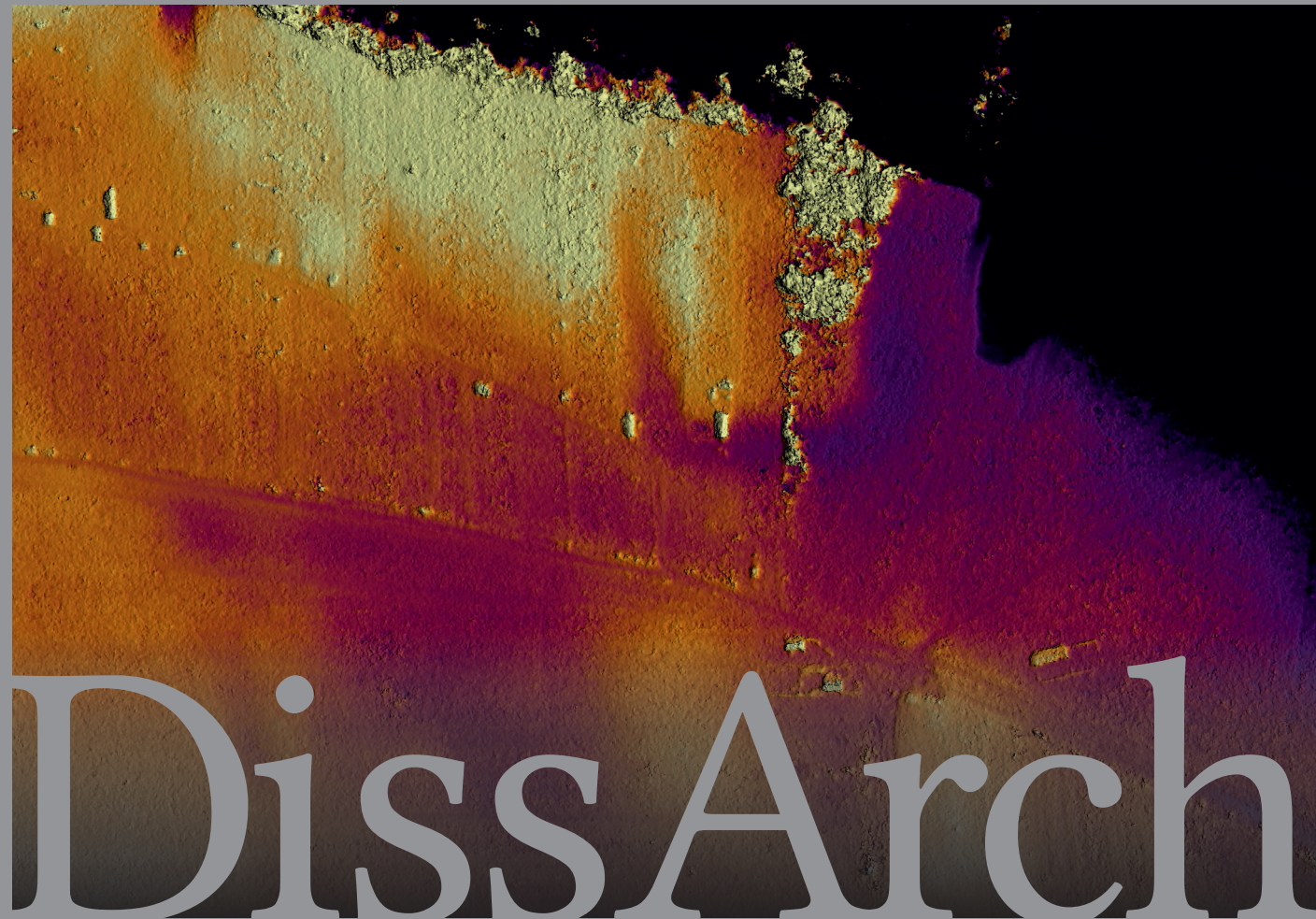


# DISSERTATIONES ARCHAEOLOGICAE

ex Instituto Archaeologico

Universitatis de Rolando Eötvös nominatae



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# Black or white, possibility or necessity?

## Virtual restoration of encrusted pottery for the better interpretation of their design

László GUCSI 

Institute of Archaeology, HUN-REN Research Centre for the Humanities, Budapest, Hungary  
laszlogucsi@gmail.com

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**Abstract:** This paper aims to draw attention to how the process of virtual restoration of encrusted pottery can play a crucial role in understanding complex ornaments if the correct method of illustration is employed. To emphasise the importance of appropriate representation, the author has re-drawn some already published Bell Beaker vessels and presents a few more reconstructed examples from the Vučedol, Somogyvár–Vinkovci, and Ljubljana ceramic traditions. The study also addresses the theoretical limitations of reconstructing encrusted motifs, with a reflection on the latest arguments published on the topic. Furthermore, the paper presents case studies based on the newly made illustrations of the reconstructed encrusted patterns, revealing new insights into the interpretation of the motifs.

**Keywords:** encrustation, Bell Beaker, ornament system, illustration methodology, Early Bronze Age

### Introduction

Drawing, as a tool of visual communication is fundamental to archaeology, a discipline in which comparison is paramount. While illustrations can be produced using a wide range of techniques, methods, and styles, in some instances, this can make them difficult to understand due to the differences in the visual approach of diverse illustrators, creating obstacles for making comparisons, which is why several studies have long sought to define the rules of a universal visual language in archaeology to avoid the ‘Babylonian chaos’.<sup>1</sup> Papers on ‘how to illustrate an archaeological object’ discuss the guidelines, tools and methods of illustrating and emphasise that the outcome must adhere to certain design standards. Regardless of these efforts, a recent study has pointed out that ‘Drawing is a problem within archaeology’.<sup>2</sup> This study focuses on correcting a specific issue related to the visual representation of encrusted decorations that seems to have been standardised wrongly and became conventionally applied due to a ‘language slip’ in visual communication.

Readers may wonder why it is so strictly articulated as a ‘right or wrong’ question. The short answer is that the basic issue addressed here is more of a ‘black and white’ question, i.e., using the right contrast pair in illustrations. In simple words, when a ceramic vessel is decorated with encrustation, the white inlay must be depicted as white in the illustration, while the body of the vessel must be portrayed in a darker tone, according to the original appearance of the object. However

1 BRZOST-ANDERSEN 2016; COLLETT 2017; MORGAN et al. 2021.

2 MORGAN et al. 2021, 614.

self-evident that might seem, it is difficult to find archaeological papers that consistently follow this rule. A similar paper with a slightly different focus has already been published in Hungarian a decade ago,<sup>3</sup> while the present paper was inspired by the workshop entitled *Interweaving Bell Beaker decorative motifs and textile patterns: Exploring technical and symbolic approaches during the 3rd millennium BCE in Europe*, held at the Natural History Museum of Vienna on 21 March, 2023.

## The encrustation

In prehistoric Europe, encrustation was a decoration technique widely used in many ceramic traditions.<sup>4</sup> More than ten archaeological cultures from the Middle Neolithic to the Late Bronze Age applied this technique in the territory of the Carpathian Basin alone. This special technique included well-planned steps organised into a complex *chaîne opératoire*,<sup>5</sup> as well as different raw materials, sometimes a specific toolkit, and advanced manual dexterity and skills (e.g., a good sense of proportion).

## How was it made?

Prehistoric potters first made impressions<sup>6</sup> of the desired pattern on the surface of the semi-dry clay vessel (firm but still malleable, in a so-called 'leather-hard' state).<sup>7</sup> A common practice for creating impressions was rhythmically pressing the tip of a pointy tool into the clay surface (the so-called stab-and-drag technique).<sup>8</sup> After firing, the impressions were filled with a white paste<sup>9</sup> which, as scientific tests indicate, can be classified into five technological groups.<sup>10</sup> The white paste was produced using different mineral and organic ingredients.<sup>11</sup> The main feature of this design is a dark-light contrast between the motifs and the



Fig. 1. Details of a Bell Beaker vessel from Tököl (Inv. no.: HNM 76.1876.9). a – irregularities in the size of the decorative panels, b – irregularities in the number of fill motifs per square, c – traces of red slip which peeled off in a small patch at the belly line in the middle (photos by L. Gucsi)

3 GUCSI 2011.

4 WOSINSKY 1904.

5 DERENNE et al. 2022, Fig. 3.

6 E.g., MÉRI 1942, Fig. 1; KISS 1996, 65; PALINÇAŞ 2010, 72; LEGHISSA 2015; ALBA LUZÓN – GARCÍA ATIÉNZA 2018, 67.

7 GUCSI 2023, 355–356.

8 MÉRI 1942, Fig. 1.10; KULCSÁR 2009, 23; BLANCO-GONZÁLEZ 2018, 22.

9 E.g., TUREK 2008, 159; GIUSTETTO et al. 2013, 4259.

10 VŠIANSKÝ et al. 2014.

11 GIUSTETTO et al. 2013, Fig. 9; SALANOVA et al. 2016, 728.

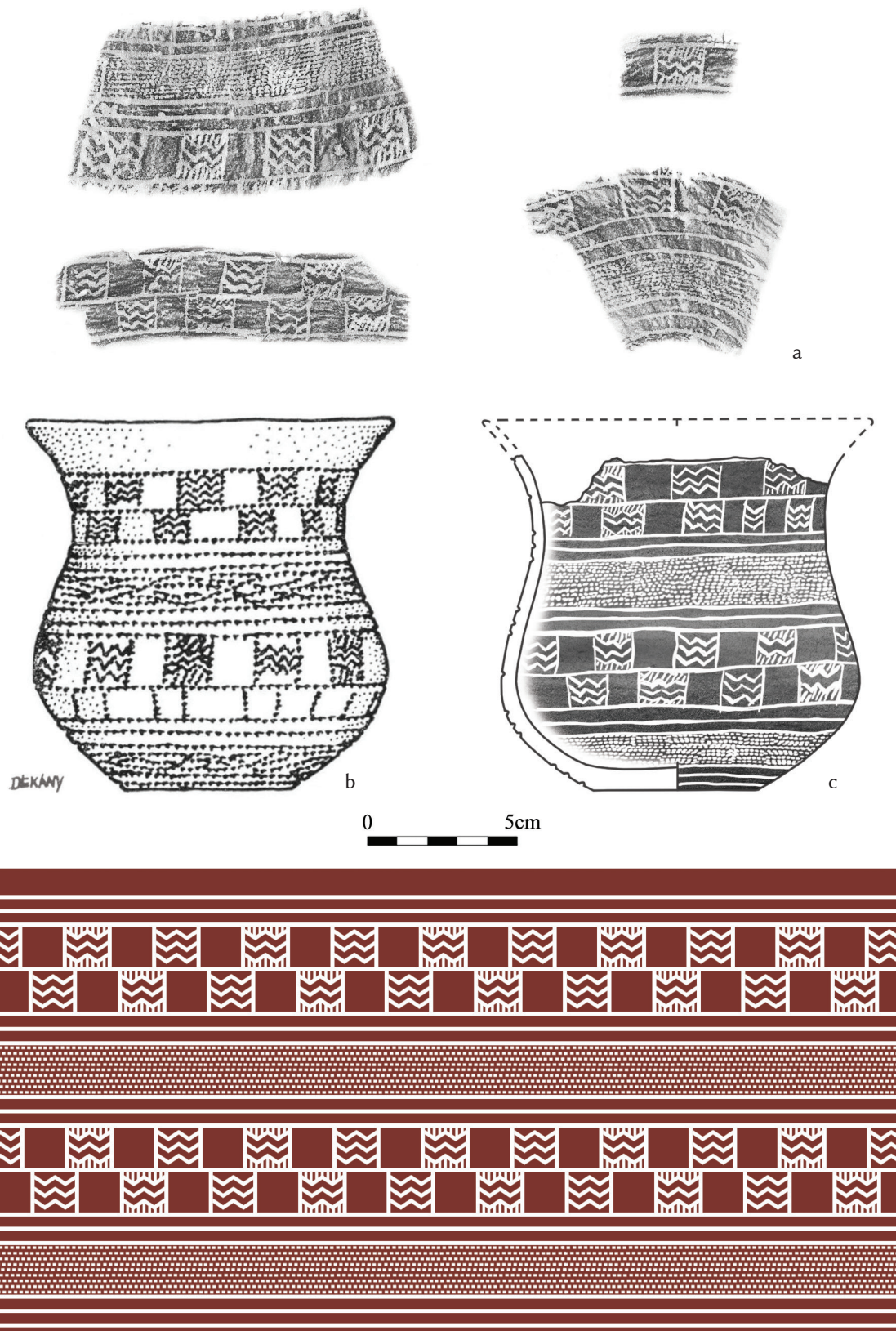


Fig. 2. Different renderings of a Bell Beaker vessel from Tököl (Inv. no.: HNM 76.1876.9). a – rubbing image, b – conventional depiction (after SCHREIBER 1975, Fig. 10.1), c – new illustration with reconstructed encrustation, d – stylised and idealised pattern reconstruction



surface of the ceramics (including vessels and figurines). Encrusted pottery is usually black or dark brown due to having been fired in a reduction atmosphere, while the inlay is white. Even though ‘dark surface with white inlay’ appears to be the general concept behind encrusted prehistoric ceramics, there are also exceptions in the colour of the inlay<sup>12</sup> or the vessel. Beakers of the Bell Beaker tradition are often reddish-orange due to having been fired in an oxygen-rich environment.<sup>13</sup> Sometimes, their colour is enhanced with red slip coating (Fig. 1.c, Fig. 6.a)<sup>14</sup> applied as a fine clay wash with high iron oxide content<sup>15</sup> to the vessel surface before burnishing and firing. One of the first examples of encrustation, made with completely different materials, is known from a *Linearbandkeramik* context (ca. 5,350–5,000 BCE) (for details, see the case study from Balatonszárszó below). Mineral-based encrustation was employed from the Middle Neolithic in the Carpathian Basin by potters of the Bükk Culture (ca. 5,200–4,950 BCE). In this tradition, the inlay was mostly white,<sup>16</sup> but there are examples of black painting alongside yellow, red, and white inlay combinations on the same vessel.<sup>17</sup> In the last decades, the material composition of encrustations has been analysed multiple times, revealing the base component to be either mineral or organic, such as talc, chalk, kaolinite, gypsum, calcined bones, antler, or shell.<sup>18</sup>

### What leads to misrepresentation?

One of the main reasons is that the lime-based substances used for inlays tend to chemically dissolve or fall out of the beds, leaving behind empty, hollow patterns.<sup>19</sup> This leads to two fundamental problems. First, if a ceramic vessel is completely missing its inlay, how do we know if it ever had one? The second question is the technical issue of illustrations (deriving from the first problem): the indented patterns are usually depicted in a tone darker than the surface, following the basic rules of shading, but this approach in the case of encrusted decoration reverses the contrast and provides an effect opposite to that of the original pattern<sup>20</sup>—as if one were supposed to capture and understand a complex visual experience from the negative of a photograph. Another problematic (but widely applied) method for depicting encrustation is to reduce the decoration to simple lines;<sup>21</sup> as if a chequerboard pattern were simplified to lines only, appearing as a grid without the black and white squares (Fig. 3), thus wiping out the possibility of playing with the game and understanding the underlying concept.

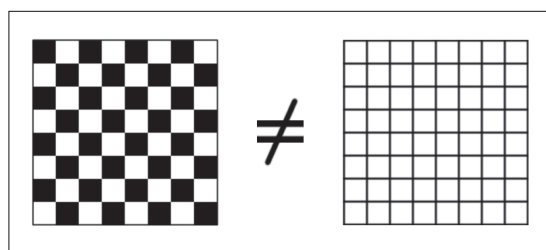


Fig. 3. The relation of the chequerboard pattern to the grid pattern

12 E.g., BLANCO-GONZÁLEZ 2018, 26; GIUSTETTO et al. 2013, 4252.

13 E.g., RYE 1981, 118; ILON 1996, 143; PATAY 2013, Fig. 13.1–3; GARCÍA PUCHOL et al. 2013, Fig. 4; GAŠPAR et al. 2022, Fig. 3.

14 E.g., TUREK 2008, 159; FAVREL 2022b, Fig. 206.B.

15 SALANOVA et al. 2016, 728.

16 CSENGERI 2015, Pl. 13.1.

17 MIHÁLY et al. 2010, Fig. 1; CSENGERI 2015, 139.

18 ROBERTS et al. 2008; MIHÁLY et al. 2010; PARKINSON et al. 2010; KREITER – TÓTH 2010; GIUSTETTO et al. 2013; VŠIANSKÝ et al. 2014; KOS et al. 2015.

19 GUCSI 2011, Fig. 3.5.

20 GUCSI 2011, Fig. 2.

21 E.g., REICH 2006; KREITER – TÓTH 2010, Figs 19–22; PALINÇAŞ 2010, Fig. 8.2–6.



The root of common visual misinterpretations related to encrusted ceramics can be better understood from Ellen Brzost-Andersen's words about the advantages of illustration over photographic representation. She wrote, "Archaeological illustrations of both ceramics, stone objects, flint, etc. depict a selection of attributes which are of interest to the archaeologist, while details which are not considered relevant may be omitted by the illustrator. Accurate illustrations of ceramic sherds can show dimensions, form, manufacturing method, surface features and decorations, which definitely are more informative than a photograph."<sup>22</sup> The words 'selection' and 'omitted' are key in this case, illustrating excellently the factors considered when rendering a 3D object to a 2D image. In light of that, any depiction is a piece of visual information filtered through the illustrator; therefore, every illustration is an interpretation made by the artist. As a high degree of subjectivity is undesired in science, this study calls for reducing it by exploring the topic in depth. Although most encrusted pottery finds are not depicted as one would expect, there are a few studies where the illustrators reconstructed the lime inlays, thus visually restoring the original appearance of the decoration and setting good examples.<sup>23</sup> The best example may be a publication by Ina Miloglav, where most illustrations are also in colour.<sup>24</sup>

### The limitations of reconstruction: the 'grey zone'

While reconstructions of various kinds have long played an important role in archaeology, authenticity has remained a key aspect. Every reconstruction must be based on facts, and added parts must be justified by logic or scientific reasons. Therefore, the proportion of the missing part determines the possible extent of reconstruction. Here, we return to the issue of the first problem: is it possible for something present once but vanished without a trace to be included in a reconstruction? Or does the current absence of the inlay mean that it was never part of the decoration?

Antonio Blanco-González addressed the problem of how "the multiple similarities traced between Bell-Beaker and Cogotas I decorative traits" can be interpreted.<sup>25</sup> Although he primarily focused on how culturally unconnected traditions can result in very similar pottery styles despite being distant from each other both in time and sometimes in space, he also dealt with technological issues related to encrustation. He states, "However, nowadays we know that neither the Early Neolithic nor the Late Bronze Age stab-and-drag designs were exclusively made to be inlaid. Recent disturbance or chemical alteration cannot be solely invoked to meet the absence of inlays in many Bronze Age vessels which simply never received such accretions."<sup>26</sup> In contrast, Jan Turek wrote in general terms that "the incised decorations were originally filled with white lime inlay."<sup>27</sup> While accepting the possibility that there were indeed a few vessels that never received any inlay, the question remains: What was the proportion of such vessels in the studied pottery traditions? Have we examined enough finds bearing 'empty' patterns, and systematically enough, with a microscope or other analytical instrument? One must keep in mind that degradation caused by natural chemical processes sometimes seriously impacting preservation cannot be underestimated either; these processes can have a severe effect on the ceramic material itself,<sup>28</sup> and ceramics are much more resilient than the lime-based encrustation. The strongest influencing factor is the acidity of the soil around the pot-

22 BRZOST-ANDERSEN 2016, 1.

23 WOSINSKY 1904, Pls 45–59, Pl. 142, Pls 151–152; SPAJIĆ 1956; HÁJEK 1966, Abb. 11.1–2; KISNÉ CSEH 1999, Pl. 6.2; KISNÉ CSEH 2000, Pl. 1.4; HÄNSEL – HÄNSEL 2002, Figs 1–2; VICZE – SØRENSEN 2023, Fig. 4.11.1–2.

24 MILOGLAV 2016.

25 BLANCO-GONZÁLEZ 2018.

26 BLANCO-GONZÁLEZ 2018, 28.

27 TUREK 2008, 159. The quote was translated from Czech by the author.

28 BLANCO-GONZÁLEZ 2014, Fig. 8; BRÖNNIMANN et al. 2020; GUCSI 2023, 375–379.

tery.<sup>29</sup> Further factors, among many others, are the lime content of the soil, which may, in certain circumstances, counterbalance acidity,<sup>30</sup> for example by ash (an alkalis-ing agent) being mixed into the archaeological layers as a result of human activity. Therefore, the degree of preservation of encrustations varies widely. Often, the encrustation is missing from almost the whole pot (Fig. 1.a–c, Fig. 13.c), having been preserved only in a few small spots, which clearly indicates post-depositional deterioration (see Fig. 4.a right to the diamond motif, Fig. 6.a, Fig. 12.c, Fig. 18.a–b).

Besides using a variety of raw materials and a cultural-ly driven selection of organic and inorganic inlay sub-stance components,<sup>31</sup> prehistoric potters occasionally experimented with new materials. Therefore, we have to take into account that the studied encrustations are, in fact, the remains of inlays that survived thousands of years. However, it is possible to use a white material (chalk or kaolinite) fastened to the bed not by a strong chemical bond (like, e.g., slaked lime) but by resin or other relatively easily degrading organic adhesive (bone or animal glue, egg-white, etc.). A recent micro-analytical study indicated the presence of kaolinite, quartzite, and protein in one sample.<sup>32</sup> Interestingly, the authors described this sample as the most poorly preserved of the ten analysed encrustations. This fact is significant, as the sherd was recovered from a deep cave (the Baradla–Domica cave system) with a stable microclimate that typically protects finds from environmental impacts, while the nine other fragments came from single-layer, open-air settlements.

As Antonio Blanco-González suggested, it is also possi-ble that some pottery traditions adopted decorative mot-ifs and borrowed techniques from others, but only cer-tain elements of a more complex technology; this may resulted in a lack of lime inlays, nonetheless making the ‘original’ and the ‘copied’ ornaments in many respects identical.<sup>33</sup> However, the pottery record of all archae-ological cultures in the Carpathian Basin which deco-rated their vessels with stab-and-drag patterns contains many well-documented encrusted pieces. Therefore, the



Fig. 4. Bell Beaker vessel from Tököl (Inv. no.: HNM 76.1876.2). a – the encrustation preserved only in a tiny spot next to the combined diamond and hourglass motif, b – detail of the base, c – detail of the decoration

29 RYE 1981, 121.

30 For example, the high natural lime concentration in soils or artificially added calcium carbonate; see UCHIDA – HUE 2000.

31 BLANCO-GONZÁLEZ 2018, 29.

32 MIHÁLY et al. 2010, 253, Tab. 2, Sample ID: AGGB-180.

33 BLANCO-GONZÁLEZ 2018, 28.



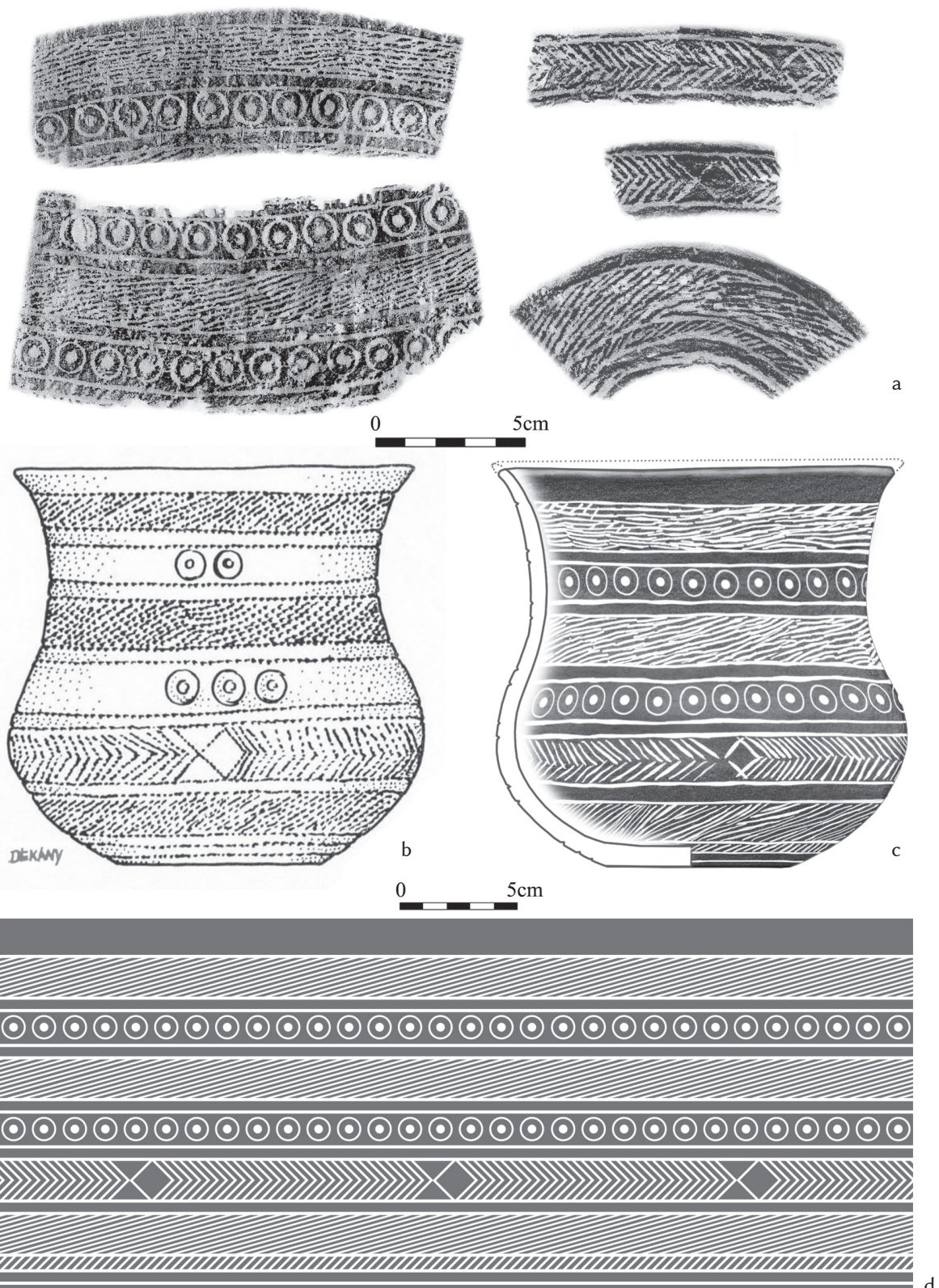


Fig. 5. Bell Beaker vessel from Tököl (Inv. no.: HNM 76.1876.2). a – rubbing image, b – conventional depiction (after SCHREIBER 1975, Fig. 9.2), c – new illustration with reconstructed encrustation, d – stylised and idealised pattern reconstruction

author agrees with Maluquer de Motes, who noted that “In reality, *Boquique* (stab-and-drag) is simply an inlay technique involving the formation of an irregular bed to achieve a greater adherence of the white inlay.”<sup>34</sup> Besides, there is little doubt about the strong connection between certain technologies, such as the stab-and-drag technique and encrustation. In contrast, a possible argument could be that “this is an effective technique to get contrasting light-shadow visual effects”<sup>35</sup> on ceramic surfaces, i.e., a distinct type of decoration itself. This statement is, however, questionable in light of all the reconstructed encrustation illustrations made to depict the correct contrast play for this study versus the originally published depictions reflecting the actual inlay-less state of the same ornaments. In addition, string-wrapped stick imprints also produce very detailed and truly interesting light-shadow effects,<sup>36</sup> although the potters of the Kisapostag and Transdanubian Encrusted Pottery traditions did not apply this technique with that in mind in the first place.<sup>37</sup>

## A case study from Balatonszárszó

A remarkable assemblage perfectly illustrates the problem of missing encrustations. The Middle Neolithic Linear Pottery Culture (LPC) has an almost century-long history of research.<sup>38</sup> Thousands of LPC pottery pieces have been excavated and published from the 1930s onwards without anyone noticing any trace of encrustation in them. Then, a surprising discovery was made at the site of Balatonszárszó-Kis-erdei-dűlő,<sup>39</sup> where a special kind of encrustation was found in many vessels.<sup>40</sup>

The shiny, white, pebble-like, 4–5 mm long seeds of purple gromwell (*Lithospermum purpureocaeruleum*) were glued into the deep, relatively wide linear grooves, presumably with birch bark tar.<sup>41</sup> It must be emphasised that the surface of the grooves features longitudinal micro-depressions<sup>42</sup> made with buckhorn (*Plantago lanceolata*) stem, as shown by experiments by Béla Eőry.<sup>43</sup>

Before discovering those vessels at Balatonszárszó, no one had ever thought that these deep and wide grooves may be associated with such an elaborate decoration technique of the LPC pottery tradition. The example raises the question of how closely this type of inlay is linked to LPC line patterns. Of course, it is hard to define how far the relevance of this example may be extrapolated. Were these wide and deep lines always designed to encase seeds? Certainly, special circumstances were required to preserve the organic parts, suggesting that many more vessels could be originally decorated this way.

As for the spatial distribution of ‘grain encrustation’, four other cases have been reported so far from Transdanubia (Hungary)<sup>44</sup> and a similar piece is known from Moravia (Czech Republic).<sup>45</sup> This scatter shows that the phenomenon was not limited to a microregion. At Balatonszárszó, it occurred mostly on vessels painted in red and sometimes also in yellow, with white, pearly dots filling the narrow, black stripes dividing the coloured zones and making the design truly

34 MALUQUER 1956, 188, 192. The quote was translated from Spanish by the author.

35 BLANCO-GONZÁLEZ 2018, 22.

36 GUCSI 2011, Fig. 3.

37 KISS 2012, 13–18.

38 TOMPA 1929.

39 MARTON 2004, 85, Fig. 5; BELÉNYESY et al. 2007, 80, Fig. 72.

40 MARTON 2015, 101–104, Fig. 5.19, Fig. 6.1, Pl. 33.3, Pl. 47.5, Pl. 49.4, Pl. 57.4, Pl. 59.1–3, Pl. 60.8, Pl. 65.1, Pl. 72.1a–b, Pl. 72.5–6, Pl. 73.7, Pl. 75.8, Pl. 76.6, Pl. 80.7, Pl. 79.3, Pl. 84.5.

41 MARTON 2015, 101, Footnote 18.

42 MARTON 2015, 100, Fig. 5.18.

43 EŐRY 2007, 63–64, Fig. 3.

44 MARTON 2015, 102, 216.

45 PROKEŠ et al. 2010, 114–117, Fig. 5.7.





Fig. 6. Bell Beaker vessel from Tököl (Inv. no.: HNM 143.1878.1). a – nicely burnished red slipped surface with pattern comb impressions (Photo: L. Gucsi), b – rubbing image

eye-catching.<sup>46</sup> A replica of one of the medium-sized vessels was completed,<sup>47</sup> and the process of its creation has revealed further interesting details. The seeds were only engaged, protruding halfway from the surface,<sup>48</sup> which significantly affected the appearance of the vessel by creating an effect exactly opposite to what one perceives when the inlay is missing (decoration protruding from the surface instead of appearing as a depression). Furthermore, tactile perception gives the impression that the pot has a firm grip and will not slip out of the hand.

## The importance of micro-depressions

Although throughout European prehistory, many different tools and methods were employed to create beds for encrustations, the essence of all was to create depressions in the soft clay surface. These beds could be made in a way similar to chip-carving, i.e., carving out deep, usually triangular-profile patterns from the vessel surface,<sup>49</sup> a method typically applied in the Carpathian Basin by the Vučedol<sup>50</sup> and Nyírség<sup>51</sup> pottery traditions. More often, however, the depressions were created by pressing some kind of tool into the soft clay. Scratching the surface with a pointy tool was much less frequent, as this easily creates a series of flanges at both edges of the line while the clay is relatively soft or ragged edges when the clay is already relatively dry, and this roughness disadvantageous when working with the white inlay paste that is supposed to stick even to the smallest indentation, including the unworked surface. Therefore, it is generally observed as a common characteristic among ceramics with a white inlay that the surroundings of the patterns are nicely smoothed or even well-burnished and in no way rough. The potters of the Bükk Culture often used a pattern comb with sharp, pointed, long teeth to draw bundles of perfectly parallel lines.<sup>52</sup> Based on the author's experience as a potter, to create beds for encrustation, the artist must keep the point of the tool at a low angle (around 8–15 degrees) to create depressions by smoothing-like or slightly pressing motion, as scratching-like movements should be generally avoided. This limitation becomes understood in light of a later stage of the *chaîne opératoire* when the bed is filled. Applying smoothing, pressing, and stamping-like movements to the leather-hard clay surface can prevent unwanted rough edges around hollow patterns.<sup>53</sup> The stab-and-drag technique (among many others) perfectly corresponds to these criteria.

Sometimes, the tools were quite specific, and their impressions were similar to stamped ones. Mile Baković mentions stamp-wheeled patterns on vessels of the Ljubljana ceramic style (Fig. 9.a–b). However, as this technological innovation would be surprising in the Early Bronze Age, his observation seems to require confirmation.<sup>54</sup> In the case of the Bell Beaker Culture, the working edge of the tool used for making encrustation beds was probably a chisel-shaped spatula with a flat, straight edge, slightly serrated by dense notches. Literature often refers to this implement as a 'comb',<sup>55</sup> albeit its teeth barely protruded from the edge, unlike a real comb with long, pointy teeth (see Fig. 1.a–c, Fig. 4.b–c, Fig. 6.a, Fig. 13.c for its imprints).<sup>56</sup> Potters of the Kisapostag pottery tradition and

46 For the digitally reconstructed patterns of these vessels, see MARTON 2015, Fig. 5.81–88.

47 The replica was made by the author.

48 MARTON 2015, Fig. 5.23.

49 BLANCO-GONZÁLEZ 2018, 26.

50 MILOGLAV 2016, 208, Fig. 10.

51 DANI – CSÉKI 2017, Fig. 10.

52 MIHÁLY et al. 2010, Fig. 1; HREHA – ŠIŠKA 2015, Pl. 142.27.

53 MILOGLAV 2016, 207.

54 BAKOVIĆ 2011, 376–378.

55 KUNST 1995, 594; MELIS 2011, 213; GARCÍA PUCHOL et al. 2013, 270; DERENNE et al. 2022, 53.

56 LEGHISSA 2015, 291; This tool is also called 'spatula' in KLEIJNE 2019, 106, Fig. 6.1.



its descendant, the Transdanubian Encrusted Pottery tradition, used a stick or spatula wrapped in (presumably) horsehair and, less often, a fine cord to impress patterns,<sup>57</sup> while craftsmen of the Corded Ware Culture only pressed the cord into the surface of the vessels.<sup>58</sup> Ornaments created by cord impressions are also present in the Bell Beaker complex<sup>59</sup> and the Kostolac–Vučedol Period I, also appearing on bowls with internal decoration.<sup>60</sup> The potters of the Bell Beaker complex also used *Cardium* shells to create impressed patterns.<sup>61</sup> The essential feature of all these techniques is that the bottom of the depressions were rusticated, creating a series of micro-depressions that helped the inlay stick better. Longitudinal micro-depressions were sometimes also created on vessels of the Neolithic LPC tradition, even though the birch bark tar used for fastening the inlay was very sticky.

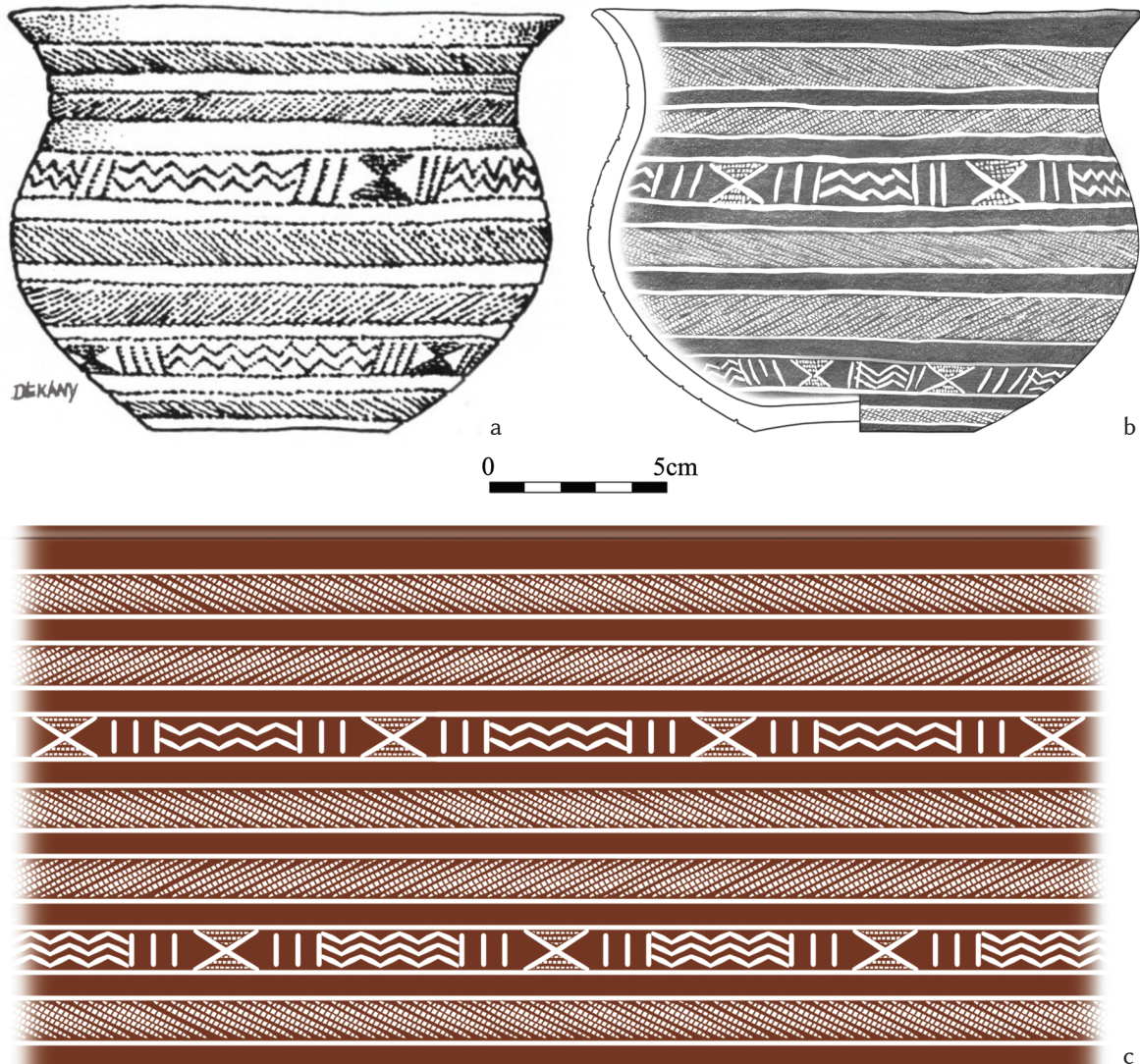


Fig. 7. Bell Beaker vessel from Tököl (Inv. no.: HNM 143.1878.1). a – conventional depiction (after SCHREIBER 1975, Fig. 15.3), b – new illustration with reconstructed encrustation, c – stylised and idealised pattern reconstruction

57 KISS 2012, 13–18; LEGHISSA 2015.

58 GRÖMER – KERN 2010.

59 KLEIJNE 2019, 106, Fig. 6.1; CARLONI et al. 2022, 1066.

60 KULCSÁR 2009, 123.

61 PRIETO MARTINEZ – SALANOVA 2009; KLEIJNE 2019, 106, Fig. 6.1, 129, Tab. 3.4.

## The importance of negative motifs

In decorations with so-called ‘negative patterns’ the light and dark parts complement each other, usually creating a mesmerising sight.<sup>62</sup> Such decorations include an intricate phenomenon called a ‘negative motif,’ when the surface surrounded by the inlay becomes the accentuated pattern instead of the inlaid white parts.<sup>63</sup> This sub-category, does not apply to simple lines (alternating dark and light ones), which are only elementary building blocks of a pattern, but does to zig-zags which consist of motifs in mostly complex relations.<sup>64</sup> Patterns are built from motifs, and decorations are a combination of patterns. Interestingly, many encrusted motifs have an inverse counterpart,<sup>65</sup> the significance of which equally important in the whole design<sup>66</sup>—like the Yin and Yang symbol embodying a unity of contrasts in one image where the light and the dark parts only make sense together, lifting the whole composition from a simple ‘mesmerising’ effect up to where complexity creates its own meaning that reflects on the intricacy of the concepts behind. In other words, the driving force behind creating ‘art’ in prehistory was in the cognitive realm of craftspersons familiar with the visual concepts and their mnemonic functions that linked material objects with ideas in the social and cognitive framework; these specialists worked in a dynamic relation with other members of their respective communities.<sup>67</sup>

The concept of negative motif is best explained by illustrating it with an example. The same ornament with opposite contrasts appears on the central band of a beaker<sup>68</sup> and the rim of a bowl.<sup>69</sup> While the beaker features a row of encrusted diamond motifs between two rows of negative triangles, triangles were encrusted on the bowl, and the row of (negative, undecorated) diamonds became visually prominent. In some cases, the negative motifs are less definite, consisting only of small dark dots created by surrounding with encrustation—a solution characteristic of the Tokod Group in Transdanubia.<sup>70</sup> The most common negative motif in prehistory is the zig-zag, made of rows of alternating triangles with a distance between them (Fig. 8.2.c–d, Fig. 9.c, Fig. 10.1.c–d),<sup>71</sup> while Bell Beaker vessels frequently bear a series of dark squares between horizontal bands.<sup>72</sup> Although the latter two references contain illustrations of two beakers each, the depictions illustrate well the ideal method of reproducing these patterns, a point also emphasised by this study. Moreover, both papers contain two reconstructions of each vessel, one with less inlay and one with filled beds.<sup>73</sup> The latter reconstruction is, however, unlikely precise because the horizontal bands above

62 COOKE 1979, 135, 145, 149, 157.

63 L. Gucsi refers to this decorative element or phenomenon as an “inverse motif” (GUCSI 2011, 279). J. Turek described this specific phenomenon without giving it a collective name (TUREK 2008, 159), while G. Kulcsár referred to negative motifs as “empty” areas (KULCSÁR 2009). R. G. Cooke described it as “positively expressed negative elements” (COOKE 1979, 476).

64 KUNST 1995, 593–594, Fig. 1.

65 For example, the originally encrusted (white) small, square impressions on a beaker in two rows in CZENE 2017, Fig. 8.3, as opposed to the (dark) negative small squares in two rows created by an inlaid grid in CZENE 2017, Fig. 8.4.

66 See MILOGLAV 2016 for many nice examples.

67 SEBŐK 2018.

68 TUREK 2008, Fig. 55.5.

69 TUREK 2008, Pl. 6.4.

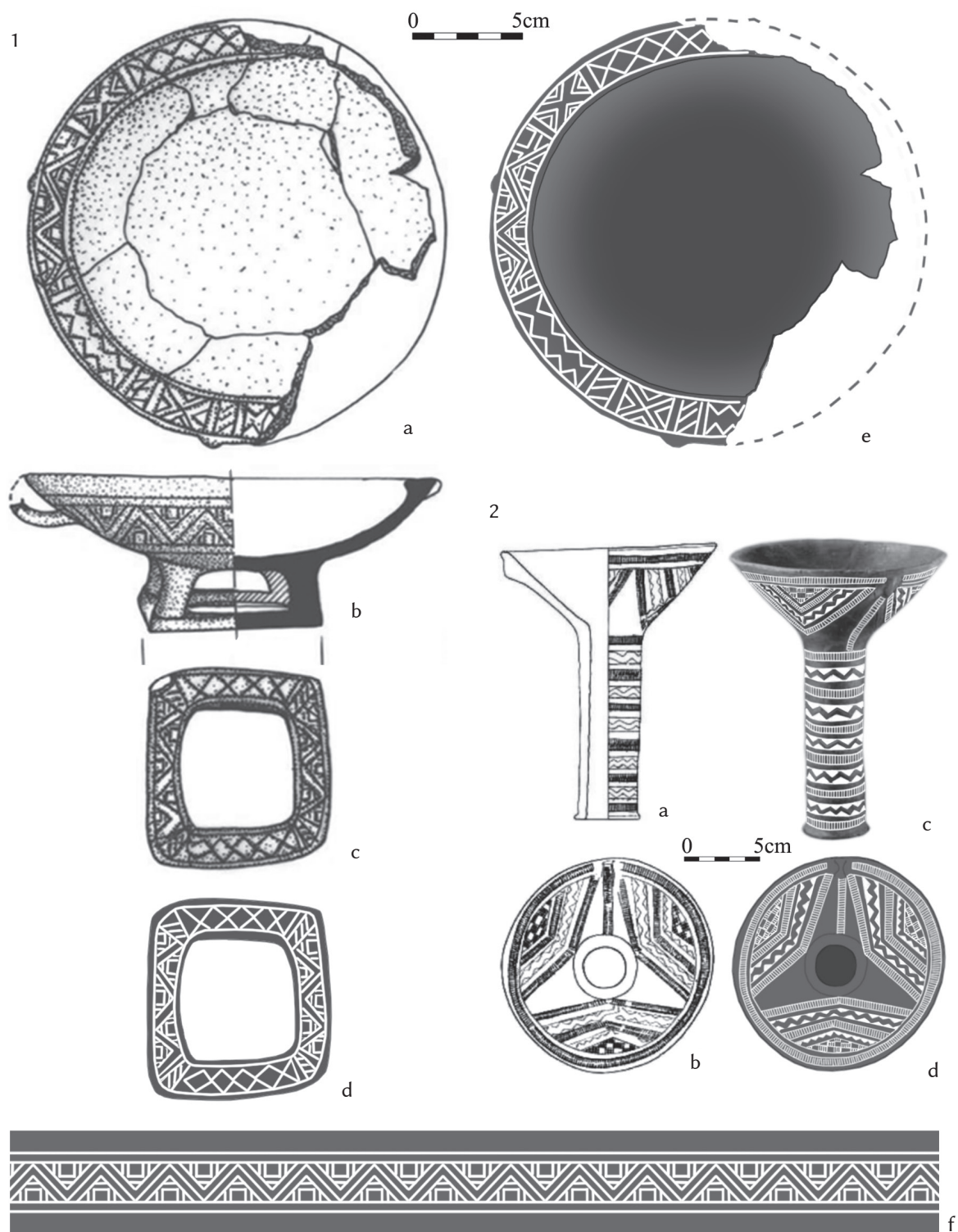
70 For example, two horizontal dot rows on the rim under the triangles on a jug in MELIS 2017, Fig. 3; single horizontal rows under the rim and on the shoulder and vertical rows in the middle of every second feather-like motif under the belly on a bowl in GUCSI 2011, Fig. 5.

71 E.g., HÁJEK 1966, Fig 11.1; TUREK 2008, 159, Fig. 55.3; KULCSÁR 2009, Pl. 15.2.

72 HÁJEK 1966, Fig 11.2; HÄNSEL – HÄNSEL 2002, Figs 1–2.

73 HÄNSEL – HÄNSEL 2002, Fig. 1.h, Fig. 2.f.





**Fig. 8.** 1 – Bowl with low openwork pedestal from Budakalász, 1.a–c – conventional depiction (after CZENE 2017, Fig. 9.1), 1.d–e – illustration with reconstructed encrustation, 1.f – stylised and idealised pattern reconstruction of the outer side of the bowl, 2 – ceramic funnel from Gruda Boljevića, 2.a–b – conventional depiction (after BAKOVIĆ 2011, Fig. 6.a–b), 2.c – encrusted pattern reconstruction based on the original image (after BAKOVIĆ 2011, Fig. 6.c), (photo by T. Lauko, reworked by L. Gucsi), 2.d – encrusted pattern reconstruction, bottom view

each other often consist of notches slanting in opposite directions,<sup>74</sup> which only makes sense if they remain visible in the final pattern (Figs 6–7).<sup>75</sup>

Taking into account the possibility that prehistoric people imitated or copied elements of foreign material cultures, it is a question whether, in the process of adaptation, the borrowed motifs were intended to and capable of retaining their original (negative) visual values if only a minor detail was taken out and copied from a complex decorative system (i.e., a focus on light-shadow effect without the aim of encrustating it). Research has already pointed out that “style can be understood as a ‘variation in processes’ or specific ‘ways of doing things’, but also as the particular characteristics of the finished products”.<sup>76</sup> Therefore, the joint presence of negative motifs, the micro-depressions at the bottom of grooves, and at least smoothed but mostly burnished surfaces around the patterns increases the likelihood that the vessel was encrusted once.

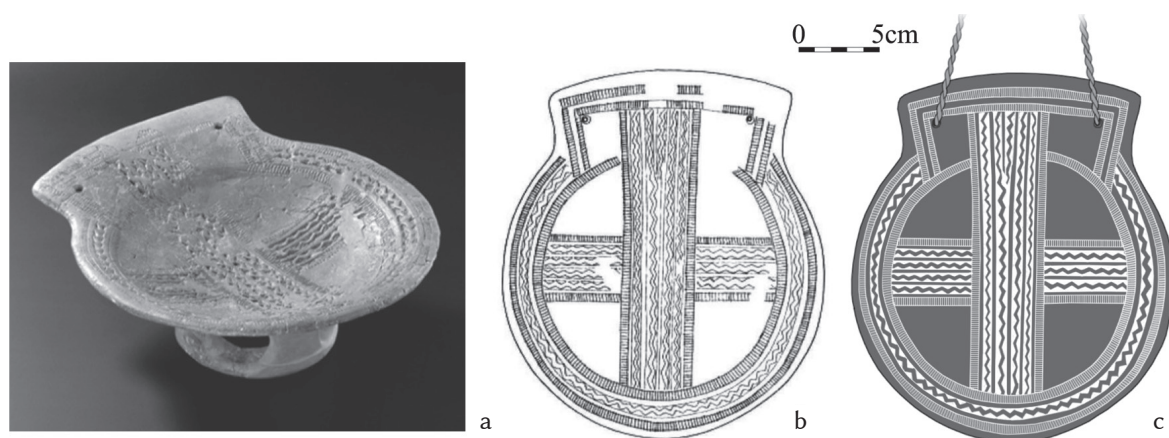


Fig. 9. Bowl with low openwork pedestal from Gruda Boljevića. a – on a photo (after BAKOVIĆ 2011, Fig. 5.c; photo by T. Lauko), b – conventional depiction, top view (after BAKOVIĆ 2011, Fig. 5.a), c – encrusted pattern reconstruction

## Leapfrogging

Ruth Tringham has drawn attention to the potential pitfalls of ‘leapfrogging’, i.e., skipping elemental questions to achieve a higher-level synthesis.<sup>77</sup> She warns that at each new level of analysis, the effects, including the potential mistakes of the previous levels, are magnified significantly until the outcome may be ‘devastating’.<sup>78</sup>

In light of that, the question of how far one can go in reconstructing inlaid motifs has high stakes. It is difficult to determine without any doubt whether the large proportion of missing encrustations in the pottery record of a particular site is the result of the vessels having been designed originally to produce the appearing light-shadow effect or be inlaid. In such cases, the practical approach might help: let’s make a reconstruction and see if a vessel’s (or sherd’s) design adds up to a complex decorative pattern. A reconstruction made this way may reveal a series of recurring concepts (such as negative motifs) applied by prehistoric potters who certainly had a clear image of the final design in mind.

74 E.g., HÁJEK 1966, Fig. 4.6; ENDRÓDI 1992, Fig. 84.10; ENDRÓDI 1992, Fig. 53.7; FAVREL 2022b, Fig. 265.1, Fig. 274.1–3, Fig. 317.1, Fig. 318.1.

75 For well-preserved inlay in sherds, see GIUSTETTO et al. 2013, Figs 2–3; FAVREL 2022a, Fig. 2.1, Fig. 99.2, Fig. 115, Fig. 116.1, Fig. 149.3.

76 BERNABEU et al. 2011, 216.

77 TRINGHAM 1978.

78 ODELL – COWAN 1986, 195–196.

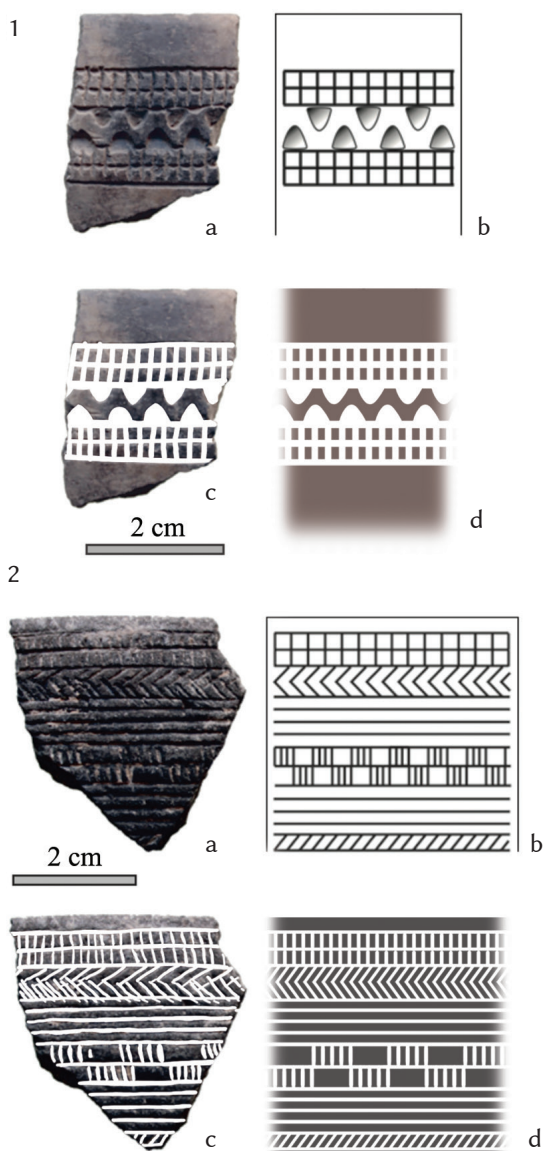


Fig. 10. Rim fragments of bowls from Peñón de la Zorra. 1.a – on a photo, 1.b – idealised pattern reconstruction based on a conventional depiction (after ALBA LUZÓN – GARCÍA ATIÉNZA 2018, Fig. 2.1.1), 1.c – pattern reconstruction based on the photo, 1.d – stylised and idealised reconstruction of the encrusted pattern, 2.a – on a photo, 2.b – idealised pattern reconstruction based on a conventional depiction (after ALBA LUZÓN – GARCÍA ATIÉNZA 2018, Fig. 10.V.14), 2.c – the pattern reconstruction based on the photo, 2.d – stylised and idealised reconstruction of the encrusted pattern

A reconstruction must be understood and appreciated as a possible interpretation created by adopting a particular set of criteria. Accordingly, an artefact depicted previously, following a different set of criteria may feature a visual effect opposite to the original. Generating biased ‘data’ this way has a history in archaeology. In textile research, which focuses on the imprints on the surface of pottery, the categorisation of directions of cord twists (S or Z) is opposite in Japanese and American archaeology, depending on whether the determination is based on the mirrored pattern of the imprint or the pattern of the original cord.<sup>79</sup> These parallel systems coexist in science, and it is necessary to clearly see their differences.

Reconstructing inlay patterns can give new insight into the practices of many prehistoric ceramic traditions in Europe. It would be useful to achieve that each encrusted pot is published together with a reconstruction of its pattern, illustrating the original light-dark contrast. One can go a step further when reconstructing ornaments and motifs from an assemblage with only a few preserved inlays, thus suggesting that the lack of encrustations at that particular site is due to exposure to destructive chemical processes.<sup>80</sup>

If this practice would become more widespread, several previous studies on design analysis should be re-evaluated,<sup>81</sup> simply because the way ornaments were broken down into motifs was determined by a different way of perceiving them. If one focuses on the pattern as a play of light and shadow instead of restoring the original white and dark contrast, its visual interpretation will be significantly different,<sup>82</sup> especially when the encrustation densely covers relatively large areas with thick and complex decorative elements (Fig. 10.1.b,d).<sup>83</sup> However, the difference will be less significant if the decoration includes loosely arranged lines (Fig. 10.2.b,d, Fig. 11.a–b, Fig. 16.a–b, Fig. 17.a–b), especially thin ones,

79 YOSHIKAZI 1979.

80 PALINÇAŞ 2010, Fig. 8.8.

81 E.g., KUNST 1987; KUNST 1995, Fig. 3; PALINÇAŞ 2010, 74; ALBA LUZÓN – GARCÍA ATIÉNZA 2018; REICH 2002; REICH 2006, 32–232; PASQUALE et al. 2022.

82 HUGGETT 2012, 212.

83 MILOGLAV 2016.



like the variant characteristic of the northern group of the Transdanubian Encrusted Pottery tradition<sup>84</sup> and also present in the Bell Beaker style (Fig. 10.2, Fig. 11.2).<sup>85</sup>

### Considerations from the perspective of graphic design—case studies

Lifelike reconstructions start with rubbing art: a piece of paper is laid on top of the vessel surface and rubbed with a graphite stick (a technique also called charcoaling or frotting). This is a simple and practical method to capture the details of relief patterns (Fig. 2.a, Fig. 5.a, Fig. 6.b).<sup>86</sup> Photos (especially taken of objects with hollow patterns lit at a low angle) may also provide a good basis for reconstruction (Fig. 8.2.c, Fig. 13.b). By processing first separately the drawing, the frottage, and the photo image, and combining them with a graphics editor software in the following phase, one may create nearly photorealistic illustrations with increased accuracy that incorporate higher amounts of data transmitted through the process of visual communication.

An important aspect of archaeological illustrations is accuracy. Although everyone creating illustrations is supposed to be aware of the importance of accuracy, there are significant differences in this regard between the published images of the four (out of six) presented vessels compared to their new reconstructions (Fig. 2.b–c, Fig. 5.b–c, Fig. 12.a–b, Fig. 13.a–b). The mistakes include depicting decorative panels as blank, mis-drawing lines, and representing the reconstructed section of the rim as intact (Fig. 2.b). Relatively minor differences are also present, like a schematically depicted pattern on the rim of a bowl with internal decoration, resembling a row of regularly spaced and mostly separate ‘bird footprints’ (Fig. 12.a), whereas its new reconstruction features a slightly different pattern; when it comes to interpretation, this can make a meaningful difference as these motifs, when reconstructed correctly, resemble ears of wheat the most (Fig. 12.b).<sup>87</sup> Another significant difference between the already published and the new illustration is the oval, dotted, grain-like impressions running between the triple line bunches in the triangles. These two ‘new’ pieces of information about this pattern enable combining of their associations and interpreting the decoration, in my opinion, as a depiction of the cultivation cycle of wheat in a cosmological framework. The central circle with the four small triangles may be a sun symbol or even a well (as the centre of the bowl has a lenticular depression). The triangles formed by the triple lines are likely ploughed soil with sowing seeds, while the other two triangles with chequerboard-like pattern may be interpreted as parcels of arable land and fallow. The two axes of symmetry can be related to the four cardinal directions and/or the four seasons, all in the periodically repeating circle of time.

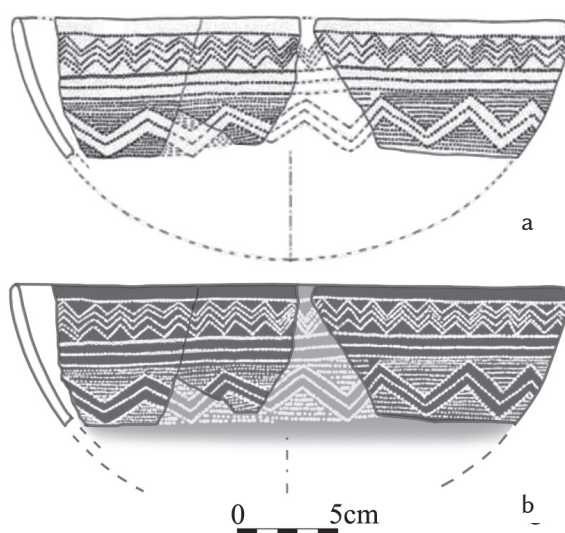


Fig. 11. Bowl from Monte d'Accoddi. a – conventional depiction (after MELIS 2011, Fig. 7.4), b – reconstruction of the encrusted pattern

84 E.g., KISS 1997; KISS 2012, 47, 59, 74.

85 MELIS 2011.

86 GUCSI 2011, 277, Figs 8–9.

87 Since ornaments reduced to highly geometric patterns are common in prehistory, it is difficult to decipher their exact meaning, or even impossible, according to K. Sebök (SEBŐK 2018, 16, 28). The four motifs, similar to the ears of wheat, could also be interpreted as branches with leaves of some tree or bush.





Fig. 12. Pedestalled bowl with internal decoration from Kaposújlak. a – conventional depiction (after KULCSÁR 2009, Fig. 59.7), b – new illustration with the reconstruction of the encrusted pattern





Fig. 13. Top view of a pedestalled bowl with internal decoration from Tököl (Inv.no.: HNM 76.1876.24). a – conventional depiction (after SCHREIBER 1975, Fig. 9.1.b), b – new illustration with the reconstruction of the encrusted pattern based on a photo of the object, c – on a photo (photo by L. Gucsi)

The outlined interpretation of this complex symbolism coincides in many elements with the interpretation of some depictions of the famous Funnel Beaker vessel from Bronocice.<sup>88</sup>

A mistake in the published illustration has also affected the interpretation possibilities of a unique bowl from Tököl. This artefact is key to the research, as it represents a link between two cultures and has chronological value.<sup>89</sup> The problematic point is that two types of zig-zag motif alternate in the quadrants on the rim (Fig. 13.b–c) instead of three, as published previously (Fig. 13.a).<sup>90</sup> Mirroring the identical, triangular panels is part of the basic design concept of Early Bronze Age bowls with internal decoration, mainly in the Makó–Kosihy–Čaka pottery tradition,<sup>91</sup> and also appears, even if less frequently, in the Somogyvár–Vinkovci Culture (Fig. 12.b).<sup>92</sup> This design principle appears on the rim of this bowl, while the chequerboard-like pattern does not follow this rule (Fig. 13.a). The bowl stands on a conical pedestal, uncharacteristic of the Bell Beaker–Csepel group but commonly employed, together with decorating the interior of bowls, by Makó–Kosihy–Čaka and Somogyvár–Vinkovci potters.<sup>93</sup> At the same time, the ornament was made with a pattern comb, a tool characteristic exclusively of the Bell Beaker tradition. While the whole pattern on the inner side of the bowl is relatively carelessly executed, a striking error is also recognisable in the composition: an elongated empty rectangle is missing from the rim opposite the handle, breaking the general concept of point symmetry.<sup>94</sup> Traces of cultural blending can also be recognised in this object,<sup>95</sup> manifesting in the unusual shape of the pedestal and an inconsistency in the use of decorative motifs. The different directions of the hatching in the chequerboard-like pattern are also conspicuous in light of similar vessels of the Makó–Kosihy–Čaka tradition, where such lines in most cases are identically oriented.<sup>96</sup> The proportions of the large, flower-like cross motif in the decoration are also unique, with only two known analogies,<sup>97</sup> as such crosses are usually more squat, consisting of trapezoids.<sup>98</sup>

A specific style of illustration uses cylindrical projection, when the curved surface of, e.g., a vessel with its decorations is ‘rolled out’ onto a flat surface (Fig. 2.d, Fig. 5.d, Fig. 6.d, Fig. 7.c, Fig. 8.f, Fig. 10.1.b,d, Fig. 10.2.b,d, Fig. 14.c, Fig. 15.b, Fig. 17.b). This method is useful for showing, for example, pattern repetition (see, e.g., the uniquely combined hourglass and diamond motifs repeated three times; Fig. 5.d).<sup>99</sup> Although this technique allows for schematisation, certain measurements must also be correctly recorded or calculated. In this case, line thickness should correspond to the average size of the original encrustation beds since these can vary within a narrow range due to being created freehand. The irregularities of undulating lines and certain small mistakes in the design may be corrected as they are considered ‘noises’ in the visual message.<sup>100</sup> At this point, it is important to note that in an image with a 300 dots/inch resolution, even a one-pixel difference in line thickness alters the outcome of the final pattern, especially if the vessel or pattern is reduced to a scale of 1:2 or less.

88 MILISAUSKAS et al. 2019, 234–235. A paper on ceramic traditions and the concept of time in the Bronze Age also supports the suggested interpretation; see KREITER 2007.

89 SCHREIBER 1975, Fig. 9.1a–b; KULCSÁR 2009, 35, 141.

90 SCHREIBER 1975, Fig. 9.1a–b.

91 KULCSÁR 2009, 128–129, Figs 27–30.

92 KULCSÁR 2009, Fig. 58.1–2, Fig. 59.5,7, Fig. 61.1–2.

93 KULCSÁR 2009, 130.

94 SCHREIBER 1975, Fig. 3a, Fig. 14.1a; KULCSÁR 2011, Fig. 9.1.

95 STOCKHAMMER 2012.

96 KULCSÁR 2009, Fig. 27.4,7–8, Fig. 28.6, Fig. 29.1,8, Fig. 30.3–4,7–8,10.

97 KULCSÁR 2009, Fig. 27.8–9.

98 KULCSÁR 2009, Figs 27–30.

99 This vessel was also published (with the site misidentified) in WOSINSKY 1904, Pl. 140.

100 GUCSI 2011, 272–273, 277–279.



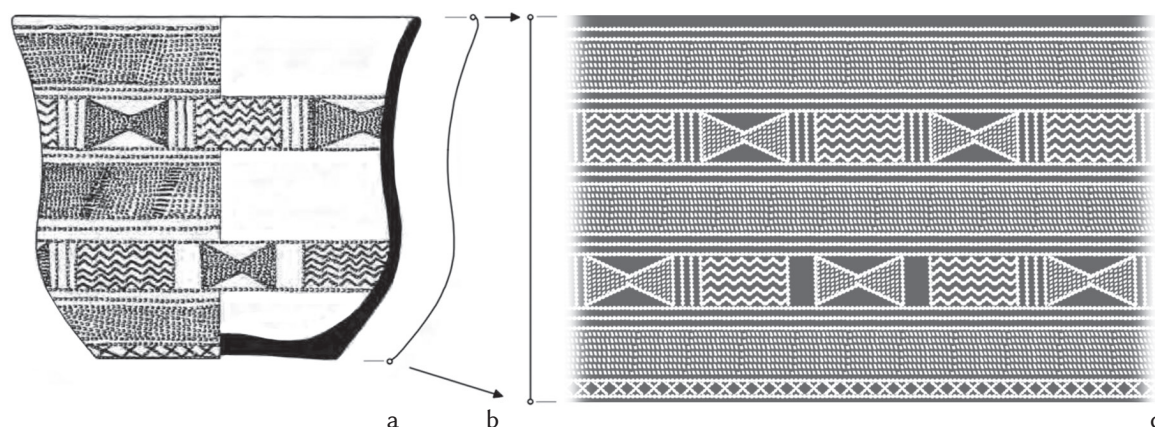


Fig. 14. Bell Beaker vessel from Proboštov. a – conventional depiction (after TUREK 2008, Fig. 55.2), b – equidistant projection for reconstruction, c – stylised and idealised reconstruction of the encrusted pattern

One typical issue in illustrations is depicting the various micro-impressions in the encrustation beds (Fig. 2.b, Fig. 5.b, Fig. 7.c, Fig. 13.a, Fig. 14.b). Considering that encrusted motifs are only defined by the edges of the impressed patterns (originally filled with white inlay), it is easy to see that any other detail drawn within the edges is also ‘noise’. For example, the teeth of the pattern comb leave small, pointy impressions in the bottom of the grooves, but this detail is irrelevant to the final design, and the edges of the impressions are straight. If pressed lightly, the pattern comb creates only a dot row pattern (Figs 6–7). Probably, this is the case with a beaker from Proboštov; a reconstructed copy was made with jagged edges after the published depiction (Fig. 14.a,c).

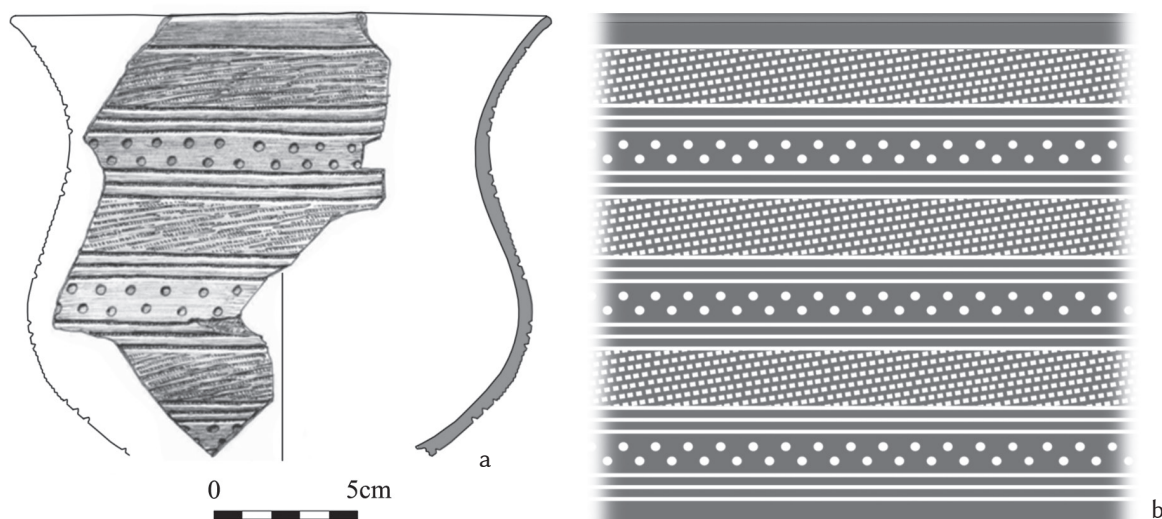


Fig. 15. Bell Beaker vessel from Albertfalva. a – conventional depiction (after ENDRŐDI – REMÉNYI 2016, Pl. 36.6), b – reconstruction of the idealistic concept of its ornament with encrustation

An additional criterion when creating such reconstructions is to avoid distortion by foreshortening. In order to achieve the best result, the height of the illustrated pattern should be depicted according to the rules of equidistant projection, i.e. the curvature of the surface needs to be taken into account, and the size of the pattern accommodated accordingly instead of squeezing everything into the original height of the object (Fig. 14.b). Notice the fairly regular vertical distances between the horizontal stripes and how they shorten under the belly and even more near the vessel



**Fig. 16.** Bowl with decorated rim from Albertfalva. a – conventional depiction (after ENDRÓDI – REMÉNYI 2016, Pl. 17.3), b – reconstruction of the encrusted pattern

construction. These vertical dashes nearly align in two cases (Fig. 6.a), although most of them seem to be randomly placed, due probably to the large length differences between the bands (the lower one is very close to the base, while the other band is positioned just above the belly of the heavily curved vessel). The related problem emerging during reconstruction was resolved by diagonally shifting the geometrically decorated panels relative to each other based on the analogies of other

base in the illustration (Fig. 7.b).<sup>101</sup> The usually rather regular distances between horizontal stripes on Bell Beakers allow one to consider that if, e.g., a stripe is 13 mm wide but the other similar ones are consistently only 11 mm wide, the wider stripe is simply a mistake made by the potter, as the general concept was to create bands of equal width. Attention to the inner proportions of the vertical spacing is also important in this illustration style. The perimeters of the base, the belly, the neck, and the rim all differ, and the lengths of the related circumferential bands or stripes change with it. At the same time, it is quite striking that certain motifs were always created in a similar size on certain vessels, like the so-called hourglass motifs on a beaker from Tököl (Fig. 6.b). Equalising the differences in the length of the horizontal pattern bands may also reduce the ‘noise’ in the pattern, as demonstrated on two beakers from Tököl (Fig. 2.d, Fig. 7.c). The decoration of both vessels includes recurring panels with motifs in various sizes, in which the length of zig-zags and the number of some additional elements are dissimilar (Fig. 1.a–c, Fig. 6.b) and include a predominant variant. While the upper band with a complex geometrical ornament contains a double zig-zag bundle, that in the lower band is always triple (Fig. 6.a–b); therefore, these characteristics were represented accordingly. Further regularities can be observed: the zig-zags almost always start and end with a dash running from top left to bottom right. Besides, hourglass motifs usually stand between two, three, or four short, vertical lines on each side, as the triple bundle is the most frequent variant selected for the virtual pattern reconstruction.

101 HÄNSEL – HÄNSEL 2002, Fig. 1.g, Fig. 2.e.

similarly decorated vessels (Fig. 14).<sup>102</sup> The other beaker from Tököl (Figs 1–2) has an unusual feature: a chequerboard-like pattern that is consistently irregular. The two wide horizontal bands, each with two rows of squares, are parallel but slightly misaligned—surprisingly, as the potter could easily correct this issue while decorating the vessel, considering that the squares have different widths anyway, and in most cases the misalignment is minimal (Fig. 1.a–c). All this suggests that the shift is the result of a conscious choice. Whether this irregularity was indeed due to simple errors (Fig. 4.c), is related to the potter’s skills,<sup>103</sup> or is the result of a conscious choice is difficult to tell, but it became a characteristic feature at least of the vessel in question as it was repeated on the entire surface (Figs 1–2). Thus, following the rules of the illustration style discussed above, flat projection and schematisation were employed to depict an idealised geometric pattern based on the most common occurrence of motifs observed on a given artefact.

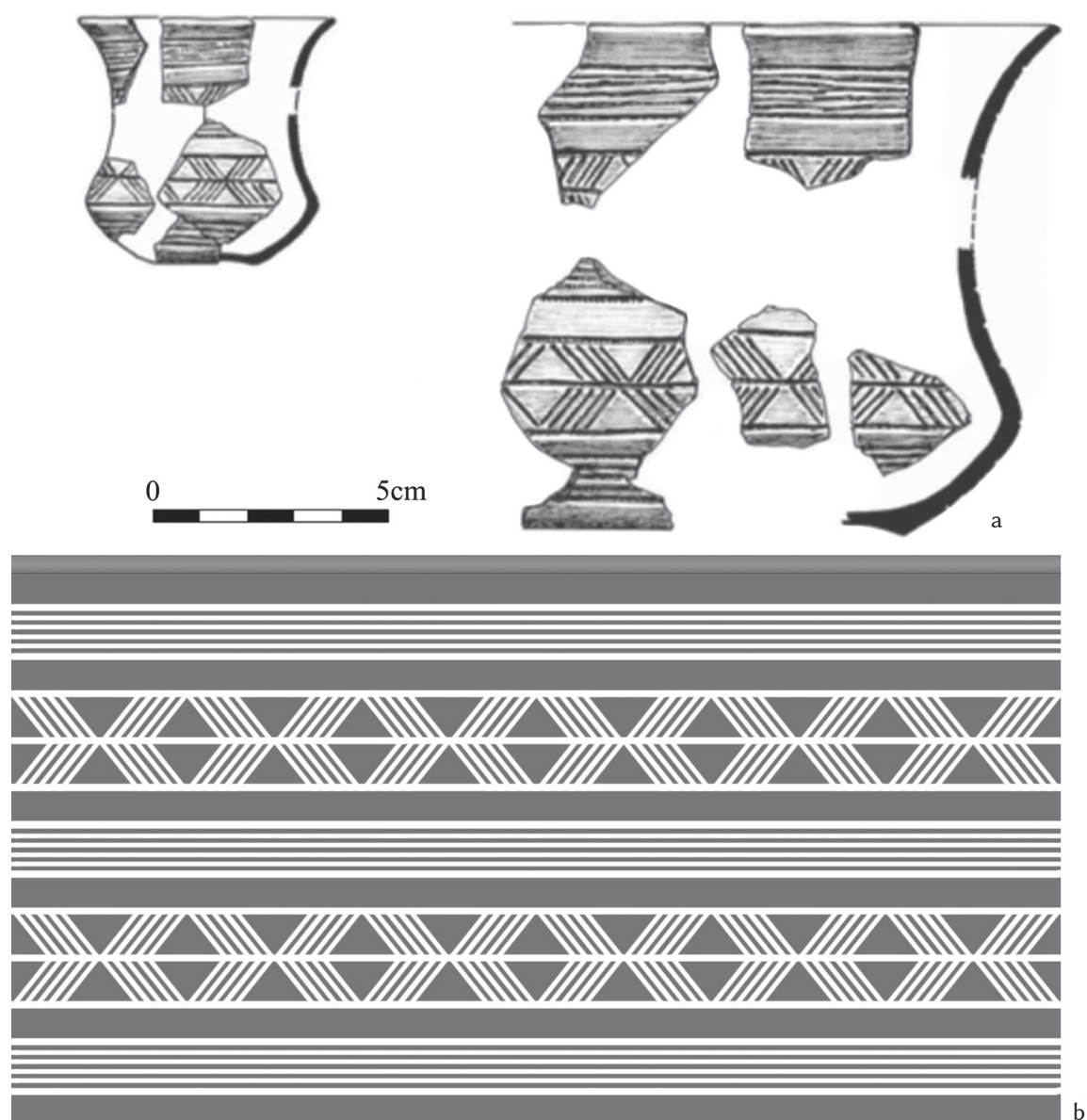


Fig. 17. Bell Beaker vessel from Albertfalva. a – conventional depiction (after ENDRÓDI – REMÉNYI 2016, Pl. 72.3), b – stylised and idealised reconstruction of the encrusted pattern

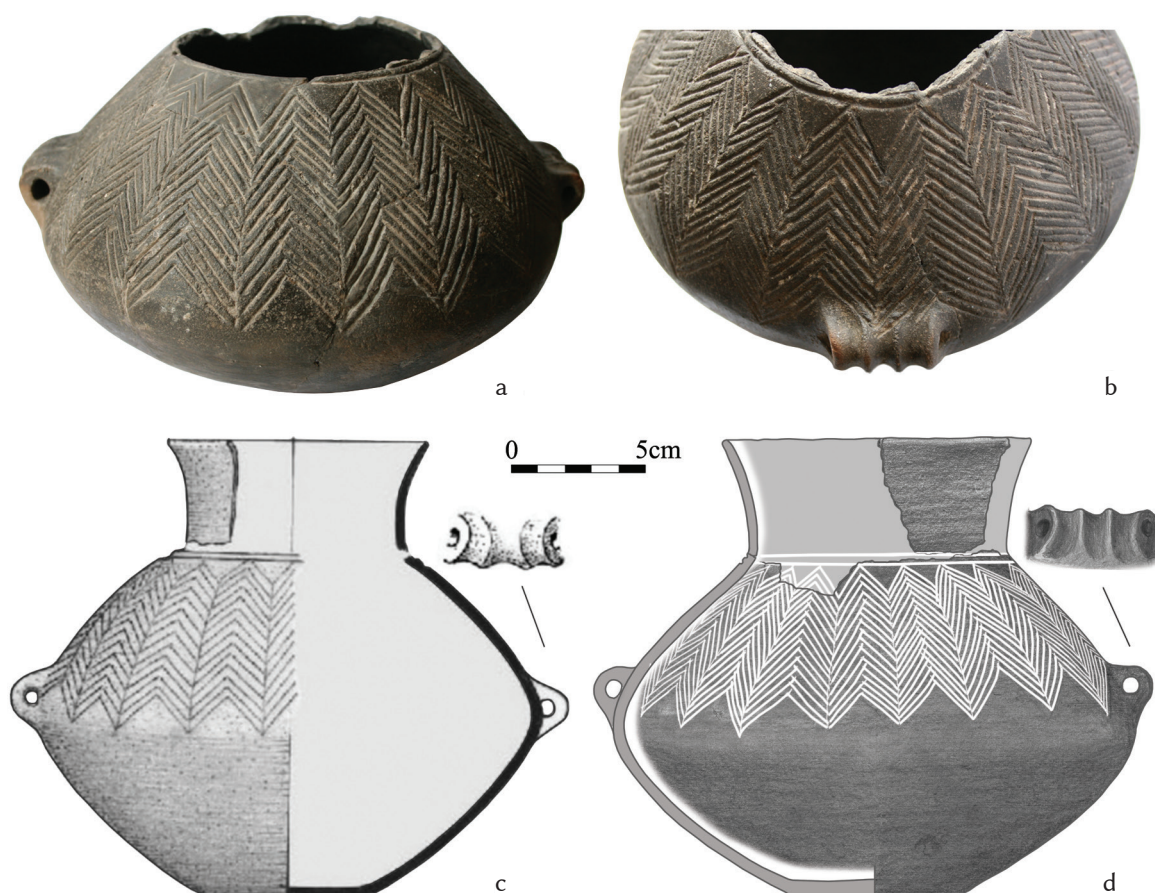
102 RATZEL-FABIAN 1983, Pl. 70.12, Pl. 71.15,19; TUREK 2006, Fig. 18.2, Fig. 24.1–2, Fig. 79; TUREK 2008, Fig. 55.2.

103 FÜLÖP 2016, 124–126; FAVREL 2022c; GUCSI 2023, 364–366.



## Further case studies based on pattern reconstructions

A comparison of the main features of the previous illustrations and the new ones allows one to draw some important conclusions. The most interesting is the presence of geometric optical illusions in the reconstructed patterns. Horizontal bands on Bell Beaker vessels are often hatched, and the direction of hatching usually alternates. This creates an optical effect similar to the so-called Zöllner illusion,<sup>104</sup> where the horizontal, parallel lines are perceived as being at an angle (Fig. 7.c). However, the illusion does not work either with the three-dimensional vessel or its nearly photorealistic illustration (Fig. 6.a, Fig. 7.a–b) because its horizontal and vertical curvatures distort the pattern. Also, the horizontal parallel lines drawn by freehand are slightly undulating, and this small irregularity may be enough to break the optical illusion. The effect only works if the pattern is depicted on an even, flat surface with regular, perfectly straight lines, which may be indirect evidence of these patterns having been borrowed from textiles, a medium capable of meeting these requirements.



**Fig. 18.** Small amphora from Ordacsehi. a–b – decorated shoulder (photos by L. Gucsi), c – conventional depiction (after KULCSÁR 2013, Fig. 4.1.b), d – new illustration with the reconstruction of the encrusted pattern

The illusion of depth is another interesting optical effect appearing, e.g., on a bowl from Boljevića (Fig. 9.c). In addition, this reconstruction revealed another possible correlation by adding virtually the cord in the suspension holes; it gives an impression that the cord runs under the corner of the hatched bands and is aligned with, or ‘continues’ as the outermost hatched and encrusted band around the rim. Similarly, but with less depth, the small, negative, framed square motifs seem to be

104 PARK et al. 2022, Fig. 1.a.

behind the zig-zag line on a pedestalled bowl from Budakalász (Fig. 8.f). A unique amphora from Ordacsehi (Fig. 18.d) also features a pattern with a depth effect: the herringbone pattern covering the shoulder appears as a paper fan-like structure with sharp edges. It must be mentioned again that optical illusions incorporated into the decoration do not necessarily work due to the curvature of the vessels; however, these vessels feature patterns which, originally, could be associated with magical properties.

Another visual effect can be observed on a beaker from Mělník, where every second horizontal band contains three dark, elongated rectangles aligned in a vertical line in one part of the ornament,<sup>105</sup> creating an effect of three vertical stripes being ‘woven’ into the pattern. A similar depiction is present on a beaker from Szigetszentmiklós; however, its decoration is not limited to a small vertically defined area but runs around the vessel in two double bands.<sup>106</sup> Another vessel has a similar decoration but with three stripes instead of two.<sup>107</sup>

## Opportunities for the future

Artificial intelligence is already involved in scientific research, and it can be useful in big data analysis to reveal clear links, e.g., between tool usage and particular users.<sup>108</sup> However, there are further possibilities in using the computing capacity available—especially teaching AI to create correct reconstructions based on previous illustrations that focused on the actual lights and shadows of the find instead of the dark-light contrast of the originally encrusted pottery. This process of ‘teaching’ or ‘feeding’ the algorithm with large data sets requires many illustrations made following the basic rules of illustrating encrusted pottery. Laser scanner systems with 3D imaging and graphics editing softwares are already available,<sup>109</sup> offering the possibility to integrate them to effectively create highly accurate reconstructions of prehistoric patterns, thus facilitating their comparison and interpretation.

## Conclusions

Since the goal of reconstruction is to create a possible view of how an object could look originally by combining existing and missing parts in a logical way, reliable reconstructions may be key in understanding complex decorations. This study provides an overview of the topic and illustrates the possibilities. How far can one get with reconstruction in a particular case? The line is difficult to draw, but research would certainly benefit from an increasing number of available reconstructions of encrusted decorations, at least of pottery with preserved traces of encrustation. The visual reconstruction of motifs linked to complex inlay decorations has the potential to lead to new interpretations, thus opening new paths and fields for research.

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105 HÁJEK 1966, Fig. 11.2.

106 PATAY 2013, Fig. 13.6.

107 HÄNSEL – HÄNSEL 2002, Fig. 1.

108 PAULOS-BRAVO – CIFUENTE-ALCOBENDAS 2023.

109 GÖTTLICH et al. 2021.

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## References

- ALBA LUZÓN, M. – GARCÍA ATIÉNZAR, M. 2018: Beaker pottery in the Peñón de la Zorra (Alicante, Spain): Change and emergence of social complexity between the Neolithic and the Bronze Age. *Journal of Neolithic Archaeology* 20, 59–78. <https://doi.org/10.12766/jna.2018S.4>
- BAKOVIĆ, M. 2011: The Princely Tumulus Gruda Boljevića Podgorica, Montenegro. In: Borgna, E. – Müller Celka, S. (eds): *Ancestral Landscapes. Burial mounds in the Copper and Bronze Ages (Central and Eastern Europe – Balkans – Adriatic – Aegean, 4th–2nd millennium B.C.) Proceedings of the International Conference held in Udine, May 15th–18th 2008*. Série recherches archéologiques 58. Lyon, 375–381.
- BELÉNYESY, K. – FÁBIÁN, SZ. – MARTON, T. – OROSS, K. 2007: Balatonszárszó-Kis-erdei-dűlő. In: Belényesy, K. – Honti, Sz. – Kiss, V. (eds): *Gördülő idő. Régészeti feltárások az M7-es autópálya Somogy megyei szakaszán Zamárdi és Ordacsehi között – Rolling Time: Excavations on the M7 Motorway on County Somogy Between Zamárdi and Ordacsehi*. Budapest–Kaposvár, 75–89.
- BERNABEU AUBÁN, J. – MOLINA BALAGUER, L. – GARCÍA BORJA, P. 2011: Le Néolithique ancien valencien. Évolution et caractérisation des productions céramiques. In: Manen, C. – Convertini, F. – Binder, D. – Sénépart, I. (eds): *Premières sociétés paysannes de Méditerranée occidentale. Structures des productions céramiques. Séance de la Société Préhistorique Française, Toulouse, mai 2007*. Mémoire de la Société Préhistorique Française 51. Paris, 215–225.
- BRÖNNIMANN, D. – WIMMER, J. – MÜLLER-KISSING, M. – STOPP, B. – RISSANEN, H. – SPICHTIG, N. 2020: One man's trash is another man's treasure. Interdisciplinary examination of taphonomic aspects of ceramic sherds, animal bones and sediments from the La Tène period settlement at Basel-Gasfabrik. *PLoS ONE* 15:7, e0236272. <https://doi.org/10.1371/journal.pone.0236272>
- BRZOST-ANDERSEN, E. 2016: *How to draw Ceramics, Class: Archaeological Practice 1*. [https://www.academia.edu/23224097/How\\_to\\_draw\\_Ceramics\\_for\\_the\\_Class\\_Archaeological\\_Practice\\_1\\_15th\\_of\\_February\\_2016](https://www.academia.edu/23224097/How_to_draw_Ceramics_for_the_Class_Archaeological_Practice_1_15th_of_February_2016) (last access: 06. 02. 2024).
- BLANCO-GONZÁLEZ, A. 2014: Tracking the social lives of things. Biographical insights into Bronze Age pottery in Spain. *Antiquity* 88, 441–455. <https://doi.org/10.1017/S0003598X00101103>
- BLANCO-GONZÁLEZ, A. 2018: Copying from Sherds Creativity in Bronze Age Pottery in Central Iberia (1800–1150 BC). In: Sofaer, J. (ed.): *Considering Creativity, Knowledge and Practice in Bronze Age Europe*. Oxford. 19–38. <https://doi.org/10.2307/j.ctvndv8rw.7>
- CARLONI, D. – ŠEGVIĆ, B. – SARTORI, M. – ZANONI, G. – BESSE, M. 2022: Who Was Buried at the Petit-Chasseur Site? The Contribution of Archaeometric Analyses of Final Neolithic and Bell Beaker Domestic Pottery to the Understanding of the Megalith-Erecting Society of the Upper Rhône Valley (Switzerland, 3300–2200 BC). *Open Archaeology* 8, 1064–1111. <https://doi.org/10.1515/opar-2022-0262>
- COLLETT, L. 2017: *Introduction to drawing archaeological pottery*. CIfA Professional Practice Paper. [https://www.archaeologists.net/sites/default/files/CIfA-A5%20pottery%20paper\\_final\\_web.pdf](https://www.archaeologists.net/sites/default/files/CIfA-A5%20pottery%20paper_final_web.pdf) (last access: 06. 02. 2024).
- COOKE, R. G. 1979: *The Archaeology of the Western Cocle Province of Panama*. PhD Dissertation, University of London, London.
- CSENGERI, P. 2015: Middle Neolithic Painted Pottery from Borsod-Abaúj-Zemplén County, North-Eastern Hungary. In: Virag, C. (ed.): *Neolithic Cultural Phenomena in the upper Tisa Basin, International Conference, July 10–12, 2014, Satu Mare*. Satu Mare, 127–160.
- KISNÉ CSEH, J. 1999: Mészbetétes edények kultúrája lelőhelyei Komárom-Esztergom megyében (Die Fundorte der inkrustierten Keramik im Komitat Komárom-Esztergom). *Komárom-Esztergom Megyei Múzeumok Közleményei* 6, 23–88.



- KISNÉ CSEH, J. 2000: Mészbetétes edények kultúrája újabb leletegyüttese Komárom-Esztergom megyéből (Eine neuere Fundgruppe der Kultur der Inkrustierten Keramik aus dem Komitat Komárom-Esztergom). *Komárom-Esztergom Megyei Múzeumok Közleményei* 7, 57–68.
- CZENE, A. 2017: The position of Bell Beaker–Csepel group at Budakalász. In: Kulcsár, G. – V. Szabó, G. – Kiss, V. – Váczi, G. (eds): *State of the Hungarian Bronze Age research. Proceedings of the conference held between 17th and 18th of December 2014*. Ósrégészeti Tanulmányok – Prehistoric Studies 2. Budapest. 179–199.
- DANI, J. – CSÉKI, A. 2017: Kora bronzkori művészeti tendenciák a Felső-Tisza-vidéken (Early Bronze Age art trends in the Upper Tisza region). In: Dani, J. – Kolozsi, B. – Nagy, E. Gy. – Priskin, A. (eds): *ΜΩΜΟΣ VIII. Óskoros Kutatók VIII. Összejövetelének konferenciakötete. Óskori művészet – Művészet az óskorban, Debrecen 2013. október 16–18*. Debrecen, 201–232.
- DERENNE, E. – CARLONI, D. – BESSE, M. 2022: Pottery Chaînes Opératoires as a Tool to Approach the Integration of the Bell Beaker Phenomenon: The ‘Petit-Chasseur’ Necropolis as a Case Study. In: Abegg, C. – Carloni, D. – Cousseau, F. – Derenne, E. – Ryan-Despraz, J. (eds): *The Bell Beaker Culture in All its Forms. Proceedings of the 22nd Meeting of ‘Archéologie et Gobelets’ 2021 (Geneva, Switzerland)*. Oxford, 49–63.
- ENDRŐDI, A. 1992: The settlement and cemetery of the Bell-Beaker Culture in the district of Szigetszentmiklós. In: Havassy, P. – Selmeczi, L. (eds): *Régészeti kutatások a M0 autópálya nyomvonalán I. – Archaeological researches on the line of motorway M0 I*. BTM Műhely 5. Budapest, 83–200.
- ENDRŐDI, A. – REMÉNYI, L. 2016: Assemblage of archaeological artifacts; Ceramics, Archaeological typological analysis. In: Endrődi, A. – Reményi, L. (eds): *A Bell Beaker settlement in Albertfalva, Hungary (2470–1950 BC)*. Budapest. 105–137.
- EÖRY, B. 2007: Növényi anyagok felhasználása a neolitikus kerámia díszítésében (Use of plants in the ornamentation of Neolithic pottery). *Ósrégészeti Levelek – Prehistoric Newsletters* 8–9, 62–65.
- FAVREL, Q. 2022a: *Universite Paris i Panthéon Sorbonne Ecole Doctorale d’archéologie ED 112 Laboratoire de rattachement: UMR8215 Trajectoires THÈSE, Pour l’obtention du titre de Docteur en archéologie Présentée et soutenue publiquement le 7 décembre 2022 à Paris par Quentin Favrel. Étude technologique des assemblages céramiques du Néolithique final du Nord-ouest de la France: la place des cultures locales et l’impact du campaniforme sur la façade Atlantique au troisième millénaire avant notre ère. Volume I: Texte*. Paris.
- FAVREL, Q. 2022b: *Universite Paris i Panthéon Sorbonne Ecole Doctorale d’archéologie ED 112 Laboratoire de rattachement: UMR8215 Trajectoires THÈSE, Pour l’obtention du titre de Docteur en archéologie Présentée et soutenue publiquement le 7 décembre 2022 à Paris par Quentin Favrel. Étude technologique des assemblages céramiques du Néolithique final du Nord-ouest de la France: la place des cultures locales et l’impact du campaniforme sur la façade Atlantique au troisième millénaire avant notre ère. Volume II: Annexes*. Paris.
- FAVREL, Q. 2022c: Degrees of Investment in Bell Beaker Ceramics from North-West-France. In: Abegg, C. – Carloni, D. – Cousseau, F. – Derenne, E. – Ryan-Despraz, J. (eds): *The Bell Beaker Culture in All its Forms. Proceedings of the 22nd Meeting of ‘Archéologie et Gobelets’ 2021 (Geneva, Switzerland)*. Oxford, 81–95.
- FÜLÖP, K. 2016: Különleges késő bronzkori gyermeksír és miniatűr edénykészlete (A special Late Bronze Age child grave and its miniature vessel set). *Tisicum – A Jász-Nagykun-Szolnok megyei Múzeumok Évkönyve* 25, 121–131.
- GARCÍA PUCHOL, O. – BERNABEU AUBÁN, J. – CARRIÓN MARCO, Y. – MOLINA BALAGUER, L. – PÉREZ JORDÀ, G. – GÓMEZ PUCHE, M. 2013: A funerary perspective on Bell Beaker period in the Western Mediterranean. Reading the social context of individual burials at La Vital (Gandía, Valencia) (Una perspectiva funeraria sobre el periodo campaniforme en el Mediterráneo occidental. Leyendo el contexto social de los enterramientos individuales de La Vital [Gandía, Valencia]). *Trabajos de Prehistoria* 70/2. <https://doi.org/10.3989/tp.2013.12112>
- GAŠPAR, A. – PETŘÍK, J. – FOJTÍK, P. – TSOUPRA, A. – MIR-MAKHAMAD, B. – CARDOSO, A. – BELTRAME, M. – MIRÃO, J. – SCHIAVON, N. – KOLÁŘ, J. 2022: Beyond Technology: Pottery Reveals Translocal Social Relations at a Bell Beaker Monumental Site in Central Europe. *European Journal of Archaeology* 26, 299–319. <https://doi.org/10.1017/eea.2022.46>
- GIUSTETTO, R. – BERRUTO, G. – DIANA, E. – COSTA, E. 2013: Decorated prehistoric pottery from Castello di Annone (Piedmont, Italy): Archaeometric study and pilot comparison with coeval analogous finds. *Journal of Archaeological Science* 40, 4249–4263. <https://doi.org/10.1016/j.jas.2013.06.012>

- GRÖMER, K. – KERN, D. 2010: Technical data and experiments on corded ware. *Journal of Archaeological Science* 37, 3136–3145. <https://doi.org/10.1016/j.jas.2010.07.015>
- GÖTTLICH, F. – SCHMITT, A. – KILIAN, A. – GRIES, H. – BADRESHANY, K. 2021: A New Method for the Large-Scale Documentation of Pottery Sherds Through Simultaneous Multiple 3D Model Capture Using Structure from Motion: Phoenician Carinated-Shoulder Amphorae from Tell el-Burak (Lebanon) as a Case Study. *Open Archaeology* 7, 256–272. <https://doi.org/10.1515/opar-2020-0133>
- GUCSI, L. 2011: Mészbetétes díszű kerámiák ábrázolásának nehézségei és lehetőségei (The difficulties and the possibilities of illustrating encrusted ceramics). *Archeometriai Műhely* 3, 269–282.
- GUCSI, L. 2023: Biography of ceramics found in the Late Bronze Age cemetery of Gelej. In: P. Fischl, K. (ed.): *Bronze Age Landscape at Gelej. Archaeological researches at Gelej-Pincehát, Gelej-Kanális dűlő and Gelej-Beltelek dűlő*. Universitätsforschungen zur prähistorischen Archäologie 391. Bonn, 339–412.
- HÁJEK, L. 1966: Die älteste Phase der Glockenbecherkultur in Böhmen und Mähren. *Památky Archeologické* 57, 201–241.
- HÄNSEL, A. – HÄNSEL, B. 2002: Zwei Glockenbecher aus Budapester Boden im Berliner Museum. *Budapest Régiségei* 36, 191–197.
- HREHA, R. – ŠIŠKA, S. 2015: *Bukohovorská Kultúra na Slovensku vo Svetle Výskumov v Šaršských Michalanoch a Zemplýnskych Kopčanoch*. Archaeologica Slovaca Monographiae 20. Nitra.
- HUGGETT, J. 2012: What Lies Beneath: Lifting the Lid on Archaeological Computing. In: Chrysanthi, A. – Murrieta Flores, P. – Papadopoulos, C. (eds): *Thinking Beyond the Tool: Archaeological Computing and the Interpretative Process*. Oxford. 204–214.
- ILON, G. 1996: A késő halomsíros – kora urnamezős kultúra temetője és tell-települése Németbánya határában (Das Gräberfeld und Tell der Späthügelgräber- Frühurnenfelderkultur in der Gemarkung Németbánya). *Pápai Múzeumi Értesítő* 6, 89–208.
- KISS, V. 1996: Megfigyelések a dunántúli mézsbetétes kerámia kultúrája edénydíszítési technikájáról (Observations on the ceramic-decoration techniques of the Transdanubian Incrusted Ware Culture). *Pápai Múzeumi Értesítő* 6, 65–76.
- KISS, V. 1997: A Mézsbetétes Edények Népe késői fázisának sírlelete Veszprémből. Die Grabfunde aus der Spätphase der Kultur der Inkrustierten Keramik von Veszprém. *Communicationes Archaeologicae Hungariae*, 39–49.
- KISS, V. 2012: *Middle Bronze Age Encrusted Pottery in western Hungary*. Varia Archaeologica Hungarica 27. Budapest.
- KLEIJNE, J. 2019: Embracing Bell Beaker. Adopting new ideas and objects across Europe during the later 3rd millennium BC (c. 2600–2000 BC). In: Kirleis, W. – Müller, J. (eds): *Scales of transformation in prehistoric and archaic societies 2*. Leiden. <https://doi.org/10.59641/c5467fo>
- KOS, K. – POSILOVIC, H. – DURNAM, A. – RISTIC, M. – KREHULA, S. 2014: White Encrustation Produced from Deer Antler Phosphate on Prehistoric Ceramics from Podunavlje. *Archaeometry* 57, 636–652. <https://doi.org/10.1111/arcn.12108>
- KREITER, A. 2007: Kerámia technológiai tradíció és az idő koncepciója a bronzkorban (Ceramic technological tradition and the concept of time in the Bronze Age). *Ősrégészeti Levelek – Prehistoric Newsletter* 8–9, 147–166.
- KREITER, A. – TÓTH, M. 2010: A dunántúli mézsbetétes kultúra kerámiáinak petrográfiai vizsgálata, és az inkrusztációösszetételének meghatározása röntgen pordiffrakciós vizsgálattal Mernye-Nagy-ároktól északra lelőhelyről. In: Kvassay, J. (ed.): *Évkönyv és jelentés a K.Ö.SZ. 2008. évi feltárásairól*. Budapest, 299–319.
- KULCSÁR, G. 2009: *The Beginnings of the Bronze Age in the Carpathian Basin. The Makó-Kosihy-Čaka and the Somogyvár-Vinkovci cultures in Hungary*. Varia Archaeologica Hungarica 23. Budapest.
- KULCSÁR, G. 2011: Untangling the Early Bronze Age in the Middle Danube Valley. In: Kovács, Gy. – Kulcsár, G. (eds): *Ten thousand years along the middle Danube: Life and Early Communities from Prehistory to History*. Varia Archaeologica Hungarica 26. Budapest, 179–210.

- KULCSÁR, G. 2013: Glimpses of the Third Millennium BC in the Carpathian Basin. In: Anders, A. – Kulcsár, G. (eds): *Moments in Time. Papers Presented to Pál Raczky on His 60th Birthday*. Ősrégészeti Tanulmányok – Prehistoric Studies 1. Budapest, 643–659.
- KUNST, M. 1987: Bell Beaker Sherds in Zambujal, Portugal. In: Waldren, W. H. – Kennard, R. C. (eds): *Bell Beakers of the western Mediterranean, The Oxford International Conference 1986*. British Archaeological Reports 331. Oxford, 591–608.
- KUNST, M. 1995: Zylindrische Gefäße, Kerbblattverzierung und Glockenbecher in Zambujal (portugal). Ein Beitrag zur Kurferzeitlichen Keramikchronologie. *Madriider Mitteilungen* 36, 136–149.
- LEGHISSA, E. 2015: Način okraševanja keramike ljubljanske kulture in pramenaste keramike – eksperimentalna arheologija (Decorating the pottery of the Ljubljana culture and the Litzen pottery – an experimental archaeology case study). *Arheološki vestnik* 66, 275–292.
- MALUQUER, J. 1956: La técnica de incrustación del Boquique y la dualidad de tradiciones cerámicas en la Meseta durante la Edad del Hierro. *Zephyrus* 7, 179–206.
- MARTON, T. 2004: Material finds from Balatonszárszó, Neolithic settlement: connections within and without the TLPC territory. *Antaeus* 27, 81–86.
- MARTON, T. 2015: *A dunántúli vonaldíszes kerámia kultúrájának kerámialelei Balatonszárszóról* (Pottery finds of the Transdanubian Linear Pottery culture from Balatonszárszó). PhD Dissertation, ELTE Eötvös Loránd University, Budapest. <https://doi.org/10.15476/ELTE.2015.001>
- MELIS, E. 2017: Research Questions Regarding the Early and Middle Bronze Age in North-Western Transdanubia (Hungary). In: Kulcsár, G. – V. Szabó, G. – Kiss, V. – Váczi, G. (eds): *State of the Hungarian Bronze Age research. Proceedings of the conference held between 17th and 18th of December 2014*. Ősrégészeti Tanulmányok – Prehistoric Studies 2. Budapest. 13–28.
- MELIS, G. M. 2011: Monte d'Accoddi and the end of the Neolithic in Sardinia (Italy). *Documenta Praehistorica* 38, 207–219. <https://doi.org/10.4312/dp.38.16>
- MÉRI, I. 1942: A mészbetétágy készítésének módja a kisapostagi edényeken. In: Mozsolics, A.: *A kisapostagi bronzkori urnatemető – Der frühbronzezeitliche Umenfriedhof von Kisapostag*. Archaeologica Hungariae 26. Budapest, 45–53.
- MIHÁLY, J. – BERTHOLD, C. – SZILÁGYI, V. – LENO, V. – ZÖLDFÖLDI, J. – CSENGERI, P. – T. BIRÓ, K. 2010: A bükki kerámia inkrusztált díszítéseinek vizsgálata mikroanalitikai módszerekkel (Investigation of the Incrustation on Bükk Pottery by means of Microanalytical techniques). *Archeometriai Műhely* 4, 249–257.
- MILISUKAS, S. – KRUK, J. – HUDSON, K. 2019: Bronocice Funnel Beaker Vessel with Wagon Motif: Different Narratives. *Archaeologia Polona* 57, 233–240. <https://doi.org/10.23858/APa57.2019.016>
- MILOGLAV, I. 2016: *Keramika u arheologiji – Lončarstvo vučedolske kulture na vinkovačkom području* (Ceramics in Archaeology: Pottery of the Vučedol Culture in the Vinkovci Region). Acta Musei Cibalensis 7 – New Series 5. Vinkovci–Zagreb. <https://doi.org/10.17234/9789531757775>
- MORGAN, C. – PETRIE, H. – WRIGHT, H. – TAYLOR, J. S. 2021: Drawing and Knowledge Construction in Archaeology: The Aide Mémoire Project. *Journal of Field Archaeology* 46, 614–628. <https://doi.org/10.1080/00934690.2021.1985304>
- ODELL, G. H. – COWAN, F. 1986: Experiments with Spears and Arrows on Animal Targets. *Journal of Field Archaeology* 13, 195–212. <https://doi.org/10.1179/009346986791535780>
- PALINCAŞ, N. 2010: Reconfiguring anatomy: Ceramics, cremation and cosmology in the Late Bronze Age in the Lower Danube. In: Rebay-Salisbury, K. – Sørensen, M. L. S. – Hughes, J. (eds): *Body Parts and Bodies Whole changing relations and meanings*. Oxford–Oakville, 72–89.
- PARK, S. – ZIKOPOULOS, B. – YAZDANBAKSHI, A. 2022: Visual illusion susceptibility in autism: A neural model. *European Journal of Neuroscience* 56, 4246–4265. <https://doi.org/10.1111/ejn.15739>
- PARKINSON, W. A. – PEACOCK, E. – PALMER, R. A. – XIA, Y. – CARLOCK, B. – GYUCHA, A. – YERKES, R. W. – GALATY, M. L. 2010: Elemental Analysis of Ceramic Incrustation Indicate Long-Term Cultural Continuity in the Prehistoric Carpathian Basin. *Archaeology Ethnology & Anthropology of Eurasia* 38, 64–70. <https://doi.org/10.1016/j.aeae.2010.08.009>



- PASQUALE, M. – CARBONI, G. – D'ERCOLE, V. – PACCIARELLI, M. – PENNACCHIONI, M. 2022: Torre Crognola (Northern Latium, Italy): A Large Settlement with Bell Beaker Findings. In: Abegg, C. – Carloni, D. – Cousseau, F. – Derenne, E. – Ryan-Despraz, J. (eds): *The Bell Beaker Culture in All its Forms. Proceedings of the 22nd Meeting of 'Archéologie et Gobelets' 2021 (Geneva, Switzerland)*. Oxford, 241–251.
- PATAY, R. 2013: Bell Beaker Cemetery and Settlement at Szigetszentmiklós: First Results. In: Heyd, V. – Kulcsár, G. – Szeverényi, V. (eds): *Transitions to the Bronze Age. Interregional Interaction and Socio-Cultural Change in the Third Millennium BC Carpathian Basin and Neighbouring Regions*. Budapest, 287–317.
- PAULOS-BRAVO, R. – CIFUENTE-ALCOBENDAS, G. 2023: Experimental Archaeology and Artificial Intelligence Applied to the Bell Beaker Decoration: Methodological Proposal and Future Prospects. Presentation in a workshop: *Interweaving Bell Beaker decorative motifs and textile patterns: Exploring technical and symbolic approaches during the 3rd millennium BCE in Europe*. Natural History Museum Vienna, 21st March, 2023. <https://www.youtube.com/watch?v=x-tRr0VjeOM> (last access: 21. 12. 2023).
- PRIETO MARTINEZ, M. P. – SALANOVA, L. 2009. Coquilles et Campaniforme en Galice et en Bretagne: mécanismes de circulation et stratégies identitaires. *Bulletin de la Société Préhistorique Française* 106, 73–93. <https://doi.org/10.3406/bspf.2009.13830>
- PROKEŠ, L. – PORCHÁZKOVÁ, M. – KUČA, M. – PARMA, D. – FOJTÁK, P. – HUMPOLA, D. 2010: Identifikace tmavých smolných hmot z neolitických nálezů na Moravě (Identification of birch bark tar residues from Neolithic contexts in Moravia). *Sborník Prací Filozofické Fakulty Brněnské Univerzity – Studia Minora Facultatis Philosophicae Universitatis Brunensis* 14–15, 114–130.
- RATZEL-FABIAN, D. 1983: *Typetafeln zur Ur- und Frühgeschichte Mitteleuropas Neolithikum*. Göttingen.
- REICH, C. 2002: Das Gräberfeld von Cırna. *Prähistorische Zeitschrift* 77, 159–179. <https://doi.org/10.1515/prhz.2002.77.2.159>
- REICH, C. 2006: *Die Nekropole von Szeremle und die Gruppen mit inkrustierter Keramik entlang mittlerer und unterer Donau*. Berliner Beiträge zur Vor- und Frühgeschichte. Neue Folge 13.2. Berlin.
- ROBERTS, S. – SOFAER, J. – KISS, V. 2008: Characterisation and textural analysis of Middle Bronze Age Transdanubian inlaid wares of the Encrusted Pottery Culture, Hungary: A preliminary study. *Journal of Archaeological Science* 35, 322–330. <https://doi.org/10.1016/j.jas.2007.03.013>
- RYE, O. S. 1981: *Pottery Technology: Principles and Reconstruction*. Manuals on Archaeology 4. Washington DC.
- SALANOVA, L. – PRIETRO-MARTÍNEZ, M. P. – CLOP-GARCÍA, X. – CONVERTINI, F. – LANTES-SUÁREZ, O. – MARTÍNEZ-CORTINAS, A. 2016: What are large-scale archaeometric programmes for? Bell Beaker pottery and societies from the 3rd millennium BC in Western Europe. *Archaeometry* 58, 722–735. <https://doi.org/10.1111/arcm.12173>
- SEBŐK, K. 2018: On the possibilities of interpreting Neolithic pottery – Az újkőkori kerámia értelmezési lehetőségeiről. *Dissertationes Archaeologicae* 3.6. 13–42. <https://doi.org/10.17204/dissarch.2018.13>
- SCHREIBER, R. 1975: A tököli korabronkori temető (Frühbronzezeitliche Gräberfelder von Tököl). *Archaeologiai Értésítő* 102, 187–203.
- UCHIDA, R. – HUE, N. V. 2000: Soil Acidity and Liming. In: Silva, J. A. – Uchida, R. (eds): *Plant Nutrient Management in Hawaii's Soils, Approaches for Tropical and Subtropical Agriculture*. Manoa, 101–111.
- SPAJIĆ, E. 1956: Izvještaj o nalazima keramike u brončanog doba iz Kozarca (An account of the Bronze Age finds from Kozarac). *Osječki Zbornik* 5, 37–46.
- STOCKHAMMER, Ph. W. 2012: Conceptualizing Cultural Hybridization in Archaeology. In: Stockhammer, Ph. W. (ed.): *Conceptualizing Cultural Hybridization. A Transdisciplinary Approach*. Heidelberg, 43–56. [https://doi.org/10.1007/978-3-642-21846-0\\_4](https://doi.org/10.1007/978-3-642-21846-0_4)
- TOMPA, F. 1929: *A szalagdíszes agyagművesség kultúrája Magyarországon. A bükki és a tiszai kultúra – Die Bandkeramik in Ungarn: die Bükker- und die Theiss-Kultur*. *Archaeologica Hungarica* 5–6. Budapest.
- TRINGHAM, R. 1978: Experimentation Ethnoarchaeology, and the Leapfrogs in Archaeological Methodology. In: Gould, R. A. (ed.): *Explorations in Ethnoarchaeology*. Albuquerque, 169–199.
- TUREK, J. 2006: Období zvoncovitých pohárů v Evropě (The Bell Beaker Period in Europe). *Archeologie ve středních Čechách* 10, 275–368.

- TUREK, J. 2008: Kultura zvoncovitých pohárů (The Bell Beaker Culture). In: Neustupný, E. (ed.): *Archeologie Pravěkých Čech. Vol. 4: Eneolit*. Prague, 147–169.
- VICZE, M. – SØRENSEN, M. L. S. 2023: *Living in a tell: Memory and abandonment, Százhalombatta-Földvár Phase 1 (Late Koszider)*. *Archaeologica Hungarica* 55. Budapest.
- VŠIANSKÝ, D. – KOLAR, J. – PETRÍK, J. 2014: Continuity and changes of manufacturing traditions of Bell Beaker and Bronze Age encrusted pottery in the Morava River catchment (Czech Republic). *Journal of Archaeological Science* 49, 414–422. <https://doi.org/10.1016/j.jas.2014.05.028>
- YOSHIZAKI, M. 1979: Foreword. In: William, M. H. (ed.): *Prehistoric Cordage: Identification of Impressions on Pottery*. Aldine Manuals on Archeology 3. Washington DC.
- WOSINSKY, M. 1904: *Az őskor mészbetétes díszítésű agyagművessége*. Budapest.

