

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/19045> holds various files of this Leiden University dissertation.

**Author:** Oelze, Viktoria Martha

**Title:** Mobility and diet in Neolithic, Bronze Age and Iron Age Germany : evidence from multiple isotope analysis

**Issue Date:** 2012-06-06

# Mobility and Diet in Neolithic, Bronze Age and Iron Age Germany

Evidence from Multiple Isotope Analysis

Proefschrift

ter verkrijging van  
de graad van Doctor aan de Universiteit Leiden,  
op gezag van Rector Magnificus prof. mr. P.F. van der Heijden,  
volgens besluit van het College voor Promoties  
te verdedigen op woensdag 6 juni 2012  
klokke 15.15 uur

door

Viktorija Martha Oelze

geboren te Koblenz  
in 1981

## Promotiecommissie

Promotors: Prof. Dr. J.-J. Hublin  
Prof. Dr. M. P. Richards

Overige Leden: Prof. Dr. H. van der Plicht  
Prof. Dr. W. Roebroeks  
Dr. S. McPherron  
Dr. M. Hoogland

Dit proefschrift is mede mogelijk gemaakt door *Bundesministerium für Bildung und Forschung*, Bondsrepubliek Duitsland, en het *Max Planck Gesellschaft*.

*Tiger got to hunt, bird got to fly;  
Man got to sit and wonder 'Why, why, why?'*

*Tiger got to sleep, bird got to land;  
Man got to tell himself he understand.*

Kurt Vonnegut  
*Cat's Cradle*, 1964



# Contents

<b>1. INTRODUCTION .....</b>	<b>7</b>
1.1. Preface.....	7
1.2. Isotopic evidence revealed from skeletal remains - a brief science history.....	9
<b>2. HUMAN DIET.....</b>	<b>11</b>
2.1. Carbon & Nitrogen .....	12
2.2. Sulphur.....	13
<b>3. MOBILITY, MIGRATION AND PROVENANCE.....</b>	<b>15</b>
3.1. Strontium.....	16
3.1.1. Local or non-local? Solving the resolution problem by biosphere $^{86}\text{Sr}/^{87}\text{Sr}$ mapping.....	17
3.2. Oxygen.....	18
3.3. Sulphur.....	19
<b>4. APPLICATIONS TO PREHISTORIC GERMANY.....</b>	<b>21</b>
4.1. The Neolithic.....	21
4.2. The Bronze Age .....	25
4.3. The Iron Age.....	27
<b>5. EARLY NEOLITHIC DIET AND ANIMAL HUSBANDRY: STABLE ISOTOPE EVIDENCE FROM THREE LINEARBANDKERAMIK (LBK) SITES IN CENTRAL GERMANY .....</b>	<b>29</b>
5.1. Introduction .....	30
5.2. Archaeological sites and material.....	32
5.3. Methods.....	34
5.4. Results and Discussion .....	35
5.5. Conclusion.....	47

5.6.	Acknowledgements.....	47
5.7.	References .....	48
<b>6.</b>	<b>'THERE'S NO PLACE LIKE HOME' - NO ISOTOPIC EVIDENCE FOR MOBILITY AT THE EARLY BRONZE AGE CEMETERY OF SINGEN, GERMANY.....</b>	<b>55</b>
6.1.	Introduction .....	56
6.2.	Materials.....	60
6.3.	Methods.....	62
6.4.	Results .....	64
6.4.1.	Strontium .....	64
6.4.2.	Oxygen .....	64
6.4.3.	Sulphur.....	68
6.5.	Discussion .....	68
6.5.4.	Environmental samples.....	68
6.5.5.	Strontium isotope signatures in human enamel .....	72
6.5.6.	Oxygen isotope ratios in human enamel.....	75
6.5.7.	Sulphur isotope ratios in human bone.....	77
6.6.	Conclusion.....	78
6.7.	Acknowledgements.....	79
6.8.	References .....	80
<b>7.</b>	<b>MULTI-ISOTOPIC ANALYSIS REVEALS INDIVIDUAL MOBILITY AND DIET AT THE EARLY IRON AGE MONUMENTAL TUMULUS OF MAGDALENENBERG, GERMANY.....</b>	<b>87</b>
7.1.	Introduction .....	88
7.2.	Materials.....	94
7.3.	Methods.....	95
7.4.	Results .....	96
7.5.	Discussion .....	100
7.5.1.	Diet .....	100
7.5.2.	Mobility and provenance .....	102
7.6.	Conclusion.....	109

<b>7.7.</b>	<b>Acknowledgements.....</b>	<b>110</b>
<b>7.8.</b>	<b>References .....</b>	<b>110</b>
<b>7.9.</b>	<b>Appendix methods .....</b>	<b>118</b>
	7.9.3. Collagen extraction .....	118
	7.9.4. Strontium .....	118
	7.9.5. Oxygen .....	119
	7.9.6. Age and sex determination .....	120
	7.9.7. References appendix.....	120
<b>9.</b>	<b>CONCLUSION.....</b>	<b>123</b>
<b>9.1.</b>	<b>Filling research gaps in prehistoric Germany .....</b>	<b>123</b>
<b>9.2.</b>	<b>Early Neolithic subsistence.....</b>	<b>124</b>
<b>9.3.</b>	<b>Early Bronze Age and Early Iron Age mobility and provenance.....</b>	<b>125</b>
<b>10.</b>	<b>ACKNOWLEDGEMENTS.....</b>	<b>129</b>
<b>11.</b>	<b>SAMEVATTING.....</b>	<b>131</b>
<b>12.</b>	<b>SUMMARY .....</b>	<b>132</b>
<b>13.</b>	<b>ZUSAMMENFASSUNG.....</b>	<b>133</b>
<b>14.</b>	<b><i>CURRICULUM VITAE</i>.....</b>	<b>132</b>
<b>15.</b>	<b>REFERENCE .....</b>	<b>135</b>



**Table of Figures**

Figure 4.1.....page 23

Figure 5.1.....page 36

Figure 5.2.....page 41

Figure 5.3.....page 41

Figure 5.4.....page 41

Figure 5.5.....page 44

Figure 5.6.....page 46

Figure 6.1.....page 56

Figure 6.2.....page 57

Figure 6.3.....page 61

Figure 6.4.....page 69

Figure 6.5.....page 73

Figure 6.6.....page 74

Figure 7.1.....page 89

Figure 7.2.....page 90

Figure 7.3.....page 101

Figure 7.4.....page 103

Figure 7.5 .....page 107

**Table of Tables**

Table 4.1 .....page 21

Table 4.2.....page 25

Table 4.3.....page 28

Table 5.1 .....page 37

Table 5.2.....page 39

Table 5.3 .....page 42

Table 6.1 .....page 65

Table 6.2 .....page 66

Table 7.1 .....page 98

Table 7.2.....page 99

Table 7.3 .....page 100

