Bernstein

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Metal-for-Amber in the European Bronze Age

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Zusammenfassung: Baltischer Bernstein wird oft als die wichtigste skandinavische Ware betrachtet, die gegen Metall aus erzreichen Regionen Europas getauscht wurde. Wenn das zutrifft, könnte dies den erstaunlichen Reichtum an Metall in der Nordischen Bronzezeit und den bescheidenen sozialen Verbrauch von Bernstein vor Ort erklären. Die Hypothese eines Metall-für-Bernstein-Prinzips im Handel wird hier erstmals auf verschiedenen Ebenen von Mikro bis Makro bewertet. Bernsteinfunde aus ganz Europa wurden erfasst, und das Ergebnis dann in Hinsicht auf die beobachteten Wechsel in den metallversorgenden Netzwerken untersucht, die sich anhand von vorhergehenden gründlichen Analysen der Isotopen-/Elementzusammensetzung nordischer Metallgegenstände von ca. 2100–1200 v. Chr. herauskristallisierten. Vergleiche deuten darauf hin, dass Bernstein und Metall ähnliche Verbreitungsmuster im Raum und Zeit aufweisen, wobei es zu bedeutenden Umstrukturierungen beim Übergang von der Frühen zur Mittleren Bronzezeit kam. Veränderungen in der Bernsteinverteilung korrelieren mit der geografischen Herkunft der in beiden Zeiträumen verwendeten Metallquellen, und die Ströme von Metall nach Skandinavien und von Bernstein nach Europa scheinen selbst in Unterperioden verknüpft zu sein. Wichtige europäische Bernsteinwege – wie auch diese kontrollierenden Knotenpunkte – konnten identifiziert werden. Hervorzuheben sind auch hier bedeutende Veränderungen am Übergang zur Mittleren Bronzezeit. Die sozialen Rollen und Bedeutungen von Bernstein in nordischen Gemeinschaften wurden ebenfalls untersucht. Es scheint, dass das Tragen von Bernstein den Träger in seiner Position als Vollstrecker sozialer Kontrolle über diese Ressource kennzeichnet. Die vorliegende Studie kommt zu dem Schluss, dass Bernstein höchstwahrscheinlich gegen Metall getauscht wurde.

Schlüsselworte: Bernstein, Metall, Identität, Bronzezeit, Kreuzungspunkte, Zentren, Vernetzung, Handel, Austausch

Abstract: Baltic amber is often considered the principal Scandinavian commodity exchanged for metal from ore-rich regions in Europe. If correct, this may explain the astonishing metal wealth of the Nordic Bronze Age and the modest social consumption of amber locally. The hypothesis of a metal-for-amber principle behind the trade is here for the first time assessed on scales from micro to macro. Amber finds were charted across Europe, and the result was then compared to evidence for regular shifts in copper ore preferences/availability, as found in the systematically changing isotopic/elemental composition of Nordic metal objects in c. 2100–1200 BC. Comparisons indicate that amber and metal followed similar spatiotemporal trajectories with major reorganizations at the turn from the Early to the Middle Bronze Age. Shifts in amber distribution correlate with the geography of metal sources used in both periods and flows of metal to Scandinavia and amber to Europe appear to be contingent even in subperiods. Major European amber tracks – and the crossroads hubs controlling them – were identified for the transfer of goods, yet again revealing major changes at the transition to the Middle

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Bronze Age. The social roles and meanings of amber among Nordic communities were likewise examined, suggesting that bearers of amber played a role in exercising social control of this resource. It is concluded that amber almost certainly was exchanged for metal.

Keywords: amber, metal, identity, Bronze Age, crossroads hubs, cosmology, social control, networking, trade, exchange

Résumé: L'ambre de la Baltique est suovent considéré comme la principale merchandise scandinave échangée contre du métal en provenance de régions riches en minerai en Europe. Si cela est correct, cela pourrait expliquer la richesse métallique étonnante de l'âge du bronze nordique et la consommation sociale modeste de l'ambre localement. L'hypothèse d'un principe d'échange de métal contre de l'ambre dans le commerce est ici évaluée pour la première fois à différentes échelles, allant du micro au macro. Les découvertes d'ambre ont été cartographiées à travers l'Europe, et les résultats ont ensuite été comparés aux preuves de changements réguliers dans les préférences/la disponibilité du minerai de cuivre, tels qu'ils apparaissent dans la composition isotopique/élémentaire systématiquement changeante des objets métalliques nordiques entre 2100 et 1200 av. J.-C. Les comparaisons indiquent que l'ambre et le métal ont suivi des trajectoires spatiotemporelles similaires, avec des réorganisations majeures au passage de l'âge du bronze ancien à l'âge du bronze moyen. Les changements dans la distribution de l'ambre sont corrélés avec la géographie des sources de métal utilisées au cours des deux périodes, et les flux de métal vers la Scandinavie et d'ambre vers l'Europe semblent être contingents même au sein de sous-périodes. Des axes majeurs de l'ambre européen – et les centres de croisement qui les contrôlaient – ont été identifiés pour le transfert de biens, révélant une fois de plus d'importants changements à la transition vers l'âge du bronze moyen. Les rôles sociaux et les significations de l'ambre au sein des communautés nordiques ont également été examinés, suggérant que les porteurs d'ambre ont joué un rôle dans l'exercice du contrôle social de cette ressource. Il est conclu que l'ambre a presque certainement été échangé contre du métal.

Mots-clés: ambre, métal, identité, Âge du Bronze, nœuds de croisement, cosmologie, commerce contrôle social, commerce, échange

Abstract: Bursztyn bałtycki jest często uważany za główny, skandynawski surowiec wymieniany za metal, pochodzący z innych, zasobnych w rudy regionów Europy. Jeśli ta teza jest prawdziwa, może ona wyjaśniać zdumiewające bogactwo społeczność nordyjskiej epoki brązu w zabytki metalowe oraz skromne, lokalne użytkowanie przez nie bursztynu. W prezentowanym artykule hipoteza wymiany metalu za bursztyn została po raz pierwszy przeanalizowana w mikro i makro skali. Znaleziska bursztynu w Europie skartografowano, a następnie porównano z przykładami różnych preferencji/dostępności rud miedzi, na co wskazuje zmieniający się skład izotopowy/pierwiastkowy nordyckich przedmiotów metalowych z okresu ok. 2100–1200 p.n.e. Analizy porównawcze sugerują, że dyspersję bursztynu i metalu charakteryzują podobne trajektorie czasoprzestrzenne, z istotnymi modyfikacjami widocznymi na przełomie wczesnej i środkowej epoki brązu. Zmiany w dystrybucji bursztynu korelują z obszarami występowania złóż metali użytkowanych w obu tych okresach, a napływ metalu do Skandynawii oraz bursztynu do Europy wydaje się być powiązany nawet w podokresach epoki brązu. Ponadto zidentyfikowano główne, europejskie szlaki bursztynowe i kontrolujące je centra komunikacyjne odpowiedzialne za przepływ towarów; ich reorganizacja ponownie wskazała na istotne zmiany zachodzące na przełomie wczesnej i środkowej epoki brązu. Przeanalizowano także wartość i znaczenie bursztynu dla społeczności nordyckich, wykazując, że jego posiadacze odegrali ważną rolę w sprawowaniu społecznej kontroli nad tym surowcem. Konkludując, bursztyn prawie na pewno był towarem przeciwstawnym do metalu.

Słowa klucze: bursztyn, metal, tożsamość, epoka brązu, centra komunikacyjne, kosmologia, kontrola społeczna, networking, handel, wymiana.

Introduction – the metal-for-amber challenge and mode of inquiry

Baltic amber is often interpreted as the principal Scandinavian commodity traded for metals from ore-bearing regions in Europe during the Early Nordic Bronze Age (ENBA, c. 1600–1200 BC). Similarly, amber has been theorised as a comparative advantage in acquiring metal from abroad[1]. Export of amber would accordingly explain the puzzling metal wealth of the Nordic Bronze Age and even the modest social consumption of amber locally, often thought to be contingent on the new focus on metal-made prestige objects.

This often-claimed status of amber as a counter-commodity for metal has however never been verified by examining the archaeological data in the framework of an appropriate methodology. A suite of methods, together able to embrace the scalar existence of amber from the local

1 Earle *et al.* 2015.

to the supra-regional in Europe, makes it possible to start testing the hypothesis of a tight amber-metal relationship. As part of this examination, it is especially important to bring the social context and geo-spatial dispersal of amber in the supposed homeland to bear on the long-distance distribution, often referred to as amber roads. Coincidentally, recent research has unveiled systematic shifts over time in the Nordic use of European metal sources. When the ore sources changed, so did the societal order and cultural affiliations[2]. This advance provides a possibility to examine whether amber and metal flows correlate in their spatio-temporal trajectories. Overall, the metal for amber question needs to be examined and discussed in the local Nordic (Danish) environment as well as in the overriding European setting complying with a chronologically synchronised format.

The so-called 'metal-for-amber' concept was coined in the late 19th century, although it has subsequently seen little rigorous testing. Thus, this is the crux of the following inquiry, which is the first to meticulously connect Nordic amber finds to amber finds in the rest of Europe and to couple amber spatial distributions to recent trace and isotopic analyses of early Scandinavian metal objects and evidence of the provenance of their metal. The spatial spread of amber at home as well as abroad during the earlier stages of bronzization[3] is largely unknown territory. Likewise, at a local scale, there is little clarity as to how Nordic Bronze Age people perceived amber as resource and matter, with implications for the supposed metal-amber nexus. A major issue is how the chronology works out in conjunction with the intersecting geographical scales from the micro to the macro? At the outset, we approach this question by separating Early Bronze Age (EBA) from Middle Bronze Age (MBA) amber finds despite deviating chronological terminologies locally (Tab. 1). With focus on ENBA burials 1600–1200 BC and prototypes thereof, the changing role of amber in the Late Nordic Bronze Age (LNBA) is only briefly considered together with the probable links between amber and the Nordic sun-centred cosmology[4]. After 1200 BC, amber acquisition, production, and transaction changed profoundly as did the societies in charge of these activities.

Baltic amber (*succinite*) occurs naturally along the Danish and Baltic Sea coastlines[5] (Fig. 1A). In terms of chemical composition, all Baltic amber is the same while it differs from other amber sources in Europe[6]. Although systematic analysis by infrared spectroscopy does not exist, there is sufficient evidence that Baltic amber was dominant in Europe in the period under examination here[7]. There were particularly rich concentrations of amber in NW Jutland, due to rich local deposits there[8]. The prevalence of amber in these coastal zones, ties to a long history of amber consumption in Scandinavia extending back into the Neolithic, even the Mesolithic and the Palaeolithic, while continuing into the Bronze Age and beyond[9]. Furthermore, it should be made clear that Baltic amber can be picked along most North Sea and Baltic Sea coastal strips however with major deposits in NW Jutland and the coast of NW Kaliningrad (Sambia). For the EBA-MBA period, the likely key source was NW Jutland, as will be explained below. However, the eastern-most amber track unveiled below for the MBA could very well link up with so-called Sambian amber and, potentially, more eastern tracks which are not charted in this article[10]. More generally, it must be considered that amber is an organic fossil. It is fragile and easily exposed to weathering processes. Therefore, the number of amber items in archaeological contexts is overall underrepresented, however likely equally so throughout the case study areas and periods.

This article's mode of inquiry is fivefold. Firstly, amber finds and amber meanings are outlined for the Danish Neolithic. This provides a historical background for the focal period 2100–1200 BC when bronze first came to define the political economy of European societies. Secondly, we investigate the social significance of amber in the Early Nordic Bronze Age (ENBA) within present-day Denmark as a focal area by examining the relatively few individuals buried with amber in the large cohort of >5000 mound-covered burials dating to 1600–1200 BC (ENBA IB–III). The centre of attention are those individuals interred with amber, and their potential links to a metal-for-amber trade and shifts therein. Thus, our study asks what social roles and meanings amber undertook in local communities of the ENBA, the bloom of which is epitomised in Jutland's waterlogged oak-coffins, the sun chariot from Trundholm on Zealand and the amber-eyed twin sun stallions in the Scanian bronze hoard of Tågaborg, the latter pointing to the cosmological significance of amber. Thirdly, the geographical dispersal of amber finds in SW Scandinavia is mapped with the aim of identifying possible focal points of amber concentrations and how these may have been linked to each other by land or sea. Fourthly, larger scale distribu-

2 Nørgaard/Pernicka/Vandkilde 2019; 2021.
3 Vandkilde 2016.
4 e. g. Jensen 1965; Kaul 2004; 2005.
5 Bech *et al.* 2018, 84; fig. 2.30.
6 e. g. Beck/Wilbur/Meret 1964.
7 e. g. Beck/Shennan 1991.
8 cf. Earle/Bech 2018; Earle *et al.* 2022.
9 Jensen 1982; 2000; Vang Petersen 1998; 2018.
10 see however Hilbert/Kneisel 2023, 40–46.

Table 1. State-of-the-art chronology, main developments, and Europe-scale synchronisations. Light blue colour highlights the early period of full metal use (LN II, ENBA IA), darker blue colour the ENBA (ENBA IB, II–III). The table indicates correlation between metal and amber in the S Scandinavian Neolithic into the Bronze Age: The relationship is detailed in the article[11]. On a European scale, green colour marks the two major periods of analysis with a major transition c. 1600 BC.

approx. ^{14}C RANGE *	MAJOR DIVISION	AEGEAN	EUROPE NORTH of ALPS	S. SCANDINAVIA	CULTURE & SOCIETY	METALS	SOCIAL AMBER
3800–2900 BC			Neolithic Farmers	Earlier Neolithic	FBC with copper objects/ metallurgy c. 3800-3500 BC	faint rise	frequent
2900-2350 BC			Corded Ware	Younger Neolithic	Corded Ware migrations & impact	bust	frequent
2350 - 2100 BC			Bell Beaker	Late Neolithic I (LN I)	West European Bell Beaker impact	faint rise	known
2100/2000-1700 BC	EBA	MH III	EBA (Br A1-2b)	Late Neolithic II (LN II)	First full metal-use with intense social competition. Impact from Classical Únětice and EBA Britain 'Wessex I'	clear rise	rare
1700-1600 BC		LH IA-B	Final EBA (Br A2c/A3)	ENBA IA	Metallurgy now comprising full tin-bronze. Towards 1600 BC: demise or crisis alongside Únětice collapse	continued rise	rare
1600–1500 BC	MBA	LH II	Early MBA (Br B1)	ENBA IB	NBA breakthrough: individualised hierarchy on rise: first big mounds. Refined metalwork. Impact from Carpathian Basin	flourishing	rare
1500-1300 BC		LH IIIA-B	Late MBA (Br B2/C)	ENBA II	NBA social consolidation and cultural *floruit*. Impact from S. German Tumulus Culture	flourishing	rare
1300-1200/1100 BC		LH IIIC	Final MBA/Early LBA (Br D-HA A)	ENBA III	Final ENBA: onset of cremation burials and impact from Urnfield groups	decline?	rare

tion maps are provided to verify how far the Baltic amber travelled once it left its assumed principal homeland in the EBA and the MBA respectively. The geographical coverage of amber is discussed in and off itself in a trans-European Bronze Age perspective. In doing this, the study seeks to pinpoint major European crossroads hubs for the transfer of goods in the EBA and MBA. Potential amber tracks with their start and end points are identified for the two main periods and major directional changes are detected and discussed. Finally, this amber-focussed result is brought to bear on a possible coupling to the commodified metal trade and potentially to detect an economic value of amber generated by overriding demands for metals and luxuries[12]. Analytic results and trends are discussed in eight sections operating on different scales to bring new insight to the metal-for-amber debate. A comprehensive dataset with amber from Danish ENBA burials in addition to wider European amber finds c. 2100–1200 BC scaffold our findings.

The paper takes a state-of-the-art social approach to the local use of amber in the ENBA. Supported by statistical and theoretical frameworks we uncover the relational identities[13] at play without losing sight of more economic amber uses. Overall, we examine how Scandinavian and European amber consumption coincides with developments in European-wide trends in the metal trade during the Early Bronze Age (EBA, c. 2100–1600 BC) and Middle Bronze Age (MBA, c. 1600–1200 BC), respectively. The transition between these two major periods, c. 1600 BC, emerges as a historical threshold with implications for the emergence of the Nordic Bronze Age as a rich cultural zone[14] while also marking the final Únětice societies' downfall[15]. The MBA highlights significant changes ending with the rise of the Urnfield complex transforming most of Europe from c. 1300–1200 BC onwards[16]. Nordic amber uses after 1200 BC in the Late Nordic Bronze Age (LNBA) were surely affected by the altered European condition simultaneously showing clear developments of indigenous Nordic trends already established in the ENBA.

State of the art – metal-for-amber in research

Previous studies of amber have generally not dedicated much attention to the NBA people behind the amber, the very individuals who interacted with and may have traded

11 table extends Nørgaard/Pernicka/Vandkilde 2021, table 1.
12 Vandkilde 2016; cf. Nørgaard/Pernicka/Vandkilde 2021.
13 Harrison-Buck/Hendon 2018.
14 Vandkilde 2014a; 2014b.
15 Meller/Bertemes 2010; Ernée 2013; Ernée/Müller/Rassmann 2012; Ernée /Longová *et al.* 2020; Nørgaard/Pernicka/Vandkilde 2021.
16 cf. Jensen 1965; Kristiansen 1998; Kristiansen/Suchowska-Ducke 2015; Bunnefeld 2016.

the translucent, golden substance: who were they? Whom did they connect to at home and abroad? At an early stage, Jensen[17] explored the materiality and extraordinary features of amber as a potential explanation for its restricted use at home, suggesting that it was perceived to have magical abilities in addition to its role as an exchange good. Kaul and Varberg[18] recently revisited these questions by studying select wealthy burials. This pointed to the existence of certain distinguished female figures. The authors further proposed a tight relationship between amber and glass beads in Scandinavian ENBA female burials while focusing especially on the prevalently blue glass beads and their provenance[19]. They envisioned an elite group of females whose power drew on the control of the amber trade to obtain the counter-commodity of glass and even gold. A cosmological meaning behind the combination of these materials, the triad of gold-amber-glass, was also put forward with reference to Egyptian mythology: amber or gold symbolising the sun, the glass the blue sky or the sea[20]. These interrelated studies had their emphasis on glass beads. Strikingly, isotopic analysis of the glass confirmed what scholars hitherto merely suspected, namely its Egyptian and Mesopotamian provenance. This contribution from the natural sciences substantiates a clear relationship between Nordic-Baltic amber and long-distance trade.

On this much larger canvas, research has long recognised that Baltic amber reached Central Europe and went as far as the Aegean, the Levant, and Egypt often in quantities apparently exceeding amber in cultural usage in the key origin areas. 'Metal-for-amber' was first coined by Jens-Jacob Asmussen Worsaae in 1882 as a concept meant to epitomise his observation of frequent finds of amber far from the ample supply at Scandinavian coasts during the Bronze Age[21]. The idea soon gained traction[22]. The early overview studies regarded amber as payment for metal and other imported objects and largely left local uses of amber out of the question in the Nordic Bronze Age[23].

Subsequent publications by Jensen[24] and Shennan[25] observed a distinct decline in local amber use in the Bronze Age in comparison to the Neolithic. They linked this turnaround to a change in amber's function from prestige symbol to exchange item for metals and especially Jensen amber's magical meanings[26]. This view was recently reiterated by Earle and colleagues concerning collection and curation of amber in Thy, NW Jutland[27] maintaining that the role of amber changed in the Bronze Age compared to the Neolithic period and linked this change to the magical properties of amber, and especially its importance in trade. They further emphasized that foreign contacts in Thy pointed directly towards the Friesian Islands, the Steinburg-Dithmarschen area and generally to the region around the Elbe estuary. This point of view broadly matches Shennan's and Jensen's argument that a parallel rise in Baltic amber finds in the elite hubs of Bronze Age Europe supports the notion of the metal-for-amber trade[28]. Quite timely in this regard, a very recent study by Earle, Bech and Villa[29] firmly couples the extraction of North Sea amber resources to the long-term social consumption of desirable objects in NW Jutland, which aligns very well with the outcome of the present study, which adds a scalar perspective evaluating the connection between metal and amber.

Recent contributions, moreover, trace the *extra*-Nordic desire for amber to the time when S Scandinavia first became fully metal-using c. 2100–1700 BC in Late Neolithic II (EBA). At this time, exchange was established through connections with copper-controlling Únětice hubs in the south and tin/copper-controlling Wessex hubs in the West[30] (Fig. 1A–C). Amber artefacts occur as multiples rather than as single pieces in richly furnished hoards and burials of the central and western European EBA centres. This corroborates an elevated social significance of amber outside the supposed Scandinavian homeland.

The amber road or roads of Bronze Age Europe have been subjected to extensive research. This notion has most recently been invigorated[31] by underlining amber's socio-economic significance in EBA Europe. While addressing circum-Adriatic and Italian amber connections, Cwaliński[32] and Bellintani[33]importantly pinpointed Apulia in SE Italy as primary MBA transfer point of amber to Mycenaean Greece whereas E Sicily comes in second. Both recognized a link between the pathways of amber and Italian-Alpine copper into the Po Valley and the adjacent Adriatic circuit. Both these results align with the findings reported in the present

17 Jensen 1982; 2000; 2002.
18 Kaul/Varberg 2017
19 Kaul 2022, 109–135.
20 Varberg/Gratuse/Kaul 2015; Varberg *et al.* 2016; Kaul/Varberg 2017; cf. Purowski/Kępa/Wagner 2018.
21 Worsaae 1882, 48.
22 Brøndsted 1939, 25–27; 44–45; 94; 122; Broholm 1944, 52.
23 Müller 1882; 1891; 1909; Brøndsted 1939; Broholm 1944.
24 Jensen 1982.
25 Shennan 1982.
26 Jensen 1982, 72–73.
27 Earle/Bech 2018; Earle *et al.* 2022; Bech *et al.* 2018, 83–85.
28 Jensen 1982, 64–67; 68–69; 74–75; 81–85; Shennan 1982.
29 Earle/Bech/Villa 2022.
30 Vandkilde 2017; 2019; Nørgaard/Pernicka/Vandkilde 2019; 2021.
31 e. g. Ernée/Longovà *et al.* 2020.
32 Cwaliński 2014, 192.
33 Bellintani 2014, 126.

paper. Earlier, Czebreszuk[34] envisioned a series of routes extended across a lengthy E-W Baltic zone of amber departure from the North along 4–6 partly converging routes all heading towards Mycenaean Greece. Harding[35] proposed a similar map with the main addition of a cross-Alpine route emanating from S Germany, and ultimately, from the amber source in Jutland. Indeed, several compilations and maps provide insight to amber use outside the Nordic region[36].

State of the art – moving beyond current knowledge

The present study takes inspiration from these previous amber studies, which however often use the vocabulary of 'amber road' as if of perpetual character. The common terminology of route or routes is useful to delineate the directionality of amber spread. We furthermore use the term 'track' (pathway, trail) to allow for tempo-spatial shifts, which will be discussed in the concluding part pinpointing travels by sea, land, and river. In addition, the term 'crossroads' is employed to indicate a networked traffic hub placed where tracks meet. We distinguish analytically between amber dispersal in the EBA and the MBA respectively, which means that we do not chart amber finds from the LBA post–1200 BC. This is a rare but not unique strategy[37].

The chronology presented in the present study is notably based on assemblages of objects in burials and hoards and not on amber-bead typology, which is not sufficiently certain as a chronological method. Considering the EBA/MBA transition c. 1600 BC a major threshold in most of Europe aligns with the state of current debates. The chronology presented in Tab. 1 supports Brunner *et al.*[38] for central Europe, hence placing the start of the MBA (Tumulus Br B1) c. 1600 BC. This agrees with the evidence in Scandinavia[39], but perhaps less so in the greater Carpathian Basin due to several competing local systems of relative chronology[40]. In summary, to advance the state of the art the following inquiry covers three focal areas.

Firstly, the early full appearance of S Scandinavian societies on the larger Bronze Age scene pushes forward the still unanswered question of amber's significance and its social roles in the North, at home in a manner of speaking; especially during the ENBA when large quantities of amber supposedly travelled southward and westward. Jensen's and Shennan's publications from 1982 are among the latest comprehensive studies of local uses of Nordic amber, thus prompting updated research. Amber's role within Scandinavia, a main area of its geological origin, is underexplored albeit the results of the two aforementioned authors and Varberg *et al.*[41], also accredited above, promise that there are more insights to gain. This potential pertains especially to the social consumption of amber. Hence in need of analysis are the intersecting social domains of identity, profession, gender, status, and belief of those Bronze Age individuals buried with amber in the amber-affluent Danish region.

Secondly, the metal-for-amber liaison possibly governing the trade needs up-to-date investigation. In this perspective, an apparent inclination for amber to associate with rich metal-controlling environments needs further consideration. Compared to previous studies, the perspective is expanded in the present study by coupling the micro and medium scales of Danish amber finds to the European setting. An enlarged dataset bridging Europe is exploited and the underlying amber data is made accessible. Besides, considering that amber apparently left the North in ample quantities, it is remarkable that maps of its dispersal remain inadequate, especially in terms of chronological periodisation and contextualisation (cf. Tab. 1). We will here couple shifts in amber dispersal to recent insights into shifting provenances of the metals in a Nordic perspective.

Thirdly, the state of the art demonstrates that the idea of amber roads has been persistent in the archaeological discourse throughout the history of archaeological research and several old and recent maps exist[42]. The present study is probably the most comprehensive so far. It comprises geo-referenced records of amber localities predominantly dating to the period 2100–1200 BC (Appendix 3). The present study furthermore differs from most other studies by specifically targeting the EBA/MBA transition as well as by scrutinising the amber-metal linkage, which began to transpire in recent research studies (Figs. 1A, 1C). Mapping the amber aims to identify major amber tracks and their potential correlation with copper moving counter wise from the mining areas known to be active at the same time.

34 Czebreszuk 2011, fig. 32.

35 Harding 2013, fig. 20.2.

36 see Harding/Hughes-Brock/Beck 1974; Beck/Shennan 1991; Palavestra 1993; Marková/Beck 1998; Marková *et al.* 2003; Stahl 2006; Czebreszuk 2007; Jaeger 2016; Woltermann 2016; Cwaliński 2014; 2020; Bunnefeld *et al.* 2023; Jaeger *et al.* 2023; Hilbert/Kneisel 2023.

37 Meller 2017.

38 Brunner *et al.* 2020, a corrective to Stockhammer *et al.* 2015, who suggested that the MBA (Reinecke B) started as early as 1700 BC.

39 cf. Vandkilde 2014a; 2014b.

40 cf. Jaeger *et al.* 2023, fig.1.

41 Varberg *et al.* 2016.

42 e. g. Stahl 2006; Cellarosi *et al.* 2016; Woltermann 2016; Meller 2017; Vandkilde 2020.

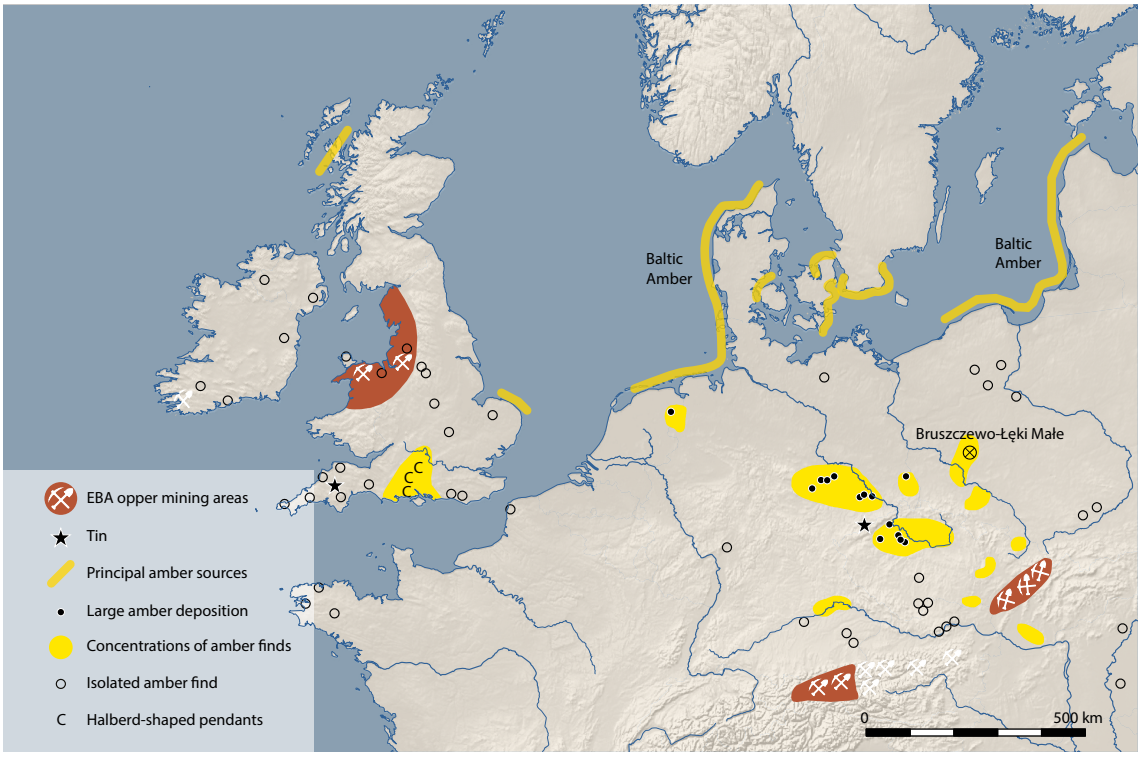

Fig. 1A: Overview of EBA resource situation regarding amber, copper, and tin c. 2000–1700 BC. Most Alpine and Irish copper sources were not in use at this time. The dispersal of amber outside Scandinavia indicates concentrations in the metal-rich crossroad hubs of Wessex, Únětician Middle Elbe-Saale, and Bruszczewo-Łęki Małe in Greater Poland. This research status 2017–2019 provides an important steppingstone for the present research article[43].

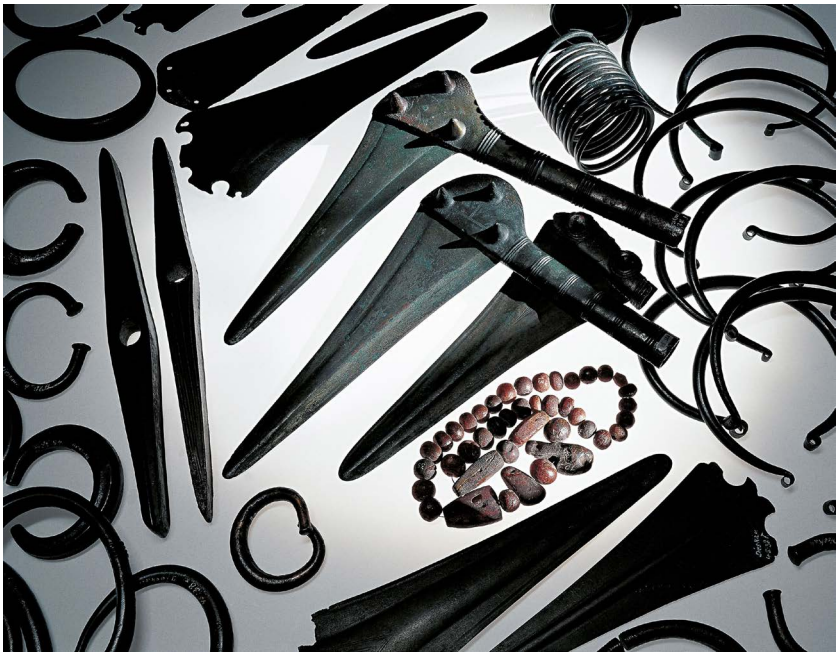

Fig. 1B: Metal objects and amber beads selected from the EBA Dieskau II hoard (Halle-Saale) containing in total 106 amber beads and numerous bronze objects, among them a British bronze flat axe. Dieskau and several other finds indicate tight interconnectedness between amber and metal investigated in this research article (photo Juraj Lipták, Courtesy of State Office for Heritage Management and Archaeology Saxony-Anhalt).

43 Vandkilde 2017, fig. 86; Nørgaard/Pernicka/Vandkilde 2019.

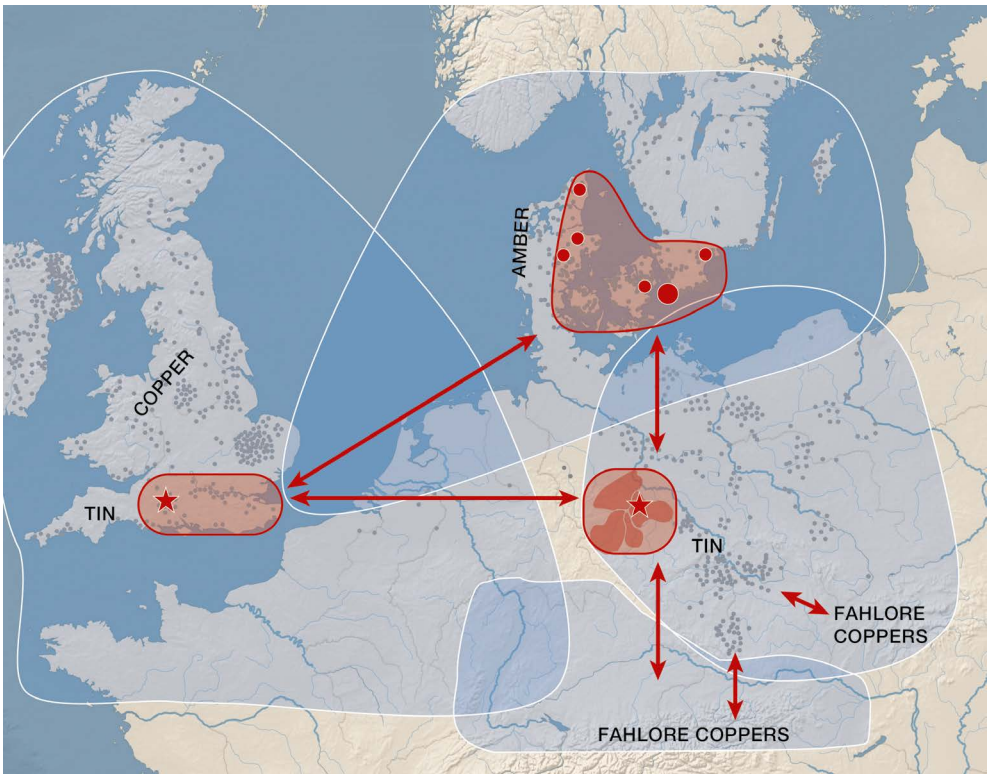

Fig. 1C: Model of networking in the EBA around 2000 BC. There are three main spheres of interaction in Northern Europe, each of them with specific resources and crossroad hubs. A fourth sphere existed in the Danubian Alpine region thriving on Ösenring copper mined in the Inn Valley of the E Alps and in high demand at the time (cf. Fig. 6B)[44].

Amber before the Nordic Bronze Age – a survey

The frequent Earlier Neolithic use of amber distinguishes itself from the relatively sporadic Mesolithic consumption of this substance in the Danish region. The amber bead was introduced and grew rapidly in importance in the Earlier Neolithic (Funnel-beaker Culture FBC 4000–2900 BC) (Tab. 1). Hoards are well attested containing unworked amber and beads in the hundreds and sometimes in the thousands. At Engholm in Thy (NW Jutland), an estimated number of 10 000 amber beads of various kinds had been deposited and remarkably, this is not the only one of its kind[45]. The amber hoards rarely combine with other objects/materials. However, in the hoard from Årupgård near Horsens in E Jutland[46], a Funnel-beaker jar contained a variety of amber beads accompanied by different-size spiral beads of copper; together probably forming a necklace. This combination of copper and amber can perhaps suggest a partnership or interchangeability between the two materials already during an interlude in the Earlier Neolithic when copper objects for a short while appeared on the Nordic scene due to contacts with the bourgeoning SE European Chalcolithic. In Funnel-beaker flat graves and megalithic tombs amber beads are rather common. Most often between 10 and 100 beads are recorded, which likely adorned the dress of the deceased as a social marker[47].

Throughout the Younger Neolithic, 2900–2350 BC, amber trinkets remained commonplace while metal objects were very rare. Amber hoards significantly decreased or ceased altogether around 2900 BC[48]. This abrupt depositional change coincides with the new manifestation of the Corded Ware Complex in Jutland; the so-called Single Grave Culture (SGC~ Corded Ware) instigating migration and societal transformation in the Scandinavian region, especially Jutland. This resulted in a nearly complete population turnover according to recent archaeo-genetical analysis[49].

44 updated version of Vandkilde 2017, fig. 103.
45 Ebbesen 1995a; Earle/Bech/Villa 2022.
46 Jensen 2001, 418; 431.
47 Becker 1947, 253; fig. 54; Ebbesen 1994; Jensen 2001, 416–430; 427.
48 Hübner 2005, 373–407.
49 Haak *et al.*, 2015; Allentoft *et al.* 2022; cf. Müller/Vandkilde 2021.

Amber beads were notably still prevalent in graves as they occur in c. 30 percent of all burials, mainly in central and W Jutland and primarily as dress ornaments or jewellery. Worked amber pieces and residues are recorded in SGC/CW settlements situated literally at the edge of the North Sea, notably at Mortens Sande 2 in Thy, continuing into the Bell Beaker period of LN I[50].

Most SGC/CW burials with amber have been interpreted as female (left hocker), which is significant since interred SGC females are significantly rarer than the males. Some of these female burials contained several amber beads for dress or body ornamentation, but most possessed merely a single amber bead[51]. Remarkably, some male burials (right hocker with battle-axes) include amber, notably in the form of disc-shaped pendants found in pairs presumably attached to the belt[52]. Special status of the deceased individuals has been argued for males buried with such pairs of amber discs but also for females often possessing merely a single symbolically charged amber bead. The principle of one bead or lump as symbolic representation included in burials recurs in the ENBA, as discussed below. The disc-shaped amber pendants attached in pairs to the belt of certain males could well be sun symbols: they recall the celebration of the sun in double format that came to prevail in the Bronze Age. The sun was often presented in twin or mirror format and amber is one of the materials that has been interpreted to symbolize the Sun[53].

Subsequently, in the centuries between 2300–1600 BC (Late Neolithic–ENBA IA), local Scandinavian consumption of amber took a significant downturn whereas metals saw gradual growth. Less than 40 sites[54] with amber finds have been recorded from the entire period, the amber retrieved mainly from megalithic chambers and some from gallery graves[55]. Several of these finds are questionable as they are retrieved from passage graves without context.

Significantly, however, amber beads had a brief and geographically restricted bloom at the very start of the Late Neolithic period in N Jutland, c. 2400–2300 BC. Amber is here recorded from c. 10 burials combined with pressure-flaked arrowheads and lancet-shaped flint daggers (type I); these are so-called archery graves linked to the Bell Beaker complex (BBC)[56]. Three amber pieces, two of them buttons with V-boring of Bell Beaker type, were retrieved from House D at the Bell Beaker settlement site of Myrhøj in N Jutland. At this site, lancet-shaped flint daggers and arrowheads were also produced. Notably, a fragmented bracer for archery was found in the same house as the amber[57]. Together, Myrhøj and the archery graves reveal the importance of amber within the Bell Beaker setting c. 2400–2300 BC in N Jutland, which furthermore initiated small-scale experiments with metallurgy[58]. To the simple repertoire of copper flat axes and gold sheet ornaments should be added the observation that the flint daggers, produced in the manifold thousands in the same region, emulate tanged copper daggers (of which one is known[59]). Some form of metal-for-amber relationship is evidently present in the Jutland BBC. Apart from metals and amber, the availability of high-quality flint was of fundamental importance to the Jutland BBC variety[60].

Objects of amber are undoubtedly underrepresented considering that old excavations of collective stone-built tombs may have overlooked small amber pieces. Still, compared to the frequent consumption of amber in the Earlier and Younger Neolithic periods amber clearly saw a bust in the Late Neolithic beginning around 2400/2350 BC and reached a low point c. 2100–1700 BC when metallurgy was permanently adopted. The first distinct increase in incoming metals from west and central Europe began c. 2100 BC[61] Indeed, at this time as a possible return transfer for metals, very large amounts of amber reached EBA hubs in S England (Wessex) and in central Europe (Únětice)[62]. In the same period in the Danish region infrequent amber correlates with frequent metal at this point of no return for the evolving Bronze Age. The long Late Neolithic falloff of amber may, as we shall see, forecast some form of controlled use of amber in the ENBA.

The Hørdum hoard, retrieved in NW Jutland near the amber deposits, dates to the earliest NBA c. 1600 BC. Its five amber models of massive Fårdrup-type shaft-hole axes in

50 Liversage 1987.

51 Hübner 2005, 372–373.

52 Hübner 2005, 272–373; Jensen 2001, 488; cf. Czebreszuk 2023.

53 cf. Kaul, 2004; 2005; cf. Maran 2012.

54 Ebbesen 1995b, 235 lists in total 38 amber finds typologically dated to the Late Neolithic period. Most are however stray finds from passage graves and nine are Bell Beaker archery graves dating to the earliest LN in NW Jutland 2400–2300 BC. A minority of beads derive from LN II–ENBA IA gallery graves, which were built in E Denmark simultaneously with the metallurgical breakthrough in the same region, 2100–1700 BC. This can indicate that amber items were rare grave goods in Danish gallery grave burials (see also Blank 2022, for a similar result regarding S Swedish gallery graves).

55 Jensen 1982, 96–97; Ebbesen 1995b, 269–271; cf. Blank 2022.

56 cf. Fabech 1986, 62–65; figs. 15–16; Ebbesen 2004, 95–110; Sarauw 2007.

57 Jensen 1973, figs. 16–17.

58 Vandkilde 1996; Nørgaard/Pernicka/Vandkilde 2021.

59 Kongens Thisted, N Jutland. Vandkilde 1996, 180; fig. 170 no. 86.

60 Müller/Vandkilde 2021.

61 cf. Vandkilde 2017; Nørgaard/Pernicka/Vandkilde 2021.

62 Ernée 2013; Meller 2017; Vandkilde 2017.

bronze may in a symbolic manner refer to an interchangeability of amber and bronze in place when the NBA began around 1600 BC[63]. These weapon axes are often ornamented, sometimes with sun symbols and related symbols of water and fish[64]. The miniature amber axes 'skeuomorphing' over-sized metal axes can furthermore hint at a symbolic-religious dimension, which may trace back to the Jutland SGC (Corded Ware) of the early third millennium BC.

The brief survey above suggests the following rhythm in the Danish region: when amber goes low, metal goes high and vice-versa (Tab. 1). Importantly, however, amber usage did not disappear at any point in the Nordic homeland[65]. The above observations are purely quantitative, but then again, amber itself hints at strong symbolic meanings likely interwoven with its practical handling. A distinct reduction in amber items commenced in the Final Late Neolithic period at around 2100 BC. After the transformative change around 1600 BC[66]. the level of amber remained low but stable; hypothetically reflecting the establishment of some form of control. Certainly, the changing quantitative relationship between metal and amber looks agent-based (rather than coincidental). On the backcloth of the extensive consumption of local amber during the Earlier and Younger Neolithic, later uses invite further scrutiny. The question of amber management and significance in ENBA society is especially imperative to answer due to the lavish social consumption of metal along with the building of estimated 25 000 burial mounds. This foregrounds the question of how all this wealth was financed.

Methodology – amber materials and analytical approach

The methodology relies on databases of amber artefacts, and in key cases their combination with other forms of material culture, in assemblages throughout Europe: from Scandinavia in the North to the Mediterranean in the South. The analytic approach strives to unveil, connect, and understand the scalar existence of amber from the micro-level of objects, people, places, and events to the macro-level of European-wide movements and transformations. In-between the micro and the macro, local societies resided. Some of them became crossroads hubs due to a favourable geographical position and possession of desirable resources whether nature-given or achieved through trade. The data-driven analytical take employs qualitative analysis in addition to quantitative statistical analyses, namely Network Analysis and NAT Analysis. Comparing amber dispersals at regional and supra-regional scales in the EBA and MBA is a key approach forming part of an effort to identify correlations between amber tracks and known preferences for specific coppers sourced to specific mining areas.

The identification of the so-called 'Baltic shoulder' in Infrared Spectroscopy studies of amber (IRS) was pioneered by Curt W. Beck in the 1960s constituting a critical opportunity to trace the provenance of amber in European prehistory[67]. Absolute credibility of the spatial spread of Baltic amber is reliant on spectroscopic tests of hundreds of amber items, and this work is still ongoing[68]. Recent criticism of the method reveals that it is not faultless[69], and it has been pointed out that minor local non-Baltic amber sources exist in Romania, Iberia, and Sicily[70]. The only Baltic amber source outside the North Sea-Baltic zone is some subterranean succinite, i. e. Baltic amber, in Ukraine[71]. This source seems difficult to access and likely was insignificant. Attempts to refine the IRS provenance method have hitherto been unsuccessful. Around a third of the amber in the database (Appendix 3) has been verified as Baltic amber, whereas the vast majority is presumed to be of Baltic origin. The mapping of amber in this study is comprehensive although not complete. There are notable 'blind spots' at the eastern fringe of Europe from Estonia in the north to E. Romania and Bulgaria in the south. We do not deem these shortcomings serious enough to undermine the credibility of the distribution maps as indicators of ancient major amber tracks.

With the aim of contextualizing the use and exchange of Nordic amber at home while mapping amber flows at a European scale, a dataset of c. 1100 locations of presumed-Baltic amber finds was recorded from across Europe, drawn from extensive prior studies (Appendix 3). Records datable to the EBA (I) and the MBA (II) were visualized in two sep-

63 Vandkilde 2014a, 70 fig. 10B; 2014b; Nørgaard/Pernicka/Vandkilde 2019; 2021.

64 Vandkilde 2014b.

65 e. g. Thrane 1984.

66 Vandkilde 2014b.

67 e. g. Beck/Wilbur/Meret 1964; Beck et al. 1965; Beck 1966; Beck/Southard/Adams1968; Beck/Fellows/Adams 1970; Beck/Southard/Adams 1972.

68 e. g. Peche-Quilichini *et al.* 2016.

69 Carlsen *et al.* 1997; Truica *et al.* 2012.

70 Romania: Teodor *et al.* 2010; Daróczi 2021; Iberia: Álvarez Fernández/Peñalver/Mollá/Delclòs Martínez 2005; Murillo-Barroso/Martinón-Torres 2012; Murillo-Barroso *et al.* 2018. Sicily: Angelini/Bellintani 2017; Murillo-Barroso/Martinón-Torres 2012; Cwaliński 2014; Murillo-Barroso *et al.* 2018.

71 Woltermann 2016, 8; fig. 2.

arate distribution maps of sites with amber finds[72]. To a limited extent, sites presumed to be MBA (0) were added to the map in a different colour. The publication source is indicated in the database, which comprises records listed or mentioned by various authors[73]. Many studies contributed[74]. This source material scaffolds the data analyses framed by the broad question of the cultural consumption of Baltic amber within Denmark and across Europe.

For Denmark alone the total record comprises 144 find locations with amber, mostly burials in addition to some hoards and settlements. For Sweden the number is 30 burial locations with amber (only included in the European spread maps). The active dataset of the present study of ENBA burials with amber consists of 118 Danish burials with amber[75]. Significantly, burials with amber have been evaluated on the total background of 5169 known burials from the ENBA the majority of which are recorded in another database[76]. Assessing amber bearing ENBA burials on the near-complete canvas of known burials from the period provides a strong data-led setup.

A total of 382 amber items from 118 ENBA burials in Denmark was selected for the article (Tab. 2 and Appendix 1). This dataset of amber in graves is considerably larger than the fifty amber pieces reported to be the complete corpus of ENBA amber in Jensen's 1982 monograph on Nordic amber[77]. Amber deposition in burials was however significantly rare compared to bronze items recorded in the thousands. Yet, considering the low preservation rates of amber as well as the difficulty of its identification[78], the known number of Danish burials with amber is estimated to be a minimum number when measured against the more robust and well-preserved metal items. When entries in catalogues concern unspecified amounts[79], we have consistently registered these as the minimum plural of '2'. Thus, our total number of amber objects is a conservative estimate. The same principle applies to other objects featured in the network analysis, meaning that the revealed groupings probably represent the minimal network that once existed. For the wider European sample amber type and amount have not been systematically recorded.

A combination of quantitative and qualitative methods is applied to selected data from the database hence allowing zooming in and out in recognition of the scalar format of the archaeological finds. The Danish data is approached quantitatively through statistics, namely network analysis and NAT (Number of Artefact Types) per burial. Next and based on the quantified results, qualitative analysis of burials selected for their particularly informative value is employed to shed further light on the Danish ENBA burials and the people who were laid to rest there. This is not mere 'cherry-picking', as such a contextualized qualitative method – a close reading of individual burials – captures intra-group variations while pinpointing divergences embedded in individual lives. These different approaches operate in conjunction to identify and chart the main tendencies of the use and role of amber rooted in a Bronze Age social reality.

Network Analysis

To illuminate the role of amber in relation to other object types and to evaluate its significance as a gender and identity marker, we performed a network analysis using the software Gephi on the 118 Danish burials with amber and with focus on artefacts relating to personal appearance and daily life more generally (Appendices 1–2)[80]. The principles underlying network analysis are based on degree centrality[81]. The investigation of centrality is a crucial aspect of network science as it evaluates which nodes are well-connected in the network and thus stand out as central. The degree centrality represents the number of links (ties/edges) connected to a node. In this manner, patterns and trends in the data are presented in visual form through the network chart exhibiting stronger (thicker) and weaker (thinner) ties between the elements of the analysed material. Specifically, a network based on the degree centrality was applied (cf. Fig. 2) to investigate the rate of recurrence, and thus the

72 The database further includes 11 Bell Beaker sites (BB, not representative for this period).

73 Roudil/Soulier 1976; Dąbrowski 1985; Butler 1990; Beck/Shennan 1991; Stahl 2006; du Gardin 1986; 1996; Czebreszuk 2011; Woltermann 2014; 2016, and Cwaliński 2014; 2020, and many more contributed profoundly to the list of European amber.

74 We welcome the publication by Jaeger *et al.* 2023. This new study emphasizes how especially EBA amber finds concentrate in Slovakia's Nitra and Hron regions with the cemeteries of Jelšovce and Nižná-Myšlá amongst others. This complete record from Slovakia was published too late to consider for our database entries. The amber maps are however in agreement.

75 Their grave good assemblages are recorded within Aner and Kersten's comprehensive catalogues Aner/Kersten 1973–2022ff – Die Funde – published from 1973 onwards (cf. Appendix 1). The latest three volumes covering the regions of Randers, Aalborg and Hjørring are currently unpublished, but we were permitted to include ten burials with amber from these three regions.

76 For availability see Felding 2020; Felding/Stott 2023.

77 Jensen 1982, 75.

78 du Gardin 1996; Earle *et al.* 2022.

79 for example, when stating that 'some' amber beads were found.

80 Bastian/Heymann/Jacomy 2009; Jacomy *et al.* 2014.

81 Freeman 1978.

significance (weight in the network) of object types found in the burials (Appendix 2). This network pattern results from a force-directed algorithm, ForceAtlas2, which builds upon the principle of a linear attraction. This is the linear repulsion model where linked nodes are attracted, and unconnected nodes pushed apart[82]. The placement of the nodes in the network cannot be read in isolation but only in relation to other nodes.

NAT Analysis

To objectively explore the status of each interred individual, a NAT analysis was performed by counting the number of different artefacts per burial. We modified this method to separate items that fall under the same object type but are made of other materials. This avoids assuming equivalency merely because the objects may have been used similarly[83]. As the original NAT method seeks to establish wealth variation as reflected in the diversity of grave goods, our revised NAT analysis is even more sensitive to fluctuations in burial wealth/assemblage. NAT analysis seeks to minimize Western pre-understandings of the value of specific object types or raw materials[84]. Furthermore, the modified approach facilitates comparison of artefacts depositions in different burial practices. This increases feasibility when comparing the preserved material remains in inhumations and cremations, which co-exist especially in ENBA III. Methods that merely count the total number of grave goods for determining social inequalities contained by mortuary assemblages can be problematic with cremations where it may be impossible to determine whether fragmented remains represent one or more objects[85].

Artefact distribution maps

Drawing on the database (Appendices 1, 3) the maps serve to visualize amber distribution in the Danish study area and moreover to identify major flows of amber in the broader European setting potentially emanating from Nordic amber sources. The degree of connectedness of the two areas is, thus, represented on the maps. For the European 'amber market', the study seeks to clarify developments over time, from the EBA (LN II–ENBA IA) to the MBA (ENBA IB–III), as this has implications for our understanding of the relationship between amber and metals. On a selective basis, connectedness is further examined through the degree to which geographically disparate burial contexts are interconnected, notably in their content of amber, glass, and gold or in the type of burial equipment, for example certain female dress components and certain male weaponry. This quantitative/qualitative method overall serves to clarify geographical variation in the patterns of deposited amber objects. Amber finds are from predominantly burials, to a lesser degree hoards, while settlements are few. For the Danish region, however, this situation has recently changed with new discoveries in the landscape of Thy close to the amber deposits, with extensive quantities of amber stored in the coastal longhouses at Bjerre[86]. This recent discovery accentuates the principal, likely Europe-wide, importance of amber sourced from the deposits in NW Jutland.

Metal provenancing

Preferences for and the availability of copper (bronze) with specific qualities varied markedly as this was contingent on the rise and decline of major resources of copper in central and west insular Europe at this time. Each of these copper sources has recognizable isotopic and trace-elemental signatures, which means that the original copper provenance can often be identified in metalwork. To evaluate potential spatial alignments between amber flows and the use of copper from particular sources in Europe, the study draws on state-of-the-art knowledge of systematic changes in geochemical signatures in relevant metalwork datable to periods and subperiods 2100–1200 BC[87]. This comparative approach is underscored by the recent publications of >600 geochemical analyses (trace-element *and* Pb isotope), provenancing the copper reaching Denmark in the EBA (LN II–ENBA IA) and the MBA (ENBA IB–III). Other recent isotope-led studies in Europe are likewise included[88]. Synchronisations between major regional chronologies are presented in Tab. 1.

Gender statistics and theory

In the descriptive statistics, we work with categories of gender rather than biological sex since a tiny proportion of the thousands of extant burials have preserved skele-

82 Jacomy *et al.* 2014.
83 Hedeager 1978; 1990; 1992.
84 cf. Brück/Jones 2018.
85 cf. Hedeager 1992, 104; Gryzińska-Sawicka 2015, 182.
86 Bech/Eriksen/Kristiansen 2018.
87 Nørgaard/Pernicka/Vandkilde 2019; 2021; 2022.
88 e. g. Pernicka 2010; Pernicka/Lutz/Stöllner 2016; Pernicka *et al.* 2016; Brügmann *et al.* 2018; Berger *et al.* 2022; Bunnefeld 2016; Ling *et al.* 2019.

tons. In the Nordic Bronze Age, the material culture of the interred persons can often be categorised as either 'male' or 'female'[89]. The identification of gendered grave goods in our analysis is based on prior studies that have observed distinct differences between male and female grave goods assemblages. Thus, belt plates, neck rings/collars and bronze tubes are associated with females, whereas swords, axes, socketed axes, belt hooks, razors and tweezers and strike-a-lights are connected to males. Daggers, awls, arm- and finger rings, pins, fibulae, and double buttons in bronze are regarded as gender-neutral[90]. This binary separation of the gender and its relationship with select artefacts is further supported by relatively few instances where skeletal remains are suitably preserved to interpret the biological sex[91].

The stark gender differences in grave good assemblages are most apparent in the upper echelons in ENBA society[92]. As the graves with amber likely belong to high-status individuals, we deem it is viable to use particular object types and their combination as a priori gender markers in this study. Even so, there are several burials whose gender for various reasons cannot be defined and therefore classify as 'undetermined'. Similarly, five juvenile burials with amber contain no typically gendered assemblages and are simply termed 'child' in our analyses. On the other hand, one juvenile skeleton with a neckring, a classic female-oriented object[93], is regarded in our study as a woman. All in all, we consider the internal arrangement of each burial to be a ritualised assemblage relating to the lived life of the deceased individual[94].

The focus of the article is to unravel the relationship between amber and metal in the EBA and the MBA. Bringing new insight to the underlying forms of transaction is not a primary objective. It is presumed however that transactions of desirable materials took place in institutionalised fora and agreed zones. These may well have been situated in the crossroads hubs defined above as networked traffic hubs placed where tracks meet. Long-distance transport was probably institutionalised notably in terms of protecting goods and travellers[95]. Transactions are furthermore assumed to have comprised economically constituted trade of commodities as well as ceremonial socially constituted gift-exchange; to the perceived advantage of the involved parties. These two modes of transaction may not have been fully separated; rather a wide spectrum of betwixt and between existed. Metal and amber no doubt moved long-distance in copious amounts. It is therefore firmly assumed that long range transfer and the coupled transactions must have been commodified and thus economic in the starting point. In their lifetime objects of metal or amber could have changed status as alienable and inalienable several times[96].

Quantitative analysis of amber in ENBA burials

On the backcloth of the recorded 5169 graves from the ENBA the 132 burials with amber (118 analyzed) showcase that a small minority (2.3 %) was buried with amber in the Danish region. The use of amber as raw material was furthermore relatively narrow: the 382 individual amber artefacts include: beads (66 %), unworked amber (20 %), buttons (11 %) and inlays (6 %). Bead size and shape vary: they are mostly spherical, although barrel-shaped or flat rectangular beads have also been recorded. Amber buttons are much rarer and amber inlays are only occasionally inserted into sword hilts, sword pommels and double buttons of bronze, nonetheless contributing to the analysis of the metal-amber interrelationship (Tab. 2).

The first overview could suggest that the deposition of amber in graves, typically in proximity to or on the body, was tied to aspects of the interred person's identity. Individuals with amber turned out to comprise both female and male burials as well as people of unknown gender and even five children. Especially, a relationship emerged between gender and the type of amber artefact accompanying the deceased. Amber beads appeared to be largely gender-neutral; however, unworked amber, buttons and inlays displayed a marked tendency to male-oriented objects. Significantly, none of the female graves include unworked amber. This may indicate that the child's burial from Egshvile in Thy NW Jutland[97] belonged to a boy[98], as it contained 20 amber lumps, two of them perforated. The child had been buried next to a female furnished with rich grave goods, which, apart from the more standardised female gear, included an amber bead and six glass beads[99] (Figs. 3B–C).

89 Sørensen 1997; 2013; Felding 2020.
90 Bergerbrant 2007.
91 Asingh/Rasmussen 1984; 1989; Sørensen 1997; Felding *et al.* 2020; Felding 2020.
92 Felding 2020.
93 Nørgaard 2011.
94 Parker Pearson 1999.
95 Kristiansen 2023.
96 Appadurai 1988.
97 Aner/Kersten 2001, no 5115A, 5115B, Egshvile, Thy, NW Jutland.
98 cf. Haack Olsen 1992, 135.
99 Haack Olsen 1992.

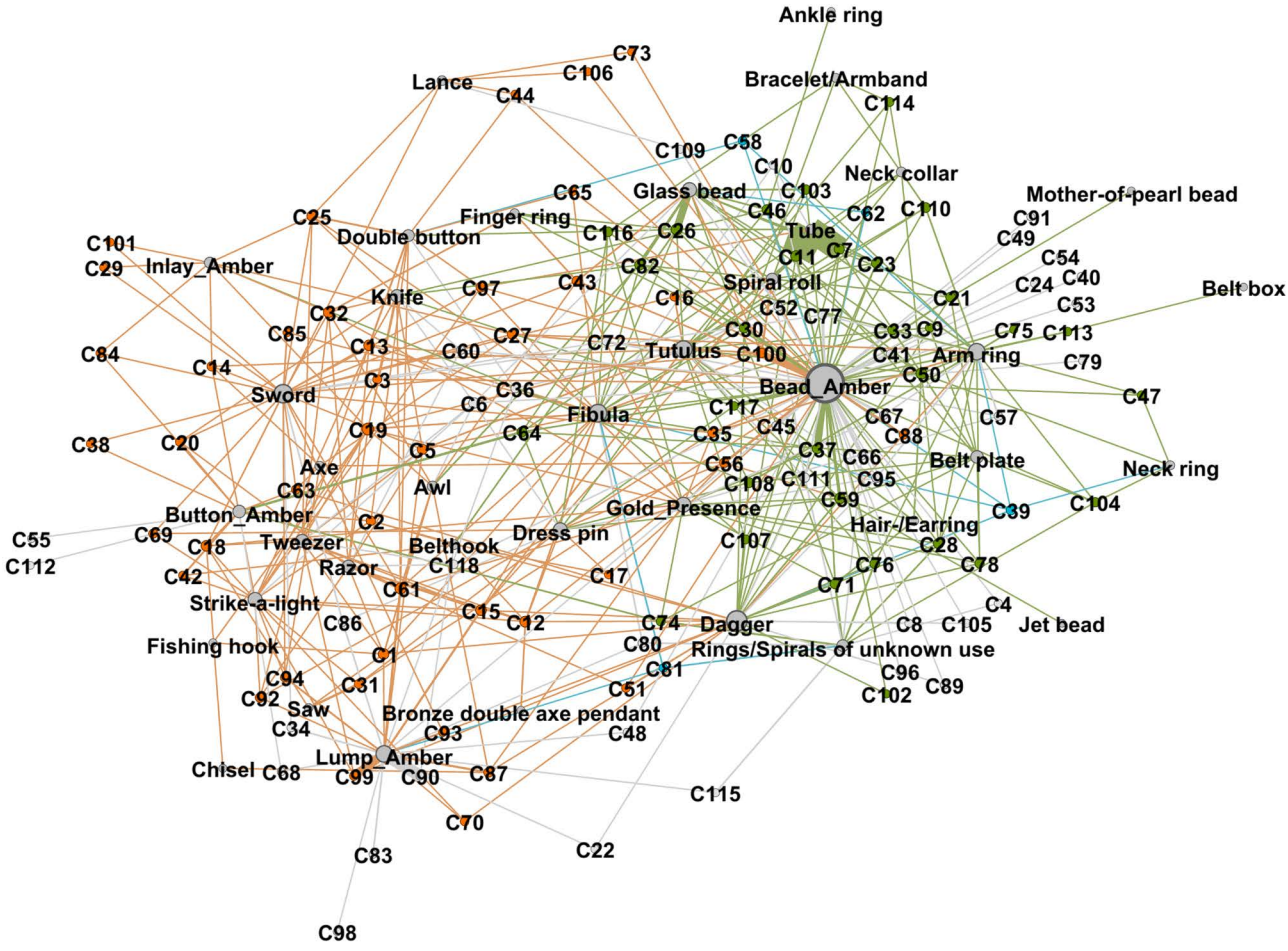

Fig. 2: Burials with amber visualised through an undirected two-mode network. Source nodes: burials. Target nodes: artefacts. Node size: by degree. Edge colour: by gender (orange=male graves; green= female graves; blue=child; grey=unknown). Data: 118 burials (Appendix 2). Software: Gephi. Layout: Force Atlas2.

Network Analysis (Fig. 2) was able to elaborate on these initial observations. The amber bead emerges as the dominant node of the network of amber burials, with unworked lump of amber coming in second as another node. The female and male-oriented artefacts appear separate from one another in the network, largely due to gender as the major grouping principle in ENBA burials and the underlying normative binary gender structure. Placed between the two gendered spheres are the gender-neutral artefacts such as dagger, fibula, tutulus, finger ring, and gold items/inlays. There is a tendency for these artefacts to associate with amber beads. However, amber beads are predominantly (but not exclusively) related to female burials, and raw lumps of amber relate to male burials and are not recorded in female burials.

The anchoring of the amber bead in the female sphere of the network graph is conditioned by its relationships with other artefacts made of metal or other materials. In the female burials, amber beads notably occur with other artefact types, predominantly jewellery, jointly mediating bodily arrangements that draw on the female standard expressions of dress. The glass bead is primarily placed in the female zone. Notably, amber lumps show different associations in the network, and are connected to weapons, tools, and toiletries as well as dress accessories such as belt-hook. Amber lumps furthermore link with another node namely the sword, which is seen to also connect to amber buttons and amber inlays. The warrior identity transpires in this setup of male objects, including the amber items[100]. The two gendered expressions follow normative standards adhering to a distinct Early Nordic Bronze Age appearance[101]. The number of different artefacts and artefact categories present in the network graph furthermore brings to light another common trend of the mound-interred ENBA-popu-

100 cf. Felding *et al.* 2020.
101 Sørensen 2013; Felding/Stott 2023, fig. 6.

Tab. 2: Data overview including the quantitative NAT analysis (data extracted from Appendix 1).

All analysed burials with amber Σ 118 (100 %)

Burial category		All amber burials		Amber object (% of burial type)*				Number of amber objects per burial (% of burial category)												
		Total	Percentage	Bead Σ 214	Unworked lump Σ 138	Button Σ 23	Inlay Σ 7	1	2	3	4	5	6	7	8	13	18	22	25	31	47
All burials with amber		118	100 %	66	20	11	7	57	18	8	3	4	3	2	1	2	1	1	1	1	1
Gender/Age																					
	Female	31	26 %	94	–	6	3	45	26	6	–	6	3	3	3	3	–	–	3	–	–
	Male	44	37 %	41	25	18	16	64	11	9	5	7	–	–	–	–	2	–	–	2	–
	Undetermined	38	33 %	68	32	8	–	58	18	8	3	–	5	3	–	3	–	–	–	–	3
	Child	5	3 %	80	20	–	–	60	20	–	–	–	–	–	–	–	–	20	–	–	–
NAT intervals																					
	1–3 NAT	47	40 %	66	18	10	6	68	15	6	2	–	2	–	–	2	–	2	–	–	2
	4–6 NAT	46	39 %	67	18	10	4	45	21	9	2	9	2	4	–	2	2	–	2	2	–
	7–9 NAT	17	14 %	50	19	19	13	59	12	12	6	–	6	–	6	–	–	–	–	–	–
	10–12 NAT	6	5 %	80	20	–	–	50	17	–	17	–	–	–	17	–	–	–	–	–	–
	13–15 NAT	2	2 %	–	50	–	50	50	–	–	–	50	–	–	–	–	–	–	–	–	–
NAT intervals by gender/age																					
1–3 NAT	Female	4	13 %	100	–	–	–	25	75	–	–	–	–	–	–	–	–	–	–	–	–
	Male	10	23 %	50	–	20	30	90	–	10	–	–	–	–	–	–	–	–	–	–	–
	Undetermined	30	79 %	70	27	10	–	70	10	7	3	–	3	–	–	3	–	–	–	–	3
	Child	3	60 %	100	50	–	–	33	33	–	–	–	–	–	–	–	–	33	–	–	’
4–6 NAT	Female	19	61 %	95	–	11	–	53	11	11	–	11	–	5	–	5	–	–	5	–	–
	Male	19	43 %	47	26	16	11	42	21	11	5	11	–	–	–	–	5	–	–	5	–
	Undetermined	7	18 %	57	57	–	–	14	57	–	–	–	14	14	–	–	–	–	–	–	–
	Child	2	40 %	100	–	–	–	100	–	–	–	–	–	–	–	–	–	–	–	–	–
7–9 NAT	Female	5	16 %	80	–	–	20	20	60	–	–	–	20	–	–	–	–	–	–	–	–
	Male	10	23 %	30	30	30	10	90	–	10	–	–	–	–	–	–	–	–	–	–	–
	Undetermined	1	3 %	100	–	–	–	–	–	100	–	–	–	–	–	–	–	–	–	–	–
	Child	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
10–12 NAT	Female	3	10 %	100	–	–	–	67	–	–	–	–	–	–	33	–	–	–	–	–	–
	Male	3	7 %	33	67	–	–	33	33	–	33	–	–	–	–	–	–	–	–	–	–
	Undetermined	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Child	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
13–15 NAT	Female	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Male	2	5 %	–	50	–	50	50	–	–	–	50	–	–	–	–	–	–	–	–	–
	Undetermined	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	Child	0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

* These percentages sometimes equal more than a 100 %, as some graves carry more than one type of amber item.

lus: that of freedom of personal expression with the range in the personal accessories and other items varying greatly from individual to individual[102].

Amber burials, overall, appear to adhere to the norms of the much broader population of mound burials in the ENBA. What binds these individuals together in this graph, different from the rest of the interred NBA mound population, is the presence of amber. Moreover, the network diagram may indicate that females and males wearing or carrying amber were engaged in social activities in the ENBA in a manner signified by amber beads and amber lumps respectively. The described bipartite pattern is present on local as well as regional scales in the Danish region. These gendered differences will be scrutinised in the following sections, namely that the social identities and actions of these females and males were tied to amber as a further way of performing in accordance with gendered norms.

The allocation of amber in the burials does indicate gender differentiated use in rough alignment with the gen-

102 Asingh/Rasmussen 1989; Holst *et al.* 2013, 97.

Tab. 3: Burial gender' in burials with amber (left) compared to the near-complete sample of ENBA burials from Denmark (right)[103]. *children, male/female, and uncategorised. While female gender is represented in merely 11 % of all ENBA burial, the 27 % of female amber burials is remarkable.

ENBA BURIAL GENDER	Amber burials DK	Almost complete burial sample DK
Female	27%	11%
Male	37%	52%
Not gendered*	36%	37%
Total	100% (Σ 118)	100% (Σ 5169)

* children, male/female, and uncategorised

dered normative binary expression observed in costumes from the period[104], as the inclusion of amber lumps was exclusively associated with male burials whereas beads can be found in both female and male burials. Furthermore, the network analysis visualizes the presence of gender-neutral prestige artefacts in the middle of the network (although closer to the females) and, lastly, presence of outliers is noted.

Notably, the relationship between gender and amber is corroborated in the higher propensity for female graves to contain amber. On the background of the poor representation of female graves (11 %) in the total record of ENBA burials (Tab. 3), a proportionally higher number of female graves contains amber. By calculation, 5.5 % of all female graves contain amber compared to 1.6 % of all male graves, meaning that *females are 3.45 times more likely to be buried with amber than males*. This is in accordance with regionalized case studies of female graves from Zealand[105].

To identify and define the amber group in quantitative terms, we conducted *NAT Analysis* on the data, working from the hypothesis that material wealth was a structuring factor. Results are reported in Tab. 2. As is evident, the NAT Analysis showed no clear pattern, which indicates that something other than the sheer number of artefact types regulated the inclusion of amber in graves. The number of amber objects included in a burial emerges as insignificant in this regard, since amber burials overwhelmingly contain only very few amber objects. Indeed, 57 % of the 118 graves included only one amber item, 18 % contained two, and graves that include more than three amber items are exceedingly rare. This reveals an important aspect of symbolic representation of the presence of amber, and the result has overriding significance for comprehending the role of these amber-bearing individuals and the rules and norms of amber deposition in ENBA burials.

Summing up the quantitative analysis and result

The Network Analysis demonstrates that individuals buried with amber (1) vary considerably in their personal appearance, i. e., in the artefacts related to dress and activities, (2) partially adhere to a gender binary, in particular for amber lumps to be exclusively found with males and beads to be primarily associated with female burials, (3) accord with the rest of the mound-interred ENBA population, and (4) connect to each other mainly through the presence of amber. In lieu of a statistically minor group of amber-bearing individuals contained within the full corpus of elite mound burials (cf. Tab. 3), the graves with amber were examined more closely in the NAT Analysis revealing that the *selection* of specific amber artefacts was a key rather than the *number* of artefacts.

Exclusiveness in terms of amber in graves aligns only approximately with the number of gold artefacts and glass beads, but a relationship between amber, glass and/or gold is visible. Amber and gold artefact pairings are quite prominent in male burials, likely suggesting a link between special social status and amber, although the connection is not explicit enough to show up in the quantitative analysis. However, among the females, a relationship between amber, glass and/or gold emerges. This material combination manifests in ENBA II and ENBA III and is unparalleled among the male burials, where glass is altogether very uncommon. The triad (trifecta) of artefacts points to a particular and temporally constrained segment of females materializing within the group of amber-bearing individuals. These broader trends in the data are examined below.

103 cf. Felding/Stott 2023, Tab. 1.
104 Sørensen 1997; Felding *et al.* 2020; Felding 2020.
105 Varberg/Kaul 2017.

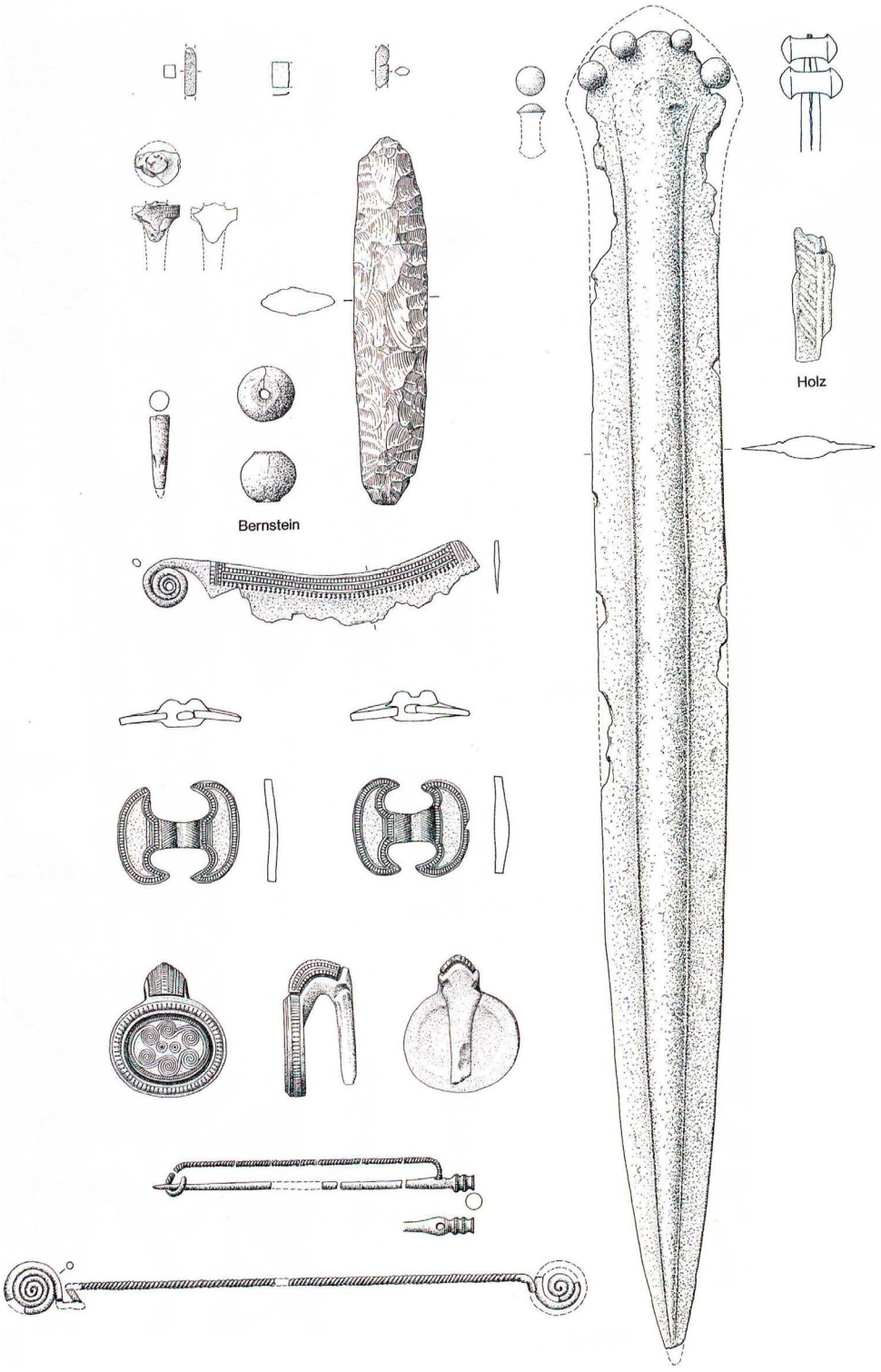

Fig. 3A: Kirke Værløse, N Zealand. Male warrior burial with a single amber bead amongst an outstanding burial equipment of Nordic as well as foreign origin. The dress pin is of likely Tumulus derivation while the double-axe pendants point towards the Aegean. Glass beads are absent as customary in male burials[106].

106 after Aner/Kersten 1973, 364.

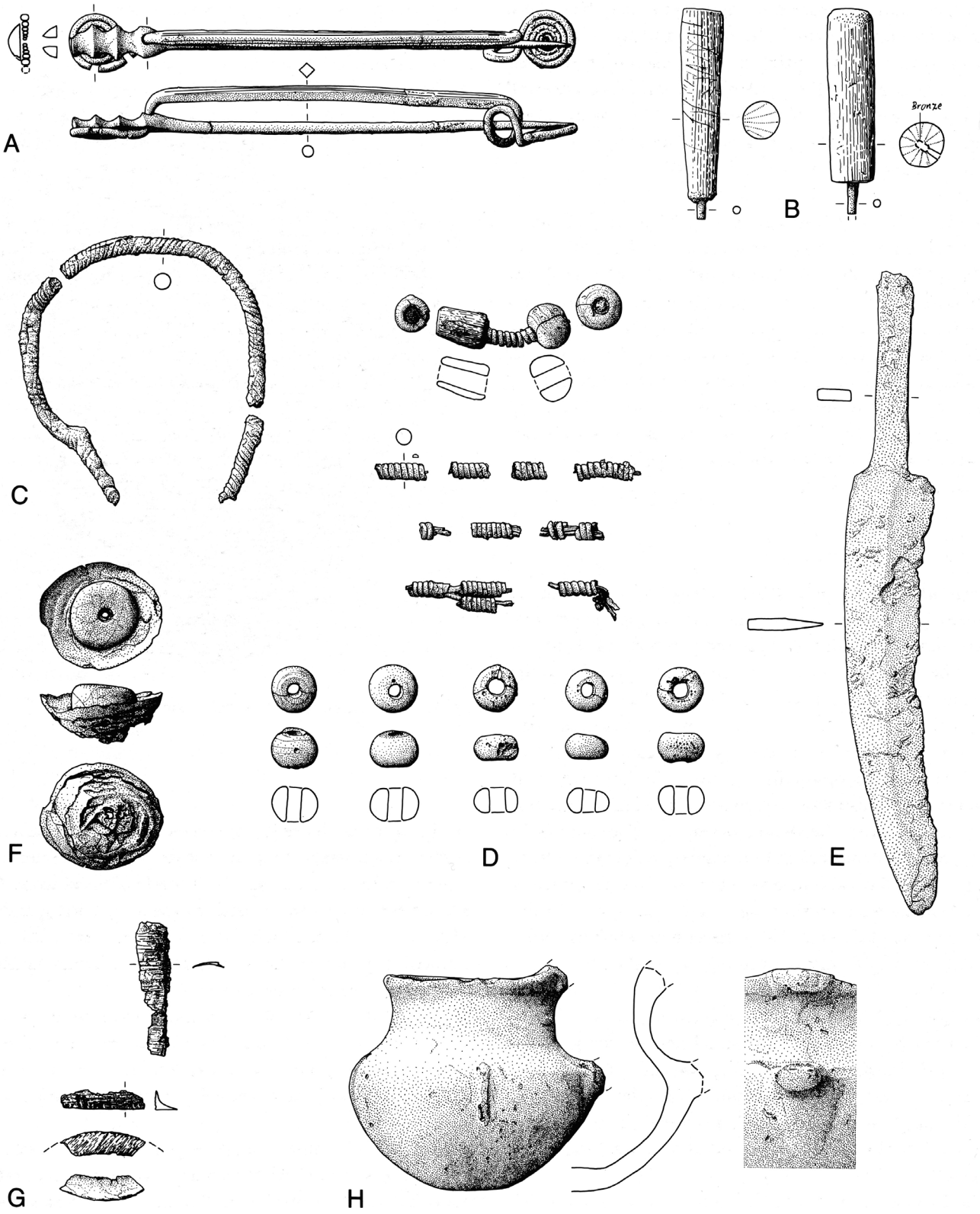

Fig. 3B: Egshvile in Thy, N Jutland near amber deposits. Female inhumation burial equipment: fibula, 2 awls, knife, armring, bracelet of 10 bronze spirals, bead of deer bone and 6 glass beads D (blue and green) as well as a large amber bead in pitch inlay E[107].

107 after Haack Olsen 1992, drawings from Aner/Kersten 2001, no 5115A, 5115B.

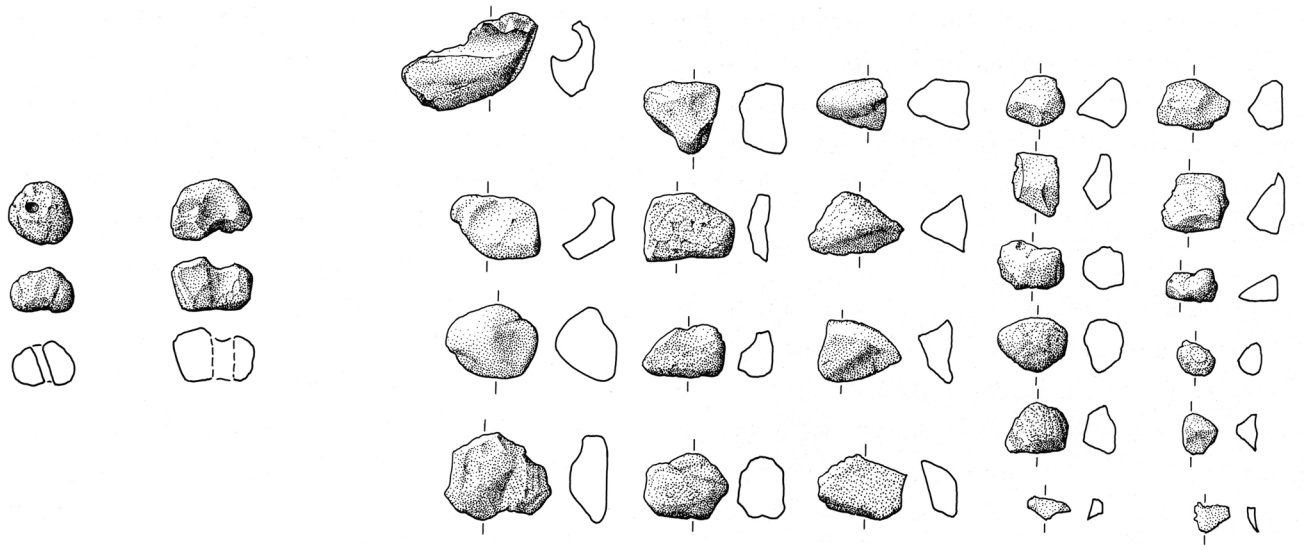

Fig. 3C: Egshvile in Thy, N Jutland near amber deposits. Urn in small cist containing the cremated bones of a 5y old child, likely a boy, accompanied by 22 amber lumps and two crudely perforated specimens[108].

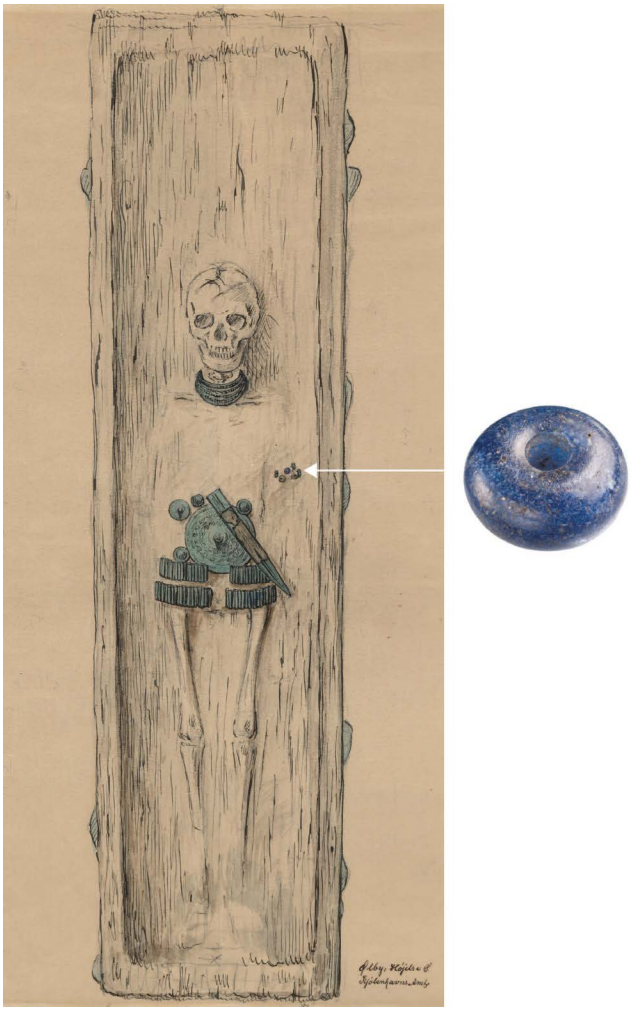

Fig. 3D: Ølby near Copenhagen N Zealand. Spectacular burial of the 'Ølby woman' exhibiting unusual features in addition to amber and glass beads[109]. Courtesy of the National Museum of Denmark.

108 after Haack Olsen 1992.

109 after Reiter *et al.* 2019; Aner/Kersten 1973, 299.

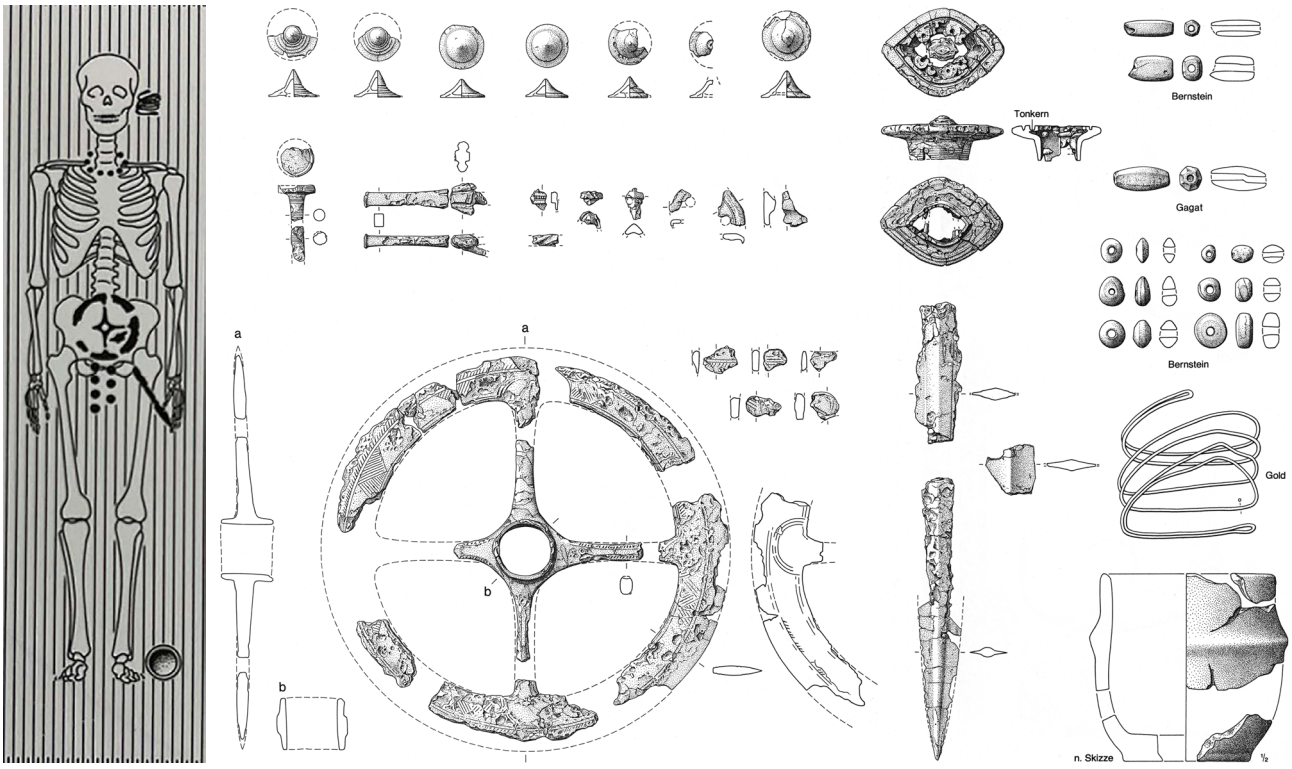

Fig. 3E: Tobøl S Jutland. Burial of a woman who had a bronze wheel placed on the belly (instead of the usual spiral-decorated disc plate). The burial equipment was unusually rich, notably amber beads, jet bead, gold rings, and Tumulus dress pin[110].

Qualitative analysis of the amber-bearers

All female burials with amber, glass or gold follow the ENBA template for the female attire albeit with individual features clearly visible when examining their find context in detail. Within these norms, a particular group of burials stands out by the total number and character of interred accessories. These conspicuous burials with amber are focused upon in the following section to capture intra-group variations and digressions among amber-bearing individuals.

Female burials with amber

One of them is the *Tobøl* burial in SW Jutland[111], dated to ENBA II (Fig. 3E). The Tobøl female carried a unique model of a four-spoked wheel of bronze placed on her belly to mimic the standard large spiral-decorated belt plate of bronze found in prominent female burials. The spoked wheels of the Trundholm Sun Chariot and the Kivik pictorial slabs are the best parallels for these items (cf. Fig. 5A) that can be recognized as an element of everyday movements but also as a part of cosmological journeys. Her costume consisted of Nordic as well as *extra*-Nordic components. In the suite of remarkable objects in her grave one can point out a black jet bead likely imported from the British Isles and a dress pin with disc-shaped head likely originating in the Tumulus Culture, perhaps the sub-region of Silesia[112]. The Tobøl burial is an extraordinary statement of individual capacity, perhaps referring to a life of long-distance travel as indicated by the wheel, but its placement on her belly is in full alignment with Nordic tradition and cosmology. The eight amber beads comprise several types accompanying a cosmetic stone and a large gold ring of double wire for example. It is possible that this burial may have contained glass bead, as could be expected from this form of rich female grave assemblage[113].

110 after Thrane 1962; Aner/Kersten 1986, 3919B.
111 Aner/Kersten 1986, 3919B.
112 Thrane 1962.
113 The archive does not mention any glass beads, but the grave had been plundered and only investigated thereafter.

This mixture of Nordic and foreign features/artefacts recalls other female burials. For instance, *Søviggaarde*[114] and *Store-Loftsgård*[115], both contain amber and glass beads. At Store-Loftsgård, more than 30 glass beads[116] occurred together with imported dress pins probably from the Tumulus complex of the Lüneburg region or further south in central Europe. Similarly, the amber bead in the female grave at *Maglebrænde*[117] was accompanied by an imported dress pin (fragmented) and gold spirals. Dress pins of central European origin occur in several ENBA II–III burials in Thy and can be seen as evidence of foreign contacts between the females from both regions[118].

The dual Nordic and foreign frame of reference is present to a lesser degree in other burials with glass beads as the only foreign component of the attire. This is the case with the Ølby burial of a well-equipped woman[119], where both her attire (including a massive neckring collar of bronze) and Sr isotope analysis suggest her local origin[120] (Fig. 3D). Similarly, graves from *Hesselager*[121], *Skrydstrup Airport*[122], *Kisum*[123], *Ordrup*[124], and *Præstegårdsmark* Melby[125] contained amber and imported glass beads and in a few cases, also gold, whilst otherwise conforming to the standardized Nordic female costume. Near Bordesholm/Rendsburg at *Grevenkrug*[126], a female burial dating to ENBA III highlights the triad of amber, glass, and gold through 48 glass beads, 12 amber beads and two gold spirals in addition to belt bowl and fibula. Although at the boundary of the Nordic area, this equipment accords very well with the female burials described above[127].

Male burials with amber

Among the males the use and display of this material likewise tie closely in with the male attire, including weaponry to emphasize the capacity for war. However, the use of amber in male graves takes more shapes than just beads, hence permitting greater variation. Amber inlays in weapons – swords and axes – especially concur with other high-status elements in the burial. Furthermore, imports often combine with Nordic-style equipment for war. At *Jægersborg Hegn*[128], a male wrapped in oxhide had been buried with, amongst other things, a palstave and a metal-sheathed sword with amber inlays recalling Mycenaean sword hilts, often gold-plated or inlaid with various materials such as 'niello'[129]. At *Åbygård*[130], amber inlays and spiral ornamentation adorned a palstave, and two gold arm-rings were also present. Other types of bronze items are rarely combined with amber inlays. In the double burial at *Karlstrup*[131], two tall males were placed at the opposite ends of a stone cist, their lower legs overlapping: they had thus been buried together. Their grave goods enclosed standardized male gear, a sword, strike-a-light and toiletry kit, but also unusual objects such as a piece of ornamented gold sheet and a large double button made of bronze with amber inlay. The warrior brotherhood signalled by this double burial is striking[132]. It is an unconventional inhumation, quite possibly referencing the significance of twins in the Nordic Bronze Age[133] as well as in epic poetry. One 'warrior twin' had a more lavish equipment than the other, perhaps a question of social status, but they shared almost identical Nordic-style horse-headed razors.

Other male graves with amber include unusual objects and arrangements, such as the two unique, bronze pendants shaped like Minoan double-axes (*labrys*) from *Kirke-Værløse*[134] amidst Nordic weaponry characteristic of ENBA II[135] (Fig. 3A). At *Dyssegård – Gundsømagle*[136], another male burial, probably double, contained an extraordinary, embossed gold-sheet band and three very special conical amber beads with circumferential ornamentation and complex borings. These items and certainly the gold band are of foreign origin, originating in Tumulus Central Europe in Br B1[137]. Sword, spearhead, and toiletries date to ENBA IB, at the very onset of the Nordic Bronze Age[138]. Evidently, the

114 Aner/Kersten 1986, 4170. Søviggaarde, SW Jutland.
115 Aner/Kersten 1977, 1477-IVA. Store-Loftsgård, Bornholm.
116 Kaul/Varberg 2017, 378.
117 Aner/Kersten 1977, 1582B. Maglebrænde, Falster.
118 Bech *et al.* 2018, 78; fig. 2.28.
119 Aner/Kersten 1973, 1582B. Nordhøj, Ølby (Højelse), Zealand.
120 Reiter *et al.* 2019.
121 Aner/Kersten 1977, 2014A. Hesselager, Svendborg, Funen.
122 Aner/Kersten 1984, 3521D. Skrydstrup Sb Nr.31, Haderslev, S Jutland.
123 Aner/Kersten 1995, 4641. Kisum NNO, Estvad, W Jutland.
124 Aner/Kersten 1976, 793F. Ordrup (Fårevejle), Holbæk, N Zealand.
125 Aner/Kersten 1973, 243I. Præstegårdsmark (Melby), Frederiksborg, N Zealand.
126 Aner/Kersten 2005, 9624A. Grevenkrug, Rendsburg-Eckernförde, Schleswig-Holstein.
127 Woltermann, 2016, 17; fig. 127.
128 Aner/Kersten 1973, 418. Jægersborg Hegn, N Zealand.
129 e. g. Karo 1930/1933; Mylonas 1972–73; Kristiansen 2002, 331.
130 Aner/Kersten 1977, 1503. Åbygård, Nyker, Bornholm.
131 Aner/Kersten 1973, 518Q a–b. Karlstrup, N Zealand.
132 Walsh *et al.* 2021.
133 Kristiansen/Larsson 2005, 258–295.
134 Aner/Kersten 1973, 364. Kirke-Værløse, København, N Zealand.
135 Kaul 2017.
136 Aner/Kersten 1973, 451I. Dyssegård (Gundsømagle), København, E Zealand.
137 cf. Metzner-Nebelsick 2010.
138 Vandkilde 1996, 234–238; Bergerbrant 2007.

Dyssegaard burial and very similar burials dating this early were founders of the Nordic Bronze Age phenomenon while their gear includes objects of early Tumulus culture origin. Novelties from the characteristic first phase (~ Br B1) springs to the eye such as *Lochhalsnadeln* occurring together with Nordic-style gear for war and chariot driving c. 1600 BC. Nordic icons like horse-headed belt fasteners likely began in this early phase as the male burial in a passage grave at *Øm in Glim*[139] indicates. Apart from a few amber beads, it contained sword, horse-headed belt fastener and an imported dress pin with a side-loop on the shaft. A peculiar selection of objects is known from the *Hvidegården* burial[140], where the deceased male in ENBA III was accompanied by a small leather pouch containing, inter alia, remains of a snake, a haematite stone, and a perforated shell from the Mediterranean in addition to an amber lump[141]. A warrior burial with similar content is *Valleberga 6* in Scania (Fig. 5B). The above graves disclose *extra*-Nordic connections in a distinct Nordic setting. A grave with amber at *Torup*[142] included remains of a folding stool also with foreign parallels[143]. It is striking how these male burials display individuality based on foreign relations likely referencing their individual life stories. Apart from the presence of amber, their common material frame and funeral inventory signify warriorhood.

Male and individuals with an undetermined gender associated with large amounts of unworked amber pieces account for the most amber-rich burials, but they are not inevitably rich in other types of objects. At *Debel*[144], an individual of undetermined gender was buried with 47 pieces of amber, whereas at *Hårup*[145], a male carried a belt pouch with 30 unworked amber lumps, tweezers and a strike-a-light. A single amber bead and a dagger were placed near the belt pouch. Highlighting the 22 pieces of amber (two with crude boring), the child's burial at *Egshvile* in Thy, quite possibly a boy[146](Fig. 3C), constitutes one of the most lavish personal displays of amber measured in quantity of individual pieces. A prominent richly equipped female was interred near the child burial with amber lumps (Fig. 3B). Such substantial collections of unworked amber probably relate directly to the nearby large-scale collecting and storing activities, as attested at the nearby residential site of *Bjerre*. In one ENBA house, 83 pieces of amber were found strewn across the floor, and a cache of 69 unworked pieces was located in a pit inside the building[147]. The ample supply of amber on the northern coasts of Jutland is underlined by a cache of 3.3 kg raw amber lumps deposited in a pot together with two ENBA II neck ring collars (1500–1300 BC) at *Understed* in Vendsyssel. In the Thy region, collecting and sorting amber were activities continuing in the LNBA, as evidenced by a several large caches of up to 1800 pieces of amber found at the settlement of Bjerre 7[148].

Amber-bearing individuals – preliminary conclusion

Through close-examination of selected burials with amber, a clear-cut profile of these individuals emerges. Apart from the common ground in the possession of amber, the subdivisions follow gender as outlined by the Nordic tradition. Warriorhood is notably confirmed to be significant among the males. Individuality – individual life histories – notably emerges as a key parameter. Both females, males, and individuals of undetermined gender associate with amber but in different ways. Amber is more often present in female graves and almost exclusively in the shape of beads. The relationship between amber, glass or gold is an overriding pattern in certain female burials linking these together and revealing trans-regional networking and contacts often pointing towards Tumulus groups in central Europe. Degrees of foreignness are a common thread among these females. This concurs with conclusions from previous studies based on a selected sample[149]. Pieces of unworked amber lumps are entirely absent from female burials, whereas they seem to be an entirely male phenomenon. The male use of amber also includes beads although not combined with glass or gold in as consistent a manner as among the females. Amber buttons and gold/amber inlays of ENBA bronze objects belong to the male domain of warriors and may well take inspiration from remote places and thus link to the cross-gender performance of certain cosmopolitan identities.

139 Aner/Kersten 1973, 451. Øm, Glim, København, E Zealand.
140 Aner/Kersten 1973, 399. Hvidegård, Lyngby-Tårbæk, København, E Zealand.
141 Goldhahn 2012.
142 Aner/Kersten 1986, 4038A. Torup, Alslev, Ribe, SW Jutland.
143 e. g. Kristiansen/Larson 2005.
144 Aner/Kersten 2008, 5654. Debel, Lille Jenshøj, Fur, N Jutland.
145 Aner/Kersten 2014, 6451A, Hårup, Linå, E Jutland.
146 Aner/Kersten 2001, 5115A; Haack Olsen 1992.
147 Earle 2002, 315–21; Earle/Bech 2018; Earle *et al.* 2022.
148 Earle *et al.* 2022.
149 Varberg *et al.* 2016; Kaul/Varberg 2017.

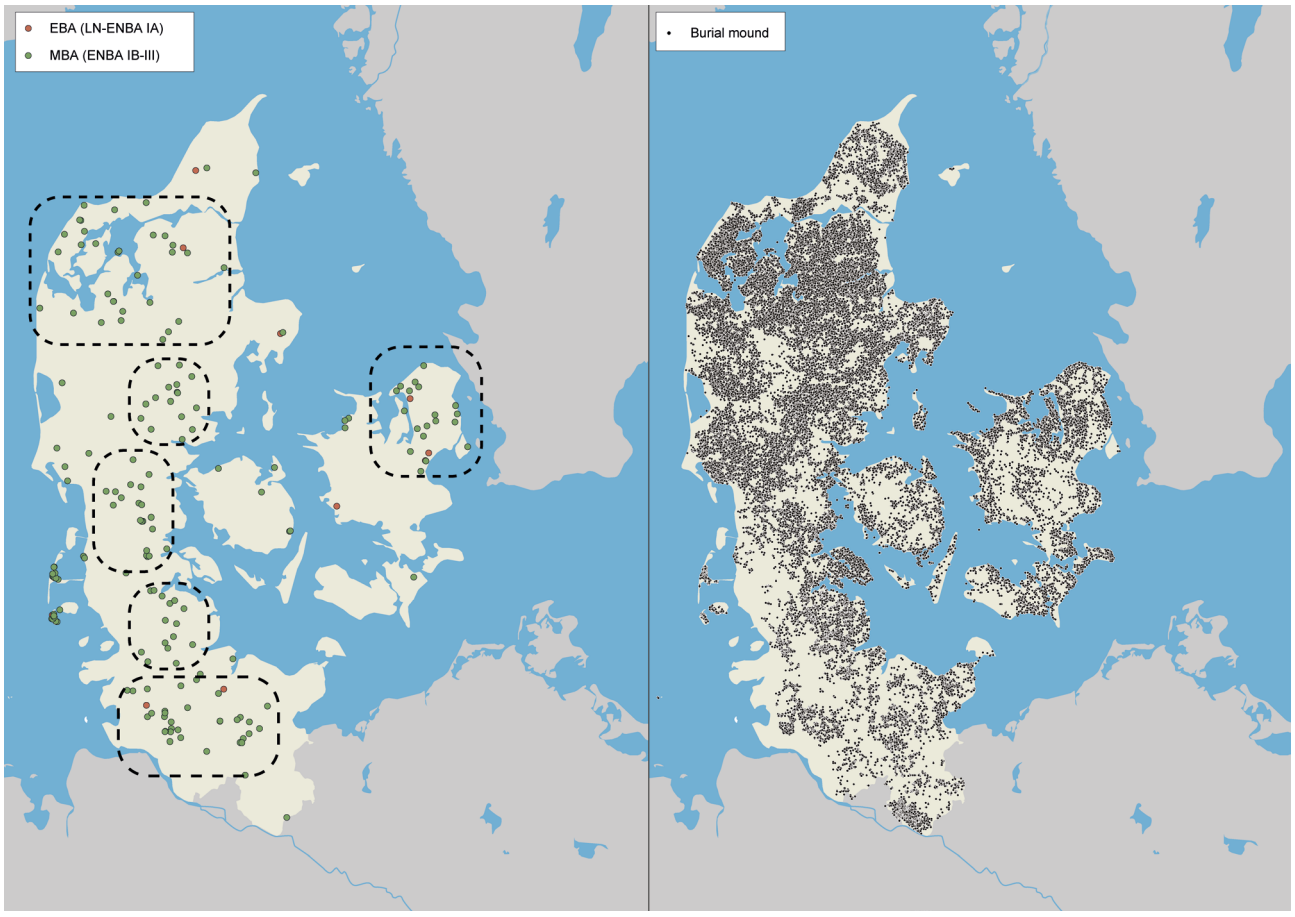

Fig. 4A: Left map: Amber burials in the Danish region and Schleswig-Holstein. Particularly amber-rich areas are delineated. **Right map**: Burial mounds of known and probable ENBA date in the Danish region and in Schleswig-Holstein[150]. Map generated from public domain data by Archaeological IT AU-MoMu.

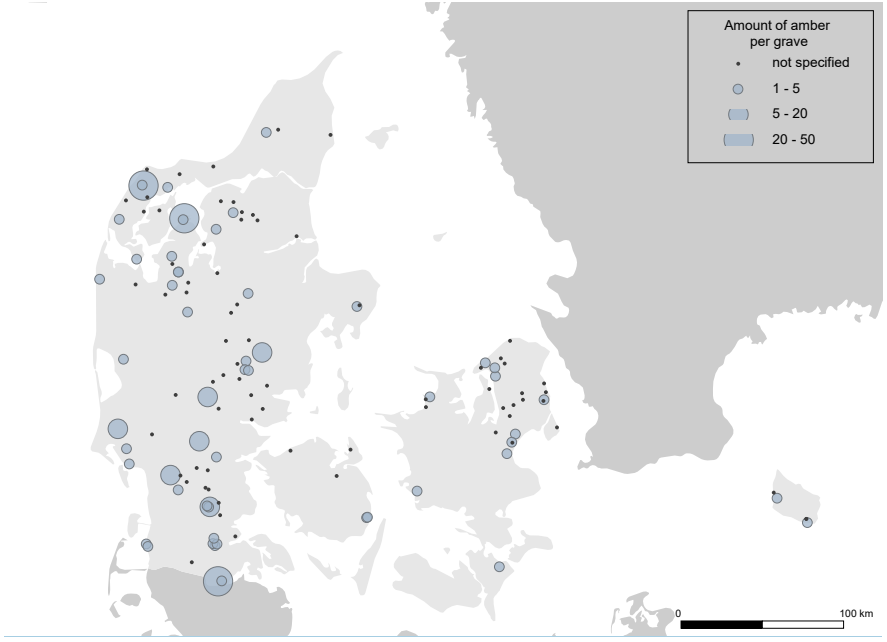

Fig. 4B: Map detailing the quantity of amber deposited per burial in the Danish region.

150 after Müller/Vandkilde 2020, fig. 1.

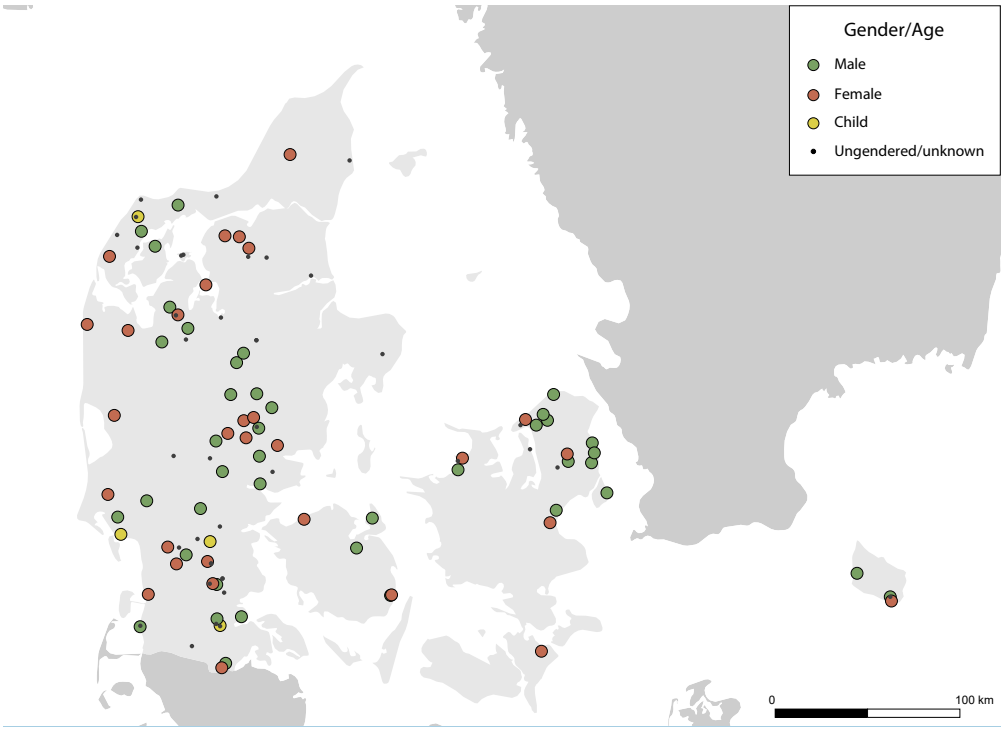

Fig. 4C: Map detailing age and gender (including ungendered/unknown) in the Danish region. Like in the rest of the buried ENBA population child burials are a minority.

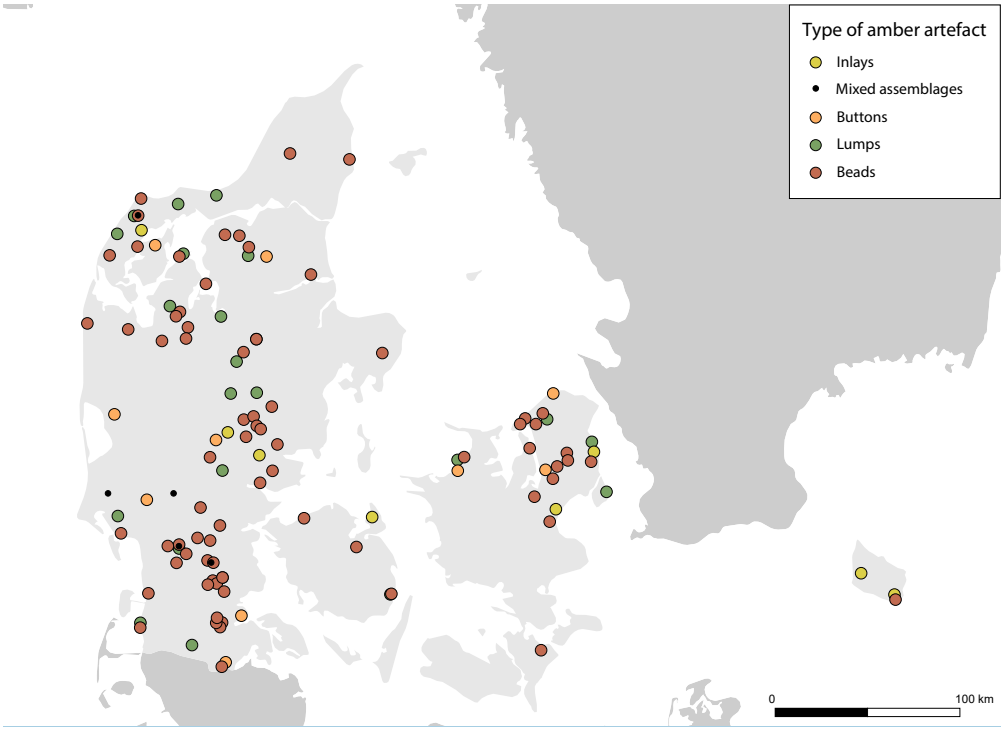

Fig. 4D: Map detailing type of amber artefact deposited in burials in the Danish region.

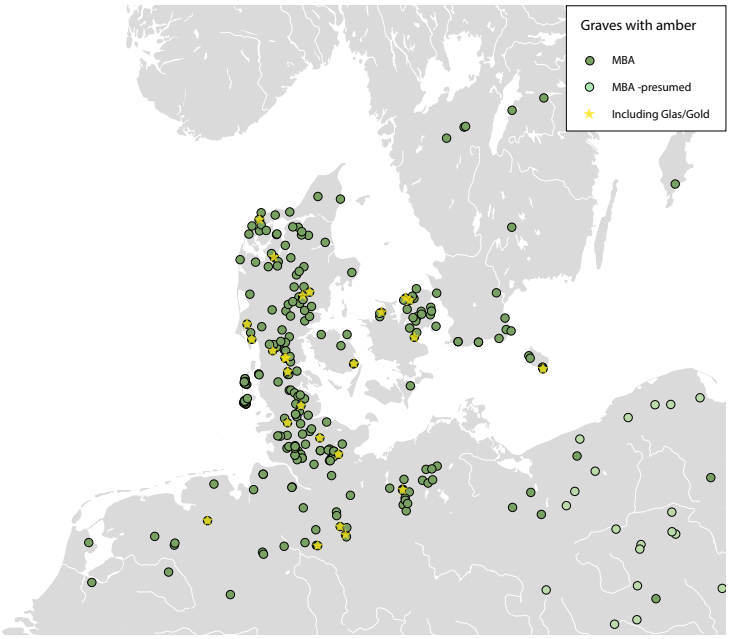

Fig. 4E: Dispersal of special graves with amber as well as either glass or gold (star) shown on the background of all burials with amber (green circle). Female so-called triad burials are marked by a yellow star. The occurrence of triad burials continues southwards into the Tumulus region (Appendix 4) (cf. Fig. 7D).

Fig. 4F: Gestalt of the three proposed ENBA regions most occupied with amber trade, namely NW Jutland, N Zealand, and the interlinked communities along the Jutland Ridge. Red star marks the presence in these amber regions of two or more burials with amber and glass or gold. Such triad burials likewise occur along the North Sea coast showing that these coastal regions were active in amber collection and trade. The occurrence of triad burials continues southwards into the Tumulus region (cf. Fig. 7D).

Spatial analysis of amber in Denmark

Burials with amber appear throughout Denmark although distinct concentrations are evident. On the backdrop of a complete map of all known and probable burial mounds from the NBA – that number in the many thousands – three distinct clusters of amber-bearing burials can be recognised in the following three geographical areas (Fig. 4A): **1.** NW Jutland, which is rich in natural amber and surrounded by the North Sea and fjord pathways. **2.** The Jutland Ridge where a wide lane of amber burials and highly visible burial mounds is present. Linking N and S Jutland with Europe since prehistory, this lengthy communication corridor is still marked by numerous ENBA burial mounds forming long chains and clusters in the landscape[151]. **3.** N Zealand, framed by Kattegat in the north and Øresund in the east. The region connects to the Skagerrak as well as to the Baltic Sea with further riverine links heading south, deep into the European continent.

Importantly, all three regions possess the full typological assortment of amber artefacts: beads and lumps, and the much rarer amber inlays and buttons. The three regions are indeed remarkably similar (Figs. 4B–4F). The similarity includes the presence of female triad/trifecta burials as well as amber-carrying warrior males, hence corroborating the existence of three main regions. The presence of amber/glass/gold burials along the Jutland North Sea can however suggest the local harvesting of amber along the entire west coast and not only in the Thy region. In addition, burials equipped with a large number of amber objects, i. e. 10–47 individual objects or pieces, is a Jutland phenomenon, hence underpinning this region as a primary area for collecting amber. Burials with amber lumps occur first and foremost in Jutland (Fig. 4D), concurring with the suggested principal source.

The individuals buried with amber may be readily interpreted as those having spent their life occupied with active trading, but this straightforward economic explanation ignores the cosmological meaning and authority emanating from some of these burials. A more cautious interpretation would see these individuals as being connected to this trade rather than necessarily being active traders; the children with amber suggest as much. Significantly, each of the three amber regions is placed at key crossroads in the vicinity of trade and communication routes across the sea or over land: they transpire as important nodes in the amber trade and formed a chain of interlocked communities. These regions were, thus, inter and intra-connected culturally and socially to one another in terms of amber, as well as other materials and ideas. Whether they all relied fully on the extensive source in NW Jutland source cannot be determined, as they may have supplemented with their own local amber sources.

Fig. 5A: Bronze 'sun-holder' with the sacred wheel-cross in amber inlay[152]. It was possibly attached to a ship model used in rituals[153]. The amber inlay is thin and has been worked so that a wheel-cross appears when light shines through it. Iconographic parallels to depictions of anthropomorphs onboard ships holding wheel crosses are known from rock carvings[154].

The cluster of ENBA amber burials in N Jutland is particularly conspicuous because of the coinciding new evidence for settlements nearby to the coast that appear to have focused on collecting amber especially in the wake of storms[155]. According to Earle *et al.*[156] the geographical proximity of large collections of unworked lumps in trade caches confirms the significance of coastal NW Jutland societies in collecting as well as trading the amber. In comparison, amber may not have been collected in the same economic manner in the inner archipelago of NW Jutland: only one lump of amber is reported by Simonsen[157], among the numerous excavated two-ailed longhouses from LN II–ENBA I. After the breakthrough of the NBA c. 1600 BC, the various categories of ENBA amber burials within this region, including unworked amber with males and beads with females, all point to an important amber crossroads hub in NW Jutland. This is further supported by the particular amber-rich nature of the graves in Jutland, including in the NW region. Amber burials featuring gold and glass, or otherwise showing foreign connections, are comparatively

151 Holst/Rasmussen 2012, figs. 432–433.

152 without provenance, National Museum Copenhagen NM B1482.

153 Kaul 2004.

154 "Solholder med rav". Jesper Weng, Nationalmuseet under CC-BY-NC-ND licence.

155 Earle/Bech 2018.

156 Earle *et al.* 2022.

157 Simonsen 2017, 402.

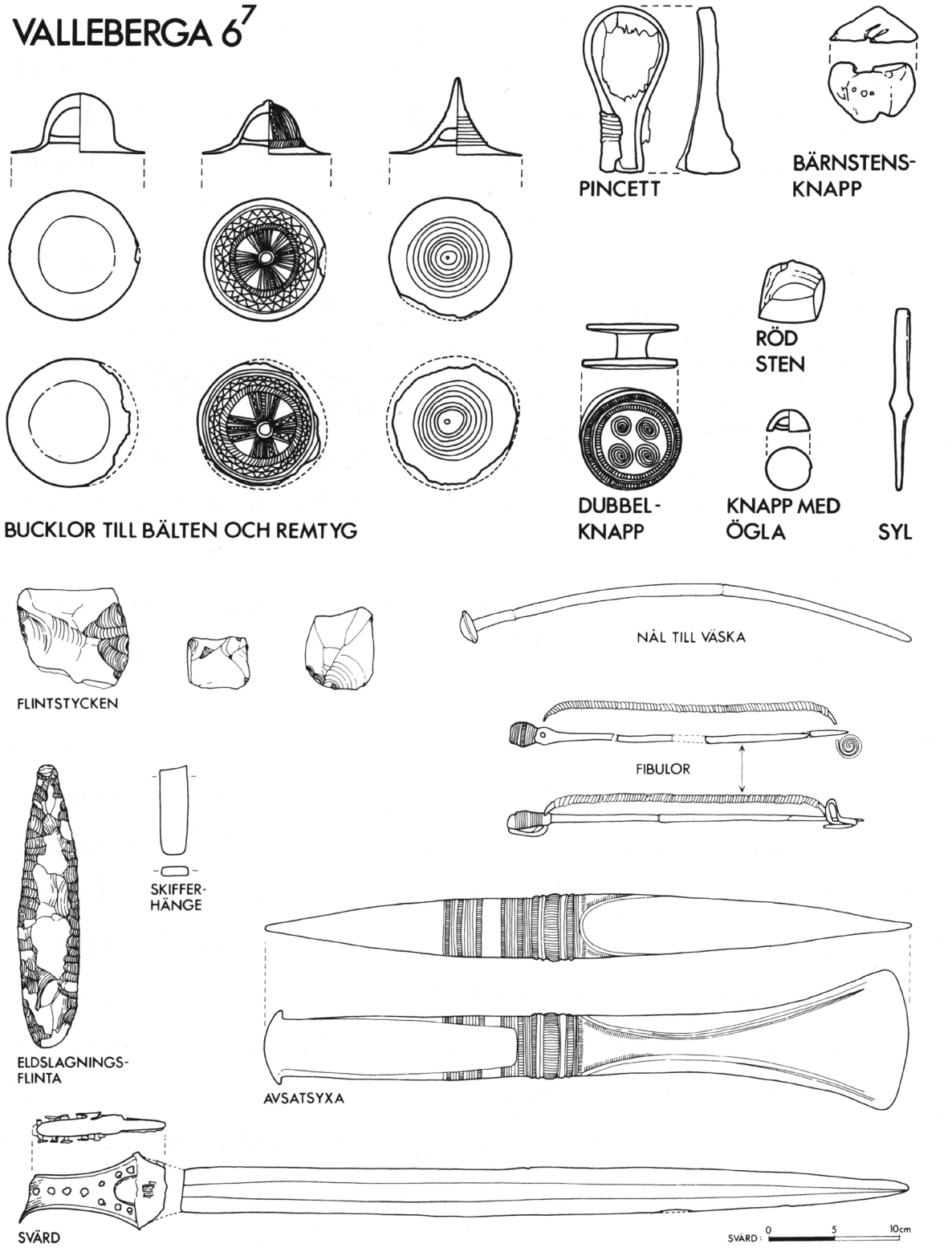

Fig. 5B: Valleberga 6 in Scania, Sweden. Male burial with equipment reminiscent of the Hvidegaarden burial in N Zealand. Apart from an amber button, the male was for example equipped with flange-hilted sword and weapon axe and a pin belonging to a purse holding little magic things. These included a red stone for putting on make-up, like in the Tobøl and Hvidegaarden burials.[158]

158 after Goldhahn 2006, figs. 6.19–6.20; cf. Strömberg 1975.

common in the southern part of the Jutland peninsula, extending across the present-day border into Schleswig-Holstein[159] with direct access to other parts of Europe. Similar burials occur elsewhere such as notably N Zealand. The spatial patterning of amber described above for the ENBA also shows connections with the wider European pattern of amber distribution in the Middle Bronze Age.

Spatial analysis of amber and metal in EBA and MBA Europe

The distribution of amber in the EBA–MBA reveals European-wide flows of amber that likely initiated in the Danish region, feeding especially from the Baltic amber source in NW Jutland but possibly also from other coasts such as N Zealand. An amber network beginning in the Danish region is particularly visible during MBA (ENBA IB–III), much less so for the EBA (LN–ENBA IA). The sparse presence of EBA amber in the Danish region, the presumed amber homeland, accords with the above analysis revealing a remarkable bust in the local social consumption of amber setting forth in the later third millennium BC[160]. The sparse presence of amber in EBA Denmark, thus, makes it challenging to track networks southwards and westwards. The few EBA amber finds in the North is remarkable, although, enough to reveal that both NW Jutland as well as N Zealand transpire already in this early period as forerunners of the MBA threefold spread (Fig. 4A–F). Recent research has provided strong archaeological evidence for long-distance south- and west-directed connections[161](Fig. 1A). The other major amber source in the eastern Baltic Sea area, namely Sambia at Kaliningrad[162] does not seem at play in the EBA, but possibly can explain some of the easternmost spread in the MBA. Already at this point, it is clear that the European EBA dispersal of amber (2100–1600 BC) (Fig. 6A) deviates distinctly from the MBA map (1600–1200 BC) (Fig.7A–7B). This demonstrates that amber was attracted to different geo-cultural landscapes in these two Bronze Age periods, with the chosen routes deviating over time.

The European Early Bronze Age distribution of amber

The EBA distribution Fig. 6A may reveal two major European flows of amber both stemming from the Danish region. NW Jutland and N Zealand are the likely starting points: Firstly, an eastern sea-land-river based flow was directed towards the Únětice region in central Europe, while secondly, a western sea-borne flow of amber was directed towards the Wessex-Cornwall districts of S England (cf. Fig. 1A)[163]. There are secondary flows also contributing to the major pattern of EBA amber dispersal, elaborated below. It should be kept in mind that the EBA is a long period of complex historical developments. These comprised both the rise and fall of the Únětician cluster of intersected local groups as well as the bloom and decline of the so-called Wessex culture with the early burial series (Bush Barrow-Wilsford) and the mostly later burials series of Camerton-Snowshill-Aldbourne. The famous amber cup from the Hove barrow belongs in the late EBA phase. This latest Wessex period covers the 17th century BC – corresponding to Br A2c/A3 in central Europe. The Aldbourne series of female burials belongs in the closing Wessex culture and in several cases the MBA. This final EBA period may be interpreted as crisis ridden as well as revealing sustainable traits and novelties. These opposite conditions forecast the onset of the MBA. All in all, the EBA distribution of amber displays lavish social consumption of amber in two fundamentally different metal-rich civilizations in central-east Europe and west Europe, hence they were connected *inter alia* by their common interest in attracting amber. Moreover, early palatial hubs in Greece join this exclusive group.

It was presumably *NW Jutland* and adequate maritime transport that at this time provided amber to the British Isles. Here, high concentrations of amber used for elaborate necklaces occur in the Wessex and Cornwall regions with a cross-Channel link to Brittany (the Armorico-British EBA)[164]. In contrast, *N Zealand* may well have been the central hub of maritime transport of amber along Øresund and across the Baltic Sea. Next, the rivers Oder and Elbe with tributaries channelled the supply to the various Únětice groups who greatly appreciated the amber: the central German and north Bohemian core regions[165] in addition to Kujavia, Greater Poland with Łęki Małe and Bruszczewo[166], as well as Silesia, Bohemia, Moravia, and Slovakia. They all formed part of the Únětice intersociety (Fig. 6C). The foothills of the

159 Bergerbrant 2007; Stahl 2006.

160 This low number, however, may be impacted by the preference for collective burial in megalithic tombs in Denmark during this time, with these tombs subjected to intensive prehistoric and historical disturbance, looting and paucity of high-quality modern excavations.

161 Vandkilde 2017, figs. 85–86; see also Bech *et al.* 2018.

162 Czebreszuk 2007.

163 Vandkilde 2017, 143.

164 Gerloff 1975; Vandkilde 2017, 142–146; figs. 85–86; 88.

165 Ernée/Longová *et al.* 2020.

166 Czebreszuk/Müller 2004. cf. Kowiańska-Piaszykowa 2008.

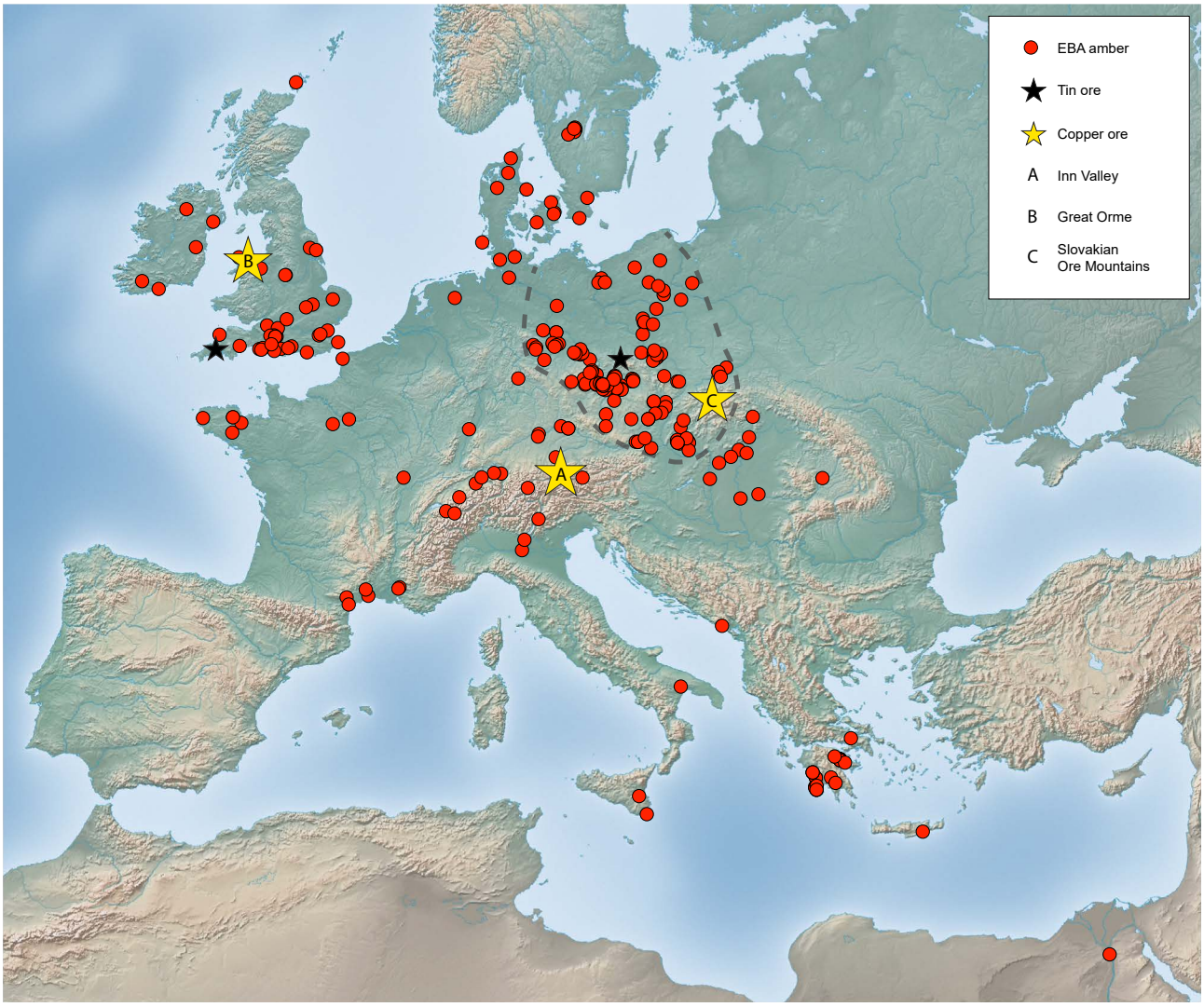

Fig. 6A: The dispersal of EBA amber and the copper sources relevant for Scandinavia (and much of Central Europe) at this time, mostly high-impurity fahlore. Marked with yellow star symbol: Inn Valley in the E. Alps and Slovakian Ore Mountains (Hron). British sources from the Great Orme and the Alderley Edge were also used in Scandinavia at this time. Black stars mark tin sources in Cornwall and Erzgebirge. The use of these specific copper sources continues throughout the EBA except for the Inn Valley Ösenring copper, which is an early phenomenon. The dotted grey line marks the territory of the Únětice intersociety (cf. Fig. 6C). Amber is charted in its full spread from Scandinavia to the Aegean in the EBA.

Slovakian Ore Mountains were the near endpoint of this eastern amber track as marked by much amber in Slovakian Únětice and Mad'arovce cemeteries[167]. The relatively little amber transferring into the Carpathian Basin and the Transdanubian Plain in the EBA must have followed passageways in Slovakia at Nitra-Hron. However, and likely coupled to Únětician amber appropriation and control, amber travelled along the Danube to other EBA groups in Lower Austria and further south-westwards into the Alpine foothills in Switzerland as far as the Massif Central and the Rhone estuary. Amber appears to have not routinely crossed the Alps in the EBA, with only three Pollada culture finds of amber in the Po valley as well as three reportedly EBA amber finds in S Italy/E Sicily[168].

Undeniably, early batches of Baltic amber arrived at a few sites in the Peloponnese in MH III and especially in LH I–IIA, and in copious amounts[169]. It should be noted that very early amber beads were recorded from the Near

167 Bátora 1986; 2000; 2018; Jaeger *et al.* 2023.

168 Cwaliński 2014, 191; fig. 11; Bellintani *et al.* 2014, figs. 1B; 2A.

169 cf. Hughes-Brock 1985; Harding/Hughes-Brock/Beck 1974; Harding 1984; Gerloff 1993, 2010; Czebreszuk 2011; Maran 2012.

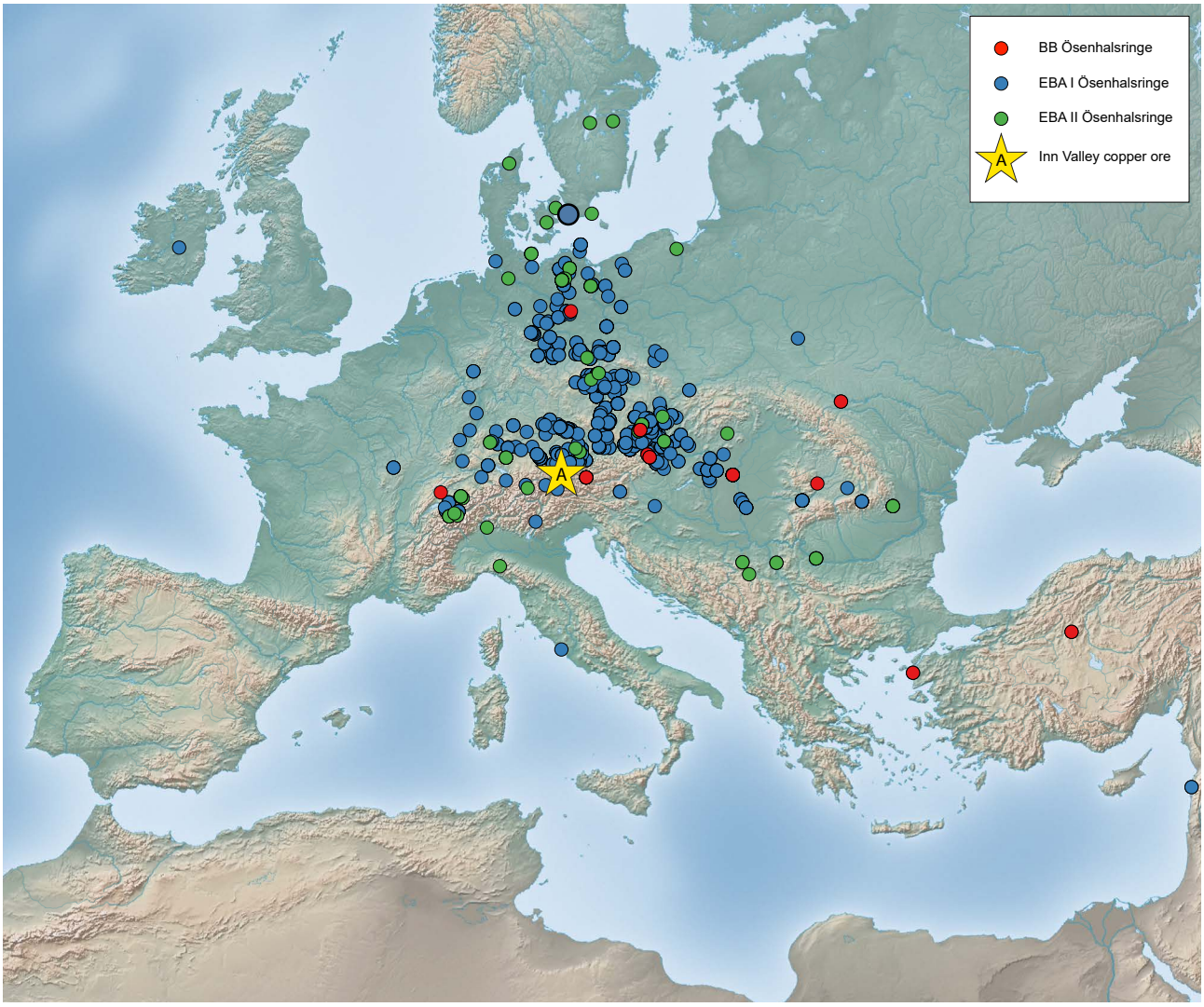

Fig. 6B: Dispersal of EBA Ösenringe made of Low-Ni fahlore from the Inn Valley (based on the Stuttgarter Datenbank SAM/SMAP[172]). There is a match between the geographical spread of Ösenringe and EBA amber spread. A large proportion of the metalwork from Pile in Scania was notably cast from this type of copper, around 2100–2000 BC[173].

East at Assur and at Tell Asmar[170]. The amber beads from Assur c. 1800 BC have been proven to be authentic 'Baltic'[171] whereas the amber pendant from Tell Asmar c. 2400 BC on inspection proved not to be amber but copal from E Africa. Baltic amber beads are likewise[174] reported from Egypt, among these early amber beads from the tomb of Teti at Saqqara around 2340 BC, but its status as 'Baltic' is at best ambiguous[175]. Other amber pieces from the Near East are later, hence belonging to our MBA map.

The distribution of amber in the EBA indicates that rising elites in Early Mycenaean Greece partook in this fascination of the yellow substance from the far North. The EBA map certainly illuminates early palatial hubs in the Peloponnesus. Ten early Mycenaean graves with Baltic amber belong in the EBA map, which reveals two amber concentrations, namely one in Messenia in the vicinity of Pylos and another in Argolis near or at Mycenae. It is less clear which routes the amber followed to reach the Aegean this early, although the Wessex crossroads hub is the most likely intermediary[176]. These concentrations of Baltic amber particularly at Kakovatos (Tholos A) and Mycenae (early shaft graves) are significant and could mean that rising elites in

170 e. g. Gestoso Singer 2008; Singer 2016.
171 Harding/Hughes-Brock/Beck 1974, 169; Bunnefeld *et al.* 2023.
172 Junghans/Sangmeister/Schröder 1968; Krause 2003.
173 Vandkilde 2017.
174 Meyer/Todd/Beck 1991.
175 Gestoso Singer 2008; Singer 2016.
176 cf. Maran 2012; Bunnefeld *et al.* 2023.

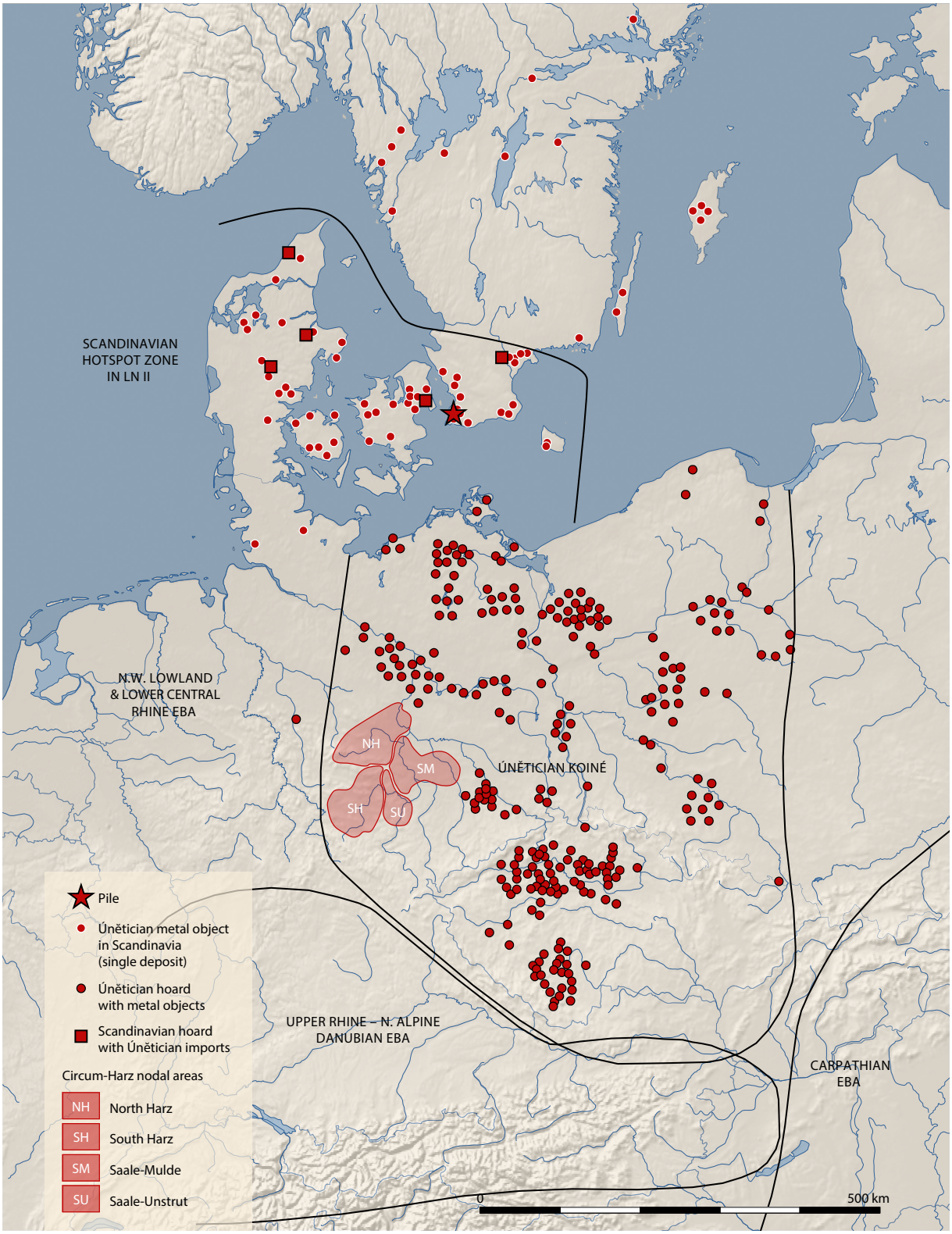

Fig. 6C: EBA Central Europe highlighting key metal hoards in Scandinavia and the geographical area of the Únětice intersociety delineated together with several of its subgroups alongside the crossroad hub at the Middle Elbe-Saale and connected groups such as the Danubian EBA[177].

177 cf. Vandkilde 2007, 93; fig. 20B; after Vandkilde 2017, fig. 87.

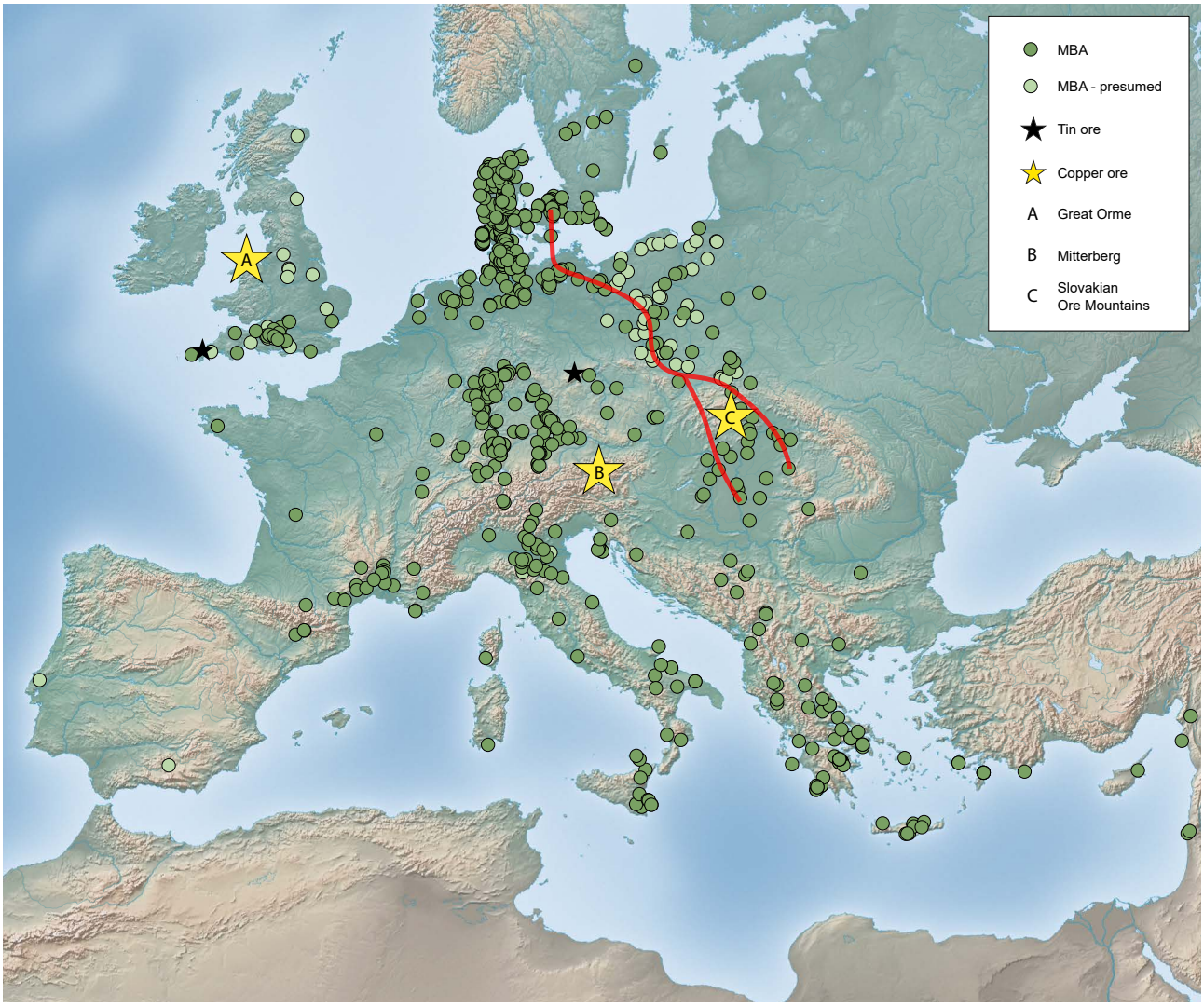

Fig. 7A: Amber in MBA northern and Central Europe and the copper sources relevant for the **earliest MBA** phase with Carpathian-Basin Koszider-linked metalwork in Scandinavia, now mostly chalcopyrite. Marked with yellow star: Mitterberg, Slovakian Ore Mountains, Wales. Black stars mark tin sources in Cornwall and Erzgebirge. Amber is charted in its full spread from Scandinavia to the Aegean in the MBA.

the Peloponnese and in Wessex[178] were linked to one another through gift-exchange in the 17th century BC.

The European Middle Bronze Age distribution of amber[179]

The spatial dispersals described above for the ENBA in the Danish region with three clusters of amber-bearing burials were directly linked to the European distribution of amber in the MBA (1600–1200 BC) (Fig. 7A–7B). The NW Jutland cluster may, via a sea route, have linked directly to the Friesian Islands, the Steinburg-Dithmarschen area and generally to the region around the Elbe, Weser, and Ems estuaries. From here, transfer to S Britain may well have ensued. This route is supported by similarities in material culture between these areas[180]. The Jutland Ridge corridor with its north-south spread of burials with amber connects directly to *the principal MBA route* (Fig. 7B), which is broadly Tumulus-related. Towards the north, the track implicates Tumulus-related groups in the N European Lowlands (Mecklenburg, N Niedersachsen, the Friesian region).

178 cf. Gerloff 1993; 2010.

179 MBA finds with amber are generally not sufficiently high-resolution to allow division into subperiods.

180 Bech *et al.* 2018, 85.

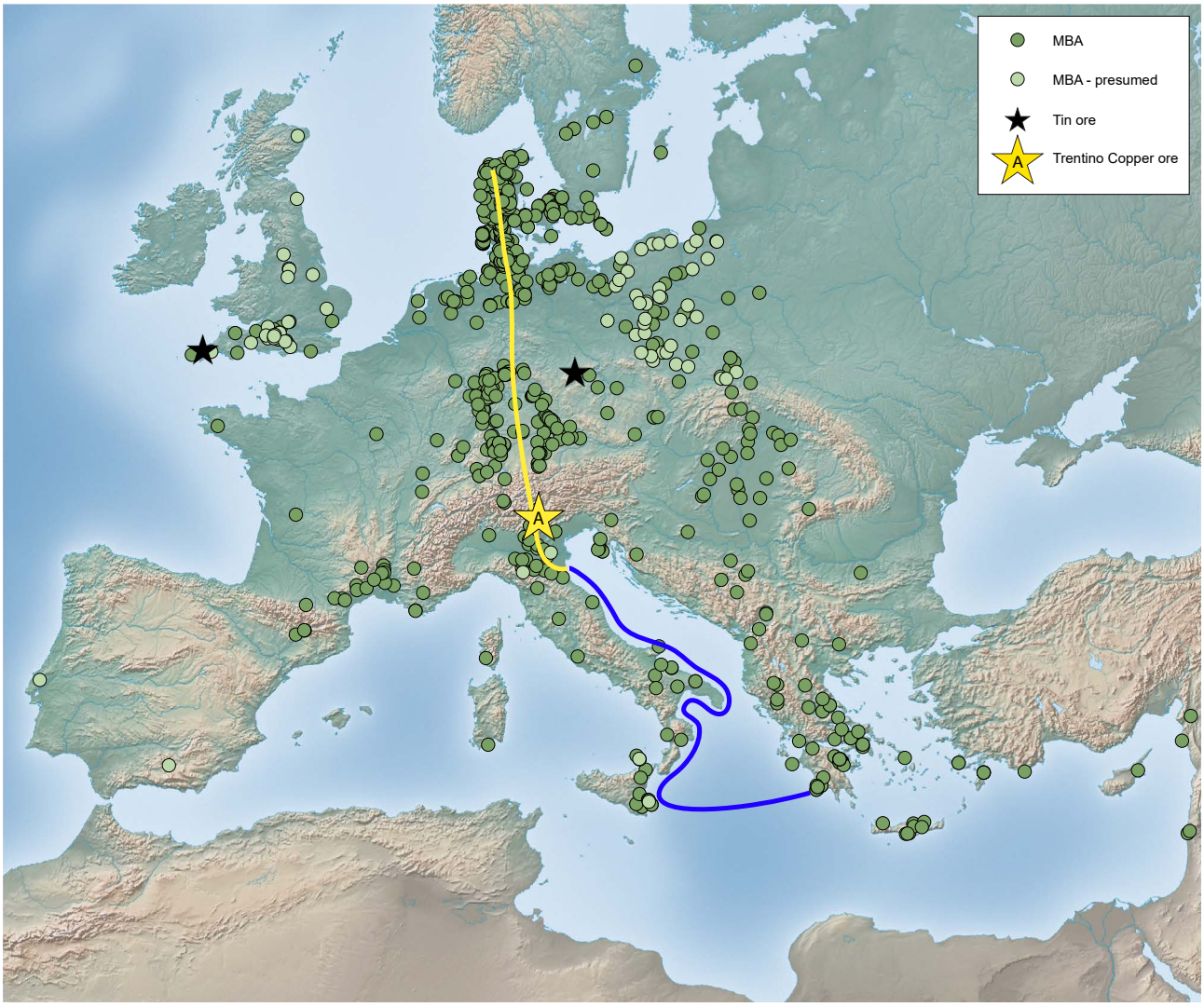

Fig. 7B: Amber in MBA northern and Central Europe and the copper sources relevant for the **mature MBA** with Tumulus-linked metalwork in Scandinavia, now mostly chalcopyrite from the Trentino area of the Italian Alps. Trentino area marked with a yellow star symbol. Black stars mark tin sources in Cornwall and Erzgebirge

This landscape includes the centrally placed Lüneburger Heide, with its particularly rich graves, including so-called *Fremde Frauen* with spectacular dress components[181]. The Lüneburg area furthermore appears on the map as an intermediary between the Jutland Ridge and Middle German Tumulus groups boasting significant quantities of amber especially in burials. From there, the track continued southwards to Tumulus groups in S Germany, the latter with rich female graves furnished with elaborate amber necklaces with complex borings, like those of Late Mycenaean Greece[182].

Remarkably, rich Tumulus burials moreover reiterate the partnership between gold, amber and glass[183] (Fig. 7D) observed above for a distinguished group of ENBA burials. From S Germany, the track for the first time continued across the Alps onto the Po Valley, where Tumulus-influenced burials are recorded[184]. From here, there were further connections to Apulia in S Italy where several Mycenaean-influenced ports-of-trade located at the S Adriatic coast, for example at Roca Vecchia[185]. Similar entrepôts existed along the eastern

181 cf. Piesker 1958; Jockenhövel 1991; Stahl 2006; Bergerbrant 2007.
182 e. g. Harding/Hughes-Brock/Beck 1974.
183 Stahl 2006.
184 Bellintani 2014, 115.
185 Guglielmino 2007; Guglielmin *et al.* 2010; Scarano/Maggiulli 2014; Bellintani 2014, 117; 126; Iacono 2015.

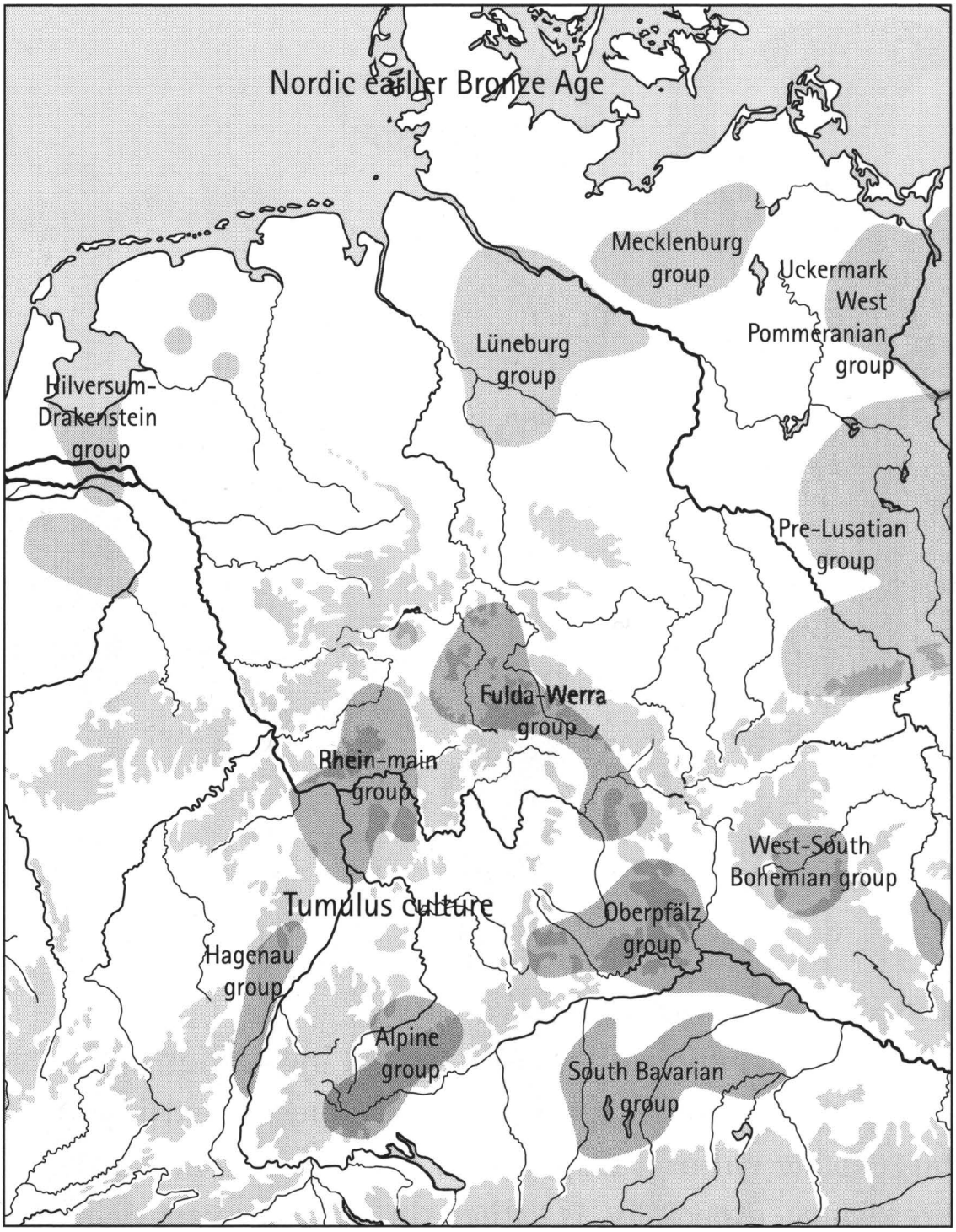

Fig. 7C: Main Tumulus-linked societies in MBA Europe[186].

186 after Vandkilde 2007, 133; fig. 36.

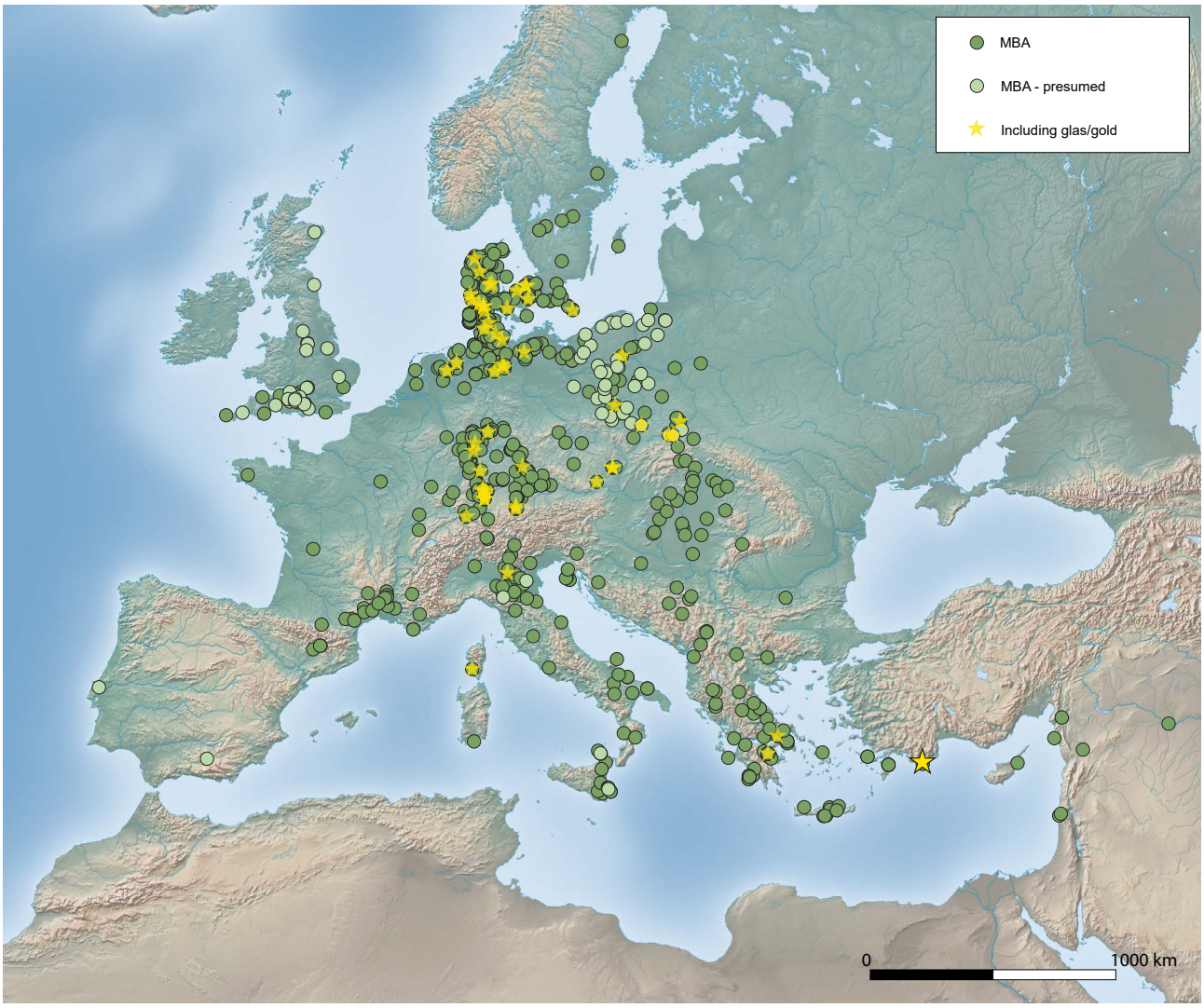

Fig. 7D: Map of MBA amber burials highlighting interments containing glass and/or gold (mostly female). They are marked by yellow star symbols (Appendix 4). The Po Valley reportedly boasts burials with glass beads, which appeared in the MBA although most of the region's glass is LBA[187]. The situation in the Po region is marked with a single star. The Uluburun cargo, c. 1320 BC[188] comprising several glass ingots is marked with one large star off the coast of S Turkey.

coasts of Sicily, for example at Thapsos[189]. From such ports, further sea-borne connections may well have transported the amber to Mycenaean Mainland Greece and from there distributed to Crete, Cyprus, the Levant, and Egypt. The Jutland Ridge can, in other words, be seen as a crucial mediator of amber from NW Jutland to other parts of Europe near and far.

The amber-empty space apparent in the map (Fig. 7A–B) between the North European Plain and the northernmost Tumulus groups (Fulda-Werra and Rhein-Main) is most probably owing to low habitation rates in this area, namely the forested *Mittelgebirge* zone of the Teutoburger Forest connecting with the Rothaar and Harz to the west and east respectively. Tumulus groups preferred to inhabit the fertile river valleys between the Alps and the *Mittelgebirge* range[190]. This is clearly reflected in the map of MBA amber depositions. On a similar note, the large region formerly occupied by the EBA Únětice complex has few MBA amber finds and thus emerges as an amber-poor space, perhaps in this case due to depopulation following the Únětice cen-

187 Bellintani 2014, 119–120.

188 Manning *et al.* 2009.

189 e. g. Cwaliński 2014, fig. 2; Kristiansen/Suchowska-Ducke 2015, fig. 1; Vandkilde 2022.

190 cf. Jockenhövel/Kubach 1994; Vandkilde 2007, 133; fig. 36.

tury-long decline[191]. The final collapse c. 1600 BC in some way transformed the geography of amber dispersal and unlocked the gateway to the rich Carpathian Bronze Age region. It was on this occasion the western exchange route and regular transalpine traffic were initiated to the Italian Peninsula, hence facilitating access to the Mediterranean Sea (cf. Figs. 6A,7A).

The distribution map also reveals *a more easterly MBA amber track* (Fig. 7A), likewise oriented N-S and running parallel to the more westerly one. This eastern track may have drawn on Danish as well as Sambian sources. It is moreover likely that this eastern track hides an earlier (Koszider Br B1) and a later amber track (Br B2–C/D); the present analysis of amber is not sufficiently fine-grained to unveil chronological variation within the MBA period. However, the map certainly indicates the existence of minor tracks. Two or three head eastwards in the landscape between the Baltic Sea and the present-day Berlin-Warsaw line. By crossing the Oder estuary, another side route connects to the main Jutland-Tumulus track, to further link with the Sögel-Wohlde region of S Jutland, Schleswig-Holstein, N Niedersachsen, and Holland[192].

The eastern track plausibly began in N Zealand, crossed the Baltic Sea to MBA groups in Mecklenburg and Uckermark-W Pomerania, here following the rivers Oder and Vistula southward to the Tumulus groups inhabiting that area[193]. Along two passageways, a substantial crossing of the Carpathian Mountains now took place. Through E Slovakia (Nitra-Hron), and via the area southeast of Cracow, this eastern track entered the Carpathian Basin and the Transdanubian Plain for the first time supplying this region with amber in quantities. Compared to the EBA, the large number of amber finds in the Carpathian Basin during the MBA[194] (Br B1–Br B2/C–D) reveal a marked change. The Carpathian Basin seems, however, to be the end point for this eastern amber track or nearly so. There is no clear evidence that amber in a routine manner transferred into the Balkans and from there further into the Aegean. Although amber objects certainly occur in the Balkans tied to *circum*-Adriatic exchange[195], amber finds of MBA date are rather rare in the area and the spread appears random, or at least without a clear track connecting the Balkans with the Aegean region. Most amber finds in the Balkans and along the N Adriatic coast belong in the LBA after 1200 BC[196]. With outset in Scandinavia and continuation in the W Tumulus region, the cross-Alpine route with possible Apulian-Sicilian links may well have been the main direct source for the amber continuing to arrive in Greece during the Late Mycenaean period.

S England retained its position as an amber hub, but the amber finds are in-and-off themselves in many cases less conspicuous with assemblages containing fewer amber objects than previously. This includes the Aldbourne series of female burials, which likely date to the early MBA, in Reinecke terms Br B1–2[197]. The relatively amber-poor situation of the British Isles in the MBA map may partly reflect that the transition from EBA to MBA in Britain, reproduced in Fig. 7A–7B, 7B, is still not fully in place regarding the burial record. By comparison, France has well-dated finds with amber many of which occur in the Alsace. They are Tumulus-related, notable located in the Forest of Haguenau[198], which may very well link up with the distinct group of amber finds in Mediterranean SE France.

On a brief note, finds of Baltic amber are also known in the Iberian Peninsula and Sicily[199]. A recent examination of Spanish material however demonstrates that Baltic amber did not appear in the region until after 1200 BC; earlier use of amber depended on local amber sources and in some measure Sicilian amber[200].

Several amber finds have been recorded from the Late Bronze Age Aegean, Levant, and New Kingdom Egypt[201]. These finds are rarely scientifically confirmed to be 'Baltic'. Of more recent finds, however, the royal tomb at Qatna (c. 1340 BC) is remarkable due to the unique lion-head shaped vessel along with lid and 90 beads, confirmed to be Baltic amber[202]. Finds of amber are known from Abu Hawam, Aphek, *Alalakh*, Mari, and Ugarit in the Levant in addition to Enkomi in Cyprus[203]. These finds may all date to the Mediterranean Late Bronze Age (our MBA map), but only the amber from the royal palace of Ugarit is confirmed as 'Baltic'[204]. In New Kingdom Egypt notably the tomb of Tutankhamun has been associated with amber; especially some of the breast plate inlays and a necklace with 60 biconvex and lentoid beads looking much like those from

191 cf. Czebreszuk/Müller 2004; Meller *et al.* 2011.
192 cf. Laux 1995.
193 cf. Jockenhövel/Kubach 1994; Vandkilde 2007, 133; fig. 36.
194 'Calibrations' were performed due to differences in terminology between the chronology of the Hungarian-Romanian region and the Reinecke system.
195 Cwaliński 2020.
196 Cwaliński 2014, 194–196; cf. Bellintani 2014, figs. 2B; 3A.
197 Gerloff 2007.
198 du Gardin 1996.
199 Barroso *et al.* 2012; Murillo-Barroso *et al.* 2018.
200 Angelini/Bellintani 2017; Murillo-Barroso *et al.* 2018.
201 Harding/Hughes-Brock/Beck 1974; Mukherjee *et al.* 2008; Gestoso Singer 2008; Singer 2016.
202 Mukherjee *et al.* 2008.
203 Gestoso Singer 2008; Singer 2016.
204 Mukherjee *et al.* 2008, 55.

Tab. 4: Comparison between amber tracks and copper sources in the EBA and MBA, including estimates for dates, starting and end points, as well as copper types and provenances.

EBA *BC*	PHASE	AMBER TRACK	START POINT	END POINT	EBA COPPER PROVENANCE	COPPER TYPE	AMBER FARTHEST REACH
2100–1600	LN II-ENBA IA (Wessex I–II)	Western maritime	NW Jutland	Wessex	British Isles (Great Orme, Alderley Edge)	British low impurity	Aegean
2100–1600	LN II (Br A1 – Br A2b)	Eastern land-sea-river	Zealand-Scania (?)	Slovakian Únětice	Slovakian Ore Mountains (Hron valley)	Fahlore	Carpathian Basin
1700–1600	ENBA IA (Br A2c)	Eastern land-sea-river	Zealand-Scania (?)	Slovakian Únětice	Slovakian Ore Mountains (Hron valley)	Chalcopyrite	Carpathian Basin
2100–1600	LN II (Br A1 – Br A2b)	Eastern land-sea-river	Zealand-Scania (?)	Danubian EBA	Inn Valley, Austrian Alps	Fahlore (*Ösenring*)	S France, Rhone estuary
MBA *BC*	**PHASE**	**AMBER TRACK**	**START POINT**	**END POINT**	**MBA COPPER PROVENANCE**	**COPPER TYPE**	**AMBER FARTHEST REACH**
1600–	ENBA IB- (British MBA)	Western-maritime	NW Jutland	Rhine estuary	British Isles (Alderley Edge, Great Orme)	British low impurity	Wessex
1600–1500	ENBA IB (Br B1)	Eastern-continental	Zealand/Sambia (?)	CB Koszider	Slovakian Ore Mountains (Hron valley)	Chalcopyrite	Balkans
1600–1500	ENBA IB (Br B1)	Eastern-continental	Zealand/Sambia (?)	CB Koszider	Austrian Alps, Mitterberg	Chalcopyrite	Balkans
1500–1200	ENBA II–III (Br B/C – D)	Western-continental	Jutland Ridge	Tumulus S Germany	N Italian Alps (Trentino-Alto-Adige)	Chalcopyrite	Aegean, Near East

Qatna[205] and with parallels in Central Europe as well[206]. The amber-lion from Qatna reiterates the lion as symbol of power and rulership, for instance at Mycenae, Knossos, Ugarit, and Hazor alongside the famous Theban Rekhmire's tomb-paintings and written records (c.1400 BC) reassembling the key elements of lion vessels, oxhide ingots, and amber-coloured necklaces. The c. 40 amber beads onboard the Uluburun wreck have been determined as being of Baltic origin[207]. The Uluburun amber was found alongside agate, carnelian, quartz, gold, bone, seashell, ostrich eggshells, faience, and glass[208]. Dating to c. 1320 BC, the wreck further comprised multiple ingots of copper, tin, and glass. Throughout the dispersal area, amber is inclined to combine with (beads of) other materials: copper/bronze, gold, glass and, in the E Mediterranean-Levant also for example agate, faience, carnelian, and lapis lazuli. They were at some level interchangeable.

In comparison with Early Mycenaean Greece, amber in the Late Mycenaean period took a more dispersed distribution in the Aegean and E Mediterranean[209]. This may suggest a change from social gift-exchange to commercial trading of amber, as a commodity on par with other precious or rare materials. Triangulating the evidence from Uluburun, Qatna, and Rekhmire's tomb may point in this direction, but it should be emphasised that gift-exchange and trade can easily occur side by side or entwined.

Jointly, all these MBA amber finds indicate the far range of Scandinavian networks after 1600 BC. The continued flow of amber into the Aegean is remarkable (Figs. 6A, 7A–B). Although the Wessex region may still be active, the S German Tumulus region emerges as a key area in the transaction of amber[210]. Compared to the Early Bronze Age, the transalpine route is particularly important in explaining the much wider spread of Baltic amber after c. 1600 BC. Amber finds in the Aegean and the Levant could derive from internal trade in the E Mediterranean *oikoumene* through Mycenaean agencies. Together, the far spread of amber in the Middle Bronze Age can justify the focus in current research on the intricate interconnectedness of Bronze Age worlds in Europe and beyond[211].

Amber and copper – delineating how their trajectories correlate

The European amber tracks in the EBA and the MBA were markedly dissimilar (Figs. 6A, 7A–B; Tab. 4). MBA networks of amber were enormously expansive with a much longer reach and the amounts in production and circulation were higher. This reflects that the societies that consumed and controlled the amber were also fundamentally different; in the EBA Únětice groups and upon their demise Tumulus MBA groups took over whereas more continuity characterized amber usage in S Britain. The shifting amber tracks over time will be further argued in the discussion section dealing with the metal-amber relationship. It is however at this point clear that the copper categories traded to Scandinavia change in the same rhythm as the amber tracks and the crossroads hubs in charge:

The *EBA spread* of amber in central and northern Europe correlates with the provenance of the three copper sources known to have been used in Scandinavia (and much of central Europe) at this time[212] (Fig. 6A). This is mostly fahlore sourced to mining areas in Slovakia and the E Alps. The assembly of Únětice societies were apparently key operators of amber and metal with the crossroad hub at the Middle Elbe-Saale as the most prominent (Fig. 6C). The amber track notably terminates in the foothills of the Slovakian Ore Mountains with rich sources of the characteristic fahlore in use in Scandinavia. Connected groups such as the Danubian EBA also received amber and may well have managed the so-called *Ösenring* copper, likely mined in the Inn Valley in the E Alps. This characteristic fahlore transferred in large amounts to Central Europe and Scandinavia likely imported as neck-ring ingots. The match between the geographical spread of *Ösenringe* and EBA amber spread is striking (Figs. 6A, 6B). In addition, British copper sourced to the Great Orme and the Alderley Edge were also used in Scandinavia at this time hence explaining the large number of amber items in the British Isles in the EBA (Figs. 1A, 1C, 6A).

The *MBA spread* of amber in central and northern Europe likewise correlates with the provenance of copper sources known to have been used in Scandinavia (and much of central Europe) at this time. The major shift in the dispersal of amber from the EBA to the MBA characteristically coincides with a marked shift from fahlores to the use of chalcopyrites[213]. This change in copper categories furthermore

205 Mukherjee *et al.* 2008, 56.
206 Harding/Hughes-Brock 1974, 149–152.
207 Pulak 1998, 206.
208 Pulak 1998, 206.
209 e. g. Harding/Hughes-Brock-/Beck 1974.
210 Maran 2012; Kristiansen/Suchowska-Ducke 2015, fig. 1.
211 e. g. Kristiansen/Suchowska-Ducke 2015; Meller 2017; Vandkilde 2016; Ialongo *et al.* 2021; Vandkilde 2021.
212 Nørgaard/Pernicka/Vandkilde 2019; 2021.
213 In the context of this study chalcopyrite refers to 'chalcopyrite-like low-impurity copper' as opposed to fahlore which is high-impurity copper. These two copper categories embed different properties and originate in different copper ores.

relates to radical social and demographic transformations (Figs 6C, 7C). The MBA amber map is currently not sufficiently fine-tuned and may well conceal two chronological phases visible in the metalwork (Tab. 1, Figs. 7A–B).

In the *early MBA* the three copper sources in use were Slovakian Ore Mountains, Mitterberg in the E Alps, and Wales. Welsh copper is quite prominent in the big Fårdrup-type shafthole axes[214] emphasizing the continued connection to the British Isles very likely rooted in metal-amber transactions. The Scandinavian preference for copper from the Slovakian Ore Mountains and Mitterberg is broadly reflected in the eastern amber track commencing at the Baltic Sea coast (N Zealand?) and ending in the Carpathian Basin, now for the first time included in the amber trade (Fig. 7A). Carpathian-Basin Koszider-linked metalwork made of Slovakian and Mitterberg copper travelled across Central Europe and reached Scandinavia around 1600 BC. The route this metalwork took corresponds to the eastern track(s) of amber in the MBA[215] while also comprising the dispersal of horsemanship and the first swords.

In the *mature MBA* the western amber track leading from Jutland to the Alps concurs with the presence of Tumulus-linked metalwork in Scandinavia, and from c. 1500 BC the use of copper from one single source, namely the Trentino-Alto-Adige chalcopyrite area of the Italian Alps. The metal-amber correlation is thus very strong. The amber track now for the first time traversed the Alps passing the Trentino copper mines[216] as well as the rock panels at Valcamonica before entering the Po plain with further connections to the Mediterranean Sea with access to a wide array of luxuries (Figs. 7B, 7D; Appendix 4). Precisely this is reflected in the rich MBA amber burials along the amber track beginning in Jutland and ending in the Aegean where the Uluburun wreck represents both end and beginning of the journey.

DISCUSSIONS 1–8

1 Approaching amber-bearing networks and roles in Denmark and beyond

The amber-bearing individuals in the subset of ENBA mound burials connect to one another through the amber and their shared expressions of foreign relations. The network and qualitative analyses above (Figs. 2–3) hint at gendered identities apparently shared across regions (Fig. 4), which calls for further discussion. Each region played a role in the transaction of amber *qua* its geographical position, suggesting a link between networks, trade, and expressions of identity.

Amber was presumably transported at connected scales from local to supra-regional and probably mostly in the shape of lumps. The dispersal of amber in the North is linked directly to wider European networks (Figs. 4,6–7), as we explore below. NW Jutland could well have been the major source of raw amber for further distribution in the network of partners. Recent discoveries in Thy provide evidence of long-term routine and curation of amber at Bjerre[217]. The nearby Egshvile burials (Figs. 3B–3C) join the broader tendency of a gendered division, as the child burial contained the typical male/ungendered lumps whereas the adult female was buried with beads. Due to the close proximity to the supposed hub for amber distribution at Bjerre, we here suggest that these wealthy burials at Egshvile point to related identities associated with the wider transport of amber and subsequent transactions. The amber-bearing individuals identified in burials across Denmark connote a relationship to amber trade through inclusion of amber in burials, possibly as active traders, their close relatives, or descendants. Especially males and individuals of undetermined gender buried with unworked amber – from one lump to very large amounts of unworked amber – seem to signify specific connections to family-level active trading and contributions to a far-reaching network. Objects made of imported copper-based metal in the amber-bearing graves stress the importance of such long-range trading networks.

The female burials with amber, glass and gold also indicate association with the amber trade but here the foreign and extra-local associations are expressed in a differentiated manner. Previous studies have revealed the importance of patrilocality and female exogamy in European and Nordic societies from the Neolithic into the Bronze Age[218]. As such, the possibility should be mentioned that some of the 'amber-glass/gold women' could be *Fremde Frauen*[219], or otherwise interwoven with the amber trade through the workings of kinship genealogies over time. Mobility and migration are common accessories to exchange networks[220].

214 Nørgaard/Pernicka/Vandkilde 2023.
215 cf. Vandkilde 2014b.
216 Marzatico 2022.
217 Earle *et al.* 2022.
218 e. g. Jockenhövel 1991; Bergerbrant 2007; Frei *et al.* 2015; Mittnik *et al.* 2019; Sjögren *et al.* 2020.
219 Jockenhövel 1991; Bergerbrant, 2007.
220 e. g. Kristiansen *et al.* 2017.

Kristiansen[221] models this as a long chain of local chiefly networks from the Alps to Denmark around 1500–1200 BC. Such both local and supra-regional movements of people and their goods may explain how intangible cultural traits, such as myths, beliefs, and knowledge, were likewise exchanged in the European Bronze Age[222]. The *extra*-local isotopic signatures of the ENBA females from Egtved and Skrydstrup have thus been suggested to indicate that such exogamic marriage patterns were in place[223], which could potentially apply to some of the women with amber combined with foreign objects. The Ølby woman, however, cautions us from uncritically assuming all females buried with glass and amber were foreign, as the Sr isotope analysis suggests her local origin[224] (Fig. 3D). Other roles within the amber trade network than extra-local marriage partners may have been undertaken by these women as well[225], or perhaps the link to the trade network may be more complex than necessarily signifying a role or label *per se*.

The gender differentiated use of amber in Nordic burials shares several aspects with burial practices in the contemporaneous Lüneburg and Tumulus complexes to the South. Here, the existence of similar amber and gold/glass furnished females in Tumulus groups south of Denmark is particularly relevant as comparison[226] (Figs 4E–4F, 7D). Although amber/glass/gold combinations are shared with the North, Tumulus women wore elaborate necklaces consisting of multiple strings of amber beads, sometimes adding bronze-spiral beads or a glass bead as well. This custom deviates markedly from the Nordic tradition of predominantly one or a few amber pieces per burial in ENBA IB–III: in the North, one piece of amber was apparently regarded as sufficient as a symbolic marker of profession or identity (see discussion below). The gendered distinction and the link between female graves, amber and foreign components in the Danish region continues into the southern zone of the ENBA in Schleswig-Holstein and N Niedersachsen, from the Sögel-Wohlde ENBA IB into ENBA II–III[227]. Outside the North, amber is often associated with the richest hoards and burials alongside cosmologically important materials like gold and glass, perhaps indicating a function as not only a prestige material but one also afforded symbolic significance.

The male burial at Kirke-Værløse in N Zealand with amber and two labrys-shaped pendants displays clear Aegean connotations combined with classical warrior gear (Fig. 3A). Whether this specific case involved personal relations as trader or indirect relations cannot be determined. Significant amounts of Baltic amber, including the characteristic spacer-plates with complex borings, reached Mediterranean palace-based societies at this time, notably Mycenae itself, attesting to such far-reaching connections. Some 1625 amber objects are known from Mycenaean Greece in LH I–IIA also known as the Shaft Grave Period[228]. Elaborate crescentic necklaces with spacer-plates formed part of the elite female attire in Wessex, Mycenaean, and Tumulus societies[229]. By comparison, only a single amber spacer-bead with complex boring is known from Denmark[230], and the ENBA region emerges mostly as the provider of the amber.

Lastly, it is worth emphasising that distant connections and related stories likely constituted building blocks for personal status in the ENBA – for both men and women[231]. Amber's cosmological properties seem to have been shared across geographical distance[232]. Furthermore, ties between identity, amber and burials seem to have been in place in widely different regional contexts: amber objects are predominantly associated with high status female graves while also present in male warrior graves in the North, in the Tumulus area and in the Aegean, notably in the shaft grave circles at Mycenae and at Pylos in the so-called Griffin Warrior Grave[233]. The MBA dispersal of amber suggests that the principal three 'amber hubs' in S Scandinavia, S Germany and S Mainland Greece were interlinked, which is noteworthy although the network was even more wide-ranging (Figs. 7B, 7D).

It is probably significant that the distinct relationship between gold, glass and amber in Scandinavia is also attested for N Germany[234] and in hoards and burial finds

221 Kristiansen 2023, 92; fig. 5.1.

222 e. g. Helms 1988; 1991; Kristiansen/Suchowska-Ducke 2015; Vandkilde 2016.

223 Frei *et al.* 2015; Frei *et al.* 2017; Kristiansen *et al.* 2017.

224 Reiter *et al.* 2019.

225 cf. Frieman/Hofmann 2019; Frieman/Teather/Morgan 2019.

226 Amber found with blue or green glass beads in Germany (Stahl 2006, 19–21; table 6): D30, D127, D158, D170, D270, D274, D322, D470:12. Danish examples usually comprise a mere bracelet of amber beads sometimes with glass or gold added: Ølby- (AK-299) with bracelet or the combination sewn onto the sleeve, Ordrup/Fårevejle (AK-793F), Puggegaard/Hasle (AK-1440J), Pedersker (AK-1477), Egshvile (AK-5115B) a supposed bracelet, Dover (AK-6572) also a bracelet, and Sønder Vissing (AK-6734). Skrydstrup Airport (AK-3521D) however, had a necklace; Woltermann 2016, 152–156, fig. 105.

227 Laux 1995; Bergerbrant 2007, 26–42; cf. Woltermann 2016.

228 Maran 2012; Harding/Hughes-Brock/Beck 1974; Harding 1984; Czebreszuk 2011.

229 Maran 2012.

230 Lomborg 1967.

231 Helms 1988; 1991; Kristiansen/Larsson 2005.

232 e. g. Bouzek 2007.

233 cf. above; Woltermann 2016, 163 ff.; Maran 2012; Stocker/Davis 2015.

234 cf. Woltermann 2016.

throughout Central and NW Europe adhering to the amber track. A tight relationship in the MBA between Scandinavia and Central European Tumulus groups materializes in several Danish amber burials, suggesting that regular transactions bound the two areas together, which has previously been demonstrated by the dispersal of similar-type metal-hilted swords of Au-Valsømagle type in Br B1, with octagonal hilt in Br B/C, and Riegsee-type swords in Br D[235]. Amber might have been exchanged for gold judging from the concentration of these two materials, especially in S Jutland and N Germany[236], but perhaps also glass, which shared a special relationship with amber and gold[237]. Possibly, a wider set of ideas, social practices and even marriage partners were shared and exchanged alongside amber and metals during this period. The societal developments occurring in Scandinavia after 1600 BC drew heavily on inspiration from the neighbouring regions, in time forming a globalised syncretic culture[238] although with a distinct Nordic footprint, which came to define the following centuries.

As already shown, the burials with amber constitute a small subgroup within the entirety of ENBA burials. The small number and relative distinctiveness of the amber burials imply that not everyone in society had access or a right to be adorned with amber in death. Likewise, amber is only found sparingly in other ENBA contexts suggesting that possession and circulation were somehow restricted even though amber can be picked up by anyone walking along the coasts of Jutland. The dichotomy between the value of amber as a material and its wide availability in Denmark may have been handled through social control functioning as a bottleneck that prevented free circulation and thus loss of value[239]. Later historical analogies from the coastlands of SW Jutland (Ribe County) show that amber control attained varying success[240]. The regional comparative advantage of amber was limited due to the general availability along the Nordic coasts[241]. However, the ENBA amber burials indicate that amber was subject to some form of successful regulation and control affecting its local-level management as well as trading. This is an important new insight with consequences for understanding the metal-for-amber contract as a bearing principle for extra-Nordic trading (see discussions below). Recent studies indicate that access to bronze relied on known routes and import from certain areas while deliberately avoiding the others[242], hence hinting at one or more managing forces in long-distance trade in the Bronze Age[243].

2 Amber as cosmological symbol – control through beliefs?

The constrained and infrequent use of amber as grave good and body ornamentation in the ENBA is remarkable in light of the southward distribution of amber across the continent. Those two phenomena must correlate: the restricted local use vis-a-vis the continental-wide spread. Could it be that amber simply lost its former significance when metals entered the scene, as often assumed? This question brings us directly to amber's symbolic significance. In this section we discuss how acquisition of amber in lavish amounts to build personal status or rank fell out of use in the Nordic Bronze Age. Seemingly, it was no longer desirable or, perhaps, tolerated. A form of effective social control seems to have been established instead. As we will show, amber, its materiality and visible impact were associated with otherworldly properties and the sacred, not just in Scandinavia but in several of the local contexts where it is found. Due to the close entanglement between ritual, belief, and other aspects of society in the ENBA, we here explore whether cosmology could function as a legitimising force enabling such social control.

Metal and metal objects were attractive for several reasons but cannot explain in and of themselves why amber at the beginning of the Bronze Age appeared within such a narrow and symbolically loaded frame. Ritual and cosmological paraphernalia linking up with celestial elements appeared around this time in N Europe: the Nebra disc, the scimitars from Rørby, the Balkåkra-Hasfalva twin drums, the sun-chariot from Trundholm, the Tågaborg amber-eyed bronze stallions, the Wismar horn, and several others[244]. Along with the commencement of the NBA, amber's symbolic meaning may have changed from a widely accepted sun symbol into a composite symbolic entity whose powerful associations were tied to a tripartite cosmos[245]. A close relationship between amber and beliefs seems to be in place already early in the ENBA.

235 cf. Vandkilde 1996, 236–238; Kristiansen 1998, 383; fig. 207; Kristiansen/Larsson 2005, 233; fig. 107; Bunnefeld 2016.
236 Brøndsted 1939, 44–45.
237 cf. Kaul/Varberg 2017.
238 e. g. Stockhammer 2012; Vandkilde 2016.
239 cf. Ricardo 1817; Ling *et al.* 2018.
240 Gundesen 1954.
241 Earle *et al.* 2015, 632; fig. 1.
242 Nørgaard/Pernicka/Vandkilde 2021.
243 In 2022 Vandkilde and colleagues suggested such a metal-controlling network in their article 'Anthropomorphised warlike beings with Horned Helmets' for the Late Bronze Age in Europe, 1200–750BC (Vandkilde *et al.* 2022).
244 e. g. Kristiansen/Larsson 2005; Kaul, 2004; 2005.
245 see Kaul 1998; 2004; 2005.

The characteristic female triad of amber, glass and gold can be seen to refer to the sun and its eternal journey within such a cosmos[246]. This distinctive relationship had emerged in ENBA II but may have appeared already in ENBA IB (~ Br B1) during which close ties were established with the groups behind the Lochham phase of the early Tumulus complex in S Germany. Amber and gold occasionally occur combined in female and male burials in ENBA IB, but glass beads are not recorded this early (1600–1500 BC). The triad essentially vanished from the graves at the threshold to the LNBA around 1200 BC. The few cases where ENBA III burials included glass, but no amber, could be a result of the poor preservation of amber, or possibly, that the accompanying gold objects symbolically equalled the presence of amber[247]. The horse is furthermore introduced to S Scandinavia at the time of the NBA commencement and immediately became attached to cosmological myth and social identity especially among a group of males in ENBA IB[248].

The Nordic associations between amber, the sun and the horse-pulled chariot is echoed in Greek myths (with Bronze Age Mycenaean antecedents) that narrate amber to be the tears of the sun-god Helios shed after having learnt that his son Phaeton had crashed with the Sky Chariot and died[249]. In a more detailed version, it is Helios' daughters, the Heliadai and Clymene, Phaeton's mother whose tears were transformed into amber. They mourned him on the banks of the mythical river Eridanus which he fell into. Seeing their sorrow, Zeus turned them into poplar trees, but they were still crying and while their tears were falling into the water, they transformed into amber[250]. Interestingly, Eridanus is often thought to be the present river Po in N Italy[251] with ample evidence of amber workshops nearby[252]. Eridanus is sometimes thought to be a great river in the North[253] where the amber-rich Hyperboreans resided according to the Greek historian Herodotos[254]. Similarly in Egypt, amber was associated with the tears of the sun god Amun-Ra[255]. A relationship between Scandinavia and the Aegean in the Bronze Age is well attested through evidence of exchange of, notably, amber (see Fig. 7B). The mythological link between amber and the sun established in Greek myths thus assists the archaeological evidence in providing a possible frame of interpretation for the symbolic role of amber in the NBA and beyond[256]. Baltic amber reached the Mycenaean Aegean in sizeable amounts from around 1700 BC as shown above[257].

Keeping these salient links in mind, the social identity bound up in the access to and control with amber may also have entangled with cosmological insights and roles. Perhaps those distinguished individuals buried with amber were not merely regulators of the trade or economic controllers. Rather, their authority was backed by ritual and cosmological expertise and knowledge not generally available; in a manner of speaking shrouded in secrecy, shared by a group of powerful people[258]. This might have been what enabled and legitimized the level of social control suggested by the restricted personal use of amber. Most burials with amber belong in the period at the floruit of the Nordic Bronze Age in terms of material culture and far-distance networks, i. e. ca. 1500–1300 BC. The vast majority of the numerous mounds were built in this period (Fig. 4A) suggesting a tight-knit relationship between political power and beliefs about the cosmos and afterlife. Connotations of belief, myth, and mystery may well have helped control amber availability and circulation. As such, a clearly defined unequivocal elite expressed by the number of artefact types has eluded us, and power may well have been exercised through knowledge and access to specialist cosmological information and associations[259] not immediately visible in the number or character of artefacts included in the grave.

3 Amber and solar symbolism in action

How do we best understand the minuscule amounts of amber included in the amber-bearing graves if the interred individuals are to be understood as particularly powerful, endowed with that rare access to amber? These burials most often held just a single amber piece. It may not always be the most eye-catching objects that mark various identities of belonging at work in a particular setting[260]. In the setting of burial and even in the lived life of the deceased, one bead or lump of amber may well have been a clear symbolic statement of a life entangled with trade[261]. By approaching

246 Kaul/Varberg 2017, 378.
247 Kaul/Varberg 2017, 378.
248 Kveiborg 2019; Kveiborg/Ahlqvist/Vandkilde 2020; Librado *et al.* 2021.
249 cf. Bouzek 2007; Kaul/Varberg 2017, 382.
250 Diodorus Siculus, Library of History 5. 23. 2; Rasmussen 1991.
251 e. g. Jeserich 2016.
252 e. g. Bellintani 2014.
253 e. g. Gimbutas 1958.
254 Romm 1989.
255 Gestoso Singer 2008.
256 cf. Maran 2012; Lomborg 1967.
257 cf. Harding/Hughes-Brock/Beck 1974; Harding/Hughes-Brock 2017; Czebreszuk 2011; 2013.
258 Hayden 2018.
259 cf. Hayden 2018.
260 Hodder 1982.
261 cf. Varberg *et al.* 2015; Kaul/Varberg 2017, 382; Woltermann 2016, 81.

other aspects of amber's properties – digging deeper than the symbolic meaning – we suggest that amber and the other artefacts in each burial could be endowed with active roles. Such agency was arguably implemented via the inclusion of amber in combination with specific other artefacts as grave good[262].

A certain level of standardisation is expressed in the ENBA graves, particularly regarding gendered appearances[263]. Simultaneously, there is remarkable variation among the known burials. Each burial assemblage transpires as a palimpsest of the buried individual anchoring this person to real world events and lived episodes while each object perhaps recalled its acquisition and successive histories[264]. It follows that the identity of the deceased was composed of a network of relations tied to the objects in the grave[265]. Depositing amber with the deceased transferred the perceived properties of that material to the human buried alongside it. Such relational identity of things, histories and humans in a network was first conceptualised in anthropology[266] and since then taken up in archaeology[267]. The concept has especially been applied to the study of burials and of NBA epistemologies[268]. In our case it boils down to the nexus of objects and connotations, which helped construct the identity of the buried Bronze Age person. Carefully selected objects and their specific temporalities became assembled in one single accumulation[269]. It is therefore not surprising that the burials include but one amber item; nothing more was necessary to invoke the networks of exchange near or far.

The foreign elements included in the burials – normatively adhering to NBA prescriptions – are extra potent in this light. The inclusion of 'exotica' provides a physical link to a still active foreign place; rather than passively representing this site. In a sense, the link between the deceased, the foreign place and the next of kin is renewed by placing the object in the grave[270]. Thus, the presence of jet, glass beads, and imported dress pins in certain female burials need not merely refer to past transaction or one-time journey abroad; rather, these objects actively imbued the amber-bearing women with distinct *extra*-Nordic capabilities and functions. Upon death, their composite identity was re-performed by the careful inclusion and choreography of artefacts in the burial[271]. Accordingly, each of these outstanding female burials of the ENBA could through their objects activate a web of connections locally and supra-regionally, emphasising and maintaining the network of amber and metal trade even in death.

Male relational identities and narratives were expressed in amber-bearing burials in similar ways by evoking a scalar network embracing local to supra-regional tracks and movements[272]. Nordic warriorhood is strongly present in these assemblages in addition to ties to Lüneburg and Tumulus type warriorhood along the westerly amber track. These connections are especially explicit in ENBA IB when the Nordic Bronze Age commenced. The Dyssegaard-Gundsømagle warrior burial[273] can exemplify how the expression of different social belongings are pooled in one assemblage. In rarer cases, the assemblage comprised Aegean elite settings[274].

These relationships were probably rendered very tangible in the minds of the Bronze Age people by the inclusion of these specific objects in burials. Collections of amber and glass beads by the arm of the buried women translate as wristbands, whereas the amber lumps at Egshvile[275] (Figs. 3B–C), Debel[276] and Hårup[277]were packed compactly, mimicking the unworked amber packed in the trade caches. In the Hårup burial, a dagger and a single amber bead were placed outside the belt pouch holding 30 amber lumps, suggesting differing norms pertaining to beads and to raw material. On the other hand, the two amber objects included in the well-known ENBA III burial at Hvidegaarden[278] were both located inside the leather pouch worn in a belt around the man's waist. The pouch with the suite of peculiar objects likewise invoked different cosmological spheres and places near and far, such as the seashell from the Mediterranean[279]. The ENBA II male burial at Valleberga in Scania (Fig. 5B) compares very well with Hvidegaarden: Both align with a warrior's identity with a twist of magic. The Valleberga burial included a similar pouch worn on the belt along with classically male items. A cosmetic stone recalls the one deposited in the lavishly furnished female grave in Tobøl[280] who wore a four-spoked wheel on her belly, de-

262 cf. Harrison-Bruck/Hendon 2018.
263 Sørensen 1997; 2013; cf. Brück 2004; Sofaer 2008.
264 cf. Chapmann 2000; Brück 2004; Fowler 2016; Brück/Jones 2018.
265 Ingold 2007; cf. Maran 2012, 158–159.
266 Strathern 1988.
267 e. g. Bjørnevad-Ahlqvist 2020.
268 cf. Jones 2007; Goldhahn 2019; Oma 2020.
269 Jones/Brück 2018; cf. Bjørnevad-Ahlqvist 2020.
270 cf. Helms 1988; Brück/Jones 2018.
271 cf. Felding 2020.
272 Hägerstrand/Pred 1981.
273 Aner/Kersten 1973, 451I.
274 such as the Kirke-Værløse burial: Aner/Kersten 1973, 364; Kaul 2017
275 Haak Olsen 1992.
276 Aner/Kersten 2008, 5654.
277 Aner/Kersten 2014, 6451A.
278 Aner/Kersten 1973, 399.
279 Goldhahn 2006; cf. Lomborg 1956; 1966b.
280 Aner/Kersten 1986, 3919B. Føvling, Ribe, SV Jutland.

scribed earlier (Fig. 3E). By the tip of the Vallerberga man's sword lay a rare conical amber button[281].

Given the careful staging of ENBA burial contents, the presence of amber in these contexts surely is significant. Amber is a material with extraordinary properties; it is electrostatic, surprisingly light and warm to the touch and floats on water, which could be perceived as indicative of inherent magical powers. Its colour may invoke solar symbolism or associations with gold[282]. Other findings with amber point in the same general direction of relational identities and, coupled with the general cosmological significance of amber, this suggest that Bronze Age people viewed amber as a mediator or facilitator of relations with the Sun.

Key research contributions to the study of NBA ritual and ontology suggest a cyclical worldview structured by the sun's movement and return. This rotational dogma materialised in the construction of mounds, in the ornamentation on metalwork and on rock art[283]. Such relations may materialise in a unique object consisting of an amber disc mounted in a bronze device, often referred to as 'the sun-holder' (Fig. 5A). The amber inlay is very thinly worked to cover a wheel cross only emerging when light shines upon it. This small object has iconographic parallels in rock carvings exhibiting anthropomorphs onboard ships while holding wheel crosses, *inter alia* at Tanum in Bohuslän, W Sweden. A thick, likewise worked amber disc – recently unearthed in an urn burial in Viborg central Jutland – has been interpreted as a parallel to the 'the sun-holder'[284]. Sunburst motifs abound on metal objects throughout the NBA (1600–500 BC), notably in the omnipresent spiral ornamentation of ENBA II and the wheel cross motif found for example in rock art and as the spoked wheel in the Tobøl burial. The design reappears in the structuring principle of ENBA mounds where perpendicular stone settings encircled by another line of stones form a wheel cross foundation[285]. Since the wheel cross only materialises when light or sunrays hit its surface, the aforementioned 'sun-holder' is a tangible link between amber and these other aspects of possible sun worship. Wheel crosses and spiral ornamentation are widespread in European Bronze Age finds.

Famously, the ENBA II Trundholm Sun Chariot embodies a physical, mobile representation of the sun's movement across the sky and adds an animal helper to the scheme, a concept that develops further in the LNBA[286]. Similarly, in the NBA II hoard of Tågaborg in Scania, one twin stallion had mysterious golden amber eyes while the other twin was badly preserved lacking its head[287] so we will never know if the twin stallions matched the golden side (sky, Upperworld) and the dark side (night or Netherworld) of the Trundholm combination. Both setups probably should be considered representations of the Sun Horses[288], the amber at Tågaborg thus not only constituting parts of the horse's anatomy but signifying its sacred cosmological nature.

In summary, understanding amber as enabling a sacred connection between people and the sun provides a more nuanced perspective on the restricted use and access suggested by the limited use in ENBA graves and the far distribution network of Baltic amber. Amber is local and abundant in the North necessitating control mechanisms to secure both internal and external flows of this potential commodity maintaining its value. Bronze is by comparison foreign and scarce in the North which relied entirely on imported metal resources. Providing metal on a regular basis required both skill and knowledge if the challenges of long-distance transport by sea, land, and river were to be overcome. Safeguarding goods along the routes of transfer must have been a challenge, even in light of the likely existence of far-reaching networks of real or imagined kinship[289]. Could these coinciding requirements for amber and for metal have been taken care of by the same system? This question invites final discussions of a possible metal-for-amber logic permeating the solid long-distance trade now in evidence for both amber and metal. Their interrelationship is discussed on micro-scale as well as macro-scale.

4 Micro-scale entwinements of metal and amber

A tight relationship between amber and metal can be observed in the frequent combination of metal and amber in European assemblages of burials and hoards as well as in the observable skeuomorphic relationship between metal and amber in some finds. This may hint at an interdependency, even interchangeability between these materials and may be contingent on amber-for-metal relations on a much larger scale[290]. Valuable raw materials and forms may have functioned as substitutes for one another. This was the case between flint and metal, exemplified by the Nordic fish-

281 Strömberg 1975; Goldhahn 2006, 183–185.
282 Maran 2012, 147; Brück/Jones 2018, 243–244; Kaul/Varberg 2017.
283 Kaul 1998; 2004; 2005; Holst *et al.* 2013.
284 Slots- og Kulturstyrelsen 2019a; 2019b.
285 Holst *et al.* 2013.
286 Kaul 1998; 2004; 2005; Ahlqvist/Vandkilde 2018.
287 Oldeberg 1974, no 196.
288 Jensen 2002, 285.
289 Kaul 2022.
290 Metal more precisely means copper/bronze unless otherwise stated.

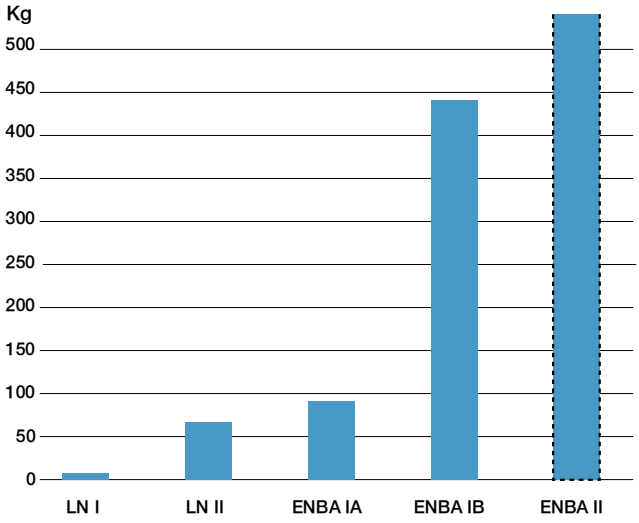

Fig. 8A: Social consumption of metal 2400–1300 BC. The ENBA II situation is indicated by the rectangle to the right with dashed line. It is an estimate based on numerous burials and hoards with metalwork[291].

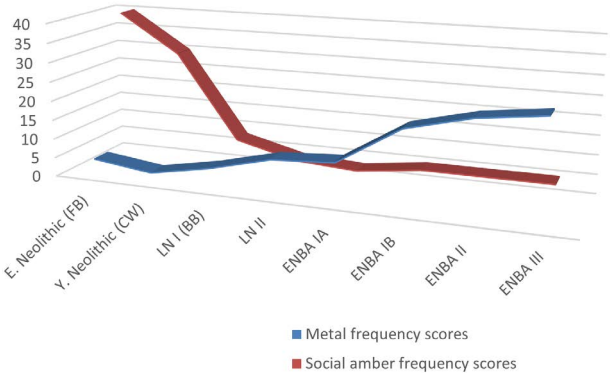

Fig. 8B: Metal-amber correlation modelled for the Danish region. Each period has received frequency scores between 1 and 100 (sum=100) regarding the frequency of the two materials. Graph scoring is based on key literature and Appendix 1[297].

tail-hilted flint dagger mimicking the Únětice metal-hilted dagger with triangular blade. The flint version has been found as far away as the Central European Únětice hubs, which in turn produced the metal dagger version in large amounts[292]. Similarly, skeuomorphic relationships also existed between amber and metal:

An amber imitation of the decorated British-type bronze flat axes was retrieved at Ejerslev Vang in Mors (Fig. 9), right at the banks of the Limfjord and close to the amber resource area of Thy[293]. Such British decorated bronze flat axes are found in LN II hoards (2100–1700 BC) treasured especially for their high value of tin[294]. Similarly, in Thy around 1600 BC, the above-mentioned hoard from Hørdum featured five amber miniature versions of oversized shaft-hole axes in bronze[295]. The amber cup from the Hove barrow in Wiltshire connects to very similar metal cups, notably the somewhat earlier Ringlemere gold cup (Wessex I). A series of such similar-shaped 'precious' cups of amber, gold, silver, and shale occur spread in NW Europe in the EBA[296], suggesting that amber was highly valued on par with gold and silver as these precious materials were used interchangeably.

Later, in the ENBA II–III sword hilts and ritual paraphernalia such as the Tågaborg horses also demonstrate such close amber-metal relationships. Furthermore, the gendered differentiation in the use of amber in graves mirrors the gender expressed and structured via bronze objects in the graves[298], adding further evidence to the suggested close relationship between the materials. Outside the Nordic area an amber-metal connection is visible in many EBA and MBA finds across Europe.

In the EBA, amber quite often combines with metal in hoards as well as in burials; some of them are mentioned in the following. The early Únětice hoard of Kyhna in Sachsen, c. 2100 BC, held many amber beads, deposited with an exotic Cypriote spearhead, small triangular dagger blade, two *Schleifennadeln*, two arm spirals, *Ösenhalsring* and other objects[299]. In the classical Únětice period, the great hoard of Dieskau II at Halle (cf. Fig 1B) combined amber and metal while the nearby Halle-Queis hoard contained numerous bronze spirals and early-type amber spacer-plates, together forming a composite necklace[300]. Females buried in the large classical Únětice cemetery of Mikulovice in Bohemia, wore elaborate necklaces of amber beads and bronze beads together forming intricate patterns[301]. In the contemporaneous aristocratic mound burials at Łęki Małe in Kujavia,

291 Fig. 8A is an updated version of the diagram in Nørgaard/Pernicka/Vandkilde 2019; cf. Vandkilde 1996, fig. 298.
292 Vandkilde 2017, 150–151; fig. 90.
293 Nielsen 2010.
294 Vandkilde 2017, 143–149.
295 cf. Vandkilde 2014a, 69–71; Jensen, 2000, 68.
296 Needham/Parfitt/Varndell 2006, 53–64; figs. 28; 30.

297 Amber data: Earlier Neolithic FBC: Becker 1947, Earle/Bech/Villa 2022. Younger Neolithic: Hübner 2005; LN II–ENBA IA: Blank 2022, appendix. Metal data: Vandkilde 1996; 2017, figs. 93; 97–100. ENBA II–III: estimated from Kristiansen 1998 and Aner/Kersten 1973–2022 ff. LN I – ENBA IA amber data is probably underrepresented hence compensated in the graph.
298 e. g. Sørensen 1997.
299 Coblenz 1986.
300 Woltermann 2016, 135; fig. 81.
301 Erneé *et al.* 2020.

Fig. 9: Amber imitation of ornamented British-type EBA bronze flat axe. From Ejerslev Vang, Mors, NW Jutland. Photo Heide Nørgaard.

amber was combined with bronze and gold[302]. In the latest EBA (Br A2c/ENBA IA), the Tinsdal hoard (Holstein near Hamburg and the river Elbe) contained ten disc-shaped amber beads together with various bronze ornaments and weapons, all deposited in a pot[303]. Later in the MBA, elaborate Tumulus necklaces are likewise known to combine amber and metal, and even glass in prominent females' burials[304].

Together, these finds indicate a close relationship between amber and metal throughout the long EBA-MBA period. Evidence of both amber and metal is infrequent in settlement contexts, but it should be mentioned that the fortified EBA site of Bruszczewo, near Łęki Małe, revealed that both amber as well and gold had been processed there[305]. In sum, a tight relationship emerges between metal and amber in the EBA into the MBA, and across borders. An astonishing example of this is the assertive presence of amber colliers in rich female burials in the Tumulus groups, in Wessex as well as in early Mycenean palatial burial grounds up against their absence in S Scandinavia where amber had more emblematic uses[306]. Nordic females in the echelons of power instead wore a massive neckring collar of bronze, for example the Ølby woman (Fig. 3D)[307].

These EBA and MBA cases may indicate that metal and amber were interchangeable when these materials moved along the long-distance trading routes unveiled above. During continued circulation local rules and values prevailed, but it is striking how the symbolic meaning of amber persisted even if expressed in different ways in the local communities. The networks and connections referenced in the ENBA amber burials and the cosmological significance of the translucent, golden substance hint at its potential as exchange item valued among the receiving parties for its rarity and visual exotic and cosmological qualities, which is mentioned in Homer's Odyssey[308]. Amber and metal had different but overlapping qualities and originated in opposite ends of this network geographically speaking. Both were highly desired commodities linked to each other's trajectories, but did this tight relationship on the micro-scale implicate a systematic metal-for-amber trade?

5 Macro-scale entwinements of metal and amber

This section elevates the previous discussion to the macro-scale of Europe while paying attention to key regional players in north, west and central Europe. Despite lack of metalliferous resources of its own S Scandinavia played a lead role owing to the abundance of amber locally (cf. Fig. 1C). Especially the MBA amber dispersal leaves little doubt about the Nordic origin of most of the amber found in other parts of Europe at this time. All the same, the quantity of metal imported to Scandinavia multiplied from the Late Neolithic into the Bronze Age with a distinct peak in ENBA II 1500–1300 BC. To judge from the number of mound burials alone (>5000 ENBA burials), many furnished with metalwork, we can assume that by ENBA II copper must have arrived in tons (Figs. 8A, cf. Tab. 4).

The analysis section could demonstrate that amber tracks and adjacent hubs changed over time in step with the likewise changing geochemical signatures obtained

302 Kowiańska-Piaszykowa 2008.
303 Hachmann 1957, no. 236.
304 e. g. Woltermann 2016, 163 ff.
305 Czebreszuk/Müller 2004; 2010; Müller *et al.* 2023.
306 cf. Wiessner 1983.
307 Reiter *et al.* 2019.
308 Homer, Book IV, 73–87.

for a sizeable proportion of known metal objects dating to LN II–ENBA II, 2100–1300 BC. Persistent changes in trace and isotopic compositions revealed ubiquitous shifts in metal provenance (ore region from which the metal was extracted) between on the one hand the LN–NBA IA (EBA), and on the other hand the ENBA (MBA)[309]. It is furthermore possible in some cases to distinguish between early and late developments in each of the major periods (Tab. 4).

There is correspondence between the identified EBA and MBA amber tracks and the assumed northwards transportation of copper from the mining fields transpiring in the isotopic and trace-elemental fingerprints detected in the Danish metalwork. Major shifts in amber dispersal turn out to correspond to major shifts in metal supplies to Scandinavia. These coinciding shifts in amber and metal concur with societal transformations on a European scale. For the EBA (~ LN II–ENBA IA), the amber-receiving parties in the Wessex and Únětice regions apparently controlled the metals mined in their outskirts while trading it to customers near and far[310] (Figs. 1C, 6C). The two materials of metal and amber were clearly traded in copious amounts via these two EBA crossroads and through their regional networks. For the MBA, from c. 1600 BC (~ENBA), a similar position as crossroads hub is suggested for the Tumulus region in S Germany regarding both metals and amber[311] (cf. Fig. 7C).

6 Metal-for-amber in the Early Bronze Age

The EBA map (Fig. 6A) suggests two separate tracks in Europe north of the Alps. Both amber tracks are furthermore coupled to long-distance transfer of metals with regional crossroads hubs involved in the trade. The western EBA track may, as already suggested, have started in NW Jutland and the adjoining maritime route most plausibly ended in the Wessex region. Notably Wiltshire accommodates amber-rich mound burials in the Bush Barrrow group at Normanton Down, transforming into the Camerton-Snowshill group in the later EBA[312]. The Cornwall tin deposits figure nearby to the west, and places for landing or anchorage may have existed in the area's natural harbours. Finds of Baltic amber scattered throughout the British Isles can indicate internal transactions of amber and metal forming widespread networks linked to the main hub in the south. Similarly, a small cluster of amber finds in Brittany could derive from such secondary trading or, alternatively, points to a second exchange location for Scandinavian seafarers.

The importance of the British Isles at this early stage can also be seen in the elaborate amber necklaces furnishing rich female burials and is arguably linked to Britain's EBA status as a major supplier of copper to Scandinavia. This coupling provides a plausible explanation for the distinct presence of British copper in Nordic LN II–NBA IA society (cf. Figs 1A, 1C). The tin-rich and elaborately ornamented British bronze flat axes afforded a source for enriching the local production of low-flanged axes of 'Pile type'[313]. The mines of the Great Orme in Wales and the Alderley Edge in English Cheshire were especially important according to the geochemical traits in the copper. At the end of the era, around 1700 BC in ENBA IA a British signature is still visible in the Nordic data and metals were evidently recycled more often than previously.

The signature of the Slovakian Ore Mountains (Hron Valley) is prominent in the Scandinavian metal data throughout the EBA hence marking another key match between trajectories of metal and amber, however, along an eastern EBA track. The Slovakian copper reaching the Danish region is in this period high-impurity fahlore. Perhaps emanating from N Zealand, this eastern EBA route (Fig. 6A) crossed the Baltic Sea thereafter following the river courses to the various regional Únětice subgroups of the EBA; all of them amply supplied with amber. Concentrations of finds with amber appear in Greater Poland[314] and Silesia; additionally Central Germany with the prominent Middle-Elbe-Saale and Saxony groups then crossing the Erzgebirge to Bohemia and Slovakia – all probably connected to the dynamic Únětice groups located in these areas (Fig. 6A, 6C). The principal Únětice hub at the Middle Elbe-Saale may well have controlled much of the amber as well as major flows of metal. Other hubs existed enroute and alongside paths in the vast Únětician territory (Fig. 6C). Remarkably, several burials in the Bohemian and Slovakian cemeteries, such as Mikulovice and Jelšovce, are very rich in amber during this period[315]. The amber track ends right in the Únětice Nitra group at the western foot of the Slovakian Ore Mountains, a central supplier of copper to S Scandinavia throughout this period. In the EBA, amber only rarely arrived in the Carpathian Basin[316], which is in accord with the rarity of

309 Nørgaard/Pernicka/Vandkilde 2019; 2021.

310 Vandkilde 2017; Nørgaard/Pernicka/Vandkilde 2019; 2021.

311 Ling *et al.* 2019, 28–30; Woltermann 2014; 2016; Kristiansen/Suchowska-Ducke 2015; Nørgaard/Pernicka/Vandkilde 2021; 2022.

312 Needham/Parfitt/Varndell 2006, 61; fig. 30; Gerloff 2007.

313 Vandkilde 2017; Nørgaard/Pernicka/Vandkilde 2021.

314 especially the Łęki Małe-Bruszczewo area.

315 Bátora 1986; 2000; 2018; Ernée 2013; Ernée/Müller/Rassmann 2012; Reiter/Frei 2015; Ernée/Longovà *et al.* 2020; Jaeger *et al.* 2023.

316 Some ten amber items recorded in this study from the Carpathian Basin (Appendix 3).

Carpathian-style metal objects in the North and elsewhere at this time.

At around 2100–1900 BC, and likely following the same eastern track, a different fahlore copper had arrived in S Scandinavia, namely from the Inn Valley in the E Alps, assumedly by Únětice intermediaries who greatly valued this copper class contained in the commodity shaped as *Ösenrings*[317]. Such neckring ingots, all made of the characteristic low-Ni *Ösenring* fahlore, were originally produced in the multiple thousands in the river valleys of the E Alpine forelands. The ring ingots were traded near and far including to S Scandinavia where they for example occur in the Pile hoard as hack metal[318]. This may explain the scattered presence of amber in the same area along the Danube and its tributaries in S Germany and Austria. It is overall remarkable that the EBA pattern of amber dispersal in surprising detail concurs with the geographical dispersal of neckring ingots (*Ösenring copper*) (Figs. 6A, 6B).

The small amounts of Baltic amber dispersed in a zone following the Danube westward, bordering the Alps into Switzerland at Lake Geneva are interesting in the light of Swiss EBA finds in S Scandinavia. Swiss EBA bronze daggers decorated with *halbes Winkelkreutz* and single or double swayed V-figure on the blade, and long-stemmed flanged axes with spatulate blade decorated with a multi-lined loop figure occasionally reached Scandinavia and inspired local metalwork in the end phase of the EBA (ENBA IA). Parallels are the splendid metalwork from Thun-Renzenbühl and Sigriswill-Ringoldswil[319]. In return for amber, Swiss metalwork may have reached Únětice intermediaries and from there, some daggers and axes reached Scandinavia.

Fahlore coppers prevail during the EBA, likely because their high impurity level made them good natural alloys at a time when tin was in high demand. Towards the end of the period in ENBA IA (~ Br A2c, 18th–17th centuries BC), low-impurity chalcopyrite copper, still from the Slovakian Ore Mountains, began to arrive in Scandinavia in modest but distinct amounts. Full integration of the alloy of bronze took place synchronously. Together, this signals winds of change[320]. The close relationship between metal and amber in the EBA confirmed by geochemical signatures adds further weight to the metal-for-amber hypothesis; at this early point, amber may have been the apex of these transactions[321]. The change from intensive use of fahlores to chalcopyrites during the long transition from EBA to MBA is closely visible in geographically altered (reorganized) amber tracks (Tab. 4). The EBA and MBA dispersals of amber differ profoundly as do the metal sources (cf. Figs. 6A, 7A–7B). The Únětice collapse appears as a major push factor behind this change[322]. With the fall of this bottleneck, access to remote worlds became possible. As will appear from the following, this European-wide breaking point is mirrored in altered albeit still coinciding flows of amber and metals now passing through other landscapes with different endpoints.

7 Metal-for-amber in the Middle Bronze Age

The MBA map (Fig. 7A–7B) connects the Danish region with two, mostly land-based, European amber tracks, which may well branch into several smaller tracks as suggested already. While the western track began in the late 16th century BC, the *eastern MBA track* may have commenced around 1600 BC[323] (Tab. 4, Fig. 7A). A tentative suggestion is that this eastern track brought Carpathian novelties to Scandinavia: Hajdúsámson-Apa-Téglás type swords and daggers of the Koszider period[324]in addition to Middle Danubian Tumulus metalwork such as Au-Valsømagle-Zajta type swords and related warrior gear[325]. Oppositely, amber started arriving in sizeable amounts in the Carpathian Basin and the Transdanubian Plain at this exact time[326]. A reasonable explanation is that Nordic amber was exchanged in return for high-quality Carpathian-style metalwork much desired in S Scandinavia. These various Carpathian-Basin styles even inspired local Nordic derivations such as Fårdrup-type shaft-hole axes, scimitars of Rørby type, Bagterp-type spearheads, local-made Hajdúsámson-Apa swords and daggers in addition to the daggers and short swords in the Sögel-Wohlde burial assemblages. That these remotely situated regions shared preference for spirals and geometric ornaments forming symbolically charged figures is hardly coincidental. The identical ritual 'drums' from Balkråka (Scania) and Hasfalva (Hungary) further point to intimate connections along an eastern amber track in the early MBA[327].

317 Krause 1998; Nørgaard/Pernicka/Vandkilde 2020.
318 Vandkilde 2017.
319 Vandkilde 1996, 216; fig. 226; Strahm 1972, 99; Abels 1972, Appendix 57–61.
320 Nørgaard/Pernicka/Vandkilde 2021.
321 cf. Vandkilde 2020.
322 cf. Meller/Bertemes 2010; Meller *et al.* 2011.
323 Even 1700 BC is a possibility; cf. Stockhammer *et al.* 2015, Massy/Stockhammer 2019; Brunner *et al.* 2020.
324 Bóna 1975.
325 cf. Lomborg 1966a; Vandkilde 1996; 2014b.
326 cf. Jaeger 2016.
327 e. g. Vandkilde 2014b, 615; fig. 5.

With the new chronology for the introduction of the domestic horse for riding and traction[328], this easterly track could very well have brought the first horses from the Carpathian Basin to Scandinavia around 1600–1500 BC. Here the presence of the horse is evidenced in ENBA IB driving gear and in details in clothing which render lively horse heads. This is the period when the Nordic Bronze Age consolidated and attracted loads of incoming metal to fuel the rise of the region as a distinct socio-cultural zone within Europe's booming MBA.

This eastern amber track is closely matched by chalcopyrite copper from the Slovakian Ore Mountains (Hron Valley) and from the E Alps at Mitterberg where mining was prominent at this time producing copper in multiple tons[329]. Chalcopyrite coppers from these two mining locations arrived in Scandinavia where it was used in the local Fårdrup-Hajdúsámson-type and Valsømagle-type bronzework[330]. The closely related hoard finds from Nebra in Sachsen-Anhalt and Apa, Hajdúsámson and Téglás in the Carpathian-Transdanubian crossroads display very similar geochemical signatures also suggesting ore provenances in the Slovakian Ore Mountains as well as in the Mitterberg in the Austrian Alps[331]. Overall, there is a close match between amber moving along the eastern MBA track and the chalcopyrite coppers in use along the long stretch from the Danish region to the Carpathian Basin and the Transdanubian Plain. The running of this eastern track probably dates to the earliest part of the MBA (~Br B1), i. e. ENBA IB. The long-range dispersal of Carpathian style weaponry further corroborates the existence of metal-for-amber mechanisms, which in turn generated a lively culture of local appropriations of the exotic and foreign[332].

The Scandinavian metalwork dating to ENBA IB furthermore reveals a British signature implying that the mines at the Great Orme and Alderley Edge still produced copper that reached Scandinavia in the 16th century BC. Amber frequency seems unchanged in Britain highlighting a still amber-reliant Wessex and indicating a continued connection to Scandinavia. Interestingly, the map may be seen to suggest a cross-channel route from the Rhine estuary to the mouth of the Thames, the 'track' ending in Cornwall. By ENBA II from c. 1500 BC, British copper can no longer be detected in the Danish metalwork[333], but Cornish tin is very likely to have been traded in excessive amounts in the MBA.

NW Jutland and the Jutland Ridge were the starting points of the *western MBA track* (Tab. 4; Fig. 7B). In ENBA II, the journey first went to the Lüneburg area and then further southward to the various MBA Tumulus groups in S Germany. The amber track continued across the Alps to the Po Valley and from there as far as, and even beyond, Late Mycenaean Greece. Remarkably, this is the first visible trace of any transalpine amber traffic, likely initiated c. 1500 BC at the time when copper was increasingly mined in the Italian Alps in S Tyrol. In Scandinavia, this north Italian Trentino-Alto-Adige chalcopyrite is sporatically present in ENBA IB, as the thorough investigation of the Fårdrup and Valsømagle axes revealed[334]. In ENBA II c. 1500–1300 BC this copper became the by far most important copper source for metalwork production in S Scandinavia. A metal-for-amber principle of exchange can explain the predominance of this N Italian chalcopyrite in Scandinavia *and* the great amounts of amber travelling in the opposite direction, even crossing the Alps near the relevant mining fields in Trentino-Alto-Adige. On its journey, amber was amply traded with Tumulus communities in S Germany – a major crossroads likely exercising control of the flows of amber towards south and metals towards the north.

The largescale, almost frenzied building of burial mounds and conspicuous consumption of metals and luxuries in Scandinavia[335] may then be linked to the import of Italian sourced copper in large amounts as well as export of amber in large quantities. In this both local and global process, the amber carried with it new but rather similar meanings in the MBA worlds[336]. What we have identified here is what is often referred to as the Amber Road in previous research. The importance of the N Italian copper is stressed as well, notably used for the characteristic octagonal-hilted swords common in the North and in the S German Tumulus complex in ENBA II/Br B–C, around 1400 BC[337]. The trifecta burials with amber, glass and sometimes gold occur spread from S Scandinavia to S Germany and beyond[338] (Fig. 7D) hence providing strong support for the importance of the western track for the metal-amber trade.

328 Librado *et al.* 2021; cf. Kveiborg 2019.

329 Berger *et al.* 2022; Nørgaard/Pernicka/Vandkilde 2021; Pernicka/Lutz/Stöllner 2016; cf. Bunnefeld 2016, 165.

330 cf. Lomborg 1966a; Brügmann *et al.* 2018; Nørgaard/Pernicka/Vandkilde 2021; 2023.

331 Pernicka 2010; Pernicka/Lutz/Stöllner 2016; Pernicka *et al.* 2016; Brügmann *et al.* 2018; Berger *et al.* 2022.

332 see Vandkilde 2014b.

333 Nørgaard/Pernicka/Vandkilde 2021; 2023.

334 Nørgaard/Pernicka/Vandkilde 2023.

335 cf. Holst *et al.* 2013.

336 Ling *et al.* 2019; Nørgaard/Pernicka/Vandkilde 2021; cf. Kaul 2017, 46.

337 e. g. Bunnefeld 2016, 167; 168; Ling *et al.* 2019.

338 Bellintani (2014, 115–119) mentions occurrence of glass beads in the Po Valley during the MBA. He notes Tumulus impact in MBA burials, specifically the amber-rich Olmo di Nogara cemetery.

Though amber reached the Aegean while glass beads travelled in the opposite direction, this southernmost part of the chain did apparently not engage in trading copper-based metals to central and northern Europe at this time.

8 Metal and amber – A persistent and expansive partnership

The dispersal of EBA amber is consistent with evidence for Nordic use of three metal sources namely the Inn Valley in the E Alps, the Slovakian Ore Mountains and Britain. By contrast and now exclusively chalcopyritic copper, the dispersal of MBA amber is in the early phase consistent with continued evidence for Nordic use of copper sources in Britain and the Slovakian Ore Mountains in addition to Mitterberg in the E Alps. In the late MBA phase, however, chalcopyrite from the Trentino of the Italian Alps had become entirely dominant. The breakthrough of the Nordic Bronze Age remarkably links up with radical changes in amber dispersal from the EBA to the MBA, around 1600 BC, producing new opportunities afforded those involved in this lucrative business.

The EBA and MBA dispersals of amber deviated profoundly to the extent that the reorganised amber tracks of the MBA still, with a handful of notable exceptions, avoided the large geographical area formerly occupied by Únětice groups (Figs. 6–7). The Únětice downfall around c. 1600 BC was a major factor behind this change, as it allowed or even pushed an expansion of trading tracks into new territories beyond high mountain ridges. This can be explained in terms of a fundamental metal-for-amber logic where demands for these valuables grew enormously in the MBA. Other luxuries, especially glass, became part of this network and probably travelled along the same tracks of trade. The Mediterranean early trade and consumption of amber may have differed in the sense that the tie to metal circulation in the Aegean is less evident albeit the cargo of the Uluburun wreck can be interpreted in terms of metal-for-luxuries on a far larger and clearly economic scale[339].

Conclusion – Worsaae's notion confirmed

Worsaae's notion[340] of a metal-for-amber trade is corroborated as well as nuanced by the clearly correlating shifts in amber distribution and the composition of Danish metal artefacts, as well as the coinciding tracks of amber and metal throughout. Intimate amber-metal relationships have been detected on scales from small to very large involving both objects and humans. Indeed, metal-for-amber almost certainly was the very logic underpinning European-wide connectivity already from 2100 BC.

Societies could change rapidly and sometimes they did, but the codependent trading of amber and metals shows remarkable resilience by readily adapting to the new times. On the backdrop of an utterly changed Europe in the MBA, there is still tight coherence between amber and metal and the altered tracks of trade. The Nordic region and the Aegean were the start- and endpoint in this long-range trade *and* communication network, which may explain labrys and sun symbolisms in both regions. Humans and luxuries of glass and weaponry also moved as did innovations and ideas about the world. Radical societal changes at the end of the EBA did not hamper this basic principle for trading. The North Sea/Baltic Sea amber resources constituted the stable point of departure for the metal-for-amber trade able to redirect trading activities toward alternative tracks and ore areas under industrial exploitation.

Extended summary and conclusion

This paper has investigated the relationship between amber, metals and humans on scales that first consider Nordic consumption of amber at the artefactual, local, and regional levels thereafter upscaling to the European dispersal of amber and metals, patterns therein and major developments over time. The most important result is the presence of tight amber-metal relationships on scales from small to very large involving both things and humans. The findings should be understood on the background of previous studies often operating within a smaller geography or relying on a smaller dataset. Motivated by the metal-for-amber conundrum first put forward by Worsaae in 1882 we here rely on an extensive dataset of amber in Europe dating to 2100–1200 BC in addition to a recent advance in isotopic and trace elemental signatures covering metalwork from the same period.

The results of this study can confirm the lead argument of metal-for-amber exchange, namely that when the amount of amber decreases the volume of metals increases (Fig. 8B). In the present-day area of Denmark, which forms a key case study area in this paper, the social consumption of amber dropped markedly after 2100 BC in the Late Neolithic period (LN II) when metallurgy first became fully integrated in Nordic society. This early amber falloff predicts the so-

339 cf. Ialongo *et al.* 2021; cf. Vandkilde 2021.
340 Worsaae 1882, 46.

cially constrained context of amber in the flourishing Early Nordic Bronze Age (ENBA), 1600–1200 BC. In other words, the notable bust in amber setting forth around 2100 BC can indicate a first step towards an effective social control of amber, consolidated in the ENBA.

One prior expectation was that ENBA individuals with amber would transpire clearly as an elite group through the various analyses. However, a well-defined and unequivocal elite expressed by the number of artefact types could not be distinguished. High status individuals could easily be picked, but no circumscribed elite stratum. In the analyses, however, amber as a grave good was constrained to a small minority of burials (132 out of the > 5000 ENBA burials below mounds). The social identity mediated by these amber-bearing individuals, including men and a disproportionally high number of women and even some children, appear to align with gendered roles and practices involving amber. This may have sustained new mechanisms of social control that were fostered to manage amber and its movements as trade good. Three geographical densities of ENBA amber burials situated at key crossroads could clarify NW Jutland as the primary provider of amber utilizing the North Sea deposits. From here, amber was transferred to regions near and far, including nearest neighbours along the Jutland Ridge and in N Zealand being key connecting points to continental Europe.

Even though amber items were infrequent in the ENBA they were more frequent than assumed previously. Amber was still a valued material with unique qualities, during this phase. Interpreting metal as outranking amber as prestige-good does not suffice as a satisfactory explanation. Rather, amber likely became commodified and managed through social control mechanisms embedded in cosmological beliefs. Access to these spheres and detailed knowledge about them may have been restricted and associated with certain personae and identities; on par with other institutions such as warrior fraternities. If so, this would accord with the fact that the dispersed group of amber-bearers was small, but rich in symbolic markers.

The confined group of amber-bearers shared a gendered display of grave goods comprising expressions of foreign connections alongside cosmological allegiance; main signifiers were shared with Tumulus groups and, it seems, underpinned by relational identities connecting people, things, and places. Most often, only one bead (mostly females) or one lump (males/ungendered) is present as a symbolic marker of identity among this interconnected subset of amber-bearing females and males in the North. The symbolic triad of yellow amber, blue glass and shiny gold was confirmed among a distinctive faction of females whereas equally distinctive males with amber were portrayed as warriors, including the use of amber-inlayed weaponry. Both stand out particularly through foreign objects, but the context is clearly Nordic. Identity should probably be understood as relational and therefore one item of amber included in the burial could refer to real-life possession of larger amounts of amber along with a social capital of personal networks of people, things, and places. Associations between amber and the sun were prevalent in several of the areas involved with the amber trade suggesting that its significance was symbolic as well as economic.

The same patterns pertained to regional and trans-regional networks, but here amber occurs much less constrained in the number of beads per burial or hoard. Whereas amber was to a substantial extent commodified in the Northern homeland, this material was in the hubs of Europe transformed into inalienable possessions and markers of high status especially in the female sphere. It is possible that amber could retain alienability in the setting of metal trading.

The European distribution of amber changed markedly from the EBA to the MBA. It is even more significant that the shifts in amber distribution correlate tightly with the geography of metal sources used in the EBA and the MBA respectively. This further corroborates that flows of metal and amber depended on one another and therefore can support the notion of metal-for-amber trade. Throughout the investigated period, amber destined for long-distance trading passed through intermediate stations; the crossroads hubs portrayed above. This can indicate that the metal-for-amber trade was organized and controlled through such junction or transfer points whose geographical position, however, shifted markedly from the EBA to the MBA hence forming part of a major historical turn. What is truly remarkable is the coinciding shifts of amber and metals in a time-space perspective:

In the *European EBA* 2100–1600 BC (~ LN II–ENBA IA) amber reached Wessex and Únětice hubs whereas it rarely passed into the Carpathian Basin nor crossed the Alps routinely at this time. Strikingly, the first metal boom in S Scandinavia, 2100–1600 BC, correlated with large amounts of amber in the very hubs that supplied copper/bronze to metal-poor but amber-rich Scandinavia, namely the British Isles, the Inn Valley in the E Alps, and the Slovakian Ore Mountains: predominantly high-impurity fahlores and characteristic EBA objects made from these coppers. Flows of amber and metal from these specific sources appear to have been controlled by prominent hubs in Wessex and the principal Únětice region at the Middle Elbe-Saale in Central Germany respectively (Fig. 6). Both these crossroads hubs thrived on accruing and redistributing copper, tin and gold from their neighbourhoods while attracting plentiful Nordic amber in

return for their metals. Sizeable amber concentrations occur in the Early Mycenaean crossroads hubs at Pylos in Messenia and Mycenae in Argolis, probably owing to maritime connections with the Wessex hub around 1700 BC. It is significant that aristocratic metal/amber-controlling hubs already in the EBA were to a considerable extent interlinked despite the long distances separating them. The Únětice decline from c. 1700 BC and its final collapse c. 1600 BC are key factors in a complete transformation in the metal-for-amber setup. Minor changes in copper ore to Scandinavia in the final EBA forecast major geopolitical changes at the outset of the MBA.

A clearly deviating dispersal of amber as well as metals is attested in the *European MBA* 1600–1200 BC (~ ENBA IB–III), reflecting that the EBA Únětice intercommunity with its main crossroads at the Elbe-Saale had by now disappeared (Fig. 7A–7B). British copper still reached early MBA Scandinavia hence can account for amber finds in S England. Importantly, an *eastern amber track*, c. 1600–1500 BC, likely commenced in N Zealand crossed the Baltic Sea and went by land and river all the way to the Carpathian Basin and the Transdanubian Plain. The metals flowing along this track are all chalcopyrites from the Slovakian Ore Mountains and from Mitterberg in the Austrian Alps. These metals were systematically exploited for making metalwork of Koszider and Hajdúsámson-Apa type travelling from the rising Carpathian-Basin crossroads all the way to SE Scandinavia. This eastern amber track possibly in part drew on Sambian amber.

NW Jutland and the Jutland Ridge were thereto starting points of a *western track* connecting with flourishing Tumulus hubs in northern and Central Europe while continuing, for the first time, across the Alps to the Po Valley and Apulia, with sea-links to Late Mycenaean Greece. Amber's first crossing of the Alps concurred with industrial extraction of Trentino-Alto-Adige copper, which was traded north in increasing amounts from c. 1500 BC. This N Italian chalcopyrite became dominant in S Scandinavia in ENBA II and can together with the amber explain the multitude of links between the ENBA and the Tumulus complex, especially at crossroads in the Lüneburg region and in the fertile river plains of S Germany. This can also explain the striking affluence of these vibrant MBA societies boasting connected histories.

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