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ORIGINAL ARTICLE

Horné Srnie: Emulation of Carpathian insignia during the Urnfield inflation

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Abstract

Double-armed insigniae of the Carpathian type are mysterious ceremonial symbols of the Urnfields representing the connection between ideological principles in the Western Carpathians. The Horné Srnie metal hoard shows that early Lusatian mountain communities developed an emulation strategy *c*.1325 BCE that shifts the origins of Lusatian metallurgy roughly by one century, using the elite style of the technologically advanced Piliny culture to represent their social status. The reproduction was motivated by the effort of Lusatian warrior-priests to maintain their authority during the period of Urnfield societal reorganization and grew into the 'homemade' production of low-quality cast specimens from recycled materials or metallurgical residues.

KEYWORDS

^{14}C analysis, emulation, Late Bronze Age, Slovak Ore Mountains, Urnfields, Western Carpathians

INTRODUCTION

Urnfield inflation (Bz C2/D = 1350–1300 BCE) is a sudden process leading to a substantial and permanent reorganization of Bronze Age society spreading from the Carpathian Basin along the Danube Corridor into Western and Northern Europe (Falkenstein, 2011). This drastic change also marks the demise of Tumulus culture and the transition from the Middle to the Late Bronze Age in the general region (Gimbutas, 1965; Harding, 2000). It is fundamentally characterized by the emergence of a cremation funeral rite and a new cosmological doctrine (Hodder, 1982), communicated through the established symbols of four elements: sun disc (fire), wheel (earth), waterfowl/bird-barge (air and water); thereby providing the possibility of insight into the beliefs of the population and its thinking about the afterlife (Primas, 2008). Since the Carpathian Basin in the Bronze Age does not show any traces of temples, sanctuaries or special sacral buildings and there is no evidence of a hierarchical religion (Pásztor, 2009), the four cosmological principles are an expression of the essence of nature, which persisted on the European continent until the creation of the periodic table (Mendeleev, 1889).

Like most ancient cosmological concepts, these symbolic and metaphorical notions of eternal life were combined into iconographic scenes – in the case of the Western Carpathians, it was the population of the Piliny culture (Mozsolics, 1973), who, using the double-armed insignia (*Kommandostab*, *Doppelarmknauf*), created one of the most penetrating and so far the most mysterious European ideograms (Figure 1), still mystifying historians and experts of prehistoric art (Novotná, 1959). This type of sacral artefact on a stick reached the peak of popularity in the (Reinecke) Bz D period (Stuchlík, 1988) and its schematic representations also passed into the repertoire of the (Tumulus) early Lusatian culture, thus symbolizing the adoption of Urnfield religious features and administrative titles (Ondrkál, 2022). Carpathian maces and their derivatives were found in many different contexts, primarily in warrior graves (Nitrica; Řepeč; Chvojka, 2010) and sacrificial deposits containing up to 48 specimens (Blatnica-Plešovica), which makes the community character of this group of artefacts very informative (Veliačik, 2004).

Degenerated D-type variants, as labelled by A. Mozsolics (1973), are medium-sized, low-quality and roughly processed imitations of the original A–C-type variants (Piliny culture), and which, together with the massive Malá Vieska type pins, are usually referred to as the first metal products originating from Lusatian metallurgical workshops at the end of Bz D (*c*.1225–1200 BCE; Novotná & Kvietok, 2015). Since, due to the monotypic circumstances of the hoards, it was in no case possible to absolutely determine the dating of the production events of the original (A–C) and modified variants (types D and E), very precise speculations lost their basis (Novotná & Furman, 2018). Due to the rich archaeological connotation (X-ray fluorescence (XRF) and ^{14}C data), the presentation of the Horné Srnie hoard and the related discussion of cultural macroevolution are of great importance here and allows one to define specifically the tendencies of the early Lusatian culture (Bouzek, 2007) to reproduce the Piliny ideological culture at the beginning of Urnfields in Central Europe.

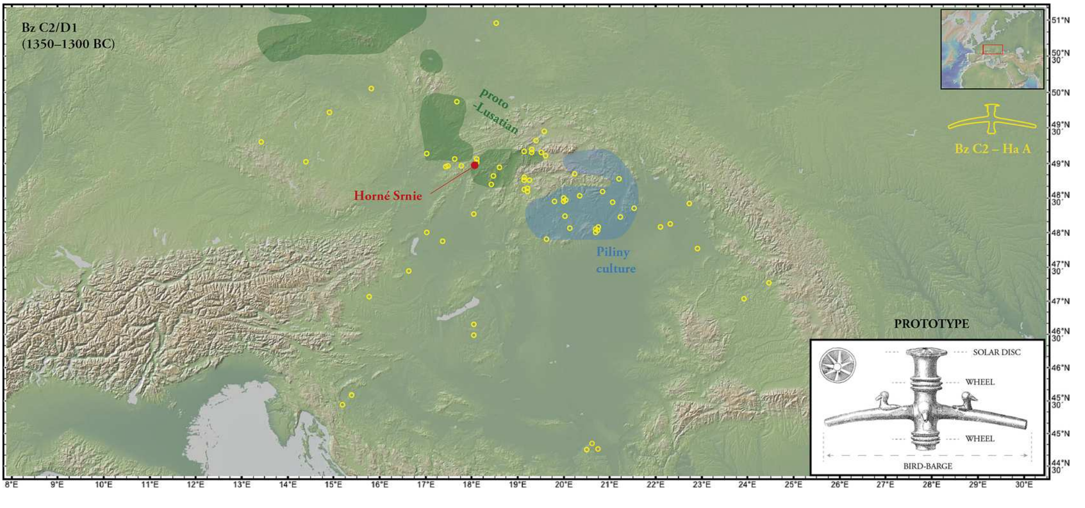

FIGURE 1 Occurrence of Carpathian double-armed insigniae on the background of ceramic cultures in Bz C/D.

MATERIAL AND METHODS

Background

Horné Srnie I is a monotypic hoard of four bronze insigniae of the Carpathian type from the northern slope of Ostrá Hora hill (Figure 2; 485 m) belonging to the municipality of Horné Srnie (Trenčín district, Western Slovakia). The regional background and the settlement area in the Vlára River basin was inhabited by the Lusatian ceramic zone probably already in the Middle Bronze Age (Reinecke) Bz C (Cheben, 1998; Nešporová, 1992, 2004), which is evidenced by the early Lusatian cemetery located on the opposite side of the valley in Nemšová, Ľuborča site (Figure 2) with the related discovery of a Carpathian B-type insignia (Veliačik, 1983). The classification of artefacts was based on their stratigraphic uniformity, which is relevant here – the selective hoard of Horné Srnie was organized and deposited at the confluence of two local springs and excavated by an accidental finder from a very hard clay–sandy matrix at a depth of about 30 cm. Part of the assemblage (mace 4) was dislocated and fragmented *ex situ*, most likely due to the impact of post-depositional processes. Considering the traditional archaeological research in this area, it was evaluated necessary to carry out a primary scientific analysis in the archaeometric laboratories of the Archaeological Centre Olomouc (Czech Republic) and, based on the detection data, to develop an archaeological discussion in order to clarify the chronology and origin of the entire collection.

Description

Bronze double-armed insigniae of Horné Srnie (1–4) are characterized by slightly sloping arms of a circular profile, growing up from a socket terminated by a stepped, hat-shaped disc (Figure 3). The decoration of the sockets consists of two opposite barbed protrusions in the middle part, as well as four orbiting plastic ribs in the basal and disc part. The metal objects are covered in a rich green-grey (often delaminated) patina, in several places with visible traces of stronger oxidation. The casting seams are noticeable on all four specimens and are cautiously polished, proving that they were cast in a two-piece mould. At the basal part of the sockets, there are obvious casting defects. The typological comparison made it possible to distinguish the anatomical features of the B-type development series without engraved decoration (maces 1, 2, 4) and the degenerate D variant (mace 3), which are generally attributed to the Bz D period (Mozsolics, 1973). Dimensions: mace 1: 20.0 × 7.1 cm, disc diameter 3.3 cm (149 g); mace 2: 19.7 × 7.4 cm, disc diameter 3.5 cm (162 g); mace 3: 18.0 × 6.4 cm, disc diameter 3.2 cm (102 g); and mace 4 (fragmentary): height 6.6 cm (preserved weight 73 g).

^{14}C dating

Organic artefacts provide a unique opportunity to determine the absolute chronology of metal hoards. Only below the groundwater level, in waterlogged or dry environments, is microbial and fungal activity reduced and archaeological wood can be preserved for thousands of years (Tegel et al., 2012). The dry and sandy subsoil of the Horné Srnie depositional context caused the preservation of organic residues of the wooden shafts (Figure 3: C14 1–3), which, together with the closed micro-space in the sockets, prevented the degradation of their components by microorganisms such as bacteria or actinomycetes, if the wood systems were in contact with the soil (Blanchette, 2000). Residues of wooden shafts were extracted from the sockets with a dental set and sent to the Debrecen radiocarbon laboratory (Hungary), where three samples were prepared by the accelerator mass spectrometry (AMS) method, a MICADAS-type system, to

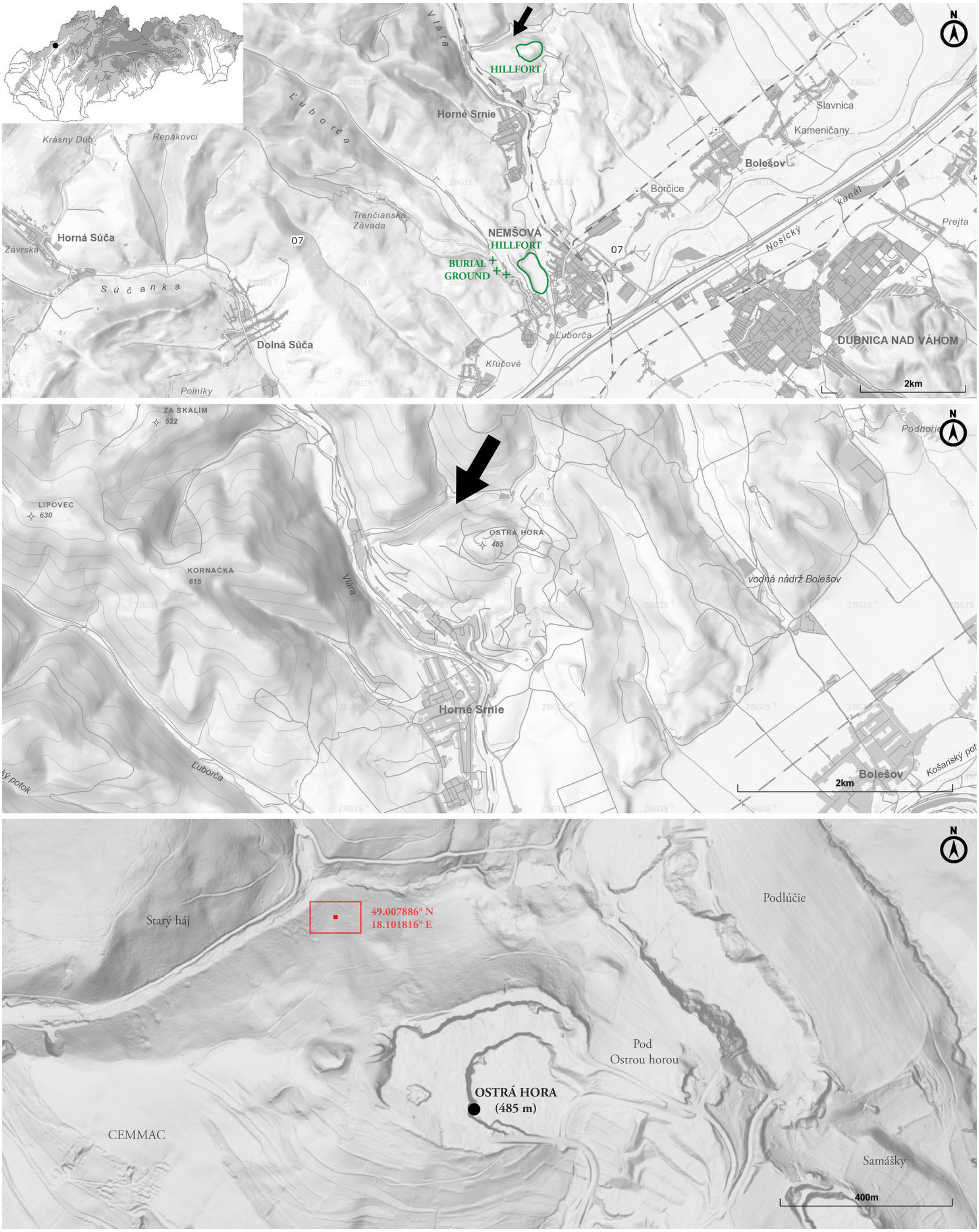

FIGURE 2 Horné Srnie: Location map of the Ostrá hora hoard.

measure the content of the ratio of radioactive carbon isotopes, ^{14}C. The usual measurement time was approximately 30 min for a sample (Molnár et al., 2012). A normalized chronological diagram was created from the resulting dates using the OxCal system (v.4.4; Bronk Ramsey, 2009) and calibrated using the IntCal20 calibration curve (Reimer et al., 2020).

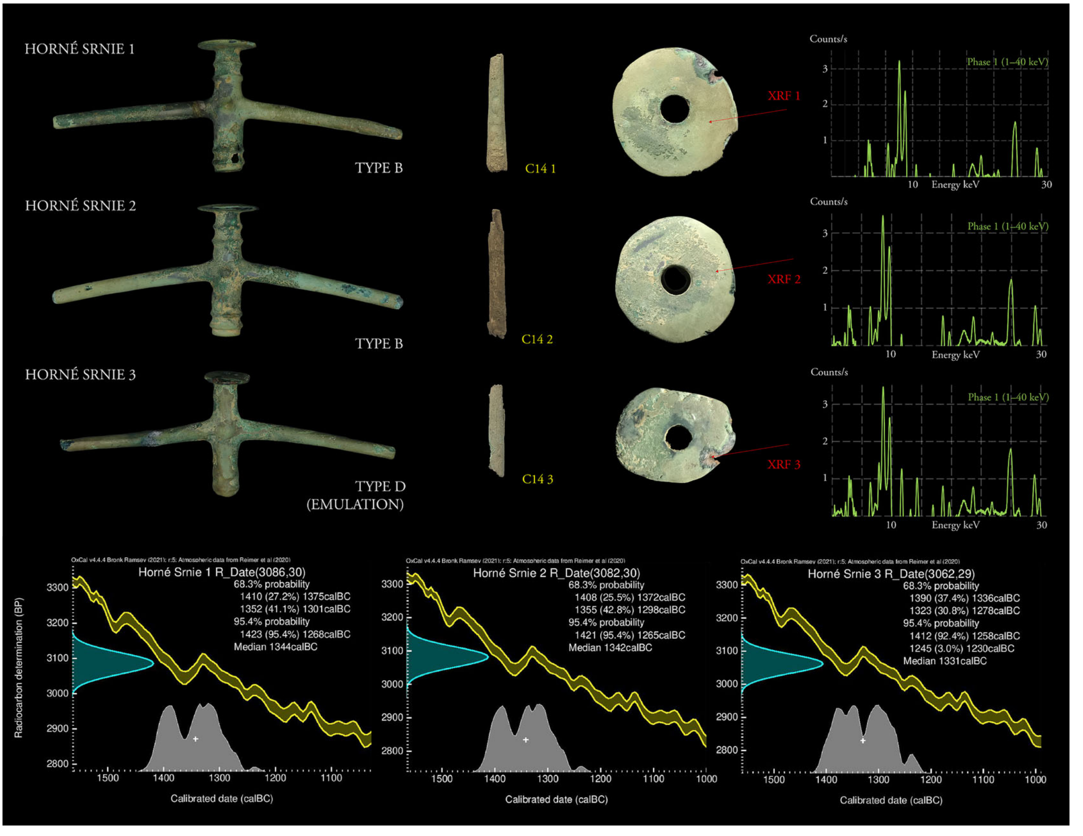

FIGURE 3 Horné Srnie: Analytical elements of the hoard. C14 1–3: samples for ^{14}C dating; and XRF 1–3: samples for X-ray fluorescence (XRF) spectrometry.

X-ray fluorescence (XRF)

Metal artefacts were on the intact internal parts (Figure 3: XRF 1–3) sampled by a Dremel drilling machine (8220 12VMax High-Performance Cordless, Dremel, Racine, Wisconsin, USA) using a carbide drill of 1.1 mm (surface spectrometry is not sufficiently valid in this case, since the patina as a surface corrosion layer shows a relative oxidation compared with the actual composition of the alloy), representing a feasible compromise between the need to ensure their physical integrity and the need to obtain reliable analytical data capable of solving historical questions (Lutz & Pernicka, 1996). The analysis of the metal composition was performed by an XRF spectrometer Delta Dynamic XRF (BAS Rudice s.r.o., Czech Republic). The parameters of the measurement were as follows: analytical mode, collimator: wide; vac pressure 1000; ambient pressure 1000; probe temperature 32–40°C. The measurement time was 300 s (1–40 keV).

RESULTS

Absolute dating

By radiocarbon sampling of directly associated organic remains, development series B and D were linked to absolute calendar years for the first time (Figure 3). The wood had a dry and relatively solid structure (mainly cellulose and part of lignin were preserved). In all cases, the material was an unspecified type of conifer (*Pinophyta*), a hard but durable wood that is very well suited for the production of narrow shafts and is documented in the form of spruce, yew and pine in Late Bronze Age contexts (Paavel et al., 2019). The wooden shafts were rigorously machined in such a way that they almost perfectly filled the inside of the conically tapering socket. Due to the small diameter of the artefacts' sockets, a young, short-lived conifer taxon, rather than the heartwood of an old tree, was probably used for the production of the shafts – thus neglecting the 'old wood effect' due to the age difference between the inner and outer rings (Schiffer, 1986). All submitted samples yielded positive results and show that B type insignia HS1 began to be used between 1410–1375 (27.2%) and 1352–1301 (41.1%) cal. BCE (1σ), HS2 insignia between 1408–1372 (25.5%) and 1355–1298 (42.8%) cal. BCE (1σ) and the degenerate D variant between 1390–1336 (37.4%) and 1323–1278 (30.8%) cal. BCE (1σ), with 68.3% confidence. Certainty at the level of 95.4% for HS1 shows ranges of between 1423 and 1268 cal. BCE (2σ), HS2 between 1421 and 1265 cal. BCE (2σ) and HS3 between 1412 and 1258 (92.4%)/1245–1230 (3.0%) cal. BCE (2σ) (Table 1). In principle, it is conceivable to count on the reuse of wood – however, since these are not architectural wood or functional objects (tools, weapons), but rather visually oriented objects, the degree of damage to the shaft and its re-shafting was less probable. This is also supported by the fact that the absolute dating results fall within the same time span.

Such data make it possible to update typological assessments and construct a time diagram based on morphological variations and excavated sites. The first occurrence of B-type undecorated specimens (Horné Srnie 1–2) can be set already in the Middle Bronze Age, but at the latest in the Bz C/D transitional phase of the Ožďany/Opályi horizon (Mozsolics, 1973; Novotná, 2001). According to this chronology, the onset of a high degree of variability of the oldest Piliny specimens is already visible during Bz C, which undoubtedly shows that A-, AB- and B-type insignia must have been produced chronologically simultaneously in several workshop series. Based on visual assessments, the degenerate D variant is the last in the production series, but absolute dating still demonstrates the beginning of its production in Bz C2/D–D1 at the latest. The Lusatian imitations of D type are characterized by the low quality of the bronze work, manifested in the very shape and imperfect technical execution (Novotná, 1959), which is evidenced by the asymmetry of the arms and shaft of the Horné Srnie 3 specimen.

Chemical composition

The compositional XRF profile obtained by invasive drilling (Table 2) showed that the primary metals are made of binary tin bronzes (Cu + Sn), involving the use of Sn as the main alloying element in the range of 6.65–7.19%, while the content of minor elements in no case exceeds 2.53%. These impurities (As, Sb, Ni, Ag, Bi, Co) appear quite often in the metallurgy of the advanced Bronze Age and are usually associated with the occurrence of these elements in copper ores (Lutz & Pernicka, 1996). The metallurgical record from Horné Srnie copies the general Central European development trend of using the sulphide copper ores with higher levels of impurities, which most often comes from the Chalcopyrite and Fahlore-group minerals with the largest sources in the area of the Eastern Alps (Mitterberg, AT; Pernicka et al., 2016) and the Slovak Ore Mountains (Schreiner, 2007). The geological signature corresponds to tetrahedral Ci with Ni (As > Sb > Bi), defined by Pernicka (1990), which contains significant amounts of Pb and Ni, but no Ag or only a very small amount of this element.

An increased value of Pb (HS 3) may indicate intentional alloying, which in the Bronze Age is documented in the range of 1–15% (Hughes et al., 1982), but other researchers report the natural occurrence of Pb in copper ore up to 2% (Johannsen, 2016). In addition, the absence of Fe

TABLE 1 Results of the ^{14}C observation of Horné Srnie 1–3 specimens.

Object	Item	Lab no.	^{14}C age (BP) (± 1σ)	Cal. age (BCE) (1σ; 68.3%)	Cal. age (BCE) (2σ; 95.4%)	App. phase (Reinecke)	δ ^{13}C versus PDB (‰) (±0.1‰)	C content (%) (±1%)	Material
Horné Srnie 1	Carpathian mace, var. B	DeA-33,871	3086 ± 30	1410–1375 (27.2%) 1352–1301 (41.1%)	1423–1268	Bz C2/D1	−27.4	33.4	Wooden shaft (*Pinophyta*)
Horné Srnie 2	Carpathian mace, var. B	DeA-33,872	3082 ± 30	1408–1372 (25.5%) 1355–1298 (42.8%)	1421–1265	Bz C2/D1	−31.3	5.9	Wooden shaft (*Pinophyta*)
Horné Srnie 3	Carpathian mace, var. D	DeA-33,873	3062 ± 29	1390–1336 (37.4%) 1323–1278 (30.8%)	1412–1258 (92.4%) 1245–1230 (3.0%)	Bz C2/D1	−26.5	30.8	Wooden shaft (*Pinophyta*)

TABLE 2 Results of the spectrometric observation of Horné Srnie 1–3 specimens.

Object	Sample no.	Preparation	Content of specified elements (%)										
			Cu	**Sn**	**As**	**Sb**	**Pb**	**Ag**	**Fe**	**Co**	**Ni**	**Ti**	**S**
Horné Srnie 1	aco_rfa_2328	Drilling	91.97%	6.65%	0.09%	–	0.22%	–	0.22%	0.04%	0.08%	0.13%	0.59%
Horné Srnie 2	aco_rfa_2330	Drilling	91.88%	6.80%	0.09%	0.05%	0.04%	–	0.18%	0.02%	0.20%	0.07%	0.69%
Horné Srnie 3	aco_rfa_2331	Drilling	90.27%	7.19%	0.39%	0.06%	1.14%	0.01%	0.03%	0.02%	0.80%	0.08%	–

occupies a significant position, which is a technological indicator of reducing conditions during melting, realized using open ceramic crucibles in direct contact with fire (Craddock & Meeks, 1987). The concentrations of Au and Bi were always below the detection limit of the device (0.01%). The high spectrometric signals of S in HS1 and HS2 measurements (0.6–0.7%) may be evidence that a new and fresh metal was used, since the S observed in the artefacts comes from residual sulphide from the ore deposits and did not form secondarily in the melt contamination (Hauptmann et al., 2003). The S concentration was lower than the limit of quantification for HS3, indicating a shift in the chemical character of the alloy due to metal recycling (Radivojević et al., 2019). Metalworking and bronze smelting could therefore be a common activity in domestic conditions that did not require any specific equipment (Ondrkál, 2018).

DISCUSSION

Ratio biplots and principal component analysis (PCA) were chosen to show the correlations of the spectrometric data of the Horné Srnie hoard, providing information on the relationships between individual variables (chemical elements) by highlighting the main trends. Spectrometric databases SAM and SAM2 of the elemental compositions of selected metal artefacts (Junghans et al., 1960, 1968, 1974) realized by optical emission spectroscopy (OES) were used. All variables are standardized and subsequently displayed at one level, while the advantage of PCA is that less prominent variables have the same value as more important ones in the correlation graph (Pearson, 1901). However, it is important to note that PCA does not define groups explicitly, and the main utility of PCA is exploratory rather than interference. Quantification of mineral resources of Western Carpathian and Eastern Alpine copper is drawn from the latest geological studies (Schreiner, 2007; Schubert & Pernicka, 2013; Pernicka et al., 2016). In the studies, the greatest weight is attributed to the Ag and Ni elements, which have predictable regularities in the pyrometallurgical process, when they change their concentration and ratio the least – changing the Ag/Ni ratio in the melt was only possible in the 19th century with the metallurgical achievements of the Industrial Revolution (Wedepohl, 1978).

Figure 4 showed general trends of the Ag/Ni quantification biplots of Carpathian double-armed insigniae and Salgótarján-type spiral armguards – the most distinctive workshop products of the Piliny culture (Mozsolics, 1967), the production of which, according to occurrence of shape-decorative analogies, was concentrated in the north-east of the Carpathian Basin on the upper course of the Tisza River (Tarbay, 2015). As can be seen from the visualization, the correlation matrix of PCA1 and PCA2 spectrodata enabled the separation of the Mitterberg (AT) and Central Slovakia (SK) material groups into separate typological-material clusters by combining the scores (62.65%), which makes this inclusion effective for the classification of individual types. The six principal component models were able to reveal the fundamental nature of the overlap of the related Horné Srnie 1–2 (HS1–2) specimens with the Mitterberg cluster (AT), demonstrating in a human-understandable visualization projection how the variance in the data depends primarily on Pb and Bi. Such a marked contradiction undoubtedly indicates that different types of artefacts were produced in different metallurgical workshops, each of which took metal from a different geological source. However, considering the Salgótarján-type spirals, it is debatable why copper of a more distant origin (Eastern Alps) was taken, although these bronze objects were certainly produced locally. In this case, however, the provenance assumptions are only exploratory, and future studies should more rigorously investigate these conclusions using more sophisticated geochemical techniques, the most known of which is the observation of Pb isotopic ratios (Pernicka, 1999).

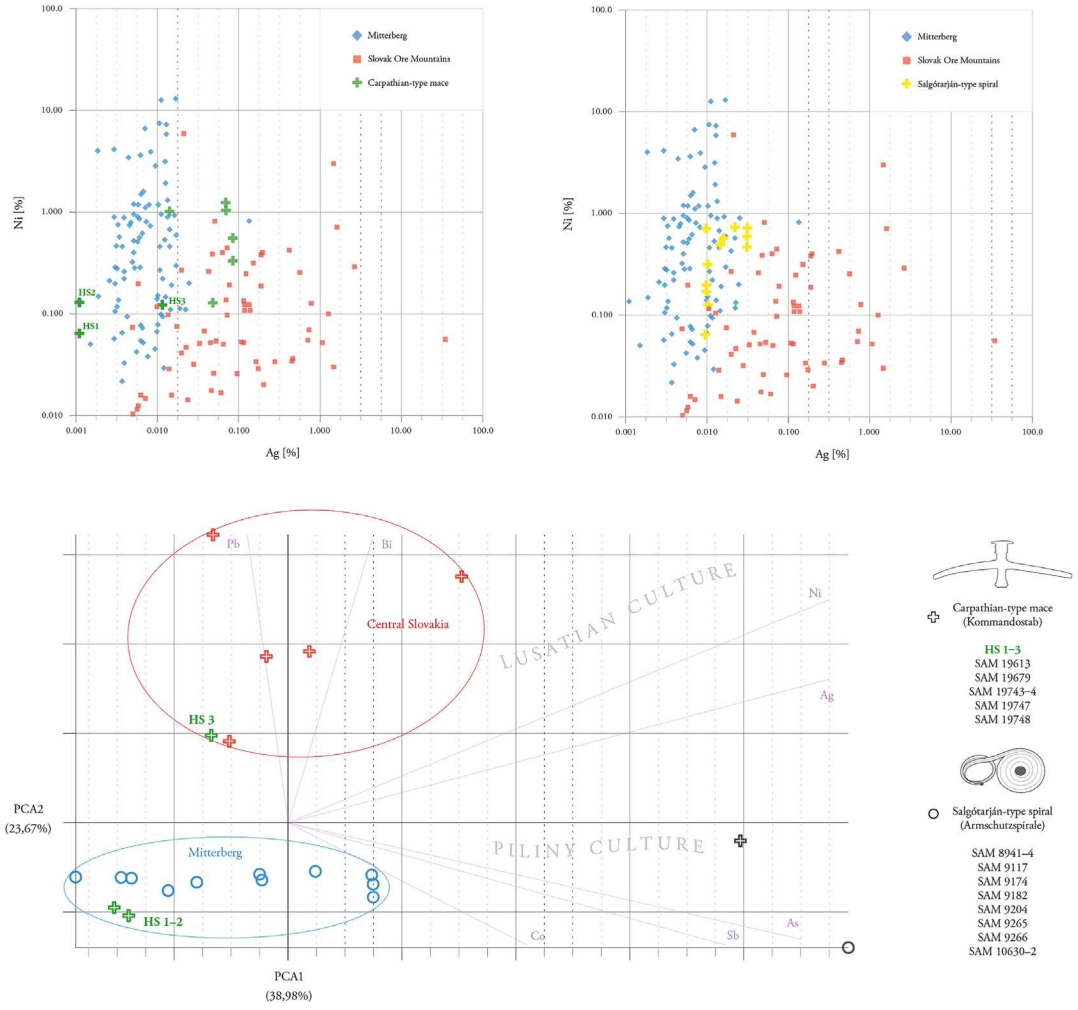

FIGURE 4 Trend-exploratory spectral biplots of Carpathian double-armed insigniae and Salgótarján-type spiral arm-guards in Europe (Ag/Ni log-ratio biplots; Pearson type PCA).

For a broad-spectral evaluation of the data, Figure 5 is exclusively focused on disc-butted axe-hammers (Nackenscheibenäxte; Vulpe, 1970; Mozsolics, 1973), since their spectrometric signals (alloy profiles) at the Piliny metallurgical zone show Pb concentrations higher than 1–2% (Re: Horné Srnie 3) in the period of the Forró and Opályi hoard horizons (Bz C–D; *c.*1375–1300 BCE; Sangmeister, 1973). Ratio diagrams of As/Sb, As/Ni, Ag/Ni and Ag/Sb demonstrate a relatively large differentiation of geological provenance, approximately 1:1 (Western Carpathians versus Eastern Alps), thus representing a high degree of variability in metal and alloy types, thus suggesting community-driven decisions and networks that were not under the control of social elites or any top-down political system (Ondrkál, 2020). The results also clearly show that synthetic Pb alloying does not correlate with a specific subtype of the artefact or its metallogenic provenance. Thus, the evidence supports a picture of decentralized production and distribution of disc-butted axe-hammers shaped by local preferences – making the production of these items appear more casual and without apparent standards.

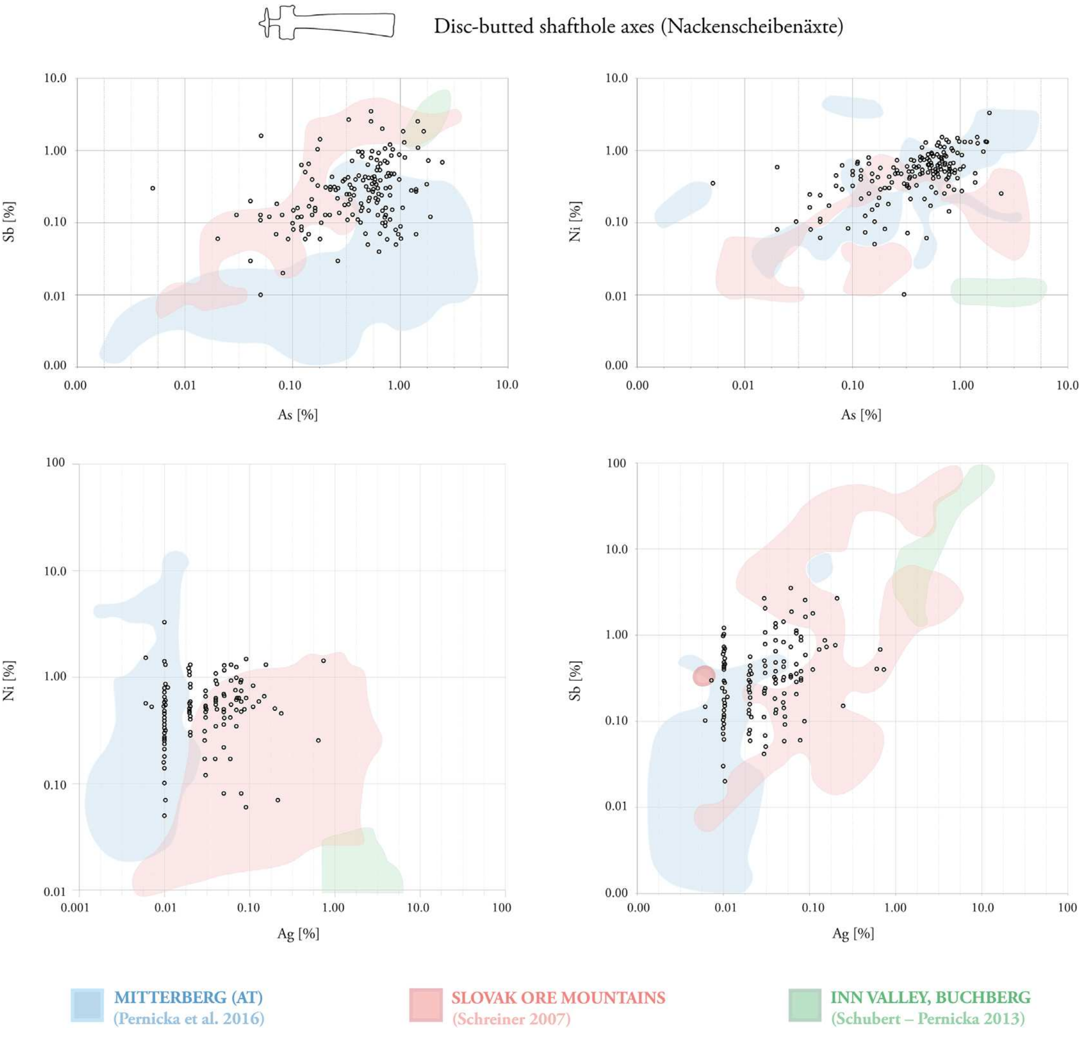

FIGURE 5 Trend-exploratory spectral biplots of disc-butted axe-hammers (Nackenscheibenäxte) in Europe (As/Sb, As/Ni, Ag/Ni, Ag/Sb log-ratio biplots).

CONCLUSIONS

The Horné Srnie depositional event confronts a metal hoard from the Western Carpathians with absolute dating for the first time, when radiocarbon sampling of directly associated organic remains enabled the connection of Carpathian insigniae of B and D development series with specific calendar years. It suggests that the typological differentiation of D type imitations is not the result of a gradual degeneration in time, but a chronologically simultaneous emulation of AB and B types by an early Lusatian community whose metallurgical knowledge was archaic and underdeveloped. The production of such imitations here seems more casual, without obvious standards, using recycled or residual materials. The metallurgical record of the Carpathian insigniae decoded the fact that the casting of high-grade metals varies not only in location but also in XRF compositional profile between specialized metallurgical workshops. The provenance models in the paper provided a rare opportunity to place the Carpathian insigniae in a local

(West Carpathian) geological environment as a contraindication to the Salgótarján-type spirals, which – most notably – were in every single case made of East Alpine copper.

The observed reality provides key information for understanding the acceptance of administrative and religious titles during the period of the Urnfield societal reorganization in the Western Carpathians (*c*.1350–1300 BCE) and refers to the tendencies of the Lusatian warrior-priests to reproduce the Piliny ideological culture. As iconic elements of cosmological identity, double-armed Carpathian insigniae were monopolized by elite members of the proto-Lusatian ethnic group and considered important enough to be buried with such individuals (Nitrica; Ondrkál, 2022). Therefore, the creation of prestigious and socially/politically significant objects had to have a wider meaning in the community, tied to manifestations of power and decisive actions in social reproduction (Sklenář, 1983). In this way, an adaptive convergence of neighbouring tribes towards more integrated political units could occur until a mosaic of small regional polities emerged over much of Central Europe, regardless of the actual benefits this system conferred on the mass of the agricultural population (Albert, 2004). What makes this epoch in the history of Central Europe most remarkable are the dramatic events associated with the influx of 'Sea Peoples' into the Mediterranean *c*.1200 BCE, when ceremonial double-armed insignia appear in the Hittite region of central Turkey (Eskiyapar; Özgüç & Temizer, 1993) as a possible evidence of involvement of the Carpathian population in the destruction of local palace centres.

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PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are all included within this article.

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