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Examples of Iron Age mobility patterns in the light of multi-isotopic evidence

Betka Danielisová

Abstract

This paper discusses the topics of mobility and migration in the field of archaeological sciences. Theoretical models used to interpret mobility data are adapted from anthropology, social history, and gender studies. Migration is seen as a complex and heterogeneous social process conditioned by various factors affecting the form and scale of movement. Here we differentiate between migration and mobility, where migration is seen as a specific process involving permanent or extended movement of people, while mobility is a continuous movement for social, cultural, or political reasons. The concept of translocality is quoted to describe high levels of multidirectional movements among social groups constantly engaged in communication networks involving mobility on various scales. These theoretical concepts are applied to the isotopic data from La Tène cemeteries to explore the *Celtic expansion* in the 4th and 2nd centuries BC north and south of the Alps. Overall, this paper highlights the importance of considering contexts, time scale, distance, frequency, or social groups involved when assessing the nature of past movements. It also emphasises the need for appropriate methods to archaeologically recognise migration as a specific process and the adoption of theoretical models that can help understand mobility patterns in the past.

Keywords: mobility, migration, translocality, Iron Age, cemeteries, isotopic data

12.1 Introduction

Similar to identity, mobility and migration are current topics in our society today. Therefore, these interests are also reflected in the archaeological sciences. Based on the recent scientific approaches that often include bioarchaeological analyses, theoretical models currently employed to interpret the mobility data are adapted from anthropology, social history, and gender studies (Anthony 1990; Burmeister 2016; Furholt 2018; 2021). These often explain migration as complex and heterogeneous social processes conditioned by a variety of motivations and factors affecting the very form and scale of the movement. What should be considered when assessing the nature of past movements are contexts, time scale, distance, frequency and besides that all, also the very participants engaged in mobility, based on their gender, age and social group (Gregoricka 2021). Mobility in past was controlled by various factors for which different models were suggested. *Migration* is currently undoubtedly the central concept in 'mobility discussions'. However, its understanding has evolved differently among the disciplines, particularly anthropology, social history and genetics. From the archaeological part, migration is understood as 'a particular form of human mobility', a distinct process, that involves the physical movement of people, individually or as a group (smaller, larger or even massive) in order to change residence permanently or at least over an extended period of time (Tsuda et al. 2015; Gregoricka 2021). As such, this process should be archaeologically recognisable when investigated by appropriate methods. The main prerequisite of migrations to be readable from the archaeological record is usually that an individual dies in a different place of residence from that in which they were born, or at least spend there a sufficiently prolonged period of their life. As a result, we should understand 'migration' as a specific process at the end of which the local population is influenced by a demographic impulse from the outside, however long this process takes, be it a few months or a few centuries.

In contrast to migration, *mobility* in a simple sense should be rather a continuous process of movement of an individual or a group between com-

munities. Motivations for this movement are complex and include mostly the desire to create and maintain social relationships for socio-economic, cultural or political reasons. Consistent social relations between the communities can be then manifested by similarities in the material culture, customs and practices, despite diverse social organisation or subsistence strategies (Furholt 2021). In order to maintain the operability of such networks, these needed to be constantly taken care of through regular circulation of the population. Patterns of such movement could be variable – temporary, cyclical, seasonal, etc., depending on motivation and overall conditions. In order to be able to describe such mobility patterns, a concept of *translocality* was recently adopted from social anthropology. It is formed by adapting the idea of *transnationalism*, an anthropological approach that understands migration as a multidirectional movement during which the ties with one´s places of origin are still actively maintained leading to the creation of hybrid socio-cultural identities (Brettell 2008). Translocality is supposed to adapt this notion to a more general and more regionally grounded basis. This concept is supposed to represent high levels of multidirectional movements among the social groups that are constantly engaged in communication networks involving mobility on various scales (Furholt 2018; 2021). Under this prerequisite, the genetic material is being passed back and forth among communities following the customs of either matri- or patrilocality and in this communication network also the goods are traded, technologies are spread, and new customs or ideologies can be transmitted. Homogeneity of material culture, exchange of marital partners or fostering children from different communities can be also included in the concept of translocality. These processes can be archaeologically visible in studies that focus mainly on local contexts. A characteristic of translocality is that besides the need to maintain social contacts, there is no single explanation and motivation for similar mobility patterns. This points out the complex interplay of motivations for movements and sometimes even changes of residency that are likely to be characteristic of the process of creating and maintaining communication networks in past.

This paper deals with the long-discussed question of the so-called *Celtic expansion* in the 4th and 2nd centuries BC. This term conventionally refers to the emergence of 'Celtic' (i.e. 'foreign') populations, especially in territories south of the Alps including north Italy, Greece, Balkans, or Spain. Here the topic is approached using the isotopic data from La Tène cemeteries north and south of the Alps and data patterns are discussed in the context of current theoretical concepts.

12.1.1 Mobility concepts applicable to *Celtic expansion*

The character of movements connected with military campaigns of the second half of the 1st millennium BC that involved the Iron Age populations on both sides of the Alps (Fig. 1) is still a huge topic among scholars. The nature of the *Celtic expansion* is believed to be a movement of solid but heterogeneous demographic groups motivated mostly by military reasons, dissolving the previous bounds and renegotiating new social concepts. This process likely took several generations (almost 200 years) and ultimately led to demographic and social changes in the affected territories (Kysela 2020; Pope 2021; Patterson et al. 2022) with the archaeological evidence of new La Tène settlements. This would be in line with the proposed concept of migration. On the other hand, an influence from the Mediterranean area, mediated by the increased mobility to and from this area, is believed to stay behind the rapid socio-economic development north of the Alps in the 3rd century BC. In this respect, rather the concepts of mobility or translocality would be more appropriate to explain the formation of socio-economic or political networks, cemented through increased movements in given periods of time. These new, or newly used, contact networks are evidenced by the sudden and rapid spread of new materials, technologies, or social customs (Venclová 2016; Hiriart 2020; Danielisová et al. 2021a). By spreading and adopting new ways of life connected with socio-economic innovations majority of people adopted also common cultural or ideological models that fa-

cilitated communication and created social links between individual groups. A good example of this concept is the mobility pattern imagined for the late Iron Age agglomeration (2nd–1st century BC) of Basel-Gaßfabrik in Switzerland, where, besides the dominant patrilocal movement recorded for the local females, other directions of movement away from or towards the agglomeration, over various distances and even climatic zones and moreover during different stages of individuals´ lifetimes, were observed (Knipper et al. 2018). Similar observations were made also at other Iron Age sites where similar analyses were applied (Scheeres et al. 2013; 2014; Sorrentino et al. 2018; author's unpublished data).

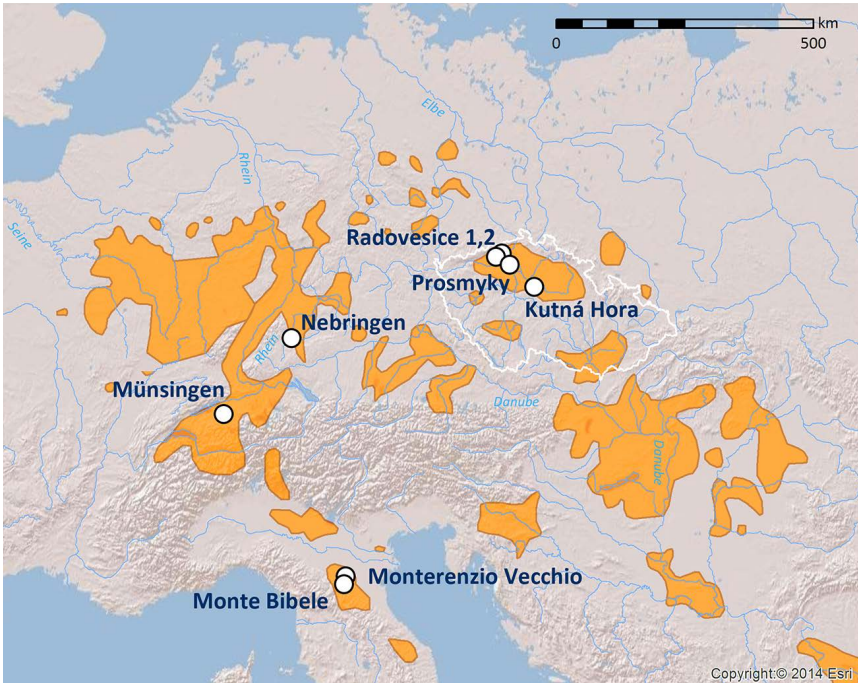

Figure 1. Map of the La Tène culture in continental Europe in the 4th and 2nd centuries BC with cemeteries analysed in this paper.

12.2 Approaching Iron Age mobility

12.2.1 Methodologies for understanding mobility patterns

Because the spread of the La Tène culture has been traditionally linked with the movement of populations and individuals, the scientific focus was directed towards recognising such movements in the archaeological record. However, as human movement and its motivations are very complex aspects of past behaviour, complicated by the fact that these aspects are largely invisible, signs of mobility can be approached by limited evidence only. To overcome these limitations, specific ways must be pursued using interdisciplinary perspectives and developing new techniques that can be interpreted using informed archaeological contextualisation. During the last two decades, especially bioarchaeology and provenance studies (i.e. studies of origin) have played an increasingly important role in mobility research in order to better explore the variations of mobility and migrations among Iron Age populations (e.g. Danielisová et al. 2021b).

Recent insights from aDNA analyses are behind the partial revival of migration as a factor in the diffusion of cultural innovations and material cultures that were before abandoned as a reaction to traditional culture-historical paradigms (Furholt 2018). Archaeogenetic approaches have enabled us to understand if the genetic signature of an individual can be explained as the result of continuity from previous local signatures or if an individual would have required additional, non-local genetic material in order to explain their genetic make-up. That is also why geneticists only explain migrations as situations when genetic material has been transmitted between different populations (Patterson et al. 2022). This method very much depends on knowledge of regional variability of genetic signatures within populations and their transformation over time (Brunel et al. 2020; Fischer et al. 2022; Patterson et al. 2022). So far, applications on the Iron Age are limited compared to studies from a more distant past. However, as limited as the Iron

Age studies are (especially genotypic analyses are still generally lacking), the genetic data have contributed to detecting the interactions between the broader populations (Schiffels et al. 2016; Brunel et al. 2020; Patterson et al. 2022; Fischer et al. 2022). The results reinforce the idea that no major demographic changes (i.e. the gene flows) due to the increased population movements were behind the formation of the Iron Age populations of western Europe and Britain. The Iron Age populations derived progressively from the previous Bronze Age populations between regional groups sharing common cultural traits and connected through a network of mutual social contacts and biological exchanges (Fischer et al. 2022). Moreover, there was recorded reduced migration to Britain from continental Europe during the Iron Age which suggests a substantial degree of genetic isolation of some parts of Europe during that time. This is further corroborated by the analysis of dental morphological traits conducted on people buried at La Tène cemeteries across continental and insular Europe (Sorrentino et al. 2018; Anctil 2020). Dental morphology, specifically the nonmetric study of dental traits, is used to assess the degree of biological variation, so-called phenotypic variability, within or among populations (Buikstra et al. 1990). The phenetic variation observed among the samples virtually shows individual biologically non-related communities across Europe. These genetically distinct regions, especially those at the fringes of the continent, were affected by population exchange only to a very limited degree and cultural expansion was not physical in terms of human migrations. In other words, according to aDNA and dental-traits analysis, human migration was not likely responsible for the diachronic changes in the material culture in the regions considered potential recipients of the *Celtic expansion* in the 4th and 2nd centuries BC. On the other hand, smaller-scale mobility has been regularly attested, indicating continuous individual or small-scale interactions between communities, even across the Channel, over the long term.

12.2.2 Examples of the application of isotopic analysis in Celtic mobility studies

An important companion in bioarchaeological mobility studies is isotopic analysis. In mobility studies, strontium (Sr), oxygen (O) and lead (Pb) are the most commonly used elements (for Iron Age: Scheeres et al. 2013; 2014; Scheeres 2014; Knipper et al. 2018; Sorrentino et al. 2018; Jay & Montgomery 2020; Laffranchi et al. 2022). Since dental enamel is the material of choice for these analyses and since dental crowns mineralise during the various stages of childhood and early adolescence, the resulting $^{87}Sr/^{86}Sr$ ratio indicates the childhood mobility of the analysed individuals. This poses a problem when the mobility of adults is the subject of study, as in the case of the potential mobility of warriors during military operations in the areas south of the Alps.

In connection with the supposed nature of the *Celtic expansion* where the mobility of armed men was envisioned to shape social communities across Europe, signs for large groups of people not born at the site where they were buried and increased male mobility were searched for in the bioarchaeological evidence (Scheeres et al. 2013; 2014; Sorrentino et al. 2018; Anctil 2020). At the majority of investigated cemeteries non-local individuals were detected, sometimes even at high proportions compare to the rest of the communities (such as Basel-Gaßfabrik: Knipper et al. 2018; Radovesice I, II and Kutná Hora: Scheeres et al. 2014). However, it seems that no uniform mobility rules were followed on a supra-regional scale. On the majority of sites, a rather low frequency of non-locals was observed suggesting potentially reduced long-distance mobility. This is the case especially for Cisalpine Italian cemeteries such as Monterrezio Vecchio (Sorrentino et al. 2018), Monte Bibele (Scheeres et al. 2013), Seminario Vescoville (Laffranchi et al. 2022), but also Nebringen in southwestern Germany (Scheeres et al. 2013), Münsingen in Switzerland (Scheeres 2014), Prosmyky in Bohemia (unpublished) or Wetwang Slack and Kirkburn in Yorkshire (Jay & Montgomery 2020). It is possible that the pre-eminence of short-distance movements can go undetected by isotopic

analyses because of homogeneous geological settings or insufficient baseline mapping. But the frequency of repetitive patterns at multiple sites, involving people of various social ranks and ages, rather speaks for the intra-regional movements between communities that were far from the supposed increased mobility of armed individuals during the period of the supposed migrations. Warrior groups, when they had the chance to be analysed for bioarchaeological data, showed rather different patterns of non-locality or locality. What is interesting is that warriors almost always formed tight-knit clusters of isotopic values, sometimes across two and more generations, that indicate similar lifestyles for these social groups. That would also include mobility patterns and the possibility that the more homogeneous the isotopic values were the greater the possibility that the warrior group was of the local origin, despite having the opportunity of being more mobile during their adult lifetime. To

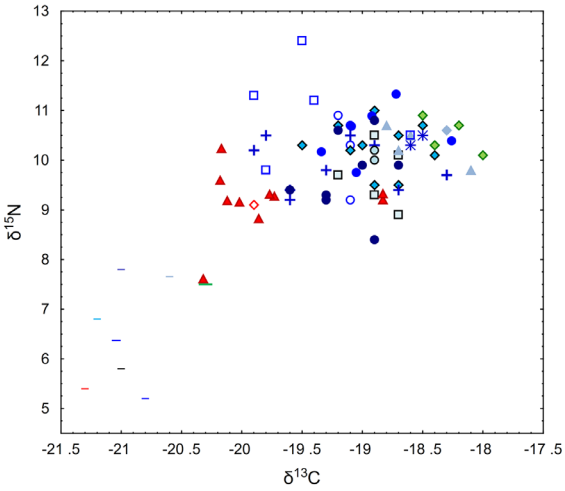

Figure 2. Comparison of diets of warriors across wider central Europe (red – Switzerland; blue – Bohemia; green – Slovakia; compared to averaged animal baselines from the respective territories indicated by horizontal dashes). Two males from the Münsingen cemetery (red triangles) show a diet more representative of the territory of Bohemia and might indicate relocation from this part of Europe (data from Le Huray 2006; Moghaddam et al. 2016; 2018).

give an example, a comparison of dietary isotopes ($\delta^{13}C$ and $\delta^{15}N$) of warriors from La Tène cemeteries across continental Europe (Fig. 2) shows a very variable diet that is most likely linked to geographic and environmental factors, but it also identified two adult individuals at the cemetery of Münsingen (Moghaddam et al. 2016) with more enriched $\delta^{13}C$ values that likely had their diets influenced by the environment in central Europe.

However, even when using multi-isotopic evidence, there are numerous cases where provenance analysis fails to detect specific places of origin. This should not be discouraging. Usually, the detection of isotopic outliers and analysis of the internal structures of data (i.e. studied communities) from the statistical point of view can bring much information about past mobility patterns without necessarily pinning exact geographical coordinates on it. Using different mineralisation times of the dental enamel and by comparing isotopic data from various tissues of one individual, one's mobility (or dietary) history can be studied (e.g. Knipper et al. 2018). By comparing childhood and adult dietary values we can detect changes in diet that can be linked with changes in the food catchments (Laffranchi et al. 2022) as was shown in the example of warriors from Münsingen. Often there is a case at La Tène cemeteries when an individual is born locally, then changes residence during early adolescence and then is buried in the area where they were likely born (the case of Prosmyky in Bohemia). This conforms to the complex multi-directional patterns of movements to and from settlements motivated by multiple reasons, like for example the attraction power of central sites that has been cited in the case of the agglomeration of Basel-Gaßfabrik (Knipper et al. 2018).

Commonly observed lower mobility of men compared to generally more dispersed values for women (Fig. 3) may indicate (regional) female exogamy and residential changes following the rules of patrilocality or small family migrations of otherwise mostly sedentary societies. These behavioural patterns conform to the concept of *translocality* outlined in the previous paragraphs. This observation, however, can differ across the regions. A feasible way how to compare mobility in different communities is to calculate the offset between childhood or early adolescence signals and local baseline values. Even though

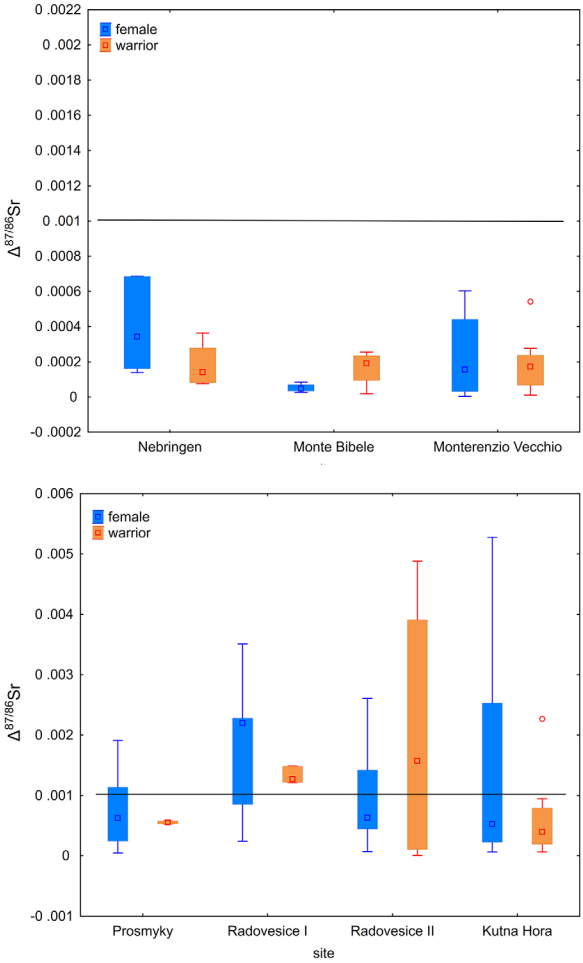

Figure 3. Comparison of the offset of strontium values indicating relocation during the individual´s lifetime. Values are more heterogeneous in the communities north of the Alps in comparison to cemeteries in northern Italy and southwestern Germany. The conventional threshold for 'childhood relocation' $\Delta^{87}Sr/^{86}Sr$ = 0.001 is indicated by a black line. Values also show different relocation patterns for men and women (data from Scheeres et al. 2013; 2014; Scheeres 2014; Sorrentino et al. 2018; author's unpublished data).

such calculations can be affected by local environmental conditions and underlying geology, the offset between values, in other words – homogeneity or dispersion of the data – can indicate the mobility dynamics of communities represented by their burial sites. A conventional threshold for the change of residence in $^{87}Sr/^{86}Sr$ ratios is $\Delta^{87}Sr/^{86}Sr > 0.001$ (depending on the internal statistical dynamics of data this offset can be also smaller, cf. Hrnčíř & Laffoon 2019). When comparing the Cisalpine (plus Nebringen) and Transalpine sites the larger mobility offset of the latter is evident (Fig. 3). It can point to lesser mobility in the regions expected to be the recipient territories of the *Celtic expansion*. It is possible that cemeteries in Italy show sedentarised populations under the influence of local indigenous communities with different social habits, such as the Etruscans, and the mobility of men was only selective for single sites. This may also be evidenced by the limited presence of burials with weapons. The heterogeneity of values north of the Alps may indicate increased mobility of individuals that in consequence can form dynamic communities following the rules of translocality and immigration from geographically more distant regions. Again, there are differences in such patterns between individual sites and more data is needed to confirm these observations.

12.3 Conclusion

In conclusion, bioarchaeological data mostly from La Tène cemeteries during the 4th and 2nd centuries BC indicate lively intra-regional, but possibly only limited extra-regional movements and this notion is supported by archaeological, isotopic, and modern genetic lines of evidence. In this respect, central European societies show a rather standard structure of sedentary, patrilocal societies following the mobility patterns in line with social rules of *translocality*. It is important to note, however, that these conclusions are drawn based on so far a limited number of samples and only when there will be more statistically robust evidence, we can count these results as generally applicable.

These above-outlined approaches highlight the need to move away from the traditionalistic concepts of movement between and beyond various social groups. It is very probable that small-scale regional movements involving the network of regional communities were continuously being carried out on a regular basis forming an integral part of the life of the past societies. The important aspect of recognising the link between mobility patterns and their role in the social composition of communities is the study of *how such patterns are expressed in the archaeological and bio-archaeological records*.

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