel; Z – storage vessels decoration. Created by K. Těsnohlídková.

Obr. 14. *Typář výzdoby pro keramiku 13. a 1. poloviny 14. století z Českomoravské vrchoviny. R – Rytá; V – vrypy, vpichy; K – kolky, rádélka; Z – výzdoba zásobnic. Sestavila K. Těsnohlídková.*

5.2 Storage vessels

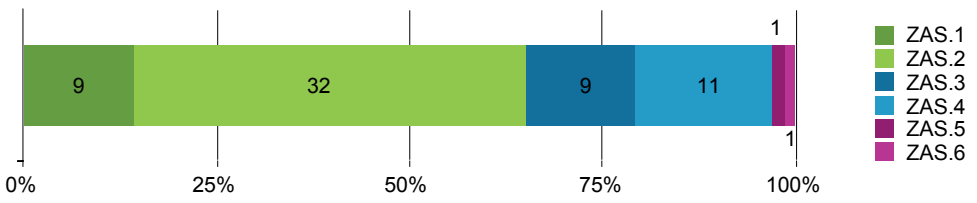
Storage vessels, the second largest group after pots, are represented by 622 fragments. They are characterised by thick walls (10–30 mm, most often 15–20 mm) and a high content of coarse-grained graphite in the ceramic fabric (most often up to 0.5 mm). Their ceramic fabric is so distinct that they have their own pottery class (CC 11). Two other probable subgroups can be distinguished here: red temper occurred in the fabric of some storage vessels (12%), in several others highly shiny graphite (2%). It can be assumed that they were made with coils and different speeds of rotation. The firing is reduction with a prevailing biscuit firing of the outer surface, less often both surfaces (sometimes also with traces of partially combusted graphite on the surface of vessels). The ceramic fabric is soft and rubs off under the influence of the high graphite content and apparently the fast and low-quality firing. Testifying to their value and extended lifetime are preserved repairs to the walls by means of drilled holes and the use of metal clips in the case of cracked walls.

Fragments of storage vessels included 63 rim sherds (Fig 15). These could be assigned to six types, with ZAS.2 rims being predominant at 50% (Graph 10). More than 70% of rims were decorated with broad grooves. Part of the body was decorated in the same way. Besides an aesthetic function, decoration with broad and deep grooves could also have strengthened the vessel during forming and firing.

The metric qualities of storage vessels are not simple to determine, as these large forms are typically preserved in highly fragmented form. As a result, it was only possible to record the diameter of the rims and bottoms. The diameter of the bottom could be determined for six edge pieces preserved along 10–15% of the circumference. The diameter of these edge pieces could be established at 320–460 mm, most often around 440 mm. The determination of the bottom diameter was better with larger preserved pieces. One entire bottom had a diameter of 300 mm. For an additional six bottoms preserved in fragments, the diameter was determined in the range of 240–300 mm.

5.3 Lids – bell-shaped and flat

Bell-shaped lids at the site significantly predominate over their flat counterparts. The assemblage from 2004 contained 87 fragments of bell-shaped and seven fragments of flat lids (Fig. 16). While all ceramic classes were represented in the fabric of the lids, sandy and micaceous fabrics have a higher representation. Forming traces testify to their predominant production from a single piece of clay with the use of fast rotation or slower rotation and pulling with the subsequent smoothing of traces; uncertain coils were documented in one case, in one other the thinning of the wall by lathe-like turning. A potter's mark was preserved on five handles, just like on a lid handle from the 2005 excavation (Fig. 16: 1–4). An imprint from the wooden throwing surface was visible on another handle. The inner side of the handle preserved in several cases as a 'navel' or 'snail', and around its circumference was a visible edge; in one case, the centre of the handle was artificially glued to the body of the lid. A drilled hole documented on three lids could have served to release steam.



Graph 10. Representation of storage vessel rim types in assemblage.

Graf 10. *Zastoupení typů okrajů zásobnic v souboru.*

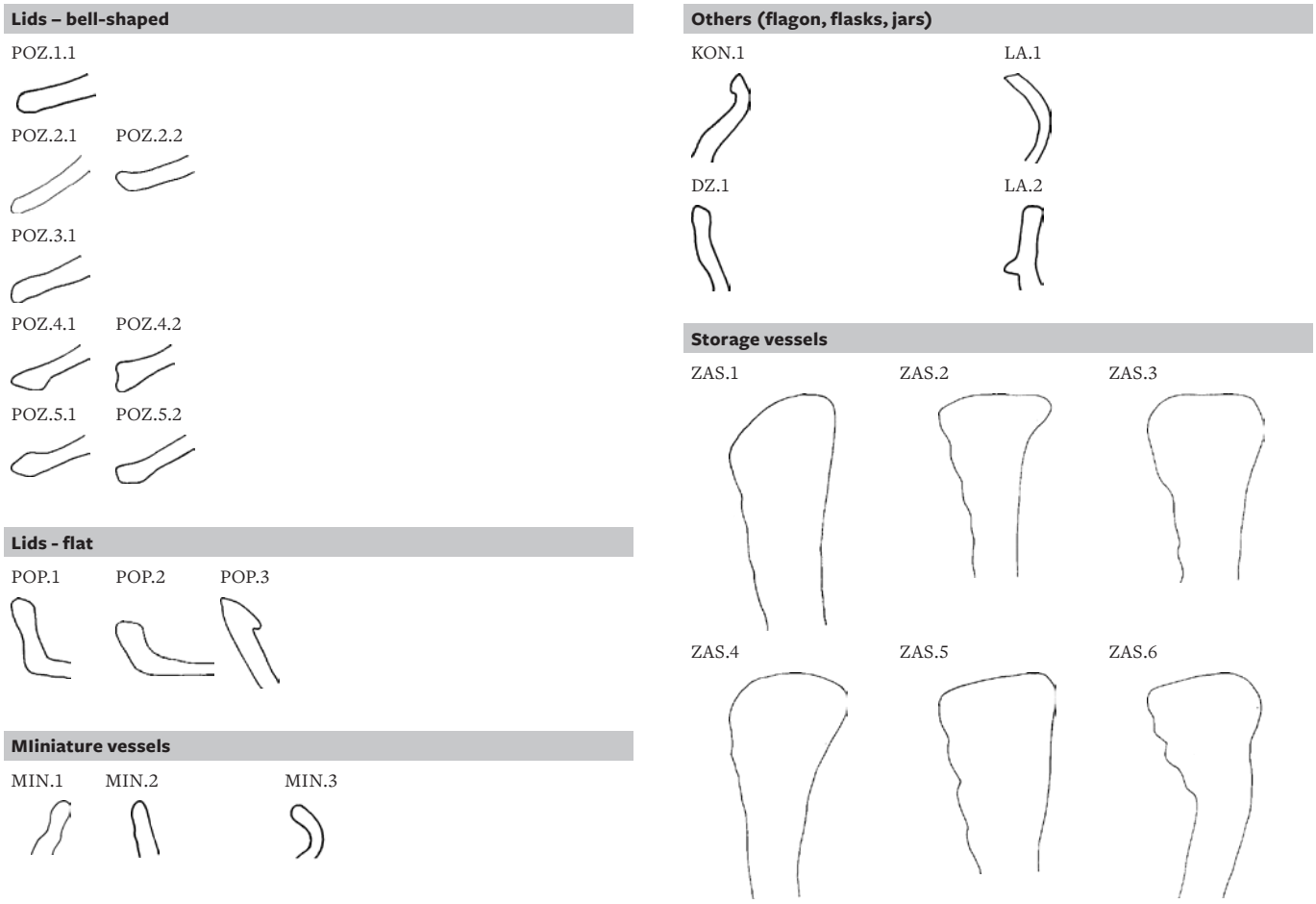


Fig. 15. Types of vessels rim for pottery of 13th and first half of 14th century from Bohemian-Moravian Highlands. Created by K. Těsnohlídková.
Obr. 15. *Typář okrajů dalších druhů nádob pro keramiku 13. a 1. poloviny 14. století z Českomoravské vrchoviny. Sestavila K. Těsnohlídková.*

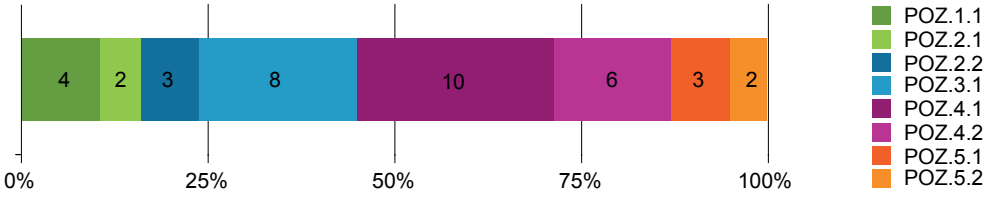
Fragments of bell-shaped lids belong to sandy ceramic classes in 68% of cases, graphite in 22% of cases and micaceous in 10% of cases. Compared to the general representation of the basic ceramic classes in the assemblage, there is a greater share of sandy and micaceous pottery at the expense of graphite pottery. Eight rim types were identified on bell-shaped lids (Fig. 15). Rims in group 3 and 4 occur in the greatest numbers (NOTE 3.1 and 4.1–2). Decoration is rare on lids, with wavy lines appearing on one inner rim, weak grooving on one body. Lid handles are mostly wider and could also be classified among bowls with a broadly bell-shaped mouth. Two handles are button-shaped – one mushroom-shaped, the other bowl-like. The diameter of lid rims was in the range of 120–160 mm, their handles 40–100 mm, most often 60–80 mm (Graph 11).

Flat lids were represented in the assemblage by only seven fragments, which belonged mainly to micaceous pottery (5), followed by sandy fabric (2). The diameter of lid bottoms was in the range of 100–130 mm, their rims 120–140 mm, lid heights 12–25 mm. Richard Zatloukal regarded the higher share of flat lids from micaceous fabric as a certain innovation in the production of the form, which was probably dying out in Moravia in the second half of the 13th century (Zatloukal 2000, 106).

5.4 Flagons and miniature vessels

Eight flagon fragments were identified during the processing of the assemblage. These were spout fragments in four cases, in three cases part of a stirrup handle, in one case a rim. Decoration in the form of fingernail nicks appeared on one handle (V.02.01). The flagon fragments belonged to sandy ceramic classes (CC 3, CC 4 and CC 12). The only documented forming traces were squeezing and gluing the spout to the body of the vessel.

A large and highly varied assemblage of flagons was obtained in 2006 during the excavation of a well in another part of the site. The flagons feature a rich range of decoration. The concentration



Graph 11. Distribution of types of rims of bell-shaped lids.
Graf 11. *Rozložení typů okrajů zvonovitých poklic.*

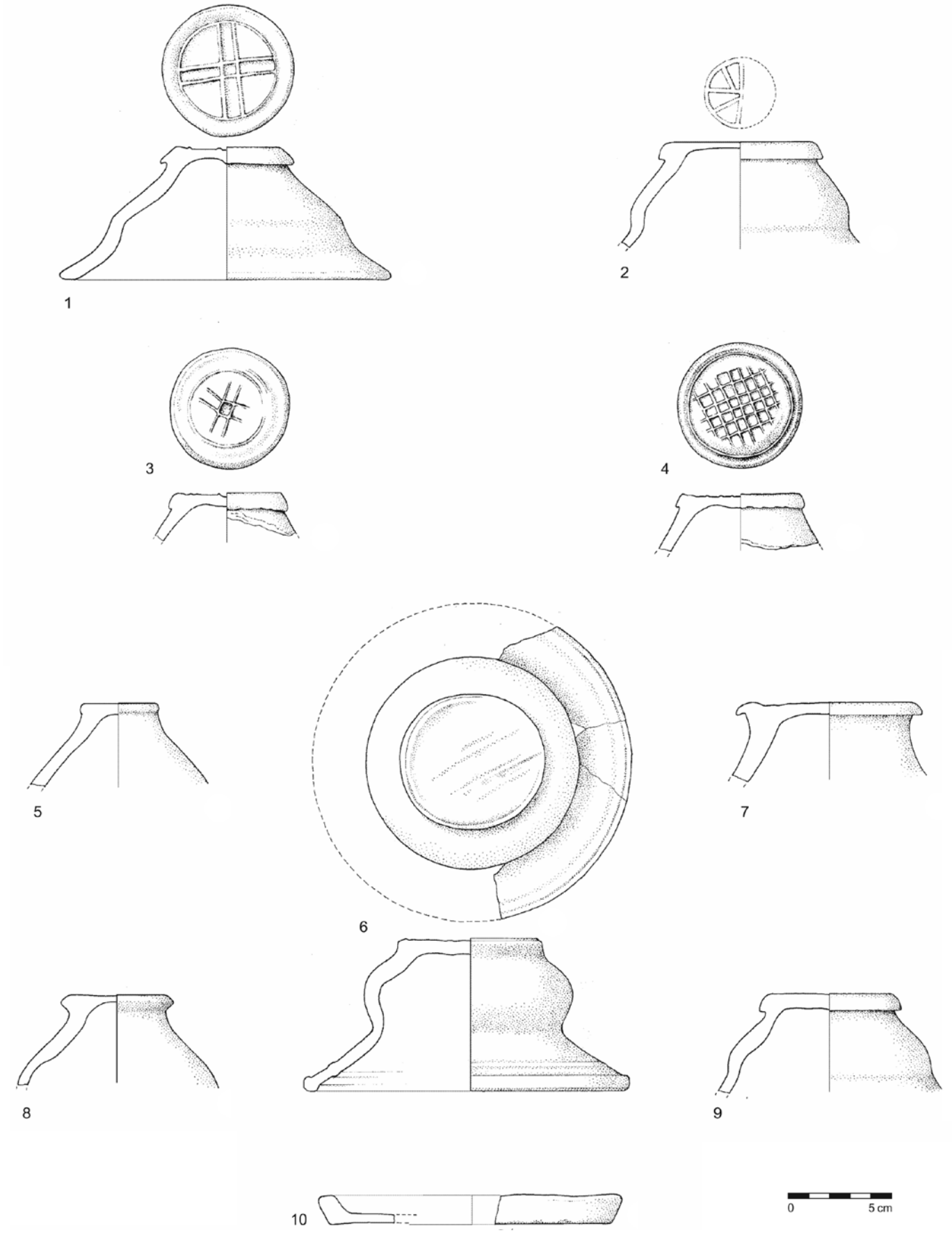


Fig. 16. Pottery lids from Žďáru nad Sázavou – Staré město. 1–9 – Bell-shaped lids; 10 – flat lids (Inv. No. and ceramic class: 1 – 50/05-287/2, CC3; 2 – 70/04-124/46, CC3; 3 – 70/04-153/7, CC3; 4 – 70/04-160/14, CC3; 5 – 70/04-252/231, CC3; 6 – 70/04-153/1, CC3; 7 – 70/04-191-5, CC3; 8 – 70/04-239/28, CC4; 9 – 70/04-133/9, CC6; 10 – 70/04-203/5, CC3). Kresba S. Plchová.

Obr. 16. *Keramické poklice ze Žďáru nad Sázavou – Starého města. 1–9 – zvonovité poklice; 10 – plochá poklice (Inv. č. a keramická třída: 1 – 50/05-287/2, KT3; 2 – 70/04-124/46, KT3; 3 – 70/04-153/7, KT3; 4 – 70/04-160/14, KT3; 5 – 70/04-252/231, KT3; 6 – 70/04-153/1, KT3; 7 – 70/04-191-5, KT3; 8 – 70/04-239/28, KT4; 9 – 70/04-133/9, KT6; 10 – 70/04-203/5, KT3). Kresba S. Plchová.*

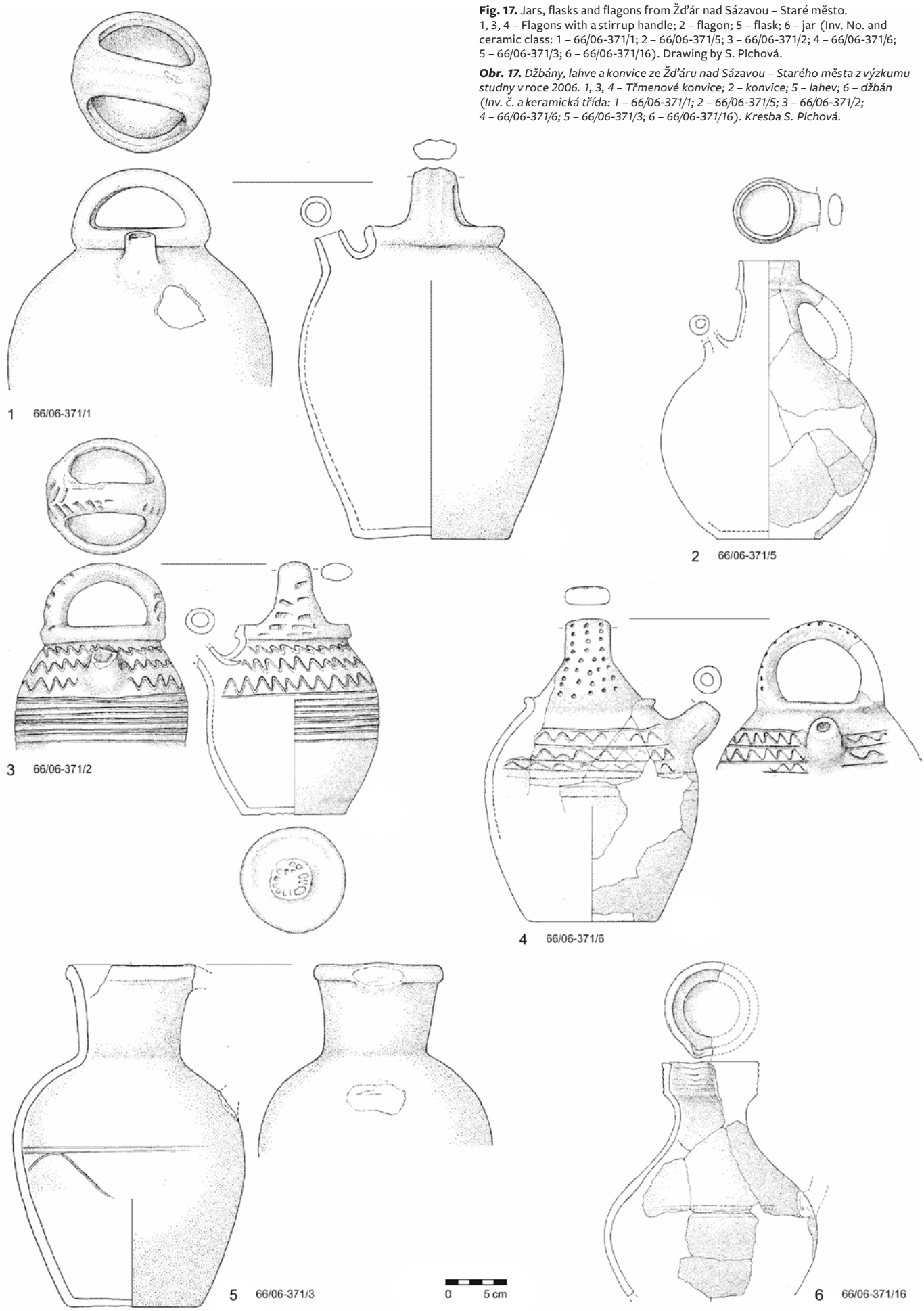


Fig. 17. Jars, flasks and flagons from Žďár nad Sázavou – Staré město.
1, 3, 4 – Flagons with a stirrup handle; 2 – flagon; 5 – flask; 6 – jar (Inv. No. and ceramic class: 1 – 66/06-371/1; 2 – 66/06-371/5; 3 – 66/06-371/2; 4 – 66/06-371/6; 5 – 66/06-371/3; 6 – 66/06-371/16). Drawing by S. Plchová.

Obr. 17. *Džbány, lahve a konvice ze Žďáru nad Sázavou – Starého města z výzkumu studny v roce 2006. 1, 3, 4 – Třmenové konvice; 2 – konvice; 5 – lahev; 6 – džbán (Inv. č. a keramická třída: 1 – 66/06-371/1; 2 – 66/06-371/5; 3 – 66/06-371/2; 4 – 66/06-371/6; 5 – 66/06-371/3; 6 – 66/06-371/16). Kresba S. Plchová.*

of flagons in the well indicates their use in transporting water. The flagons had a stirrup handle or a side strip handle and a tubular spout (Fig. 17: 1–4).

The assemblage contained fragments of three miniature vessels, a small ceramic flagon with a stirrup handle belonging to CC 3 (Fig. 18: 2) and two pot-like forms belonging to CC 5 and 7 (Fig. 18: 4). Other excavations produced two miniature vessels (2005) – a small flagon belonging to CC 3 and a cup belonging to CC 5 (Fig. 18: 1); the 2006 excavation produced a cup belonging to CC 5 (Fig. 18: 3). This form also included small vessels from a fine light material that is glazed in some cases, which can perhaps be considered imports, as well as ware of classes typical for local production.

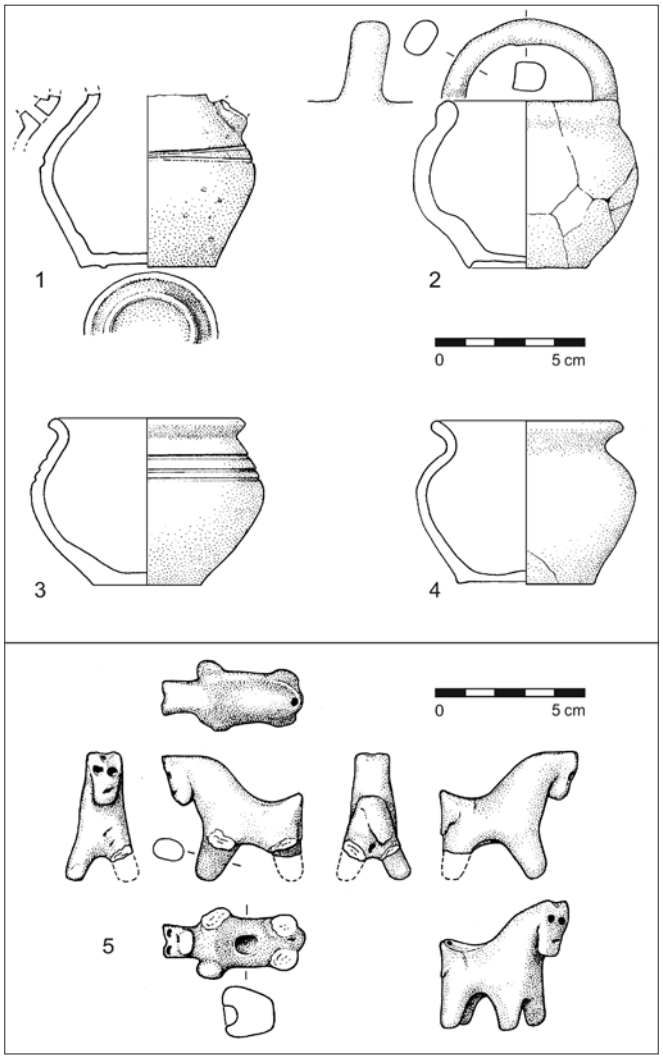


Fig. 18. Miniature vessels and horse figurine from Žďár nad Sázavou – Staré město. 1, 2 – Miniature flagons; 3, 4 – miniature pots; 5 – ceramic horse figurine, lower right reconstruction (Inv. No. and ceramic class: 1 – 50/05-297/1, CC3; 2 – 70/04-133/2, CC3; 3 – 50/05-287/1, CC5; 4 – 70/04-154/1, CC7; 5 – without Inv. No.). Drawing by S. Plchová.

Obr. 18. *Miniaturní nádobky a figurka koníčka ze Žďáru nad Sázavou – Starého města. 1, 2 – Konvičky; 3, 4 – Hrnečky; 5 – keramický koníček, bottom right rekonstrukce (Inv. č. a keramická třída: 1 – 50/05-297/1, KT3; 2 – 70/04-133/2, KT3; 3 – 50/05-287/1, KT5; 4 – 70/04-154/1, KT7; 5 – bez inv. č.). Kresba S. Plchová.*

5.5 Jugs, flasks and other vessels

Jugs and flasks were preserved in the assemblage in four rim fragments. Several handles decorated with fingernail nicks, wheel-pressed ornament or spirals could have belonged to jugs or even pots. All of the fragments belonged to sandy ceramic classes (CC 1–3). Dents documenting the use of fast rotation appeared on the rims; the firing was reduction in one case, in three cases oxidising biscuit. Rims are simple or with a transition to a collar, in two cases with grooved decoration. Rim diameters were in the 70–130 mm range (10–15% of the total rim circumference was preserved). Other dimensions cannot be deduced.

Two nearly intact jugs were found in a well during an excavation in 2006. One is a massive, thick-walled form with a handle and two grooves and wavy lines on the body; the second vessel is relatively thin-walled with a handle, several grooves on the body and rim, and with a spout on the rim (Fig. 17: 5–6).

A pan on feet was represented by one fragment of a handle. The find comes from a feature and apparently is not an intrusion. The fragment belongs to ceramic class 12 and bears signs of an interior glaze. Another fragment of the foot of a pan was published in the assemblage processed by R. Zatloukal (Zatloukal 2000, 108). Beakers and lamps were not identified with certainty in this assemblage. R. Zatloukal presents several fragments of these forms in the assemblage from the site that he processed (Zatloukal 2000, 107–109).

A small fragment of a handle of fine, light, oxidation fired ceramic class 5 with a yellow-green glaze with a content of sulphur (Inv. No. 70/04-252/207) could belong to an alembic, i.e. a device for distilling alcohol, or it could be the handle of an aquamanile. Two other pottery forms are known from earlier excavations: a ceramic figurine of a horse and a fragment of an aquamanile in the form of a ram (Fig. 18: 5). Richard Zatloukal evaluated both of these finds in detail (Zatloukal 2000, 111–113).

6. Pottery kiln

The only direct evidence of pottery production in Žďár nad Sázavou – Staré město is a pottery kiln with part of a preserved batch of pottery. This is a simple single-chambered kiln with undivided internal space (Kochan et al. 2020, 118; Geisler 2006, 33–35). The dimensions of the bottom of the feature (No. 1548) were 1.4 m × 0.95 m and a preserved depth of 0.5 m (Fig. 19). The orientation of the feature sunk into the sandy subsoil was NNE–SSW. The bottom descended slightly towards the front part of a combustion hole. The walls and bottom of the kiln were burnt to shades of red, grey and black, penetrating about 2 cm into the walls, less so on the bottom of the kiln (Geisler 2006, 35).

The fill of the feature contained small stones, charcoals, fragments of pottery forms in at least two layers; above the burnt bottom was a continuous carbonaceous layer 1–3 cm thick. Although a pit in front of the kiln was not captured in the excavation, a pit was found in the vicinity of the kiln (feature No. 1546). It is not clear whether this pit can be connected to the kiln, and it could have been a clay pit (Geisler 2006, 33–35, Fig. 19).

A total of 11 entire and five larger but incomplete vessels were reconstructed (Fig. 20). Also determined were rims of bell-shaped lids, the neck of a flask/jug, the spout of a flagon and fragments of handles apparently belonging to a cup or jug. The morphological traits of pots correspond to the analysed pottery from the 2004 excavation season. The rims of pots and their larger fragments have a similar share in the representation of roof-shaped and upwardly everted variants, with simple-edged rims appearing only rarely. Roughly a third of all pots have a neck that is sharply offset from the body. Incisions and grooves appear on the shoulders. In a few cases, wavy lines appear on the rim or in

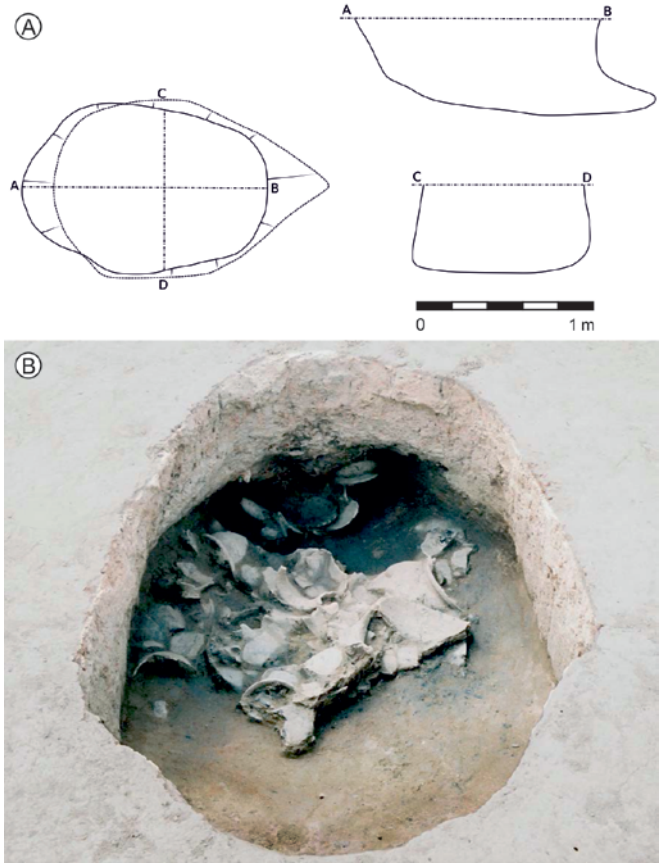


Fig. 19. Pottery kiln from Žďár nad Sázavou – Staré město. A – Drawing documentation – redrawn by K. Slavíček; B – layer of pottery on bottom of kiln. After Geisler 2006, Tab. 15.

Obr. 19. *Hrnčířská pec ze Žďáru nad Sázavou – Starého města. A – Kresebná dokumentace; B – vrstva keramiky na dně pece. Podle Geisler 2006, tab. 15.*

Fig. 20. Pots from kiln in Žďár nad Sázavou – Staré město and technological traces on them. A – Evidence of coils in vessel walls; B – bottom with fine dusting on the surface and traces of attachment/removal from the throwing surface of the wheel around the circumference; C – whole reconstructed forms. A, B – Photo by V. Nosek; C – after Geisler 2006, Tab. 98.

Obr. 20. *Hrnce z pece ze Žďáru nad Sázavou – Starého města a technologické stopy na nich. A – Doklady válků ve stěnách nádob; B – dno s jemnou podsýpkou v ploše a se stopami po připevnění/sejmutí z desky kruhu po obvodu; C – celé zrekonstruované tvary. A, B – foto V. Nosek; C – podle Geisler 2006, tab. 98.*

combination with grooves on the body. The higher occurrence of roof-shaped rims on sandy and micaceous pottery than on graphite pottery indicates that a more innovative component of local pottery was produced in the kiln. As such, it may have been in operation in the later phase of the settlement's existence (Těsnohlídková 2021, 278–280).

The ceramic fabric of the vessels was medium-grained (less often fine-grained) with sandy inclusions, i.e. this was sandy CC 2 and 3. The fabric contained graphite in a small number of cases (CC 10). However, traces of forming are documented by the presence of coils in the walls of larger vessels, often in combination with signs of fast rotation (Fig. 20a), thus pointing to the presumed prevailing technique of profiling turning, probably of a lower degree. The surface of vessel bottoms bears traces of dusting, while the edge pieces have evidence of attachment or removal from the potter's wheel (Fig. 20b). Although these marks were not captured as often on fragments of abraded bottoms, they were apparently characteristic of the entire site. Traces of firing do not show significant signs of over-firing and basically correspond to local production known from settlement contexts with a predominance of oxidising biscuit firing of the surface on the dark reduction shard (Těsnohlídková 2021, 278–280).

7. Pottery from Žďár nad Sázavou – Staré město and its production technology in the context of the surrounding regions

In Bohemia and Moravia, the 13th century is associated with a significant transformation in pottery production, in the context of the settlement of certain areas and socio-economic changes, when the growth of urban agglomerations, the establishment of new towns and the development of rural settlement increased the demand for pottery, which neither traditional production centres nor established technologies could satisfy. These changes involved vessel morphology, the formal spectrum, the profiling of rims and decoration, but also technology – especially the expansion of the fast-rotating wheel and kilns for firing pottery (Čapek et al. 2018, 85; for Bohemia: Vařeka 1998, 127–133; Klápště 1998, 155–156; for Moravia: Procházka, Peška 2007, 232; Sedláčková 2020, 11–20).

Traditional pottery forms (pots, storage vessels, in rare cases flasks) and lids/bowls during the 13th century in the Bohemian-Moravian Highlands were supplemented by new forms primarily related to the Austrian Danube region, i.e. flat lids, stirrup flagons and jugs, which we encounter earlier in south Moravia (Sedláčková 2020, 8–10). Storage vessels and certain types of rims point to contacts with the Moravian milieu (Procházka, Peška 2007; Čapek et al. 2022). The provenance of bell-shaped and conical lids, which in time came to be completely dominant, can probably be traced to the north Moravia production sphere (Čapek et al. 2022). As the nature of the ceramic fabric and perhaps the development of rim profiling suggests, the transformation of traditional production occurred gradually – the innovated component does not form sharply distinguished technological-morphological groups (Čapek et al. 2022). Pot rims long retained local and highly variable types of low everted, simple or oval profiles along with 'Danubian innovations' – roof-shaped and later folded rims (Čapek et al. 2022).

Although 13th- and 14th-century pottery of the Bohemian-Moravian Highlands still included a certain share of graphite ware, it gradually decreased. Besides graphite pottery, the share of sandy ware grew, and from the second half of the 13th century a certain occurrence of micaceous pottery is also observed. Sandy pottery dominated in the 14th century and the ceramic fabric gradually became finer. In the 13th century, traces of coils

and fast rotation are found on vessel bodies. In addition to traditional turning, profiling turning developed and the technology of wheel-thrown pottery from a single piece of clay gradually increased. Traces of dusting usually appear on the bottoms of vessels in combination with traces around their circumference of attaching or removing the bottom from the wheel surface – a mark that can apparently be connected most often with a low degree of profiling turning. Signs on the surface of vessel bottoms from being cut off the wheel platform aren't encountered on a large scale until the first half of the 15th century. Most of the time, traditionally fired ware was completely dominant, i.e. fully reduction firing with a dark core or the oxidising biscuit firing of the surface. Smoking technology began to be employed more in the 14th century before becoming fully dominant in the first half of the 15th century (Těsnohlídková 2021, 294).

Jihlava production differs from Žďár production in the occurrence of folded rims, which can be regarded as a district Lower Austrian influence, one that is evident in assemblages from Staré hory or Masarykovo náměstí. Evident in two horizons from Masarykovo náměstí is a decrease in upwardly everted rims and an increase in roof-shaped, folded and collar rims during the second half of the 13th century to the first half of the 14th century, as well as a declining share of graphite pottery (Hrubý et al. 2006, 206–213; Zimola 2012, 38–42, 48–55; Procházka, Peška 2007, 173; Těsnohlídková 2021, 282–285).

Comparative material also comes from two Jihlava pottery kilns, both dated to the second half of the 13th century up to the turn of the 14th century. The kiln from the U Skály site is the same type as the kiln from Žďár – a simple single-chamber device without additional division, the kiln from Křížová Street a more advanced type with two heating channels (Zatloukal 1998, 26–34; Kochan et al. 2020, 118). The formal spectrum of vessels in both Jihlava kilns is richer than found in the Žďár kiln, and the material from both kilns also shows a higher degree of standardisation. Compared to the material from the Jihlava kilns, the walls of the vessels from Žďár are relatively uneven and more robust, including signs of squeezing the walls during the handling of the unfired vessel. In general, the pottery from the Jihlava kiln can be regarded as more technologically advanced and more standardised, which can also be related to the social environment of the developing royal town. Technologically, the Žďár pottery is closer to the material from the U Skály kiln, i.e. the more frequent occurrence of coils and a higher share of graphite ware. As in Žďár, the U Skály pottery features dusted bottoms, which had traces along the circumference of attachment and removal from the wheel platform. However, compared to the Žďár vessels, the thickness of vessel walls from the U Skály kiln had thin-walled dimensions (Těsnohlídková 2021, 265–268; 272–277; Kochan et al. 2020).

In the southern part of the region with an old settlement tradition, a distinctive horizon with wheel-pressed decoration on predominant graphite ware appears in the first half of the 13th century. The occurrence of this decoration is sporadic elsewhere in the Vysočina region. The rise of Danube Region production can be observed from the first half of the 13th century in the occurrence of new pottery forms and an increased share of roof-shaped and folded rims (Těsnohlídková 2021, 292–293).

The share of graphite ware, for example, can be compared with Žďár production: graphite ware dropped among Třebíč pottery from 71% in the first half of the 13th century to 31% in the second half of the 13th century, although marks related to firing are identical (Poláček 1992, 225–249; Vokáč 2001; 137–143). At the Telč – Staroměstský rybník site dated on the basis of morphology mostly to the first half of the 13th century, the share of graphite pottery was 27%, and similar to Žďár, there was a higher occurrence of coils in graphite than in sandy ware (Běhounková 2015).

Pottery in the Pelhřimov region corresponds to the specific production of the Bohemian-Moravian Highlands. As in Žďár, there is a high occurrence of upwardly everted rims. A smaller share of colonisation elements appears in the lower representation of flat lids, jugs and pots with roof-shaped and folded rims. The gradual decline of graphite ware can also be assumed here. In the pottery assemblage from a sunken cellar in Počátky dated to the second half of the 13th century to the beginning of the 14th century, the share of macroscopically determined graphite pottery was 21% (Bláha 1968, 55–57; 148–150; 1970,7–8; Těsnohlídková et al. 2018, 132–134; Těsnohlídková 2021, 258–264, 296), and a similar tendency can also be assumed in the neighbouring Havlíčkův Brod region, though a chronologically anchored published assemblage is missing. Based on a range of information, it appears that the local production is typical for the region and it is perhaps possible to assume certain influences from east Bohemia. However, we have no support for a comparison with production from Žďár (Rous 1982, 10–39, 77–124, 126–159; 1995, 124–131; Rous, Málek 2002, 209; Hejhal 2011, 77, 98–101).

8. Pottery production of the 13th century based on a technological analysis of pottery from Žďár nad Sázavou – Staré město

Analyses confirmed the low quality of ceramic fabric for normal production, i.e. brickmaking, non-loess clays containing iron oxides and relatively small amounts of clay minerals. This fact and its local origin confirm the assumption that pottery was still relatively tolerant at that time of the choice of raw materials, which were not a limiting factor for production.

In the 13th century, graphite ware generally declined at the expense of sandy ware, which is already slightly predominant in the Žďár assemblage, and later even micaceous ware, which occurs in the minority at the site.

The rise of the potter's wheel and the turning of pottery from a single piece of clay is perceived not only as a technological advance but can also be tied to the professionalisation of the craft related to social change during the great transformation of 13th-century society (Roux 2013, 323; Klápště 2002, 20; Procházka, Peška 2007, 173). Despite knowledge of new technologies, the use of coils in creating vessels with varying degrees of rotation could have survived for a long time in connection with the quality of the ceramic fabric, the conservatism of producers, maintaining tradition, the remoteness of areas or the fact that the potter was not tied down to a single place (Rogier 2015, 72–78).

The change related to forming and ceramic fabric is reflected in technological marks and their share on potsherds. The higher variability of marks and more frequent evidence of coils in the walls of graphite ware together with its greater robustness probably suggest more archaic and less standardised technologies used in the production of graphite ware compared to sandy ware. Although the technology of profiling turning was predominant in both groups, rotation was evidently applied in reduced quality on graphite ware. Despite its lower representation and yet, based on marks, already fully wheel-thrown, micaceous ware then stands out from other products.

Marks connected with the technology of forming vessel bottoms are difficult to identify in the fragmented assemblage, a fact highlighted by finds of intact forms from a pottery kiln, on which there was a predominance of dusting in connection with traces from the attachment and removal of the bottom around the circumference on vessels produced by profiling turning. This

technology can also be assumed on the majority of pottery from the analysed assemblage.

The main technological innovation in the firing of pottery is the advent of pottery kilns, which increase markedly in archaeological finds beginning in the 13th century. Before then, pottery is thought to have been fired in simple field furnaces, pits or bonfire (Varadzin 2010, 27; Procházka 2015, 215–224; Čapek, Preusz 2019, 313–355; Scharrer-Liška 2007, 25–26; Rogier 2015, 78–81).

Signs dominating the standard production from Žďár nad Sázavou – Staré město indicate fast firing with low maximum temperatures or only short times at high temperatures, which can be done in hearths, pits or simple or temporary clamps. This interpretation is confirmed by the results of experimental firings and the conclusions of scientific analyses (Těsnohlídková 2021, 172–174).

Technological marks on pottery must also be evaluated in the context of the find of the pottery kiln at the site. Although the pottery in the kiln bore technological firing traces identical to the majority production at the site, other qualities suggest a later component of pottery ware (Těsnohlídková 2021, 278–280). The kiln evidently did not utilise the full functional potential of the device and may not have been used until the later phase of the settlement's existence. It could have been adapted, for example, to close off the firing to reduce the risk of fire caused by an open fire or to save fuel, or perhaps in response to customer demand (in detail in Těsnohlídková 2021, 307–308).

9. Conclusion

The pottery assemblage from Žďár nad Sázavou – Staré město can be dated to the second half of the 13th century. Graphite pottery at the site made up 41% of the assemblage, sandy ware 55% and coarse micaceous ware 4%. According to the petrographic composition, the sandy and graphite ware is of local origin. The composition of the micaceous pottery points to an origin of the material at least 8 km to the north or northwest of the site; it is not possible to determine whether the import involved the raw material or finished vessels. Graphite ware shows a wider range of forming techniques and a higher share of profiling turning of lower degrees. Production by profiling turning was also predominant among sandy ware, which, however, has more evidence of fast rotation and less frequent traces of coils. Micaceous pottery appears to have been purely wheel-thrown. An oxidising biscuit firing was predominant, with reduction firing having a more distinct representation. The remaining fragments were fired in a mixed atmosphere, an oxidation atmosphere, with a dark core or sandwich effect. The firing technology was apparently the same for graphite, sandy and micaceous storage vessels. In terms of surface treatment, glaze appears on only several fragments of apparently imported pottery.

Pots predominate at the site, with storage vessels and bell-shaped lids also having a higher share. Other represented forms include several fragments of miniature vessels, flat lids, stirrup flagons, flagons, jugs, flasks, bowls, aquamaniles, an alembic and a horse figurine. Pot rims are dominated in more than half of cases by variants of upwardly everted rims, with roof-shaped rims, collars, simple-edged rims, simple rims and oval rims occurring in smaller numbers. The occurrence of folded rims characteristic of the neighbouring Jihlava region is very low. The decoration of vessel bodies and rims is dominated by incisions and grooves, and wavy lines also appear more frequently. Fingernail nicks, wheel-press decoration and combed wavy lines are rare.

In the Moravian part of the Bohemian-Moravian Highlands in the 13th century, we can observe the fading use of traditional forms of technology of the Early Middle Ages, despite the continued use of graphite in the ceramic fabric. This is reflected in the emergence of specific forms of innovated domestic pottery supplemented by new south German and Austrian forms, but also perhaps those of a central German origin such as flagons, jugs, conical or bell-shaped lids, which predominate significantly over their flat counterparts. The domestic component shows the effects of south Bohemian production, especially the occurrence of offset shoulders and some types of rims (Bláha 1975, 11–12; Procházka, Peška 2007, 172–173).

The emergence of the potter's wheel and kilns took place at a similar time, with a certain correlation apparent between them. A change in ceramic fabric is evidently also related to them. In addition to the technological advantages they provided, their introduction can be attributed mainly to increased market demand and society's openness to changes during the period of great transformation. The potential of pottery kilns was not fully exploited in the region until the 14th century with the advent of smoked pottery, as was the case with the pottery wheel, where standardised production associated with regular thin walls and cut-off bottoms cannot be considered until the first half of the 15th century.

In the ceramic fabric, these innovations are not manifested as a significant turning point, but rather in the gradual decline of graphite ware or higher occurrence of fragments with traces of fast rotation. A change in firing technology can be captured only with the advent of smoked pottery. A technological difference between graphite and sandy ware with local sources is apparent in the assemblage from Žďár nad Sázavou – Staré město. Graphite ware, already occurring in smaller amounts at the site, bears more archaic marks – higher variability in forming marks indicates less stable technology, less evidence of fast rotation, the overall greater robustness of forms and wall thicknesses and a higher share of some earlier types of rims. Micaceous ware with traces of having been fully wheel-thrown can be regarded as completely innovative. The sources of their material are located at least 8 km from the site, thus raising the possibility that the pottery was either made locally or imported. Based on macroscopic marks, firing technology was the same for all three types of pottery, with analyses pointing to a possible difference in the firing of micaceous ware, on which a higher firing temperature was identified.

Appendix: Description System for Describing Technological Marks on High and Late Medieval Pottery

This description system for describing macroscopically discernible technological marks on pottery was created for pottery from Žďár nad Sázavou – Staré město and was gradually expanded to other sites in the Bohemian-Moravian Highlands with pottery finds from the 13th century to the first half of the 14th century, especially from the territory of today's Jihlava and Počátky, with support from the results of experimental archaeology and ethnography (Těsnohlídková 2021, 67). The system focuses on a description of technology for even highly fragmented assemblages. It is also possible to anticipate its broader chronological application in other regions – for late medieval or even Modern pottery. The system has already been partially published in a heritage process devoted to the description of medieval pottery in general (Čapek, Těsnohlídková 2020, 39–82).

The standardised description of pottery technology often runs into the problem of missing or nonuniform terminology or the issue of separating the description of marks and their direct interpretation. Current systems often combine all technological marks into a pottery class category, which can distort the resulting interpretation of the assemblage (Procházka 2007; Čapek 2015). Nevertheless, this system assumes the category of pottery class as the basic criterion for classifying pottery into technological groups, even with regard to the possibility of effective comparison with sites evaluated according to other description codes. A fundamental difference over existing systems is that it does not include traces from forming, which may be preserved on only a small number of fragments; moreover, they are often inconclusive. Traces from forming are compared with pottery classes only during the actual evaluation of the assemblage, as is evident above when evaluating the technology of the assemblage from Žďár nad Sázavou – Staré město. This category, which generally includes properties related to material and firing technology, corresponds to the 'fabric' used in the Anglo-Saxon environment or 'Ware' in the German-speaking countries (e.g. Lüdtke, Schnitzel, Hrsg. 2001, 955–957; Orton, Hughes 2013, 151; in detail in Těsnohlídková 2021, 6).

The macroscopic description system for describing marks related to the technology of pottery production includes the determination of the pottery class and four basic groups of marks. The arrangement of marks in the description system is based on the *chaine opératoire* and the life cycle of pottery; Roux 2019, 1–14; Santacreu 2014, 45–48; Jervis 2014, 131–153). These are marks related to the composition of the ceramic fabric. Their description is based mainly on the characteristics of inclusions, primarily a chronologically important graphite or mica component and the properties of sandy temper. Marks are also related to the shaping of vessels and surface treatment. Traces from forming are evident on the inner walls and bottoms of vessels. The third group is marks related to firing. The description of colours is reduced and the colour scale has been abandoned. The colour during oxidation is identified and the basic determined types of firing were expanded to reflect its course. The final group of marks contains properties related to use or the archaeological transformation of the pottery. As these manifestations can cover some of the production marks, it is advisable to work with them when analysing the technology. The system is open to allow its expansion (in detail in Těsnohlídková 2021, 67–68).

1.1 Ceramic class

CC

The ceramic class is determined for the potsherd/specimen based on the classes defined for the given location. Sample lists of ceramic classes with basic descriptions have been compiled, including detailed photo documentation of the surface and cross-section. The class number is preceded by the abbreviation for the relevant location (e.g. ZR – Žďár), or the class is created by an abbreviation specifying a particular commodity (e.g. L – Loštice pottery).

CC note

Supplemental information for specifying the ceramic class.

1.2 Ceramic fabric

Graphite

Determined from the surface and broken edges of potsherds based on visual qualities, mainly the typical silvery or metallic sheen of graphite (Tab. 9, Fig. 21). The basic description does not contain information on whether or not the temper was intentional; this determination is a subject of discussion or can be supported by analysis.

Symbol	Form of graphite component	Fig.
X	oxidation (in cases of oxidation firing, the graphite/organic temper can combust completely)	*21a*
A	without graphite	
B	small amount or uncombusted organic charcoal (impossible to macroscopically determine with certainty whether this is graphite or an organic charcoal)	*21b*
C	medium to large amount – powdered graphite (pottery has a silvery metallic sheen and leaves a streak when rubbed on paper)	*21c–e*
D	medium to large amount – macroscopically visible grains	*21f, g*
E	extreme amount of graphite, including grains; fabric even crumbles	*21h*

Tab. 9. Form of graphite component in ceramic fabric.
Tab. 9. *Podoba grafitové složky v keramické hmotě.*

Mica

Determined from the surface and broken edge of potsherds based on the content and form of micaceous temper (Tab. 10, Fig. 22). The basic description does not contain information on whether or not the temper was intentional; this determination is a subject of discussion or can be supported by analysis.

Symbol	Form of micaceous component	Fig.
0	without mica	
1	small amount	*22a, b*
2	medium to large amount – fine – grains (ca. 1 mm)	*22c*
3	medium to large amount – coarse – flakes (ca. 2 mm)	*22d, e*
4	extreme amount (fabric crumbles, flakes)	*22f*

Tab. 10. Form of micaceous component in ceramic fabric.
Tab. 10. *Podoba slídové složky v keramické hmotě.*

Granularity

Determined according to the prevailing component of sandy temper in the ceramic fabric (Tab. 11, Fig. 23). Isolated large grains may be mentioned, for example, in a note. Quartz often predominates in a sandy component (Fig. 23a–d)

Symbol	Determination of granularity according to prevailing component	Fig.
c	compact (0.1 mm)	*23a*
j	fine-grained (0.1–0.5 mm)	*23b*
s	medium-grained (0.5–1.5 mm)	*23c*
h	coarse-grained (1.5–2.5 mm)	*23d*
v	highly coarse-grained (>2.5 mm)	

Tab. 11. Granularity of ceramic fabric. After Procházka 2007, 241.
Tab. 11. *Zrnitost keramické hmoty. Podle Procházka 2007, 241.*

Other temper

Text field. Other tempers present in the ceramic fabric include grog and organic inclusions (Fig. 24).

Ceramic fabric – note

Additional information for the description of the ceramic fabric

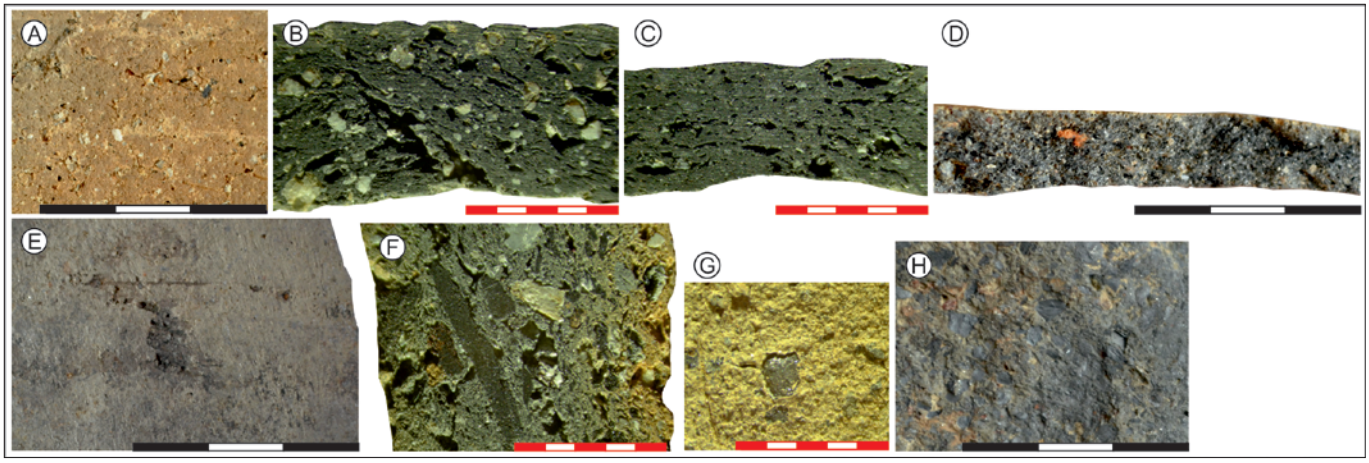


Fig. 21. Graphite and its basic appearances on the surface or broken edges of potsherds. A – Graphite burning off from the surface of pottery with oxidation firing; B – pottery with inclusions of organic charcoals, in which it is not possible to distinguish a small inclusion of graphite on a polished section; fine graphite without macroscopically observable grains; C – on polished section; D – on broken edge; E – on the surface of pottery with reduction firing; grains of graphite; F – on polished section; G – on the surface of pottery after oxidised biscuit firing; H – large amounts of graphite in the ceramic fabric of a storage vessel. A–G – Počátky – Palackého náměstí; H – Žďár nad Sázavou – Staré město. Photo by K. Těsnohlídková, K. Slavíček (black scale in cm, red in mm).

Obr. 21. *Grafit a jeho základní podoby na povrchu či lomech keramických fragmentů. A – Vyhořívající grafit z povrchu keramiky při oxidačním výpalu; B – keramika s příměsí organického uhlíku, u které nelze rozeznat případnou malou příměs grafitu na nábrusu; jemný grafit bez makroskopicky pozorovatelných zrn; C – na nábrusu; D – na lomu; E – na povrchu redukčně pálené keramiky; zrna grafitu; F – na nábrusu; G – na povrchu keramiky s oxidačním přesahem; H – velké množství grafitu v keramické hmotě zásobnice. A–G – Počátky – Palackého náměstí; H – Žďár nad Sázavou – Staré město. Foto K. Těsnohlídková, K. Slavíček (černé měřítko v cm, červené v mm).*

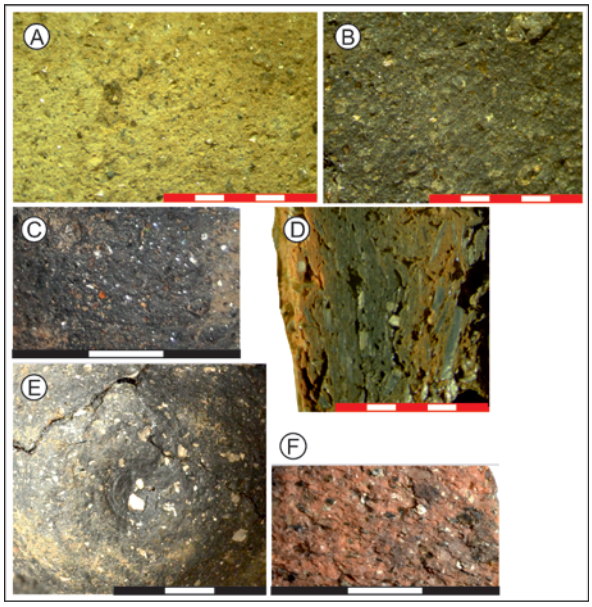


Fig. 22. Mica on the surface of pottery. Fine mica probably occurring as a natural inclusion in the ceramic fabric. A – On the surface of pottery with oxidation firing; B – on the surface of pottery with reduction firing; C – small grains; D – larger amounts of coarse-grained mica on a polished section of pottery; E – flakes of mica; F – large amounts of mica causing the fragment to crumble. A–C, E, F – Žďár nad Sázavou – Staré město; D – Lichnice – Ohrada. Photo by K. Těsnohlídková, K. Slavíček (black scale in cm, red in mm).

Obr. 22. *Slída na povrchu keramiky. Jemná slída obsažené patrně jako přirozená příměs v keramické hmotě. A – Na povrchu oxidačně pálené keramiky; B – na povrchu redukčně pálené keramiky; C – zrníčka; D – větší množství hrubozrnné slídy na nábrusu keramiky; E – šupinky slídy; F – vysoké množství slídy způsobující drolivost střepu. A–C, E, F – Žďár nad Sázavou – Staré město; D – Lichnice – Ohrada. Foto K. Těsnohlídková, K. Slavíček (černé měřítko v cm, červené v mm).*

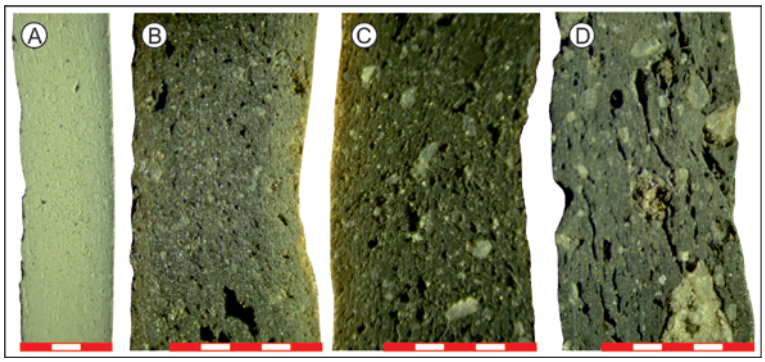


Fig. 23. Polished sections of pottery with different degrees of granularity. A – Compact; B – fine-grained; C – medium-grained; D – coarse-grained pottery. A – Experimental pottery; B–D – Žďár nad Sázavou – Staré město. Photo by K. Těsnohlídková, K. Slavíček (scale in mm).

Obr. 23. *Nábrusy řezů různě zrnité keramiky. A – Celistvá; B – jemně zrnitá; C – středně zrnitá; D – hrubozrnná keramika. A – Experimentálně vyrobená keramika; B–D – Žďár nad Sázavou – Staré město. Foto K. Těsnohlídková, K. Slavíček (měřítko v mm).*

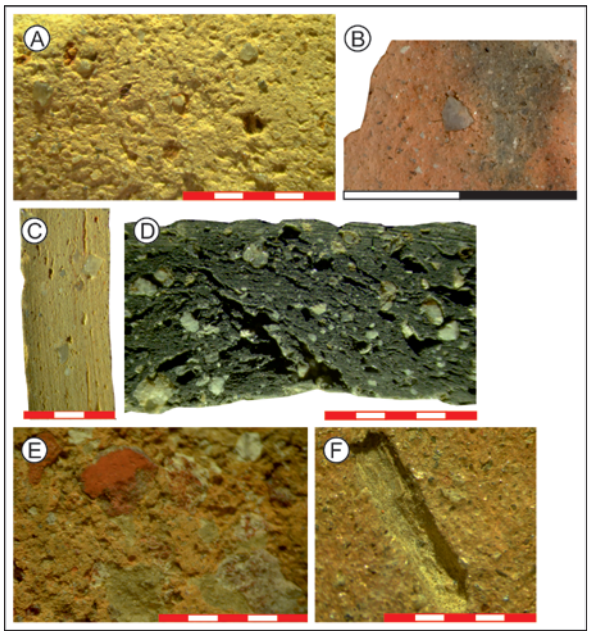


Fig. 24. Details of various types of nonplastic inclusions in the ceramic fabric of pottery. Quartz in sandy inclusion. A – On the surface of fine ceramic fabric; B – on the surface, including a large grain with cracks from firing; C – on a polished section of fine ceramic fabric; D – on a polished section of medium-grained ceramic fabric; E – apparent grog in the ceramic fabric of a storage vessel; F – combusted organic inclusion on the surface of pottery. A, E, F – Žďár nad Sázavou – Staré město; B–D – Počátky – Palackého náměstí. Photo by K. Těsnohlídková, K. Slavíček (black scale in cm, red in mm).

Obr. 24. *Detaily různých druhů neplastických příměsí v keramice. Křemen v písčité příměsi. A – Na povrchu jemné keramické hmoty; B – na povrchu včetně velkého zrna s prasklinami vzniklými během výpalu; C – na nábrusu jemné keramické hmoty; D – na nábrusu středně zrnité keramické hmoty; E – patrně šamotové ostřivo v hmotě zásobnice; F – vyhořelá organická příměs na povrchu keramiky. A, E, F – Žďár nad Sázavou – Staré město; B–D – Počátky – Palackého náměstí. Foto K. Těsnohlídková, K. Slavíček (černé měřítko v cm, červené v mm).*

1.3 Shaping of vessels

Shaping traces on vessel walls

These are typically found on the inner sides of fragments; their occurrence on the outer walls is rather rare. There are also instances of their occurrence on both the inner and outer sides of fragments (Tab. 12, 13, Fig. 25–27). The location of these traces can also be followed on vessels in assemblages with large preserved fragments or with intact vessels (in the upper, middle or lower part of the vessel).

Term	Scope	Description	Fig.
Vacuoles	l	vacuoles of small hollows created by filling the joints between coils – they are clearly demarcated, typically deep and occur cyclically in specific intervals	*25d, g; 27d, e*
Lines	l	connections between coils/coil lines in the form of thin grooves or pressure lines resulting from pressure at the point of imperfectly joined coils	*25e–h; 27d–f*
Depressions	ao	irregular decreases in wall thickness – linear depressions between coils, which are reflected in the unevenness of the wall thickness and are best visible on the broken edge of potsherds, occur cyclically according to the thickness of the coils and are relatively sharply demarcated	*25e, f, h–j*
Dents	l	finger impressions at the joints of coils	*25h; 27c, g, h*
Rings	ao	symmetric undulations in walls creating transverse grooves in the wall, which correspond to the laying of fingers during rotation with varying pressure – the transition is rounded, in contrast to depressions (with fast rotation, the space between the rings is irregular, and drops of clay may be present on it; the rings are regular when a slower, more careful approach is employed)	*26c, d, g; 27d, f*
Grooves	ao	cyclical traces of fingerprints caused by papillary lines, or traces of the employed tool	*26e–h; 27c, d, g, h*
Incisions	l	incisions caused by the movement of nonplastic particles in the wall, possibly with a grain at the end of the incision	*26h, i; 27h*
Regular wall	ao	an even wall typical for wheel-thrown pottery	*26e, f*
Depressions/ Rings	ao	when it is not possible to decide on one or the other	*27c–e, h*
Bend	ao	vertical bending in 'fishbone' form caused by the upward movement of the clay during rotation	*27g*
Pulls	ao	vertical or oblique direction, traces of pulling the vessel or a part of it upwards from one piece	*27h*
Other		description in note or can be added to list, marks can be combined	

Tab. 12. Marks typically on the inner walls of vessels related to the forming technique with the use of rotation Scope: l – local; ao – all over.

Tab. 12. *Znaky zpravidla na vnitřních stěnách nádob související s technikou formování s využitím rotace. Rozsah: l – lokální; ao – plošné.*

Term	Scope	Description
Slab-joint	l	Slabs: joints between slabs (slab-built pottery)
Form-impression/ joint	ao/l	Form: incisions or impressions from contact with form or with the layer between the form and the vessel (possibly supplemented with grooves from finger pressure), impressions of joints between form parts
Other		description in note or can be added to list

Tab. 13. Marks typically on the inner walls related to the forming technique without the use of rotation; not commonly encountered on medieval pottery. Scope: l – local; ao – all over.

Tab. 13. *Znaky zpravidla na vnitřních stěnách nádob související s technikou formování bez využití rotace, na středověké keramice se s nimi běžně nesetkáme. Rozsah: l – lokální; ao – plošné.*

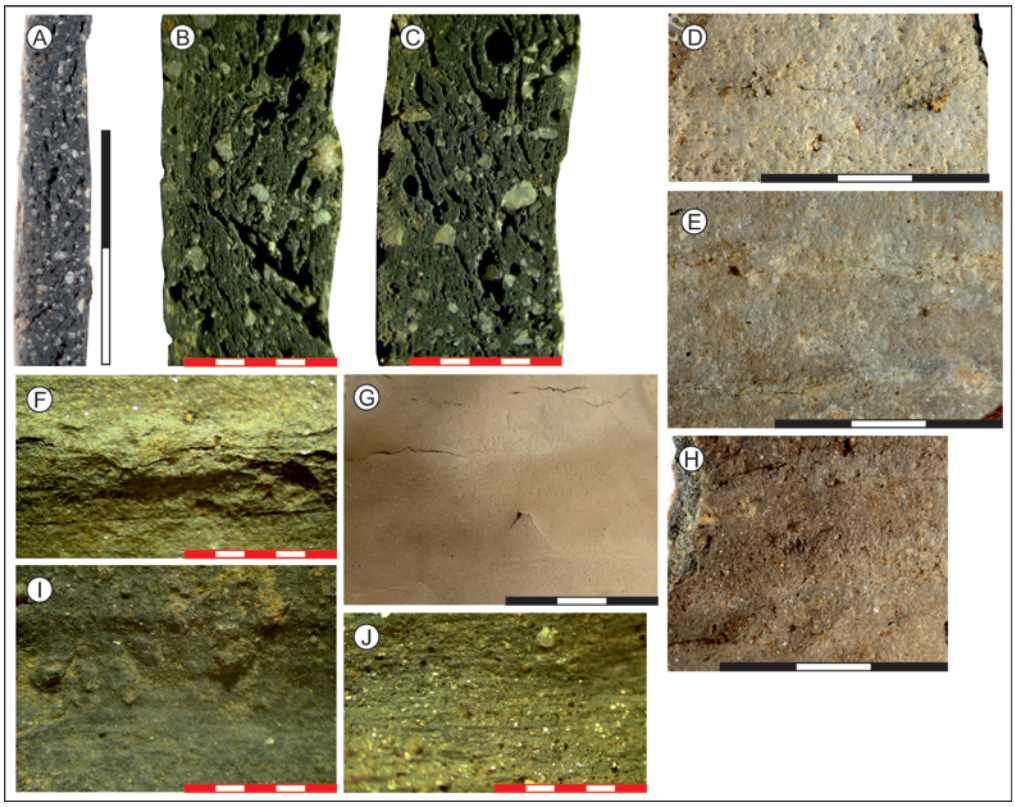


Fig. 25. Marks on the inner walls and polished sections of the wall testifying to the production of pottery from coils with the use of slow rotation. A–C – Specific orientation of pores and temper according to coils in the ceramic fabric; D – vacuoles; E, F – lines, depressions; G – vacuole, lines; H – lines, dents and depressions; I – depressions at the joints of coils on graphite pottery; J – depression at joints of coils on mica pottery. A–F, H – Počátky – Palackého náměstí; I, J – Žďár nad Sázavou – Staré město; G – experimental pottery. Photo by K. Těsnohlídková, K. Slavíček (black scale in cm, red in mm).

Obr. 25. *Znaky na vnitřních stěnách a nábrusech kolmých řezů stěnou svědčící o výrobě keramiky z válků s využitím pomalé rotace. A–C – Specifická orientace pórů a ostřiva podle válků v keramické hmotě; D – vakuoly; E, F – linie, deprese; G – vakuola, linie; H – linie, prohlubně a deprese; I – deprese v místech spojů válků na grafitové keramice; J – deprese v místech spojů válků na slídové keramice. A–F, H – Počátky – Palackého náměstí; I, J – Žďár nad Sázavou – Staré město; G – experimentální keramika. Foto K. Těsnohlídková, K. Slavíček (černé měřítko v cm, červené v mm).*

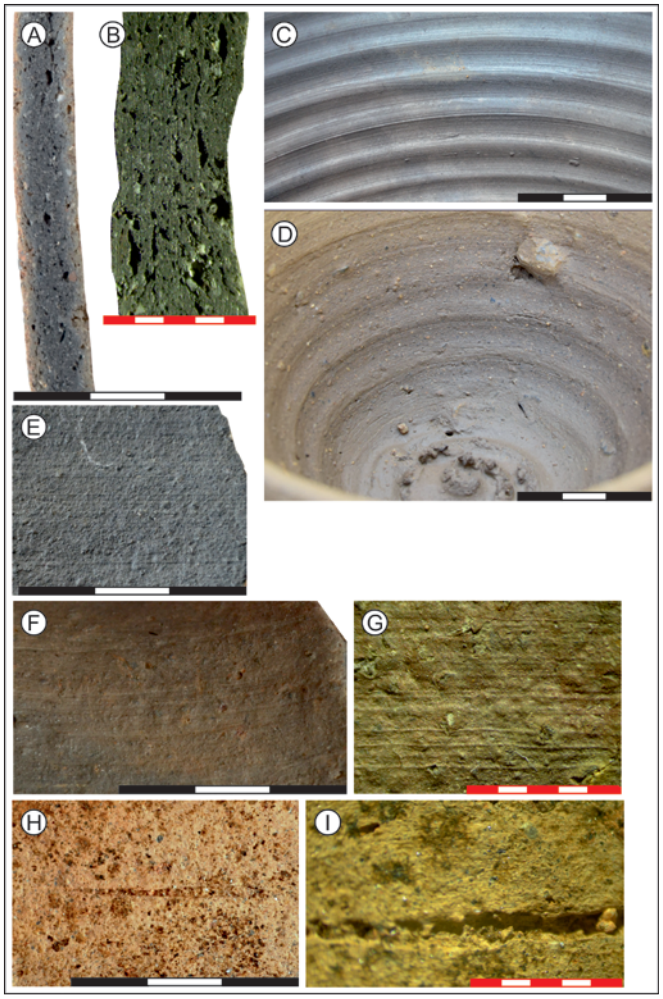


Fig. 26. Marks on the inner walls and polished sections of the walls of vessels turned from a single piece of clay. A, B – Polished sections – regular structure, lengthwise pores and their orientation; C, D – rings related to finger pressure on clay during turning; E–F – imprints of papillary lines or tools in the form of grooves in clay of varying coarseness; G – grooves and rings; H, I – incisions caused by the movement of grains of nonplastic inclusion. A, B, E, G–I – Počátky – Palackého náměstí; C, D – experimental pottery; F – Žďár nad Sázavou – Staré město. Photo by K. Těsnohlídková, K. Slavíček (black scale in cm, red in mm).

Obr. 26. *Znaky na vnitřních stěnách a nábrusech kolmých řezů stěnou nádob vyrobených z jednoho kusu hmoty vytáčením. A, B – Nábrusy – pravidelná struktura, podélné póry a jejich orientace; C, D – prstence související s tlakem prstů na hmotu při vytáčení; E–F – otisky papilárních linií či nástroje v podobě drážek na různě hrubé keramické hmotě; G – drážky a prstenec; H, I – rýhy způsobené přesunem zrn neplastické příměsi. A, B, E, G–I – Počátky – Palackého náměstí; C, D – experimentální keramika; F – Žďár nad Sázavou – Staré město. Foto K. Těsnohlídková, K. Slavíček (černé měřítko v cm, červené v mm).*

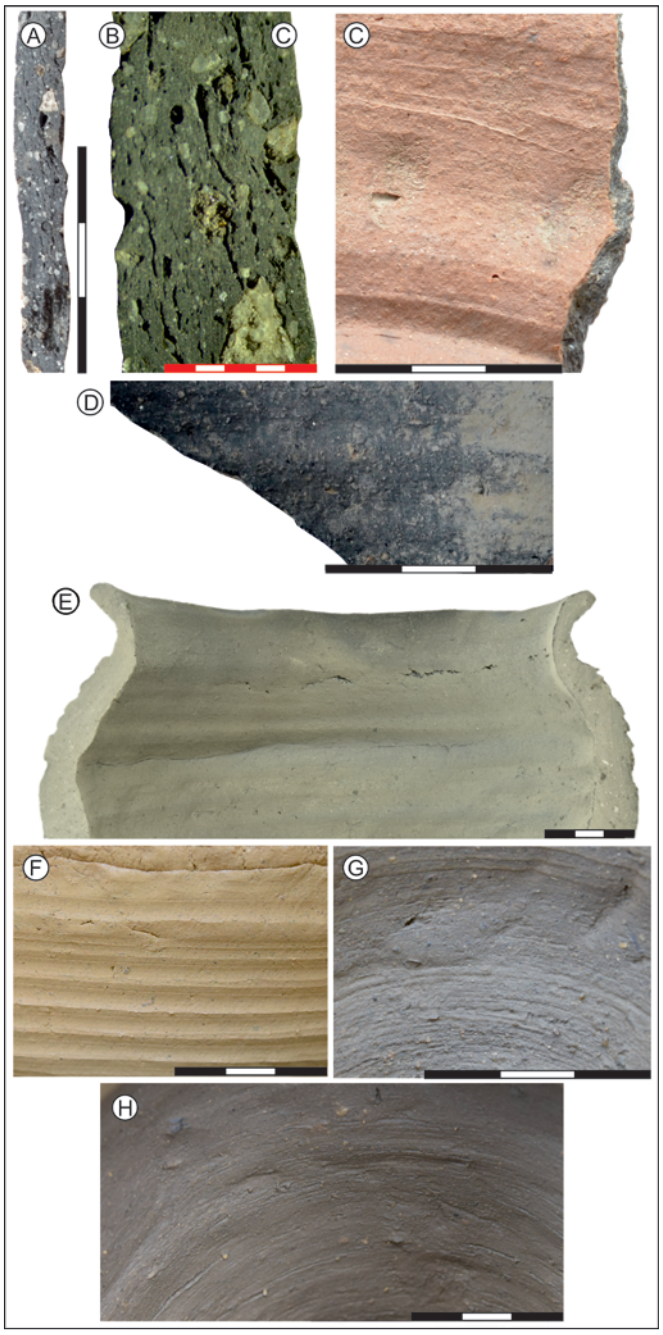


Fig. 27. Combination of marks proving at least the partial use of rotating kinetic energy and also the presence of coils in the vessel walls. A, B – Orientation of pores and nonplastic inclusions on polished sections; C – dents, depressions/rings, grooves; D – vacuoles, lines, rings/depressions, grooves; E – lines, vacuoles, depressions/rings; F – lines, rings; G – dents, grooves; H – dents, grooves, incisions, rings/depressions. A, B, D – Žďár nad Sázavou – Staré město; C – Počátky – Palackého náměstí; E–I – experimental pottery. Photo by P. Duffek, K. Těsnohlídková (black scale in cm, red in mm).

Obr. 27. *Kombinace znaků dosvědčující aspoň částečné využití rotační kinetické energie a zároveň přítomnost válků ve stěnách nádob. A, B – Orientace pórů a neplastických příměsí na nábrusech; C – prohlubně, deprese/prstence, drážky; D – vakuola, linie, prstence/deprese, drážky; E – linie, vakuoly, deprese/prstence; F – linie, prstence; G – prohlubně, drážky; H – prohlubně, drážky, rýhy, prstence/deprese, A, B, D – Žďár nad Sázavou – Staré město; C – Počátky – Palackého náměstí; E–I – experimentální keramika. Foto P. Duffek, K. Těsnohlídková (černé měřítko v cm, červené v mm).*

Techniques serving to modify wall thickness of vessels

Techniques serving to modify the wall thickness of vessels are characterised by traces most frequently apparent on the inner walls of the lower parts of vessels (Tab. 14, Fig. 28).

Term	Description	Fig.
Compression	compression incisions – oblique rippling – 'over-turning' of pottery – oblique rippling of clay, most often in narrowed parts of the vessel interior	*29a, b*
Crack	horizontal crack at joints between coils	*29c*
Fissure	vertical or oblique fissures in the wall caused by the movement of the clay	*29d*
Fine fissures	at certain height levels inside the vessel, vertical or oblique, related to fast production of the vessel or as a result of the insufficient plasticity/hardening of clay	*29e*
Horizontal fracture	found on larger fragments, the fracture occurred horizontally along the coil	
Transverse/ vertical fracture	found on larger fragments, the fracture occurred across the vessel	*29f*
Incisions	irregular and substantial incisions occurring on only part of the vessel	
Deformation	the shape of the vessel is irregular due to denting/ sagging of part of the wall	
Denting	denting by finger/fingernail	
Impression	finger/fingernail impression	
Other	description in note or can be added to list	

Tab. 14. Overview of traces of techniques related to thinning vessel walls.
Tab. 14. *Přehled stop po technikách souvisejících se zeslabováním stěn nádob.*

Body – production defects

Production defects can occur on the inner and outer wall of the vessel or can penetrate the entire wall (Tab. 15, Fig. 29).

Term	Description	Fig.
Compression	compression incisions – oblique rippling – 'over-turning' of pottery – oblique rippling of clay, most often in narrowed parts of the vessel interior	*29a, b*
Crack	horizontal crack at joints between coils	*29c*
Fissure	vertical or oblique fissures in the wall caused by the movement of the clay	*29d*
Fine fissures	at certain height levels inside the vessel, vertical or oblique, related to fast production of the vessel or as a result of the insufficient plasticity/hardening of clay	*29e*
Horizontal fracture	found on larger fragments, the fracture occurred horizontally along the coil	
Transverse/ vertical fracture	found on larger fragments, the fracture occurred across the vessel	*29f*
Incisions	irregular and substantial incisions occurring on only part of the vessel	
Deformation	the shape of the vessel is irregular due to denting/ sagging of part of the wall	
Denting	denting by finger/fingernail	
Impression	finger/fingernail impression	
Other	description in note or can be added to list	

Tab. 15. Defects in connection with the process of forming the vessel body.
Tab. 15. *Vady vzniklé ve spojitosti s procesem formování těla nádoby.*

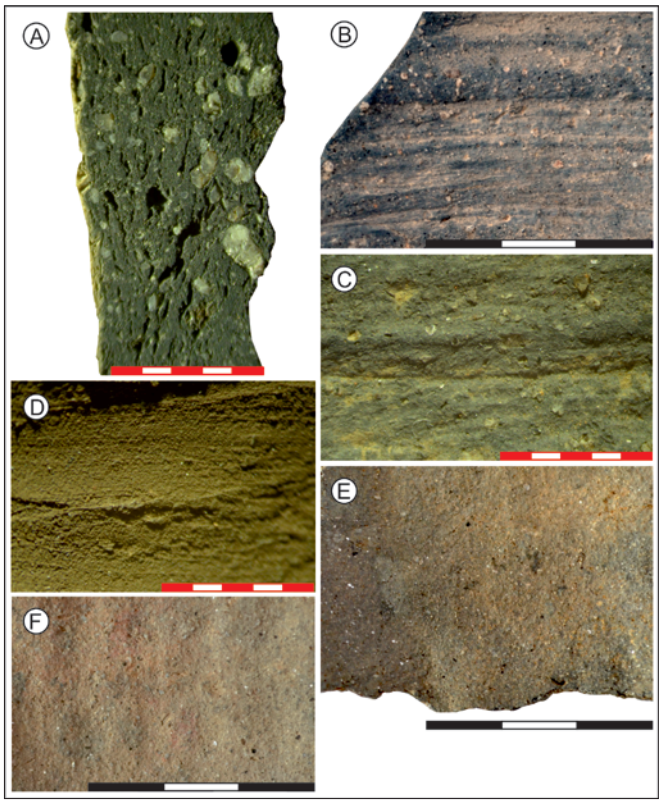


Fig. 28. Traces of the thinning of walls by turning or squeezing. A – Turning of the inner wall of pottery on polished section; B, C – typical 'notches' from turning; D – traces of thinning of wall by turning on experimental pottery – notches are coarser at the beginning; E, F – wall tapered by squeezing – most often in the lower part of vessels. A–C – Žďár nad Sázavou – Staré město; D – experimental pottery; E, F – Počátky – Palackého náměstí. Photo by K. Těsnohlídková, K. Slavíček (black scale in cm, red in mm).

Obr. 28. *Stopy zeslabování stěn soustružením či vymačkávání. A – Soustružení vnitřní stěny keramiky na nábrusu; B, C – typické „zářezy" po soustružení; D – stopy zeslabení stěny soustružením na experimentálně vyrobené keramice – na začátku jsou zářezy hlubší; E, F – stěna zúžená vymačkáváním – nejčastěji ve spodní části nádob. A–C – Žďár nad Sázavou – Staré město; D – experimentální keramika; E, F – Počátky – Palackého náměstí. Foto K. Těsnohlídková, K. Slavíček (černé měřítko v cm, červené v mm).*

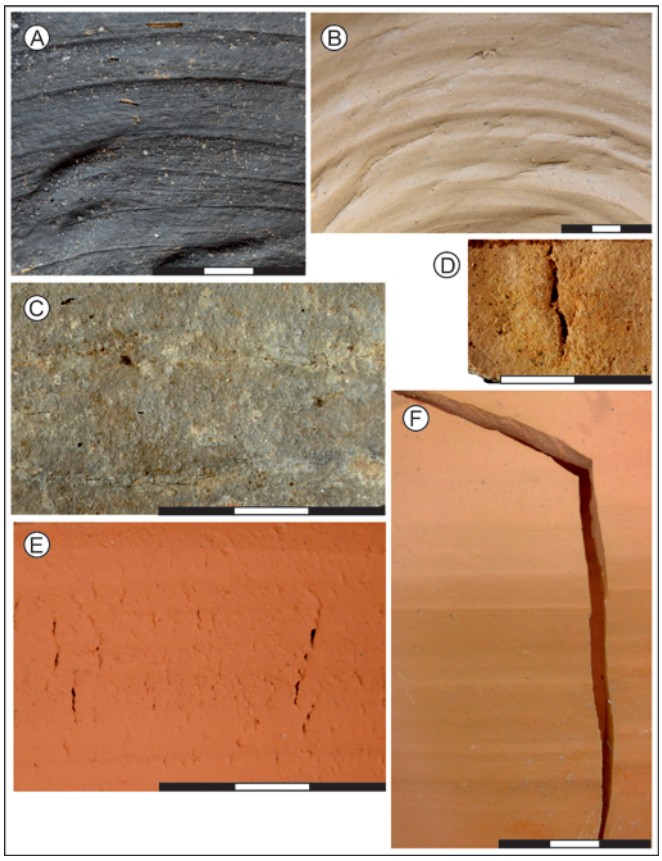


Fig. 29. Defects on vessel bodies related to the forming technique. A, B – Compression creases resulting from the movement of clay during turning; C – horizontal cracks at the joints of coils; D – fissure created on the inner wall of vessel during turning; E – fine fissures created during forming and caused by insufficient plasticity or inadequately hardened clay; F – vertical break/crack in the vessel body typical for vessels made from a single piece of clay. A, C – Žďár nad Sázavou – Staré město; B, E, F – experimental pottery; D – Počátky – Palackého náměstí. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 29. *Vady na tělech nádob související s formovací technikou. A, B – Komprimační záhyby vzniklé přesunem hmoty při vytáčení; C – horizontálně vedené praskliny v místech spojů válků; D – trhlina vzniklá ve vnitřní stěně nádoby při vytáčení; E – jemné trhliny vzniklé při formování a způsobené nedostatečně plastickou, příp. nedostatečně uzrálou keramickou hmotou; F – vertikální lom/prasklina procházející tělem nádoby typická pro nádobu vyrobenou z jednoho kusu hmoty. A, C – Žďár nad Sázavou – Staré město; B, E, F – experimentální keramika; D – Počátky – Palackého náměstí. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

Bottom – outer side

Traces from the technology of forming on the outer side of the bottom occur during the forming of the vessel or during its removal from the wheel and could document the method of securing the vessels to the forming device (Tab. 16, Fig. 30).

Term	Description	Fig.
Cutting off with knife	straight parallel traces from cutting	*30a*
Cutting off with string	conchoidal traces from cutting	*30b*
Potter's mark	typically in the middle of the bottom, can be characterised by some type of deformation, thus documenting a series of vessels from one production device or could document wear on the production device	*30c, d*
Technological marks	mark related to the form of the upper plate of the production device, perhaps documenting a series of vessels from one production device	
Wheel axis impression	a specific technological mark in the middle of the bottom is an impression of the wheel axis – it can vary in its is visibility and document the gradual wear of the production device	
Impression of wooden board	a specific technological mark, an impression of the wood structure on the bottom or its part from the production surface, can be characteristic and testify to a series of vessels from one production device	*30e*
Dusting	traces of dusting with sand or other material on the bottom – preserved grains or their imprints	*30f, g*
Coarse bottom without traces	coarse bottom – production traces may be wiped off	*30h*
Smooth bottom without traces	smooth bottom without visible production traces	*30i*
Other	description in note or can be added to list	

Tab. 16. Traces of forming on the outer side of the bottom.

Tab. 16. *Stopy po formování na vnější straně dna.*

Fig. 30. Examples of traces on the outer sides of the bottom related to the technique used to attach/remove vessels to/from the production device. A – Removal by knife; B – removal by string; C, D – potter's signs; E – wheel imprint; F, G – dusting; H – coarse bottom; I – smooth bottom. A, G – Experimental pottery; B – Lichnice – Ohrada; C, F, H, I – Žďár nad Sázavou – Staré město; D, E – Počátky – Palackého náměstí. Photo by P. Duffek, K. Těsnohlídková (black scale in cm, red in mm).

Obr. 30. *Příklady stop na vnějších stranách dna související s technikou použitou k připevnění/odejmutí nádob k výrobnímu zařízení. A – Odříznutí nožem; B – odříznutí strunou; C, D – hrnčířské značky; E – otisk desky; F, G – podsýpka; H – hrubé dno; I – hladké dno. A, G – Experimentální keramika; B – Lichnice – Ohrada; C, F, H, I – Žďár nad Sázavou – Staré město; D, E – Počátky – Palackého náměstí. Foto P. Duffek, K. Těsnohlídková (černé měřítko v cm, červené v mm).*

Bottom – inner side

Traces from the technology of forming the bottom visible on its inner part created during the forming of the vessel under the influence of the technique chosen for forming the bottom (Tab. 17, Fig. 31). Examples of marks in the forming of inner walls can also be used in part.

Term	Description	Fig.
Lines	joints between coils in the form of thin incision or pressure lines resulting from pressure in places of the incomplete attachment of coils – they should be arched on the bottom (corresponding to the winding of the coils)	*31a*
Depressions	irregular decreases in the thickness of the bottom – arch-shaped depressions between coils on the bottom, best visible on a broken edge or cross-section, occur cyclically based on the thickness of the coils and are relatively sharp-edged – they should be arched on the bottom (corresponding to the winding of coils)	*31a*
Vacuoles	small hollows created by filling the joints between coils – they are clearly demarcated, typically deep and should be arched (corresponding to the winding of coils)	
Dents	finger impressions at the joints between coils – should be arched on the bottom (corresponding to the winding of coils)	
Grooves	cyclical traces of fingerprints caused by papillary lines, or traces of the employed tool (turning)	*31b*
Incisions	incisions caused by the movement of nonplastic particles on the surface of the bottom, possibly with a grain at the end of the incision (turning)	*31b*
Rings	concentric rings from the middle of the bottom – correspond to the placement of fingers during rotation, discernible to a varying extent – transition is rounded, unlike depressions (turning)	
Slightly rippled	slight concentric rippling of surface (turning)	*31c*

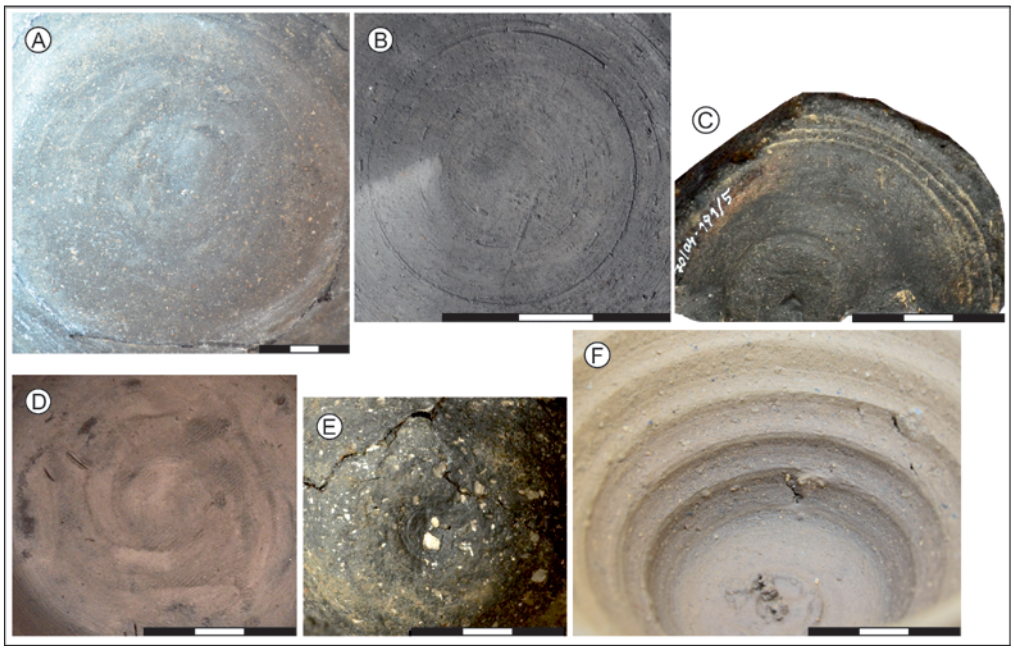


Fig. 31. Examples of traces from forming on the inner side of the bottom related to the technique for forming the bottom. A – Depressions and lines indicating a bottom wound from coils; B – grooves and incisions on the turned bottom from one piece; C – concentric slight rippling; D – central navel and rings; E – central circle; F – scroll corresponding to a bottom turned from a single piece of clay. A, D, E – Žďár nad Sázavou – Staré město; B, C, F – experimental pottery. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 31. *Příklady stop po formování na vnitřní straně dna související s technikou formování dna. A – Deprese a linie ukazující patrně na dno stočené z válků; B – drážky a rýhy na vytáčeném dně z jednoho kusu; C – koncentrické mírně zvlnění; D – středový pupek a prstence; E – středový kruh; F – šnek odpovídající dnu vytáčenému z jednoho kusu. A, D, E – Žďár nad Sázavou – Staré město; B, C, F – experimentální keramika. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

Term	Description	Fig.
Navel	raised centre of bottom (turning)	*31d*
Ring	raised ring around centre of bottom (turning)	*31e*
Scroll	protrusion in the middle of the bottom that continues to unwind (turning)	*31f*
Dimples	dents and dimples irregularly occurring next to one another (squeezing)	
Straight bottom	straight regular bottom without additional traces (made from a single piece – from a slab or turning)	
Depression/ Ring	when it is not possible to decide on one or the other	
Sign	sign pressed from below – imprint from production device	
Other	description in note or can be added to list	

Tab. 17. Traces of forming on the inner side of the bottom.
Tab. 17. *Stopy po formování na vnitřní straně dna.*

Traces on the circumference of the bottom

Traces from the technology of forming the bottom visible at the circumference of the bottom are created when forming the transition between the bottom and the body or when attaching or removing the vessel from the production device (Tab. 18, Fig. 32).

Term	Description	Fig.
Coil on bottom	distinctive 'coil/thickening' above the bottom	*32a, b*
Pasted bottom	pasted bottom – denting along circumference of bottom	*32c*
Cutting off	on bottoms only attached to the production device along their circumference (outer circumference of bottom), or if the vessel was attached to the wheel using an additional strip along the circumference, which was subsequently cut off upon the completion of production (at the transition from the bottom to the body)	
Strip	added strip along the circumference serving for attachment to the production device, which was not subsequently removed or only partially removed	*32d*
Border	more pronounced border around the bottom related to attachment to the production device	*32e, f*
Other	description in note or can be added to list	

Tab. 18. Traces of forming along the circumference of the bottom.
Tab. 18. *Stopy po formování po obvodu dna.*

Defects – bottom

Defects appearing on the bottom as the result of its forming occur during forming, drying or firing (Tab. 19, Fig. 33).

Term	Description	Fig.
Annular crack – circumference	annular crack(s) along the circumference of the bottom	33a
Annular crack on the surface of the bottom	annular crack/arch-shaped cracks on the surface (inner or outer) of the bottom	33b
Transverse crack	resulting from shrinkage during drying or firing on bottoms made from a single piece of clay, can have an S-shaped form	33c
Compression	inner side of bottom, over-turning of clay	33d
Uneven bottom	pronounced and irregular deviations in the thickness of various parts of the bottom	
Other	description in note or can be added to list	

Tab. 19. Defects occurring in connection with forming the bottom or its attachment to the body of the vessel.
Tab. 19. *Vady vzniklé v souvislosti s formováním dna či jeho napojením na tělo nádoby.*

Note – forming

Additional information and observations concerning traces from forming.

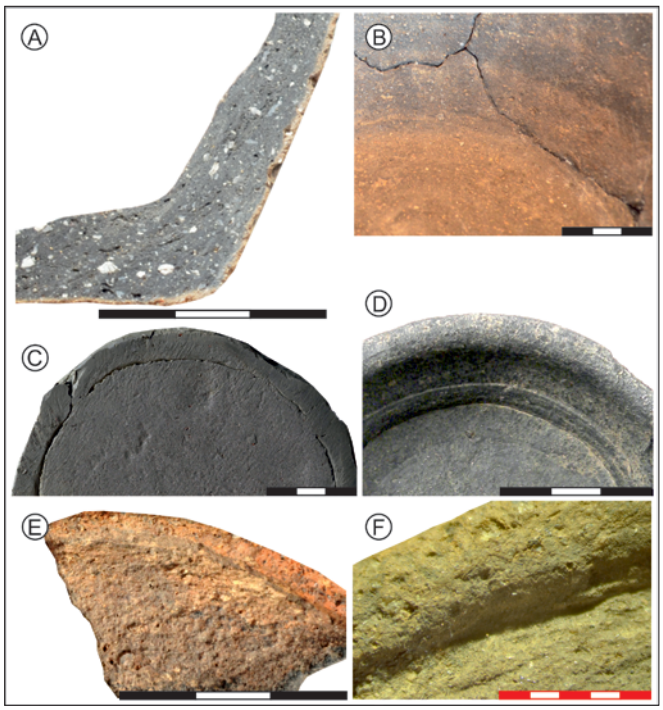


Fig. 32. Selected traces at the transition from the bottom to the body. A, B – Pronounced coil on bottom; C – pasted bottom; D – added strip; E, F – border at the edge of the side of the bottom. A, B, E, F – Žďár nad Sázavou – Staré město; C – experimental pottery; D – Jihlava. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 32. *Vybrané stopy na přechodu dna a těla. A, B – Výrazný válek nad dnem; C – vlepené dno; D – přídatný pásek; E, F – lem na kraji spodní strany dna. A, B, E, F – Žďár nad Sázavou – Staré město; C – experimentální keramika; D – Jihlava. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

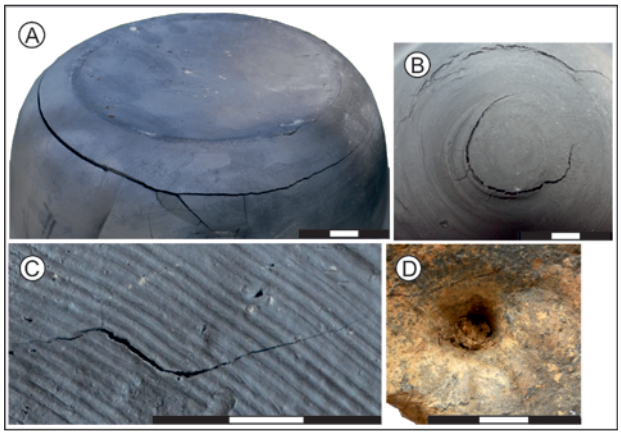


Fig. 33. Traces on bottoms created in connection with the forming technique. A – Annular crack around the circumference created during firing, probably as a result of the insufficient drying of the thickest part of the clay at the transition from the bottom to the body; B – annular crack in the surface of the bottom created during firing (insufficient drying of overly thick bottom); C – transverse S-shaped crack of a shape characteristic for fast drying or fast temperature increase during firing, typical for bottom made from a single piece of clay; D – compression creases on the inner bottom of a bell-shaped lid resulting from the movement of the clay during forming. A–C – Experimental pottery; D – Jihlava. Photo by K. Těsnohlídková (scale in cm).

Obr. 33. *Stopy na dnech vzniklé v souvislosti s technikou formování. A – Prstencová prasklina po obvodu vzniklá při výpalu patrně vlivem nedostatečného proschnutí silnější vrstvy keramické hmoty v místě přechodu těla a dna; B – prstencová prasklina v ploše dna vzniklá při výpalu (nedostatečné proschnutí příliš tlustého dna); C – příčná prasklina esovitého tvaru charakteristická pro rychlé sušení nebo rychlý teplotní nástup při výpalu, typická pro dna vyrobená z jednoho kusu hmoty; D – komprimační záhyby na vnitřním dně zvonovité poklice vzniklé přesouváním hmoty při formování. A–C – Experimentální keramika; D – Jihlava. Foto K. Těsnohlídková (měřítko v cm).*

1.4 Surface treatment

Surface coarseness

Determined on the basis of a combination of touch and observation on the outer side of the fragment (Tab. 20, Fig. 34).

Symbol	Description	Fig.
L	very smooth – polished	*34a*
H	smooth – surface of worked/planed wood	*34b*
D	mildly rough – fine sandpaper	*34c*
K	sandy – clear grains of temper typically up to 0.5 mm	*34d*

Tab. 20. Scale for determining the surface roughness of pottery.
Tab. 20. *Škála pro určení hrubosti povrchu keramiky.*

Surface treatment

Macroscopic determination of the type of surface treatment (Tab. 21, Fig. 35–39). In certain cases, e.g. with engobe, it cannot be macroscopically determined with certainty – it is best to make a note and later verify using more detailed methods.

Symbol	Description
b	inner and outer surface
o	outer surface
i	inner surface
p	partial
s	stains
j	other (add to list or describe in note)

Tab. 21. Basic types of surface treatment for the High and Late Middle Ages.
Tab. 21. *Základní druhy povrchové úpravy pro vrcholný a pozdní středověk.*

Surface treatment – location

Where the surface treatment appears on a vessel/fragment, or in what form (Tab. 22).

Symbol	Description
b	inner and outer surface
o	outer surface
i	inner surface
p	partial
s	stains
j	other (add to list or describe in note)

Tab. 22. Description of location of surface treatment on pottery.
Tab. 22. *Popis umístění povrchové úpravy na keramice.*

Surface treatment – colour

Text field containing a basic determination of the colour of the surface glaze, or it is possible to enter the determination according to the chosen scale, e.g. the Munsell colour chart.

Surface – note

Additional information concerning the pottery surface, e.g. information on its disruption by post-depositional processes.

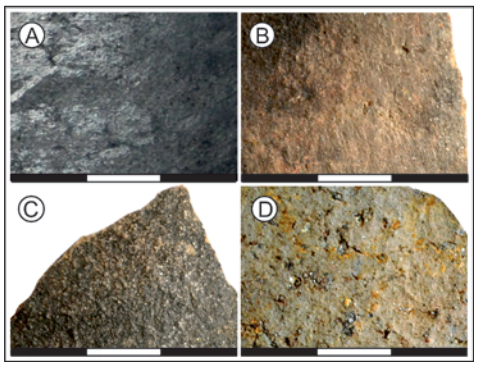


Fig. 34. Various degrees of coarseness of the outer surface of the pottery. A – Very smooth, polished surface; B – smooth surface; C – mildly rough surface; D – sandy. A – Lichnice – Ohrada; B–D – Počátky – Palackého náměstí.
Photo by K. Těsnohlídková (scale in cm).

Obr. 34. *Různé stupně hrubosti vnějšího povrchu keramiky. A – Velmi hladký, leštěný povrch; B – hladký povrch; C – jemně drsný povrch, D – krupičkovitý. A – Lichnice – Ohrada; B–D – Počátky – Palackého náměstí. Foto K. Těsnohlídková (měřítko v cm).*

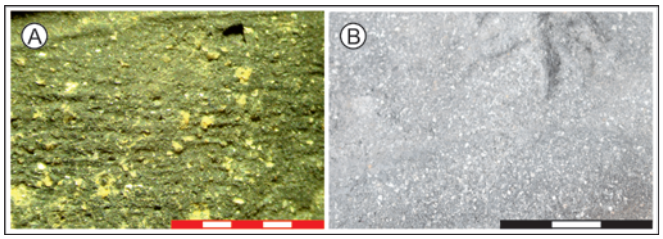


Fig. 36. Mica on surface of fragments. A – Concentration of mica on the surface of pottery, apparently of natural origin (naturally occurring mica in the clay; Žďár nad Sázavou – Staré město); B – mica surface treatment by means of a mica coating on experimentally produced stove tile (experimental pottery by A. Netopilová).
Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 36. *Slída na povrchu fragmentů. A – Koncentrace slídy na povrchu keramiky vzniklá patrně přirozeně (díky slídě obsažené v keramické hmotě; Žďár nad Sázavou – Staré město); B – poslídování pomocí slídnatého nátěru na experimentálně vyrobené kachli (experimentální keramika, A. Netopilová). Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

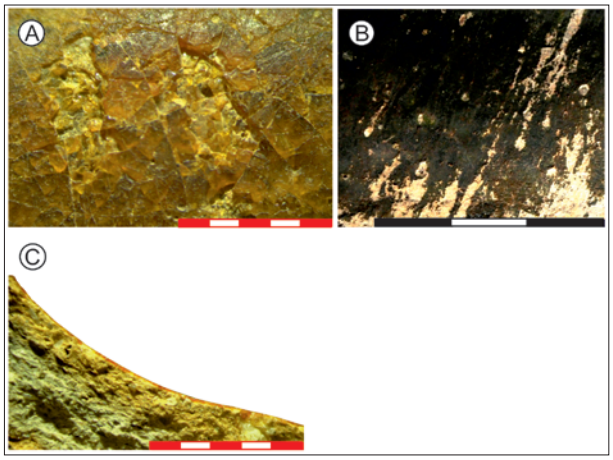


Fig. 38. Details of glaze on medieval pottery. A – Lead glaze containing sulphur on an alembic with a fine ceramic fabric; B – lead glaze on the inner side of potsherd; C – thin layer of glaze on polished section. A – Žďár nad Sázavou – Staré město; B, C – Počátky – Palackého náměstí. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 38. *Detaily glazur na středověké keramice. A – Olovnatá glazura s obsahem síry na alembiku z jemné hmoty; B – olovnatá glazura na vnitřní straně keramického fragmentu; C – tenká vrstva glazury na nábrusu. A – Žďár nad Sázavou – Staré město; B, C – Počátky – Palackého náměstí. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

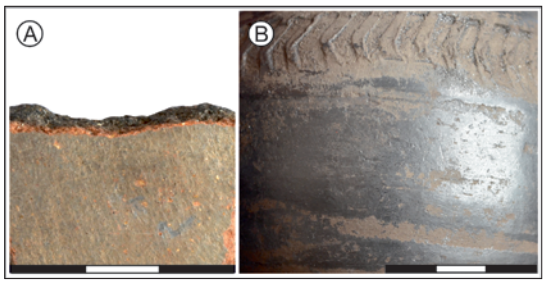


Fig. 35. Graphite coated pottery surface. A – Graphite coating on pottery with oxidised biscuit surface (Počátky – Palackého náměstí); B – experimentally produced graphite coated pottery. Photo by K. Těsnohlídková (scale in cm).

Obr. 35. *Potuhovaný povrch keramiky. A – Grafitový nátěr na keramice s oxidačním přežahem povrchu (Počátky – Palackého náměstí); B – experimentálně vyrobená potuhovaná keramika. Foto K. Těsnohlídková (měřítko v cm).*

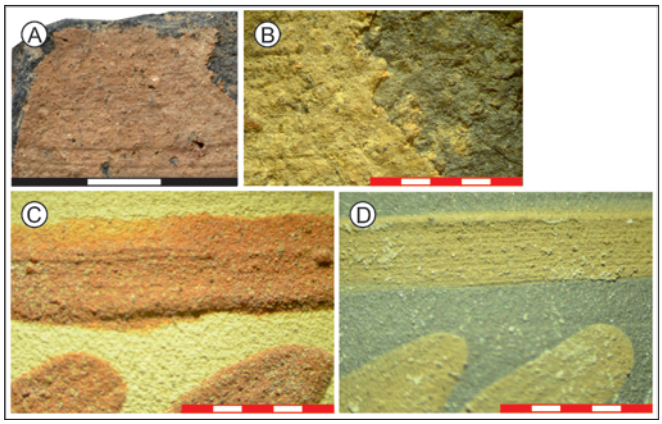


Fig. 37. Engobe and painting on pottery. A, B – Probably engobe on the surface of pottery – the flaking of the thin upper fine layer is visible. Painting on the principle of engobe – a different clay containing iron oxides is used for painting on a light ceramic fabric. C – Laboratory oxidation firing; D – field firing in kiln by smoking. A, B – Žďár nad Sázavou – Staré město; C, D – experimental pottery. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 37. *Engoba a malování na keramice. A, B – Patrně engoba na povrchu keramiky – je patrné odlupování tenké horní jemně vrstvy. Malování na principu engoby – na malování na světlou keramickou hmotu je použitá jiná hlína s obsahem oxidů železa. C – Laboratorní oxidační výpal; D – polní výpal v peci zakuřováním. A, B – Žďár nad Sázavou – Staré město; C, D – experimentální keramika. Foto. K. Těsnohlídková (černé měřítko v cm, červené v mm).*

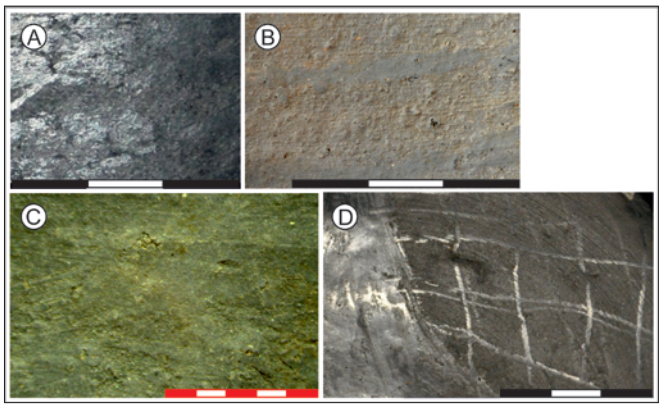


Fig. 39. Polishing of pottery surface. A – Polishing of entire surface in multiple directions; B, C – polished strips; D – polishing on experimental pottery. A – Lichnice – Ohrada; B, C – Počátky – Palackého náměstí; D – experimental pottery by M. Novák.
Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 39. *Leštění povrchu keramiky. A – Plošné leštění více směry; B, C – leštěné pruhy; D – leštění na experimentální keramice. A – Lichnice – Ohrada; B, C – Počátky – Palackého náměstí; D – experimentální keramika, M. Novák. Foto. K. Těsnohlídková (černé měřítko v cm, červené v mm).*

Firing

The basic determination of firing is based on a determination of the atmosphere and changes during firing (Tab. 23, Fig. 40–49).

Symbol	Colour
1	white
2	beige
3	light grey
4	ochre
5	orange
6	brick red
7	light brown
8	medium brown
9	dark brown, brown-red

Tab. 23. Basic types of firing for pottery of the High and Late Middle Ages.

Tab. 23. *Základní druhy výpalu pro vrcholně a pozdně středověkou keramiku.*

Colour of oxidation firing of clay

Determined in the case of oxidation firing or the presence of an oxidation-fired layer on pottery with the use of a basic scale (Tab. 24).

Symbol	Colour
1	white
2	beige
3	light grey
4	ochre
5	orange
6	brick red
7	light brown
8	medium brown
9	dark brown, brown-red

Tab. 24. Basic colour scale for oxidation firing of clay.

Tab. 24. *Základní barevná škála pro oxidační výpal keramické hmoty.*

Hardness

Determined by picking at the surface of the potsherd with a fingernail/iron/glass, or the degree of sintering of the fabric (Tab. 25).

Sign	Description
s	soft – impression with fingernail
m	medium hard – impression with iron
h	very hard/ringing – impression with glass
p	partially sintered – 'semi-stoneware', stoneware matrix
m	sintered – stoneware

Tab. 25. Scale for determining the hardness of pottery. After Gregerová et al. 2010, 48.

Tab. 25. *Stupnice pro určení tvrdosti keramiky. Podle Gregerová et al. 2010, 48.*

Firing – defects

Defects on pottery that can be linked to firing – can be influenced by the clay matrix, the forming method, use, or transformation processes (Tab. 26, Fig. 50–52).

Firing – defects	Description	Fig.
Fine cracks in the surface	small cracks on the surface of the pottery can be caused by heat shock and the presence of certain inclusions in the pottery	*45a–c*
Crack – oblique	oblique crack in the wall of the vessel resulting from firing/drying – the appearance of the crack depends on the forming technology	*45d, e*
Crack – horizontal	horizontal crack in the wall of the vessel resulting from firing/drying – the appearance of the crack is often related to the forming technology	
Crack – vertical	vertical crack in the wall of the vessel resulting from firing/drying – its form is often related to the technology of forming	*45f*
Crack – bottom	crack on the bottom of the vessel resulting from firing/drying – its form is often related to the technology of forming	
Destruction of form	part of the vessel is missing due to cracking (only for whole vessels)	*45f*
Deformation of form by heat	bent rims, denting of walls as the result of high temperatures during firing	
Cracks around grains of quartz	the result of quartz inversion at 573°C	*46a, b*
Combustion of organic matter	Negative from the combustion of organic inclusion	*46c*
Partially combusted graphite grain on the surface	graphite inclusions in the clay combust at certain temperatures during oxidation firing	*46d, e*
Surface crumbling	heavily cracked and crumbly surface, probably due to unsuitable inclusions in the clay	*46f*
Imprint – smoking	depending on how the vessels were stacked on each other in the kiln (mainly with smoked pottery, can be described in greater detail in note)	*47b, c*
Flame	traces from the position of the vessel in the kiln (mainly with smoked pottery)	*47d, e*
Imperfect smoking	caused by the overlapping of vessels in the kiln or imperfect smoking (with smoked pottery)	*47a–c, e, f*
Other	description in note or can be added to list, marks can be combined	

Tab. 26. Defects related to the firing technology of pottery.

Tab. 26. *Vady související s technologií výpalu keramiky.*

Firing – note

Additional information concerning marks related to the firing of pottery.

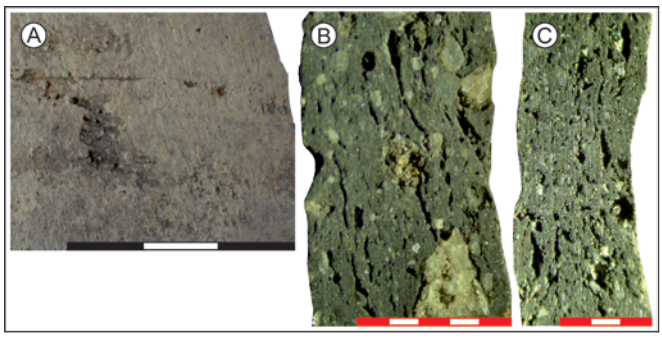


Fig. 40. Reduction firing. A – Surface of reduction-fired pottery; B, C – polished sections of reduction-fired pottery. A – Žďár nad Sázavou – Staré město; B, C – Počátky – Palackého náměstí. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 40. *Redukční výpal. A – Povrch redukčně pálené keramiky; B, C – nábrusy redukčně pálenou keramikou. A – Žďár nad Sázavou – Staré město; B, C – Počátky – Palackého náměstí. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

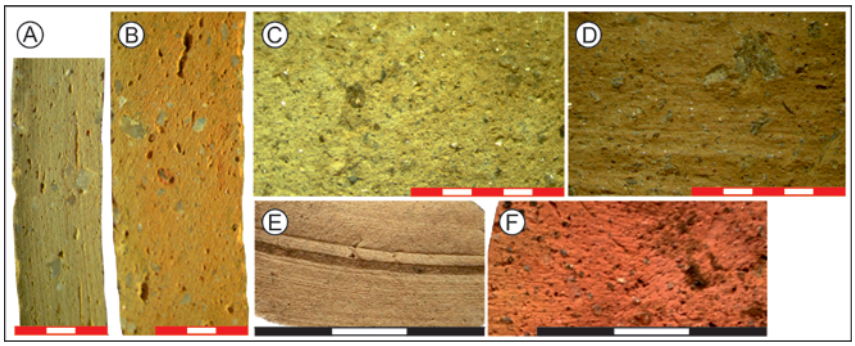


Fig. 41. Various shades of ceramic fabric with oxidation firing. A, B – On polished sections of pottery; C–F – on surface of pottery. A–B – Počátky – Palackého náměstí; C–D – Žďár nad Sázavou – Staré město; E, F – Lichnice – Ohrada. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 41. *Různé odstíny keramických hmot při oxidačním výpalu. A, B – Na nábrusech keramiky; C–F – na povrchu keramiky. A, B – Počátky – Palackého náměstí; C, D – Žďár nad Sázavou – Staré město; E, F – Lichnice – Ohrada. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

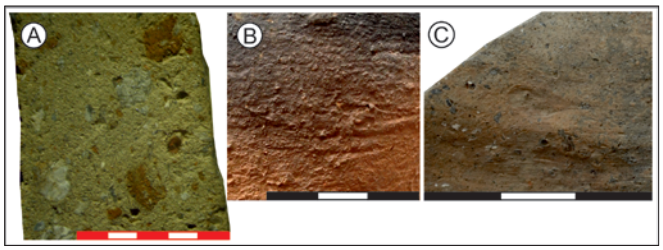


Fig. 42. Mixed firing appears in the colour spectrum of oxidation and reduction. A, B – Experimental pottery; C – Žďár nad Sázavou – Staré město. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 42. *Smíšený výpal se projevuje barevným spektrem oxidace a redukce. A, B – Experimentální keramika; C – Žďár nad Sázavou – Staré město. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

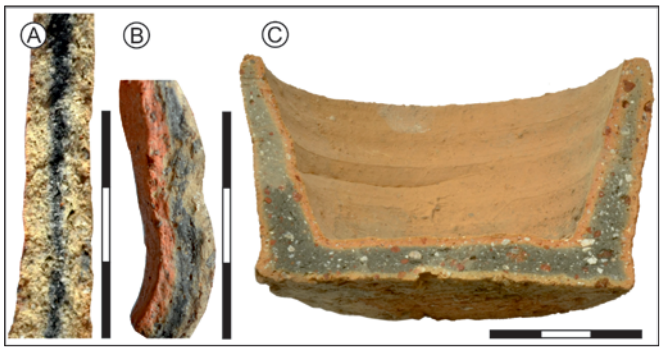


Fig. 43. Black core is visible on a fractured edge or polished section of pottery – inorganic inclusions from the core of the ceramic fabric did not combust during firing. A – Počátky – Palackého náměstí; B – Žďár nad Sázavou – Staré město; C – experimental pottery. Photo by P. Duffek, K. Těsnohlídková (black scale in cm, red in mm).

Obr. 43. *Černé jádro je patrné na lomu či nábrusu keramiky – při výpalu nedošlo k vyhoření organických příměsí z jádra střepu. A – Počátky – Palackého náměstí; B – Žďár nad Sázavou – Staré město; C – experimentální keramika. Foto P. Duffek, K. Těsnohlídková (černé měřítko v cm, červené v mm).*

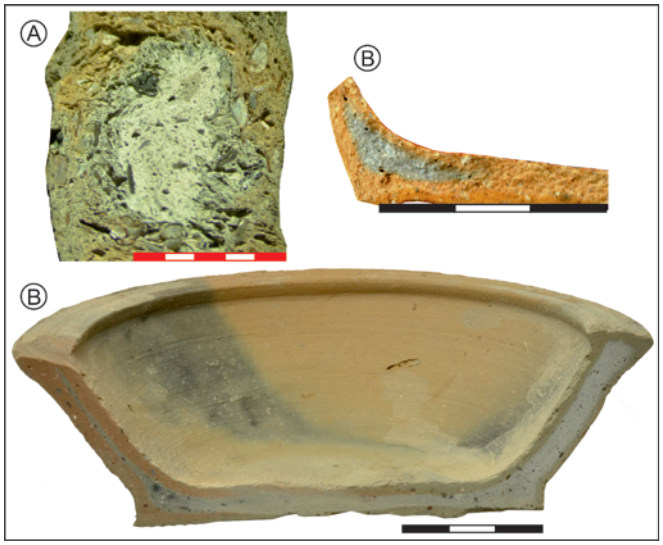


Fig. 44. White or light grey core can appear with pottery of various firings. A – Polished section of pottery with mixed firing (Žďár nad Sázavou – Staré město); B – fractured oxidation-fired pottery with inner glaze (Počátky – Palackého náměstí); C – experimental pottery. Photo by P. Duffek, K. Těsnohlídková (black scale in cm, red in mm).

Obr. 44. *Bílé, příp. světle šedé jádro se může projevit u různě pálené keramiky. A – Nábrus keramiky se smíšeným výpalem (Žďár nad Sázavou – Staré město); B – lom oxidačně pálené keramiky s vnitřní glazurou (Počátky – Palackého náměstí); C – experimentální keramika. Foto P. Duffek, K. Těsnohlídková (černé měřítko v cm, červené v mm).*

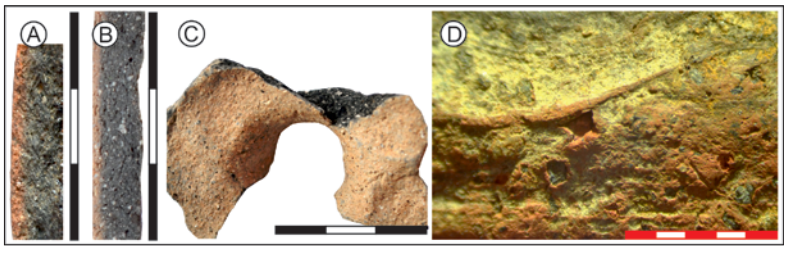


Fig. 45. Oxidised biscuit firing. A – Outer surface on fractured edge; B – outer surface on polished section of pottery; C – oxidised biscuit firing of inner and outer surface on a fragment of a flagon spout; D – detail of oxidised biscuit firing of surface, including combusting grains of graphite. A, B – Počátky – Palackého náměstí; C, D – Žďár nad Sázavou – Staré město. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 45. *Oxidační přežah. A – Vnějšího povrchu na lomu keramiky; B – vnějšího povrchu na nábrusu keramiky; C – oxidační přežah vnitřního i vnějšího povrchu na fragmentu výlevky konvice; D – detail oxidačního přežahu povrchu včetně vyhořívajících zrn grafitu. A, B – Počátky – Palackého náměstí; C, D – Žďár nad Sázavou – Staré město. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

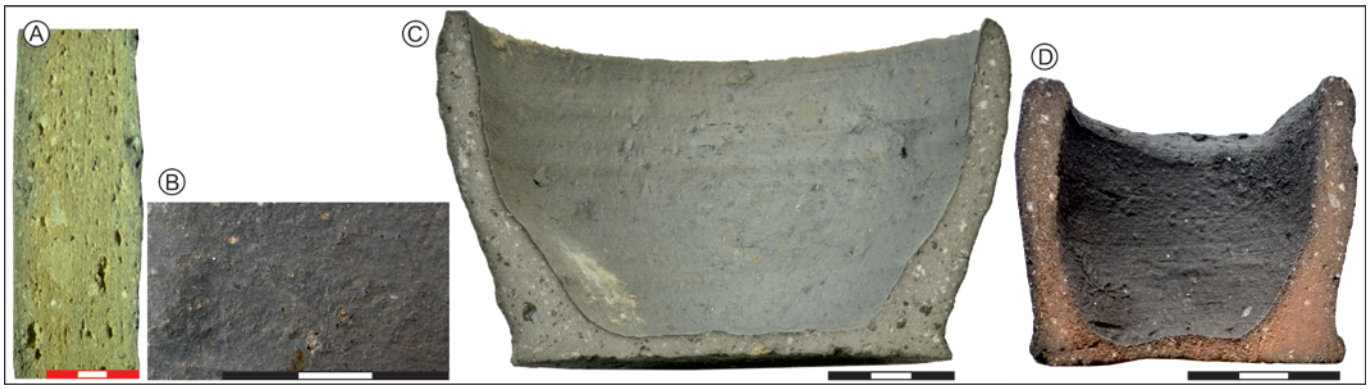


Fig. 46. Smoked pottery. A – Smoking of surface can be weak and minimally visible on polished sections; B – the surface of smoked pottery is medium grey to black; the core can be various colours depending on the type of clay and firing atmosphere – C – light grey core; D – orange core. A, B – Počátky – Palackého náměstí; C, D – experimental pottery. Photo by P. Duffek, K. Těsnohlídková (black scale in cm, red in mm).

Obr. 46. *Zakuřovaná keramika. A – Zakouření povrchu může být slabé a z nábrusů minimálně patrné; B – povrch zakouřené keramiky je středně šedý až černý; jádro může mít různé barvy podle druhu hmoty a atmosféry výpalu – C – světle šedé jádro; D – oranžové jádro. A, B – Počátky – Palackého náměstí; C, D – experimentální keramika. Foto P. Duffek, K. Těsnohlídková (černé měřítko v cm, červené v mm).*

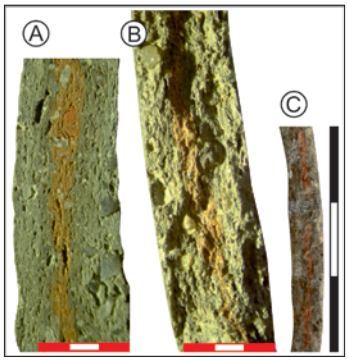


Fig. 47. False smoked pottery with thin oxidation cores. A – On a polished section; B, C – on the fractured edges of pottery. Počátky – Palackého náměstí. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 47. *Nepravá zakuřovaná keramika s tenkými oxidačními jádry. A – Nábrus; B, C – lomy keramiky. Počátky – Palackého náměstí. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

Fig. 48. Sandwich firing with dark core, light shell and dark surface of pottery. A, B – On the fractured edge of a body fragment; C – on the fractured edge of a handle fragment; D – on a polished section from the body. A, B, D – Počátky – Palackého náměstí; C – Žďár nad Sázavou – Staré město. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 48. *Sendvičový výpal s tmavým jádrem, světlými plášti a tmavým povrchem keramiky. A, B – Na lomu fragmentů výdutí; C – na lomu fragmentu ucha; D – na nábrusu výdutě keramiky. A, B, D – Počátky – Palackého náměstí; C – Žďár nad Sázavou – Staré město. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

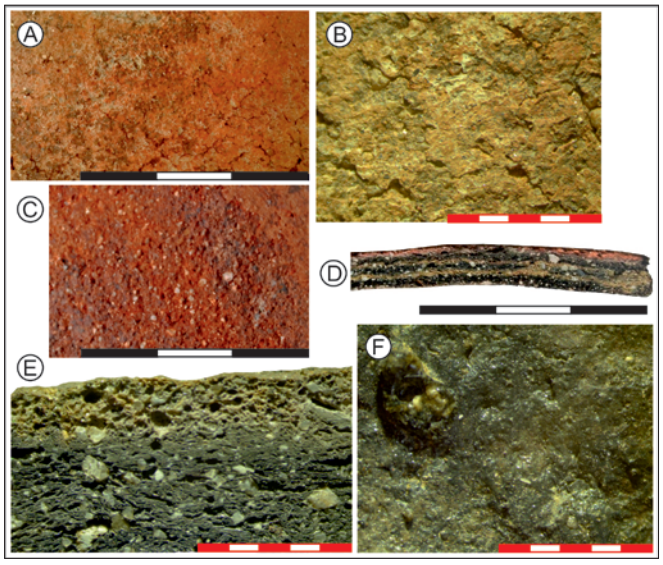


Fig. 49. Over-fired pottery. A, B – Surface of slightly over-fired pottery; C – surface of medium over-fired pottery – visible grains of melting quartz; D – polished section of medium over-fired pottery – coloured layers created on the potsherd profile; E, F – polished section and surface of heavily over-fired pottery. Počátky – Palackého náměstí. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 49. *Přepálená keramika. A, B – Povrch mírně přepálené keramiky; C – povrch středně přepálené keramiky – patrná natavující se zrna křemene; D – nábrus středně přepálené keramiky – barevné vrstvy vzniklé na profilu střepu; E, F – nábrus a povrch silně přepálené keramiky. Počátky – Palackého náměstí. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

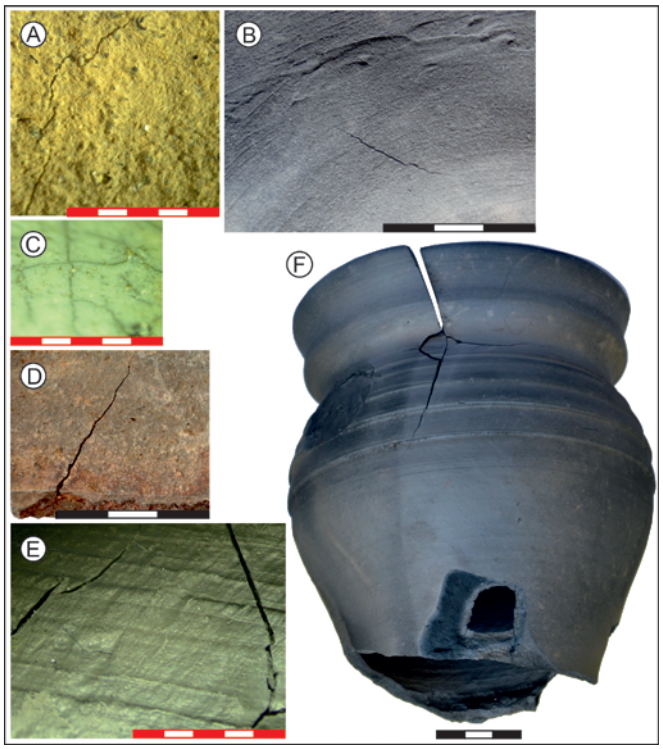


Fig. 50. Fissures and cracks from firing. Small fissures (A–C) to significant cracks (D, E) could appear on the surface in the case of higher temperature jumps than were appropriate for the relevant pottery clay; the pottery form was destroyed (F) in extreme cases. A, D – Počátky – Palackého náměstí; B, C, E, F – experimental pottery. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 50. *Trhliny a praskliny z výpalu. Při vyšších teplotních skocích, než jsou pro danou keramickou hmotu vhodné, se na povrchu mohou objevit drobné trhliny (A–C) až výrazné praskliny (D, E), případně může dojít k destrukci keramického tvaru (F). A, D – Počátky – Palackého náměstí; B, C, E, F – experimentální keramika. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

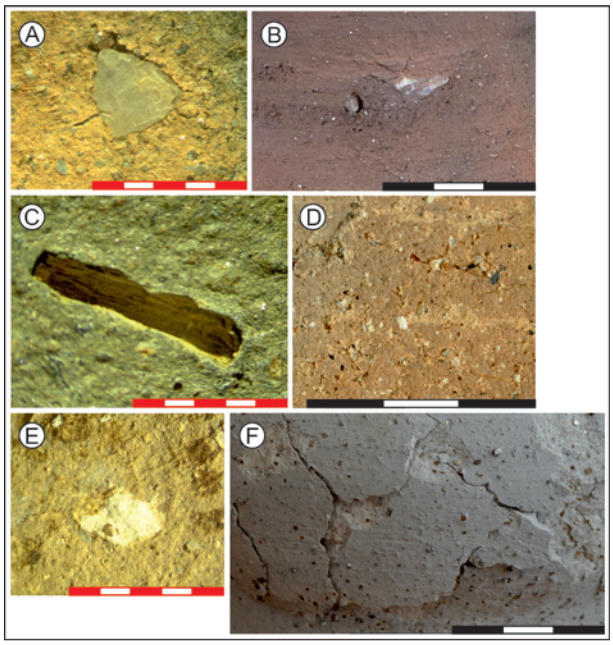


Fig. 51. Various tempers and their firing behaviour. A, B – Cracks around grains of quartz related to its modification transformation when exceeding 573°C in both directions; C – combusted organic inclusion/impurity on the surface of graphite pottery; D – the combustion of graphite from the surface of pottery is best visible on macroscopically comparable grains; E – grain of graphite combusted during oxidised biscuit firing of surface; F – surface damage caused by unsuitable temper in fine clay. A, C–E – Počátky – Palackého náměstí; B, F – experimental pottery. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 51. *Různá ostřiva a jejich chování při výpalu. A, B – Praskliny kolem zrn křemene související s jeho modifikační přeměnou při překračování teploty 573°C oběma směry; C – vyhořelá organická příměs/nečistota v povrchu grafitové keramiky; D – vyhořívání grafitu z povrchu keramiky je nejlépe patrné na makroskopicky pozorovatelných zrnech; E – zrno grafitu vyhořelé při oxidačním přežahu povrchu; F – poškození povrchu způsobené nevhodným ostřivem v jemné keramické hmotě. A, C–E – Počátky – Palackého náměstí; B, F – experimentální keramika. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

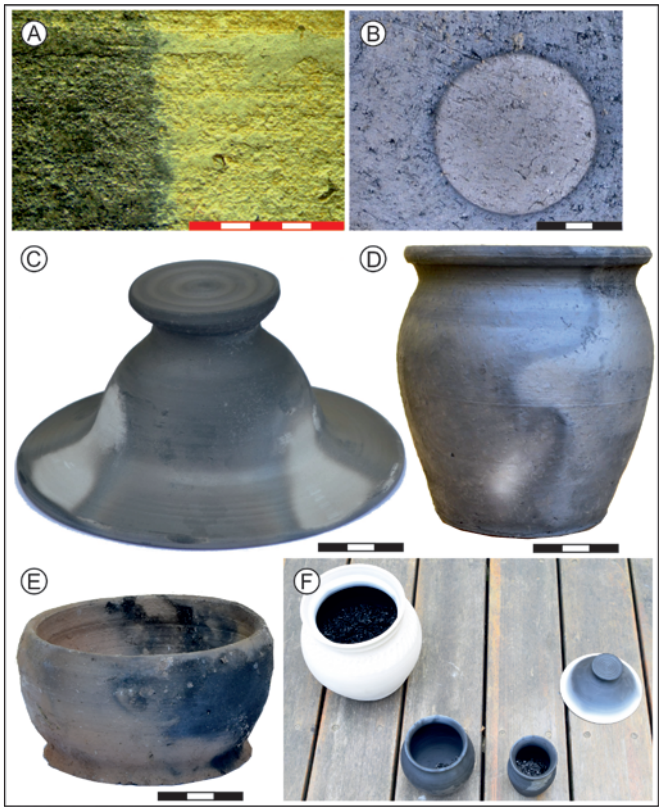


Fig. 52. Traces of the position of vessels in the kiln are more frequently visible with larger fragments of vessels; this information often disappears with fragmentation. A – Ceramic fabric with partially smoked surface, borders apparently occurring during firing due to placement of vessel in kiln; B – unsmoked stain on the bottom of vessel resulting from the placement of a small vessel on this place; C – unsmoked places on a lid caused by its placement across the mouth of a pot; D – traces from the movement of flame in the kiln; E – black stains at places of direct contact with fuel (caused by the direct migration of carbon from the fuel to the pottery); F – reduction from a closed vessel with sawdust during otherwise oxidising firing. A – Počátky – Palackého náměstí; B–F – experimental pottery. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 52. *Stopy umístění nádob v peci jsou častěji patrné při dochování větších torz nádob, s fragmentarizací tyto informace často mizí. A – Střep s částečným zakouřením povrchu, hranice vznikla patrně při výpalu vlivem umístění nádoby v peci; B – nezakouřená skvrna na dně nádoby způsobená položením malé nádobky na toto místo; C – nezakouřená místa na poklici vzniklá jejím položením přes ústí hrnce; D – stopy po tahu plamene v peci; E – v místech přímého kontaktu s palivem jsou černé skvrny (vlivem přímé migrace uhlíku z paliva do střepu); F – redukce v uzavřené nádobě s pilinami při jinak oxidačním výpalu. A – Počátky – Palackého náměstí; B–F – experimentální keramika. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

1.5 Use and post-depositional processes

Use

Description of unambiguous traces of vessel use – this mostly involves the presence of various stains or charred macro-remains (Fig. 53). Smoking or mechanical damage to the inner walls of vessels, e.g. from mixing, may be visible. These traces can be recorded verbally in the database and analysed as part of a detailed macroscopic description or scientific analyses.

Secondary use

If a specimen/fragment bears traces of modification for a use different than the originally intended function. This can include potter's blades and other grinding edges, for example, to use the remnants of the bottoms of pots as bowls or lamps. It is recorded in a text field with the possibility of a detailed description. If a secondary adaptation results in a different pottery type, it is entered in the relevant field, e.g. sieve, bowls, potter's blade, with a note (Fig. 54).

Post-deposition

A text field with information on manifestations on pottery clearly related to post-depositional processes – e.g. oxidised biscuit firing on the edges of potsherds, scratching/treatment of the outer surface (Fig. 55, 56). The abrasion of fragments described below is closely related to this category. Other marks described under-firing (over-firing, oxidised biscuit firing) or the coarseness of the pottery surface included under surface treatment could also be connected with post-depositional processes.

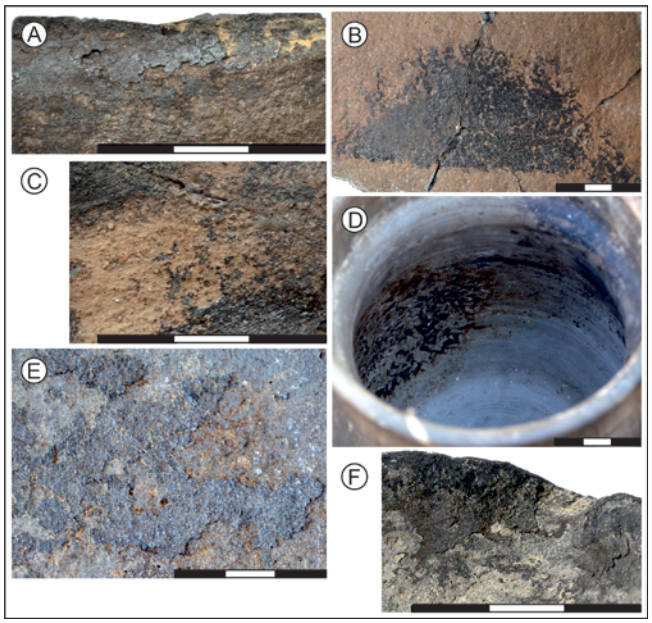


Fig. 53. Evidence of the use of vessels in the form of carbonaceous macro-remains melted to the walls of vessels. A – On pot rim; B, C – on vessel walls; D – on the walls of a pot after the experimental use of pottery; E – on the wall of storage vessel; F – near lamp wick. A–C – Žďár nad Sázavou – Staré město; D – experimental pottery by P. Macků; E – Počátky – Palackého náměstí; F – Jihlava. Photo by K. Těsnohlídková (black scale in cm, red in mm).

Obr. 53. *Doklady používání nádob v podobě uhlíkatých přitavenin a makrozbytků na stěnách nádob. A – Na okraji hrnce; B, C – na stěnách nádob; D – na stěnách hrnce po experimentálním používání keramiky; E – na stěně zásobnice; F – v okolí umístění knotu na kahanu. A–C – Žďár nad Sázavou – Staré město; D – experimentální keramika, P. Macků; E – Počátky – Palackého náměstí; F – Jihlava. Foto K. Těsnohlídková (černé měřítko v cm, červené v mm).*

Abrasion

The abrasion of rims and the pottery surface testifies mainly to post-depositional processes and is related, for example, to the hardness of firing and inclusions in the fabric – e.g. soft pottery and pottery with a high content of graphite are less resistant to external forces. Pottery that has lain on the surface of the ground for a long period of time is more abraded than pottery deposited at a single time in features. The following table (Tab. 27) serves for a description.

Use and post-deposition – note

Provide supplemental information related to the use of pottery vessels or their abandonment and deposition in an archaeological context.

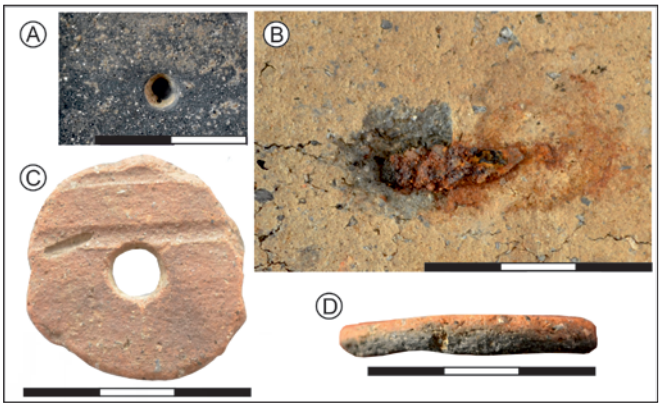


Fig. 54. Evidence of pottery repairs and secondary modifications/use. A – Hole in lid; B – repair of wall of storage vessel from the 13th century with an iron clip; C – disk secondarily made from potsherd, perhaps as a spindle whorl or button; D – secondarily ground potsherd edge. A, C, D – Žďár nad Sázavou – Staré město; B – Počátky – Palackého náměstí. Photo by K. Těsnohlídková (scale in cm).

Obr. 54. *Doklady reparací keramiky a sekundárních úprav/používání. A – Otvor ve stěně poklice; B – reparace stěny zásobnice ze 13. století se železnou svorkou; C – kolečko vyrobené sekundárně ze střepu, mohlo sloužit např. jako přeslen či knoflík; D – sekundárně zbroušená hrana na keramickém fragmentu. A, C, D – Žďár nad Sázavou – Staré město; B – Počátky – Palackého náměstí. Foto K. Těsnohlídková (měřítko v cm).*

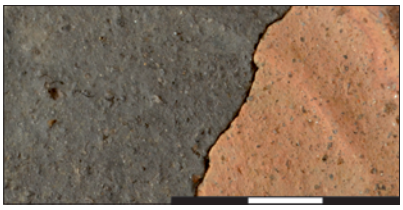


Fig. 55. Oxidised biscuit firing can result from post-depositional processes only after the vessel breaks. It can then appear only on some fragments, and in some cases is even present on fractured edges of potsherds. Počátky – Palackého náměstí. Photo by K. Těsnohlídková (scale in cm).

Obr. 55. *Oxidační přežah může vzniknout vlivem postdepozičních procesů až po rozbití nádoby. Může se poté projevit jen na části fragmentů, případně je přítomný i na lomech. Počátky – Palackého náměstí. Foto K. Těsnohlídková (měřítko v cm).*

Acknowledgements

This article was realised with the support of PRO ARCHAEOLOGIA MEDIAEVALI – *Nadace Miroslava Richtera a Renaty Fabešové* (Czech Academy of Sciences, Institute of Archaeology, Prague).

Firing – defects	Description	Fig.
Fine cracks in the surface	small cracks on the surface of the pottery can be caused by heat shock and the presence of certain inclusions in the pottery	*45a–c*
Crack – oblique	oblique crack in the wall of the vessel resulting from firing/drying – the appearance of the crack depends on the forming technology	*45d, e*
Crack – horizontal	horizontal crack in the wall of the vessel resulting from firing/drying – the appearance of the crack is often related to the forming technology	
Crack – vertical	vertical crack in the wall of the vessel resulting from firing/drying – its form is often related to the technology of forming	*45f*
Crack – bottom	crack on the bottom of the vessel resulting from firing/drying – its form is often related to the technology of forming	
Destruction of form	part of the vessel is missing due to cracking (only for whole vessels)	*45f*
Deformation of form by heat	bent rims, denting of walls as the result of high temperatures during firing	
Cracks around grains of quartz	the result of quartz inversion at 573°C	*46a, b*
Combustion of organic matter	Negative from the combustion of organic inclusion	*46c*
Partially combusted graphite grain on the surface	graphite inclusions in the clay combust at certain temperatures during oxidation firing	*46d, e*
Surface crumbling	heavily cracked and crumbly surface, probably due to unsuitable inclusions in the clay	*46f*
Imprint – smoking	depending on how the vessels were stacked on each other in the kiln (mainly with smoked pottery, can be described in greater detail in note)	*47b, c*
Flame	traces from the position of the vessel in the kiln (mainly with smoked pottery)	*47d, e*
Imperfect smoking	caused by the overlapping of vessels in the kiln or imperfect smoking (with smoked pottery)	*47a–c, e, f*
Other	description in note or can be added to list, marks can be combined	

Tab. 27. Scale for determining the degree of pottery abrasion. After Čapek 2010, 43–44.
Tab. 27. *Stupnice pro určování stupně abraze keramiky. Podle Čapek 2010, 43–44.*

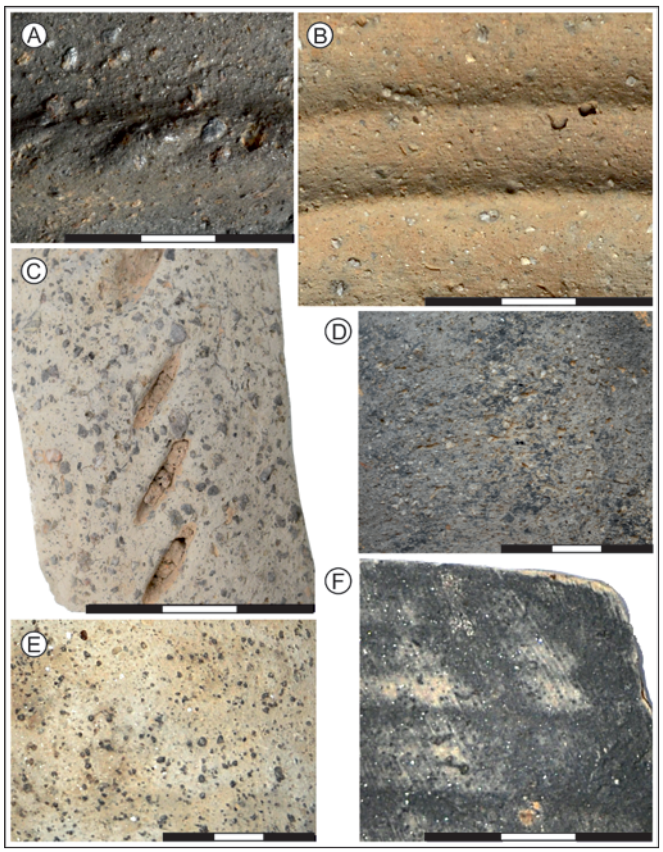


Fig. 56. Pottery surface damaged by post-depositional processes and during archaeological processing. A, B – Worn surface resulting from post-depositional processes in the case of pottery with graphite; C, D – worn surface of medium-grained sandy pottery and smoked pottery; E – surface damaged by post-depositional processes (traces of smoking remain only near grains of nonplastic inclusions); F – traces of a co arse brush used for washing. A, B – Deserted medieval village Zhořec; C, D – Žďár nad Sázavou – Staré město; E, F – Lichnice. Photo by K. Těsnohlídková (scale in cm).

Obr. 56. *Poškozený povrch keramiky postdepozičními procesy a při jejím archeologickém zpracování. A, B – Omletí povrchu vlivem postdepozičních procesů u keramiky s grafitem; C, D – omletí povrchu středně zrnité písčité keramiky a zakuřované keramiky; E – poškození povrchu vlivem postdepozičních procesů (stopy po zakouření zůstávají pouze v okolí zrn neplastické příměsi); F – stopy po hrubém kartáči použitém při mytí. A, B – Zaniklá středověká ves Zhořec; C, D – Žďár nad Sázavou – Staré město; E, F – Lichnice. Foto K. Těsnohlídková (měřítko v cm).*

References

Běhounková, L. 2015: *Keramická produkce ze středověkého sídliště Telč – Staroměstský rybník se zaměřením na technologii výroby nádob.* Manuscript of the thesis. Masarykova univerzita. Filozofická fakulta. Ústav archeologie a muzeologie. Stored in: Ústav archeologie a muzeologie Filozofické fakulty Masarykovy univerzity. Available also from: https://is.muni.cz/th/hq7o4/?info.

Bláha, J. 1968: *Vývoj osídlení jihozápadní Moravy do doby husitské (se zvláštním zřetelem k osídlení středověkému).* Manuscript of the thesis. Masarykova univerzita. Filozofická fakulta. Ústav archeologie a muzeologie. Stored in: Ústřední knihovna Filozofické fakulty Masarykovy univerzity.

Bláha, J. 1970: Zjišťovací výzkum na hradě Šternberku a některé problémy keramiky vrcholného středověku na jihozápadní Moravě. *Vlastivědný věstník moravský* XXII(3), 5–36.

Bláha, J. 1975: K otázce vnějších vlivů na vrcholně středověkou keramiku západní a východní Moravy. *Zprávy Československé společnosti archeologické při ČSAV* XVII(1–2), 10–17.

Bočková, Z., Doležalová, K., Kochan, Š., Mazáčková, J., Slavíček, K., Těsnohlídek, J. 2014: Experimentální výroba keramiky v Panské Lhotě. *Archaeologia historica* 39(1), 119–137. Available also from: https://digilib.phil.muni.cz/handle/11222.digilib/130283.

Čapek, L. 2010: *Depoziční a postdepoziční procesy středověké keramiky na parcelách Českých Budějovic. (Případová studie z domu čp. 16).* Plzeň: Západočeská univerzita v Plzni.

Čapek, L. 2015: Okruhy studia (středověké) keramiky aneb Keramika jako archeologický pramen. *Acta Fakulty filozofické Západočeské univerzity v Plzni* 7(2), 13–38. Available also from: https://dspace5.zcu.cz/handle/11025/16731.

Čapek, L., Preusz, M. 2019: Středověké a novověké hrnčířské pece v Čechách – kritické zhodnocení výpovědních možností studia. *Archaeologia historica* 44(1), 313–355. DOI: 10.5817/AH2019-1-14. Available also from: https://digilib.phil.muni.cz/handle/11222.digilib/141305.

Čapek, L., Procházka, R., Sedláčková, L., Těsnohlídková, K., Slavíček, K., Plchová, S., Plzák, J., Nosek, V., Zemancová, T. 2022: *Vrcholně a pozdně středověká keramika v Českých zemích. Výroba – regionalizace – metody – interpretace.* Plzeň: Západočeská univerzita v Plzni.

Čapek, L., Těsnohlídková, K. 2020: *Zásady tvorby deskripčních systémů středověké keramiky a jejich databázové aplikace. Památkový postup* [online]. Plzeň, Brno. [cit. 2022-08-09]. Available from: https://drive.google.com/file/d/1-OO1TA-bkxIWNVp9w1Zw_7tqNiuM93CJ/view.

Čapek, L., Těsnohlídková, K., Slavíček, K., Všianský, K., Pracný, P. 2018: *Technologie výroby a archeometrické studium středověké keramiky*. Plzeň, Brno: Západočeská univerzita, Masarykova univerzita.

Geisler, M. 2004: *Žďár nad Sázavou, sídliště Klafar II 2004 – akce č. 70/04*. Manuscript of the excavation report, No. MTX201702962. Stored in: Archiv nálezových zpráv Archeologického ústavu AV ČR, Brno, v. v. i.

Geisler, M. 2005: *Žďár nad Sázavou. Sídliště Klafar II 2005 – akce č. 50/05*. Manuscript of the excavation report, No. MTX201702968. Stored in: Archiv nálezových zpráv Archeologického ústavu AV ČR, Brno, v. v. i.

Geisler, M. 2006: *Žďár nad Sázavou 2006, sídliště Klafar II, akce č. 66/06*. Manuscript of the excavation report, No. MTX201702878. Stored in: Archiv nálezových zpráv Archeologického ústavu AV ČR, Brno, v. v. i.

Gregerová, M., Čopjaková, R., Beránková, V., Bibr, P., Goš, V., Hanuláková, D., Hložek, M., Holubová-Závodná, B., Kristová, L., Kuljovská, Z., Macháček, J., Mazuch, M., Procházka, R., Škoda, R., Všianský, D. 2010: *Petroarcheologie keramiky v historické minulosti Moravy a Slezska*. Brno: Munipress.

Hejhal, P. 2011: *Havlíčkův Brod, revitalizace centra města, akce č. A052/2009*. Manuscript of the excavation report. Stored in: Archaia Brno z. ú.

Hejhal, P., Hrubý, P. 2005: Dřevěná architektura 13. století v Jihlavě, Pelhřimově a Humpolci. In: D. Merta, M. Peška (eds.): *Forum Urbes Medii Aevi II*. Brno: Archaia Brno o.p.s., 126–147.

Hlavica, M., Nosek, V., Valášková, L., Petřík, J. 2016: Technické značky jako opomíjený archeologický pramen? Fotogrammetrická analýza den nádob z velkomoravských hrnčířských dílen ze Starého Města (okr. Uherské Hradiště), polohy „U Víta". *Archeologické rozhledy* LXVIII(3), 381–412. Available also from: https://1url.cz/frHej.

Holub, P., Kolařík, V., Merta, D., Peška, M., Zapletalova, D., Zůbek, A. 2005: Ke stavu poznání nezděné měšťanské architektury vrcholně středověkého Brna. In: D. Merta, M. Peška (eds.): *Forum Urbes Medii Aevi II*. Brno: Archaia Brno o. p. s., 44–101. Available also from: https://www.archaiabrno.org/media/doc/04_fuma_ii_archaia.pdf.

Hołubowicz, W. 1950: *Garncarstwo wiejskie zachodnich terenów Bialorusi*. Toruń: Nakładem Towarzystwa Naukowego w Toruniu.

Hrubý, P., Jaroš, Z., Kočár, P., Malý, K., Mihályová, J., Militký, J., Zimola, D. 2006: Středověká hornická aglomerace na Starých Horách u Jihlavy. *Památky archeologické* XCVII, 171–264. Available also from: https://1url.cz/krHeh.

Hrubý, P., Hejhal, P., Malý, K., Kočár, P., Petr, L., 2014: *Centrální Českomoravská vrchovina na prahu vrcholného středověku*. Brno: Masarykova univerzita. Available also from: https://digilib.phil.muni.cz/handle/11222.digilib/132996.

Jervis, B. 2014: *Pottery and social life in medieval England*. Oxford: Oxbow Books. DOI: 10.2307/j.ctvh1dwkm.

Klápště, J. 1998: Die Anfänge der jüngeren mittelalterlichen Keramik in Böhmen als kulturhistorisches Problem. *Archeologické rozhledy* L(1), 138–158. Available also from: https://1url.cz/2rHeZ.

Klápště, J. 2002: Svědectví artefaktů. Keramika. In: J. Klápště (ed.): *Archeologie středověkého domu v Mostě (čp. 226)*. Mediaevalia archaeologica 4. Praha, Most: Archeologický ústav AV ČR, Ústav archeologické památkové péče severozápadních Čech, Okresní muzeum v Mostě, 10–34.

Kochan, Š., Těsnohlídek, J., Těsnohlídková, J., Duffek, P. 2020: Hrnčířská pec U skály a další archeologické výzkumy Staré Jihlavy. *Archeologické výzkumy na Vysočině* 9, 118–127.

Ludvikovský, J., Zemek, M., Pohanka, J., Mertlík, R. 1964: *Cronica domus Sarensis*. Brno: Krajské nakladatelství.

Lüdtke, H., Schnitzel, K. (Hrsg.) 2001: *Handbuch zur mittelalterlichen Keramik in Nordeuropa. Band 2: Kataloge*. Neumünster: Wachholtz.

Nekuda, V., Reichertová, K. 1968: *Středověká keramika v Čechách a na Moravě*. Brno: Moravské zemské muzeum.

Orna, J., Dudková, V., Pavelka, J., Bernardt, T. 2011: *Keramická produkce města Plzně v období 14. a 15. století*. Plzeň: Scientia.

Orton, C., Hughes, M. 2013: *Pottery in Archaeology*. Second edition. Cambridge: Cambridge University Press.

Pavelka, J. 2019: *Kompletní seznam analyzovaných vzorků keramiky z projektu NAKI II Vrcholně středověká keramika*. Manuscript of the final report. Stored in: Katedra archeologie Filozofické fakulty Západočeské univerzity v Plzni.

Pavelka, J., Šmejda, J., Hynek, R., Hrdličková-Kučková, Š. 2016: Immunological detection of denatured proteins as a method for rapid identification of food residues on archaeological pottery. *Journal of Archaeological Science* 73, 25–35. DOI: 10.1016/j.jas.2016.07.004. Available also from: https://www.sciencedirect.com/science/article/pii/S0305440316300917.

Poláček, L. 1992: *Vývoj mladohradištního osídlení jihozápadní Moravy: ve světle archeologických nálezů z Třebíčska*. Manuscript of the dissertation. Masarykova univerzita. Filozofická fakulta. Ústav archeologie a muzeologie. Stored in: Ústřední knihovna Filozofické fakulty Masarykovy univerzity.

Procházka, R. 2007: Deskripční systém brněnské keramiky. In: R. Procházka, M. Peška: Základní rysy vývoje brněnské keramiky ve 12. – 13./14. století. Příloha 1. *Přehled výzkumů* 48, 234–270. Available also from: https://www.arub.cz/prehled-vydanych-cisel/PV48_studie_9_priloha_1.pdf.

Procházka, R. 2015: Mittelalterliche Töpferöfen in Mähren. In: L. Grunwald (Hrsg.): *Der Töpfern auf der Spur – Orte der Keramikherstellung im Licht der neuesten Forschung*. RGZM-Tagungen. Band 21. Mainz: Verlag des Römisch-Germanischen Zentralmuseum, 215–224.

Procházka, R., Peška, M. 2007: Základní rysy vývoje brněnské keramiky ve 12. – 13./14. století. *Přehled výzkumů* 48, 143–299. Available also from: https://www.arub.cz/prehled-vydanych-cisel/PV48_studie_9.pdf.

Richter, M. 1974: Archeologický výzkum a otázky nejstarší sídlištní topografie Žďáru nad Sázavou. In: M. Zemek (ed.): *Dějiny Žďáru nad Sázavou III. 1784–1974*. Brno, Žďár nad Sázavou: Muzejní spolek v Brně, 231–240.

Richter, M. 1982: *Hradišťko u Davle. Městečko ostrovského kláštera*. Praha: Academia.

Rogier, M. 2015: *Mittelalterliche nachgedrehte Keramik. Überlegungen zur Definition, Bestimmung und Interpretation am Beispiel Baden-Württemberg*. Tübingen: Verlag des Vereins für Archäologie des Mittelalters, Schloss Hohentübingen.

Rous, P. 1982: *Osídlení Havlíčkova Brodu v raném a vrcholném středověku*. Manuscript of the thesis. Karlova univerzita. Filozofická fakulta. Oddělení prehistorie při Katedře obecných dějin a pravěku.

Rous, P. 1995: Nález středověké keramiky u osady Ovčín u Havlíčkova Brodu. *Zpravodaj muzea v Hradci Králové* 21, 124–134.

Rous, P., Málek, O. 2002: Nové stopy vrcholně středověkého osídlení na katastru města Přibyslavi. *Zpravodaj muzea v Hradci Králové* 28, 208–219.

Roux, V. 2009: Wheel Fashioned Ceramic Production during the Thiird Millennium BCE in the Southern Levant: a Perspective from Tel Yarmuth. In: S. A., Rosen, V. Roux (eds.): *Techniques and*

People, Anthropological Perspectives on Technology in the Archaeology of the Protohistoric and Early Historic Periods in the Southern Levant. Paris: Centre de Recherche Francais a Jerusalem, 195–212.

Roux, V. 2013: Spreading of Innovative Technical Traits and Cumulative Technical Evolution: Continuity or Discontinuity? *Journal of Archaeological Method Theory* 20, 312–330. DOI: 10.1007/s10816-012-9153-4. Available also from: https://link.springer.com/article/10.1007/s10816-012-9153-4.

Roux, V. 2019: *Ceramic and Society. A Technological Approach to Archaeological Assemblages*. Cham: Springer.

Roux, V., Courty, M. A. 1998: Identification of Wheelfashioning Methods: Technological Analysis of 4th–3rd Millennium BC Oriental Ceramics. *Journal of Archaeological Science* 25(8), 747–763. DOI: 10.1006/jasc.1997.0219. Available also from: https://www.sciencedirect.com/science/article/pii/S0305440397902193?via%3Dihub.

Santacreu, D. A. 2014: *Materiality, Techniques and Society in Pottery Production*. Warsaw, Berlin: De Gruyter Open Poland. DOI: 10.2478/9783110410204.

Sedláčková, L. 2020: *Proměny vybavení brněnské měšťanské kuchyně vrcholného a pozdního středověku* [online]. Manuscript of the dissertation. Masarykova univerzita. Filozofická fakulta. Ústav archeologie a muzeologie. Stored in: Archiv závěrečných prací Masarykovy univerzity [cit. 2022-08-09]. Available from: https://is.muni.cz/th/rlnud/.

Scharrer-Liška, G. 2007: *Die hochmittelalterliche Grafitkeramik in Mitteleuropa und ihr Beitrag zur Wirtschaftsgeschichte. Forschungsstand – Hypotheses – Offene Fragen*. Monographien. Römisch-Germanisches Zentralmuseum, Foschungsinstitut für Vor- und Frühgeschichte. Band 68. Mainz: Römisch-Germanisches Zentralmuseum.

Slavíček, K., Těsnohlídková, K., Petřík, J. 2021: *Zpráva z archeometrické analýzy keramiky ze Žďáru nad Sázavou – Starého města*. Manuscript of the final report. Stored in: Ústav geologických věd Přírodovědecké fakulty Masarykovy univerzity v Brně. Available also in: Těsnohlídková, K. 2021: Technologie vrcholně a pozdně středověké keramiky. Manuscript of the dissertation, sv. II, příloha 30. Available from: https://is.muni.cz/th/ozfnb/.

Těsnohlídková, K. 2021: *Technologie vrcholně a pozdně středověké keramiky. Hrnčířská produkce Českomoravské vrchoviny 13. a 1. poloviny 14. století* [online]. Manuscript of the dissertation. Masarykova univerzita. Filozofická fakulta. Ústav archeologie a muzeologie. Stored in: Archiv závěrečných prací Masarykovy univerzity [cit. 2022-08-09]. Available from: https://is.muni.cz/th/ozfnb/.

Těsnohlídková, K., Těsnohlídek, J., Duffek, P. 2018: Archeologie nejstaršího horizontu města Počátky (okres Pelhřimov). *Archaeologia historica* 43(1), 147–175. DOI: 10.5817/AH2018-1-7. Available also from: https://digilib.phil.muni.cz/handle/11222.digilib/138125.

Varadzin, L. 2005: Značky na dnech keramických nádob ve středověku. *Studia Mediaevalia Pragensia* V, 165–199.

Vařeka, P. 1998: Proměny keramické produkce vrcholného a pozdního středověku v Čechách. *Archeologické rozhledy* L(1), 123–137. Available also from: https://1url.cz/brHey.

Vokáč, M. 2001: Nové archeologické poznatky ke vzniku města Třebíče. *Západní Morava* 5, 130–150.

Zatloukal, R. 1998: Středověké hrnčířské pece z Jihlavy a okolí. *Vlastivědný sborník Vysočiny, oddíl věd společenských* 11, 27–44.

Zatloukal, R. 1999: Zpráva o archeologickém výzkumu ve Žďáře nad Sázavou v letech 1996-1999. In: M. Ježek, J. Klápště (eds.): *Mediaevalia Archaeologica 1*. Praha, Wrocław: Archeologický ústav AV ČR, 193–207.

Zatloukal, R. 2000: *Fórum cisterciáckého kláštera ve Žďáru nad Sázavou a jeho postavení v rámci podobných tržních útvarů 13. věku i osídlení regionu*. Manuscript of the thesis. Masarykova univerzita. Filozofická fakulta. Ústav archeologie a muzeologie. Stord in: Ústřední knihovna Filozofické fakulty Masarykovy univerzity.

Zimola, D. 2012: Hornická sídliště v okolí Jihlavy podle archeologických pramenů. *Archeologické výzkumy na Vysočině* 3, 27–57.

Resumé

Studie se zabývá zpracováním a vyhodnocením keramického souboru ze Žďáru nad Sázavou – Starého města se zaměřením na analýzu technologie výroby nádob. Její součástí je deskripční systém určený pro popis technologických znaků na středověké keramice vytvořený na základě principů operačního řetězce. Pro vyhodnocení byl vybrán materiál z výzkumné sezóny 2004, později doplněný o nálezy z hrnčířské pece na lokalitě. Studie vychází z dizertační práce autorky obhájené na Ústavu archeologie a muzeologie Filozofické fakulty Masarykovy univerzity.

V souboru převažovaly hrnce (82 %). Početněji se vyskytovaly ještě zásobnice (15 %) a zvonovité poklice (2 %). Další kusy byly zastoupeny pouze několika fragmenty: miniaturní nádoby, ploché poklice, třmenové konvice, mísa či patrně alembik. Ze starších výzkumů na lokalitě známe fragment akvamanile či plastiku koníka, z výzkumu studny v roce 2006 několik celých rekonstruovaných tvarů konvic, džbánů a lahví. U hrnců převažují varianty vzhůru vytažených okrajů (54 %), dále okraje střechovité (14 %), okruží (12 %), jednoduché hraněné (10 %), jednoduché (5 %) a ovalené (4 %). Přehnuté okraje, které jsou četné na sousedním Jihlavsku, jsou zde zastoupeny pouze 1 %. Výzdobou bylo opatřeno na 25 % výdutí – převažovaly rýhy a žlábky (94 %), setkáme se s vlnicemi, nehtovými vrypy a ojediněle s rádélkem či hřebenovou vlnicí. Výzdoba byla často aplikována na okrajích, a to v 39 %, nejvíce u vzhůru vytažených.

Grafitová keramika zde tvořila 41 % souboru, písčitá 55 % a hrubé slídové zboží 4 %. Patrná je vyšší přítomnost archaických prvků (masivnější stěny, vyšší podíl nádob z válků) u grafitové keramiky a u slídové naopak progresivních (převaha vytáčené keramiky). Podle petrografického složení jsou písčitá a grafitová keramika lokálního původu. Složení slídové keramiky ukazuje na původ materiálu minimálně 8 km severně až severozápadně od lokality – nelze říct, zda jde o import suroviny či hotových nádob. Grafitová keramika nesla oproti písčité více stop po válcích ve stěnách a méně dokládajících využití rychlé rotace. Ve výpalu převažoval oxidační přežah na 72 % fragmentů, redukční výpalna 22 %, zbytek tvořily fragmenty vypálené ve smíšené atmosféře, oxidačně, s tmavým jádrem či sendvičovým efektem. Nádoby nalezené v hrnčířské peci nesou převažující stopy užití válků ve stěnách na písčitém i grafitovém zboží a výpal odpovídající majoritě keramiky na lokalitě – převahu oxidačního přežahu povrchu.

Zpracovaný soubor obohacuje stav poznání středověké keramické produkce na Českomoravské vrchovině v období středověké transformace společnosti, zde úzce spojené s kolonizací oblasti, a zasazuje ji do kontextu širší produkce. Podrobná analýza technologie založená na publikovaném deskripčním systému a propojená s poznatky experimentálního výzkumu výroby středověké keramiky pomáhá pochopit proces výroby keramiky i postupného etablování hrnčířství jako řemesla ve sledovaném období.

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