Metal, networks, and social change in Central Europe and Southern Scandinavia (c. 4100–1700 BC)

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Zusammenfassung

Metall, Netzwerke und gesellschaftlicher Wandel in Mitteleuropa und Südskandinavien (ca. 4100–1700 v. Chr.)

In den vergangenen zehn Jahren haben Untersuchungen anhand von Bleiisotopenanalysen an mittel- und nordeuropäischen Kupfer- und Bronzeartefakten zu einer teils veränderten Rekonstruktion der europaweiten Austauschnetzwerke geführt. Ebenfalls liegen neue Nachweise früher Metallurgie vor. Dementsprechend werden sämtliche Kupferartefakte und -erze, die bis etwa 3350 v. Chr. in Mitteleuropa und Südskandinavien verwendet oder eingeführt wurden, südosteuropäischen Kupferquellen zugeschrieben, wohingegen die südmitteleuropäischen Kupferquellen hauptsächlich danach und die nordwesteuropäischen Ressourcen erst ab ca. 2200 v. Chr. ausgebeutet wurden (Brozio et al. 2023).

Die für ca. ab 3800 v. Chr. nachgewiesenen überregionalen Netzwerke und einheimische Kupferverarbeitung stehen mit sozialgeschichtlichen Transformationen im Zusammenhang. Einige Gemeinschaften lehnten die neue Technologie ab, andere nahmen sie an. Interessanterweise fällt der Beginn der einheimischen Kupfertechnologie in Mitteldeutschland mit der Errichtung der chalkolithischen Grabhügel für Einzelbestattungen ab ca. 3800 v. Chr. zusammen und die Einführung der Zinnbronzetechnologie mit dem Bau der großen frühbronzezeitlichen Hügel ab etwa 2000 v. Chr. Damit verbundene performative Architektur wird hier als Ausdruck sich ändernder sozialer Praktiken gedeutet.

Neue Untersuchungen am Schneiderberg in Baalberge, Salzlandkreis – namensgebend für die chalkolithischen Baalberge-Gesellschaften – haben ergeben, dass es sich um einen chalkolithischen Grabhügel handelt, der in der Frühbronzezeit von einem zweiten Hügel überdeckt wurde (Zolchow et al. in prep.). Die Biografie des Fundortes spiegelt offensichtlich die zwei Haupttransformationshorizonte der Einführung der Kupfer- bzw. Zinnbronzemetallurgie wider.

Schlagwörter Kupferverarbeitung, Neolithikum, Bronzezeit, Netzwerke, soziale Veränderungen

Summary

In the last ten years, studies with lead isotope analyses of Central and Northern European copper and bronze artefacts have led to a partially modified reconstruction of Europe-an-wide exchange networks. New evidence on early metallurgy has also emerged. Accordingly, the copper artefacts and ores used or introduced into Central Europe and Southern Scandinavia up to c. 3350 BC are attributed in their entirety to Southeastern European copper sources, whereas Southern-Central European copper sources are primarily exploited thereafter and Northwestern European resources are also utilised only from c. 2200 BC onwards (Brozio et al. 2023).

Supra-regional networks and indigenous copper processing documented from around 3800 BC are linked to sociohistorical transformations. Some societies rejected the new technology, others embraced it. Interestingly, the emergence of indigenous copper technology in Central Germany correlates with the construction of Chalcolithic burial mounds for individual burials from c. 3800 BC onwards and the introduction of tin bronze technology with the construction of Early Bronze Age large burial mounds from c. 2000 BC onwards. Corresponding performative architecture is interpreted here as an expression of changed social practices.

New investigations at the Schneiderberg of Baalberge, Salzlandkreis district, which gave its name to the Chalcolithic Baalberge societies, have shown that we have a Chalcolithic burial mound here, which was later covered over by a secondary mound again in the Early Bronze Age (Zolchow et al. in prep.). The biography of the site obviously represents the two main transformation horizons for the introduction of copper and tin bronze metallurgy.

Keywords copper metallurgy, Neolithic, Bronze Age, networks, social differentiation

Introduction

A key aspect of European prehistory is the question whether and in what form the introduction of copper or bronze metallurgy brought about changes in social practices[1]. To what extent can we assume that social consequences were associated with the introduction of these new technologies due to, for example, the need to organise processes based on the

1 Klassen 2003; Meller et al. 2014; Pernicka 2004; Strahm 2001.

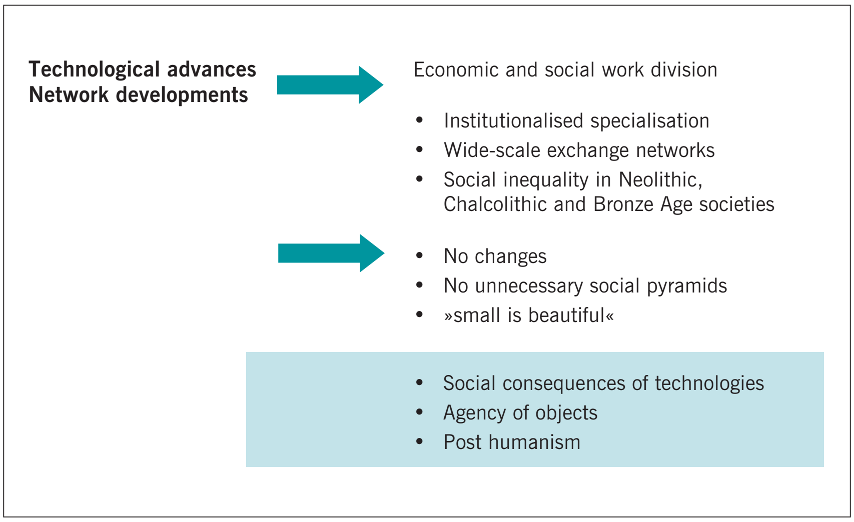


Fig. 1 Possible contrary consequences of technological innovation and network developments.

Abb. 1 *Mögliche gegensätzliche Folgen von technologischer Innovation und Netzwerkentwicklungen.*

division of labour or the maintenance of regional and supra-regional supply networks? The highly topical question is therefore whether technologies inherently cause social change without the actual actors being aware of it.

These »socio-technological aspects« of prehistoric technological innovations also relate to the question of the social consequences of technologies raised by T. Adorno (1966), among others, which is also reflected in the comments of I. Illich (1973) and L. Mumford (1967), who all emphasise the agency of technologies in the context of social or ecological issues.

In principle, the question is whether technological advances and network developments lead to economic and social work division with (1) institutionalised specialisation, (2) wide-scale exchange networks, and (3) social inequality in Neolithic, Chalcolithic, and Bronze Age societies, or whether (1) no changes, (2) no unnecessary social pyramids, and (3) »small is beautiful« are possible (Fig. 1).

Archaeologists have been discussing this for a long time. Both the extreme advances in metal analysis and in dating precision make it currently much easier to empirically evaluate archaeological sources with regard to the question of the relationship between technological innovations and social changes. Even if the interpretative approaches of those who attach great importance to metallurgical production for social development (Strahm 2010) and of those who tend to negate its importance (Bartelheim 2007) raise further questions, the relationship between the appearance of monuments for individuals and peaks in metalworking in Central Europe remains striking, in addition to differences in the acceptance of new prehistoric metal technologies.

In the following, we will therefore first present some new findings on copper technology, then introduce the question of the social consequences of the acceptance/rejection of technologies, and, finally, outline the consequences using the example of the Schneiderberg of Baalberge.

The changing picture of copper supply between the Black Sea and the North Sea

Recent metallurgical provenance studies based on lead isotope analyses show that metallurgical products were bartered from the Balkans to Central Europe and Southern Scandinavia both earlier and longer than originally assumed. As early as 2015, E. Pernicka and C. Frank, and later E. Pernicka, H. W. Norgaard, and H. Vandkilde, were able to prove that the so-called Mondsee copper did not originate from Eastern Alpine copper resources, but must have come from Balkan copper sources (Frank/Pernicka 2012; Pernicka/Frank 2015; Nørgaard et al. 2019). Another study, in particular on Bronze Age copper artefacts, also showed that metal artefacts from the Nordic Neolithic have corresponding signatures (Nørgaard et al. 2021).

Irrespective of these changing indications, the great importance of copper metallurgical developments in Southeastern Europe is beyond question due to their early appearance, to their possible socio-historical consequences, and to their influence on Central and Northern European development[2].

In a study that we recently presented, 45 Neolithic copper objects were newly investigated, representing the largest number of corresponding artefacts from the Northern Central European lowlands and from Southern Scandinavia thus far (Brozio et al. 2023). These analyses suggest that the origins of the Early Neolithic northern artefacts (c. 4100–3300 BC) are from the Serbian mining areas, whereas the Middle Neolithic artefacts (c. 3300–2800 BC) are from the Slovak Ore Mountains, the Eastern Alps, or the Serbian mining areas still in operation. Late Neolithic and Early Bronze Age artefacts (c. 2300–1700 BC) are also based on materials from the Slovak Ore Mountains and the Alpine region, after 2000 BC also from Wales.

2 Hansen et al. 2015; Klassen 2004; Radivojević/Roberts 2021; Radivojević/Rehren 2021; Rosenstock et al. 2016.

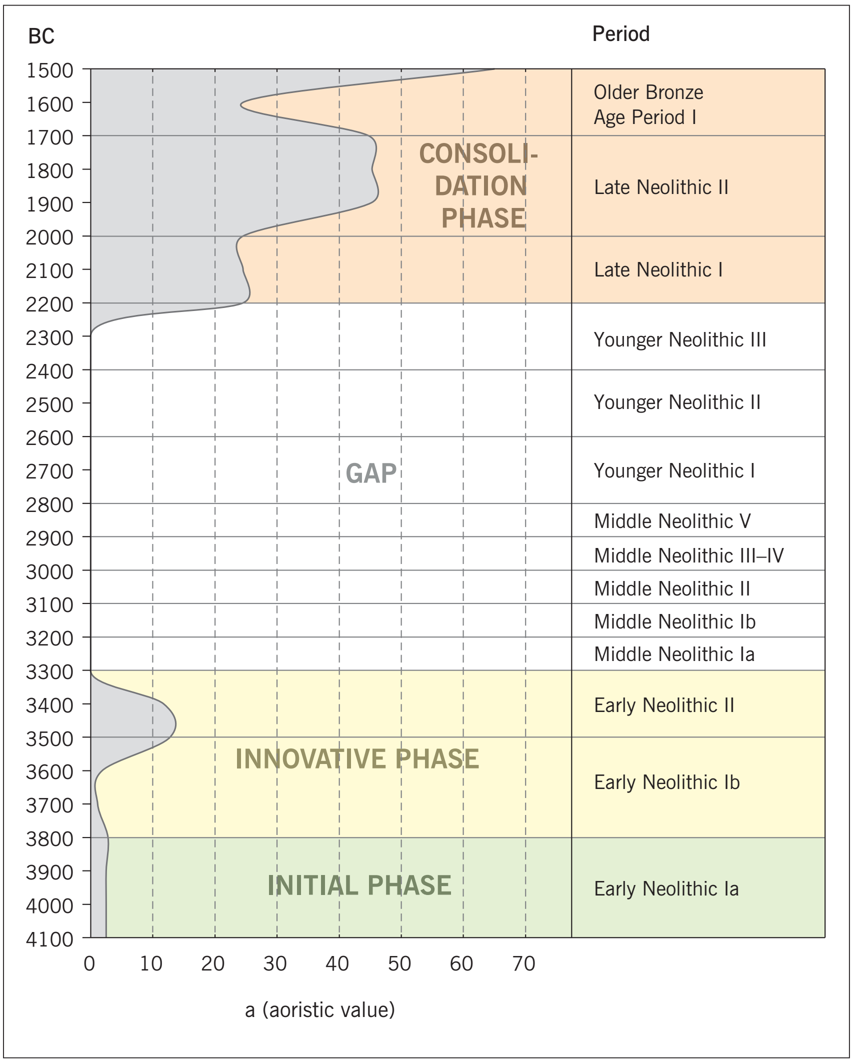


Fig. 2 Relative frequency (number of objects per century) of Neolithic copper objects in Northern Germany and Southern Scandinavia (cf. Brozio et al. 2023, 3 Fig. 3). The duration of the archaeological periods in Southern Scandinavia and Northern Central Europe are marked. The classification of metal use and production is also indicated. An initial phase with first copper item imports, an innovative phase with local metal processing, and a consolidation phase with an established metal production are marked. The »gap« describes a period with only very low indications of metal items.

Abb. 2 *Relative Häufigkeit (Anzahl der Objekte pro Jahrhundert) von neolithischen Kupferobjekten in Norddeutschland und Südskandinavien (vgl. Brozio et al. 2023, 3 Abb. 3). Die Dauer der archäologischen Perioden in Südskandinavien und Nordmitteleuropa ist angegeben, ebenso die Klassifizierung in Metallverwendung und -produktion. Eine Anfangsphase mit den ersten importierten Kupferobjekten, eine Innovationsphase mit lokaler Metallverarbeitung und eine Phase der Konsolidierung mit etablierter Metallherstellung sind gekennzeichnet. Die Lücke (»GAP«) stellt eine Zeit mit sehr wenigen Hinweisen auf Metallobjekte dar.*

Quantities and qualities of copper supply in the north

Based on various publications, there are clear periods of utilisation or deposition of copper artefacts in the Nordic region (Fig. 2). Both quantitatively and qualitatively, we can identify different phases of copper utilisation, as they have also been defined for other areas, e.g., Southern Central Europe, Southeastern Europe, or the Near East (first in Strahm 1994): an initial phase with the first metal objects, an innovative phase with independent local copper metallurgy, and a consolidation phase with established metal production. A gap, i.e., an interruption in development with only minor evidence of metal objects, can also be detected in the north, similar to Southern Central Europe.

The earliest objects probably appear from 4100 BC with the beginning of the Neolithisation of Southern Scandinavia and Northern Germany, while the first boom in copper artefacts occurs from around 3600 BC and especially in the Early Neolithic II (Fig. 3–4).

The oldest objects are a cross-edged axe of the Jászladány type and various hatchets, which were analysed for trace element concentrations. The probable origin of mining areas in Burgas, Bulgaria, and Belovode, Braničevo district and Majdanpek, Bor district (both Serbia) confirms the link to the core regions of South-eastern European technological development. Typochronologically, we find ourselves in Bulgaria in the area of Varna/KGK VI (Kodjadermen-Gumelniţa-Karanovo VI) and Sălcuţa/Krivodol, and in Serbia in the vicinity of Vinča D and Bubanj-Hum Ia. The main copper-processing societies of Southeastern Europe are therefore involved. For them a more stratified society is assumed, partly due to the depiction of relational power in the Varna cemetery or in Durankulak.

Social analyses of the Durankulak cemetery show that the increase in individual differences concerning access to resources led to increased inequality (Windler et al. 2012). While the tell settlement habitation practice was largely abandoned on the Lower and Middle Danube, the export of the first metal artefacts to the north was followed by the introduction of copper casting around c. 3800 BC also in Northern Central Europe. The appearance of the oldest copper artefacts in Northern Europe thus coincides with a period of considerable change both on the Lower and Middle Danube at the end of the settlement mound construction phase there and the transformation to agrarian production methods in Southern Scandinavia and Northern Central Europe.

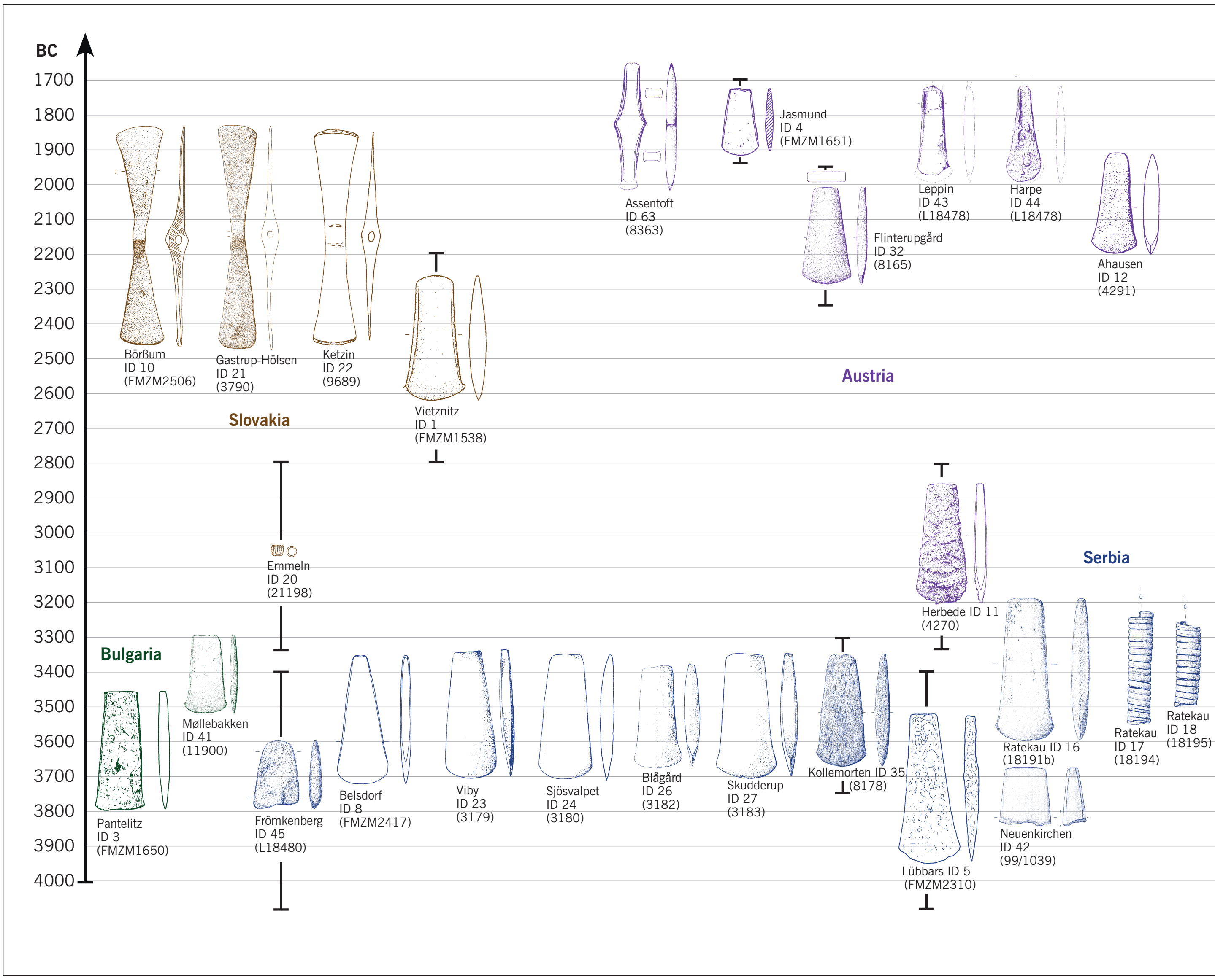


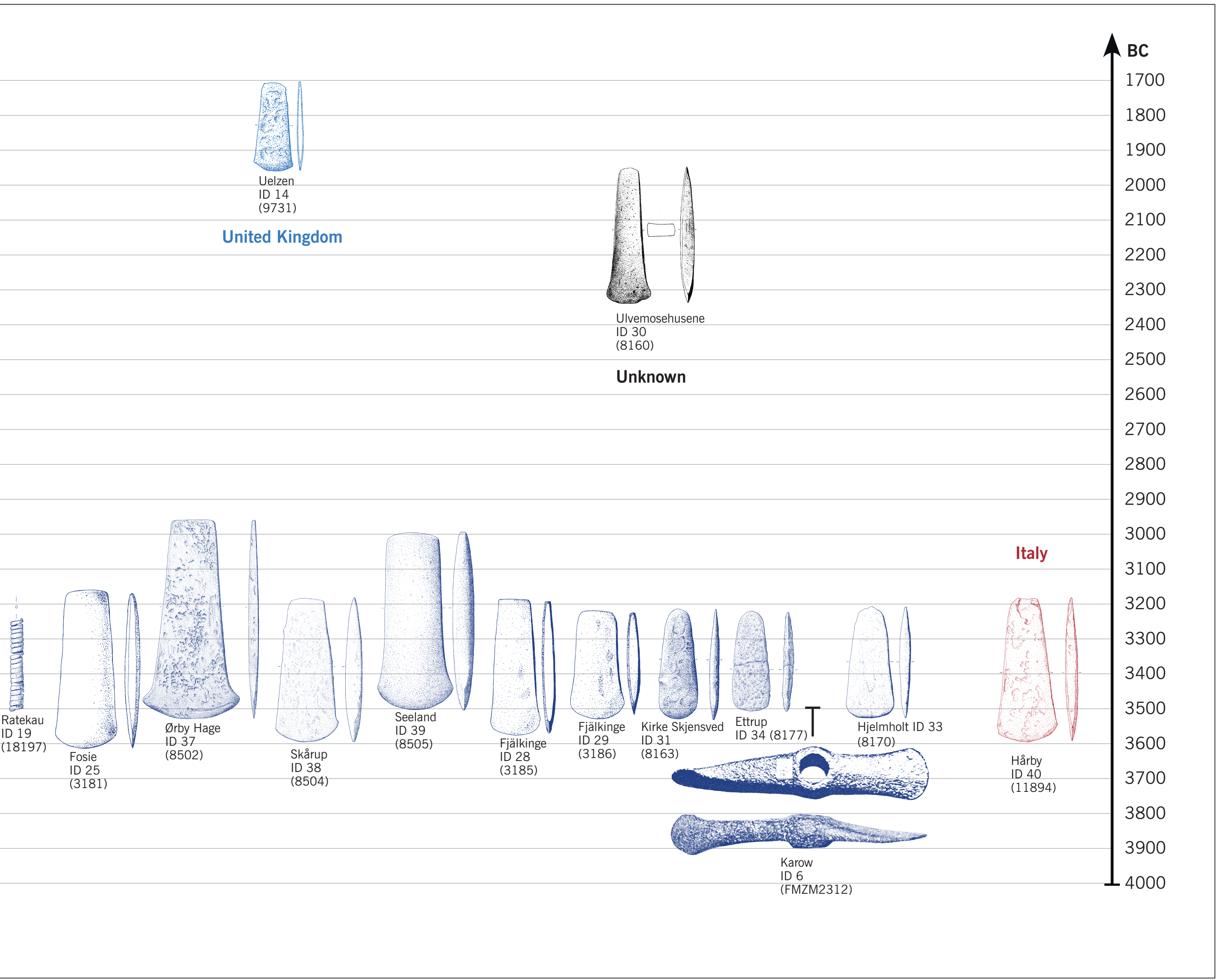
Fig. 3 Chart of the chronological sequence of the Neolithic copper artefacts and the origin of the raw material in the recent study (Brozio et al. 2023).

Abb. 3 *Chronologische Abfolge der neolithischen Kupferartefakte und der Herkunft des Rohmaterials aus der jüngsten Untersuchung (Brozio et al. 2023).*

There is direct evidence of the introduction of copper technology in the north from various sites. Here, a tuyère from the Funnel Beaker settlement of Kotowo, Wielkopolsky county (Central Western Poland; Żurkiewicz et al. 2023) probably comes from a metal workshop and radiometrically dates to the 39th or 38th century BC (cf. Skorna in this volume). In Lønt, Haderslev Municipality in Southern Jutland (Gebauer et al. 2021, 29–34), fragments of a crucible and a tuyère were also found under a long barrow with two dolmens in connection with pottery from the Early Neolithic Ib (3800–3650 BC). The investigations showed that the vessel came into contact with molten copper. Another indication of local metallurgical activity is the »deliberate fragmentation of copper flat axes by hot-shorting« – a method of reworking and possibly recycling copper objects (cf. Skorna in this volume). This technology was observed at the Neuenkirchen hoard and the Bygholm hoard (Skorna 2022).

Sociohistorically, we observe a change in the Funnel Beaker societies at this early time from around 3800 BC. For the first time, non-megalithic long barrows were erected for individuals, and human bones were deposited in Nordic bogs (Müller et al. 2014; Sörensen 2020). The extent to which this is a representation of social differences – as postulated by some – should be left open at this point. In any case, it is clear – with a more or less constant quantity of deposited copper objects – that objects produced by others initially appear as part of the exchange networks of the ear-

3 Of the objects analysed, a spiral from the depot find of Ratekau, Ostholstein district (Riesebusch; ID 17) could come from a Slovakian ore source. A flat axe from Tremmen, Havelland district (Brandenburg; ID 7) might come from Alpine raw materials, but it is chemically not consistent with ores from »Austria, North Tyrol«. The typochronological classification of the flat axe from Harby, Syddanmark, (ID 40) is unclear and will not be considered further here (cf. Brozio et al. 2023).



liest Funnel Beaker Cultures at the beginning of Neolithisation and, from around 3800 BC, copper metallurgy is also temporarily established at the same time as the appearance of the first superficially visible monuments.

The first boom in metal artefacts, which were evidently casted locally, began around 3600 BC and continued until around 3300 BC. The copper sources continued to be located in Southeastern Europe (Fig. 5). Two artefacts could indicate the beginning of the exploitation of Alpine sources[3]. This first boom in metal artefacts in the north was accompanied by considerable environmental and social transformations. Their economic expression can be found in the considerable clearances, which may be linked to the introduction of the plough and wagon (Müller 2019). Social and ritual practices were also changing: Numerous causewayed enclosures were now built. The Funnel Beaker communities seemed to organise themselves cooperatively, which is also reflected in their first megalithic tombs.

Subsequently, the deposition of metal objects and the utilisation of copper in the north came to a standstill from 3300 BC (cf. Klassen 2003; Brozio et al. 2023). In the western FBC, a spiral from Emmeln, Emsland district, and a flat axe from Herbede, Ennepe-Ruhr district, probably date to this period. According to the lead isotope analyses, these Middle Neolithic artefacts can be attributed to Southern Central European ore sources (of Slovakian and Austrian origin). Three Danish flat axes, which can be dated to around 3200 BC and whose raw material comes from Serbian sources, could certainly also date earlier (Brozio et al 2023).

Overall, we would associate the reduction in copper utilisation in the northern Middle Neolithic not only with the collapse of Southeastern European social relationships, but also with the changed social conditions in the Funnel Beaker communities. Since the exploitation of Slovakian copper sources is now obviously possible, the »copper emptiness« that now set in in the north can certainly be attributed to social network relationships. After the period of the dominance of passage graves as a collective burial practice and the establishment of the first village communities, the emphasis on the individual through individual graves began in many areas around 3100 BC at the latest. Here, other ways of displaying prestige or status probably became social practice – without metals playing a role. Even if isolated objects (e.g., the flat axe from Vietznitz, Havelland dis-

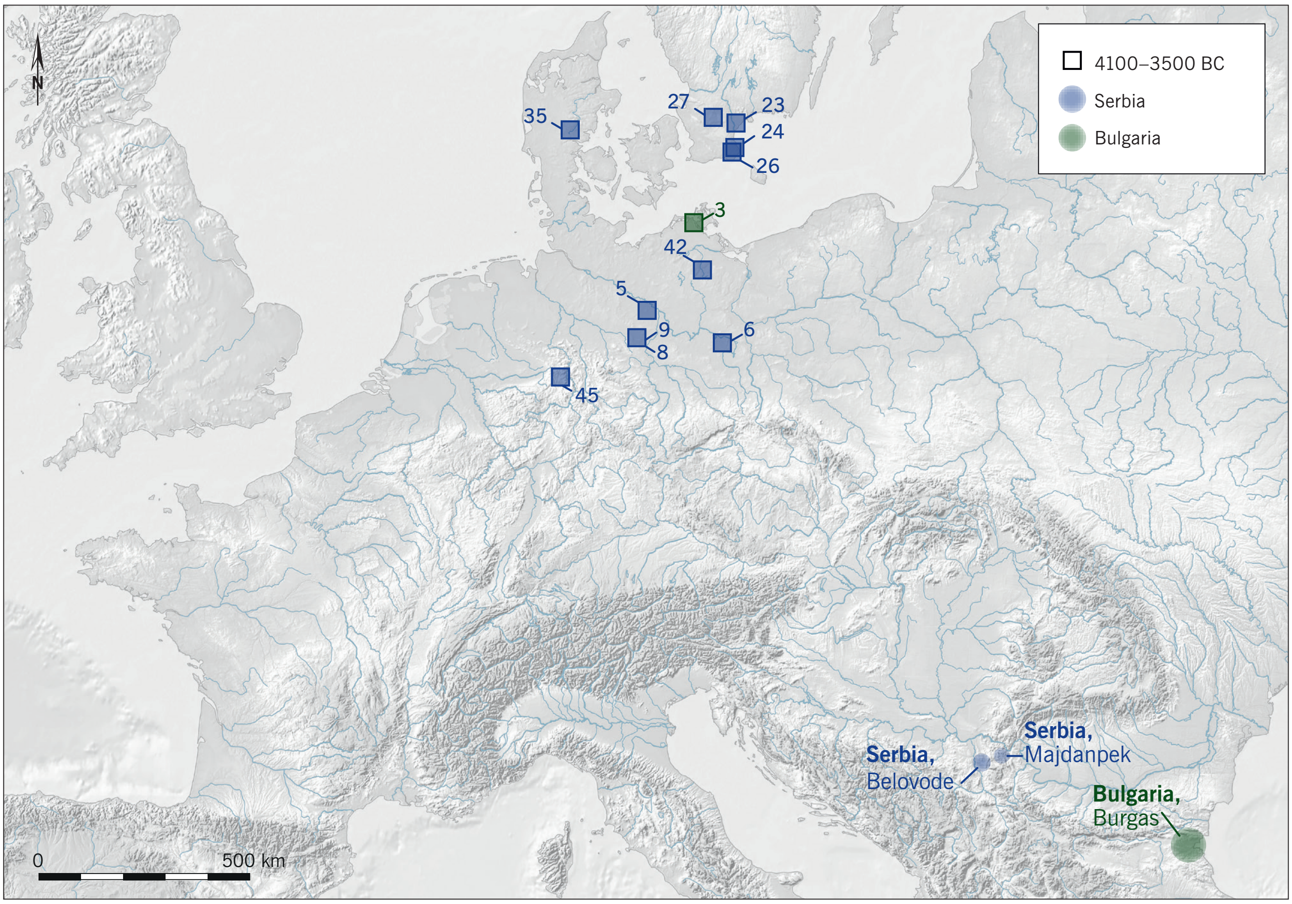


Fig. 4 Sites of the sampled objects (c. 4100–3500 BC) and the regions of origin of their copper based on the analyses of the recent study of copper items (cf. numbers in Brozio et al. 2023).

***Abb. 4** Fundorte der untersuchten Objekte (ca. 4100–3500 v. Chr.) und die Herkunftsregionen des Kupfers anhand der jüngsten Analysen (Nummern vgl. Brozio et al. 2023).*

trict, ID1 in Brandenburg) can be dated to the following period, this absence of metal continues until around 2300 BC in the period under consideration.

From around 2300 BC, Zabitz axes made of Slovakian ore are found in southern regions of Northern Germany, whereas, from 2200 BC at the latest, numerous flat axes from Alpine copper sources, but also individual examples from North Wales, likewise found here. The now developing quantitative peak in the Nordic Late Neolithic and the Nordic Early Bronze Age certainly reflects the changed social conditions. The production of metal objects increasingly became the basis of exchange systems.

Economic and social interpretation in the north: Cooperative societies against copper?

Overall, it becomes clear, especially in comparison with the economic and social development, that copper metallurgy in the north only rarely played a role in which the necessities of technological development brought about social changes. The discovery and use of the first copper objects before 3800 BC (as in other regions) are linked to general exchange relations at the time of the initial Neolithisation. The use of a »small technology« with its own small copper metallurgical workshops in settlements from around 3800 BC can possibly be linked to social differentiation processes, which some scholars recognise in the non-megalithic long barrows (Sörensen 2020). Interestingly, this increase in regional copper metallurgical products breaks off at a time when more cooperative social relationships can be recognised in the Middle Funnel Beaker societies. Thus, the megalithic boom parallels a metallurgical bust (Fig. 6): Elements other than ›copper‹ come to the fore in the communal shaping of the new agricultural cultural landscape. The minor importance of metallurgical production leads to the abandonment of corresponding references in this phase. Obviously, cooperative societies are active in other technological environments.

A corresponding socioarchaeological context has already been discussed in relation to the distribution of early metal daggers in Central and Northern Germany (Müller 2012; Müller 2013). It was argued that metal daggers were known and occasionally worn in Northern Germany around 3800/3700 BC, but, in contrast to Southern Central Europe, they did not establish a ›dagger tradition‹ for purposes of social representation – neither in metal nor flint. This was labelled a ›missed innovation‹ (Fig. 7).

This results in the following model for Northern Germany and Southern Scandinavia:

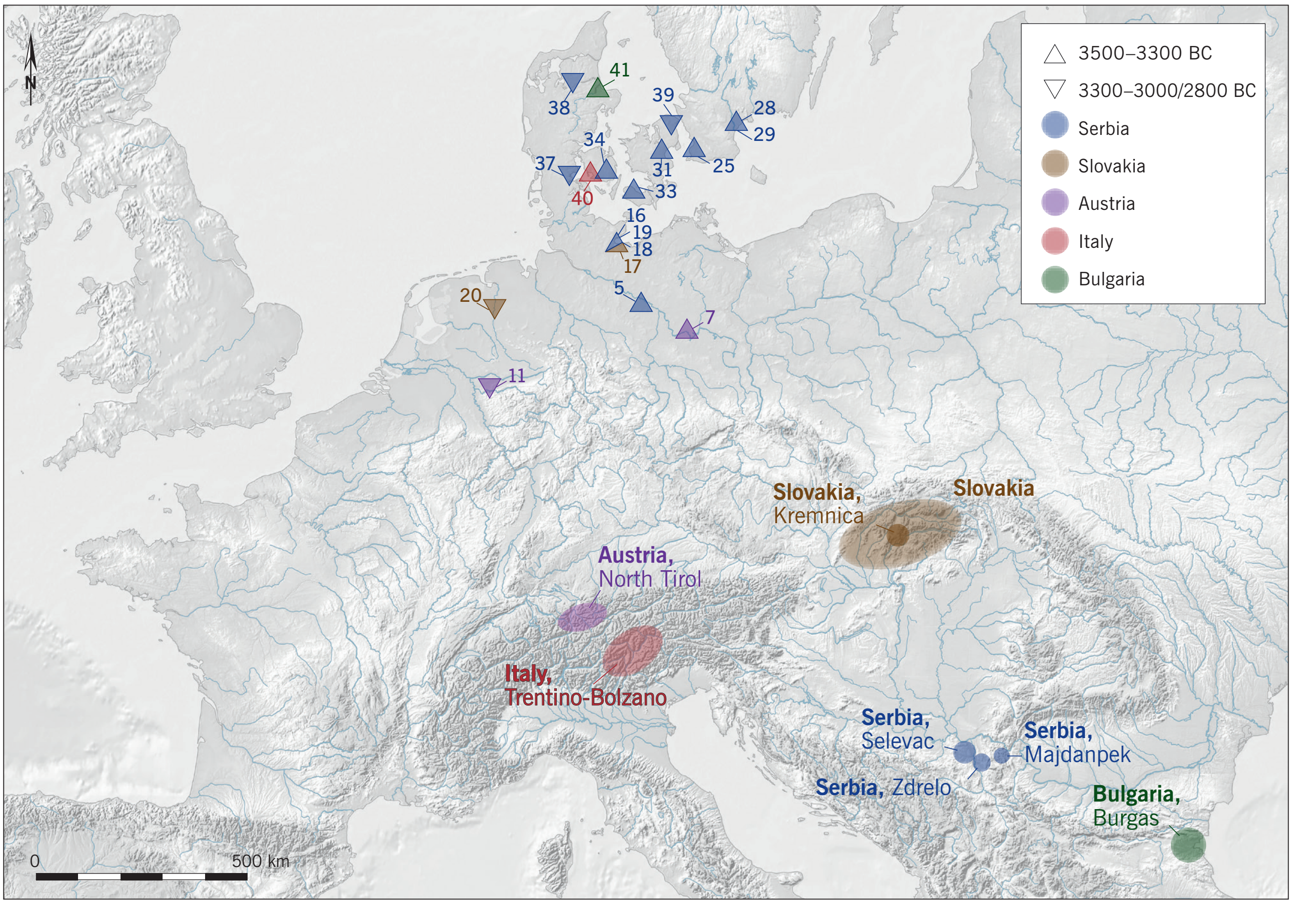


Fig. 5 Sites of the sampled objects (c. 3500–3300 BC and 3300–3000/2800 BC) and the regions of origin of their copper based on the analyses of the recent study of copper items (cf. numbers in Brozio et al. 2023).

Abb. 5 *Fundorte der untersuchten Objekte (ca. 3500–3300 v. Chr. und 3300–300/2800 v. Chr.) und die Herkunftsregionen des Kupfers anhand der jüngsten Analysen (Nummern vgl. Brozio et al. 2023).*

1 The introduction of copper usage and casting remained small-scale and without any social consequences. This becomes visible, e.g., in the small flow of imports until c. 3300 BC, in the small number of locally casted copper items, and in the rejection of a prestige value for metal objects.
2 Even if a ›metallic gap‹ with only low numbers of metal objects was postulated for other areas of Central Europe,

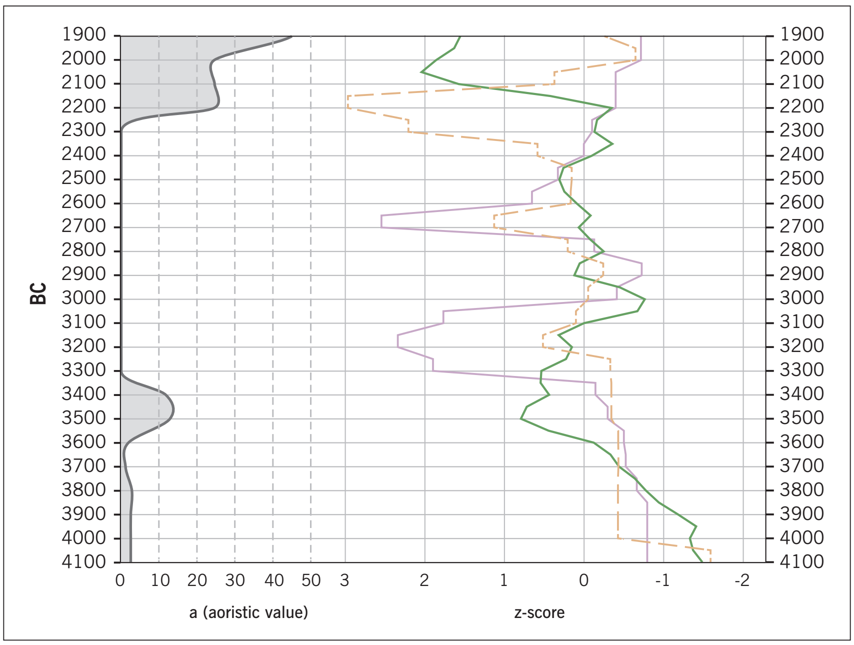


Fig. 6 A comparison of the relative frequency of metal objects and economic and social practices in northern Germany and southern Scandinavia. The latter were calculated based on palynological data and relative frequencies of architecture and depositions in Northern Germany. Green: land opening; purple: monuments; light brown: deposition of prestige goods (cf. Fig. 2 and study of Brozio et al. 2019).

Abb. 6 *Vergleich der relativen Häufigkeit von Metallobjekten sowie wirtschaftlichen und sozialen Praktiken in Norddeutschland und Südskandinavien. Letztere wurden anhand von pollenkundlichen Daten und der relativen Häufigkeit von Architektur und Niederlegungen in Norddeutschland bestimmt. Grün: Abholzung; lila: Monumente; hellbraun: Niederlegungen von Prestigeobjekten (vgl. Abb. 2 und Analysen von Brozio et al. 2019).*

Abb. 7 The dagger of Aspenstedt (length 11.8 cm). While the early copper daggers in Southern Germany were triggering the adaptation of ›daggers‹ as a social symbol within societies, in the ›north‹ this was not the case. Early copper daggers, like this one from Aspenstedt, remain an exception.

Fig. 7 *Dolch von Aspenstedt (Länge 11,8 cm). Während die frühen Kupferdolche in Süddeutschland zur Übernahme von »Dolchen« als sozialem Symbol führten, war dies im »Norden« nicht der Fall. Frühe Kupferdolche wie der von Aspenstedt bleiben eine Ausnahme.*

the gap seems especially more extreme and long-lasting in the ›north‹.

3 The consolidation of metal production as a primary technology for producing utilitarian and non-utilitarian items takes place simultaneously with the economic changes in the Nordic Late Neolithic.

This development is very different from what we know from Central Germany and Greater Poland.

Economic and social development in Central Germany

In contrast to the cooperative societies of the north, we have long been familiar with the debate surrounding the social interpretation of the legacies from the Chalcolithic and Early Bronze Age of Central Germany and Greater Poland[4]. On the one hand, the introduction of copper metallurgy from c. 3800 BC is associated with considerable differentiation in the burial system (including the construction of round and long mounds for individual burials) and a boom in large causewayed enclosures (Klassen 2014; Schwarz 2003). On the other hand, the large burial mounds of the Early Bronze Age Únětice Group, in particular, are an expression of increased hierarchisation in connection with the consolidation of tin bronze technology (Bertemes 2010; Bertemes 2016; Steffen 2010). While the extraordinary development in the introduction of copper metallurgy initially appears to be limited to the Central German region, the social developments in the introduction of tin bronze technology between Central Germany and Greater Poland can certainly be considered parallel (e.g., Czebreszuk et al. in print; Müller et al. 2023).

In fact, the appearance of the oldest round barrows for individual burials in Central Europe in the Central German Baalberge area is probably linked to economic changes that caused increased social differentiation within society (Müller 2001). These economic changes included the introduction of copper metallurgy as well as changes in the subsistence sector.

In contrast to the Baalberge burial mounds, the Únětice burial mounds provide evidence that the control over metallurgical processes was obviously exercised by the individuals buried there (Bertemes 2016).

The two phases of greater social differentiation in Central Germany, which may also be linked to the role of metallurgy, are paradigmatically illustrated by the Baalberge-Schneiderberg burial mound. The site, which gave its name to the Baalberge societies, contains the various prehistoric remains known since the old excavation. Geophysical investigations and dating of drilled sediments from the burial mound have now shown that it is comprised of a two-phase burial mound fill (Müller et al. in prep.) – first, a 1.5–2.0 m high Baalbergian primary mound, which was subsequently covered over by a 3.0–3.5 m high secondary burial mound in the Early Bronze Age for the rich Early Bronze Age ceremonial burial (Fig. 8).

Conclusion

The brief reference to new lead isotope analyses and the comparison of the results with some social developments have confirmed certain ideas about the role of metallurgy for the early copper-using societies of the north, while refuting others.

4 Czebreszuk 2013; Meller et al. 2016; Müller 2001; Münster et al. 2018.

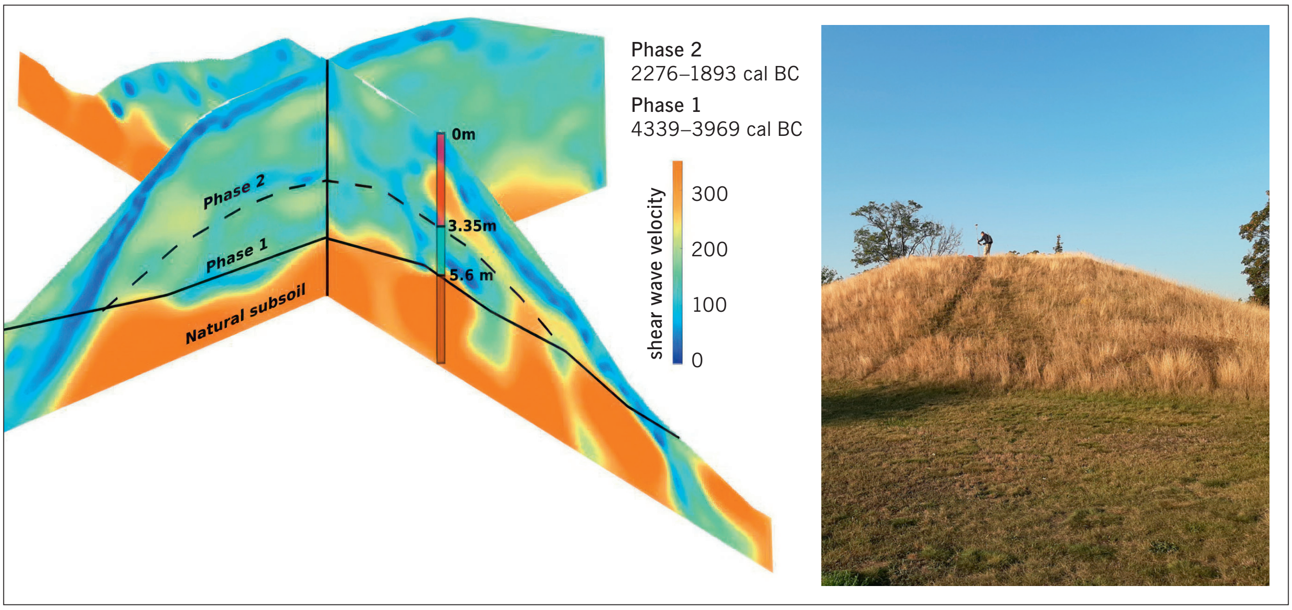


Abb. 8 Schneiderberg, Baalberge, Salzlandkreis district (Saxony-Anhalt). With different geophysical methods, two phases of the mound have been detected. Phase 1 (height 1.80 m) is associated with the Baalberge cist; phase 2 (additional 3.35 m height) with the EBA burial. Based on ^{14}C-dating of material from drillings, phase 1 filling material is dated to soil from 4340–3970 cal BC; phase 2 filling material to soil from 2275–1890 cal BC (Müller et al. in prep.).

Fig. 8 *Schneiderberg, Baalberge, Salzlandkreis (Sachsen-Anhalt). Mithilfe verschiedener geophysikalischer Methoden konnten zwei Phasen des Hügels ermittelt werden. Phase 1 (Höhe 1,80 m) wird mit dem Baalberge-Steinkistengrab in Zusammenhang gebracht; Phase 2 (weitere 3,35 m Höhe) mit der frühbronzezeitlichen Bestattung.* ^{14}C*-Daten von Bohrungen haben ergeben, dass das Aufschüttungsmaterial von Phase 1 auf 4340–3970 cal BC datiert, von Phase 2 auf 2275–1890 cal BC (Müller et al. in prep.).*

While local metallurgical processing techniques were already present, the role and meaning of copper artefacts was not the trigger of a social transformation of the northern societies.

The first integration of copper metallurgy and the use of copper objects in Neolithic societies in Northern Central Europe and Southern Scandinavia was part of a wider development of transformation processes in the 4^{th} millennium BC, including:

- communication and exchange networks
- changes in the subsistence economy
- new technologies, such as the introduction of the animal drawn plough or the wheel and wagon.

The early consolidation of copper metallurgy was not a sustainable process, perhaps rejected by cooperative societies. Only Nordic Late Neolithic and Early Bronze Age societies integrated copper metallurgy in such a way into their economic system that these metallurgical societies reached a point of no return with respect to metallurgy:

- increasingly using more metal artefacts as tools in the subsistence economy
- and for the display of power structures.

In contrast to Northern Europe, metallurgical input took place in Central Germany already at 3800 BC. Here, power structures were displayed in the earliest burial mounds of Central Europe for single individuals and in the Early Bronze Age mounds. Beside the well-known examples from Bornhöck, Saalekreis district, Helmsdorf, Mansfeld-Südharz district, and Leubingen, Sömmerda district, a fourth example is now known with Baalberge-Schneiderberg, where mound-building activities could be associated with the Central German Únětice Group.

Despite or precisely because of the results presented, we can in no way identify a socio-technological consequence of early metallurgy. Rather, the role of the new production technology remains embedded in the general economic and social development, which results from an interplay of different components of social transformation or stability.

Acknowledgements

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Source of figures

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