CHAPTER 1

SCOPE AND OUTLINE

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**Scope and objectives of this study**

Nearly 60 years ago, during the early 1960s, the development of the processual archaeological theories resulted in rejection of the concept of migration to explain cultural change. Archaeologists proposed that ‘evolutionary’ processes in cultural development (i.e., the change of human beings themselves) resulted in cultural change, rather than outside influences such as migrations and invasions (Binford, 1962; Renfrew and Bahn, 2016). It took over 20 years, after the processual archaeology lost its hegemony in the early 80’s of the previous century, for the concept of mobility and its impact on cultural developments and population dynamics to again become subject to research and debate.

The original models of migratory patterns in (pre)history were based upon the spatial dispersal of cultural artefacts, with the best known proxies for the analysis of migration being the distribution of typological identical artefacts and the merging of typological groups (Burmeister, 2000; Theuws, 2009). The use of typology to trace ancient migration patterns, however, has led to an active debate about the extent to which the archaeological record represents the actual movement of people or the diffusion of ideas (e.g., Childe, 1925; Burmeister, 2000; Hakenbeck, 2008). Burmeister (2000), for instance, states that supra-regional distributions of cultural artefacts ‘outline areas of communication’, but do not prove direct social contacts. In addition, he suggests that although indicators of migration might be identified, it will remain ‘difficult to define a region of origin for the immigrants’. A new perspective on this debate, and a tool to enable the development of a method to identify migratory patterns and areas of origin, is provided by the archaeological subdiscipline of archaeological science.

The isotopes of lead (Pb), neodymium (Nd), oxygen (O), carbon (C), and in particular strontium (Sr) have been extensively used as tracers of origin. The application of these isotopes to solve archaeological questions has matured over the last three decades. Organic tissues such as fabrics (e.g., Frei et al., 2009a,b; Von Holstein et al., 2016, but also see Von Holstein et al. (2015) with regards to the difficulties in removal of exogenous Sr signals), wood (e.g., Horsky 2010), keratins such as hair and nails (e.g., Meier-Augenstein and Kemp, 2009; Font et al., 2012), ivory (e.g., Van der Merwe et al., 1990; Rijkelijkhuizen et al., 2015), shell (e.g., Eerkens et al., 2005) and in particular (fossilised) human and animal bone, dentine and enamel (e.g., Schweissing and Grupe, 2003; Pye, 2004; Bentley, 2006; Britton et al., 2009; Copeland et al., 2010; Schwarcz et al., 2010; Laffoon et al., 2014, and references therein) have been subject to isotope analysis to study migration, specifically on the individual level. In addition, isotope research has proven to be a valuable tool for tracing the provenance of raw materials for pottery, metal and glass, providing solid evidence for trade or exchange of artefacts (e.g., Brill, 1970; Pye, 2004; Henderson et al., 2005; Degryse and Schneider, 2008; Degryse et al., 2010; Pryce et al., 2011; Thibodeau et al., 2013).
Even though the isotopic study of mobility is tightly bound to archaeology, it does not fall exclusively within the realm of archaeology; stable isotope research has proven its value in many environmental migration studies and forensic cases as well (Pye, 2004; Wassenaar et al., 2008; Hillaire-Marcel et al., 2013; Font et al., 2015a,b,c). Albeit isotope analysis is not a panacea, it is nowadays one of the most widely utilised research fields in archaeological and forensic sciences. Nevertheless, despite its international success and proven potential, a geochemical approach to understanding ancient migratory patterns was, up to a few years ago, only occasionally applied on Dutch cultural heritage. In addition, a spatial bioavailable strontium isotope distribution map of the Netherlands, a sine qua non for data interpretation in palaeomobility studies applying strontium, was absent. This knowledge gap was acknowledged by the KNAW (Royal Netherlands Academy of Arts and Sciences) in 2011, as well as by the NOaA (National Archaeological Research Agenda): both urged to fill in the gap (www.noaa.nl; KNAW, 2011). In order to rectify the problem it has been recognised that the commercial archaeology (responsible for nearly all archaeological excavations in the Netherlands: a direct consequence of the 1992 Valletta Treaty or Malta Convention) and the archaeological science need to be bridged as well (Van der Veld, 2011).

This PhD project therefore aims to fill in this knowledge gap and focuses on the applicability and integration of strontium isotope research in Dutch cultural heritage. This goal is achieved by:

- the generation of isotope data through the execution of isotope research within numerous commercial projects in the Netherlands, and even in some of its former overseas territories;
- the application of the data through the creation of the essential bioavailable strontium isotope distribution map of the Netherlands, that will enable a more accurate interpretation of the (archaeological) human and faunal $^{87}\text{Sr}/^{86}\text{Sr}$ data;
- the implementation and valorisation of data through A) the organisation of national symposia on the application of isotope research in archaeology (e.g., the 1st Biologisch-Archeologisch Platform (BAP) symposium "Isotopes for Dummies" in March 2013, the ARCHON (research school) workshop "Archaeological questions, isotopic answers? About possibilities and problems in isotope studies" in January 2014), B) the presentation of data at other national conferences (e.g., Reuvensdagen 2015, Metaaltijdendag 2015), and C) the publication of informative and scientific articles in professional magazines (e.g., Kootker, 2012, 2016), archaeological reports, popular books and academic journals (see Addendum – Data dissimination for a more exhaustive overview).

The first and second focus areas laid the foundation of this PhD thesis, in which faunal (baseline) and human data gathered from various (commercial) executed projects are presented. The objectives of this dissertation are:
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• to assess the applicability of isotope geochemistry in Dutch archaeology, taking temporal and spatial variability into account, and
• to gain more insight into the role mobility might have had in the composition of ancient populations and the possible cultural changes that immigration may have had introduced or catalysed.

Organisation of the thesis

In addition to this introductory chapter, this thesis is organised in seven chapters. Five of them are written as scientific papers, of which four are published in or submitted to peer-reviewed journals (chapters 3, 4, 5 and 7), and one is published as a chapter in a book (chapter 6). The chapters that comprise this thesis are outlined as follows:

Chapter two, General Introduction, gives an overview of the possibilities and limitations of isotope geochemistry in archaeology. Although brief introductions into the relevant isotope systems are given in nearly all chapters, this chapter focuses specifically on the application of carbon (C), nitrogen (N), strontium (Sr), and oxygen isotopes (O) in archaeological contexts, and gives a thorough synopsis of the mechanisms behind these methodologies. Moreover, it gives an overview of the current state of affairs with regards to the integration of the field of bioarchaeology into Dutch commercial archaeology.

In Chapter three, Strontium isoscapes in the Netherlands. Spatial variations in $^{87}\text{Sr}/^{86}\text{Sr}$ as a proxy for palaeomobility, the first bioavailable strontium distribution map of the Netherlands is presented. This study addresses the need for large-scale strontium distribution maps. The map presented here shows the spatial variations of strontium isotopes in the Netherlands and forms the backbone of this PhD thesis. In this study teeth of numerous archaeological rodents have been analysed in order to delineate their isotopic composition and spatial variation in the Dutch archaeological and geological subsurface.

Chapter four, Breaking traditions: An isotopic study on the changing funerary practices in the Dutch Iron Age (800 - 12 BC), provides the first biogeochemical evidence that Dutch Iron Age communities in the central river area were heterogeneous in terms of geological origins. The high percentage of non-locally born individuals supports the hypothesis that the change in burial practice from cremation to inhumation was the result of the influx of foreign people, who were being allowed to keep their own burial customs, whereas part of the local inhabitants adapted the foreign burial rites, leading to a heterogeneous burial rite for some centuries.

Chapter five, Beyond isolation: Understanding past human-population variability in the Dutch town of Oldenzaal through the origin of its inhabitants and its infrastructural connections, reports the results of coupled strontium and oxygen isotope analyses on 198 dental enamel samples from Oldenzaal, the Netherlands (AD 985 - 1850). Here, a first
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attempt is made to contextualise the observed extent of mobility through the integration of the isotope data within our understanding of extant communication routes from recently reconstructed medieval route maps. The main question answered in this chapter was whether the absence or presence of mobile individuals in Oldenzaal, and/or the identification of particular locations of origin could be explained by the city’s level of connectivity.

In Chapter six, The Alkmaar mass graves: A multidisciplinary approach to war victims and gunshot trauma, a case-study is presented in which combined osteoarchaeological and multi-isotope investigations of the skeletal material from two mass graves contributed to a fuller understanding of the siege of Alkmaar in AD 1573 during the Eighty Years’ War (AD 1568-1648). This study shows that through multi-disciplinary research, isotope analyses can contribute to a better understanding of the social structure of a population and its burial rites in times of war. Moreover, an appendix is provided, Subsistence in times of war – a palaeodietary assessment of the victims of the siege of Alkmaar using carbon and nitrogen isotopes. The primary aim of this supplementary study was to assess the palaeodiet of the individuals in both mass graves and to identify possible differences in dietary habits between the suspected male soldiers in one of the mass graves and civilian victims.

Chapter seven, Dynamics of Indian Ocean slavery revealed through isotopic data from the Colonial era Cobern Street burial site, Cape Town, South Africa (1750-1827), presents the use of combined carbon, nitrogen and strontium isotope research to constrain the geographic origins of the non-European underclass from the burials excavated at Cobern Street, Cape Town. The study focuses on the mobility throughout their lives. This information can be extrapolated to tell us about the slave networks in existence in the Indian Ocean world during the early modern period.

In Chapter eight, Strontium isotopes in Dutch cultural heritage research: A critical evaluation, the obtained results are combined and assessed to provide a synthesis of the thesis, and a summary of the main conclusions. More importantly, this chapter provides a critical assessment of the work executed so far. It concludes this thesis with recommendations for future isotope investigations in commercial and academic archaeological contexts.