



## Shine like metal: an experimental approach to understand prehistoric graphite coated pottery technology



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### ABSTRACT

In the Late Bronze and Early Iron Ages, so-called graphite-coated vessels were ubiquitous in the Carpathian Basin. Studies on graphite-coated vessels are usually carried out from a typological point of view, describing the shape and decoration of such wares and assessing the effects that co-existing cultural groups may have had on each other. Even though the practice of graphite coating had been present in East-Central Europe for several centuries, the way graphite coating was produced has never been investigated systematically. Technological study of graphite coating can, however, highlight interesting details about this practice and the high skill and knowledge of potters that was necessary for this type of ceramic production. In this study, a methodology of making graphite coated vessels, and in turn achieving a metallic luster, is presented through a range of experiments. The results are compared with graphite coating found on archaeological ceramics from a Late Bronze Age site. The experiments point out that graphite coating can be achieved in several different ways; however, only a limited number of technological choices would result in highly metallic luster. During the experiments different graphite coating techniques were tried which elucidate the possible ways prehistoric potters utilized graphite, surface treatments and firing conditions.

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### 1. Introduction: background to graphitic pottery

Graphite-decorated pottery is a distinctive type of ceramic ware in European prehistory which first appeared in Middle Neolithic cultures of the Balkans and Central Europe (von Carnap-Bornheim, 1998, 594). Graphite was first used for painting motifs on vessels, and the appearance of this practice seems to be associated with Neolithic black/brown/red painted pottery (Vajsov, 2007, 98). Rarely, graphite also appeared on burnished vessel surfaces and as tempering material in Central Europe, in the Linear Pottery Culture (Pechtl and Eibl, 2011, 394–396). Graphite painting was a dominant decorative method for most of the Chalcolithic cultures of the East Balkan region, however later it gradually disappeared

(Papadopoulos, 2007). Graphite-decorated pottery also occurred sporadically in the Early and Middle Bronze Ages, but until the Late Bronze Age graphitic techniques were strongly bound to the geological sources of graphitic rocks (e.g. Bulgaria, Moravia in Czech Republic and south Bavaria in Germany) (von Carnap-Bornheim, 1998, 594; Leshtakov, 2004).

The use of graphite in Late Bronze Age pottery decoration shows a swiftly increasing tendency. The appearance of burnished surface treatment associated with graphite and the newly performed graphite coating technique can be dated between 1300 and 1250 BC (Bz D) in the Eastern Alpine regions and in the Carpathian Basin. In the second half of the 13th century BC graphite coating/burnishing became a widely used surface treatment technique: graphite-coated/burnished pottery appears in large numbers in the tumulus burials of the eastern Alpine area (Burgenland) and in the western and eastern parts of Hungary (Transdanubia, Great Hungarian Plain) (Kovács, 1975, 49; Lochner, 1986a, 271; Kustár, 2000, 24). Graphite appears especially on table wares (bowls, jugs, mugs, cups) and mixing vessels (deep bowls). Presumably, these fine-made vessels were the representative elements of the *table-sets*

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of houses (Helgert, 1995, 214–215; Nebelsick, 1997, 377–378; V. Szabó, 2004, 89–90), but these ceramics were neither unique nor special pieces of Late Bronze Age households. Therefore, it is probable that graphite-coated/burnished vessel-sets found in burial mounds were accessories of funeral feasts (Kustár, 2000, 22–24; Váczi, 2013a, 826). Based on the burials and depots of the Bz D period (13th century BC) it seems that weapons, jewelry and dress fittings and ornaments were the primary means of social representation in the Late Bronze Age (Váczi, 2013b, 221).

Metal vessels are absent in household assemblages of the Bz D period, therefore graphite-coated ceramics, imitating the texture and appearance of metal vessels, could have been the most prominent instruments of social representations at feasts. Moreover, in the majority of cases graphite had to be imported and the production of graphite-coated vessels required special knowledge. These characteristics render graphite-coated vessels to be a special group of ceramics.

Even though it is widely assumed that graphite-coated vessels may have imitated metal vessels, no detailed analysis has been carried out to establish the assumed relationship between graphite coating and metal vessels. There are no direct archaeological data referring to how the graphite-coating technique appeared in the Carpathian Basin, and neither is it known how graphite was obtained and utilized. Based on dress fittings and ornaments, jewelry and weapons of western Hungarian burials, an intensive relationship and exchange network must have existed between the Carpathian and Moravian Basins in the Bz D period (Váczi, 2013b, 225, Fig. 8). It is very probable that in this period graphite reached the Carpathian Basin through this exchange network. It must be noted that Moravia, as the acquisition area for graphite, also seems to be important in the Celtic period (Kreiter et al., 2013b).

After a short decline, graphite-coated pottery became abundant again in the East-Alpine region and in the neighboring territories in the final phase of the Late Bronze Age (Ha B), around 1000 BC (Říhovsky, 1982, 70). Besides making the whole vessel surface graphitic, striped decoration made by graphite, which became characteristic in the Early Iron Age, also appeared (Podborský, 1970, 65, Abb. 12:1, 21; Lochner, 1986b, 305). Graphite polishing/burnishing became one of the most popular decorating techniques in the Early Iron Age of Central and East-Central Europe (Dobiat, 1980, 127). In the Ha C period (c. 800–650 BC), besides graphite-coating graphite-painting also appeared. In the latter case it seems that graphite was applied on vessel surfaces similarly to painting, in a liquid form as graphitic suspension (Trebsche, 2011, 449–451). Later, during the Ha D period (c. 650–475 BC), polished or drawn graphitic grid patterns represent the most common decorative element in the local variants of the East Hallstatt culture that played a key role in the spread of this type of ceramic further to the east in the neighboring territories (Kreiter et al., 2013a).

The Celtic period brought considerable changes in the use of graphite; it was used as tempering material, which was unprecedented earlier, and the use of graphite-coating/decorating techniques decreased then later disappeared. The Celts started using graphite during the early La Tène period (Jerem and Kardos, 1985), but this practice became more common during the early LT B2 (beginning of the 3rd century BC) in the Carpathian Basin (Szabó, 2007, 317–318). From this period graphite-tempered pottery was a substantial element of Central European Celtic pottery assemblages right up until the decline of the Celtic world (first half of the 1st century AD in Hungary) (Trebsche, 2011). Curiously enough, as opposed to many other pottery forms and techniques, Celtic graphite-tempered wares were not adopted for use by the Romans. Since Celtic graphite-tempered pottery technology was discussed elsewhere (Kreiter et al., 2013b) we do not deal with this subject here.

According to the above, several methods of graphite decoration can be distinguished and these techniques could also be combined. Researchers considered that, if the raw material was pure enough, graphite could have been rubbed on the surface of vessels or it could have been used as a crayon. Otherwise it may have been applied as liquid suspension (Frierman, 1969, 43; Evans, 1986, 397; Yiouni, 2000, 209; Vajsov, 2007, 98; Trebsche, 2011, 449–451). Graphite slip is assumed to be used for coating from the Late Bronze Age to achieve a metallic shine, however it is not underlined scientifically how graphitic slip was made and how one may distinguish between graphitic slip, graphite burnishing and other ways of graphite application. Several graphite prisms are known at sites, far away from the geological sources of graphite (e.g. Gróh, 1984, 61, Fig. 6.13–15; Gáti, 2009, 66, Fig. 4.12–13), which may reinforce the above-mentioned existence of burnishing/drawing/polishing methods, especially in the Early Iron Age and sheds further light on exchange networks.

The use of graphite for ceramic production, since it burns off easily, required a very well controlled firing technology which may have been different from the previous practice of vessel firings; thus its utilization resulted in the emergence of new ceramic styles characterized by black vessels (Vajsov, 2007, 98). The firing temperatures of graphite-coated/decorated ceramics from Chalcolithic and Iron Age sites seem to be below 850 °C but in some cases below 650 °C (Maniatis and Tite, 1981, 75; Jerem and Kardos, 1985, 69; Gebhard et al., 2004, 210; Havancsák et al., 2009, 48–49; Kreiter et al., 2013a, 485, 487).

Researchers agree that graphite-coated/decorated vessels had to be fired under reducing conditions (Yiouni, 2000, 209; Berdelis, 2002) but no detailed study explains the whole production sequence that was necessary to achieve a lustrous black vessel with metallic appearance.

In the light of the above it is clear that several interpretations were made about graphite coating/decoration. However, no clear technological descriptions exist on the whole production sequence of graphite coating/decoration. Therefore, in the following sections the results of a set of experiments are introduced on different ways of graphite coating.

## 2. Methodological approach of the experiment

The experiment was carried out on small cylindrical vessels made by the authors (Fig. 1.1) from commercially available clay called Kishajmás type, which is widely used in Hungary by potters. No attempt was made to reproduce archaeological vessel forms; the aim of this experiment is to assess how graphite coating was produced and how such vessels could have been fired. The prepared vessels provide a large enough surface to observe the results of the experiment. The raw graphite used for this experiment was obtained from Ménfőcsanak–Széles földék (N–W Hungary) archaeological site, the graphite lumps were found in Celtic features (3rd century BC) (Fig. 1.2). The experiment was designed to combine different graphite coating methods, surface treatments, firing temperatures and firing circumstances. As a result, a total of 27 graphite-coated vessels were manufactured. The processes they were subjected to are summarized in Appendix 1.

During the experiment the following questions were examined:

The first question concentrated on how graphite may have been applied on vessel surfaces by prehistoric potters. Was graphite applied in powder form or as suspension, or were graphite lumps rubbed on the surface? Was graphite applied on a dry or leather hard vessel surface and was graphite applied before or after firing?

The second question regarded the surface treatments of vessels, which seem vital to achieve metallic luster. It was investigated

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