European Journal of Archaeology 2024, page 1 of 19

Dietary Variability in the Varna Chalcolithic Cemeteries

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This article presents the results of AMS radiocarbon dating, stable isotope analysis, and FRUITS dietary modelling to investigate dietary variability among sixty individuals buried at Varna in the mid-fifth millennium BC*. The principal pattern was the isotopic clustering of some forty-three per cent of the population, which suggests a 'Varna core diet', with the remainder showing a wider variety of isotopic profiles. While there is a slight trend for heightened meat and fish consumption among male individuals compared to female and undetermined individuals, the authors found no clear correlation between dietary variation and the well-attested differentiation in material culture in the graves. Three children had isotopic profile and estimated diets unmatched by any of the adults in the sample. Two scenarios, dubbed 'regional' and 'local', are presented to explain such dietary variability at Varna.*

Keywords: Varna, isotopic dietary studies, FRUITS, Bulgaria, children, Chalcolithic

Introduction

The Chalcolithic of the eastern Balkans has been described as a climax period in later prehistory (Nandris, 1978), the golden fifth millennium BC (Boyadziev & Terzijska-Ignatova, 2011), because of its peak in settlement densities, mortuary splendour, and technological advances. Tell settlements expanded in most regions, except in the western Black Sea coast, where flat sites and community cemeteries, alongside occasional tells, continued a long Neolithic tradition (Todorova & Vajsov, 1993). The hitherto regional ceramic traditions coalesced in a process of network linkage to form the 'Kodzhadermen-Gumelnița-Karanovo VI' complex (Sherratt, 1972; Todorova, 1978), with the closely related Varna group distributed along the Black Sea coast. The gradual long-term increase in the quantity and diversity of mortuary deposits is best observed in the Durankulak cemetery, reaching a peak in the Late Chalcolithic (Todorova, 2002; Chapman, 2017) — the time of the Varna cemetery complex.

The Varna cemetery complex, dating to the mid-fifth millennium cal BC, was discovered by chance in 1972 (Ivanov, 1978). It was excavated over thirteen non-consecutive seasons, revealing more than 310 graves (Slavchev, in prep), and has since become an iconic site for Bulgarian and European prehistory due to the exuberant deposition of gold artefacts (Slavchev,

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2010) and skilfully produced objects, such as flint macroblades up to 410 mm long (Manolakakis, 2004) and faceted carnelian beads (Kostov, 2007). Two further groups of burials were discovered in later years, named Varna 2 (2.5 km to the west) and Varna 3 (*c.* 2.5 km to the east/south-east) to differentiate them from the burial ground found in the 1970s, which became known as Varna 1. Varna 2 has three excavated graves since most of the cemetery was destroyed during construction work. In 2017, rescue excavations unearthed fifteen prehistoric graves in Varna 3 (Slavchev et al., 2018), which AMS dating showed to be contemporary with Varna 1 (Gaydarska et al., 2021). The most differentiated mortuary assemblages have been found in Varna 1, where the graves ranged from having no grave goods at all (Grave 44) to the adjacent grave (Grave 43), where the burial of a mature male was accompanied by over 1000 items, comprising thirteen categories of objects, of which the gold artefacts alone weighed almost 1.6 kg. In addition to the more frequent extended and crouched inhumations, Varna included a small number of what have been termed 'symbolic' graves; no human bone remains were interred in these (so-called 'cenotaph' graves) and in some a clay head, formerly described as a 'mask', has replaced the skull. Most of the graves with exceptionally rich grave goods were the 'symbolic' graves (Ivanov, 1988).

The Varna cemetery complex has posed challenges for those wishing to interpret its extraordinary finds in social terms. In parallel with the preparation of the full publication of Varna 1 (Slavchev, in prep), two broad lines of approach have been attempted: social reconstructions based largely on the range of grave goods, and bioarchaeological and archaeometric studies of the osteological remains, including stable isotope analyses. While there has been a general consensus that Varna represents an early example of distinct social categorization, as suggested by the differential grave good deposition and the presence of symbolic graves, there is no agreement on the social realities of Varna. Various authors have identified social complexity, some arguing for chiefdoms (Renfrew, 1978), or a state (Raduntcheva, 1989), or a centre for metallurgical production (Rusev et al., 2010). Others have maintained a less hierarchical view (Whittle, 1996; Bailey, 2000), while yet others have argued for a tension between dividual, individual, and communal identities in the cemetery (Chapman, 2020).

Various scientific analyses to address the nature of Varna's social categorization are relatively recent, mainly owing to a virtual moratorium on scientific analysis from the early 1980s to the 2000s, imposed by the excavator. In the past two decades, bioarchaeological and archaeometric studies have been concerned with absolute chronology through AMS dating and Bayesian modelling (Higham et al., 2018; Gaydarska et al., 2021; cf. the non-Bayesian methods used by Krauß et al., 2017), the identification of diet through stable isotope analysis (Honch et al., 2006), the study of genomic history using aDNA analysis (Mathieson et al., 2018; Penske et al., 2023), and—as one of many forms of characterizing the Varna objects—the archaeometallurgical analysis of gold and copper grave goods (Dimitrov, 2007; Leusch et al., 2017). Here, we offer a new integration of scientific data and social interpretations, an approach so far quite limited.

Scope and Aims

Our original, small-scale pilot study centred on material from the discovery of a new mortuary focus at Varna 3 in 2017 and a sample of individuals from Varna 1. The FRUITS (Food Reconstruction Using

Isotopic Transferred Signals; Fernandes et al., 2014) modelling of twenty-nine Varna individuals (ten from Varna 3 and nineteen from Varna 1; Gaydarska et al., 2021, 2022) demonstrated differences in diet between the two cemetery populations, and between males and females, and in particular revealed some individuals to be distinct isotopic outliers relative to more centrally grouped isotopic profiles. At that time, aDNA data for several of the burials provided a basis for discussing mobility in the Varna population, with one explanation for 'dietary outliers' being that some individuals were migrants, possibly from as far as the North Pontic steppes. However, a recent revision (Penske et al., 2023) of the original aDNA analyses (cf. Mathieson et al., 2018) of some Varna 1 individuals does not support the North Pontic steppe link. Hence, given the reconsideration of the aDNA line of reasoning as to the source of the observed stable isotope variations, we are continuing to investigate the significance of these 'outliers' for our understanding of dietary variation at Varna. The results of the pilot study by Gaydarska and colleagues (2021, 2022) have been incorporated into an analysis of a larger sample of Varna 1 graves, which we report here. It addresses the apparent dietary variation found through isotopic analysis of individuals buried in the Varna 1 and Varna 3 cemeteries.

Dietary regimes are important components of prehistoric lifeways, with implications for many, if not all, daily settlement practices. To adapt John Robb's (2007: 157) aphorism that 'eating the Chalcolithic way meant reproducing Chalcolithic society', continuity in food production, hunting, fishing, and gathering implies similar social relationships of production that framed the everyday tasks of most of a local prehistoric population. By contrast, dietary variability raises questions about different food practices or varied access to foodstuffs. The observed dietary variability at Varna, based on stable isotope analyses and dietary interpretations from proportional modelling, may provide a deeper understanding of the development of the Copper Age. In addition, we use the results of new Bayesian modelling that incorporates insights from proportional dietary estimates and the potential effect from marine-sourced radiocarbon offsets on AMS dating for the Varna populations (Gaydarska et al., in prep).

Here, we aim to provide some insights into the possible social relationships of the buried population at Varna by: (1) characterizing individual diets; (2) exploring associations between diet and burial deposition patterns; and (3) determining how those diets may relate to social groupings.

Methods

For this study, we have added thirty-one burials from the Varna 1 cemetery to our original study of twenty-nine individuals (Gaydarska et al., 2022). The expanded study population now comprises sixty individuals in two cemeteries: fifty Late Chalcolithic individuals from Varna 1 and ten from Varna 3.

The full details of the FRUITS modelling are included in the Supplementary Material (S1). Its results provide an estimation of individual proportional food consumption, which was employed for two purposes: in this article, for our interpretations of potential social relationships among the population of the Varna cemeteries and, to be published in a forthcoming paper (Gaydarska et al., in prep), estimated marine offset components for individual radiocarbon calibration. The values derived from bone samples reflect roughly the mix of the previous ten years of life, varying depending on the bone sampled and the individual's age. The term 'mix' is used since many factors of diet intake and metabolism shape the observed result, such as disease and extreme and/or long-term changes in diet or food supply.

As few faunal and no plant remains have been recovered from the Varna vicinity, proxies for foods likely to have been available at Varna were drawn together from previously published work on regional sources. 'Cereal/pulses' refer to carbon and nitrogen values for archaeobotanical samples of wheat, barley, lentil, and bitter vetch from sites within 500 km of Varna (Azmak, Karanovo, Slatina, and Kapitan Dimitrievo; Bogaard et al., 2013: tab. 2). 'Terrestrial animals' are herbivore and omnivore/carnivore animal bone from the Durankulak and Varna cemeteries (Honch et al., 2006: tab. 1). The baseline for 'Black Sea fish' is flesh values of modern free-range Black Sea sprats, mackerel, and anchovies (Bănaru & Harmelin-Vivien, 2009), with adjustments to reflect the temporal variations in $\delta^{13}C$ incorporated into marine organisms relative to modern waters. The weight and concentration of each of the three diet sources were set at 100 per cent.

We also consider factors that support the assumption that marine fish (i.e. our baseline Black Sea fish) rather than freshwater species are the aquatic food source in Varna diets. Freshwater fish diet sources have a terrestrial range $\delta^{13}C$ of −28.2‰ to −20.2‰, compared to marine and brackish water fish of −14.9 to −9.4‰ (see Fuller et al., 2012; Robson et al., 2016) due to contributions to freshwater environs from dissolved inorganic carbon and terrestrial runoff. With the trophic effect factors that we have used in the FRUITS modelling (4.8 ± 0.5‰ for $\delta^{13}C$ (Fernandes et al., 2014, 2015) and 5.5 ± 0.5‰ for $\delta^{15}N$ (O'Connell et al., 2001)), freshwater fish would contribute to $\delta^{13}C$ values of consumer isotopic profiles in the range of −23.4 to −15.4, as compared to similar trophic enrichment that would see marine/brackish water fish contribute to consumers in the −10.1‰ to −4.6‰ range, as well as drive higher $\delta^{15}N$ values.

We first plotted the Varna 1 and 3 sample population of sixty individuals by $\delta^{13}C$ and $\delta^{15}N$ to illustrate the possible relationships in diet variation in the Varna population (Figure 1). We employed HDBSCAN to derive these groupings (see Supplementary Material S2). This exercise resulted in a core cluster of twenty-six isotopic profiles and four outlier groups (A–D), with an additional seventeen single-point outliers plotting separately from any cluster.

Results

We shall first consider the full set of samples from the Varna 1 and 3 cemeteries and then the individuals from the core dietary group in comparison with those of the outlier groups and points. We move between these two different data sets as appropriate.

Table S1 (see Supplementary Material) presents the cumulative isotopic and FRUITS dietary modelling estimates for the sixty individuals in the Varna 1 and Varna 3 cemetery populations, and Figure 1 illustrates the plotted distribution of individual isotopic profiles.

The core cluster of twenty-six individuals (43.3% of the sample population) is made up mainly of Varna 1 burials but includes two individuals from Varna 3 (Graves G15, a 20–30-year-old female, and G4, a 10–12-year-old of indeterminate sex). The cluster comprises females (n = 6), males (n = 14), and individuals of undetermined sex (n = 6). The cluster has an overall mean $\delta^{13}C$ of −18.8 ± 0.2‰, and $\delta^{15}N$ of 10.0 ± 0.3‰. The range of

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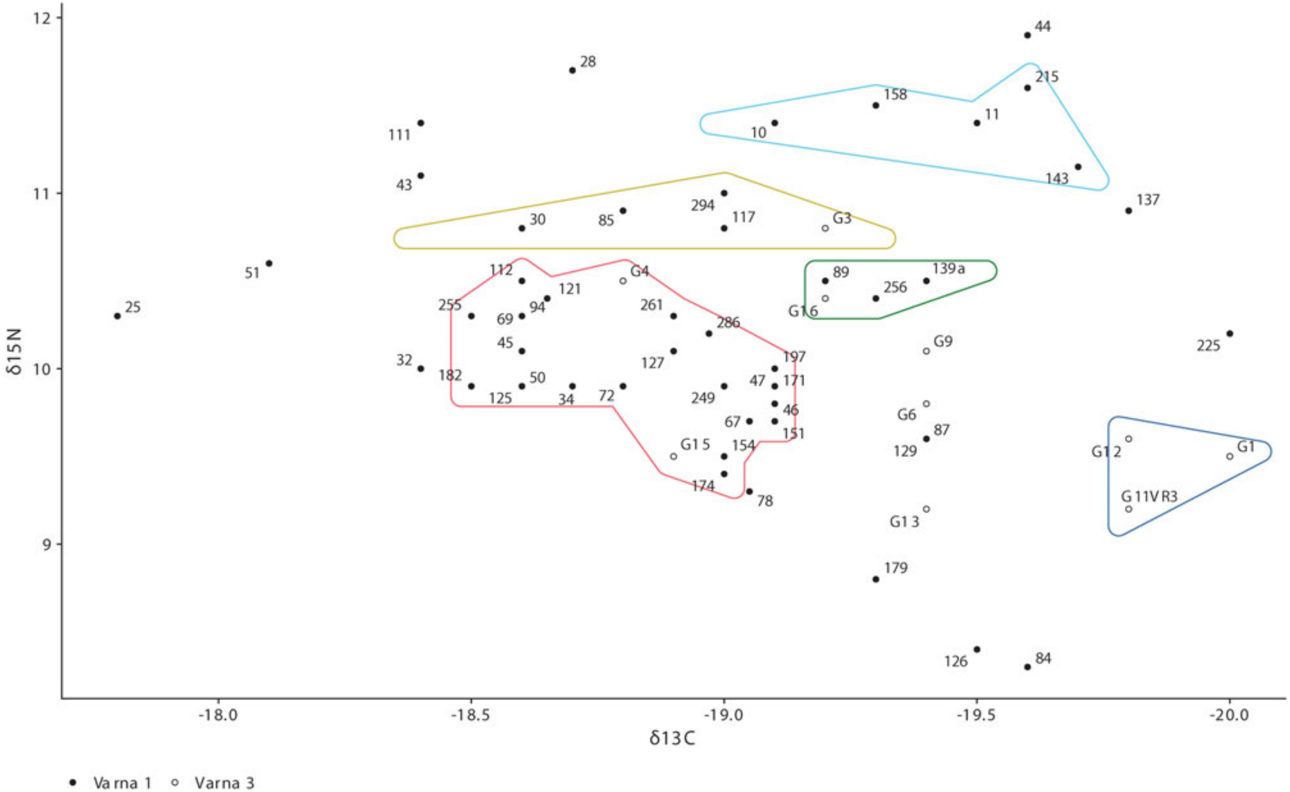

Figure 1. *Late Chalcolithic individuals from the Varna cemeteries plotted on* $\delta^{13}C$ *and* $\delta^{15}N$ *values. The distribution is marked by a core group of twenty-six individuals, smaller sub-groups (A–D), and seventeen single-point outliers, the latter reflecting singular diet profiles unrelated to other clustered individuals.*

isotopic values (minimum, maximum) has a 1.0‰ variation in $\delta^{13}C$, and a 1.2‰ variation in $\delta^{15}N$. FRUITS diet proportion estimates for cereals and pulses are a mean 70.7%±15.5%, mean terrestrial animal values come to 23.2%±16.9%, with a mean Black Sea fish component of 6.1% ±4.5%. The core group's mean intake of terrestrial animals and fish is a combined proportion of 29.3 per cent.

We turn to the seventeen individuals who make up the four smaller clusters A to D, and another seventeen individual points that are outliers to the possible groupings. Individuals who form smaller clusters or present as individual points outside the central group constitute 56.7 per cent of the population sample (see Supplementary Material S3 for a detailed discussion).

For clusters A and B, the average proportions of FRUITS-estimated terrestrial animals and fish together makes up 47.6 per cent, compared to the core group's 29.3 per cent. Group C has FRUITS-estimated proportions of terrestrial animal and Black Sea fish that indicate a combined meat and fish diet proportion of 34.3 per cent. Group D has FRUITS estimates showing that cereal/pulses formed the greater part of the diet (82.6%±11.3%), with terrestrial animal and fish contributing only a combined 17.4 per cent, i.e. a more basic cereal and pulse diet and far lower meat and fish sources than other groups.

The seventeen outlier points are individuals who exhibit singular variations in the Varna diets. Among these points are six individuals that can be broadly described as those with enriched $\delta^{13}C$ and $\delta^{15}N$. Among these is the richest burial in the cemetery, Grave 43 from Varna 1, the 40–60-year-old male whose 1000+ grave goods included nearly 1.6 kg of gold artefacts (Rusev et al., 2010). Mean FRUITS estimates indicate that a combined 44.7 per cent animal and fish components in these diets is driving the higher nitrogen and enriched $\delta^{13}C$ for these six individuals, suggesting access to higher-status foods.

A second trend among individual outliers is marked by depleted $\delta^{13}C$ and a broader range of $\delta^{15}N$. These individuals' range of isotope profiles seems to show differing access or dietary preferences, with lower FRUITS-estimated terrestrial animals and minimal proportions of Black Sea fish, inferring diets which rely mainly on non-flesh sources. Among these are two children (Grave 84, a 7–8-year-old, and Grave 179, a 6–8-year-old) who have the lowest $\delta^{15}N$ values in the entire population; their nearest possible isotopic associate is Grave 126, a 25–30-year-old of indeterminate sex. FRUITS estimations suggest less animal flesh in their diets and negligible Black Sea fish, which indicate either access to, or dietary preference for, diets much lower in animal flesh and with little or no fish.

The individual in Grave 44 is a thirteen-year-old male with the most enriched $\delta^{13}C$ and $\delta^{15}N$ of all individuals in the Varna population. His closest isotopic neighbours in Figure 1 are in cluster B, comprising five of the burials with the highest $\delta^{15}N$ (mean 11.4‰) and mean $\delta^{13}C$ (–19.4‰) in the cemetery population.

As a further illustration of isotope variation between the core group and the outliers, we have produced a graph of the FRUITS-estimated diet proportions of cereals/pulses, terrestrial animals, and Black Sea fish per individual in the core group, and then constructed a second graph with the diet proportions per individual in the outlier groups and single points (Figure 2). The variations in the proportions of diet sources of the core group can be compared with the wider variation of dietary proportions in the outlier groups and single points.

Having demonstrated that a distinct isotopic 'core' group existed within the Varna cemetery population as well as a diverse set

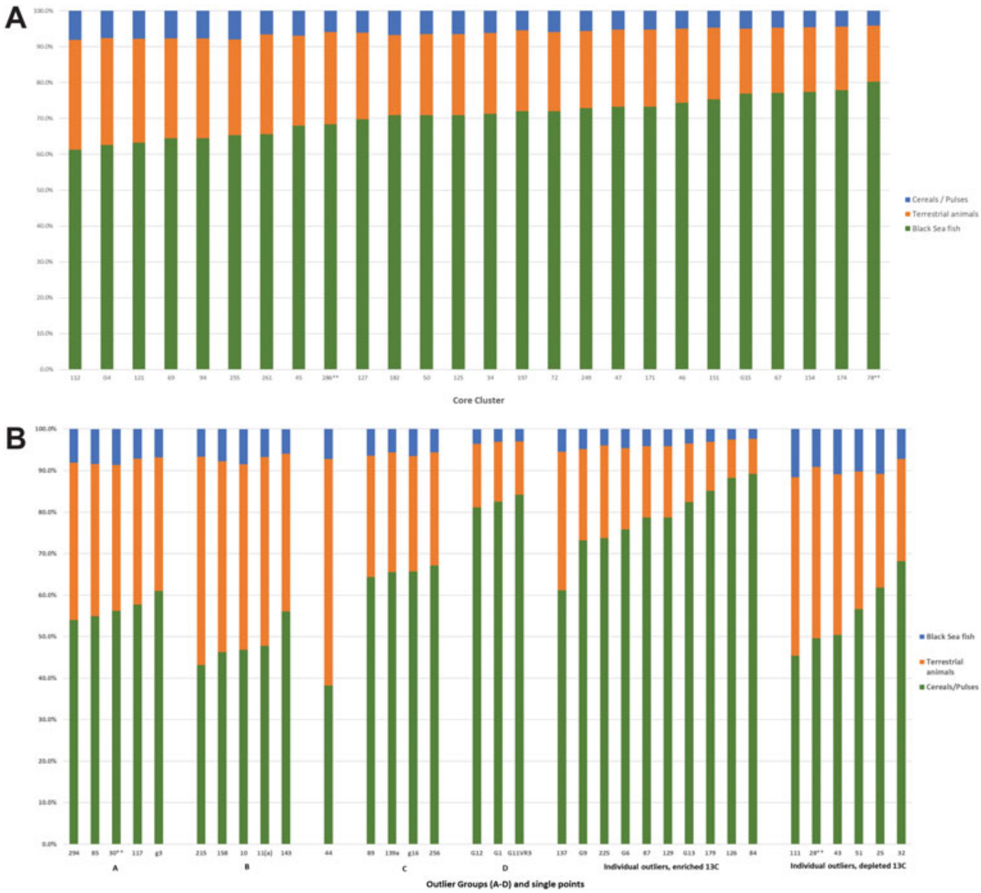

Figure 2. *Plots of the FRUITS-estimated diet proportions (by percentage) from Figure 1. a) core cluster of Varna burials compared to b) estimated diet proportions of the outlier clusters (A–D) and individual points.*

of 'outlier' groupings and single points—seen in the isotopic profiles (Figure 1) and the related FRUITS estimations of diet (Figure 2)—we turned to exploring possible links with the temporal development of the cemeteries and other aspects of the burials, such as the age and sex of the deceased and their status as measured by the proxy of grave goods deposited.

Our first step was to examine the change through time of the dietary variability of the core group and the outliers. The Varna cemetery chronology uses personalized calibration curves that have been constructed for each of the dated burials, including the estimated potential marine offset from that individual's FRUITS analysis. We have assembled the first comprehensive internal chronology for the Varna 1 cemetery (Gaydarska et al., in prep; cf. the correspondence analysis-based chronology of Krauß et al., 2017). It shows that the Varna 1 cemetery can be divided into four phases, with all the Varna 3 burials falling into phase 2. Summed probability estimates for the phasing of each burial in terms of the four phases of cemetery usage indicate that there is no obvious chronological difference between the graves in the core group and the outliers (Figure 3).

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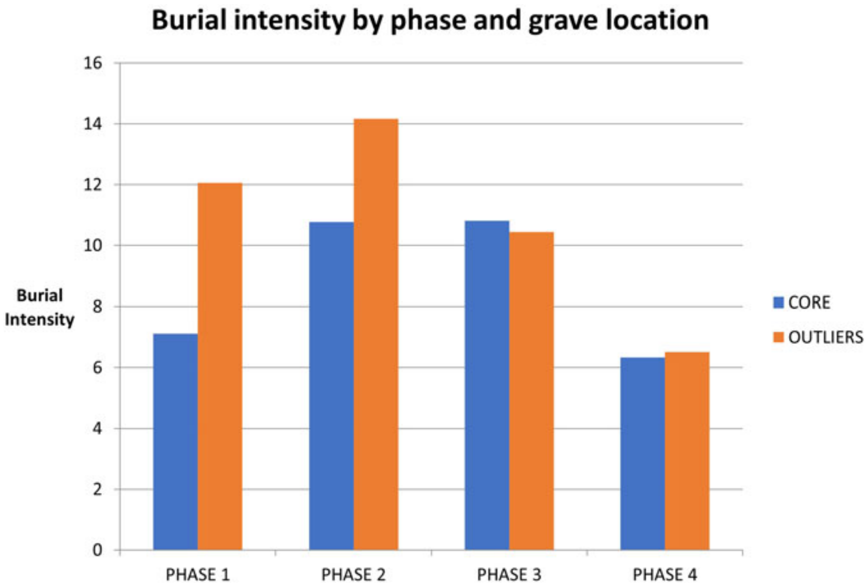

Figure 3. *Burial intensity at the Varna 1 cemetery by phase and burial location based on the dietary plot (Figure 1). Burial intensity is measured by dividing the summed probabilities of graves in each of the four phases by the length of each phase in years. Burial location is divided into core graves and outliers (including both outlier groups and isolates).*

The next step was to examine the stable isotope distribution in Varna by sex (male, female, and indeterminate individuals) in the adult population (>13 years old) and children (≤13 years old) (Graves 179, 84, 158, and 44 from Varna 1, G4 from Varna 3) (Figure 4) within the whole sample. There is minimal isotopic difference between the mean values for the sexes. Adult males (n = 32) have a mean of 10.4 ± 0.3‰ δ^{15}N, quite similar to that for females (n = 16) at 10.0 ± 0.2‰. The range of δ^{15}N values between these are also similar, with a male minimum/maximum δ^{15}N of 9.3‰ to 11.7‰, and 9.2‰ to 11.4‰ for females. The δ^{13}C mean between males and females are also similar, at δ^{13}C of −18.9 ± 0.2 for males and −19.2 ± 0.2 for females. Indeterminate graves (n = 7) have mean δ^{15}N values of 9.8 ± 0.3‰ but the maximum δ^{15}N is 10.6‰; given the lower mean nitrogen, it is notable that there are three individuals with enriched ^{13}C (Graves 51, 94, 125) that contribute to a mean for the cohort of −18.9, with a minimum of −19.5 and a maximum of −18.1.

While age estimations reported from the original Varna excavation skeletal analyses are often inexact (e.g. '*adultus*', 'young individual', etc.), enriched δ^{15}N (11‰ to 11.6‰; Graves 10, 28, 111, 143, 215, and 294) is mainly found among adult males 20–30+ years old but also include a 14–15 year-old female (Grave 11) with a δ^{15}N value of 11.4‰. The exception to this generalization about younger individuals and enriched nitrogen values is the mature male buried in Grave 43, the richest of the Varna burials. Among children aged ≤13 years, mean δ^{15}N is 10.2‰ with a range of 8.3‰ to 11.9‰, the latter being the highest value of δ^{15}N in the entire Varna study population. Children with enriched δ^{15}N comprise a thirteen-year-old (Grave 44) with δ^{15}N of 11.9‰, and Grave 158, a 5–7-year-old with δ^{15}N of 11.5‰.

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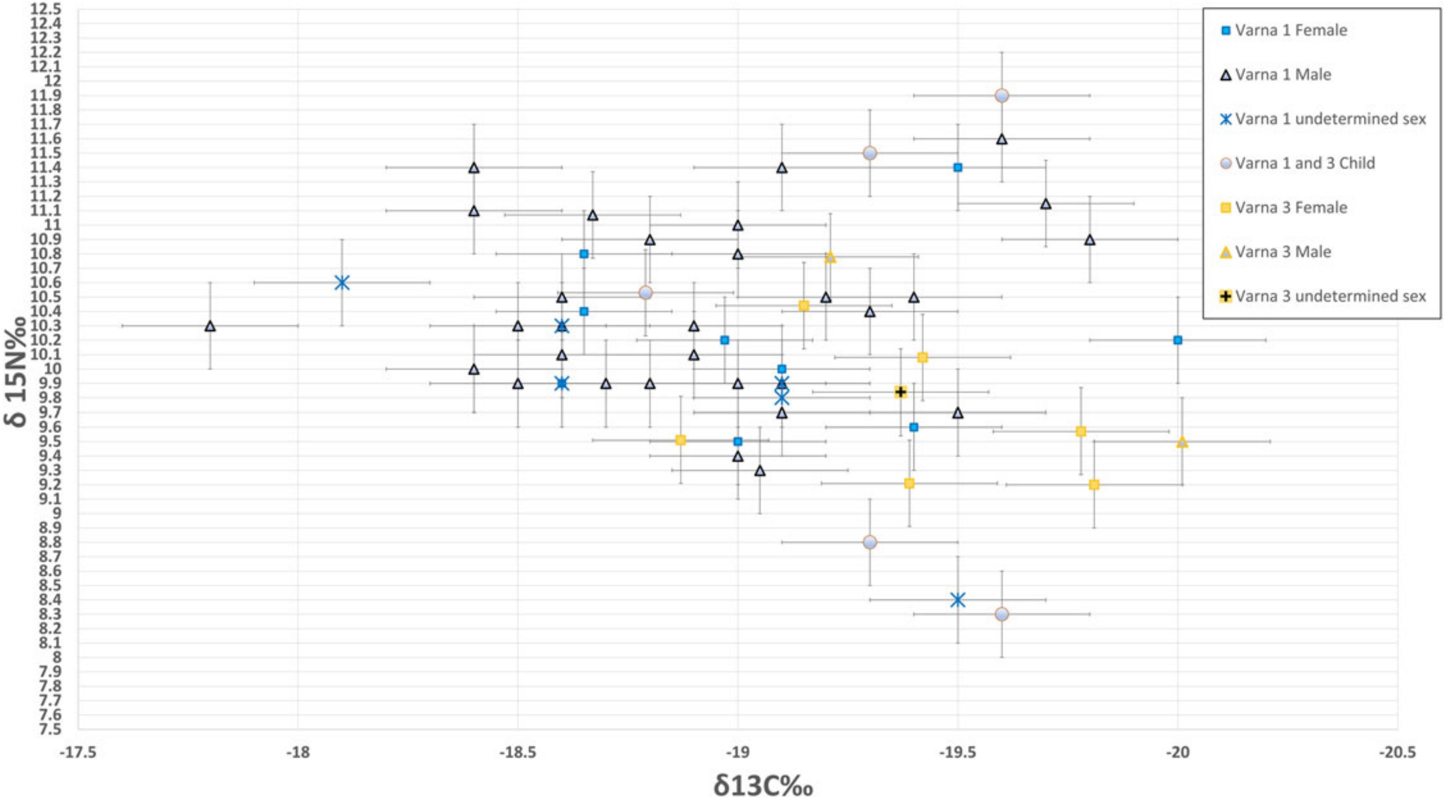

Figure 4. *Distribution of $\delta^{13}C$ and $\delta^{15}N$ for Varna 1 and Varna 3 individuals, by sex and age. Sex-based variations in stable isotope profile do not produce a particular pattern. Error bar values are 0.2‰ for $\delta^{13}C$ and 0.3‰ for $\delta^{15}N$.*

When FRUITS estimations of the diet proportions among adult males, females, and indeterminate individuals are compared, adult males had the highest combined animal and fish intake (35.8%), followed by females (28.1%) and those of indeterminate sex (28.04%). Estimated diet proportions for the five children ≤13 years old are quite variable. While the mean combined animal and fish proportion is 35.7 per cent, we find that Grave 44 and Grave 158 have the highest individual animal and fish proportions in the entire Varna population, at combined totals of 61.8 per cent and 53.8 per cent, respectively. As reported earlier, these children exhibit enriched ^{15}N, but are well over weaning age, so the potential for enriched δ^{15}N associated with nursing is not a contributing factor.

We then turned to a study of aDNA recovered from twenty-five Varna individuals (Penske et al., 2023) that shows a credible shared genomic heritage with the 'Anatolian farmer' cluster. Thirteen of the individuals in our current Varna study population have both FRUITS and aDNA results. While five of these individuals fell within the core group, the other eight burials (Graves 28, 32, 43, 44, 117, 139a, 158, and 294) were dietary outliers. Indeed, a child (Grave 158), a male adolescent (Grave 44), and the richly furnished adult male burial (Grave 43) are represented in outlier groups with nitrogen values greater than that of the core group. There is thus a contrast between the genomic homogeneity of the Varna population sampled so far and the dietary variability between a core group, the four outlying sub-groups, and the set of seventeen isolates.

Finally, we considered possible relationships between grave good deposition and individual Varna diets. Here, we chose the simplest assessment of grave goods for two reasons: the cemetery is still unpublished, and the deposition of grave goods is enormously complex at Varna. We therefore used the number of items found in each grave and compared it with a factor that has been taken to imply a higher-status diet, i.e. the total percentage of terrestrial animal and fish for each individual. Plotting the total animal and fish content against the number of grave goods of the complete sample of dated graves shows a complete lack of correspondence between the two variables (Figure 5). While graves with no grave goods or a single offering (Graves 44, 47, 50, 89, 94, 121, 137, 139a, 197, and 225) showed a total animal and fish diet percentage range of 26.2 per cent to 61.8 per cent, 'richer' graves with over 100 objects (Graves 11, 43, 143, 154, and 158) varied in total animal and fish content from 22.6 per cent to 53.8 per cent. Moreover, the presence of very large and very small grave good assemblages in both the core group graves and the outlier burials shows that there is little difference between these two sub-groups.

Discussion

Our first finding from the examination of the Varna stable isotope and estimated dietary variation is that we can define a 'core' Varna group and a diverse set of 'outlier' groupings (Figure 1). We also investigated relationships between diet and age/sex, diet and aDNA, and diet and grave goods. There was a heightened consumption of terrestrial animals and fish among males, especially between the ages of twenty and thirty, over females (28.1% compared to 35.8% for males). Even though there were few other important differences between age/sex groupings in the complete sample, it seems that the male/female difference in total animal and fish food sources is an important pattern. The differences between adult diets and the diets of three children at Varna will be discussed below.

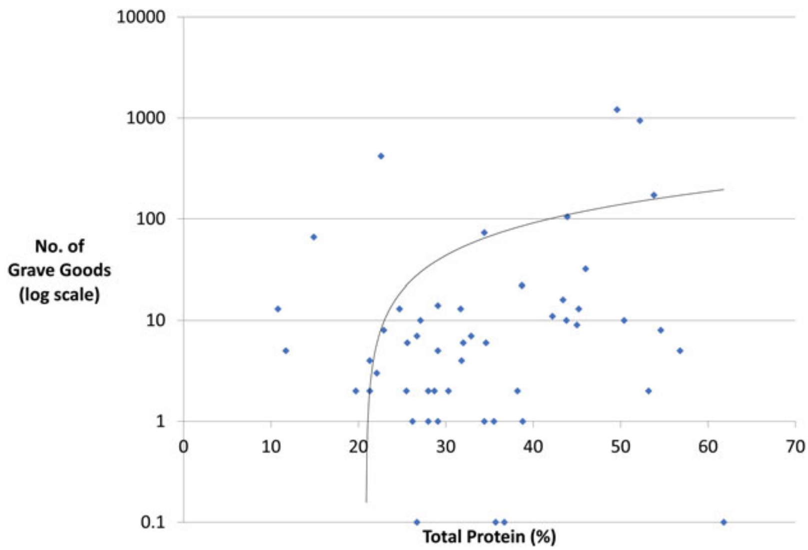

Figure 5. *Number of grave goods in relation to total terrestrial animal and fish consumption in Varna 1, from individual FRUITS calculations. In the logarithmic scale, the use of the '0.1' value indicates graves with no grave goods.*

The genomic homogeneity of the sample stands in contrast to the heterogeneity of grave good deposition, which itself shows no correspondence with dietary variability. Given the extraordinary grave goods found at Varna 1, these findings require further consideration. The general contrast between group-oriented dietary variation and personally-oriented grave good variability could help us understand the lack of correlation between grave goods and diet. This fits well the model of cross-cutting significance of both individual and dividual identities at Varna (Chapman, 2020), insofar as both diet and grave goods are enchained to many other people and places while embodying a personal statement summarizing those wider relations.

So far, there are no obvious explanations for the dietary variability shown in the Varna sample. We propose two scenarios for what dietary insights might mean for social relationships—a wider regional scenario and a local scenario. But before discussing these scenarios, we must briefly introduce the background of the sociability of food consumption that has influenced our interpretations, using our insights concerning the diet of the youngest persons buried at Varna.

The sociability of food sharing at various scales, from daily household consumption to ceremonial feasts, has a long history of research (e.g. Russell, 1999; Pearson, 2003; Kassabaum, 2019). Food preparation, including the collection of ingredients from gathering, hunting, stock-rearing, and fishing, is also increasingly seen as a communal event as opposed to the outdated stereotypical division of labour by gendered tasks. Still poorly developed are socially engaged explanations of similarities and differences in the dietary regimes of children after the end of breast-feeding (references in Crawford et al., 2018). As part of the community, children took part in preparing and sharing food. Even with their faster metabolism, they would have isotopic values similar to those of the adults in the same community. Such a pattern can be

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affected by famine, mobility, or diseases but the fundamental principle remains: people in the same co-resident group show little variability between children and adults within the unit (i.e. they have a communal rather than an individual diet).

While a brief survey of recent research on the archaeology of childhood indicates that children contributed in many ways to subsistence and craft-working (e.g. Sofaer Derevenski, 2000; Baxter, 2005; Cokşuncu, 2015; Crawford et al., 2018), few studies have suggested the differentiation of household or community diet by age. The most thorough investigation of diet in relation to age comes from the multi-regional coverage of Neolithic Linearbandkeramik (LBK) diets (Bickle & Whittle, 2013). Over a dozen burial sites show no evidence of a significant difference in diets between juveniles and adults. The general conclusion is that there are, overall, no major differences in the diets of juveniles and adults, except for the nursing effect and, less commonly, a late growth spurt (Hedges et al., 2013: 355). It is worth repeating that the Varna population examined here does not include any infants of weaning age. The Varna pattern of an isotopically defined core group and multiple outlying groups or points was not seen in the LBK site studies (e.g. of the Aiterhofen cemetery in Bavaria: Hofmann et al., 2013: fig. 6.7). The dietary difference embodied in the occasional isotopic 'outliers', as at the burial ground of Kleinhadersdorf in Lower Austria, was sometimes reinforced by differences in mortuary practice, while the trend for higher δ^{15}N values with increasing male age and lower values for increasing female age was interpreted to reflect higher protein content for males and lower protein content for females. In the light of the LBK results, what are the dietary relationships between children and adults at the Varna cemetery?

To draw conclusions about relations between individual adults and children without the benefit of aDNA or grouped inhumations of children with adults is challenging, leaving us to rely on conclusions derived from the groupings of individuals as shown in Figure 1. There are five individuals under or of the age of thirteen, one in the core dietary group (Grave G4), one in the outlier group B (Grave 158), and three isolates (Graves 44, 84, and 179). Since Figure 1 is based on similar locations of individuals with similar diets, it follows that any adult graves close to the children's graves will share similar diets. This is the case of both children's graves that belong to groups: child Grave G4 (Varna 3 cemetery) plots close to adult Graves 121 and 261, while child Grave 158 plots close to adult Graves 10 and 11. In each case, while there are no specific indicators that the children and any of the other adults in these examples have familial relationships, the grouping of these individuals by diet suggests common dietary preferences or common access to food; whether this is by coincidence or due to some social relationship is yet to be determined.

For the three children's graves outside any grouping, the converse is true: the diets of the children in Graves 44, 84, and 179 are unlike those of any sampled adults. Moreover, two of the graves lie at the extreme ends of the range of δ^{15}N values. This raises the question: what has happened to the adults caring for and feeding these children? Several explanations may account for the absence of carers who consumed food similar to that of the children. First, the adults who cared for these children, whether local or non-local (see below), may not be buried at Varna at all. Second, the carers of these children were buried at Varna but were not included in our sample for dietary analysis. Third, there may have been still

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unrecognized cultural practices which specified varying diets for people of different ages (but see above).

Whether carers were not buried at Varna or simply not included in our sample, these children remain representative of a much wider social unit. If we consider the concept of non-local carers, it may be that these children were also migrants (see below). It is important to recognize that the same pattern of associations also applies to all the outlier groups, each of which can potentially stand for a larger group of individuals with similar diets who are missing from our sample for either of the first two reasons we have envisaged.

The dietary variability in our population sample might be explored in two possible social scenarios: wider regional forces may be reflected in divergence from the core group, or the variation in diet represents extensive consumption differences among the local Varna population. In the regional version, those people whose diets fell into outlier groups and points separate from the core group (Figure 1) came from regions outside the Varna area. In the local version, all the people represented in either the core or the outlier groups were local to the Varna area, and the variability of their diet bore some relation to status or greater access to meat and fish.

To expand on our 'local' social explanation for dietary variation, we posit that the isotopically differentiated groups of Figure 1 indicate social groups who have similar forms of access to types of foods (cereals/pulse, meat, fish), and/or shared food made from these food types. Some food types would have been produced in sufficient quantity to provide for extended familial or inter-familial groups. Dušan Borić and colleagues (2012: 49) have suggested that 'grains are the taste of household solidarity, meat [and we can add here 'fish'] the taste of inter-household sociality'. Most mammals provided far more meat than a typical household could consume in daily life, thus implying inter-house consumption if not feasting. By contrast, the quantities of bread and cereal/pulse preparations produced in the household could be more readily tailored to daily household requirements. With the exception of large marine species such as tuna, most fish was suitable for household consumption but the apparent rarity of fish in the diet made it a special dish.

The 'local' explanation relies more on local social differentiation insofar as the outlier dietary values mark major differences not so much in different foods but rather in the proportions of foodstuffs consumed. But while there is a distinct differentiation in diet—at one extreme people were eating meat and/or fish more frequently than cereals/pulses (e.g. Grave 44), while at the other end of the spectrum people were eating more cereals and pulses than meat and fish (e.g. Grave 84) (Figure 2)—markers of social differentiation such as grave furnishings reveal no obvious relationship.

Assuming that food consumption marked a social event shared within social groups (commensality), this dietary variation emphasizes the differences in food preparation, cooking, and consumption among the various social groups represented by outlier individuals. We cannot yet identify the nature of these co-resident groups (e.g. families, other kinship groupings), but we contend that groups with strongly different diets were important components of the wider Varna society, which is commensurate with the local explanation.

A 'regional' social explanation—that the dietary outlier groups consisted of people who came to Varna from the wider region—arises from our appreciation of the stronger role of mobility in prehistoric Europe than was previously thought (Whittle, 1996; Hofmann, 2016; Johnson et al., in press). This idea does not necessarily rely on concepts of long-distance or inter-regional mobility at the scale of the Kodzhadermen-Gumelniţa-Karanovo VI group, with its wide range of local environments. Environmental contrasts can also be found much closer to Varna. For example, the landscape around Durankulak on the Black Sea coast differs strongly from the inland valleys near lowland Provadia and upland Ovcharovo. At Durankulak, a strong preference for cattle among the domesticates was complemented by a broad-spectrum use of thirty-eight wild animal taxa (Manhart, 1998), while there was a balanced consumption of cattle, caprines, and pigs with fewer wild species at Provadia (Ninov, 2008) and Ovcharovo, the latter nevertheless distinguished by a greater interest in hunting than the former (Vasilev, 1983). These variations in animal exploitation could have led to isotopic dietary contrasts on the scale found at Varna, even though the cultivation of broadly similar cereal taxa, with an increase in *Triticium aestivum/compactum*, is widely found in the Chalcolithic (Marinova, 2009).

The regional social explanation would align with Varna being a key regional mortuary centre for the burial of not only local people but also members of other regional communities with different dietary regimes. The similar material culture in these other groups would thus underline their cultural relatedness to the local Varna community, and so would have created an acceptance of non-local people, guaranteeing them the right to bring their specially honoured dead to Varna for burial. The information from Penske et al. (2023) of a common aDNA genomic heritage among the population buried in Varna does not necessarily counter the wider regional version, since the regional extent of such a genomic heritage is currently unknown and may possibly have extended much further than the Varna cemetery's 'extended territory'.

Conclusions

In our introduction, we noted the poor integration between archaeological science and social reconstructions for the study of the Varna cemetery. We hope to have moved towards integrating these two approaches through a social interpretation of the larger corpus of isotopic dietary data. Two key conclusions can be drawn from our expanded analysis of diet at the Varna cemeteries: first, there is an apparent absence of correspondence between dietary variability and grave good deposition; and, second, the high proportion (well over half) of individuals who ate a diet sufficiently different from those of the core group to plot as members of dietary 'outlier groups' or isolates (Figure 1).

Our original observation in the smaller sample of the pilot study (Gaydarska et al., 2022) of the lack of correspondence between individual diets and grave goods is confirmed by the analyses of this larger sample. There are no readily apparent connections between the range of highly performative mortuary practices and varying estimated diets, despite the high level of material differentiation in the Varna mortuary zone. These results confirm our earlier suggestion that Varna was an exception to Twiss' (2012) widely-supported principle that higher-protein diets (here presented as percentages of terrestrial animals and marine fish) corresponded with higher-status lifestyle. Teasing out this contrast between group-oriented eating and drinking and individually-oriented grave good deposition is a future research avenue.

Our second conclusion is that the Varna cemetery represents a highly diverse population; 28.3 per cent of individuals have a diet sufficiently different from those in the core group to mark them out as members of dietary 'outlier groups', and a further 28.3 per cent of isolates do not form a group with any other burial. The contrast between the core group and those eating the varied diets found in the outlying groups and the isolates is present throughout all four phases of the cemetery's usage. Such dietary variability could imply differences in the availability of, and access to, particular amounts of foods such as cereals/pulses, meat, and fish, or it may reflect the presence of migrant peoples from environs different from Varna's local food ecosystem. Future research might also investigate the extent to which shared funerary traditions reflected shared identities/quotidian practices. While we considered two explanations for the observed dietary variability, the regional scenario, which envisages that individuals which are isotopically different from the Varna core group are migrants, has merit. Explanations linking social relationships with diet variation must account for the three children with isotopic profiles reflecting diets that show them to be isolated from apparent relationships with any adult in the sample population; it implies that we are missing other members of their social group.

Instead of positing a spatial explanation for the dietary differences at Varna (e.g. male individuals from coastal communities *vs* female individuals from inland communities) for which there is currently scant evidence, the 'regional' explanation for the patterns of isotopic/dietary variation observed at Varna supports the case that it was a regional mortuary congregation site. Whatever the reasons for the dietary variability and the famous diversity of the Varna grave goods, these phenomena occurred together but do not appear to be causally related. They also stand in contrast to the homogeneity of the aDNA results. The Varna cemetery will continue to fascinate and challenge us to resolve such crucial issues, which will form an important part of the future research agenda for the Varna cemetery complex.

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Supplementary Material

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Variabilité alimentaire dans les nécropoles chalcolithiques de Varna

Les auteurs de cet article cherchent à élucider les variations dans l'alimentation de soixante individus ensevelis à Varna au milieu du Ve millénaire av. J.-C. grâce aux résultats obtenus par datations *radiocarbone AMS, par analyses des isotopes stables et par modélisation de l'alimentation (modélisation bayésienne FRUITS). Un regroupement isotopique d'environ 43 pour cent de la population est évident, indiquant une alimentation « de base » à Varna, le pourcentage restant représentant une plus grande diversité de profils isotopiques. Bien qu'une légère tendance à consommer plus de viande et de poisson parmi les hommes que parmi les femmes et les individus indéterminés soit perceptible, il 'n'existe pas de corrélation nette entre la variabilité alimentaire et les différences bien attestées dans le mobilier funéraire de Varna. Le profil isotopique et l'alimentation de trois enfants ne correspond à aucun profil parmi les adultes échantillonnés. Les auteurs proposent deux scénarios, l'un « régional », l'autre « local », pour expliquer la variabilité dans l'alimentation à Varna.* Translation by Madeleine Hummler

Mots-clés: Varna, analyses des isotopes dans l'alimentation, modélisation bayésienne FRUITS, Bulgarie, enfants, Chalcolithique

Variabilität in der Ernährung der Bevölkerung der kupferzeitlichen Grabstätten von Varna

Dieser Artikel enthält die Ergebnisse der AMS-Radiokarbon Datierungen, der Analyse von stabilen Isotopen und der Bayesschen Modellierung der Ernährung (FRUITS Modell), welche die unterschiedliche Ernährung von sechzig Bestattungen der Mitte des 5. Jahrtausends in Varna erläutern. Sie belegen eine Gruppierung von 43 Prozent der Bevölkerung, was auf eine „Kern-Ernährung“ deutet, während der Rest ein breiteres Spektrum von isotopischen Profilen aufzeigt. Obschon ein leicht höherer Konsum von Fleisch und Fisch bei den Männern als bei den Frauen und unbestimmten Individuen nachweisbar ist, gibt es keinen klaren Zusammenhang zwischen der Variabilität der Ernährung und der gut belegten Differenzierung unter den Grabbeigaben. Drei Kinder hatten isotopische Profile und eine Ernährung, die nicht mit denjenigen der Erwachsenen übereinstimmten. Die Verfasser schlagen zwei Szenarien vor, ein „regionales“ und ein „lokales“, um die Unterschiedlichkeit der Ernährung in Varna zu erklären. Translation by Madeleine Hummler

Stichworte: Varna, Analyse von stabilen Isotopen, FRUITS Bayessche Modellierung, Bulgarien, Kinder, Kupferzeit