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Interpreting Past Human Mobility Patterns: A Model

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In the last decade, the exponential increase in migration studies focusing on the mobility of groups and single individuals—mostly based on aDNA and strontium isotope analyses—has provided an important extra layer of information regarding past social dynamics. The current relatively large quantity of data and their constant increase provide an opportunity to examine human mobility in unprecedented detail. In short, the course of academic dialogue is changing from producing evidence for movement to examining differences or similarities in human mobilities across temporal and geographical barriers. Moreover, the amount and type of new data are beginning to provide new kinds of information that can help us grasp why that movement first came about. We present the first potential mobility model focusing on single individuals during different life stages based on in vivo *movement patterns. We draw on previous studies in recent mobility research that provide a variety of case studies to illustrate the model. We hope that this model will prove valuable for future discussions regarding human mobility by integrating the present archaeological contextual discourse with the increasing body of data being produced.*

Keywords: mobility, migration causes, model, movement

Introduction

The interplay of the movement of persons, people, and ideas are essential for our understanding of the ebb and flow of human physical, cultural, and social evolution (Helms, 1994; Urry, 2007; White & Beaudry, 2009; Shellar, 2011). However, until quite recently, socio-analyses of cultural flux revolved mainly around the flow of objects rather than of persons. While the discipline has long been aware of the rich and varied evidence for cultural interaction over time, archaeology's concentration on measurable, object-based patterns may have unintentionally disconnected (at least partially) the dispersal of material culture from the mobility of the persons who actually moved it around (Huntington, 1996).

Recent advances in human mobility investigations based on aDNA and isotopic scientific analyses are currently providing unprecedented opportunities to investigate ancient socio-cultural flux directly from human remains (e.g. Evans et al., 2006; Haak, et al., 2008; Allentoft et al., 2015; Frei et al., 2015b, 2017; Kristiansen et al., 2017; Price et al., 2019). Consequently, it seems opportune to try to start investigating human mobility patterns in a new light. The purpose of this article is, therefore, to present a model of human individual mobility patterns as a means of facilitating comparison and future discussions of mobility studies between different prehistoric periods and regions.

Present investigations of mobility can be divided into two main groups: 1) individual mobility, and 2) group mobility

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Table 1. *A brief overview of various means of identifying individual versus group mobility.*

	Method
INDIVIDUAL	Strontium isotope analysis
	Oxygen isotope analysis
	Lead isotope analysis
	Sulphur isotope analysis
GROUP	Palaeolinguistics
	aDNA
	Non-metrics
	Past population demographics

(Table 1). These groups differ from each other not only in the way human mobility is investigated but also, importantly, in the way information about mobility is provided. As the new body of scientific data is based primarily on human remains, we are dependent on the preservation of the record in terms of which human tissues are available for sampling if we are to identify the mobility of single individuals during different phases of life. Additionally, the level of detail in which single individuals can be investigated is particularly reliant on the span of potentially mobile time that each of the human tissues represent (i.e. different teeth, bone, hair, nails, and internal organs) (Müller et al., 2003; Eerkens et al., 2014; Frei et al., 2015, 2017; Knipper et al., 2017). Such detailed studies of single individuals are mostly based on isotope analyses; consequently, these mobility studies require the ancient movements to have occurred between isotopically different food catchment areas. People who drew sustenance from a single region (regardless of their own mobile or sedentary nature) will appear to be stationary according to isotopic analysis. Moreover, if mobile persons moved between isotopically-similar food catchment areas (e. g. Garnett, 1945: 139 on the preference of Linearbandkeramik farmers for loess soils), such movements would be difficult or even impossible to detect.

The aim of the present study is to provide a model for future discussions regarding the mobility of single individuals based on the current and constantly growing body of isotopic data.

Research Approach

We hold, as other researchers have (Urry, 2007; Greenblatt, 2010; Frankopan, 2015; Marshall, 2015), that examination of the specific, categorical and quantifiable conditions surrounding human movement can be highly informative. Many useful attempts have been made to describe the social structure of mobile groups along a continuum (e.g. Beardsley et al., 1955; Murdock, 1967; Binford, 1980). Other approaches (Kelly, 1992, 1995) involve the quantification of residential moves per year by average distance covered. However, it is arguable that, 'the reality of a mobile existence is far more complex than the ordering principles used to describe it' (Wendrich & Barnard, 2008: 15). It seems that the most accurate means of modelling mobility is through a thorough examination of a variety of phenomena in combination with archaeological context. Notable examples of these defining criteria include:

1. Mobility (length of time, season);
2. Number of journeys;
3. Segment of the population which moved (as defined by gender, age, health, occupation, or social position);
4. General socio-political organization;
5. Logistics and available modes of transport.

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In an ideal world, these five[1] categories (see discussion, e.g. Urry, 2007; Wendrich & Barnard, 2008; Cabana & Clark, 2011; Adey et al., 2014) should be investigated via multiple samples from multiple individuals from a site, region, and culture group who represent the full gamut of ages, sexes, and social levels. Unfortunately, the fragmentary nature of the archaeological record rarely includes material suitable for covering all parameters.

While both individual and group mobility data are inherently very different (as are mobility and migration), historically, archaeology has examined them in somewhat similar ways. Archaeologists have used both migration and mobility as catch-all categorizations for the causes of cultural change. The roots of this style of interpretation date back to culture-historical approaches and the drawing of *Kulturkreise* ('culture spheres'; Frobenius, 1898, 1899) which characterized material culture as a proxy for language, ethnicity, and self-identity. However, the increasingly rigorous typologies and chronologies also made '*les autres*' ('the others'; Tordorov, 1992) more apparent in terms of the style and manner of the items with which they were buried (Jockenhövel, 1980, 1991, 1995; Wels-Weyrauch, 1989; Jockenhövel & Kurbach, 1994).

In recent decades, advances in mobility research have created a broader understanding of how mobility—or potential mobility—functions in an increasingly connected world (see discussion of push/pull in Heberle, 1938; Lee, 1966; cost/benefit in Sjastaad, 1962; and 'motility' in Kaufmann et al., 2004). New methods in the field of isotopic tracing, such as the analysis of hair and fingernails, micro-sampling of multiple skeletal elements as well as the consecutive analysis of molars, has enabled scholars to create high-resolution timelines for individual human movements (Font et al., 2012; Tipple et al., 2013; Knipper et al., 2014; Frei et al., 2015a, 2015b, 2017; Scharlotta, 2018). Studies of various cases of single individual mobility timelines can be combined with other group analyses, thereby allowing archaeology to gain a better handle on the complexity of the networks connecting human biology, ethnicity, culture, and heritage (Haak et al., 2008; Knipper et al., 2017). In short, the course of academic dialogue is changing from producing evidence for movement to examining how different human mobilities either resemble or differ from each other across temporal and geographical barriers. Moreover, we are beginning to provide new and unprecedented information that can help us grasp why that movement first came about.

A Mobility Model

Thirty years ago, David Anthony criticized archaeologists for their approach to migration: 'instead of developing the needed tools, archaeologists have avoided the subject' (Anthony, 1990: 895). The increased temporal depth and breadth of mobility research coupled with better baseline coverage and new osteological techniques (e.g. Evans et al., 2010; Frei, 2013; Eerkens et al., 2014; Kootker et al., 2016; Frei et al., 2017; Stewart et al., 2017; Hoogewerff et al., 2019) have allowed archaeologists to address the five criteria for mobility assessment in an increasingly concrete fashion. Although there are (and always will be) holes in the record, we

1 Although some authors (Kaufmann et al., 2004; Urry, 2007; Cabana and Clark, 2011) speak of a sixth category of mobility involving imagined or symbolic travel, this will not be addressed here. While hugely important within archaeological interpretations of individual and group identity (see Reiter, 2014; Reiter & Frei, 2015), the definition of 'local-ness' versus 'foreign-ness' within the context of this article focuses on isotopic data rather than on archaeology.

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propose a mobility model composed of four over-arching mobility patterns which we have named as follows: 1) non-migratory; 2) point-to-point migratory; 3) back-and-forth; 4) repeated mobility, subdivided into 4a (cyclical mobility) and 4b (non-cyclical mobility) (see Table 2).

The following consists of a series of short discussions exemplifying these four kinds of mobility patterns from the present (mainly European) data. Given the preliminary nature of this model and the vagaries of interpretation, we have intentionally produced broad categories containing overlapping elements. We anticipate that the model will require later re-evaluation as more data appear.

Non-mobility: The Case of Singen (Germany)

Within this type of mobility pattern, individuals are stationary in terms of migration and mobility. They tend to be born, live, and die within the same area or region. We propose that a stationary farmer would exemplify this pattern. Within archaeological contexts, this type of pattern is visible in individuals whose burial context and isotopic data both indicate local provenance without apparent signs of mobility. It *also* includes individuals whose isotopic values in different human tissues point to a local origin despite the presence of non-local archaeological associated material(s), other atypical styles/decorations, and/or manners of construction within a specific grave.

An example of the latter can be seen near Lake Constance at the cemetery of Singen (Hohentwiel). Although the site contains elements of Corded Ware, Bell Beaker, Urnfield, and La Tène cultures (Kimmig, 1958), Singen is best known for its Early Bronze Age finds (Krause, 1988). While typological parallels for some of the objects (e.g. the daggers) have been found as far away as southwest Britain and in Brittany, Singen is particularly well known for the kind of metal used in the production of Early Bronze Age artefacts. The characteristic copper alloys used in what has become known as 'Singen metal' have been found along the Baltic and the Carpathian Basin (Krause, 1988; Oelze et al., 2011). While the evidence for such far-reaching connections might lead one to expect a high proportion of non-locals at the site, strontium and oxygen isotope analyses conducted by Oelze et al. (2011) suggest that the individuals they examined were overwhelmingly local. Even though the people from Singen clearly had contact with the outside world, in most cases, the mobility pattern exhibited by the inhabitants was non-migratory. Hence, this serves as an example of cultural exchange through means other than migration, where individuals seem to be local despite of the 'non-local' ancillary contextual evidence at the site. As studies of additional cemeteries within the region and the period as a whole come to fruition, and when additional samples—or perhaps even sequential samples from otherwise apparently 'non-mobile' people—become available, scholars may be able to shed more light on whether Singen represents a singular case or whether its non-mobility data forms part of a wider pattern.

Point-to-Point Mobility: The Case of the Skrydstrup Woman (Denmark) and the *Capacocha* Child Sacrifice in the Andes

A point-to-point mobility pattern can be distinguished from non-mobility through the single, unidirectional movement of the individual(s) concerned. Here we provide examples of individuals who appear to have moved either because of exogamy or

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Table 2. Mobility model: the schema proposes a series of five different patterns of human mobility.

No.	Mobility pattern	Category	Description	Stereotype	Examples of potential motives for movement (if present)
1	(A)	Non-mobility	Stationary living	Farmer	Stationary farming Subsistence activities Non-migratory crafting
2	A → B	Point-to-point mobility	Single mobility/ migration	Victim of Irish potato famine	Exogamy Natural disaster Warfare
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	Anglo-Saxon ward Pilgrims	Kinship network Fosterage system Pilgrimage
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	Travelling smith Transhumant herdsman	Mobile specialist craftsman Seasonal fishing/agriculture Trade Transhumance
4b	(A)→ B…C…D →(A) **Or** A…B…C…D…**etc.**	Repeated mobility (non-cyclical mobility)	Sequential short- and long-term stays in various different places Constant movement	*'Auf der Waltz sein'*	Journeyman status Military True Nomadism

pilgrimage/sacrifice. However, many other causes could result in this kind of mobility pattern, e.g. victims of warfare, famine/natural disaster or the need/desire to relocate for professional reasons.

An example of such type of mobility can be seen in the detailed mobility investigations of one of Denmark's well-preserved oak coffin burials: that the Skrydstrup Woman. The Skrydstrup female burial offered a unique opportunity for a detailed mobility study because the human remains consist of skeletal tissues as well as soft tissues like hair (Broholm & Hald, 1939). The Skrydstrup female was unearthed in 1935 from a burial mound dated to the Early Nordic Bronze Age period III (1300–1100 BC) (Frei et al., 2017). Until recently, scholars assumed that she had local geographical origins because she was buried in the manner of the local elite. Frei and colleagues (2017) recently analysed dental enamel from her first and third molar as well as sequential hair segments (Skrydstrup Woman's total scalp hair length was over 60 cm) and were able to create a detailed timeline for her movements. All in all, the strontium isotope results indicate that Skrydstrup Woman moved from one geological area (represented by the signature from her first and third molars as well as part of her scalp hair) to another (represented by the remainder of her hair samples and a lower strontium isotopic signature in the third molar compared to the first molar). The detailed baseline study of the area combined with these values suggests that she most probably lived locally at the second location (Skrydstrup) until the end of her days. These results seem to imply that the Skrydstrup female might have been an example of what Bronze Age literature refers to as the '*fremde Frau*' ('foreign woman'; Jockenhövel, 1991, 1995), i.e. a woman who moved from one area to another as a means of creating and/or validating an economic-political alliance or kinship bonds between different—but related—social groups (Wels-Weyrauch, 1989; Bergerbrant, 2007).

Regardless of the reason(s) why she moved, the results from the new analysis of Skrydstrup Woman suggest a single, unidirectional movement. In other words, a single migration. As this mobility coincided with Skrydstrup's early adolescence, exogamy is a potential cause for her individual mobility pattern. However, alternative scenarios might include unstable political/environmental situations, movement related to kinship networks or perhaps even adaptations to changes in the long-distance networks related to the metal trade (Ling et al., 2013, 2014; Melheim et al., 2018).

Within specific contexts, we can expand our understanding of single point-to-point mobility to include a sacrificial element. If we move our focus from Europe to the Incan Empire, we find another interesting example of unidirectional movement. The *capacocha* rituals of the Inca involved the sacrifice of children and material goods to the gods as a way of alleviating the results of natural disasters or of honouring key events in the life of the Inca emperor (Reinhard & Ceruti, 2015). The rituals included the selection of materials and young persons from various regions, their transport to Cuzco, and then further movements to places of particular ritual importance throughout the empire (Ceruti, 2004). Against a backdrop of written sources that describe the practice of sourcing sacrificial victims for the *capacocha* ritual from throughout the Inca empire, Andrushko et al. (2011) confirmed the presence of non-local child sacrifices by strontium isotope analysis of the children's human remains. The authors concluded that some of the children travelled or were brought to Cuzco Valley with the specific intent of being sacrificed. This conclusion had already been posited for the mummies from

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the Sara Sara (Peru) and Llullaillaco (Chile/Argentina) volcanoes in Wilson and colleagues' (2007) examination of carbon, nitrogen, oxygen, and sulphur isotopes. These studies provide evidence for unidirectional travel ending in the demise of the victims.

Back-and-Forth Mobility: The Case of Haraldskær Woman (Denmark)

Back-and-forth mobility can be distinguished from a point-to-point mobility pattern by the simple fact that, in the former case, the mobile individual returns to their starting point, whereas, in the latter, they do not. A case study of back-and-forth mobility comes from the Danish pre-Roman Iron Age (500–0 BC) bog body of Haraldskær Woman. Recovered by peat cutters working near Vejle in Jutland in 1835 (van der Sanden, 1996), the body, which also became known as Queen Gunhild (a mistaken attribution to the Viking Age), is a well-preserved bog body (Glob, 1969). Recent detailed strontium isotope analyses of the body's tissues (tooth enamel and scalp hair) and the wool textile recovered with the remains revealed a 'there-and-back-again' mobility pattern (Frei et al., 2015b). While the $^{87}Sr/^{86}Sr$ ratios of Haraldskær Woman's tooth enamel suggest that she was likely to have spent her childhood within the area of present-day Denmark, the strontium isotope ratios from her scalp hair suggest that she undertook a long-distance journey shortly prior to her death. The authors suggest that she may have been on a kind of pilgrimage which could have been related to her end as an offering in the bog (Frei et al., 2015b).

Repeated mobility

We have grouped together different kinds of repeated mobility in a single over-arching group. As a general rule, what we have termed 'repeated mobility' involves movements over an individual's lifespan between two (or more) areas. While there are several different forms that this kind of mobility can take, we have sub-divided the category into cyclical and non-cyclical mobilities.

Repeated (cyclical) mobility: the case of Nieder-Mörlen (Germany) and Ötzi (Italy)

Repeated (cyclical) mobility refers to repeated mobility either over a specific period or throughout a lifetime between different (but repeated) areas. This type of mobility can have many iterations, e.g. it can be seasonal and can involve either single individuals or groups.

Isotope analyses have been carried out in the surroundings of the site of Nieder-Mörlen (Hesse), an important and central area in the Early Neolithic (Gronenborn, 1999) in order to shed light on potential migration to the site (Nehlich et al., 2009). Archaeologically, Nieder-Mörlen is of interest not only because of its long-term occupation (Schade-Lindig & Schmitt, 2003), but also because it shows clear changes in the style of pottery a few generations after the arrival of the first settlers, marking the earliest Flomborn phase of the Linearbandkeramik. The stable and radiogenic isotope analyses of teeth from several individuals buried at the site revealed a very complex mobility pattern (Nehlich et al., 2009). The individuals investigated proved to be a combination of local and non-local people that point to a 'cultural mix' (Nehlich et al., 2009: 1798). A group of non-local juveniles merits particular attention. Strontium isotope analyses combined with strontium concentrations (Nehlich et al., 2009: 1793–95) of these juveniles from the population subset which the authors refer to as 'Group III'

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suggest mobility in early childhood between the ages of 4 and 6 years. The authors of the study note that this pattern resembles migration patterns in semi-nomadic pastoral societies in which the adults care for the cereal crops and the children are tasked with protecting the herds (Nehlich et al., 2009 :1797). Based on these analyses and the archaeological context, the authors suggest that these juvenile individuals might have engaged in pastoral transhumance.

Another example of a similar type of mobility is suggested by the multi-isotopic investigation conducted on the prehistoric mummy found in 1991 in glacial melt-water along the Italian-Austrian border (Müller et al., 2003). Known as 'the Iceman' or 'Ötzi', this mummy has been intensively studied and has proved useful in providing information about the Neolithic-Chalcolithic transition in Europe. Müller and colleagues (2003) conducted strontium, lead, and oxygen isotope analyses on Ötzi's skeletal and soft tissues to identify his potential mobility and provenance. The cross-disciplinary investigations on cortical and trabecular bone, dental enamel, intestinal wall, and the Iceman's stomach contents led the authors to suggest that Ötzi may have been engaged in repeated mobility, which the authors associate with transhumance (Müller et al., 2003: 865) between low-altitude settlements and summer grazing areas above the timberline. The authors posit this scenario due to the similar $^{87}Sr/^{86}Sr$ ratio of the Iceman's intestinal wall and that of his earliest tooth enamel. The later discovery of evidence for the violent death of the Iceman (Nerlich et al., 2009; Maixner et al., 2013; Pernter et al., 2007) has led other scholars to dispute Müller and colleague's transhumant shepherd hypothesis in favour of viewing Ötzi as a travelling elite (Gleirscher, 2004; Lippert et al., 2007).

Repeated (non-cyclical) mobility: the cases of the medieval Silk Road, Roman York, Viking Age Trelleborg, and La Tène Bohemia

This last sub-category of repeated mobility is characterized by movements between different areas which may be regular or irregular (i.e. they may be seasonal, or related to other phenomena, such as socio-political events or weather). This can be distinguished from the previous sub-category by the fact that this pattern does not show mobility within the same areas but may instead involve visiting new regions. The duration of the 'stay' in each area may vary and some of the areas (but not all) may be repeated.

An example of potential repeated mobility has recently been published in a study of urban *versus* nomadic communities along the medieval Silk Road in Uzbekistan, Kazakhstan, and Turkmenistan (second to sixteenth century AD) (Hermes et al., 2018). In their study, Hermes et al. (2018) examined carbon and nitrogen isotopes of bone collagen as a proxy for dietary intake via isotopic niches. Assuming that urban populations could be distinguished by more limited dietary resources compared to nomadic groups, the authors conclude that low isotopic variation reflects urban groups, while an open and more opportunistic system of food production due to a more mobile lifeway will be reflected by a larger isotopic variation.

Isotopic diversity among frequent or well-travelled groups seems to be one of the only unifying factors other than find context. Results such as those from a second-century AD cemetery of 'headless Romans' uncovered in Driffield Terrace in York (UK) may be interpreted as representing the result of frequent movement associated with military service and recruitment (Müldner et al., 2011).

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Evidence for a similarly diverse recruitment pattern is also visible in the varied origins of the persons buried at the tenth-century fortress of Trelleborg in Denmark, the stronghold of the Viking king Harold Bluetooth (Price et al., 2011).

Similar patterns of high mobility within what are interpreted as warrior contexts have also been identified by Scheeres et al. (2014) in three early La Tène (fourth/third century BC) cemeteries in Bohemia, namely Radovesice I, Radovesice II, and Kutná Hora. In this study, oxygen and strontium isotope analyses of human teeth were used to assess the validity of the so-called 'Celtic migrations'. The data gathered from the mostly male cemetery population indicate that many of the individuals originated from different geological settings. This might be an indication that the deceased travelled with other warriors through a number of different areas before ending at the sites where they were buried.

Discussion

The current boom in studies of mobility combined with recent scientific advances in creating detailed timeline investigations of single individuals (Font et al., 2012; Tipple et al., 2013; Eerkens et al., 2014; Knipper et al., 2014; Frei et al., 2015a, 2015b, 2017; Plomp et al., 2017) has created a new way of layering new questions regarding social dynamics. Here, we propose a simple model of different types of mobility that this new corpus of data appears to suggest with the aim of providing new tools with which we can discuss past mobility more in detail. The material allows for future expansion and refinement; the similarity of many of the categories and the resultant overlap would benefit greatly from comparison with more high-resolution data. Although, as discussed above, a plethora of studies have identified non-local people and, hence, mobility, the recent addition of a temporal element, such as can be achieved through sequential molar sampling or through the analysis of hair and fingernails, is still relatively novel. Knowing *when* people travelled in a human lifespan and tracing the pattern of their movements has allowed us to fulfil the criteria described above to a degree hitherto unknown within archaeological contexts. When detailed material is complemented by repeat sequential samples from individuals and more examples from an entire site or region, scholars will begin to make suggestions about the cultural mores associated with movement and non-movement across socio-demographic lines.

All told, the mobility patterns identified in the present model cleave to three overarching kinds of mobility: non-mobility, single mobility/migration, and multiple movements. The causes of non-mobility and different types of mobility can be manifold. Non-mobility may include lack of sufficient funds or surplus, social obligations, health status, age, and social standing (serf, slave, landed gentry). Single, unidirectional movements may have been caused by marriage alliances; family movements; social, political, or economic instability; violence (enslavement, kidnapping); or health issues. By contrast, individuals who show evidence of multiple movement were likely to have been moving because mobility formed part of their employment, beliefs (ritual), or lifestyle. Although a warrior or soldier, herder, trader, or traveller within an extensive kinship network may present very different mobility patterns, they are all unified by the fact that their chosen occupation or social group(s) exhibit some form of mobility mandate.

Agency also has an important role to play within mobility patterns. Sociologists believe that social status is created by

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means of self-presentation to others through wealth, professional experience, or formal position (Veblen, 1899; Mead, 1934; Goffmann, 1959; Podolny, 2005). The causes of mobility intersect with the reception of foreigners along specific breaking points. The right to move or not to move is vastly different from an obligation to move or not to move (e.g. Cresswell, 2012). The social reception of foreigners by a host society is predicated on whether travellers came (or were caused to come) because they were exercising a right, whether they had selected a particular lifestyle, or whether they were suffering a particular obligation (Shellar, 2018).

Let us take the example of the non-mobile people from Singen (Oelze et al., 2011). The fact that the overwhelmingly non-mobile inhabitants of that site were also interred with exotic goods not only underscores the importance of non-local materials or items in social negotiations (Vandkilde, 2007), but also exemplifies the ways the inhabitants expressed power. It seems that, in Singen, it was not through individual travel and the acquisition of non-local goods that one expressed one's social standing, but rather by causing exotica to be brought to one's own doorstep.

The causes of back-and-forth mobility are difficult to define as different reasons could spur a single to-and-from journey to a specific place of cultural, religious, or personal importance. Although this may be difficult to investigate within archaeology, the example of the bog body of Haraldskær Woman seems to indicate this type of mobility.

Repeated mobility, be it cyclical or more irregular (non-cyclical), can also be closely related to social status. For example, a peddler, small-scale trader, or migrant worker's identity and integration (or non-integration) into the society (or societies) with which they have contact can be defined by their transitory lifestyles. Modern ethnographic examples of travelling smiths, such as the West African Senufo Kule and the Inaden from northern Nigeria, show that both the profession and its mobile nature removed metalworkers from 'normal' society; in many cases, they formed a separate social category (Neipert, 2006). This could also be the case with warriors. Although contact with migratory workers or specialists was necessary for temporary collaboration, prolonged contact might involve severe social change (Neaher, 1979; Bollig, 1987).

Conclusion

We present a simple but, we hope, useful model of different types of human individual mobility as revealed through isotope analyses of archaeological human remains. The model consists of four main types of mobility: 1) non-migratory (no mobility), 2) point-to-point, 3) back-and-forth, and 4) repeated mobility. Our principal goal is to present a new dimension, based on the current scientific individual mobility data, which can provide a framework for discussing the impact different types of mobility had on society. It is our hope that it will facilitate cross-comparisons and, eventually, interpretations of the causes and influence of mobility in the past.

Even though the periods, regions, and people included in this discussion and model of (chiefly Old World) mobility differ widely, they share a particular emphasis on mobility—or non-mobility—as a definitive phenomenon. Individual mobility patterns are just that: individual. It is through the specific patterns represented by individuals as well as inter- and intra-group patterning comparisons that we will be able to further archaeological mobility

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research as a whole. We believe that the discipline can move from producing evidence of movement to examining how different human mobilities resemble or differ from each other across temporal and geographical barriers. Fortunately, the methodological developments within archaeological sciences/archaeometry of the last few decades have provided a great deal of evidence suitable for the study of mobility, and it is increasing exponentially. Moreover, we are beginning to see new and unprecedented information that can help us grasp why such movement first appeared. It is, therefore, expected that future refinements of the model will be necessary.

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Biographical Notes

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Un modèle d'interprétation des diverses manifestations de la mobilité dans le passé

Au cours de la dernière décennie, la croissance exponentielle des études concernant la migration mettant l'accent sur la mobilité de groupes ou d'individus—la plupart basées sur des analyses de l'ADN ancien et des isotopes du strontium—a fourni une série supplémentaire de données sur les dynamiques sociales du passé. Aujourd'hui, la quantité de ces données, un nombre qui augmente constamment, permet d'examiner la mobilité des humains avec un degré de précision inédit. La teneur du débat scientifique est en train de changer, passant d'une présentation des indicateurs de mouvement vers un examen des différences ou ressemblances entre la mobilité des gens, au travers des barrières temporelles et géographiques. De plus, la quantité et le caractère de ces données commencent à fournir de nouvelles informations sur l'origine de ces mouvements. Nous présentons ici un premier modèle de mobilité potentielle focalisé sur des individus dans différentes phases de leur vie et fondé sur des schémas de mouvement in vivo. *Nous nous basons sur des études récentes sur la mobilité qui fournissent divers exemples illustrant notre modèle. Nous espérons que ce modèle s'avèrera utile dans de futures discussions sur la mobilité humaine en combinant le discours actuel basé sur le contexte archéologique avec les nouvelles données toujours plus abondantes.* Translation by Madeleine Hummler

Mots-clés: mobilité, causes de la migration, modèle, mouvement

Ein Modell für die Deutung der menschlichen Mobilität in der Vergangenheit

Im letzten Jahrzehnt zeigte sich eine exponentiell zunehmende Entwicklung innerhalb der Migrationsforschung in der Archäologie, welche die Mobilität von Menschengruppen oder Individuen betreffen und vor allem auf Analysen von alt-DNA (aDNA) und Strontium Isotop-Analysen beruhen. Diese Forschungen sind heute eine wichtige zusätzliche Informationsquelle innerhalb der Diskussion zu den Dynamiken vor- und frühgeschichtlicher Gesellschaften. Die zurzeit recht große und stetig zunehmende Menge von Daten bietet die Gelegenheit, menschliche Mobilität mit bisher unerreichter Genauigkeit zu untersuchen. Fokussierte die Forschung noch vor wenigen Jahren auf den einfachen Beweis für Mobilität, so ermöglicht die steigende Menge Daten heute die Untersuchung von Unterschieden und Gemeinsamkeiten innerhalb der menschlichen Mobilität, in Zeit und Raum. Darüber hinaus erlauben die neuen Daten bereits neue Angaben zu den Ursachen vor- und frühgeschichtlicher Möbilität In diesem Artikel stellen wir erstmals ein Modell zur Bestimmung potenzieller Mobilitätsmuster vor. Das Modell basiert auf in vivo *Bewegungsmustern einzelner Individuen in verschiedenen Lebensphasen. Neueste Forschungsergebnisse verschiedener Projekte werden als Beispiele herangezogen um das hier vorgestellte Modell illustrieren. Das hier vorgestellte Modell wird hoffentlich zukünftige Diskussionen zur menschlichen Mobilität durch die Verbindung des aktuellen kontextuellen Diskurses in der Archäologie mit der zunehmenden Menge neu erzeugter Daten anregen.* Translation by Madeleine Hummler

Stichworte: Mobilität, Ursachen der Migration, Modell, (Bevölkerungs)Bewegung

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