Kinship, status, and mobility in the Bronze Age Lech Valley

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Zusammenfassung

Verwandtschaft, Status und Mobilität im bronzezeitlichen Lechtal

Während der mitteleuropäischen frühen Bronzezeit, die von zunehmender Mobilität und Austausch geprägt war, traten hierarchische Gesellschaftsstrukturen hervor. Belege hierfür finden sich in den ungleichen Bestattungszeremonien, wie das Auftreten von Fürstengräbern in der Region der Aunjetitzer Kultur. Solche vermeintlich überregionalen Eliten wurden in den archäologischen Befunden in Süddeutschland aus dieser Zeit nicht beobachtet. In dieser Region lebten viele kleine Gemeinschaften, die einzelne landwirtschaftliche Gehöfte bewirtschafteten. Die mit diesen Gehöften assoziierten Gräberfelder brachten jedoch archäologische Funde zu Tage, die die Region in ein weiterreichendes mitteleuropäisches Netzwerk einbetten. Sie legen sogar Statusunterschiede innerhalb von Haushalten nahe.

Eine ganzheitliche Herangehensweise, welche genetische, isotopische, archäologische, metallurgische und anthropologische Daten von 107 endneolithischen bis mittelbronzezeitlichen Individuen kombiniert, die in der Mikroregion des Lechtals in der Nähe von Augsburg ausgegraben wurden, erlaubt uns Einblicke in beispielloser Auflösung in die Dynamiken von sozialem Gefüge und Mobilität zu gewinnen, die den Epochenwandel vom Neolithikum zur Bronzezeit begleiteten. Wir sehen, dass diese Gemeinschaften Teil eines lange Zeit bestehenden exogamen Mobilitätsnetzwerkes waren, das weitreichende Kontakte gestärkt haben muss.

Reichtum und/oder Status innerhalb der Haushaltsgemeinschaften hingen auch mit biologischer Verwandtschaft zusammen, was die Anhäufung von wertvollen Grabbeigaben innerhalb patrilinealer Mehrgenerationsfamilien vermuten lässt. Die naturwissenschaftlichen Analysen zeigten, dass einige Frauen, die – nach den Beigaben zu schließen – in den Bauernhöfen des Lechtals ein hohes Ansehen genossen, in mindestens 350 km vom Lechtal entfernten Regionen aufwuchsen. In den Haushalten lebten zugleich Individuen von geringerem Status, die mit niemandem genetisch verwandt waren. Hier deuten sich komplexe Haushaltsstrukturen an, wie sie in ähnlicher Weise aus dem antiken Griechenland und Rom etwa 1500 Jahre später bekannt sind, und bezeugen eine lange Geschichte sozialer Ungleichheit innerhalb von Haushaltsverbänden.

Summary

During the Central European Early Bronze Age, a time of increasing mobility and connectivity, hierarchical societal structures emerged. Evidence for this proposal is based on the inequality of burial ceremonies, such as the establishment of princely graves in the regions of the Únětice Culture. Such putative supra-regional elites were not observed in the archaeological record of Southern Germany at the time, which attests to many small communities operating single farmsteads. The cemeteries associated with these farmsteads, however, reveal archaeological finds that connect the region to a wider Central European network and suggest status differences even within households.

A holistic framework combining genetic, isotopic, archaeological, metallurgical and anthropological data from 107 Final Neolithic to Middle Bronze Age individuals excavated in the microregion of the Lech Valley near Augsburg provides us with an unprecedentedly high-resolution insight into the dynamics of social interaction and mobility that accompanied these cultural transitions. We find that the communities were part of a long-standing exogamous marriage network, which would have strengthened wide-ranging contacts.

Wealth and/or status within the household community was generally correlated with biological relatedness, suggested by the accumulation of valuable grave goods within multigenerational patrilineal families. We detect the presence of unrelated, high-status women, who grew up in regions at least 350 km from the Lech Valley. Unrelated, lower-status individuals were nevertheless part of the same households, a social organization that anticipates similar complex household structures known from ancient Greece and Rome some 1500 years later and attests to a deep history of social inequality within kin groups.

Introduction

After overcoming many »teething troubles« (Hagelberg et al. 2015), the study of ancient DNA has proved instrumental in unravelling some of the most contested and long-standing major questions in European prehistory, such as the mode of the Neolithic transition (e.g. Skoglund et al. 2012; Lazaridis et al. 2014), or the human migrations at the onset of the European metal ages (e.g. Allentoft et al. 2015; Haak et al. 2015). In the latter case, the study of ancient genomes has documented the spread of a type of genetic ancestry that first emerged among early pastoral groups from Eastern Euro-

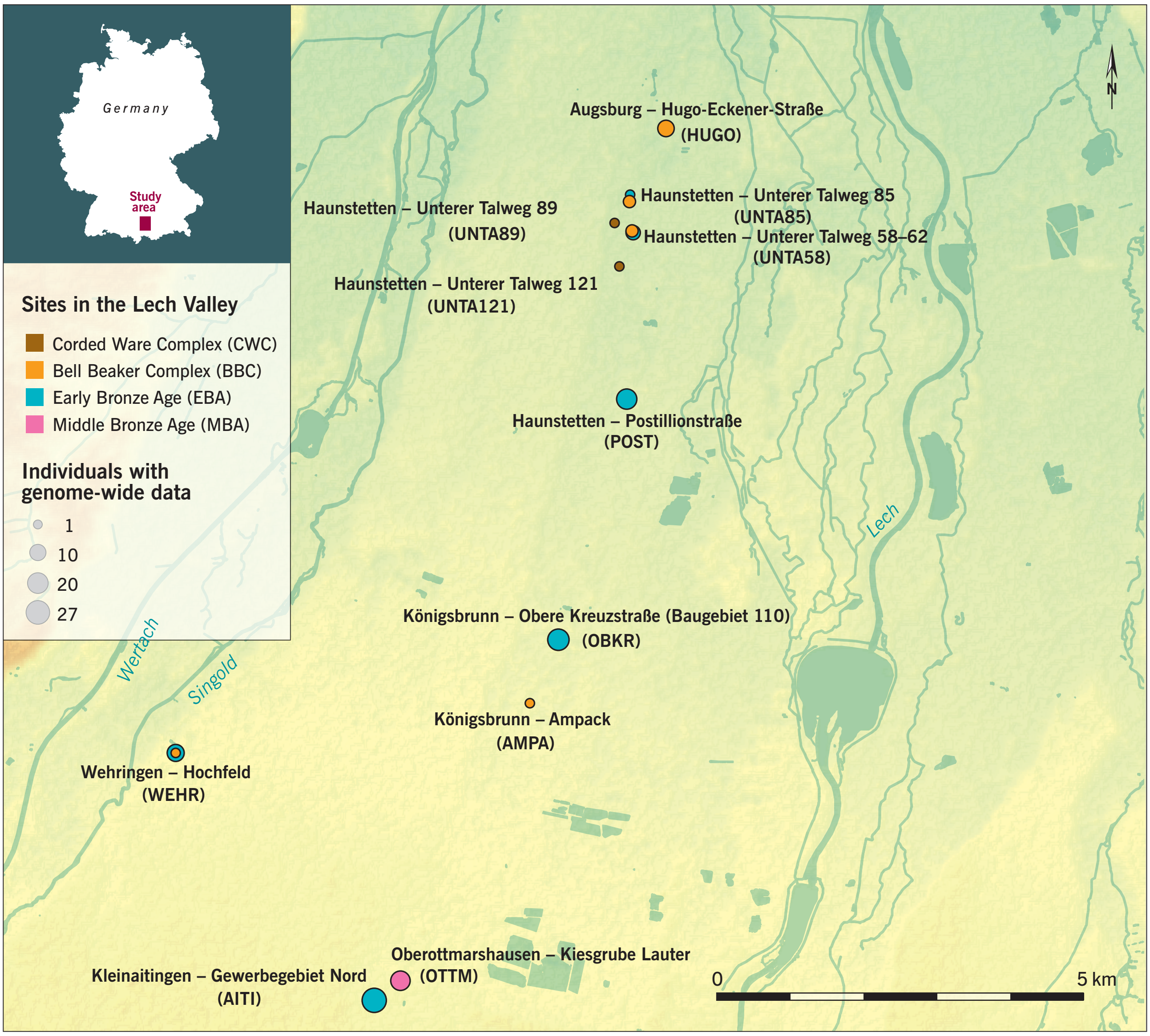


Fig. 1 The studied microregion of the Lech Valley in southern Germany and sites with genome-wide ancient DNA data. Sites are mapped and marked according to their chronological assignment and are labeled with full site name and abbreviation.

Abb. 1 *Die untersuchte Mikroregion des Lechtals in Süddeutschland und die Fundstellen mit genomweiten alten DNA-Daten. Die Fundstellen sind nach ihrer chronologischen Zugehörigkeit eingefärbt und jeweils mit dem vollen Fundstellennamen sowie Abkürzung angegeben.*

pean steppes and forest-steppes into Eastern and Central Europe in the early 3rd millennium BC, and its subsequent dispersal throughout Europe by the early 2nd millennium BC, and which was associated with newly emerging cultural complexes such as the Corded Ware and Bell Beaker cultural complexes[1]. While these findings have given some insight into the broad sequence of events during those tumultuous eras, questions remain as to how fine-scale dynamics, involving the social organization of communities and interactions of their members, affected, and were in turn affected, by the large-scale changes happening in the European record. In particular, the increase of social inequality, the unequal distribution of power and economic wealth within a society, from the European Neolithic onwards, associated with populations' growth, emerging new technologies, and increased complexities of modes of living and political systems[2], has been a major focus of archaeological inquiry. In the past, researchers have used various approaches, including analysing material culture, technology and interconnectedness, diet, gender and mobility to study social inequality. Adding the analysis of ancient DNA to the arsenal of methodologies within the archaeological sciences now provides us the opportunity to incorporate evidence of biological relatedness between individuals into a holistic approach to address aspects of kinship, family structure and inheritance in the formation of the societies of Europe's early metal ages.

1 Allentoft et al. 2015; Haak et al. 2015; Mathieson et al. 2018; Mittnik et al. 2018; Olalde et al. 2018; Olalde et al. 2019; Furtwängler et al. 2020; Papac et al. 2021; Saupe et al. 2021; Villalba-Mouco et al. 2021.

2 McGuire/Paynter 1991; Elliott 2017; Kohler et al. 2017; Müller 2017.

Background

In 2013, under the title »Times of Upheaval – Interdisciplinary investigations of social and population dynamics at the onset of the Central European Bronze Age (2500–1400 BC) in Southern Bavaria, Germany«, a project funded by the Heidelberg Academy of Sciences set out to investigate a case study of a microregion undergoing the major cultural shifts of the Final Neolithic and the Early and Middle Bronze Ages (EBA and MBA). Besides archaeological (Massy 2018), osteological and genetic analyses on the human remains excavated from several sites in the region, the research comprised a thorough reassessment of the region's chronology with a gapless series of new radiocarbon dates (Stockhammer et al. 2015a; Stockhammer et al. 2015b), the analysis of isotopes obtained from enamel for the reconstruction of individual mobility (Knipper et al. 2017) and of diet (Massy et al. 2017), as well as metal analysis to determine the origin of raw materials used for the production of the locally found artefacts.

The microregion under study is an approximately 10 x 30 km stretch of land along the Lech Valley, ca. 6 km south of the center of the modern city of Augsburg, Bavaria (Fig. 1). The fertile Loess soil made it an attractive area for agricultural settlement in the 3rd and 2nd millennium BC (Bartelheim 2010) and the amount of excavated burials suggests it was one of the most densely populated regions in Southern Germany during the EBA (Massy 2018). The archaeological record indicates the presence of a series of small unfortified hamlets, large enough to be operated by and sustain a small community of people. They were located like »pearls on a chain« along the border of the Loess terrace and often

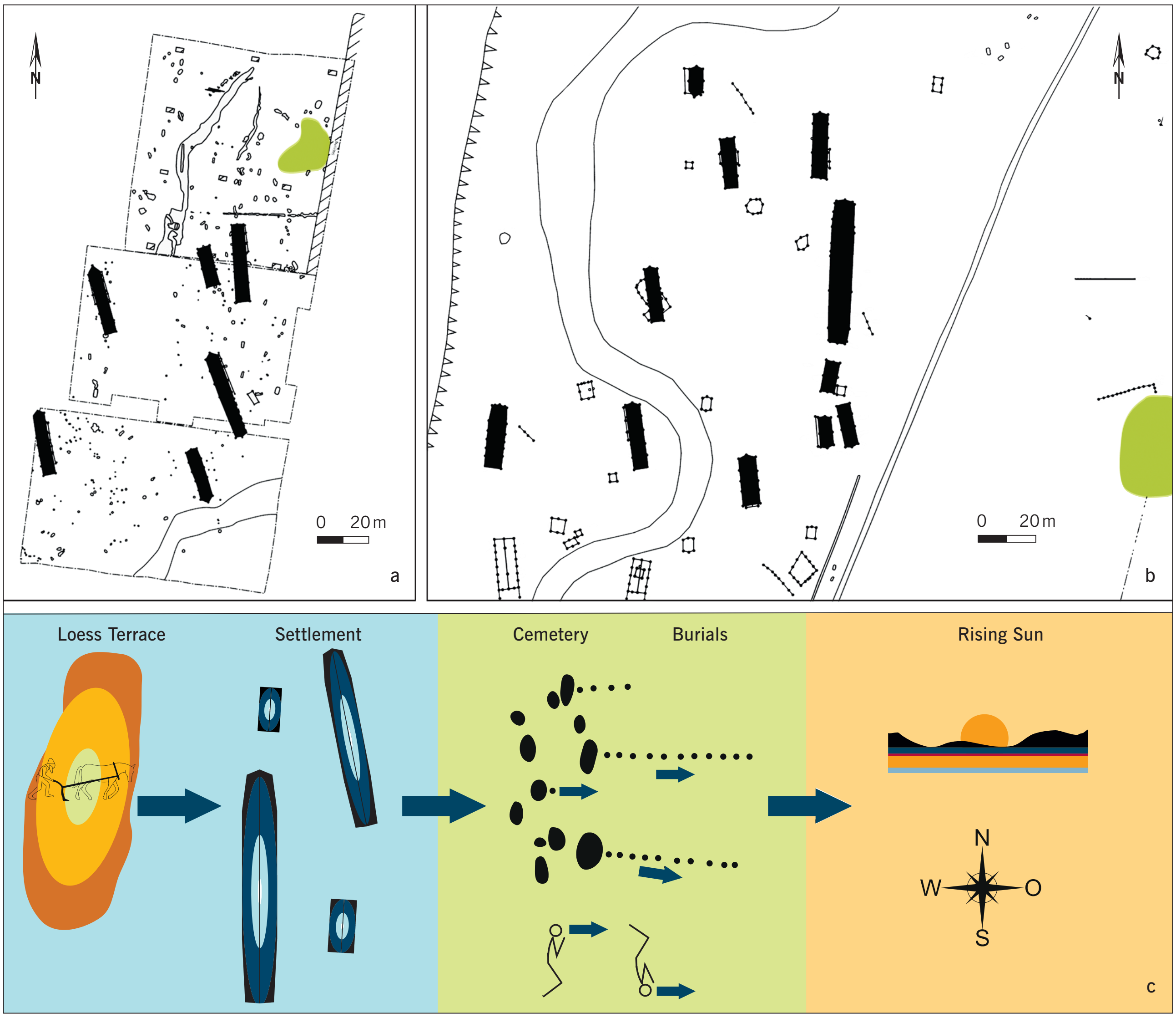


Fig. 2a–c Topographical comparisons of settlements (blue) and their accompanied burial sites to the east (green) in the Lech Valley. a Haunstetten – Unterer Talweg 111–115; b Haunstetten – Unterer Talweg 85; c Schematic representation of the area of the living with farming ground and hamlets (blue); the area of the dead with burials of both sexes facing east and post alignments in the same direction (green); the direction of the rising sun (orange).

Abb. 2a–c *Topografische Vergleiche von Siedlungen (blau) und den dazugehörigen Gräberfeldern im Osten (grün) im Lechtal. a Haunstetten – Unterer Talweg 111–115; b Haunstetten – Unterer Talweg 85; c Schematische Darstellung des Gebiets der Lebenden mit landwirtschaftlichen Flächen und Weilern (blau); der Bereich der Toten mit Bestattungen beider Geschlechter mit nach Osten gerichtetetem Blick und in dieselbe Richtung verlaufende Pfostenreihen (grün); die Richtung des Sonnenaufgangs (orange).*

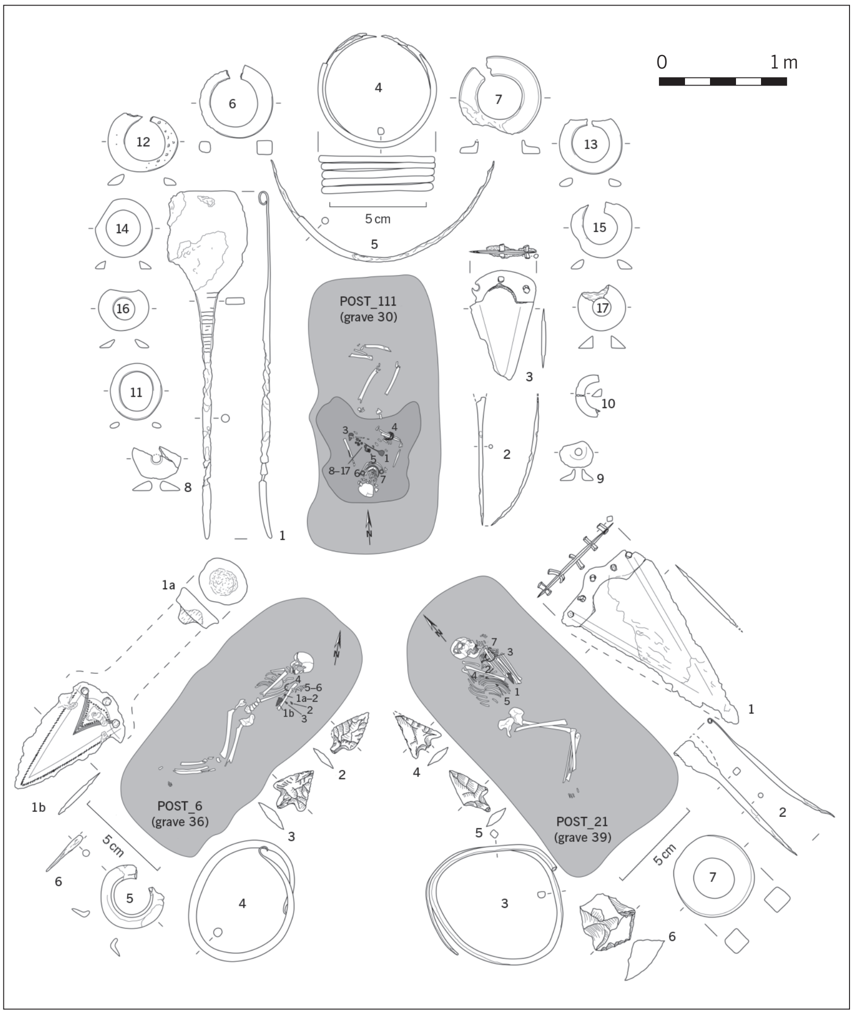


Fig. 3 Haunstetten-Postillionstraße, city of Augsburg. Burials POST_111 (female, 25–45 years), POST_6 (male, 14–16 years) and POST_21 (male, 25–35 years) with their grave goods. All three individuals are 2nd degree-related to each other, show comparable high status grave good assemblages, are buried in the southern part of the cemetery and belong to its younger phase according to the radiocarbon dates.

Abb. 3 *Haunstetten-Postillionstraße, Stadt Augsburg. Die Gräber POST_111 (weiblich, 25–45 Jahre), POST_6 (männlich, 14–16 Jahre) und POST_21 (männlich, 25–35 Jahre) mit ihren Grabbeigaben. Alle drei Individuen sind 2. Grades miteinander verwandt, weisen Grabbeigaben von vergleichsweise hohem Status auf, sind im südlichen Teil des Gräberfeldes bestattet worden und gehören den Radiokarbondatierungen zufolge in die jüngere Phase des Gräberfeldes.*

within less than 1 km distance from each other. These hamlets are often accompanied by a cemetery to the east, containing up to a few dozen graves, presumably including several generations of individuals who operated and lived at the farmstead (Fig. 2; Massy 2018). Thus, these individuals represent what we define as a »household« – a group of people living in a closed architectural space (such as a hamlet), who are connected through shared traditions and daily practices, and may include both biologically related and unrelated individuals (Louise et al. 2010).

The Lech Valley, as part of the so-called Straubing Culture of the Northern Alpine EBA, exhibits the richest burials in the region with respect to amount and quality of metal grave goods and the high proportion of burials that received grave goods. There is, however, an absence of conspicuous »princely graves« containing prestigious gold artefacts or weapons, which emerged during the EBA in many other regions of Europe (Vandkilde 1999; Vandkilde 2016), such as, for example, the contemporaneous Únětice Culture. These burials attest to an increase in trans-regional connectivity based on trade of raw materials and knowledge that accompanied the novel technology of metallurgy, and a resulting negotiation of power hierarchies that led to an emphasis on warriorhood and weapons[3].

The degree of inequality with regard to wealth and power is less evident in the Lech Valley. Agriculture as the main source of limited individual and communal wealth was proposed by M. Bartelheim to have led to »flat hierarchies« with local to micro-regional structure (Bartelheim 2002; Bartelheim 2010). Nevertheless, stratification with regard to wealth and/or status within the Lech Valley burial communities is suggested by differences in grave furnishing, ranging from very rich to no grave goods at all. Hierarchies may have resulted from kin-groups or communities participating in and controlling trans-regional networks of exchange of raw materials, objects, technologies, and ideas[4]. The importance of knowledge and influence in trans-regional networks would have also allowed traders and craftsmen to achieve power and status outside of their kin-group (Bertemes 2004; Bertemes 2010; Nessel 2012). Other aspects likely played a role in positioning individuals within social structures, such as age and gender. The importance of gender in organizing the society of the Lech Valley is suggested by the adherence to the practice of gendered burial orientation that followed widespread customs. For example, during the Corded Ware period individuals were buried facing south, males were laid crouched on their right and females on their left, and during the Bell Beaker period

3 Vandkilde 2006; Harding 2007; Stockhammer 2015; Hansen 2016.

4 Bertemes 2010; Krause 2010; Strahm 2010; Kneisel/Müller 2011.

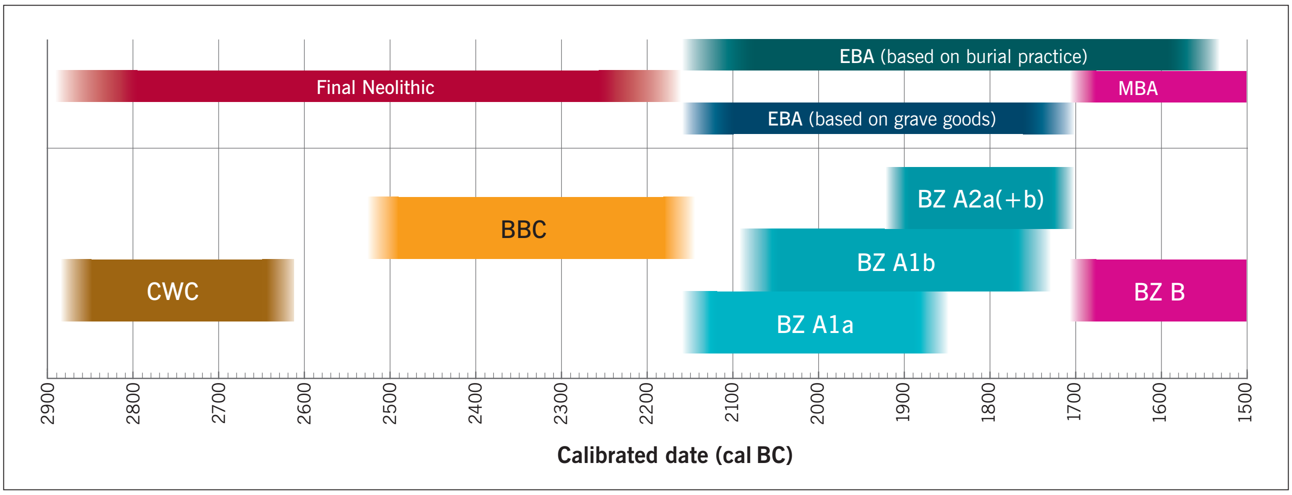


Fig. 4 Chronological sketch of radiocarbon dates from the Lech Valley and their associated cultural groups. The gap between Corded Ware (CWC) dates and Bell Beakers (BBC) is most likely due to the lack of dated individuals, rather than a real hiatus. Early Bronze Age (EBA) dates are differentiated between burials with grave goods and their relative chronological assignment and the typical crouched position (burial practices). Radiocarbon dates for the Middle Bronze Age (MBA) burials from the Lech Valley extend until ca. 1300 cal BC.

***Abb. 4** Chronologische Darstellung von Radiokarbondaten aus dem Lechtal und die damit verbundenen kulturellen Gruppen. Die Lücke zwischen den Schnurkeramikdaten (CWC) und der Glockenbecherkultur (BBC) ist höchstwahrscheinlich auf den Mangel an datierten Individuen zurückzuführen und stellen keine wirkliche Lücke dar. Die frühbronzezeitlichen Daten (EBA) werden zwischen Bestattungen mit Grabbeigaben, ihrer relativen chronologischen Zugehörigkeit und der typischen Hockerhaltung (Bestattungssitte) unterschieden. Radiokarbondaten für die mittelbronzezeitlichen Bestattungen (MBA) im Lechtal reichen bis ca. 1300 cal BC.*

and EBA facing east, males were laid crouched on their left side and females on their right. Gender differences are also observed in the furnishing of burials and in costumes, e.g., complex head-dresses were found exclusively with females, while daggers and other weapons were most commonly found with males (Fig. 3). In contrast to the Únětice Culture of Central Germany, where women were commonly poorly furnished, women in the Straubing Culture exhibited markedly richer burial goods, suggesting they played a more significant role in this society, akin to what is seen in the Únětice Culture of Bohemia (Ernée et al. 2020).

In view of the complex interaction of the different aspects under which social organization can be constructed, the integration of genetic data, which allows us to identify biological ties within burial communities, i.e. households, is crucial in providing an understanding of the size and the structure of kin-groups. This information also allows recognition of patterns of residence and inheritance, and in turn reveals the mechanisms behind the rise in social inequality that marks the onset of the Bronze Age.

Genetic data

We prepared ancient DNA libraries (Kircher et al. 2012; Dabney et al. 2013; Rohland et al. 2015) and employed shotgun-sequencing and hybridization-capture approaches for the mitochondrial DNA (Maricic et al. 2010). We did this for a panel of ca. 1.2 million single-nucleotide polymorphisms (1240K SNP set) on the nuclear genome, which are informative for genetic ancestry (Fu et al. 2013; Haak et al. 2015; Mathieson et al. 2015) and allowed us to generate genome-wide data for 138 individuals excavated in the Lech Valley, dated from the Final Neolithic to Middle Bronze Age (ca. 2900–1300 cal BC; Fig. 4; Massy 2018).

After authentication, validation and quality control, described in detail in C. Knipper et al. (2017) and A. Mittnik et al. (2019), we retained sufficient nuclear data suitable for a relatedness analysis of 101 individuals. These acquired data include two individuals from two burial sites associated with the Corded Ware Complex (CWC), dated to ca. 2750–2460 BC, 13 individuals from five Bell Beaker Complex (BBC) burial sites, dated to ca. 2480–2150 BC, 73 individuals excavated at 6 sites dated to the EBA (ca. 2150–1550 BC) and 13 individuals from a Middle Bronze Age site (ca. 1700–1300 BC; Fig. 1 and Appendix 1). In addition, we generated 133 complete, or nearly complete mitochondrial genomes, which provided information about maternally inherited lineages (Appendix 2). Following the publication of Mittnik et al. (2019), we generated genome-wide data for additional individuals. While the complete analyses of these data are still in progress, we take the opportunity to recapitulate in this paper the main observations laid out in Knipper et al. (2017) and Mittnik et al. (2019) and illustrate them with the case study of the EBA site Haunstetten-Postillionstraße, city of Augsburg (abbr. POST; Wirth 1993; Massy 2018), for which we present the preliminary results of analyses for six additional individuals, bringing the total number of individuals with working genomic data from this site to 21, of the 23 individuals sampled for DNA and the 41 individuals excavated from the site (Tab. 1).

Population trajectories in the Late Neolithic-Early Bronze Age transition

We visualize the genetic diversity seen in the ancient populations of the Lech Valley in relation to the neighboring regions, and respective sites, of Central Germany, Poland, Bohemia, Singen, and Switzerland by means of principal

Individual ID (Site ID_Feat. Nr.)	Labor Nr.	^{14}C Age	±	cal 2σ	Age in years	Data available	Covered SNPs (1240K SNP set)	Genetic Sex
POST_38	MAMS 18963	3717	23	cal BC 2197–2034	> 21	in prep.	493851	male
POST_50	MAMS 18966	3707	24	cal BC 2196–2029	30–35	Mittnik et al. 2019	815920	male
POST_12	MAMS 18956	3697	20	cal BC 2190–2028	7–11	Mittnik et al. 2019	85202	female
POST_44	MAMS 18964	3681	23	cal BC 2139–1979	30–45	Mittnik et al. 2019	909788	male
POST_24	MAMS 18959	3679	20	cal BC 2137–1980	6–10	in prep.	150449	male
POST_47	MAMS 18965	3662	24	cal BC 2134–1956	20–30	Mittnik et al. 2019	63467	male
POST_2	MAMS 18953	3648	19	cal BC 2126–1948	> 20	Mittnik et al. 2019	24140	female
POST_99	MAMS 18969	3641	25	cal BC 2130–1930	20–30	Mittnik et al. 2019	1041643	female
POST_111	MAMS 18970	3639	20	cal BC 2122–1941	(25)-45	in prep.	97296	female
POST_84	MAMS 18967	3638	24	cal BC 2126–1928	3–5	in prep.	60263	female
POST_131	MAMS 18971	3635	20	cal BC 2120–1938	6–10	Mittnik et al. 2019	49130	female
POST_140	MAMS 18973	3631	20	cal BC 2114–1926	> 25	Mittnik et al. 2019+in prep.	353742	male
POST_85	MAMS 18968	3631	24	cal BC 2120–1921	2–4	Mittnik et al. 2019	22942	male
POST_35	MAMS 18962	3621	20	cal BC 2033–1918	35–55	Mittnik et al. 2019	869649	female
POST_32	MAMS 18961	3619	20	cal BC 2032–1916	20–30	Mittnik et al. 2019	101581	female
POST_137	MAMS 18972	3613	20	cal BC 2029–1912	9–15	in prep.	229287	male
POST_16	MAMS 18957	3612	20	cal BC 2029–1911	> 25	Mittnik et al. 2019	24590	female
POST_28	MAMS 18960	3608	20	cal BC 2027–1906	17–25	Mittnik et al. 2019	503443	male
POST_21	MAMS 18958	3606	20	cal BC 2025–1903	25–35	in prep.	169497	male
POST_1	MAMS 18952	3583	28	cal BC 2024–1882	4–6	Mittnik et al. 2019	50042	female
POST_6	MAMS 18955	3574	19	cal BC 2009–1883	14–16	Mittnik et al. 2019	998686	male

Table 1 Overview of samples with genome-wide data from the EBA site of Haunstetten-Postillionstraße, city of Augsburg.

Tabelle 1 *Übersicht über die Proben mit genomweiten Daten der frühbronzezeitlichen Fundstelle Haunstetten-Postillionstraße, Stadt Augsburg.*

component analysis, thus projecting the ancient individuals on a scaffold of modern-day Western Eurasians who were characterized at ~600 000 SNP positions (Fig. 5). The first principal (PC1) component distinguishes European and West Asian populations, while the second principal component (PC2) serves to differentiate ancestry derived from 4th millennium BC steppe pastoralists in the upper part (in the following denoted »steppe-like ancestry«) and ancestry derived from European Middle and Late Neolithic farmers in the lower (»farmer-like ancestry«). In modern-day Europeans,

mtDNA haplogroup assignment	Y-chromosomal lineage assignment	Consistency with local isotopic signature	Number of grave good types	Relation to core pedigree	Burial features and grave goods
H1e	R1b-P312	consistent	0	no	
T1a1	R1b-P312	consistent	6	yes	burial mound, post alignment, dagger, three arrow heads, metal pin, bangle, bone disc, two cattle teeth
J1c3g	n/a (female)	consistent	0 (robbed)	no	
K1a3a	R1b-P312	consistent	0 (slightly disturbed in Roman period)	yes	post alignment
H1b1	R1a-M417	consistent	1	no	ceramic vessel
K2a5	R1	consistent	4	yes	arrow head, bangle
n/a	n/a (female)	consistent	2 (robbed)	no	large paddle headed pin, neck ring
K1a4a1	n/a (female)	inconsistent	3	no	neck ring, two lunula shaped pendants, awl
U5b2b2	n/a (female)	uncertain	6	yes	burial mound, post alignment, dagger, large and small paddle headed pins, neck ring, bone disks
X2b+226	n/a (female)	consistent	2	yes	bone disks
T2c1d+152	n/a (female)	consistent	4	yes	paddle headed pin, awl, bangle, bone disks
H41a	R1b-P312	consistent	2	yes	dagger, bone pin
X2b+226	R	consistent	1	yes	stone pendant
H41a	n/a (female)	consistent	4	yes	large paddle headed pin, two bangles, awl
T2	n/a (female)	inconsistent	4	no	two earrings, two bangles, fingerring, bone disk
T2c1d+152	R1b-P312	consistent	0 (robbed)	yes	burial mound, post alignment
T2f8a	n/a (female)	consistent	0 (robbed)	no	
K2a5	R1b-P312	consistent	0 (maybe more recent disturbance)	yes	
n/a	R1b-L52	consistent	5	yes	dagger, two arrow heads, paddle headed pin, bangle, bone disc
H2a1a	n/a (female)	consistent	2	yes	bone pin, bone disk
U5a1a1+16362	R1b-P312	consistent	5	yes	dagger, two arrow heads, bangle, bone pin, bone disc

who are descended mainly from a mixture between those two groups, the percentage of either ancestry is correlated with geography, producing an approximate north-east to south-west cline of decreasing steppe-like ancestry (Lazaridis et al. 2014; Allentoft et al. 2015; Haak et al. 2015). This »mixing of ancestry« first took place during the 3rd and 2nd millennium BC, as large-scale long-distance mobility and emerging networks of connectivity brought people of very distinct ancestries together. This resulted in a cline of large genetic diversity between the two »ancestral poles« that can even be seen within a single site, such as our case study of POST (Fig. 5). Some general geographical and cultural patterns can be recognized: The individuals of the CWC, located in Central and Eastern Europe, who are arguably culturally most

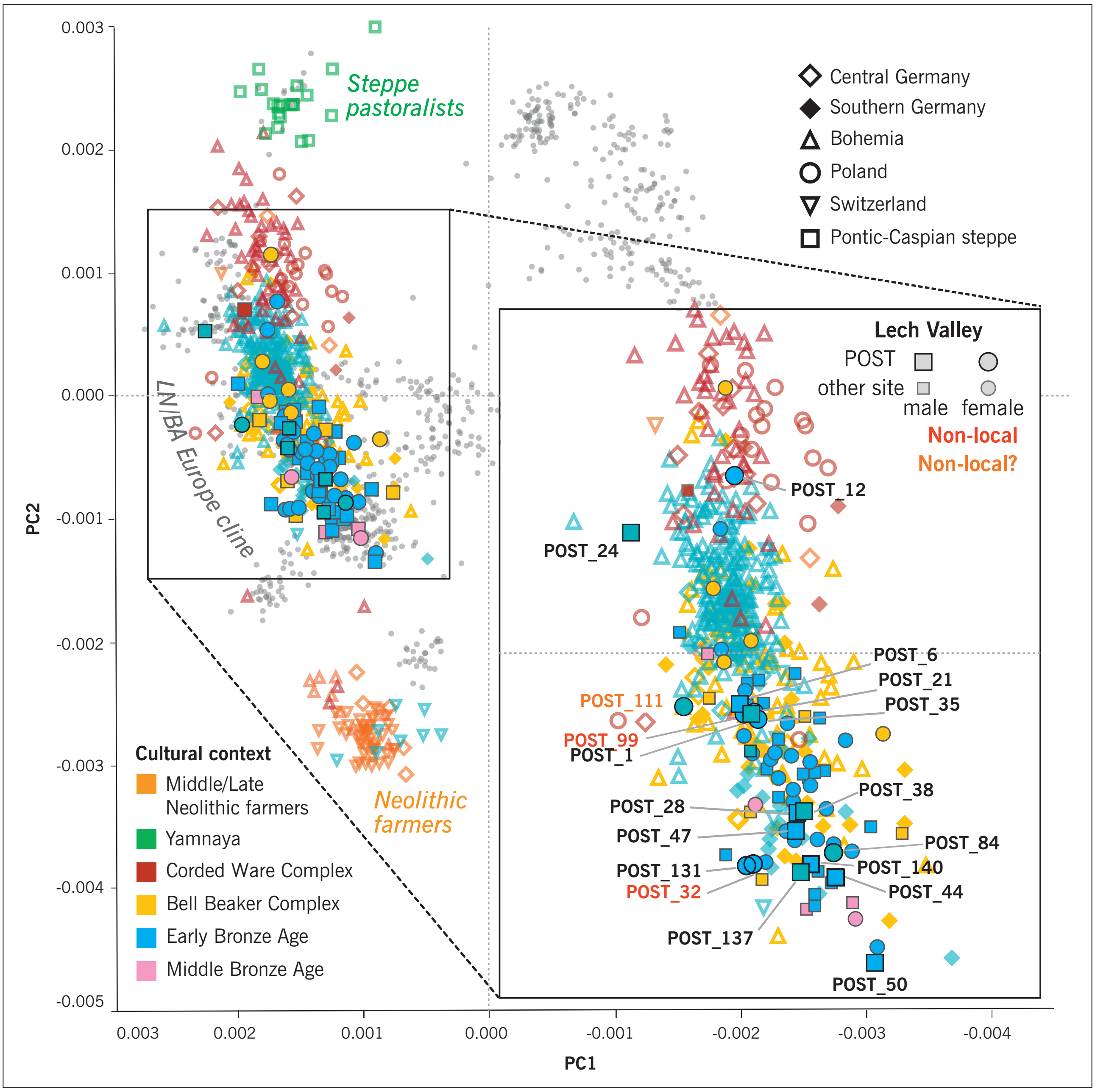


Fig. 5 Principal component analysis of the genotype data of Lech Valley and other relevant ancient individuals. The first and the second principal (PC1 and PC2) are constructed using modern-day West Eurasian individuals (grey dots). Ancient individuals are color-coded by their chronological or cultural assignment and their origin is indicated by shape. The inset in the lower right corner shows a zoom-in on the Lech Valley individuals. Males and females are represented by squares and circles, respectively. Individuals from Haunstetten-Postillionstraße (POST) are labelled and shown with larger symbols.

Abb. 5 *Analyse der Hauptbestandteile der Genotypdaten der Individuen aus dem Lechtal und anderen relevanten prähistorischen Individuen. Die erste und die zweite Hauptkomponente (PC1 und PC2) sind mit Hilfe von modernen westeurasischen Individuen konstruiert (graue Punkte). Prähistorische Individuen sind nach ihrer chronologischen oder kulturellen Zugehörigkeit farblich markiert und ihre Herkunft ist als bestimmte Umrissform angegeben. Die Einfügung in der unteren rechten Ecke zeigt vergrößert die Individuen des Lechtals. Männer werden als Quadrate und Frauen als Kreise dargestellt, Individuen von Haunstetten-Postillionstraße (POST) sind gekennzeichnet und werden mit größeren Symbolen angegeben.*

similar to the steppe pastoralists, are also overall genetically closest to them, and very distinct from the preceding Neolithic farmers of the same regions that lack any steppe-like ancestry. Individuals of the succeeding BBC, which was present from Central Europe to the Atlantic, are found again to have more farmer-like ancestry. High individual mobility together with shared cultural practices and norms in this period likely facilitated the spread of steppe-like ancestry westward and the resurgence of farmer-like ancestry in the east (Olalde et al. 2018). In the EBA, a genetic differentiation between the Únětice Culture of Central Germany and Bohemia and the Northern Alpine EBA groups emerges, with the latter overall having less steppe-like ancestry. In the Lech Valley, where a chronological continuum from the BBC to the EBA exists (Stockhammer et al. 2015a; Stockhammer et al. 2015b), genetic continuity cannot be rejected, and is even suggested by the persistence of some mitochondrial haplotypes (Knipper et al. 2017; Appendix 2).

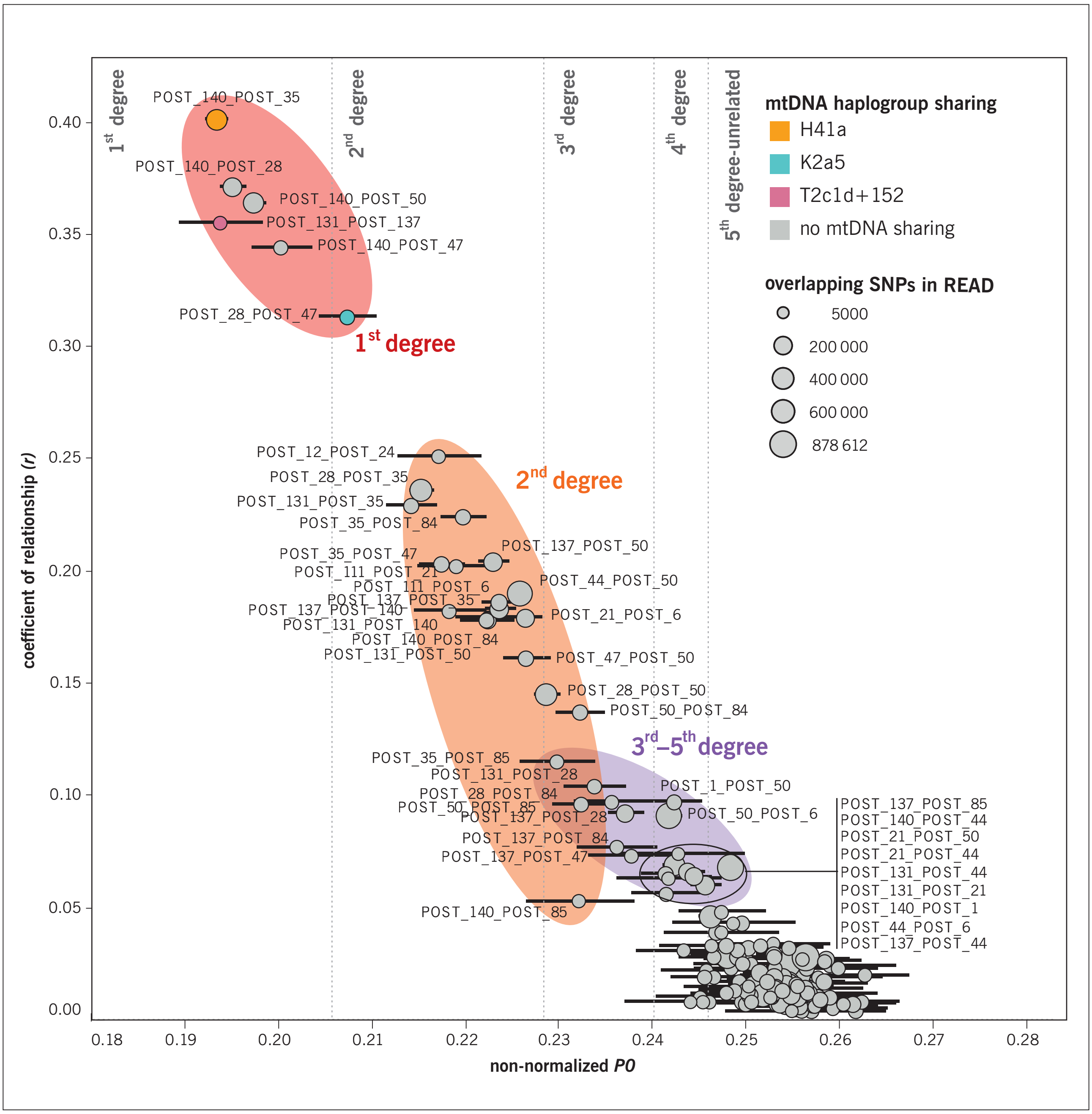


Fig. 6 Results of relatedness analysis. P0, calculated with READ is plotted against *r*, calculated with lcMLkin. Horizontal error bars represent 2 standard errors for P0. Vertical dotted lines show the cut-off for each degree of relatedness as estimated following the approach in READ, using the median P0 value for all pairs that have coverage on at least 5000 SNPs. Shaded ellipses highlight the clusters corresponding to each degree of relatedness. Due to the uncertainty in the analysis, especially in pairs that have low coverage, the assignment of the degree of relatedness can be ambiguous.

***Abb. 6** Ergebnis der Verwandtschaftsanalyse. P0, das mit READ berechnet wurde, ist gegen r aufgetragen und mit IcMLkin berechnet. Horizontale Fehlerbalken stellen 2 Standardfehler für P0 dar. Senkrechte gepunktete Linien zeigen den geschätzten Grenzwert für jeden Verwandtschaftsgrad, wie er nach dem Ansatz von READ unter Verwendung des mittleren P0-Wertes für alle Paare mit einer Abdeckung von mindestens 5000 SNPs geschätzt wurde. Schraffierte Ellipsen heben die Cluster hervor, die mit jedem Verwandtschaftsgrad korrespondieren. Wegen der Ungenauigkeit in der Analyse, besonders bei Paaren, die eine niedrige Deckung besitzen, kann die Zuordnung zu dem Verwandtschaftsgrad unsicher sein.*

At POST, we find that the genetic diversity of the majority of individuals matches the diversity seen across all of Southern Germany during the EBA. However, contact with other regions is suggested by the presence of two subadults, POST_12 and 24, who are genetic outliers more consistent with the genetic diversity seen in the regions of the Únětice Culture. Furthermore, the male POST_24 carries the Y-chromosomal R1a-M417 lineage, which was widespread in the CWC and was also found in EBA Bohemia (Papac et al. 2021). On the other hand, all other males for whom a Y-chromosomal lineage can be assigned belong to the R1b-P312 lineage, which is associated with the spread of the BBC.

Overall, the genetic diversity in the Lech Valley is upheld from the EBA into the MBA, although there is an increase in farmer-related ancestry over time (Mittnik et al. 2019).

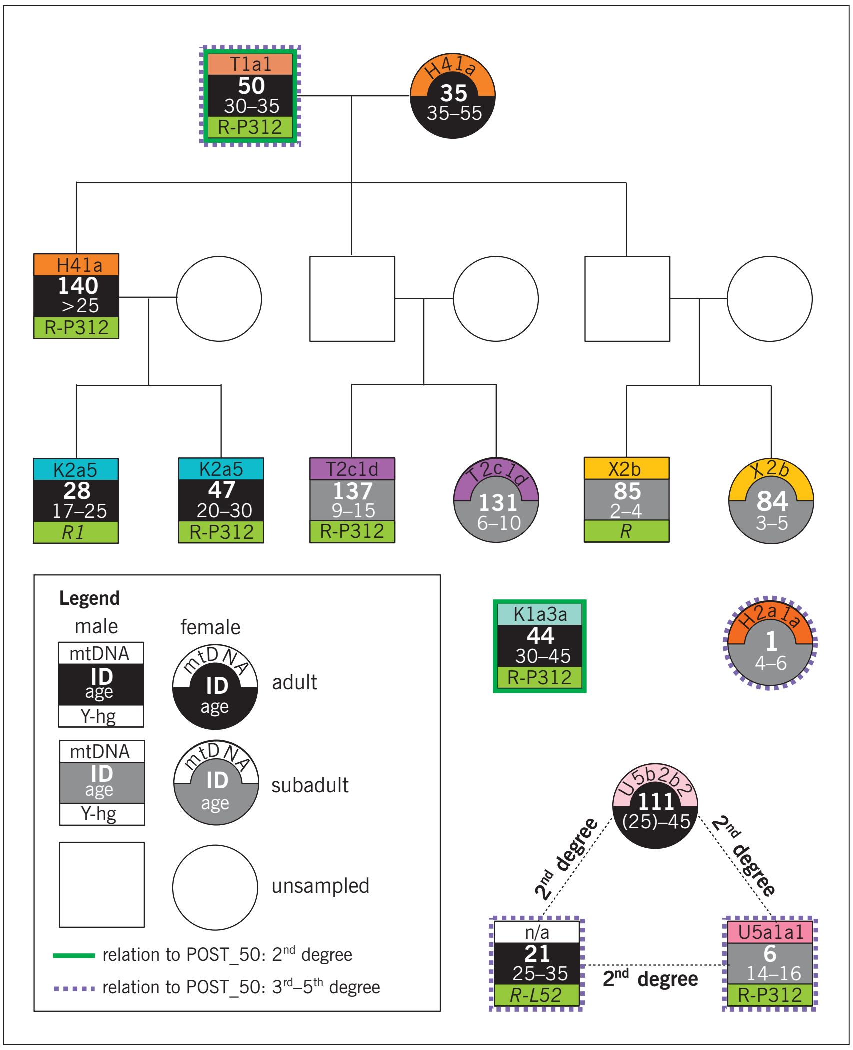


Fig. 7 Reconstructed family tree of Haunstetten-Postillionstraße (POST). In this burial site, at least three generations are connected by a paternal lineage. Black symbols denote adult individuals and grey filled symbols subadult individuals, unsampled individuals inferred in the tree are denoted by unfilled symbols. Upper and lower colored bars on each symbol represent mtDNA and Y-chromosomal haplogroups, respectively. All Y-chromosomal haplogroups in the tree are consistent with belonging to the lineage R1b-P312, and are denoted with italics where they are not fully resolved. The bottom right part of the figure shows individuals that are part of the core pedigree, but whose position in the family tree cannot be determined. Colored outlines show the degree of relatedness to POST_50.

Abb. 7 Rekonstruierter Stammbaum von Haunstetten-Postillionstraße (POST). In diesem Gräberfeld sind mindestens drei Generationen durch eine paternale Linie miteinander verbunden. Schwarze Symbole kennzeichnen adulte Individuen und grau ausgefüllte Symbole subadulte Individuen. Nicht beprobte Individuen, die im Stammbaum angenommen werden, sind als leere Symbole angegeben. Die oberen und unteren Farbbalken in jedem Symbol stellen jeweils die mtDNA und Y-chromosomale Haplogruppen dar. Alle Y-chromosomalen Haplogruppen im Stammbaum gehören konsistent zu der Linie R1b-P312 und sind in kursiver Schrift angegeben, wenn sie noch nicht vollständig bestimmt sind. Der rechte untere Teil des Diagramms zeigt Individuen, die Teil der Kernabstammung sind, aber deren Position im Stammbaum nicht zugewiesen werden kann. Farbliche Umrandungen zeigen den Verwandtschaftsgrad zu POST_50.

Patrilineality, female exogamy and kinship-based inequality

We calculate two different measures of relatedness with the tools READ (Monroy Kuhn et al. 2018) and *lcMLkin* (Fig. 6; Lipatov et al. 2015). *P0*, estimated with READ, quantifies the pairwise mismatch in SNP variants between two individuals and becomes higher, the more distantly two individuals are related. *lcMLkin* calculates the coefficient of relatedness *r*, the fraction of the genome common to two individuals due to direct kinship, i.e., 0.50 for parent and offspring or full siblings, 0.25 for grandparent and grandchild, etc. These estimates are possible up to the 5^{th} degree of relatedness and are subject to some uncertainty due to the incomplete and damaged nature of ancient DNA data. Nevertheless, together with the information provided by maternal and paternal uniparentally inherited markers, the mtDNA and Y-chromosome, respectively, and the age of death of the individuals, they allow us to reconstruct family relationships.

At POST (Fig. 7) we construct a multigenerational pedigree of at least three generations, and at Wehringen-Hochfeld and Königsbrunn-Obere Kreuzstraße, both Augsburg district, of at least four generations, corresponding to a use of the farmsteads and cemeteries for about 100 years. All multigenerational lineages were strictly patrilineal. Among the pedigrees of offspring we did not find a single adult daughter, but ten adult sons, as well as subadults of both sexes. This is consistent with a society that practices female exogamy in which a daughter leaves her parental residence upon reaching a certain age for the purpose of marriage. In accordance with this, none of the adult women were related to anyone else at the same site, besides their own offspring. Close biological relationships of 1^{st} or 2^{nd} degree are mostly found within sites and only in one case (the potential half-sisters POST_99 and OBKR_76, who are both isotopically non-local) between sites.

The newly generated data for POST increases the number of individuals that can be securely identified as part of the main pedigree from seven to 14. The centrality of the parents POST_50 and 35 in the northern part of the cemetery, where their descendants are buried in close proximity, becomes very apparent (Fig. 8). Moreover, this highlights the social cohesion that accompanied biological relatedness within this society. It is possible that the pair represents the founders of this hamlet. The only individual that might precede them is POST_44, who was also buried in the northern part of the cemetery and is a 2^{nd} degree relative of POST_50, i.e., his grandfather, uncle, or paternal half-brother. The placement of these individuals in the earlier generations of the pedigree is consistent with the early

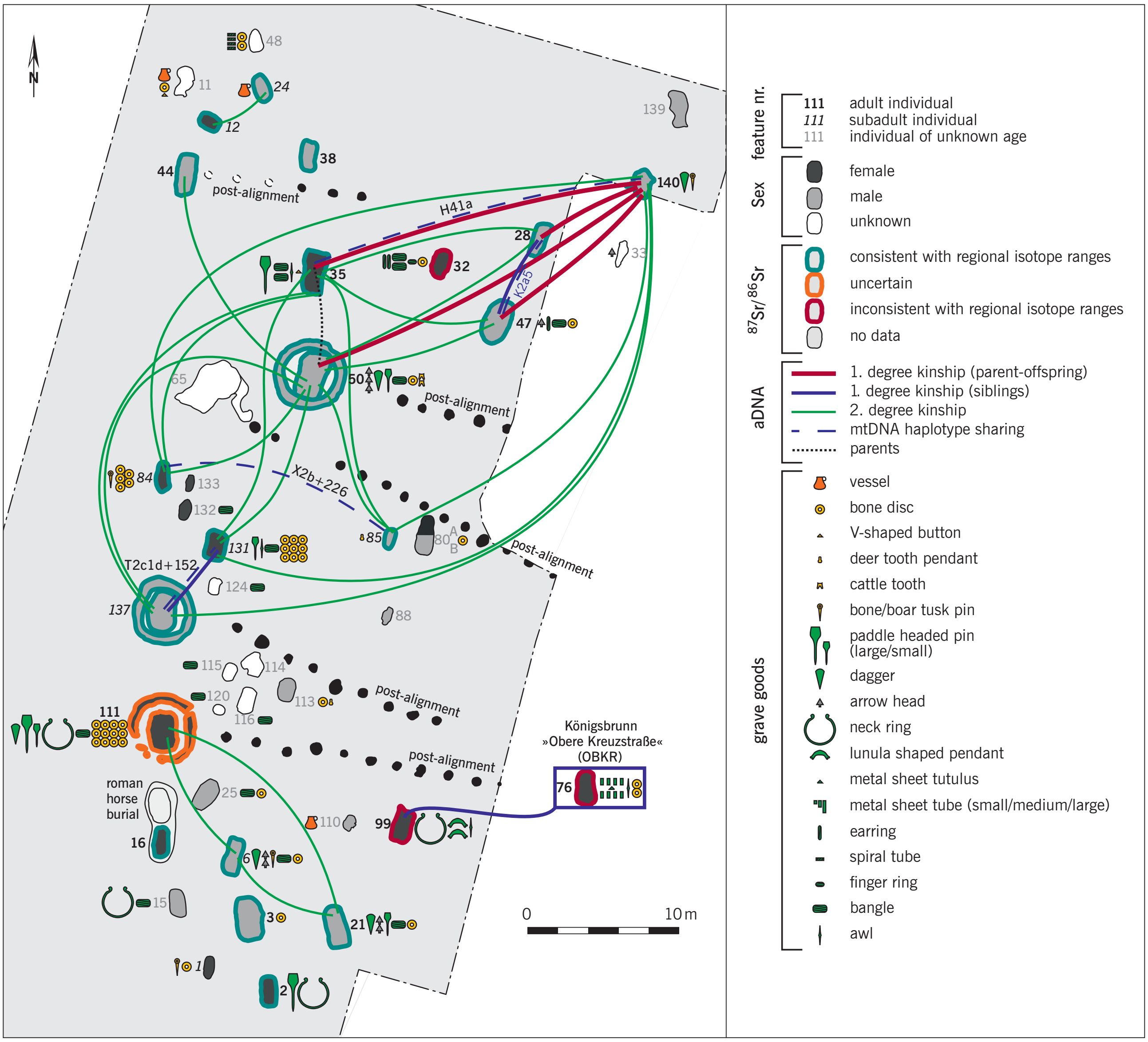
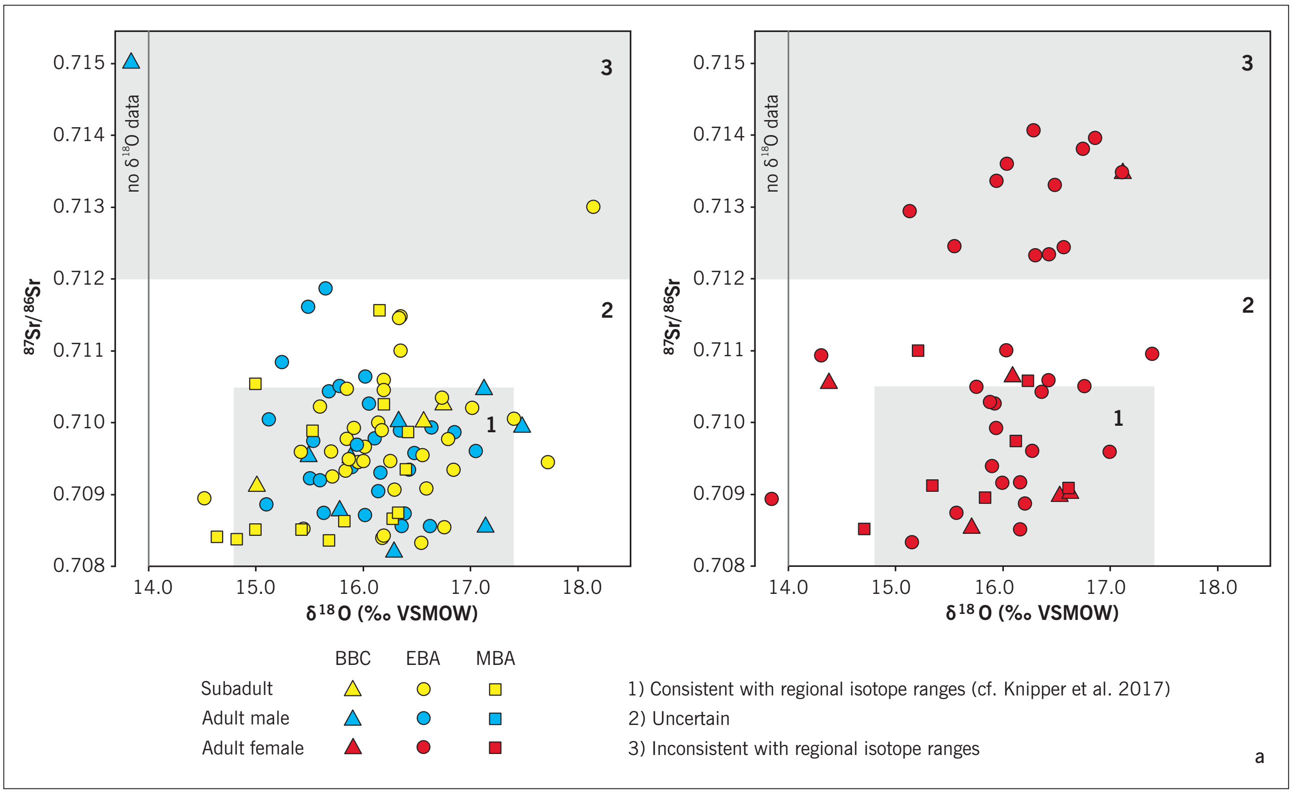


Fig. 8 Early Bronze Age burial site of Haunstetten-Postillionstraße (POST). Burials are labeled with the feature number in black for individuals that were sampled for ancient DNA and in grey for unsampled individuals. Three of the 41 graves (POST_50, 111 and 137) were covered with burial mounds. Those, and two additional ones (POST_44 and 65), were accompanied by post alignments marking them above ground as important individuals. The possible founding couple of the core pedigree, POST_50 and 35, was buried in the northern part of the cemetery with two generations of descendants buried in close proximity. All sampled individuals of the northern group with metal grave goods are biologically related to each other except the non-local female burial (POST_32). Burials belonging to a second branch of the pedigree, related to POST_50, are found in the southern part of the cemetery and are also richly furnished (POST_111, 6 and 21). Individuals POST_12 and 24 in the northern part of the cemetery are related to each other but not to the core pedigree. The second non-local individual within the cemetery (POST_99) was very well furnished and only biologically related to another non-local female (OBKR_76) from the cemetery of Königsbrunn-Obere Kreuzstraße, Augsburg district (OBKR).

Abb. 8 Frühbronzezeitliches Gräberfeld von Haunstetten-Postillionstraße (POST). Die Gräber sind mit Befundnummern gekennzeichnet: schwarz bei Individuen, denen Proben für alte DNA entnommen wurden und grau, bei denen keine Proben entnommen wurden. Drei der 41 Gräber (POST_50, 111 und 137) waren mit Grabhügeln bedeckt. Diese und zwei weitere (POST_44 und 65) wurden zudem von Pfostenreihen begleitet, die sie obererdig als wichtige Individuen markierten. Das mögliche Gründerpaar, POST_50 und 35, war im nördlichen Bereich des Gräberfeldes bestattet, und zwei Generationen von Nachkommen waren in nächster Nähe begraben. Mit der Ausnahme des nicht-lokalen weiblichen Individuums (POST_32) sind alle ausgewählten Individuen der nördlichen Gruppe mit Grabbeigaben aus Metall biologisch miteinander verwandt. Gräber, die zum zweiten Strang des Stammbaums gehören und mit POST_50 verwandt sind, fanden sich im südlichen Teil des Gräberfeldes und sind zudem reich ausgestattet (POST_111, 6 und 21). Die Individuen POST_12 und 24 aus dem nördlichen Teil des Gräberfeldes sind miteinander, aber nicht mit der Kernabstammung verwandt. Das zweite nicht-lokale Individuum innerhalb des Gräberfeldes (POST_99) war sehr reich ausgestattet und nur mit einer anderen nicht-lokalen Frau (OBKR_76) aus dem Gräberfeld Königsbrunn-Obere Kreuzstraße, Lkr. Augsburg (OBKR), biologisch verwandt.

radiocarbon dates (Massy 2018). We have discovered in the southern part of the cemetery a group of three individuals who are also part of the larger pedigree (Figs. 3 and 8). The possibly non-local adult female POST_111 is not directly biologically related to POST_50, but shares descendants with him in POST_6 and 21. Therefore, this group represents a side branch of the family tree to the descendants of POST_50 and 35. POST_111 could plausibly be the partner of POST_50's brother or son by a woman other than POST_35. The subadult POST_1 is also distantly related to POST_50, by the 3rd to 5th degree, but an definite placement within the pedigree is not possible.



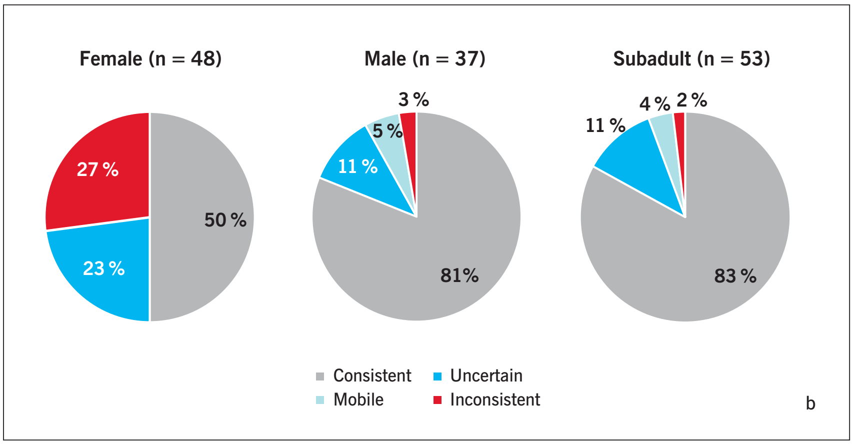


Fig. 9a–b Haunstetten-Postillionstraße. Results for stable isotope analysis in the study area. a Scatter plot of oxygen and strontium isotope ratios in tooth enamel grouped according to age, sex, and archaeological cultural association. b Consistency of strontium and oxygen isotope ratios with the baseline ranges of the study area, breakdown according to sex and age.

***Abb. 9a–b** Haunstetten-Postillionstraße. Ergebnisse der stabilen Isotopenanalyse aus dem Arbeitsgebiet. a Streudiagramm von Sauerstoff- und Strontium-Isotopenverhältnissen im Zahnschmelz, gruppiert nach Alter, Geschlecht und archäologischer Kulturzugehörigkeit. b Konsistenz von Strontium- und Sauerstoff-Isotopenverhältnissen mit den Basislinienbereichen des Arbeitsgebietes, aufgeteilt nach Geschlecht und Alter.*

Markers of wealth or high status are concentrated with members of this »core pedigree«, an observation that can be generalized for the whole Lech Valley, where we see a correlation of the number of grave good types with the fraction of relatives found within the same site (Mittnik et al. 2019). Most notably, above-ground grave monuments that marked the buried as important individuals, such as burial mounds (POST_50, 111 and 137) and post alignments (POST_50, 111, 137 and 44), were only found for members of the core pedigree[5]. Similarly, daggers were only given to members of the core pedigree (POST_50, 140, 111, 6 and 21). That high-status markers are also found with subadults indicates that wealth and status were inherited by offspring from their parents and that their social status was inherited rather than acquired during their lifetime.

The burial of a woman at POST_111 is remarkable, as the individual has a burial mound, the grave site is richly furnished with items typical for high-status female burials, such as a neck ring, copper pins and perforated disks made of antler, but also contains a dagger, which is usually only reserved for high status male burials in the Straubing Culture (Fig. 3; Massy 2018). These markers could signify an outstanding role for this woman in the community.

We identified only one other related pair within the site: the children POST_12 and 24, buried in close proximity to each other on the northeastern fringe of the cemetery, are 2nd degree relatives, unconnected by biological relatedness to the core pedigree. As mentioned, these two individuals are also genetic outliers to the EBA Lech Valley population and more similar to the individuals of the Únětice Culture

5 POST_65 also has a post alignment, but could not be sampled because it did not contain any skeletal remains due to modern disturbances.

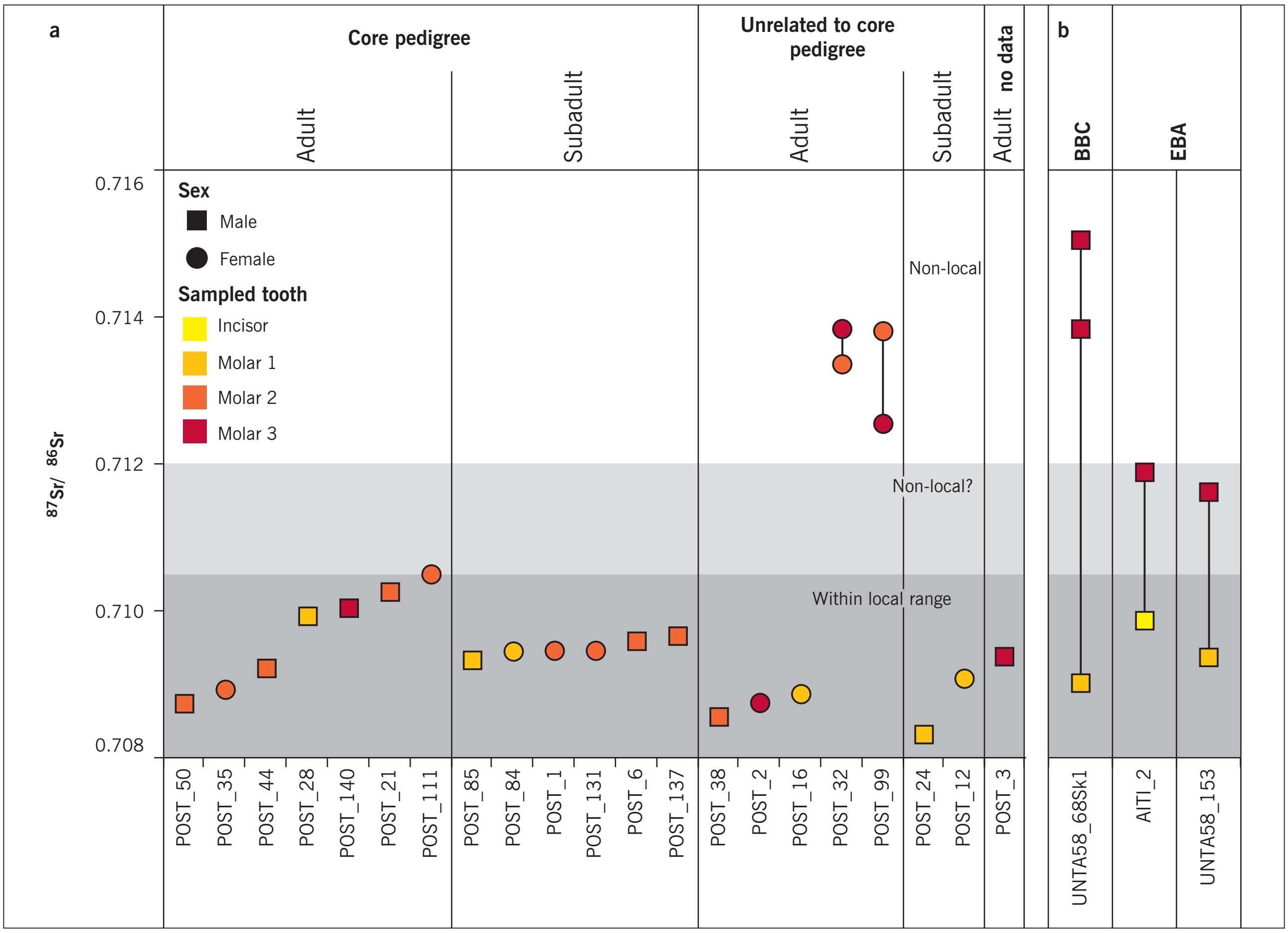


Fig. 10a–b Haunstetten-Postillionstraße (POST). Selected $^{87}Sr/^{86}Sr$ isotopic ratios measured from teeth. a Strontium isotope ratios for individuals from POST, grouping members and non-members of the core pedigree together, respectively. POST_32 and POST_99 fall within the non-local range of values for both the early-developing tooth and molar 3, which develops in late adolescence, indicating that they moved to the Lech Valley only after adolescence. b Three cases of males with notable $^{87}Sr/^{86}Sr$ value shifts between an early-developing tooth and molar 3, indicating residence outside of the local range during adolescence. BBC Bell Beaker Complex; EBA Early Bronze Age.

***Abb. 10a–b** Haunstetten-Postillionstraße (POST). Ausgewählte $^{87}Sr/^{86}Sr$-Isotopenverhältnisse, gemessen im Zahn. a Strontium-Isotopenverhältnis von Individuen aus POST, wobei Mitglieder und Nichtmitglieder der Kernabstammung jeweils zusammengruppiert dargestellt sind. POST_32 und POST_99 fallen in den nicht-lokalen Bereich der Werte für sowohl den frühentwickelten Zahn als auch den Molar 3, der sich im späten Adoleszentenalter herausbildet, was darauf hindeutet, dass sie erst nach der Adoleszenz ins Lechtal gezogen sind. b Drei Fälle von Männern mit merklichen $^{87}Sr/^{86}Sr$-Werteverschiebungen zwischen dem frühentwickelten Zahn und Molar 3, was auf einen Aufenthalt außerhalb des lokalen Bereichs während des Erwachsenenalters hindeutet. BBC Glockenbecherkomplex; EBA Frühe Bronzezeit.*

(Fig. 5). Both individuals were radiocarbon dated to the earliest phase of the EBA (phase 1; Massy 2018) and are amongst the oldest burials in the cemetery. Their strontium values are consistent with the locally bioavailable strontium, and they are not accompanied by any metal grave goods[6]. We find such individuals (isotopically local, poorly furnished and biologically unrelated to the respective core pedigree) at each EBA site. This suggests the presence of lower-status individuals and even families who were differentiated from the members of the core pedigree, but like them, they made regular use of the same cemetery and thus were also residents of the local hamlet. This likely reflects social stratification in a society in which it was commonplace for individuals of different wealth and status to live together as part of complex households. We interpret this group of people as menial workers, or possibly even slaves; however, it remains uncertain whether religion, worldviews, or social institutions, such as »classes« or »castes«, contributed to the creation and maintenance of the status distinctions seen in Lech Valley farmsteads (Stockhammer/Massy 2023).

Patterns of mobility

Measurements of $^{87}Sr/^{86}Sr$ and $\delta^{18}O_p$ values in dental enamel revealed stark sex- and age-based differences that are in concordance with a patrilocal society that practices female exogamy (Fig. 9a). 28 % of adult females showed isotope ratios that were clearly non-local, while 50 % were con-

6 POST_12 might have been furnished but could have been robbed in ancient times.

sistent with the local range. In contrast, only 3 % of adult males and 2 % of subadults had non-local values, while the majority (84 % and 82 %, respectively) were consistent with the local range (Fig. 9b; Mittnik et al. 2019). Notably, non-local women, like POST_32 and 99, were generally of high-status, but did not have any offspring or other relatives among the communities with which they were buried. Based on similarities of grave-items and isotope data, some individuals could have come from areas inhabited by the Únětice Culture, about 350 km away. Similar strontium isotope values in pairs of second and third molars from the same women suggest that these individuals went through residential changes during adolescence or later, after full formation of the enamel on their teeth (Fig. 10a). Therefore, their age and acquired knowledge might have situated them as influential agents of cultural transmission, more so than could be expected for younger children. Their role in the communities they were buried in is unexplained, but might be illuminated by future research revealing their relatives at other sites outside of the Lech Valley. Their grave good assemblages do, however, fit perfectly within the local grave furnishing of women of the Straubing Culture. Thus, we may assume that they were substantially integrated in the household communities of the Lech Valley, notwithstanding their foreign origin.

Three males had notable changes in the strontium ratios of their first molars, which were within the isotope range of the Lech Valley, to more radiogenic values in their third molars (Fig. 10b). This suggests that these individuals moved away from the study area during late childhood or adolescence and returned later in life. Practices, such as apprenticeship or fosterage, could account for this residence change (Stockhammer/Massy 2023).

Conclusion

The examination of family structures and social disparities is crucial to understand the social organization of ancient societies, and this includes biological factors such as genetic ancestry and relatedness[7]. Integrating archaeological, anthropological, genetic, and isotopic evidence from the EBA Lech Valley reveals that communities were organized in socially stratified, complex households in which wealth and status were likely inherited within a long-standing patrilineage that operated a farmstead. Strikingly, the patrilineal residence rule persisted during the transition from the Late Neolithic BBC to the EBA. Similar complex household forms are known historically millennia later in the *oikos* of Classic Greece and the Roman *familia*, both comprising the kin-related family and their slaves (Dixon 1992; Cox 1998). The practice of female exogamy was the norm in a society that was supra-regionally well-connected. In particular, long-distance mobility, evidenced in adult women and to a lesser extent in adolescent males, could have facilitated and reinforced the same networks that also served as the vectors for the trade of raw material and products, as well as the transfer of knowledge and culture.

7 E.g. Sanchez-Quinto et al. 2019; Schroeder et al. 2019; Fowler et al. 2022; Villalba-Mouco et al. 2022.

Bibliography

Allentoft et al. 2015
M. E. Allentoft/M. Sikora/K. G. Sjogren/S. Rasmussen/M. Rasmussen et al., Population genomics of Bronze Age Eurasia. Nature 522,7555, 2015, 167–172.

Bartelheim 2002
M. Bartelheim, Metallurgie und Gesellschaft in der Frühbronzezeit Mitteleuropas. In: J. Müller (ed.), Vom Endneolithikum zur Frühbronzezeit: Muster sozialen Wandels? (Tagung Bamberg 14.–16. Juni 2001). Univforsch. Prähist. Arch. 90 (Bonn 2002) 29–43.

Bartelheim 2010
M. Bartelheim, Schmiedefürsten oder Großbauern?. Elite und Metalle in der Frühbronzezeit Mitteleuropas. In: H. Meller/F. Bertemes (eds.), Der Griff nach den Sternen. Wie Europas Eliten zu Macht und Reichtum kamen. internationales Symposium in Halle (Saale) 16.–21. Februar 2005. Tagungen Landesmus. Vorgesch. Halle 5,2 (Halle [Saale] 2010) 865–880.

Bertemes 2004
F. Bertemes, Frühe Metallurgen in der Spätkupfer- und Frühbronzezeit. In: H. Meller (ed.), Der geschmiedete Himmel. Die weite Welt im Herzen Europas vor 3600 Jahren (Darmstadt 2004) 144–149.

Bertemes 2010
F. Bertemes, Die Metallurgengräber der zweiten Hälfte des 3. und der ersten Hälfte des 2. Jt. v. Chr. im Kontext der spätkupferzeitlichen und frühbronzezeitlichen Zivilisationen Mitteleuropas. In: H. Meller/F. Bertemes (eds.), Der Griff nach den Sternen. Wie Europas Eliten zu Macht und Reichtum kamen. internationales Symposium in Halle (Saale) 16.–21. Februar 2005. Tagungen Landesmus. Vorgesch. Halle 5,1 (Halle [Saale] 2010) 131–162.

Cox 1998
C. A. Cox, Household interests. Property, Marriage Strategies, and Family Dynamics in Ancient Athens (Princeton, NJ 1998).

Dabney et al. 2013
J. Dabney/M. Knapp/I. Glocke/M. T. Gansauge/A. Weihmann et al., Complete mitochondrial genome sequence of a Middle Pleistocene cave bear reconstructed from ultrashort DNA fragments. Proc. Nat. Acad. Scien. USA 110,39, 2013, 15758–15763.

Dixon 1992
S. Dixon, The Roman family. Ancient Soc. Hist. (Baltimore, London 1992).

Elliott 2017
M. Elliott, Inequality has deep roots in Eurasia. Nature 551, 2017, 573–575.

Ernée et al. 2020
M. Ernée/M. Langová/L. Arppe/P. Bednář/D. Berger et al., Mikulovice. Pohřebiště starší doby bronzové na Jantarové stezce. Early Bronze Age Cemetery on the Amber Road. Pam. Arch. Suppl. 21 (Prague 2020).

Fowler et al. 2022
C. Fowler/I. Olalde/V. Cummings/I. Armit/L. Buster et al., A high-resolution picture of kinship practices in an Early Neolithic tomb. Nature 601,7894, 2022, 584–587.

Fu et al. 2020
Q. Fu/M. Meyer/X. Gao/U. Stenzel/H. A. Burbano et al., DNA analysis of an early modern human from Tianyuan Cave, China. Proc. Nat. Acad. Scien. USA 110,6, 2013, 2223–2227.

Furtwängler et al. 2020
A. Furtwängler/A. B. Rohrlach/T. C. Lamnidis/L. Papac/G. U. Neumann et al., Ancient genomes reveal social and genetic structure of Late Neolithic Switzerland. Nature Commun. 11,1915, 2020.

Haak et al. 2015
W. Haak/I. Lazaridis/N. Patterson/N. Rohland/S. Mallick et al., Massive migration from the steppe was a source for Indo-European languages in Europe. Nature 522,7555, 2015, 207–211.

Hagelberg et al. 2015
E. Hagelberg/M. Hofreiter/C. Keyser, Introduction. Ancient DNA: the first three decades. Phil. Transact. Royal Soc. London. Ser. B, Biol. Scien. 370,1660, 2015, 20130371.

Hansen 2016
S. Hansen, »Arm und Reich« in der Bronzezeit Europas. In: H. Meller/H. P. Hahn/R. Jung/R. Risch (eds.), Arm und Reich – Zur Ressourcenverteilung in prähistorischen Gesellschaften. 8. Mitteldeutscher Archäologentag vom 22. bis 24. Oktober 2015 in Halle (Saale). Tagungen Landesmus. Vorgesch. Halle 14,1 (Halle [Saale] 2016) 197–218.

Harding 2007
A. Harding, Warriors and Weapons in Bronze Age Europe. Archaeolingua Ser. minor 25 (Budapest 2007).

Kirchner et al. 2012
M. Kircher/S. Sawyer/M. Meyer, Double indexing overcomes inaccuracies in multiplex sequencing on the Illumina platform. Nucleic Acids Research 40,1, 2012, e3.

Kneisel/Müller 2011
J. Kneisel/J. Müller, Produktion, Distribution, Konsumtion und die Formation sozialer Unterschiede in frühbronzezeitlichen Gesellschaften Mitteleuropas. In: S. Hansen/J. Müller (eds.), Sozialarchäologische Perspektiven: Gesellschaftlicher Wandel 5000–1500 v. Chr. zwischen Atlantik und Kaukasus. Internationale Tagung Kiel 2007. Arch. Eurasien 24 (Mainz 2011) 295–324.

Knipper et al. 2017
C. Knipper/A. Mittnik/K. Massy/C. Kociumaka/I. Kucukkalipci et al., Female exogamy and gene pool diversification at the transition from the Final Neolithic to the Early Bronze Age in central Europe. Proc. Nat. Acad. Scien. USA 114,38, 2017, 10083–10088.

Kohler et al. 2017
T. A. Kohler/M. E. Smith/A. Bogaard/G. M. Feinman/C. E. Peterson et al., Greater post-Neolithic wealth disparities in Eurasia than in North America and Mesoamerica. Nature 551, 2017, 619–622.

Krause 2010
R. Krause, Bronzezeitliche Kupfergewinnung in den Alpen – Überlegungen zur Organisation des Metallkreislaufs. In: H. Meller/F. Bertemes (eds.), Der Griff nach den Sternen. Wie Europas Eliten zu Macht und Reichtum kamen. internationales Symposium in Halle (Saale) 16.–21. Februar 2005. Tagungen Landesmus. Vorgesch. Halle 5,2 (Halle [Saale] 2010) 845–864.

Lazaridis et al. 2014
I. Lazaridis/N. Patterson/A. Mittnik/G. Renaud/S. Mallick et al., Ancient human genomes suggest three ancestral populations for present-day Europeans. Nature 513,7518, 2014, 409–413.

Lipatov et al. 2015
M. Lipatov/K. Sanjeev/R. Patro/K. Veeramah, Maximum Likelihood Estimation of Biological Relatedness from Low Coverage Sequencing Data. bioRxiv 2015, <https://doi.org/10.1101/023374> (09.02.2023).

Louise et al. 2010
M. Louise/S. Sørensen/J. Bech/B. Kulcsarne-Berzsenyi/K. Kristiansen et al. Households In: T. Earle/K. Kristiansen (eds.), Organizing Bronze Age Societies. The Mediterranean, Central Europe, and Scandanavia Compared (Cambridge 2010) 122–154.

Maricic et al. 2010
T. Maricic/M. Whitten/S. Pääbo, Multiplexed DNA sequence capture of mitochondrial genomes using PCR products. PLOS ONE 5,11, 2010. e14004.

Massy 2018
K. Massy, Gräber der Frühbronzezeit im südlichen Bayern. Untersuchungen zu den Bestattungs- und Beigabensitten sowie gräberfeldimmanenten Strukturen. Materialh. Bayer. Arch. 107 (Kallmünz/Opf. 2018).

Massy et al. 2017
K. Massy/C. Knipper/A. Mittnik/S. Kraus/E. Pernicka et al., Patterns of Transformation from the Final Neolithic to the Early Bronze Age: A Case Study from the Lech Valley South of Augsburg In: P. W. Stockhammer/J. Maran (eds.), Appropriating innovations. Entangled knowledge in Eurasia, 5000–1500 BCE (Oxford 2017) 241–261.

Mathieson et al. 2015
I. Mathieson/I. Lazaridis/N. Rohland/S. Mallick/N. Patterson et al., Genome-wide patterns of selection in 230 ancient Eurasians. Nature 528,7583, 2015, 499–503.

Mathieson et al. 2018
I. Mathieson/S. Alpaslan-Roodenberg/C. Posth/A. Szecsenyi-Nagy/N. Rohland et al., The genomic history of southeastern Europe. Nature 555,7695, 2018, 197–203.

McGuire/Paynter 1991
R. H. McGuire/R. Paynter (eds.), The Archaeology of Inequality (Oxford 1991).

Mittnik et al. 2018
A. Mittnik/C. C. Wang/S. Pfrengle/M. Daubaras/G. Zarina et al., The genetic prehistory of the Baltic Sea region. Nature Commun. 9,1, 2018, 442.

Mittnik et al. 2019
A. Mittnik/K. Massy/C. Knipper/F. Wittenborn/R. Friedrich et al., Kinship-based social inequality in Bronze Age Europe. Science 366,6466, 2019, 731–734.

Monroy Kuhn et al. 2018
J. M. Monroy Kuhn/M. Jakobsson/T. Gunther, Estimating genetic kin relationships in prehistoric populations. PLOS ONE 13,4, 2018, e0195491.

Müller 2017
J. Müller, Rebellion and Inequality: Hierarchy and Balance. In: S. Hansen/J. Müller (eds.), Rebellion and Inequality in Archaeology. Proceedings of the Kiel Workshops »Archaeology of Rebellion« (2014) and »Social Inequality as a Topic in Archaeology« (2015). Univforsch. Prähist. Arch. 308 (Bonn 2017) 23–32.

Nessel 2012
B. Nessel, Hervorgehobene oder verborgene Identität?: Zu Ausstattungsmustern von Metallhandwerkergräbern. In: I. Heske/B. Horejs (Eds.), Bronzezeitliche Identitäten und Objekte. Beiträge aus den Sitzungen der AG Bronzezeit auf der 80. Tagung des West- und Süddeutschen Verbandes für Altertumsforschung in Nürnberg 2010 und dem 7. Deutschen Archäologiekongress in Bremen 2011. Univforsch. Prähist. Arch. 221 (Bonn 2012) 55–74.

Olalde et al. 2018
I. Olalde/S. Brace/M. E. Allentoft/I. Armit/K. Kristiansen et al., The Beaker phenomenon and the genomic transformation of northwest Europe. Nature 555,7695, 2018, 190–196.

Olalde et al. 2019
I. Olalde/S. Mallick/N. Patterson/N. Rohland/V. Villalba-Mouco et al., The genomic history of the Iberian Peninsula over the past 8000 years. Science 363,6432, 2019, 1230–1234.

Papac et al. 2021
L. Papac/M. Ernée/M. Dobes/M. Langova/A. B. Rohrlach et al., Dynamic changes in genomic and social structures in third millennium BCE central Europe. Scien. Advances 7,35, 2021.

Rohland et al. 2015
N. Rohland/E. Harney/S. Mallick/S. Nordenfelt/D. Reich, Partial uracil – DNA – glycosylase treatment for screening of ancient DNA. Phil. Transact. Royal Soc. Ser. B, Biol. Scien. 370,1660, 2015.

Sanchez-Quinto 2019
F. Sanchez-Quinto/H. Malmstrom/M. Fraser/L. Girdland-Flink/E. M. Svensson et al., Megalithic tombs in western and northern Neolithic Europe were linked to a kindred society. Proc. Nat. Acad. Scien. USA 116,19, 2019, 9469–9474.

Saupe et al. 2021
T. Saupe/F. Montinaro/C. Scaggion/N. Carrara/T. Kivisild et al., Ancient genomes reveal structural shifts after the arrival of Steppe-related ancestry in the Italian Peninsula. Current Biol. 31,12, 2021, 2576–2591.

Schroeder et al. 2019
H. Schroeder/A. Margaryan/M. Szmyt/B. Theulot/P. Wlodarczak et al., Unraveling ancestry, kinship, and violence in a Late Neolithic mass grave. Proc. Nat. Acad. Scien. USA 116,22, 2019, 10705–10710.

Skoglund et al. 2012
P. Skoglund/H. Malmstrom/M. Raghavan/J. Stora/P. Hall et al., Origins and genetic legacy of Neolithic farmers and hunter-gatherers in Europe. Science 336,6080, 2012, 466–469.

Stockhammer 2015
P. W. Stockhammer, Die Wirkungsmacht des Identischen: Zur Wahrnehmung von Metallobjekten am Beginn der Bronzezeit. Germania 93, 2015, 77–96.

Stockhammer et al. 2015a
P. W. Stockhammer/K. Massy/C. Knipper/R. Friedrich/B. Kromer et al., Kontinuität und Wandel vom Endneolithikum zur frühen Bronzezeit in der Region Augsburg. In: H. Meller/H. W. Arz/R. Jung/R. Risch (eds.), 2200 BC – Ein Klimasturz als Ursache für den Zerfall der Alten Welt? 7. Mitteldeutscher Archäologentag vom 23. bis 26. Oktober 2014 in Halle (Saale). Tagungen Landesmus. Vorgesch. Halle 12,2 (Halle [Saale] 2015) 617–641.

Stockhammer et al. 2015b
P. W. Stockhammer/K. Massy/C. Knipper/R. Friedrich/B. Kromer et al., Rewriting the Central European Early Bronze Age Chronology: Evidence from Large-Scale Radiocarbon Dating. PLOS ONE 10,10, 2015, e0139705.

Stockhammer/Massy 2023
P. W. Stockhammer/K. Massy, Mobility at the Onset of the Bronze Age: A Bioarchaeological Perspective. In: M. Fernández-Götz/C. Nimura/P. W. Stockhammer/R. Cartwright (eds.), Rethinking Migrations in Late Prehistoric Eurasia, Proc. British Acad. 254 (Oxford 2023) 170–188.

Strahm 2010
C. Strahm, Die ökonomischen und ideellen Bedingungen der Formation frühbronzezeitlicher Eliten. In: H. Meller/F. Bertemes (eds.), Der Griff nach den Sternen. Wie Europas Eliten zu Macht und Reichtum kamen. Internationales Symposium in Halle (Saale) 16.–21. Februar 2005. Tagungen Landesmus. Vorgesch. Halle 5,1 (Halle [Saale] 2010) 163–175.

Vandkilde 1999
H. Vandkilde, The princely burials of the Únětice Culture. In: K. Demakopoulou/C. Eluére/J. Jensen/A. Jockenhövel/J.-P. Mohen, Gods and heroes of the European Bronze Age. 25th Council of Europe Art Exhibition (London 1999) 103–105.

Vandkilde 2006
H. Vandkilde, Warfare, Weaponry and Material Culture: An Introduction. In: T. Otto/H. Thrane/H. Vandkilde (eds.), Warfare and Society. Archaeological and Social Anthropological Perspectives (Aarhus 2006) 483–490.

Vandkilde 2016
H. Vandkilde, Bronzization: The Bronze Age as Pre-Modern Globalization. Prähist. Zeitschr. 91,1, 2016, 103–123.

Villalba-Mouco et al. 2021
V. Villalba-Mouco/C. Oliart/C. Rihuete-Herrada/A. Childebayeva/A. B. Rohrlach et al., Genomic transformation and social organization during the Copper Age-Bronze Age transition in southern Iberia. Scien. Advances 7,47, 2021, eabi7038.

Villalba-Mouco et al. 2022
V. Villalba-Mouco/C. Oliart/C. Rihuete-Herrada/A. B. Rohrlach/M. I. Fregeiro et al., Kinship practices in the early state El Argar society from Bronze Age Iberia. Scien. Reports 12,22415, 2022.

Wirth 1993
S. Wirth, Ein Friedhof der frühen Bronzezeit in Haunstetten. Arch. Jahr Bayern 1992 (1993) 49–52.

Sources of figures

1 A. Mittnik; Tableau 2020.4.1, OpenStreetMap
2 K. Massy, adapted from Massy 2018, 110; Fig. 56; Pl. 143B2; 144A2
3 K. Massy, adapted from Massy 2018, pl. 33A; 34C; 36A
4 K. Massy, adapted from Stockhammer/Massy 2023, 174; Fig. 8.2
5–8 A. Mittnik
9 C. Knipper, adapted from Mittnik et al. 2019; Fig. S10; S11
10 A. Mittnik

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Appendix 1

Dating	mtDNA haplogroup assignment	Number of individuals assigned to haplogroup in period	Shared mtDNA lineage	mtDNA lineage sharing across period
CWC	V2	1		
	W3a1c	1		
BBC	H1	1		
	H15a1	1		
	H2a1	1		
	J1c	1		
	J1c1b1a	1		
	J1c2	1		
	J1c3g	1		
	K1a	2	UNTA58_68Sk2, UNTA58_67	
	K1a4a1	1	OBKR_2, OBKR_93, WEHR_1192SkA	yes
	T2b33	1		
	U4d3	1		
	U5a1a1	1		
	U5a2b3	2	HUGO_169Sk1, HUGO_169Sk2	
	U5b2a3	1		
	U5b2b3a	1		
	U5b2b4	2	HUGO_180Sk1, HUGO_180Sk2	
EBA	H	1		
	H1+152	2	AITI_35, AITI_37	
	H13a2b2a	2	WEHR_1415adult, WEHR_1415child	
	H1af	1		
	H1b1	1		
	H1ba	1		
	H1c	1		
	H1e	3	AITI_62A, AITI_62B	
	H1j2	1		
	H23	1		
	H27+16093	1	OBKR_85, OTTM_97	yes
	H2a1	1		
	H2a1a	2		
	H2a2a1	1		
	H3	1		
	H41a	2	POST_140, POST_35	
	H49	1		
	H4a1a1a	1		
	H5a4a1	1		
	H5d	1		
	H6a	1		
	H7a1	1		
	HV	1		
	HV0	1		
	I1a1	2	AITI_77A, AITI_77B	
	J1c2c2	3	AITI_36, AITI_70, AITI_72	
	J1c3	1		
	J1c3g	1		
	J1c8a	1		
	J2b1a	1		
	K1a	1		
	K1a1b1g	3	WEHR_1380, WEHR_1414, UNTA58_149	
	K1a2a	1		
EBA	K1a3	3	OBKR_80, OBKR_86	
	K1a3a	1		
	K1a4a1	3	OBKR_2, OBKR_93, WEHR_1192SkA	yes
	K1c1	1		
	K2a5	3	OBKR_67, POST_28, POST_47	
	R1a1a	1		
	T1a1	1		
	T2	1		
	T2a1b1a1b	1		
	T2c1d+152	2	POST_131, POST_137	
	T2f8a	1		
	U4a	1		
	U4a1a	4	AITI_119, AITI_120, AITI_86, AITI_87	
	U4a1b	1		
	U5a1a1+16362	1		
	U5a1i1	1		
	U5b1c2	3	UNTA58_150, UNTA58_151, UNTA58_152	
	U5b2a1a1	1		
	U5b2a2b	1		
	U5b2b2	1		
	U5b2b3a	1		
	V	3	WEHR_1474, WEHR_1564, WEHR_1586	
	V1a	1		
	V2	1		
	V7	3	OBKR_5, OBKR_6, OBKR_84	
	X2b	2	OBKR_81, OBKR_82	
	X2b+226	5	AITI_95, AITI_32, POST_85, POST_84, OTTM_151ind2	yes
MBA	H	1		
	H13a1a1	2	OTTM_151ind1, OTTM_152	
	H1e6	1		
	H27+16093	1	OBKR_85, OTTM_97	yes
	H3	1		
	H3ag	1		
	HV16	1		
	J1c3e1	1		
	J1c3g	1		
	J2b1a5	1		
	T2b21	1		
	T2b23	1		
	U5a1j	1		
	U5b1d1a	1		
	U5b3	1		
	V1b	1		
	X2b	2		
	X2b+226	1	AITI_95, AITI_32, POST_85, POST_84, OTTM_151ind2	yes

Appendix 2

Individual ID	Site name	Latitude	Longitude	LaborNr.	^{14}C Age	±	cal 2σ
HUGO_167	Augsburg – Hugo-Eckener-Straße	48.32852	10,898	MAMS 18912	3741	24	cal BC 2270–2039
HUGO_168	Augsburg – Hugo-Eckener-Straße	48.32852	10,898	MAMS 18913	3788	23	cal BC 2289–2141
HUGO_169Sk1	Augsburg – Hugo-Eckener-Straße	48.32852	10,898	MAMS 18914	3942	25	cal BC 2562–2345
HUGO_171	Augsburg – Hugo-Eckener-Straße	48.32852	10,898	MAMS 18917	3815	25	cal BC 2387–2146
HUGO_180Sk1	Augsburg – Hugo-Eckener-Straße	48.32852	10,898	MAMS 18918	3860	25	cal BC 2461–2210
HUGO_180Sk2	Augsburg – Hugo-Eckener-Straße	48.32852	10,898	MAMS 18919	3871	25	cal BC 2463–2235
HUGO_190	Augsburg – Hugo-Eckener-Straße	48.32852	10,898	MAMS 18921	3748	19	cal BC 2268–2046
POST_1	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18952	3583	28	cal BC 2024–1882
POST_12	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18956	3697	20	cal BC 2190–2028
POST_131	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18971	3635	20	cal BC 2120–1938
POST_140	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18973	3631	20	cal BC 2114–1926
POST_16	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18957	3612	20	cal BC 2029–1911
POST_2	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18953	3648	19	cal BC 2126–1948
POST_28	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18960	3608	20	cal BC 2027–1906
POST_32	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18961	3619	20	cal BC 2032–1916
POST_35	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18962	3621	20	cal BC 2033–1918
POST_44	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18964	3681	23	cal BC 2139–1979
POST_47	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18965	3662	24	cal BC 2134–1956
POST_50	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18966	3707	24	cal BC 2196–2029
POST_6	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18955	3574	19	cal BC 2009–1883
POST_85	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18968	3631	24	cal BC 2120–1921
POST_99	Haunstetten – Postillionstraße	48.29573	10,891	MAMS 18969	3641	25	cal BC 2130–1930
UNTA121_FK61	Haunstetten – Unterer Talweg 121	48.31181	10,890	MAMS 23728	4234	24	cal BC 2904–2711
UNTA58_68Sk1	Haunstetten – Unterer Talweg 58–62	48.31611	10,892				
UNTA58_68Sk2	Haunstetten – Unterer Talweg 58–62	48.31611	10,892	MAMS 18935	3910	20	cal BC 2470–2310
UNTA58_147	Haunstetten – Unterer Talweg 58–62	48.31611	10,892	MAMS 18937	3612	25	cal BC 2031–1900
UNTA58_149	Haunstetten – Unterer Talweg 58–62	48.31611	10,892	MAMS 18938	3597	24	cal BC 2023–1892
UNTA58_152	Haunstetten – Unterer Talweg 58–62	48.31611	10,892	MAMS 18942	3558	23	cal BC 2007–1779
UNTA58_153	Haunstetten – Unterer Talweg 58–62	48.31611	10,892	MAMS 18943	3553	24	cal BC 1971–1776
UNTA85_1336	Haunstetten – Unterer Talweg 85	48.31966	10,892	MAMS 18948	3893	22	cal BC 2465–2300
UNTA85_1343	Haunstetten – Unterer Talweg 85	48.31966	10,892	MAMS 18949	3819	24	cal BC 2397–2149
UNTA85_1412	Haunstetten – Unterer Talweg 85	48.31966	10,892	MAMS 18951	3602	25	cal BC 2025–1895
UNTA89_FK231	Haunstetten – Unterer Talweg 89	48.31707	10,889	MAMS 23729	4155	23	cal BC 2875–2635
AITI_119	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21594	3470	27	cal BC 1882–1696
AITI_120	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21595	3417	27	cal BC 1866–1638
AITI_2	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21562	3477	28	cal BC 1884–1698
AITI_32	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21565	3454	28	cal BC 1878–1691
AITI_33	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21566	3364	28	cal BC 1742–1562
AITI_36	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21568	3552	27	cal BC 2006–1774
AITI_37	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21569	3560	28	cal BC 2013–1777
AITI_40	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21570	3469	28	cal BC 1882–1695
AITI_43	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21571	3486	27	cal BC 1888–1701

Chronology	Age in years (anthropological determination)	Sex determined by archaeology	Sex determined by anthropology	Genetic Sex (M=Male, F=Female, U=Unknown)	SNPs of 1240K set used for relatedness analysis	SNPs of 1240K set used for population genetic analysis after quality filtering	mtDNA haplogroup assignment	Most derived reliable Y-chromosomal haplogroup assignment	Consistency with local isotopic signature
BBC	> 21	M	n/a	U	20164	n/a	U5b2b3a	n/a	consistent
BBC	> 25	F	n/a	F	933961	326173	H1	n/a (female)	uncertain
BBC	> 21	M	n/a	M	536670	62676	U5a2b3	G2-M3267	consistent
BBC	12–18	F	n/a	F	235885	19512	U5a1a1	n/a (female)	consistent
BBC	> 21	M	n/a	M	679566	77226	U5b2b4	R1b-M269, CTS623	uncertain
BBC	9–15	F	n/a	M	282333	36558	U5b2b4	F-P160	consistent
BBC	> 21	U	n/a	F	736279	97567	J1c3g	n/a (female)	inconsistent
EBA	4–6	F	U	F	47671	n/a	H2a1a	n/a (female)	consistent
EBA	7–11	U	U	F	81420	n/a	J1c3g	n/a (female)	consistent
EBA	6–10	F	U	F	46843	n/a	T2c1d+152	n/a (female)	consistent
EBA	> 25	(M)	U	M	314636	28835	H41a	R1b-P312	consistent
EBA	> 25	F	U	F	23398	n/a	T2f8a	n/a (female)	consistent
EBA	> 20	U	U	F	22955	n/a	n/a	n/a (female)	consistent
EBA	17–25	M	U	M	476398	476398	K2a5	R1b-P312	consistent
EBA	20–30	F	(F)	F	97406	n/a	T2	n/a (female)	inconsistent
EBA	35–55	F	U	F	827092	195171	H41a	n/a (female)	consistent
EBA	30–45	M	M	M	853686	853686	K1a3a	R1b-P312	consistent
EBA	20–30	M	U	M	60612	60612	K2a5	R1	consistent
EBA	30–35	M	(M)	M	770026	770026	T1a1	R1b-P312	consistent
EBA	14–16	M	U	M	933318	933318	U5a1a1+16362	R1b-P312	consistent
EBA	2–4	M	U	M	21939	n/a	X2b+226	R	consistent
EBA	20–30	F	U	F	991199	428612	K1a4a1	n/a (female)	inconsistent
CWC		M	M	M	20552	n/a	V2	n/a	consistent
BBC	> 21	M	n/a	M	555552	555552	J1c	G2a-PF3170	inconsistent
BBC	> 21	F	n/a	F	805134	182894	K1a	n/a (female)	consistent
EBA	35–55	F	n/a	F	177067	13319	H2a1	n/a (female)	inconsistent
EBA	9–15	M	n/a	M	26755	n/a	K1a1b1g	BT-M9242	consistent
EBA	7–12	F	n/a	F	72129	n/a	U5b1c2	n/a (female)	consistent
EBA	12–21	M	n/a	M	197341	197341	R1a1a	R1b-L23	uncertain
BBC	> 21	M	n/a	F	123823	n/a	H2a1	n/a (female)	consistent
BBC	> 21	F	n/a	M	794981	794981	J1c2	R1b-P312	consistent
EBA	3–5	(M)	n/a	M	299953	299953	H	R1b-CTS3575, L773, PF6434,PF6497	consistent
CWC		M	M	M	33712	n/a	W3a1c	n/a	inconsistent
EBA	13–17	M	(M)	M	534416	534416	U4a1a	R1b-P310	consistent
EBA	ca. 30	M	M	M	506947	506947	U4a1a	R1b-P312	consistent
EBA	50–60	M	M	M	745241	745241	H6a	R1b-P312	uncertain
EBA	14–25	F	(F)	F	32296	n/a	X2b+226	n/a (female)	inconsistent
EBA	5–8	M	U	M	56287	n/a	H2a2a1	F-P159	uncertain
EBA	20–23	M	M	M	20990	20990	J1c2c2	BT-M9138	consistent
EBA	5–6	F	U	F	55773	n/a	H1+152	n/a (female)	uncertain
EBA	21–45	M	M	M	200941	200941	T2a1b1a1b	R1b-L500	uncertain
EBA	ca. 30	M	M	M	853589	853589	X2b+226	R1b-P312	consistent

Individual ID	Site name	Latitude	Longitude	LaborNr.	^{14}C Age	±	cal 2σ
AITI_5	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21564	3493	28	cal BC 1892–1704
AITI_50	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21572	3505	33	cal BC 1920–1705
AITI_51Sk2	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21573	3531	34	cal BC 1946–1754
AITI_55	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21575	3504	33	cal BC 1919–1705
AITI_62A	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21576	3459	34	cal BC 1881–1691
AITI_62B	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21577	3478	33	cal BC 1889–1695
AITI_65adult	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21578	3456	34	cal BC 1881–1690
AITI_66	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21580	3489	34	cal BC 1899–1696
AITI_70	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21582	3594	37	cal BC 2116–1785
AITI_72	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21583	3508	34	cal BC 1926–1705
AITI_77A	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21584	3548	34	cal BC 2008–1769
AITI_77B	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21585	3469	35	cal BC 1885–1693
AITI_78	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21586	3474	34	cal BC 1887–1694
AITI_86	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21587	3480	34	cal BC 1891–1694
AITI_87	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21588	3433	28	cal BC 1876–1660
AITI_92	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21590	3489	28	cal BC 1889–1701
AITI_95	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21591	3422	28	cal BC 1870–1640
AITI_98	Kleinaitingen – Gewerbegebiet Nord	48.22281	10,845	MAMS 21592	3370	27	cal BC 1742–1613
AMPA_1	Königsbrunn – Ampack	48.25886	10,873	MAMS 18887	3924	23	cal BC 2476–2310
OBKR_117	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18911	3581	23	cal BC 2019–1883
OBKR_2	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18888	3599	22	cal BC 2023–1894
OBKR_47	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18894	3671	22	cal BC 2136–1977
OBKR_50	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18895	3623	23	cal BC 2112–1912
OBKR_6	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18890	3611	23	cal BC 2029–1903
OBKR_66	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18896	3609	22	cal BC 2028–1903
OBKR_67	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18897	3599	22	cal BC 2023–1894
OBKR_73	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18898	3603	23	cal BC 2024–1897
OBKR_76	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18899	3567	23	cal BC 2013–1785
OBKR_80	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18901	3664	24	cal BC 2134–1959
OBKR_81	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18902	3602	24	cal BC 2024–1896
OBKR_82	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18903	3600	24	cal BC 2023–1894
OBKR_84	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18905	3575	25	cal BC 2021–1830
OBKR_86	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18907	3615	24	cal BC 2032–1901

Chronology	Age in years (anthropological determination)	Sex determined by archaeology	Sex determined by anthropology	Genetic Sex (M=Male, F=Female, U=Unknown)	SNPs of 1240K set used for relatedness analysis	SNPs of 1240K set used for population genetic analysis after quality filtering	mtDNA haplogroup assignment	Most derived reliable Y-chromosomal haplogroup assignment	Consistency with local isotopic signature
EBA	ca. 25	F	F	F	131559	n/a	H5d	n/a (female)	consistent
EBA	2–4	(M)	(M)	M	320590	320590	J1c3	R1b-L11	consistent
EBA	21–23	U	M	M	22615	n/a	H7a1	n/a	consistent
EBA	55–65	M	M	M	38146	n/a	K1c1	n/a	uncertain
EBA	11–12	M	U	M	17758	n/a	H1e	n/a	uncertain
EBA	7–9	M	U	M	28277	n/a	H1e	n/a	consistent
EBA	21–25	F	F	F	524061	71181	H1af	n/a (female)	consistent
EBA	30–40	F	F	F	721756	176496	U5b2b3a	n/a (female)	inconsistent
EBA	20–21	M	M	M	372392	372392	J1c2c2	R1b-P312	consistent
EBA	35–40	M	M	M	701339	701339	J1c2c2	R1b-P312	consistent
EBA	3–4	F	(F)	F	255749	25350	I1a1	n/a (female)	consistent
EBA	3–4	F	(F)	F	309480	25494	I1a1	n/a (female)	consistent
EBA	30–60	U	M	M	659930	659930	H3	R1b-P312	uncertain
EBA	4–6	U	U	M	37702	n/a	U4a1a	n/a	consistent
EBA	30–40	F	F	F	220561	29564	U4a1a	n/a (female)	consistent
EBA	21–23	F	F	F	475755	84076	H5a4a1	n/a (female)	consistent
EBA	30–45	F	F	F	629248	136157	X2b+226	n/a (female)	consistent
EBA	5–7	M	(M)	M	329102	329102	H49	R1b-P312	uncertain
BBC	> 21	M	M	M	768956	87767	T2b33	n/a	consistent
EBA	21–24	U	M	M	561240	69931	U4a1b	I-CTS5650, CTS48, FI2	consistent
EBA	25–30	F	F	F	365032	31240	K1a4a1	n/a (female)	consistent
EBA	25–35	F	(M)	M	53435	n/a	J2b1a	n/a	consistent
EBA	25–30	F	F	F	683096	135818	HV0	n/a (female)	inconsistent
EBA	15–18	F	U	F	39654	n/a	V7	n/a (female)	consistent
EBA	40–60	F	F	F	355759	25529	U4a	n/a (female)	inconsistent
EBA	40–60	M	M	M	338941	37580	K2a5	R1b-P312	consistent
EBA	20–25	(F)	F	F	103942	n/a	U5b2a1a1	n/a (female)	uncertain
EBA	25–30	F	F	F	23910	n/a	K1a	n/a (female)	inconsistent
EBA	30–40	M	M	M	718030	718030	K1a3	R1b-P312	consistent
EBA	ca. 4	F	U	F	63138	n/a	X2b	n/a (female)	consistent
EBA	ca. 3	F	(F)	F	17462	n/a	X2b	n/a (female)	consistent
EBA	ca. 1–2	F	U	F	23817	n/a	V7	n/a (female)	consistent
EBA	30–40	M	M	M	463560	50295	K1a3	R1b-P312	consistent

Individual ID	Site name	Latitude	Longitude	LaborNr.	^{14}C Age	±	cal 2σ
OBKR_93	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18908	3621	23	cal BC 2111–1907
OBKR_95	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18909	3608	23	cal BC 2027–1901
OBKR_96	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18910	3567	23	cal BC 2013–1784
OBKR_9A	Königsbrunn – Obere Kreuzstraße (Baugebiet 110)	48.26656	10,879	MAMS 18891	3596	22	cal BC 2022–1892
OTTM_109	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21550	3360	37	cal BC 1743–1534
OTTM_141	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21552	3297	36	cal BC 1681–1499
OTTM_142	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21554	3309	37	cal BC 1682–1504
OTTM_151ind1	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21555	3370	38	cal BC 1749–1535
OTTM_151ind2	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21556	3288	27	cal BC 1623–1504
OTTM_152	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21557	3295	28	cal BC 1630–1505
OTTM_154	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21558	3449	72	cal BC 1949–1563
OTTM_156	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21559	3241	28	cal BC 1609–1442
OTTM_165	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21561	3349	29	cal BC 1735–1535
OTTM_81	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21542	3277	33	cal BC 1630–1459
OTTM_84	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21543	3283	32	cal BC 1636–1465
OTTM_87	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21544	3324	34	cal BC 1687–1517
OTTM_91	Oberottmarshausen – Kiesgrube Lauter	48.22519	10,850	MAMS 21545	3075	41	cal BC 1426–1230
WEHR_1192SkA	Wehringen – Hochfeld	48.25283	10,809	MAMS 18922	3810	19	cal BC 2331–2150
WEHR_1192SkB	Wehringen – Hochfeld	48.25283	10,809	MAMS 18923	3523	18	cal BC 1918–1772
WEHR_1193	Wehringen – Hochfeld	48.25283	10,809	MAMS 18924	3544	19	cal BC 1945–1777
WEHR_1414	Wehringen – Hochfeld	48.25283	10,809	MAMS 18927	3601	19	cal BC 2022–1897
WEHR_1415adult	Wehringen – Hochfeld	48.25283	10,809	MAMS 18929	3573	19	cal BC 2008–1883
WEHR_1415child	Wehringen – Hochfeld	48.25283	10,809	MAMS 18928	3596	19	cal BC 2021–1893
WEHR_1474	Wehringen – Hochfeld	48.25283	10,809	MAMS 18930	3614	19	cal BC 2029–1916
WEHR_1564	Wehringen – Hochfeld	48.25283	10,809	MAMS 18931	3594	19	cal BC 2020–1892
WEHR_1586	Wehringen – Hochfeld	48.25283	10,809	MAMS 18932	3550	19	cal BC 1951–1779

Chronology	Age in years (anthropological determination)	Sex determined by archaeology	Sex determined by anthropology	Genetic Sex (M=Male, F=Female, U=Unknown)	SNPs of 1240K set used for relatedness analysis	SNPs of 1240K set used for population genetic analysis after quality filtering	mtDNA haplogroup assignment	Most derived reliable Y-chromosomal haplogroup assignment	Consistency with local isotopic signature
EBA	18–23	F	F	F	221774	19117	K1a4a1	n/a (female)	consistent
EBA	13–15	F	(F)	F	28989	n/a	V1a	n/a (female)	consistent
EBA	30–40	F	F	F	104670	n/a	H1j2	n/a (female)	consistent
EBA	25–30	F	F	F	587323	72499	K1a2a	n/a (female)	uncertain
MBA	7–19	U	U	M	22775	n/a	X2b	n/a	consistent
MBA	30–50	U	(F)	F	39028	11728	H3ag	n/a (female)	consistent
MBA	17–21	F	F	F	285671	55652	U5b1d1a	n/a (female)	consistent
MBA	2–3	U	U	F	387779	41835	H13a1a1	n/a (female)	consistent
MBA	20–50	U	U	F	609841	220702	X2b+226	n/a (female)	uncertain
MBA	2.5–4	U	U	M	52779	n/a	H13a1a1	n/a	consistent
MBA	2.5–4	U	U	M	41091	41091	H3	CT-M5757	consistent
MBA	15–18	U	U	M	135811	135811	V1b	R/K2b2a2-P227	uncertain
MBA	20–40	U	F	F	131014	17727	H	n/a (female)	consistent
MBA	3–4	U	n/a	F	37195	n/a	T2b21	n/a (female)	consistent
MBA	30–40	U	n/a	F	171214	13913	U5b3	n/a (female)	consistent
MBA	30–50	F	U	F	376731	65045	HV16	n/a (female)	uncertain
MBA	50–70	U	U	F	63982	n/a	J1c3g	n/a (female)	consistent
BBC	> 21	M	n/a	M	936299	936299	K1a4a1	R1b-P312	consistent
EBA	> 21	F	n/a	F	249376	25647	U5b2a2b	n/a (female)	uncertain
EBA	> 21	F	n/a	F	69513	n/a	H4a1a1a	n/a (female)	inconsistent
EBA	15–18	M	n/a	U	182178	n/a	K1a1b1g	BT-M9214	consistent
EBA	> 21	F	n/a	F	878099	209150	H13a2b2a	n/a (female)	consistent
EBA	0–6	U	n/a	M	529351	529351	H13a2b2a	R1b-L151	consistent
EBA	> 21	M	n/a	M	499656	65029	V	CT-M5681	consistent
EBA	> 21	M	n/a	M	308916	35242	V	CT-M5711, M5782	consistent
EBA	> 21	F	n/a	F	952940	379408	V	n/a (female)	consistent