Tales from Ginderup Mound in Thisted County, Denmark

Further Investigations of Female Mobility in the Nordic Bronze Age

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ABSTRACT

The preservation of organic and human remains in Early Nordic Bronze Age mounds (1700 BCE -1100 BCE) permits new provenance work on this important period. To further extend the growing amount of comparative data, we conducted strontium isotope provenancing (Graves A and B) and osteological analysis (Graves A, B and C) on several individuals from the mound at Ginderup in Thisted County, Denmark. The mound contained both adult and juvenile remains from inhumation burials (of which Grave A also included a probable corded skirt) as well as several later cremation urns.

Our results revealed that the strontium isotope ratios obtained from the corded skirt grave (Grave A) yielded one ratio (M2) which was local to present-day Denmark and one non-local ratio (M3). The results from Grave B yielded a ratio which also falls within the local baseline of present-day Denmark. These results suggest that the Ginderup Woman was probably of local origin (i.e. from mainland Denmark), but that she also was repeatedly mobile during her life. We put these data in context relative to possible causes for mobility in the Nordic Bronze Age world, with a particular concentration on the consideration of fosterage practices, a somewhat under-studied cause for mobility (particularly for females) in this period. All in all, these new data are further evidence for the Nordic Bronze Age's complex socio-dynamics.

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Introduction

The Bronze Age was a period of rapid cultural transmission which may share some parallels with modern globalization (Reiter 2014; Vandkilde 2016). The frequent, sometimes long-distance movements of objects, materials and ideas during this time are evident in the archaeological record (Earle 2002; Earle and Kristiansen 2010; Frei et al. 2017a; Jockenhövel 1980, 1991, 1995; Jockenhövel and Kurbach 1994; Kristiansen 1998, 2017; Kristiansen et al. 2017; Kristiansen and Suchowska-Ducke 2015; Ling et al. 2012, 2014, 2019; Ling et al. 2018; Melheim et al. 2018; Nørgaard et al. 2019; Treherne 1995; Wels-Weyrauch 1989b, 1989a). Although it is clear that objects, materials and ideas are unlikely to have been made mobile in the Bronze Age without human intervention (Bergerbrant 2007), the many recent archaeometric analyses of human remains from this time add a new dimension to the extant material data (Bergerbrant et al. 2017; Cavazzutti et al. 2019a; Cavazzutti et al. 2019b; Felding et al. 2020; Frei et al. 2019; Frei et al. 2022; Frei et al. 2017b; Knipper et al. 2017; Mittnik et al. 2019; Nielsen et al. 2020; Oelze et al. 2011; Reiter et al. 2019; Reiter and Frei 2015; Taylor et al. 2020).

Further supporting the postulates of the New Mobilities Paradigm (Shellar and Urry 2006; Urry 2007), strontium isotope analysis conducted thus far on Southern Scandinavian human remains suggest that both enacting mobility (Bergerbrant et al. 2017; Felding et al. 2020; Frei et al. 2019; Frei et al. 2015a; Frei et al. 2015b; Frei et al. 2017b) and causing mobility to be enacted by others (Reiter et al. 2019; Reiter and Frei 2021) was present during this time. Interestingly, studies from various places in Europe have pointed to a high degree of specifically female mobility during the Bronze Age as a whole (Cavazzutti et al. 2019a; Cavazzutti et al. 2019b; Frei et al. 2015a; Frei et al. 2017b; Knipper et al. 2017). Archaeologists have also remarked upon the burials of 'Fremde Frauen': women from predominantly upper-class Bronze Age society who were buried with funerary equipment that was demonstratively foreign to the traditions of the area in which they were interred (Jockenhövel 1995; Wels-Weyrauch 1989b). Osteological data, however, suggests that elite Bronze Age women with non-local grave items are not necessarily themselves non-local. One such case is that of the Ølby Woman (who was likely local according to isotopic analyses in spite of the clear long- and short-range trade connections evidenced by her grave goods; Reiter et al. 2019). Similar examples have appeared elsewhere in Europe (for Bell Beaker contexts in UK, see Parker Pearson et al. 2016, 2019; for Scandinavia, see Bergerbrant et al. 2017; Frei et al. 2019).

Due in part to technical advances in strontium isotope provenancing methods (Font et al. 2012; Frei et al. 2015a; Harvig et al. 2014; Jørkov et al. 2009; Taylor et al. 2020; Tipple et al. 2013; Tipple et al. 2018a, 2018b) as well as the ever-increasing body of comparative data (and the periods of the lifespan associated therewith), we are beginning to be able to trace the mobility of people to hitherto unprecedented degrees of time resolution. Comparing this data against models of different patterns of mobility allows us to analyse archaeological and anthropological hypotheses in new ways. The mobility model which we reference in this text (Reiter and Frei 2019; see Table 1) represents a fusion of anthropological/geo-cultural understandings of mobility (e.g. Anthony 1990; Wendrich and Barnard 2008) with the kind of results produced by archaeometric analyses such as those which are also included in the present article.

One of the current scholarly models of Bronze Age society suggests that various chiefdoms were linked together with other groups (both near and

No.	Mobility pattern	Category	Description
1	(A)	Non-mobility	Stationary living
2	A→B	Point-to-point mobility	Single mobility/ migration
3	A→B (B) B→A Or A→B→A	Back-and-forth mobility	Mobility from A to B and from B to A interspersed with an interval at point B
4a	A→B B→C C→A Or A→B B→A	Repeated mobility (cyclical mobility)	Movements between two or more locations followed by short stays
4b	(A)→B…C…D…(A) Or A…B…C…D…etc.	Repeated mobility (non-cyclical mobility)	Sequential short- or long-term stays in different places or constant movement

Table 1. Mobility model (after Reiter and Frei 2019). Using such a framework as a point of comparison for the new provenancing data from human individuals allows us to identify possible similarities and differences between different individuals, thereby further nuancing our ability to interpret the potential causes of their movements.

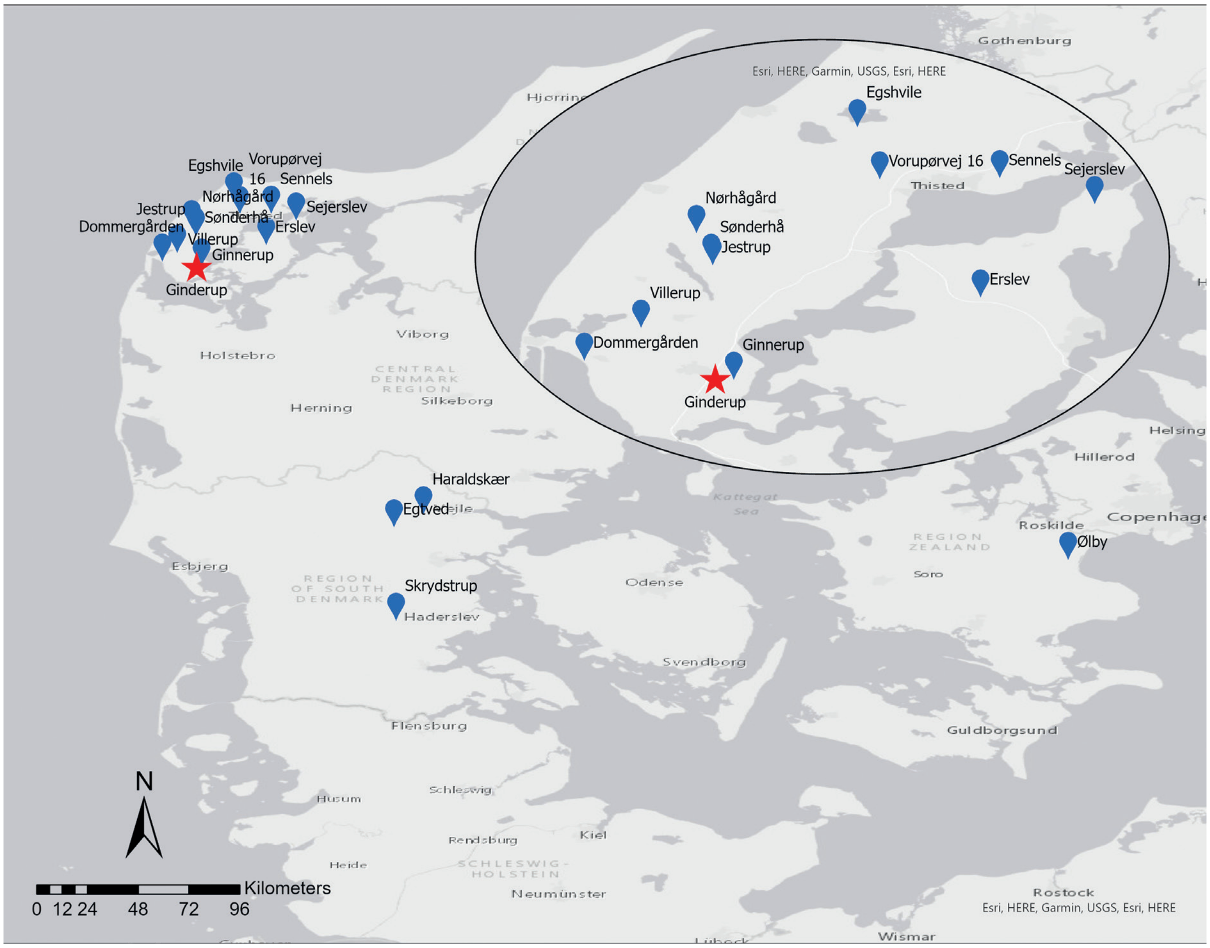

Figure 1. Map showing the location of Ginderup Mound/ FF 110605-47 (red star) alongside other Danish sites mentioned in the text (blue pins). This map was generated by SSR using ArgGIS Pro software and basemaps, licensed to the National Museum of Denmark.

far) through trade/exchange as well as through complex systems of marriage-like alliances and kinship (Earle 2002; Egeler 2009; Kristiansen 1994, 1998; Kristiansen and Larsson 2005; for contrary model see e.g. Holst et al. 2013). Scholars have argued that one of the principal modes for constructing such alliances was through the exchange of women (Lévi-Strauss 1969) within an exogamic and patrilocal system (Egeler 2009; Kristiansen and Larsson 2005 and references therein) . However, regardless of whether or not they were equipped with atypical jewellery styles or foreign materials in their tombs, the ever-increasing amount of data suggests that there may have been other types of mobility (including non-mobility) available to high-status females at this time. In order to investigate the question of female mobility in the Early Nordic Bronze Age further, we conducted provenance studies on the female interred with a possible corded skirt from the central grave at Ginderup in Thisted County, northern Jutland (Denmark). In pursuit of this, we conducted strontium isotope and osteological analyses from two of the deceased's molars and complemented these with strontium isotope and osteological analyses of other individuals who were buried inside the mound at a later point.

Site Description

The site of Ginderup lies in Thisted County (FF 110605-47; Ke 5451) and includes a loose group of 3-4 m high burial mounds on a slight elevation overlooking the Limfjord (Figure 1). The burial mound SB no. 47 was excavated by Johannes Brøndsted from 4-11 April, 1933 (Brøndsted 1934) and was already partially worn down by ploughing at the time of excavation. Broadly speaking, the area has a long history of human interactions, ranging from the elongated

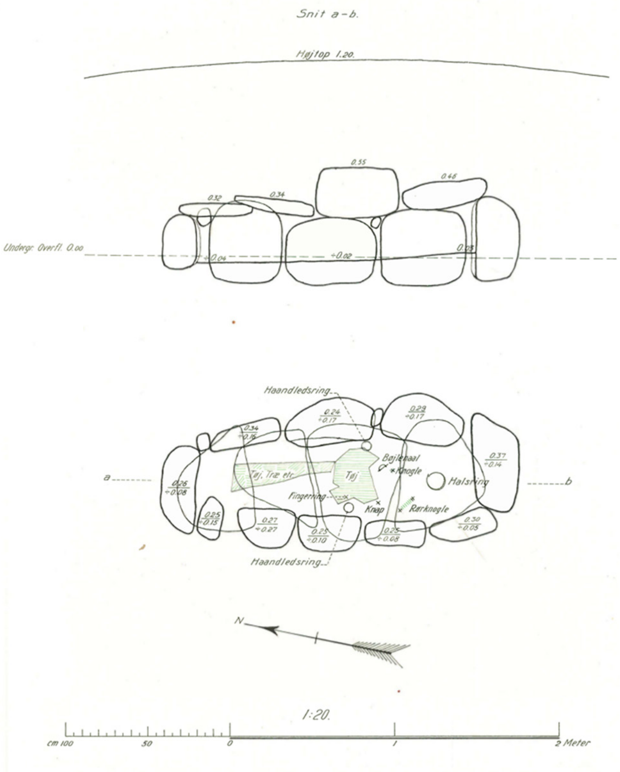

Figure 2. Original sketch of Grave A from 1933 excavation report (Nationalmuseet Archives; Brøndsted 1933).

Neolithic mound to the southwest of SB 47 as well as Roman Iron Age and even later burials in the vicinity. From inside the mound which concerns us here (SB 47), Brøndsted unearthed six funerary entities spread over what appears to have been five separate events. Of these, the central grave (Grave A) lay 70 cm below the top of what was left of the mound. The inhumation was placed in a stone cist and was accompanied by a thin twisted neck ring, a fibula, a double button, two arm rings (one each at the right and left wrists) and a finger ring (on the left hand side) (Aner and Kersten 2001; Brøndsted 1934). The grave is additionally described as having included both wool textiles as well as a wool fringe (Figures 2-3). Brøndsted suggested that the latter likely represented the remains of a corded skirt or, perhaps, the fringe of a blanket (1934, 3). Other scholars support the first interpretation, comparing it to the Egtved skirt (Bender Jørgensen 2016, 104; Bergerbrant et al. 2012). The grave goods suggest that the deceased may have been female.

Though not much of the individual was preserved, the crowns of several teeth survived until excavation. Initial analysis of these crowns by K. Fisher Møller suggested that the deceased (henceforth 'Ginderup Woman') was aged 16-18 at the time of her death (Broholm 1943, 161). Re-assessment of the teeth by Jørkov for the present study suggests a slightly younger age (14-15 years). For the purposes of this study, we sampled dental enamel from an M2 and an M3 from Ginderup Woman (Ginderup Grave A, AS 10/76, NM1 52/53).

Grave B from the same mound (SB no. 47; Ginderup Woman's mound) included a so-called 'cremation' within an irregular sub-circular stone cist (Figure 4). Although this last had no grave goods, due to the particularities of its construction Brøndsted nonetheless suggested that the grave seems to date from the later part of the Early Nordic Bronze (1934, 5). The only object associated with this grave was what excavators described as a strike-a-light within the backfill of the grave shaft. In the interest of obtaining as complete a picture as possible from this mound and in order to complement

Figure 3. Photo documentation of Grave A from 1933 excavation report (Nationalmuseet Archives, Brøndsted 1933).

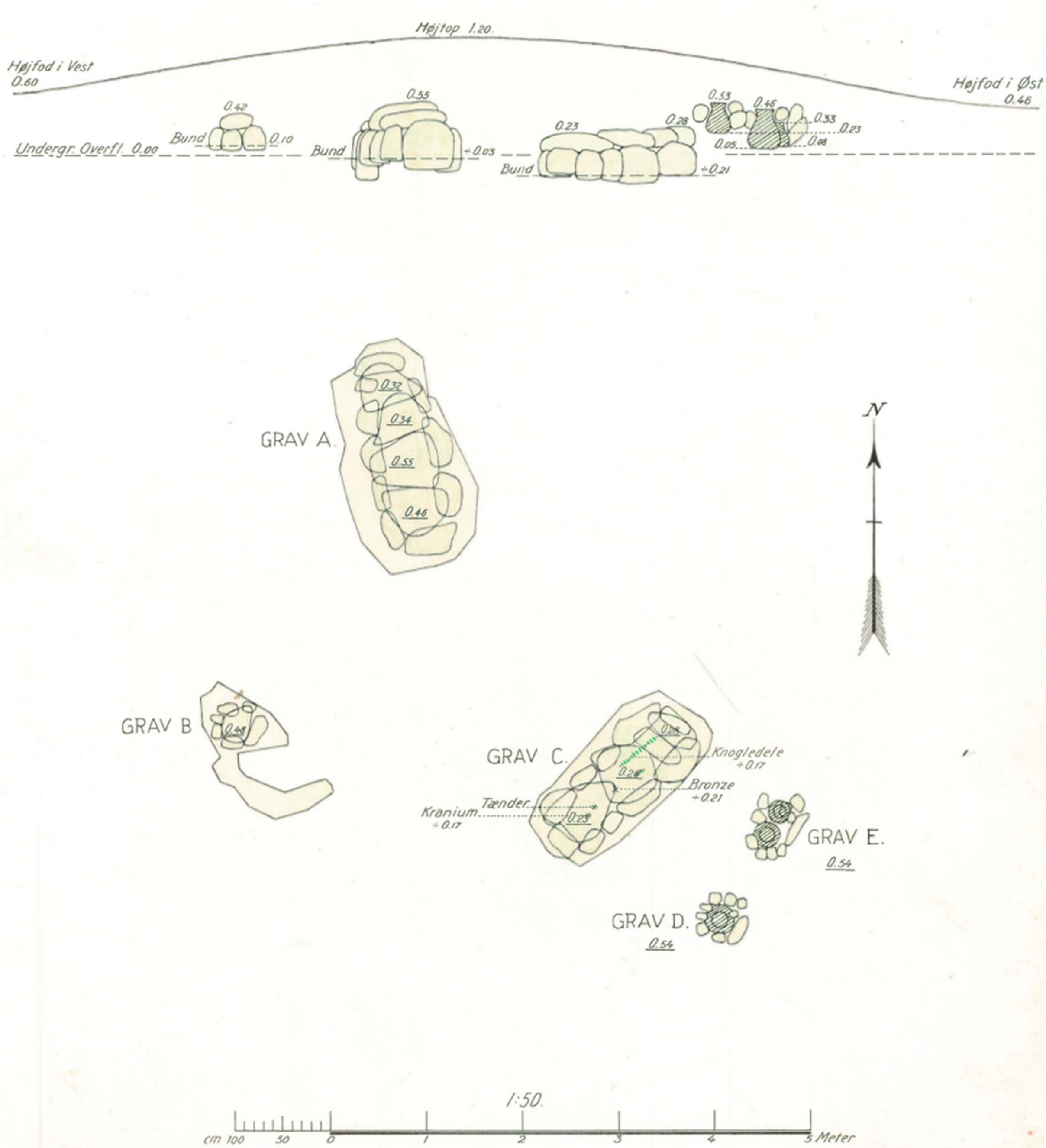

Figure 4: Original plan of Ginderup Mound SB. 47 from 1933 excavation report (Nationalmuseet Archives; Brøndsted 1933).

other studies (Frei et al. 2019; Kristiansen et al. 2020; Reiter et al. 2021), we also conducted strontium isotope analysis of dental enamel sampled from a first molar from this individual (Ginderup Grave B AS10/76, NM1 52/53). An analysis of the remains (also by Jørkov for this study) based on the dental development and fusion of bone elements (AlQahtani et al. 2010; Scheuer and Black 2000) indicate that the individual interred in Grave B may have been ca. 3-4 years upon his or her demise.

Although Grave C lay 25 cm deeper in the mound (Ginderup SB. 47) than Grave A, its deposition seems to have been secondary to that of Grave A (Aner and Kersten 2001; Brøndsted 1934). Like Grave A, Grave C was also an inhumation grave in a stone cist. The grave goods included a double button, an unknown and heavily-decayed bronze object and some kind of organic layer at the bottom of the grave cut. This last is assumed to represent either a hide or cloth cover/clothing. The button suggests a date from Period III (1300-1100 BC;

Jensen 2006; Montelius 1986). Jørkov's osteological analysis suggests an age of 14-15 years (similar to Grave A). It was not possible to assess sex. Unfortunately, as very little enamel remained from the skeletal material, we were not able to conduct strontium isotope analysis on this individual.

Two stone packed cists at the southern edge of the mound included single urn D as well as a double urn burial (E). While D contained no grave goods, one of the urns in cist E included a razor, tweezers and an awl. Due to the manner of internment, these could broadly be assumed to date from the Late Bronze Age. Unfortunately, no material suitable for strontium analysis was found from urn burials D or E.

Materials and Methods

Strontium isotope analyses conducted on tooth enamel from archaeological human remains can provide information on provenance and potential mobility at the individual level (Bentley 2006; Montgomery 2010). We conducted strontium isotope analysis on two upper molars (M2 and M3) from Grave A and an upper first molar (M1) from Grave B.

It is important to mention that our $^{87}Sr/^{86}Sr$ data do not represent the same periods of the human lifespan. The mineralization of tooth enamel occurs within different times over the life course from early childhood to adolescence (i.e. the formation of the first molar's tooth enamel takes place in utero until *c.*3 years of age, the second molar between the ages of ca. 2-8 years and the third molar from ca. 7-16 years) (AlQahtani et al. 2010).

The tooth enamel samples were pre-cleaned by removing the enamel's surface with a drill bit. Subsequently, a few milligrams of the precleaned enamel were sampled either by a cut or drilled from each tooth. The tooth enamel samples were dissolved in precleaned 7 ml Teflon beakers (Savillex) in a 1:1 solution of 0.5 ml 6 N HCl (Seastar) and 0.5 ml 30 % H_2O_2 (Seastar). The samples typically dissolved within five minutes, after which the solutions were dried on a hotplate at 80 °C. Thereafter, the enamel samples were taken up in a few drops of 3N HNO_3 and then loaded onto disposable 100 µl pipette tip extraction columns into which we fitted a frit which retained a 0.2 ml stem volume of intensively pre-cleaned mesh 50-100 SrSpec (TrisKem) chromatographic resin. The elution recipe essentially followed that by Horwitz et al. (1992), albeit scaled to our needs (i.e. strontium was eluted / stripped by pure deionized water and then the eluate dried on a hotplate).

Thermal ionization mass spectrometry was used to determine the Sr isotope ratios. Samples were dissolved in 2.5 µl of a Ta_2O_5-H_3PO_4-HF activator solution and directly loaded onto previously outgassed 99.98 % single rhenium filaments. Samples were measured at 1250-1300 °C in a dynamic multi-collection mode on a VG Sector 54 TI mass spectrometer equipped with eight Faraday detectors (Institute of Geosciences and Natural Resource Management, University of Copenhagen). Five nanogram loads of the NIST SRM 987 Sr standard that were ran during the time of the project yielded $^{87}Sr/^{86}Sr$ = 0.710239 +/- 0.000015 (n=4, 2σ), which we compare to the generally accepted value of $^{87}Sr/^{86}Sr$ = 0.710245 (Thirwall, 1991).

Results

The results of the strontium isotope analysis conducted on the human remains from Graves A and B ranged between $^{87}Sr/^{86}Sr$ = 0.70978 to 0.71176 (Table 2). However, in order for these results to have meaning, they need to be put into perspective. To that end, it is imperative to have knowledge of the

Individual	Tooth	Sample No.	$^{87}Sr/^{86}Sr$	(±2SE)
Grave A	Upper right M2 (7+)	KM114	0.71074	0.00001
Grave A	Upper right M3 (8+)	KM115	0.71176	0.00001
Grave B	Upper right M1 (6+)	KM116	0.70978	0.00002

Table 2. The results of the strontium isotope analysis from Ginderup Graves A and B.

local bioavailable strontium isotope baseline range for the region in which the human skeletal material was found (Frei 2012). While different kinds of proxy materials have been used to define bioavailable baseline ranges for specific regions, scholars have yet to reach a consensus regarding which type of proxy (e.g. surface water, plants, soil, fauna, etc.) is most suitable (Grimstead et al., 2017). Several baselines have been established for Denmark based on different types of environmental samples, including surface waters, plants, soil leachates and fauna (Frei 2012; Frei et al. 2022; Frei and Frei 2011, 2013; Frei and Price 2012). These are in accordance with a recently published baseline study for Europe which was based on the results from almost 1200 soil samples taken throughout Europe which, though more general, adds yet another layer of data (Hoogewerff et al. 2019).

Although there has been a discussion about the potential strontium contamination by agricultural lime in Danish surface waters (Andreasen and Thomsen 2021; Thomsen and Andreasen 2019; Thomsen et al. 2021), results from soil profiles studies from beneath agricultural farmland collected in the glaciogenic outwash plain of central West Jutland, Denmark, show that strontium (and its derived isotope composition) from lime products is efficiently retained near the surface (Frei et al. 2019). Consequently, the agricultural lime hosted strontium does not affect the surface waters (Frei et al. 2020, Frei 2021) to the extent previously postulated by Thomsen and Andreasen (2019) and by Andreasen and Thomsen (2021). Furthermore, Thomsen and Andreasen (2019) argued for the use of only environmental samples from what they called "pristine" forest sites for the purpose of constructing strontium baselines for archaeological studies. However, new investigations (Frei et al. 2022; Johnson et al. 2022) clearly reveal that sampling of such sites are inappropriate for archaeological studies. This is because samples from these "pristine" forest areas do not reflect the biosphere conditions of the past due to the acid leaching processes that took place over time in these areas (Frei et al. 2022; Johnson et al. 2022). Price (2021) argues that the conclusions of Thomsen and Andreasen (2019) about the impact of their finding on prehistoric mobility are not correct. Consequently, in the present study we apply the originally-proposed local bioavailable baseline ranges between $^{87}Sr/^{86}Sr = 0.7081$ to 0.7111 for the area of present-day Denmark (excluding the island of Bornholm) (Frei 2012; Frei and Frei 2011; Frei and Price 2012).

Our results from Ginderup reveal that all but one sample yielded strontium isotopic values that fall within the baseline for present-day Denmark. The individual with the possible corded skirt from Grave A (from which we have two samples) yielded both a value within the above mentioned baseline (M2; $^{87}Sr/^{86}Sr = 0.71074$) as well as a value outside it (M3; $^{87}Sr/^{86}Sr = 0.71176$). The individual from Grave B yielded a $^{87}Sr/^{86}Sr$ result which falls within the Danish baseline.

Discussion

During the last 10 years, there has been a considerable number of mobility studies based on strontium isotope analyses made on Bronze Age human skeletal material unearthed in Europe. These studies have provided an ever-increasing background against which the present research can be compared (Bergerbrant et al. 2017; Cavazzutti et al. 2019a; Cavazzutti et al. 2019b; Felding et al. 2020; Frei et al. 2019; Frei et al. 2017b; Knipper et al. 2017; Knöpke 2010; Mittnik et al. 2019; Montgomery 2013; Montgomery et al. 2007; Nielsen et al. 2020; Oelze et al. 2011; Reiter et al. 2019; Reiter and Frei 2015, 2021; Taylor et al. 2020; Wahl 2009; Wahl and Price 2013). Thus far, research suggests that many different forms of mobility defined persons (elite or not) from this dynamic period of European prehistory. Moreover, mobility trajectories appear to have been individual-dependent, and may have been influenced by the specificities of the socio-political situation of the communities in which individuals were enmeshed (Austvoll 2021; Earle 2002, 19-42; 293-96; Earle and Kristiansen 2010; Ling et al. 2018b; Randsborg 1975). In order to address the Ginderup Woman's strontium isotope data in relation to extant work as well as the possible mobility scenarios which her data suggest, we first compare our new data with others from the mound as well as in relation to information obtained from other contemporary nearby sites.

The results of the strontium isotope analysis of one of the second molars of the Ginderup Woman (which provide information on potential mobility between the ages of approximately 2-8 years) suggest that she was living either locally or within another area (but with a similar or overlapping strontium isotope baseline to the one for present-day Denmark as defined above). By contrast, the $^{87}Sr/^{86}Sr$ ratio from her third molar yielded a value that falls outside the Danish strontium isotope bioavailable baseline range. This indicates some kind of mobility during the later part of her lifespan. Although the data from tooth enamel does not allow for a high-precision mobility timeline, such as is the case for hair like in for example the studies of the Egtved (Frei et al. 2015a) and the Skrydstrup females (Frei et al. 2017b), they do allow some insights as to when that mobility may have taken place. It seems that Ginderup Woman lived within the region of present-day Denmark (or within a region with an overlapping $^{87}Sr/^{86}Sr$ baseline bio-available range) during her childhood (e.g. between the ages of 2 and 8 years), but that somewhere during the time period in which her third molar mineralized (between the ages of approximately 7-16 years), the data suggests she may have lived or travelled for a considerable period in an area outside of present-day Denmark. These data from the Ginderup Woman can be contrasted with those from e.g. the Skrydstrup Woman, the Egtved Girl and the Ølby Woman. The Skrydstrup Woman exhibited non-local values for the both the M1 and M3 (Frei et al. 2017b), the Egtved Girl also exhibited non-local values from the M1 (Frei et al. 2015a) while the Ølby Woman exhibited values that fall within the strontium baseline for present-day Denmark from her M1, M2 and M3 (Reiter et al. 2019).

Seen very broadly, the two individuals analysed from Graves A and B from Ginderup mound had $^{87}Sr/^{86}Sr$ values which fit within the established baseline for present-day Denmark, at least at some point during their lifetimes. The sample from Grave B yielded a strontium isotope ratio that falls within the local baseline range (for present-day Denmark) and corresponds to the period in which the individual was in utero up until three years of age. Unfortunately, we were not able to conduct analyses on the individuals from Grave C or Urns D and E.

If we compare these new strontium isotope data from Ginderup mound with other extant studies from Thisted County, the results are similar insofar as the analysed $^{87}Sr/^{86}Sr$ values lie within the baseline for present-day Denmark. Data from a study on the introduction of the cremation rite to Early Nordic Bronze Age Denmark included material from five different Early Nordic Bronze Age sites from Thisted County, including Villerup, Egshvile, Erslev, Nørhågård and another of the Ginnerup mounds (SB no. 58) 1.2 km to the east of the Ginderup (SB no. 47) examined within the present research (Reiter et al. 2021). With the exception of a young child from Egshvile (KF2052), whose $^{87}Sr/^{86}Sr = 0.71205$, all other contemporary samples from Thisted County revealed values suggesting that the individuals may have been locals. Nevertheless, it is important to remark here once again that archaeological data supports the potential connection of Thisted County with especially northern Germany (Haack Olsen 1992) and the Frisian Island of Sylt (Bech et al. 2018, 71; Haack Olsen and Bech 1993; Kersten and La Baume 1958). However, given the overlapping strontium baseline ranges for these areas, it is difficult to winnow out further evidence for migration at present. A similar issue with respect to the difficulties in describing what is 'local' in terms of archaeological context versus what is understood as 'local' as seen from a strontium isotope baseline perspective and the issues related to the overlapping baselines has been previously discussed by Croix et al. (2020).

However, if we juxtapose the results from the present research with those from a recent large-scale study examining mobility data from the third and second millennium BC in Denmark, the picture becomes even more intriguing. That study (Frei et al. 2019) included strontium isotope analyses from 88 individuals of which seven (from the sites of Vorupørvej 16, Sennels, Sejerslev, Nørhågård, Sønderhå, Jestrup and Dommergården) are also located in Thisted County. Of the individuals tested within that dataset, only one exhibited $^{87}Sr/^{86}Sr$ suggesting that this individual may have been of non-local origin, and whose $^{87}Sr/^{86}Sr$ is statistically the same as that measured for the Ginderup Woman's second molar ($^{87}Sr/^{86}Sr = 0.71176$). Given the grave goods, this non-local individual from Jestrup – who has been interpreted as a male warrior (Kristiansen et al. 2020) – yielded a $^{87}Sr/^{86}Sr$ = 0.71177 (Frei et al. 2019). He was buried alongside a Rixheim sword typical of southwest Germany, Switzerland and eastern France (Reim 1974; Schauer 1971) as well as a Nordic-style fibula and double-button suggesting a date within Period II (1500-1300 BC; Aner and Kersten 2001; Jensen 2006; Montelius 1986), a combination evocative of the complex socio-dynamics underlying the time and region in which he was interred (Kristiansen et al. 2020).

Elsewhere in Thisted County (at Nørhågård), we have documented other similarly close instances of $^{87}Sr/^{86}Sr$ in the combined cremation and inhumation grave of a male ($^{87}Sr/^{86}Sr$ = 0.71046; Frei et al. 2019) and female ($^{87}Sr/^{86}Sr$ = 0.71040; Reiter et al. 2021) which also included burned ovid/capra bones ($^{87}Sr/^{86}Sr$ = 0.71041; Reiter et al. 2021). The tight connection in terms of potential provenance between humans (male and female, inhumation and cremation) and animal at Nørhågård can perhaps be further underscored due to deposition within a single grave. By contrast, in spite of the close similarity of their strontium values, the burial sites of the Jestrup male with the Rixheim sword ($^{87}Sr/^{86}Sr$ = 0.71177; Frei et al. 2019) and Ginderup Woman ($^{87}Sr/^{86}Sr$ = 0.71176; see above) lie a mere 15 km apart.

In the above, we have made use of the standard archaeometric strontium terminology for describing whether the individual values from Ginderup graves A and B fall within a specific baseline range (making them 'local') or outside of it (making them, therefore, 'non-local'). However, we also wish to consider these nominative categories in relation to archaeological understandings of localness/non-localness as well. Although most contexts within Southern Scandinavia are grouped chronologically into the Nordic Bronze Age and its composite periods (Jensen 2006; Montelius 1986), it is often understood in terms of smaller areas of regional influence and tradition (Anfinset and Wrigglesworth 2012; Earle et al. 2015; Ojala and Ojala 2020). As such, it may behoove us to consider Thisted County itself (sometimes the literature refers to the larger peninsula of Thy, though this is larger than Thisted County) as a particular regional unit, as it is unique not only within Denmark due to the richness of the Bronze Age finds located there, but also due to the many barrows which make the area one of the most authentic barrow landscapes in Europe (Bech et al. 2018; see also Earle et al. 1998; Earle et al. 2023).

But, let us return to the Ginderup Woman's particular case and the values which are not only non-local to Denmark, but also non-local to Thisted County. In terms of further drawing out these results, at least two possible interpretations can be put forward. In the first scenario, (1) she may have been a local individual who travelled during her adolescence outside present-day Denmark (here defined with the exclusion of the Danish island of Bornholm), thereafter returning to her place of origin within present-day Denmark. Alternatively, (2) she may have been a non-local, who originated from an area with a strontium baseline that overlaps with that of present-day Denmark who travelled in her adolescence. When working with strontium isotopes in archaeology it is important to remember that provenancing works off of the premise of exclusion; values which fall within a defined baseline can represent either local values or non-local values which fall within the same range. Consideration of alternative scenarios (i.e. with origins from different areas with overlapping baseline ranges) may be illuminative (see e.g. in relation to the similar material culture and chronological changes observed between Thisted County and the Frisian Islands as remarked by Haack Olsen and Bech 1993 and Kersten and La Baume 1958). In terms of strontium isotope values, the overlapping baseline ranges for Thisted County and the Frisian Islands has also been remarked upon (Reiter et al. 2021). If Ginderup Woman's mobility followed this second scenario, it would suggest that she travelled from her place of origin outside of present-day Denmark to another place characterized by values more radiogenic than the area from which she came. Finally, she may have made yet another journey, this time to Thisted County, Denmark, where she also found her final resting place.

In other words, in the light of Reiter and Frei's mobility model (2019, see above), the first scenario fits with a back and forth type of mobility, while the second scenario fits more with a repeated mobility pattern. As both hypotheses are possible, we will briefly assess both potential mobility patterns in the light of the present knowledge of Nordic Bronze Age socio-dynamics.

Scenario 1: Potential causes for back and forth mobility in the Bronze Age

In Bronze Age terms, a system in which an individual moved away from home as a young person, and then returned at (or after) the age of marriageability may be indicative of social, political and even economic strategies promoting the alliances of distant groups, such as the arrangement of marriage alliances (Kristiansen 1998, 85-98; Rowlands 1980 based on the anthropological frameworks proposed by Mauss 2002 and Lévi-Strauss 1969) or fosterage practices. Particularly in recent years, the passive female role in marriage alliance scenarios has come under critique; Frieman et al. (2019, 4) pointedly and poetically describe such thinking: "Indeed, the female body become a thing itself, an ambulatory manikin on which men's power is displayed."

As we have discussed such critiques of marriage models elsewhere in relation to mobility patterns from the emergent strontium data (Frei et al. 2017b; Reiter et al. 2019; Reiter and Frei 2015, 2021, 2022, forthcoming), we will focus our efforts in this section on fosterage, a practice which has had – as has been previously remarked – little attention thus far in Nordic Bronze Age research (Bergerbrant 2019).

Fosterage describes a system in which young persons particularly from influential upper social echelons would come to be raised in the household of other important (and often distant) society members in order to encourage social ties and alliances between the two units. Although scholars have hypothesized the presence of a fosterage system in Bronze Age Europe (e.g. Kaul 2017; Kristiansen 1998; Kristiansen and Larsson 2005; Mittnik et al. 2019), most interpretations and theories rely upon either comparisons with the Classical World (Finley 1977; Frank 2011; Matić 2015), or potentially through the careful analysis of later Iron Age cemeteries (Scheeres et al. 2014). Possible exceptions to this from Scandinavia focus on southern Sweden and include Blank et al.'s work on early Middle Neolithic to Early Bronze Age contexts and Bergerbant's (2019) interpretation of the six-eight year old child buried in the Early Bronze Age in grave 4/2 at Abbekås.

If we examine Viking Age and medieval accounts of fosterage, the typical age for placement with a foster family (which should be differentiated quite strongly from our modern-day associations with fosterage) would be between the ages of seven and approximately seventeen (Charles-Edwards 2000, 116; Hadley and Hemer 2014; O'Donnel 2017; O'Donnell 2020, 33). Although there is some evidence suggesting that even suckling infants may have been fostered in the ancient world (see ομογάλακτος; lit 'homogalaktos' or 'milk-sibling' (Aristotle 1889 and discussions in Derks 1995; von Wilamowitz-Moellendorff 2010) and 'ridā'a' (رضاعة) or 'milk-kinship' in Arab society (Altorki 1980), the seven year-to-later adolescence age range corresponds approximately with early traditions elsewhere. Interestingly, Blank et al.'s work (2021) on the site of Falbygden suggests that, if people were mobile, it seems that they were mobile in late childhood or adulthood. When viewed as a whole, their study of sites from southern Sweden suggests that women in late pregnancy and children up until the age of 10 months may have been stationary (Blank et al. 2021). Moreover, there may have been a temporal change in relation to children's mobility within their study region; it seems as if in the Early Middle Neolithic, children were mostly local or what Blank et al. call 'semi-local'; by contrast, in the Late Neolithic and Early Bronze Age, the dataset suggests a majority of non-local children and adults and only a single local juvenile (2021, 26).

Such a potential emphasis on movement in later childhood/adolescence finds support in the historical record. Later textual evidence suggests that this point in human development (later adolescence) marked the movement away from childhood and into social adulthood. For example, Roman males underwent a significant rite of passage between the ages of fourteen and sixteen at a ceremony in which they replaced their toga praetexta with the toga virilis and removed their bulla (Eyben 1993, 6). This event signified a new social age at which young men were considered to be more responsible adolescens until approximately twenty-five to thirty years of age (Weidemann 1989, 116). By contrast, it seems that females had no similar rite of passage in Roman times; it was only upon marriage that they experienced a change of status similar to that undergone by their male counterparts (Leijwegt 1991, 55). Epigraphic and documentary evidence from the Middle Ages, however, suggests that (at least within the upper echelons of society) a girl became eligible for marriage only after celebrating her twelfth birthday (Hopkins 1965). This age coincides with that recognized by Anglo-Saxon law codes as the age of legal majority (Crawford 1993, 17) as well as estimated age of menarche for prehistoric and early modern females (Papadimitriou 2016).

While this may seem quite young to modern sensibilities, it is important to point out that concepts of childhood are very strongly culturally-defined (Alanen 1988; Chamberlain 1997; James and Prout 2015). In being 'away from home' for a significant amount of time between the approximate ages of seven to early adolescence (a period which roughly corresponds to the timespan that the tooth enamel of the M3 represents; AlQahtani et al. 2010), young persons like the Ginderup Woman may have been living and developing within what we presume to be a foreign environment. In choosing precisely these early years for fostering, prehistoric Europeans were literally shaping society. Childhood/early adolescence is a period of physical, emotional and psychological development in which self-image is in a state of flux and in which peers and the surrounding environment hold increasing sway (Pletsch et al. 1991; Simmons et al. 1973). The importance of fosterage during this impressionable time in a person's life is expressed in the old Irish proverb which states "fostering is two-thirds of a child's nature" (Gwynn 1913, 106–7).

Scenario 2: Potential causes for repeated mobility in the Bronze Age

Above we have described a potential association between back-and-forth mobility at a young age within Nordic Bronze Age contexts. This can be contrasted with the second potential mobility pattern associated with the Ginderup Woman's new mobility data; namely that she may have engaged in repeated mobility (Reiter and Frei 2019). Such mobility could have involved Location A (a place outside of present-day Denmark, but with a similar overlapping strontium isotope baseline, Location B (a place which was more radiogenic than present-day Denmark) before her final interment at Location C (Thisted County) in Ginderup.

There are various potential causes for a repeated mobility pattern such as that possible for the Ginderup Woman within Bronze Age contexts. While it is entirely possible that Ginderup Woman may have grown up at Location A, been fostered at Location B and been sent to live with a new community at location C/Thisted County as part of a marriage alliance within an e.g. patrilocal, exogamous system, these are not the only potential causes for her specific mobility type. She may have taken part in a family trading operation, or even been apprenticed to a travelling craftsman or ritual specialist, as has previously been suggested in relation to mobile women (see Frieman 2012; Frieman et al. 2019).

It is worth noting that repeated mobility has also been associated with transhumance, especially in terms seasonal migration. Recent examples of this include the remains of a group of Early Neolithic juveniles from Nieder-Mörlen, Hesse (Germany), who Nehlich et al. suggested may have been transhumant herders (2009, 1797) as well the Chalcolithic "Iceman" colloquially known as "Ötzi" (Müller et al. 2003; Ruff et al. 2006). Here we must emphasize that, due to the preservation of the human remains from the Ginderup Woman, the resolution of the mobility data obtainable is not fine enough to either support or deny whether she engaged in seasonal transhumance, such as has posited for the above examples, though transhumance has been suggested as a possible organization type for this area in the Nordic Bronze Age (Rasmussen and Holst 2013) .

Alternatively, one may also consider examples such as the Neolithic Granhammer Man from Sweden (Lindström 2021) or even the Iron Age Haraldskær Woman from Denmark (Frei et al. 2015b) who also seem to have travelled shortly prior to their deaths. However, as these individuals' burial contexts are not only from different historical and socio-political contexts but are also otherwise unusual insofar as they contain a distinct ritual or sacrificial aspect which is not evident in the grave of the Ginderup Woman, Granhammer Man and Haraldskær Woman's potential as comparisons is not ideal.

Comparison with other female mobility patterns

Comparison with the mobility patterns of other Nordic Bronze Age females unfortunately offers no exact parallel to which Ginderup Woman can be likened. Recent research regarding the provenance of the Egtved Girl (Frei et al. 2015a), the Skrydstrup Woman (Frei et al. 2017b) and the Ølby Woman (Reiter et al. 2019) has demonstrated different mobility patterns. According to Reiter and Frei's model (2019), the Egtved Girl exemplifies back and forth mobility, the Skrydstrup Woman demonstrates point-to-point mobility and the Ølby Woman shows non-mobility.

Nevertheless, we must remember that there are some other important differences within the scales of analysis to which these ladies' remains have been subjected. Due to the preservation of organic remains, the high-resolution mobility timelines available for the Egtved Girl and the Skrydstrup Woman were not possible for other sets of (comparable) human remains, providing a lower time-resolution of mobility data. New evidence for movement at such comparatively young ages can be juxtaposed with e.g. Bergerbrant's suggestion (2007, 118 ; see also references therein) that the Fremde Frauen we see in the archaeological record might represent post-menopausal females, citing the removal of the possibility of childbearing as a potential additional freedom in relation to mobility.

To return to the strontium values, however, it is interesting to note that the strontium isotope ratio of the Egtved girl's first molar ($^{87}Sr/^{86}Sr$ = 0.71187; Frei et al. 2015a) is quite similar to that of the Ginderup Woman's third molar ($^{87}Sr/^{86}Sr$ = 0.71176; see above). While this may be coincidental, it may also point to a specific area outside present-day Denmark with which Jutland had close contact. This possibility is further suggested by the similarity of the strontium isotope ratio measured on the Jestrup male warrior (again, $^{87}Sr/^{86}Sr$ = 0.71177; Frei et al. 2019) to the ratios measured for the two females.

One important factor to consider in relation to the evidence for mobile females in the Nordic Bronze Age is that the very presence of their rich bronze accoutrements may have contributed to the preservation of their skeletal material (Kibblewhite et al. 2015). Secondly, there is also a certain bias in the archaeological data which gives pause. Due to preservation issues, many of the prehistoric skeletons found in Scandinavia are classed as male or female according to the artefacts buried with them rather than their osteological characteristics. Importantly, research suggests that the number of female graves identified in this fashion (e.g. by grave goods) is significantly lower than the number of male graves (Bergerbrant 2007, 65-80; Holst et al. 2013, 85). However, proportions of male versus female burials exhibit some chronological and geographic variation across Southern Scandinavia (Asingh and Rasmussen 1989; Austvoll 2021; Bergerbrant 2007, 89-90; Bergerbrant et al. 2017, 3-40). This intersects with the current study insofar as it affects our ongoing conceptualization of not only mobility in the Nordic Bronze Age, but also male and female mobility in this period. What we find may not just be examples of mobile females, but instead be examples of certain kinds of females who were mobile. That some of those mobile women have been observed to have had different kinds of mobility patterns opens up a wealth of further interpretational possibilities which both include and expand upon those linked with marriage alliances (Kristiansen 1998; Rowlands 1980).

One further area of similarity between three of the four female graves described above lies within elements of funeral dress. Egtved Girl, Ølby Woman and Ginderup Woman seem to have been buried with corded skirts, which can be contrasted with the longer woven skirt allocated to the Skrydstrup Woman. Various interpretations have been put forward in relation to the unique corded (or string) garments associated with the female burials from Egtved, Ølby and Ginderup which may have some impact on the potential types of mobility/non-mobility expressed during their lifetimes. Thomsen (1929) suggested that it was the clothing of a young rather than a mature woman. Not fifty years later, Nielsen (1971) posited that shorter kilts could have been remade from longer skirts, leading Eskildsen and Lomborg (1977) to go a step further and suggest that corded skirts may have been characteristic of married matrons rather than unmarried maidens. Randsborg (2011) proposed that the skirts represented summer clothing, or indeed clothing which may have had a more ritual aspect. As an item of dress, the corded skirt has become a modern-day icon for prehistoric dress which is often linked (whether or not this is erroneous) to Denmark in particular. In her review of scholarly thought on the corded skirt. Bergerbrant (2014) suggested that the skirts may have been more common than their extraordinary appearance might otherwise suggest.

Although further data is necessary in order to investigate this fascinating aspect of the Bronze Age world, our new data provides new insights about the time and pace of the mobility enacted by the corded-skirt wearer we refer to here as the Ginderup Woman and which may help to point future research in a new direction. Renaissance thinker Erasmus of Rotterdam claimed 'vestis virum facit,' literally 'clothes make the man'. However, continuing examination of the mobility patterns associated with Bronze Age females – especially those who, like the Ginderup Woman, seem to have been clad with similar iconic corded skirts – may show that clothing (and the social roles therewith associated) may not necessarily have 'made the woman', or at least dictated the trajectory of her movement(s)/ non-movements across Europe.

Conclusion

The present study presents strontium isotope data and new osteological analyses from Early Bronze Age human remains from two different individuals from the same burial mound from Ginderup in Thisted County, northern Jutland (Denmark). The aim was to investigate mobility in light of previous analyses of other Early Bronze Age elite female burials unearthed in Denmark from other Bronze Age burial mounds. Osteological analyses of three individuals suggested the presence of two 14-15 year old individuals in Graves A and C as well as one 3-4 year old subadult from Grave B. Our strontium isotope analyses revealed that the subadult from Grave B yielded a $^{87}Sr/^{86}Sr$ ratio which falls within the baseline range for present-day Denmark, suggesting that this individual may have been of local origin. By contrast, the female individual interred with a possible corded skirt from the mound's central grave (Grave A) and from whom we were able to analyse two teeth, had one strontium isotope ratio that fell within (M2) and another that fell outside (M3) the local bio-available baseline range. This can be interpreted in several ways. In relation to Reiter and Frei's mobility model (2019), we present two possible scenarios for the interpretation of the strontium isotope ratios measured for this female individual.

1) She may have been a local individual that travelled during her adolescence outside present-day Denmark, who returned thereafter to her place of origin within present-day Denmark.
2) Alternatively, she may have been a non-local (who originated from an area with a strontium baseline that overlaps with that of present-day Denmark, such as has been suggested for other contemporary graves from Thisted County; Reiter et al. 2021). If this is the case, it will suggest that she travelled from her place of origin outside present-day Denmark to another place characterized by values more radiogenic than the place from which she originated, before finally moving a third time to what would become Thisted County.

According to the mobility model (Reiter and Frei 2019), the first scenario fits with a back and forth type of mobility, while the second scenario fits more with a repeated mobility pattern. We have discussed back and forth mobility patterns specifically in relation to fosterage practices and repeated mobility within the light of fosterage, marriage alliances, trading systems and potential travel associated with e.g. ritual specialists, transhumance and/ or ritual sacrifice.

Interestingly, another conclusion drawn from this new study is related to dress. Ginderup Woman, like the Egtved Girl and Ølby Woman, seems to have been interred wearing a corded skirt. Current research suggests that these three women engaged in very different kinds of mobility in spite of their similarities in dress. This may perhaps mean that wearing corded skirts (or the role that the wearing of such items of dress represented) may not have demanded a specific form of mobility in and of itself.

Although further data is needed in order to gain a better hold of how mobility/non-mobility may have played a role in Nordic Bronze Age social dynamics, the ever-increasing amount of human provenance and mobility data suggests that there may have been a larger variety of different paths that women could have taken in relation to mobility than previously anticipated. Our study also emphasizes the importance of investigating several teeth from single individuals representing different time spans when investigating socio-dynamics in prehistory wherever possible.

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