

Fringes of the empire: diet and cultural change at the Roman to post-Roman transition in NW Iberia

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Fringes of the Empire: Diet and cultural change at the Roman to post-Roman Transition in NW Iberia

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1 **Fringes of the Empire: Diet and cultural change at the Roman to post-Roman**
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5 **2 Transition in NW Iberia**
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ABSTRACT (250)**Objectives**

A growing number of paleodiet investigations over recent years have begun to reveal the stark dietary differences that existed between regions of the Roman Empire, as well as significant changes in subsistence strategies after its fall. The present study explores the dietary changes at the Roman to post-Roman (Germanic) transition in the Northwest Iberian Peninsula, in order to improve our understanding of the changes that occurred at end of the Roman Empire in different regions across Europe and to also consider the influence of climate had on them.

Materials and Methods

We present the carbon and nitrogen stable isotope investigation in bone collagen from A Lanzada, NW Spain (100-700 AD), which was an important commercial, coastal settlement. A human sample of 59 individuals, 6 of them subadults, is compared with 31 faunal specimens, which include a number of marine fish.

Results

Isotope data for the terrestrial fauna reveal the influence of the sea on the local isotope baseline. Analysis of the human samples indicates a mixed marine-terrestrial diet. A shift in mean human $\delta^{13}\text{C}$ values from -16.7 to -14.3‰ provides clear evidence for a significant change in diet in the post-Roman period, probably through the intensification of both marine resources exploitation and C_4 -plant consumption (presumably millet).

Discussion

A deterioration of paleoenvironmental conditions, together with a poor socioeconomic situation and the arrival of new people, the *Sueves*, who brought a new political and socioeconomic system have been discussed as the main causes for the dietary modification in post-Roman times.

56 **Introduction**

57 The study of diet and foodways and their change over time offers important
58 insights into human societies and individuals in terms of their social and economic
59 structure, health status and standards of living (Mintz and Du Bois 2002). Dietary
60 change may be triggered by historical events, such as foreign invasions, but more often
61 reflect general changes of the social, cultural, economic or environmental conditions
62 humans lived in. Methodologies, such as the analysis of stable isotopes performed on
63 human and faunal bone collagen, provide information on the major sources of protein
64 intake (Jim et al. 2004) during the life of an individual (e.g. the review articles by
65 Schwarcz and Schoeninger 1991; Sealy 2001) depending on the turnover of the
66 analysed tissue (Hedges et al. 2007). These are a particularly efficient way of tracing the
67 history of human diet and its changes over time. Recently, routine applications of this
68 type of analysis have provided abundant data about the diet and subsistence strategies of
69 ancient populations (e.g. in Spain Alexander et al. 2015; Arias and Schulting 2010;
70 Davis 2002; Fuller et al. 2010; García-Guixé et al. 2009; García et al. 2004; García
71 Guixé et al. 2006; López-Costas et al. 2015; Munde 2009; Salazar-García et al. 2014;
72 Van Strydonck et al. 2002; Van Strydonck et al. 2005). Consequently, it has now
73 become established as a key tool for understanding the relationship between humans
74 and their cultural and natural environment in the past.

75 The end of the Roman Empire and the Migration Period (5th to 8th centuries AD)
76 had a profound impact on the European landscape, laying the foundations for the
77 political geography of many modern European countries (Musset 1975). The Migration
78 period has been relatively unexplored in Spanish archaeology compared to other
79 periods; however, the interest in it has increased more recently. This is probably due to
80 the realization that the demise of the Roman Empire had far-reaching consequences for

the way of life and standards of living of the local populations, due to the breakdown of the old political and economic structure, the Germanic invasions and the accompanying climatic downturn which occurred at the end of the Roman Warm Period (among others Büntgen et al. 2011; Martínez-Cortizas et al. 1999; Mighall et al. 2006). Previous paleodietary studies of the Roman to post-Roman transition in Central and South-eastern Europe have detected an increase in the consumption of C₄ plant products, most probably millet, which may have been related to the arrival of ethnic groups with different cuisines and traditions (Hakenbeck et al. 2010; Lightfoot et al. 2012).

The Iberian Peninsula is considered an essential region in the Imperial economy, especially during Late Roman times (Kulikowski 2004). Despite being conquered relatively late (end of the 1st century BC) (Syme 1934), the Roman province of *Gallaecia*, to the Northwest, played an essential role in the Atlantic trade routes and in mining, among others. The historical importance of Northwest Iberia extended beyond the end of the Roman Empire to the Migration period, also known as the ‘Germanic invasions’ in Spain. One of the main reasons is that the Iberian Peninsula, and the Northwest in particular, was one of the first areas where the foreign populations permanently settled (Kulikowski 2004; Musset 1975). The historical relevance of the area contrasts with the poor knowledge of features related to everyday life, such as diet. The historiography and archaeological evidence about these topics is scarce for Roman times and dramatically decreases with the arrival of Germanic peoples (Díaz 2011).

In *Gallaecia* the overthrown of Roman rule by a Germanic group known as the *Sueves* in the early 5th century AD, is regarded as the end of the Roman period and the beginning of Early Middle Ages (see Castellanos and Viso 2005; Díaz 2011). The *Sueves* permanently settled in the area of modern day Galicia and North Portugal, creating a Kingdom that lasted almost two centuries (AD 409-585). Recent

106 palaeoenvironmental studies suggest that the landscape underwent a number of
107 significant human-made transformations during this time, through deforestation and
108 new modes of agriculture and animal husbandry, which still shape much of the
109 environment today (Ferro-Vázquez et al. 2014; Martínez Cortizas et al. 2005). These
110 changes could have implications for the subsistence economy during the transition from
111 Roman to post-Roman times, which may have left an imprint in human remains.

112 The present study explores the dietary changes at the Roman to post-Roman
113 transition in the Northwest Iberian Peninsula, in order to improve our understanding of
114 the end of the Roman Empire at the western fringe of Europe, paying particular
115 attention to the possible influence of climate. In order to address this aim, we carried out
116 a programme of carbon and nitrogen stable isotope analyses of bone collagen on
117 samples from the coastal cemetery site of A Lanzada (Galicia, NW Iberia) (100-700
118 AD) (Blanco Freijeiro et al. 1967), where two funerary areas have been described: one
119 from the Roman (2nd to 4th centuries AD) and the other from the post-Roman (5th to 7th
120 centuries AD) times (López-Costas 2015).

121 **THE COASTAL NECROPOLIS OF A LANZADA**

122 The archaeological site of A Lanzada is located in the province of Pontevedra
123 (Galicia, NW Spain) on a small headland just south of the O Grove peninsula, between
124 the estuaries of Arousa and Pontevedra, two of the so-called *Rias Baixas* (see Fig. 1).
125 Since the area is surrounded by the sea, a range of different coastal ecosystems occur in
126 the immediate vicinity and the position of the site once offered excellent control over
127 the maritime traffic along the coast (see Fig. 1). The soils are not particularly well suited
128 for agriculture due to their sandy texture, low water retention and high input of sea-
129 spray, and they are subject to constant winds and soil erosion; however, further inland,

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2
3 130 the quality of the soils improves (López-Costas et al. 2016). Fish and seafood are
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5 131 abundant in the area and good pasture for domestic animals is provided by the many
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7 132 halophytic grasses and shrubs that can be found locally on saltmarshes (Valdés-Bermejo
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9 133 and Silva Pando 1986).

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13 134 Probably because of its strategic location, A Lanzada area has been occupied
14
15 135 since prehistoric times. Remains from a Bronze to Iron Age settlement, a Roman and
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17 136 post-Roman cemetery with possible traces of a settlement, as well as a defensive tower
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19 137 and a Romanesque church from the medieval period have been found (Fariña Busto and
20
21 138 Filgueira Valverde 1974) (see Fig. 2). Recent excavations have uncovered salting
22
23 139 facilities for seafood dating back to the Iron Age and historical sources suggest that a
24
25 140 nearby marshland was intensively exploited for salt production during the Late Roman
26
27 141 and Medieval periods (Rodríguez Martínez et al. 2011). A significant amount of
28
29 142 imported pottery and other foreign artefacts dating from the 5th century BC to the 6th
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31 143 century AD, attests to A Lanzada lasting importance in the long-distance trade network
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33 144 even after the end of the Roman phase (González Ruibal 2004; Naveiro López 1991).
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35 145 Additionally, a large midden deposit, which consisted mainly of faunal remains
36
37 146 presumably dated from Iron to Roman period, was found in the area (Rodríguez
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39 147 Martínez et al. 2011).

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44 148 The main evidence of occupation from the Roman and post-Roman period is a
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46 149 cemetery located at the Eastern edge of the headland (Fig. 2), which was partially
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48 150 excavated during several campaigns between 1949 and 1963 (Blanco Freijeiro et al.
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50 151 1967; Filgueira Valverde and Blanco Freijeiro 1962) and from 1975 to 1977 (Fariña
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52 152 Busto 1975). Although many areas were intensively investigated, the available
53
54 153 documentation is of varied quality and only part of the results from the graves were
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56 154 formally published (Blanco Freijeiro et al. 1961; Blanco Freijeiro et al. 1967; Carro
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155 Otero et al. 1987; Filgueira Valverde and Blanco Freijeiro 1962). The preservation of
156 the human bones was good and the archaeologists also collected some faunal remains
157 from the graves.

158 The burials belong to two funerary areas with different dating based on
159 archaeological evidence and radiocarbon dates (Fig. 2) (López-Costas 2015),
160 (information about individual burials is summarised in Table 3). Of the 85 skeletons,
161 including several sub-adults, which have been recovered, 59 were selected for this
162 study, based on suitable skeletal preservation and avoiding non-adults under 12 years
163 old.

164 The first phase comprises the burials from the northern cemetery area (Fig.2),
165 which are dated to the Roman period (2nd to 4th centuries AD). The bodies were
166 predominantly aligned south-north and three main types of tombs have been recorded:
167 (1) simple earth graves or simple trench burials (see Fig. 3.A), (2) earth grave
168 surrounded by stones, (3) *Tegulae* grave (*cappuccina*) and/or earth grave with an *imbrex*
169 (curved tile) under the head (see Fig. 3.A). A detailed description of the burial rites has
170 been published elsewhere (López-Costas 2015). About 50% of the individuals were
171 accompanied by dress accessories (e.g. hob-nails), which suggests that they had been
172 buried clothed. Grave goods (pottery, glass) were also frequently present and at least
173 three skeletons were accompanied by coins, which dated between 213 and 325 AD.
174 While the majority of burials were inhumations, two cremation burials also belong to
175 this phase, but no human remains were collected from them. Following Toynbee's
176 (1971) classification, the burials could be interpreted as a lower-middle class Roman
177 cemetery.

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3 178 The second phase of the cemetery was excavated during the 1970s. According to
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5 179 the photographs it was located south of the previous excavations (Fig. 2) and it was
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7 180 characterised by either simple earth graves or graves constructed from stone slabs (Fig.
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9 181 3.B) (López-Costas 2015). Three of the stone slab coffins were used for multiple
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11 182 consecutive burials (Fig. 3B). All skeletons were west-east oriented, laid in supine
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13 183 position and there was a total absence of grave goods, although scallop shells found
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15 184 near some of the bodies may have been deliberately placed. This second phase has been
16
17 185 dated to the post-Roman or Migration period, 5th to 7th centuries AD. Although stone
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19 186 slab tombs have also been found in earlier Roman cemeteries in other parts of the
20
21 187 Empire (e.g. Philpott 1991), this mode of burial is known as typical for the Germanic
22
23 188 kingdoms of NW Iberia, where it has also been associated with Christian burials (Fariña
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25 189 Busto and Suarez Otero 1997).

29 30 31 MATERIAL AND METHODS

32
33 191 Samples for isotope analysis were taken from a total of 59 humans and 31
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35 192 animals. The faunal set comprised bone and tooth samples mainly of cattle (11),
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37 193 sheep/goat (9) and pig (3) that were taken from the burials themselves, although they
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39 194 may originally have belonged to the midden deposit from the Iron and Roman Age. We
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41 195 also included seven marine animals, six bony fish and a dolphin, obtained from 15th
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43 196 century contexts at the site of Ponte do Burgo at Pontevedra, ca. 20 km south-east of A
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45 197 Lanzada (animal species information are summarized in Table 1), in order to trace the
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47 198 isotopic background of the marine resources. The human sample was made up of 59
48
49 199 individuals: 38 from the first phase of the cemetery and 20 from the second, later phase,
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51 200 as well as a single medieval (10th century AD) skeleton found in the western part of the
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53 201 site. The male/female ratio of the human sample was almost 1:1 (29/24 and 6
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55 202 subadults). The remains of sub-adults (with an age-at-death over 12 years in order to
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203 avoid the breast-feeding effect; see for example Fuller et al. 2006) were included if they
204 were well preserved. Since the mode of excavation used from the 1950s-1970 implied
205 the incomplete retrieval of the skeletons and, specifically, the lack of smaller bones like
206 ribs, samples were taken from various skeletal elements (table 3). The human remains
207 were examined morphologically using standard methods for human osteological
208 analysis and reference database containing other Iberian populations. Detailed results of
209 osteological and paleopathological analysis are presented elsewhere (López-Costas
210 2012).

211 The isotopic analyses were carried out at the Department of Archaeology at the
212 University of Reading (U.K.). Bone collagen was extracted following the method
213 described by Longin (1971) with modifications recommended by Collins and Galley
214 (1998), according to the protocol described in Britton et al. (2008). No ultrafiltration
215 was applied (Pestle et al. 2014). The degree of preservation has been addressed by
216 Pyrolysis GC/MS, finding no relationship between the molecular and isotopic ($\delta^{13}\text{C}$ and
217 $\delta^{15}\text{N}$) composition of extracted bone collagen (Kaal et al. 2016).

218 Carbon and nitrogen stable isotope ratios were measured in duplicate on a
219 Europa 20-20 isotope ratio mass spectrometer coupled to a Sercon elemental analyzer.
220 Analytical error was calculated by repeated analyses of internal standards and was
221 $\pm 0.2\text{‰}$ or less for both elements (1 s.d.- standard deviation). Statistical analysis of the
222 data was made using the program SPSS 16. The comparisons among two groups were
223 computed by Student's t-test (t-test), or Mann-Whitney U test (M-W-test) whenever the
224 size of one of the series was equal or smaller than 15 individuals. The non-parametric
225 Kruskal-Wallis (K-W test) test was performed for comparisons of more than two
226 series/groups, since at least one series had less than 15 individuals (e.g. comparisons
227 among three groups of animals or different age groups in humans).

RESULTS AND DISCUSSION

Even though the low pH of Galician soils commonly causes poor skeletal preservation (López-Costas 2012; López-Costas et al. 2016), the collagen obtained from the A Lanzada samples was well preserved with an average yield of $8.3 \pm 5.1\text{wt}\%$ (1s.d.). The carbon ($35.7 \pm 6.8\text{ wt}\% \text{ C}$) and nitrogen ($12.6 \pm 2.6\text{ wt}\% \text{ N}$) contents indicate that the majority of the samples had good preservation. Samples with lower contents have not atypical values in other parameters and all human and animal C/N ratios were between 3.1 and 3.6. The individual data and summary statistics are given in Tables 1-7. Data are plotted in Figures 4-6.

Faunal isotope data

Since this is the first stable isotope study on material from the North-West Iberian coast, the analysis of animal remains is important in order to map the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ baseline variations in the A Lanzada environment. The terrestrial animals have a relatively wide range of carbon and nitrogen isotope values of $-19.9 \pm 1.2\text{‰}$ (-21.5 , -16.4‰) and $7.8 \pm 1.8\text{‰}$ (4.5 , 11.7‰), respectively (see Table 2 for basic summary statistics). No systematic differences were found between herbivores and omnivores (M-W-test $U=41.500$, $p=0.40$ for $\delta^{13}\text{C}$; $U=48.000$, $p=0.17$ for $\delta^{15}\text{N}$), or between the three most common animal groups, cattle, sheep-goat and pigs ($\delta^{13}\text{C}$: Kruskal=Wallis test $H_{(2)}=2.85$, $p=0.240$; $\delta^{15}\text{N}$: K-W test $H_{(2)}=2.95$, $p=0.229$). The different groups of animals are discussed below.

Herbivores. The $\delta^{13}\text{C}$ of the terrestrial herbivores range over almost 3‰ (-21.5‰ to -18.8‰ ; $-20.2 \pm 0.7\text{‰}$, average $\pm$ standard deviation), excluding the outlier 906a (see below). These values are similar to those observed at the Balearic sites (Fuller et al. 2010; García et al. 2004) and indicate a diet based on C_3 -plants. High carbon

isotope values in some of the animals (with $\delta^{13}\text{C} > \sim -20\text{‰}$) are consistent with the presence of small amounts of C_4 plants or seaweed, in the food chain, or alternatively with grazing on saline pastures (see discussion below). Consumption of such resources is particularly evident in the case of outlier 906a (Fig. 4). The sample belonged to a young sheep or goat (less than 24 months) with elevated $\delta^{13}\text{C}$ (-17.7‰) and $\delta^{15}\text{N}$ (11.2‰). According to the age at death, part of the enrichment could be related to the suckling effect (Balasse and Tresset 2002), but the input of a ^{13}C -enriched supplement fodder is also likely. The fact that this signal is particularly evident in a young animal could suggest that it was a seasonal rather than year-round supplement to herbivore diet at A Lanzada. Dental serial sections would be needed to test this hypothesis (see for example Balasse et al. 2006).

The herbivore $\delta^{15}\text{N}$ also shows a wide range of variation, over 5.5‰ , and a mean of $7.4 \pm 1.6\text{‰}$. In this context, it is remarkable that about half the samples have $\delta^{15}\text{N}$ between 8‰ and 10‰ which are elevated values in comparison with most other sites from West and South-West Europe (e.g., Craig et al. 2009; Fuller et al. 2010; García-Guixé et al. 2009; García et al. 2004; Müldner and Richards 2007; Stevens et al. 2010) (see Fig. 4).

While a number of factors can lead to ^{15}N -enriched values in plants and herbivore tissues, such an effect has been specifically observed for saline soils including animals grazing in salt-marshes (Britton et al. 2008; Cloern et al. 2002; Heaton 1987; Van Groenigen and Van Kessel 2002; Virginia and Delwiche 1982). It is therefore reasonable to assume that the high herbivore $\delta^{15}\text{N}$ can be attributed to the environmental conditions at A Lanzada. It is possible that traditional farming practices, which are documented for the area in recent historical times and involve the fertilization of fields with seaweed, seagrass or small crustaceans, were already in use in the more distant past

(Ferreiro García et al. 1993; Pérez García 1979; Villares et al. 2007), affecting the nitrogen isotope composition of the crops (see Fraser et al. 2011). While direct evidence for this is lacking for the Roman period, soil characteristics (i.e. acidic pH) could suggest that these methods of fertilization may already have been practiced in antiquity. Nevertheless, it is also likely that humans exploited the nearby O'Vao salt-marshes as pasture grounds for at least part of the year. Salt-marsh grazing could also explain the ^{13}C -enrichment in the bone collagen of several of the animals, either through the effect of salinity on the carbon isotope composition of C_3 -plants (e.g. van Groenigen and van Kessel 2002) or through direct input of C_4 -plants to the herbivore diet: one of the common halophytes, or salt-loving plants, in the marshland near A Lanzada today is *Spartina maritima* (Valdés-Bermejo and Silva Pando 1986), which follows the C_4 photosynthetic pathway (Sage and Monson 1999:221). Nevertheless, since millet, also a C_4 -plant which is known to have been used for animal foddering in classical times (see Spurr 1986), was cultivated in Roman Galicia (Dopazo Martínez et al. 1996), it also may be responsible for the elevated $\delta^{13}\text{C}$ in the herbivores, as is the use of sea-weed as supplementary fodder, for example during the winter months (see Balasse et al. 2006).

In summary, even though the method employed here does not allow us to distinguish between the possible mechanisms and pathways that could explain the herbivore isotope data, it appears that the coastal location and ecology of A Lanzada had a significant impact on the isotopic composition of the foods available to animals (and, by implication, humans) at the site, which will need to be taken into account when interpreting the human data. Since it is likely that high herbivore $\delta^{15}\text{N}$ can be attributed to the specific conditions at the coast, it can further be hypothesed that animals with lower nitrogen isotope values ($<\sim 6\text{‰}$) were therefore not raised at A Lanzada but

301 brought there from further inland, demonstrating the wider connections of the site in
302 antiquity.

303 ***Omnivores.*** Although only three pigs were available for sampling, their results
304 are surprisingly varied, ranging from -21.2‰ to -16.4‰ for carbon and from 8.0‰ to
305 11.7‰ for nitrogen isotope values. This indicates very different diets or management
306 strategies, from exclusively C₃-terrestrial foods to a significant input of C₄-plants or,
307 perhaps more likely, giving the scavenging behaviour of pigs and the fact that fish-
308 waste must almost certainly have been freely accessible on site, marine-based protein.
309 Sample 906b (Fig. 4), the pig with the highest $\delta^{13}\text{C}$ is, again a young animal (less than
310 12 months) and its $\delta^{15}\text{N}$ is therefore likely elevated by the suckling effect.

311 ***Marine Animals.*** The fish bones were tentatively identified as belonging to six
312 different individuals of four species, (see Table 1). Even though the remains are not
313 from A Lanzada itself but from a site nearby, all fish, as well as one marine mammal
314 (dolphin), are native to the Galician coast and have evidently been frequently consumed
315 by past humans (the sampled dolphin vertebra also bore butchery marks). Therefore
316 they should provide suitable reference values for the local marine ecosystem.

317 The $\delta^{13}\text{C}$ average of the marine animals is $-12.0 \pm 0.6\text{‰}$ (see Table 2), which is
318 comparable to data from the Atlantic coast (Barrett et al. 2008). While the carbon
319 isotope range is relatively narrow (1.5‰), the $\delta^{15}\text{N}$ values spread over 5.9‰,
320 presumably reflecting differences in fish ecology, trophic level and size (Tables 1-2).

321 **Human diet at A Lanzada**

322 The isotopic data from the human bone collagen are remarkably variable.
323 Human samples have a $\delta^{13}\text{C}$ range of 5.9‰ (-18.7 to -12.8‰) with a mean of -
324 $16.0 \pm 1.5\text{‰}$ (1 s.d.); as well as $\delta^{15}\text{N}$ range of 3.9‰ (10.5‰ to 14.4‰) with a moderately

high average of $12.3 \pm 0.9\%$ (1 s.d.) (Fig.5). The carbon isotope ratios from A Lanzada are among the most ^{13}C -enriched values observed in any Iberian population, including Mesolithic hunter-gatherers (Fuller et al. 2010; García et al. 2004; García Guixé et al. 2006), but excluding other Galician coastal populations (López-Costas 2012). Although some individuals from Islamic sites on Ibiza (Fuller et al. 2010) and Valencia (Alexander et al. 2015) exhibit similar $\delta^{13}\text{C}$, the population averages are considerably lower.

Even though the isotopic results suggest considerable heterogeneity in the human diets at A Lanzada, no significant differences exist between males and females (Student t-test $\delta^{13}\text{C}$: $t_{(51)} = -1.210$ $p=0.23$; $\delta^{15}\text{N}$: $t_{(51)} = -1.030$ $p=0.308$) or different ages-at-death (Kruskal-Wallis test $\delta^{13}\text{C}$: $H_{(3)} = 0.022$ $p=0.99$; $\delta^{15}\text{N}$: $H_{(3)} = 5.119$ $p=0.16$) regardless of the time period.

Burial rite, however, and in particular tomb typology shows an association with the isotopic data. It is worth to remind that tomb typology is a clear reflection of the two time periods they represent, Roman and post-Roman (see methods and material section). Kruskal-Wallis combined with Dunn-Bonferroni post-hoc tests indicate that the $\delta^{13}\text{C}$ of individuals buried in stone-slab graves are significantly different from those in simple earth graves ($p=0.023$), *tegula* graves ($p=0.001$) and stone graves ($p=0.023$; K-W test $H_{(3)} = 16.65$, $p=0.001$). Differences in $\delta^{15}\text{N}$ are not significant ($H_{(3)} = 6.69$, $p=0.082$). This trend is even stronger when burials from the different time-periods are compared.

Bones of individuals in post-Roman burials (which include all stone-slab graves and a number of simple earth graves) are significantly enriched in ^{13}C and ^{15}N over those of the Roman burials (which comprise stone graves, *tegula* graves as well as earth

349 graves) (Roman vs. post-Roman M-W test $\delta^{13}\text{C}$, $U=29,475$, $p<0.000$; $\delta^{15}\text{N}$, $U=9.905$,
350 $p=0.002$). Rather than dietary variation between individuals afforded different burial
351 rites, the observed isotopic differences between grave types therefore likely indicate a
352 significant shift in diet between the Roman and the post-Roman period. There are no
353 significant differences between males and females or age-groups within each of the time
354 periods (see Tables 6-7 and Fig. 6). The unique medieval skeleton from A Lanzada, the
355 245, plots most closely with the Roman samples (Fig. 5) and while a single sample is
356 insufficient to characterise the diet of a whole period, this result at least suggests a
357 continuation of dietary traditions at the site at least in broad terms.

358 Similarly high carbon isotope ratios observed in all the human samples from A
359 Lanzada have been previously related to marine fish or shellfish consumption in other
360 archaeological sites from different parts of Europe (e.g. Müldner and Richards 2007;
361 Richards and Hedges 1999; Schoeninger et al. 1983). The fact that A Lanzada site is
362 surrounded by the sea and deeply related to it, a variety of fish and shell species
363 (Vázquez Varela and García Quintela 1998), as well as fish hooks and net sinkers
364 (Suárez Otero and Fariña Busto 1990) and a fish-salting factory (Rodríguez Martínez et
365 al. 2011) were identified at the site, attesting to the importance of marine resources in
366 the life of the inhabitants. The $\delta^{15}\text{N}$ average indicates the presence of moderately
367 important sources of animal protein coming from the sea or inland. Even considering
368 the difficulties in interpreting the $\Delta^{15}\text{N}$ between human diet and collagen (O'Connell et
369 al. 2012), the observed values are in agreement with a high-moderate presence of
370 marine food in diet. An alternative explanation of ^{13}C enrichment is the direct or
371 indirect (animals fed with them) ingestion of C_4 plants, such as millet (e.g. Fuller et al.
372 2010; Reitsema et al. 2010; Tafuri et al. 2009). Since millet (*Setaria italica* and, more
373 commonly, *Panicum miliaceum*) was commonly cultivated at A Lanzada and

neighbouring areas during medieval and post-medieval times (Armas Castro 1992; Seijas Montero 2001) and in other areas of Galicia at least from the Iron Age onwards (Aira Rodríguez et al. 1990; Dopazo Martínez et al. 1996; Ramil-Rego 1993), its inclusion in peoples' diet could be as common as marine resources probably were. More so, if we consider that the herbivores also show elevated ^{13}C values. In summary, the observed $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ data suggest that A Lanzada people may have had a diet with an important input of marine resources and/or C_4 plants, the exploitation of which is supported by the historical and archaeological data available for the area.

In accordance with the previous discussion on the global human averages, the differences observed between Roman and post-Roman individuals must have also been caused by differential intake of C_4/C_3 plants and/or marine/terrestrial resources in a mixed diet. Both, the $\delta^{13}\text{C}$ and the $\delta^{15}\text{N}$, are significantly different between the two groups, supporting the idea that post-Roman people may have consumed more marine resources and C_4 plants than the Roman individuals. However, the isotopic differences between the averages (post-Roman $\bar{X}$ -Roman $\bar{X}$) are wider for carbon (2.4‰) than for nitrogen (0.7‰), which suggests that C_4 plants intake must have been more influential in the intra-population differences. The linear trend between $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values within the Roman sample shows a higher correlation ($r=0.49$) than that for the post-Roman one ($r=0.00$), which is totally flat (see fig. 7), a fact that also points in this direction.

Unfortunately, there are no ichthyological and palaeobotanical studies on A Lanzada for the periods studied by us, which prevents the comparison of the diachronic trends in marine exploitation or millet cultivation from different methodological perspectives. Similar analyses made on other Galician sites suggest that the

398 establishment of Roman rule did not have marked effect on local Iron Age subsistence
399 strategies based on terrestrial animals (Dopazo Martínez et al. 1996). However, the
400 exploitation of marine resources seems to have had a progressive increase in NW Spain
401 from the 2nd century BC onwards (although there is no data from post-Roman times)
402 (González Gómez de Agüero 2013). This enrichment parallels a seemingly marked
403 preference for more profitable species (e.g. sardine) and widespread access to marine
404 resources in coastal and inland regions from the 2nd century AD onwards (Fuertes Prieto
405 and Fernández Rodríguez 2010; González Gómez de Agüero 2013). In fact, millets,
406 mainly *Panicum miliaceum*, continued to be very important crops in Northwest Iberia
407 throughout the Roman period (Tereso 2012). In contrast, almost nothing is known about
408 subsistence change after the demise of the Roman Empire in this area, mostly due to a
409 scarcity of well-excavated post-Roman settlements. Nevertheless, pollen evidence
410 shows a relatively sudden increase in deforestation in 5th century AD (Martínez Cortizas
411 et al. 2005) which might suggest a change in agricultural preferences.

412 **Marine resources and millet vs. culture and environment**

413 Considering that the analytical data suggest an increase in the use of marine
414 resources and possibly also C₄ plants (probably millet) by the A Lanzada population in
415 the post-Roman compared to the Roman period, we proceed to contextualize the
416 possible causes. Since it is well documented that both foods were readily available
417 during both periods (see discussion in the previous section), it is necessary to
418 understand the motivations that may have led to an increase in either resource in
419 everyday diet.

420 Millet has a short vegetative cycle and a wide germination temperature range
421 (16° to 34° C) (James et al. 2011), which allows it to adapt well to different soils and

climates (Hunt and Jones 2008). That represented a clear advantage if a hard winter or other event ruined crops with longer growing seasons. Similarly, fish and seafood were abundant in A Lanzada coast and people could intensify their exploitation in case of need.

Some important environmental changes also occurred across the Roman/post-Roman transition. Modifications in marine currents from coastal areas near to A Lanzada have been registered (Lebreiro et al. 2006; Muñoz Sobrino et al. 2014), which may have led to an expansion of the salt-marshes and unpredictable changes in the abundance of marine resources in estuaries. The climate was also affected (Martínez-Cortizas et al. 1999; Mighall et al. 2006). The temperature and humidity conditions in Galicia from the 2nd to the 4th century AD were not optimal for agriculture, but the climate prevailing at this time would provide conditions necessary for a good growing season for the majority of crops. In contrast, during post-Roman times there was a considerable increase in humidity (pointing towards a two-fold increase in rainfall) (Mighall et al. 2006) and temperatures fell in a similar way to those recorded in Central Europe during the decline of the Roman Empire (Martínez-Cortizas et al. 1999). Although rainfall seasonality has not been analyzed for this area, these latter weather conditions could have been harmful for crops production especially for delicate cereals such as wheat. The millets could have been used as a complement once other crops failed, and even become a substantial part of human and animal diet. In this situation, fish and shellfish could have also been used as alternative foods.

A probable increase in the consumption of millet between the Roman and post-Roman periods has been reported for individuals from Central and Southeast European populations, and has been convincingly explained by the post-Roman migrations (Hakenbeck et al. 2010; Lightfoot et al. 2012). To our knowledge, there are no similar

447 reports for Galicia or Iberia, a fact that may be explained by the absence of specific
448 paleodiet studies or ancient texts. The post-Roman burials of A Lanzada, and more
449 specifically the stone slabs tombs (where individuals with the highest isotopic values
450 were found), represent a burial rite frequently associated with the Suevic or Germanic
451 rule in Northwest Spain (Fariña Busto and Suarez Otero 1997). Since the *Sueves* arrived
452 in Galicia from Central Europe, where there is evidence for an increase in millet
453 consumption in the post-Roman period (Hakenbeck et al. 2010; Rösch 1998), they
454 could have brought with them a preference for this cereal. Unfortunately, little is known
455 about the *Sueves*' way of life and food preferences and it is difficult to assess their
456 impact on the local population. On the other hand, the burial rite observed at A Lanzada
457 in the post-Roman period, the WE-orientation and the absence of grave goods in
458 particular, has been also associated with Christian burials (Blanco Freijeiro et al. 1967).
459 Although Christianity played a less important role in rural areas compared to urban ones
460 (Kulikowski 2004), at least part of the post-Roman individuals might have lived as
461 Christians. The Early Christian Iberian doctrines taught abstinence from meat (Ferreiro
462 2008) and ancient texts promoted the idea of a largely vegetarian diet with occasional
463 supplements of fish: "*the monks were encouraged to eat vegetables, greens, beans, and*
464 *on occasion fresh or salt fish* " (Campos Ruíz and Roca Melia 1971). An increase in
465 fish consumption at A Lanzada might therefore be explained by their conversion to
466 Christianity. Nevertheless, these early food rules were largely directed at a monastic
467 (rather than lay) audience and economic status should therefore have had a greater
468 influence than religion on dietary preferences.

469 Parallel to the arrival of new people and religions, important changes to the
470 economy of NW Iberian villages also took place. The Roman period (1st century AD
471 onwards) saw a high level of economic activity and coastal villages such as A Lanzada

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3 472 were thriving trading settlements on a maritime route that connected the Mediterranean
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5 473 with the North Sea (Naveiro López 1991). From the 4th century AD onwards, the
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7 474 Roman Empire faced an economic crisis on the Iberian Peninsula which ultimately led
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9 475 to its political break down (Kulikowski 2004) and resulted in a stark deterioration of the
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11 476 Atlantic commerce (for NW Spain see Naveiro López 1991). The situation became
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13 477 worse with the Germanic invasions and coastal settlements such as A Lanzada faced
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15 478 isolation and political insecurity. The establishment of the Suevic Kingdom also appears
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17 479 to have coincided with some dramatic environmental changes most likely resulting from
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19 480 intensive economic activities, such as increasing deforestation, soil erosion,
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21 481 metallurgical activity and pollution (Kylander et al. 2005; Martínez Cortizas et al. 2005;
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23 482 Ramil-Rego et al. 1998). These factors could have caused a modification to the daily
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25 483 subsistence strategies of the inhabitants of A Lanzada, such as in the way they exploited
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27 484 their local resources, i.e. eating more fish if it was impossible to sell it.
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32 485 In summary, the environmental and historical events that took place during the
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34 486 occupation of the site provide observed number of plausible explanations to the
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36 487 observed changes in human diet. Nevertheless, and especially since the factors are all
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38 488 interrelated, it is difficult to distinguish whether these changes were primarily a
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40 489 response to local or conditions or to the events that affected the Iberian Peninsula as a
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42 490 whole at the time.
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492 CONCLUSIONS

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52 493 The analysis of this Roman and post-Roman community located on the very
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54 494 fringes of Europe has revealed a very distinct food-web, which was highly dependent on
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56 495 the surrounding marine environment. The connection with the sea and its resources was
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496 presumably working in many ways. The results suggest that animals were managed
497 using different strategies, which includes possible grazing on saline pasture or the use of
498 seaweed foddering. A variable amount of C₄ plants, such as millet but also the
499 halophyte *Spartina sp.*, would also have been present in the diet of herbivores.
500 Humans' diet may have been also closely connected to marine resources along the time
501 increasing the consumed amount during specific periods (e.g. post-Roman time). The
502 observed strong relationship with the sea emphasizes the importance of considering a
503 local perspective to understand dietary preferences, even in the well-defined and known
504 Roman period.

505 Our study also suggests that the end of the Roman Empire and the Migration
506 Period had a profound impact on diet, as it presumably had in the European landscape.
507 Other authors' conclusions (Hakenbeck et al. 2010; Lightfoot et al. 2012) about the
508 increase in millet consumption during the post-Roman or the Early Medieval period
509 with respect to the Roman times are in agreement with our data. In the case of A
510 Lanzada, the rise of the use of millet may have been parallel to an increase in the
511 exploitation of local marine resources. We argue that the palaeoenvironmental
512 conditions, and more specifically the climate, could have played an important role in the
513 observed change in food preferences. However, based on the evidence available, it is
514 not possible to distinguish the effects of climate deterioration in NW Spain at the time
515 from the changes likely brought about by the arrival of new people, the *Sueves*, who
516 brought a new political and socioeconomic system with them. Understanding how the
517 establishment of Suevic rule in the area may have influenced the subsistence base and in
518 particular the reliance of marine resources and the cultivation of millet is still an open
519 question which will be addressed by further studies.

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3 520 This project is the first stable isotope study of a Roman/post-Roman community
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5 521 in the Iberian Peninsula (some isolated skeletons have been reported) and the largest on
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7 522 the Southwestern fringe of the Roman Empire. For future palaeodietary studies, we
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9 523 believe that well-defined local palaeoenvironmental reconstruction can be a highly
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11 524 successful way to examine the causes of dietary change and to distinguish between
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13 525 environmental factors and changes in cultural or economic preferences. This seems
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15 526 particularly important in transitional periods such as after the end of the Roman Empire,
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17 527 where profound environmental changes were coupled with significant political, social
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19 528 and economic change, including migration. We consider that additional investigations
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21 529 are necessary to understand the dietary adaptations in neighbouring areas and periods
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23 530 will provide further insights into these transitions.
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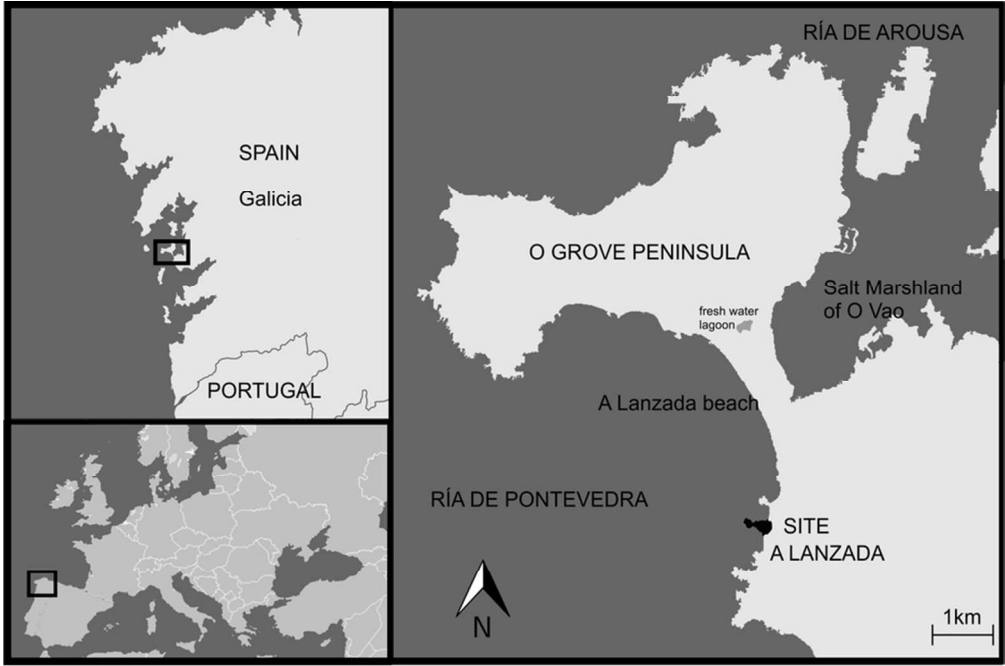


Figure 1. Map of the site location including the main fresh water and marine resources near the site.
78x52mm (300 x 300 DPI)

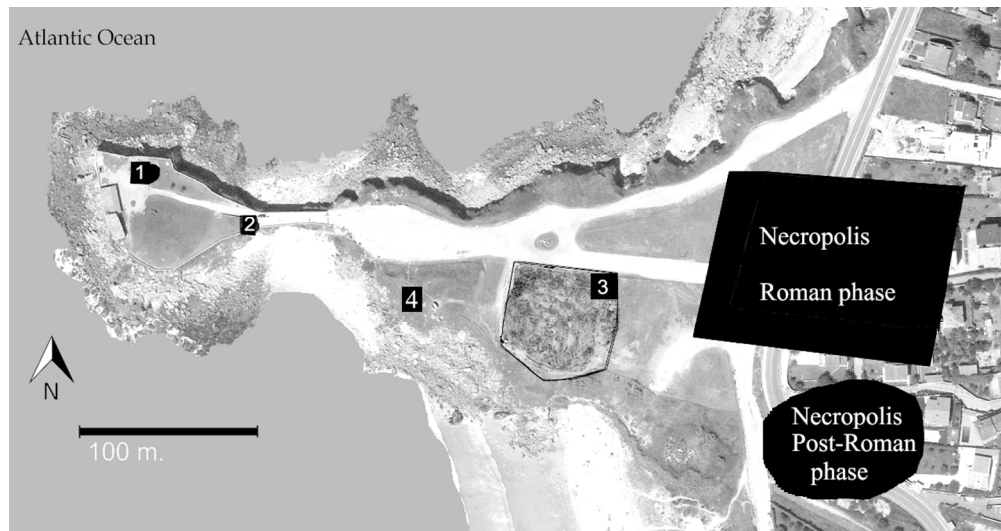


Figure 2. Area of the site at present. The two phases of the necropolis and other archaeological sectors are emphasized, such as the Romanesque church (1), the medieval tower (2) and the Iron Age-Roman settlement area with the seafood salting installation (3). Number 4 indicates where the medieval skeleton was found. Modified from Google Earth ©2014 Google
338x177mm (96 x 96 DPI)

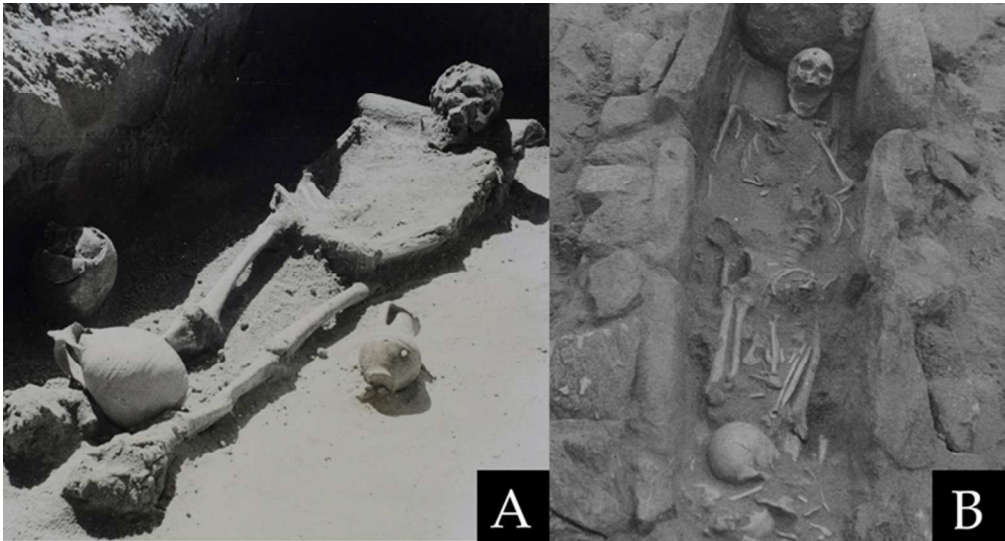


Figure 3. Pictures from two representative burials of the Roman (A) and post-Roman (B) phases of A Lanzada necropolis. The picture "A" corresponds to the earth grave of skeleton 202, which contained an imbrex placed under the head, ceramic vessels as gravegoods and hobnails (remains of nailed shoes). The picture "B" shows the stone slab tomb of skeleton 249. A second individual can be seen at the feet of 249, possibly representing an older burial that was moved aside (multiple non-consecutive burial).
63x34mm (300 x 300 DPI)

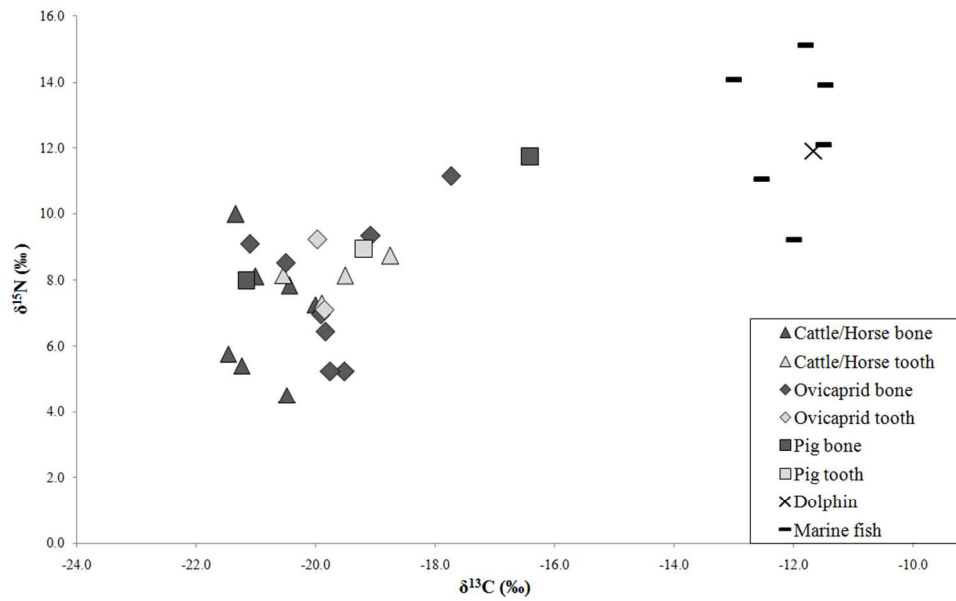


Figure 4. Animals bone collagen isotope results. Terrestrial samples are grouped by bone or tooth (dentin).
295x176mm (96 x 96 DPI)

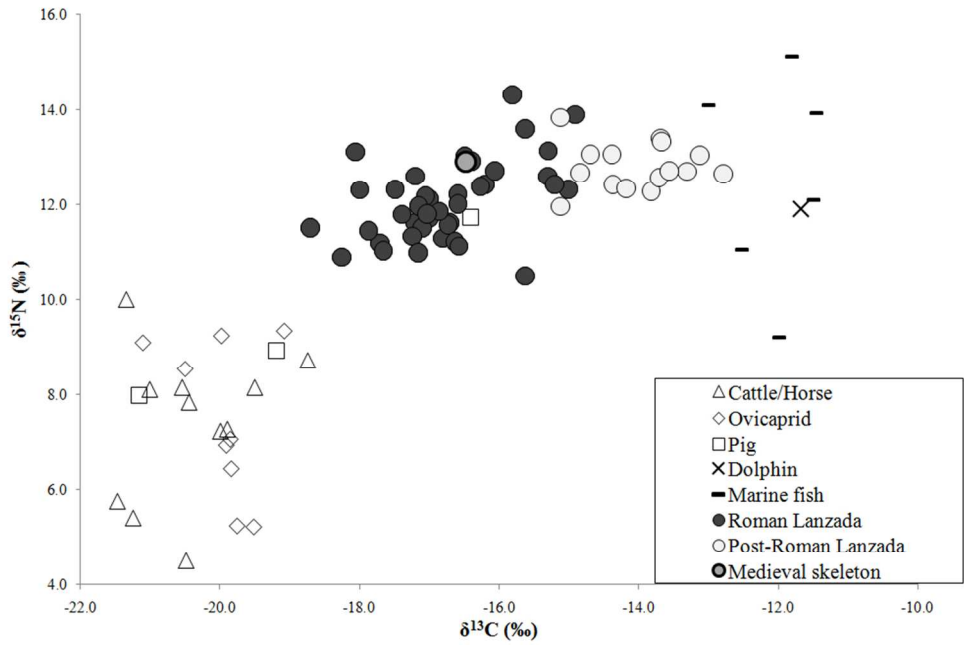


Fig. 5. Bone collagen $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values of animal and human samples from A Lanzada grouped by time period.
270x174mm (96 x 96 DPI)

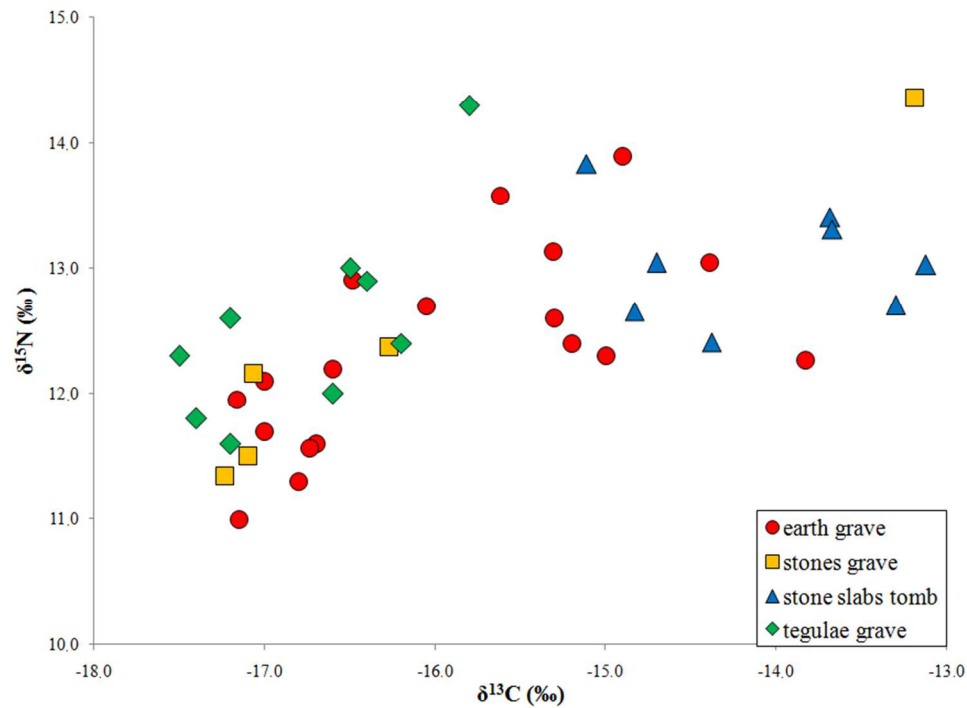


Figure 6. Scatter plot of carbon and nitrogen isotope ratios for humans according to grave typology. Since the information about the burial typology of some skeletons was lost or not totally clear, the sample plot here is smaller than the represented according to the period of use.
240x170mm (96 x 96 DPI)

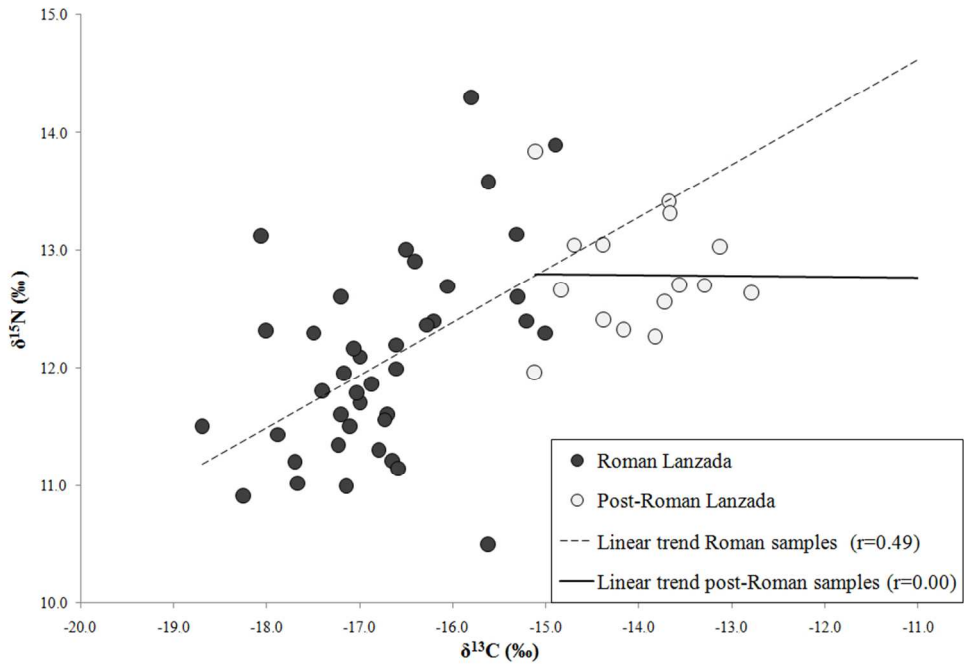


Figure 7. Scatter plot and linear regression of carbon and nitrogen isotope ratios for Roman and post-Roman humans
268x178mm (96 x 96 DPI)

TABLE 1. Carbon and nitrogen stable isotope ratios, collagen quality indicators, and tentatively species identification of the non human animals.

Sample number	Site	Animal group	Specie	Sample area	$\delta^{13}C$	$\delta^{15}N$	C/N	%C	%N	%Coll
904	A Lanzada	Herbivore	Cattle	horn	-18.8	8.7	3.2	35.5	12.8	11.3
907a	"	"	Cattle	calcaneus	-20.5	4.5	3.3	33.7	11.9	6.6
907d	"	"	Cattle	rib	-20.4	7.8	3.3	36.9	13.2	10.5
907f	"	"	Cattle	metapodial	-20.0	7.2	3.3	28.8	10.3	4.1
911	"	"	Cattle	tooth	-19.5	8.1	3.3	41.7	14.8	7.9
913a	"	"	Cattle	tooth	-20.5	8.1	3.3	42.7	15.0	10.2
913d	"	"	Cattle	talus	-21.5	5.8	3.4	40.3	13.7	3.1
914a	"	"	Cattle	tibia	-21.2	5.4	3.3	42.3	15.1	5.1
914b	"	"	Cattle	radio	-21.0	8.1	3.3	35.9	12.8	8.2
906c	"	"	Cattle/horse	tooth	-19.9	7.3	3.3	41.7	14.9	10.5
907e	"	"	Cattle/horse	humerus	-21.3	10.0	3.5	25.3	8.5	5.9
903	"	"	Ovicaprid	tibia	-19.5	5.2	3.4	29.2	10.1	5.4
905	"	"	Ovicaprid	metapodial	-19.1	9.3	3.2	33.7	12.2	6.9
906a	"	"	Ovicaprid	femur	-17.7	11.2	3.5	22.4	7.5	5.1
906d	"	"	Ovicaprid	cranium	-19.9	6.9	3.3	43.5	15.4	2.8
907b	"	"	Ovicaprid	cranium	-19.8	6.4	3.3	36.9	12.9	6.2
908	"	"	Ovicaprid	metapodial	-20.5	8.5	3.2	36.6	13.1	10.6
909	"	"	Ovicaprid	tibia	-19.8	5.2	3.2	41.0	14.8	15.6
910	"	"	Ovicaprid	tooth	-20.0	9.2	3.3	41.9	15.1	5.3
913b	"	"	Ovicaprid	tooth	-19.9	7.1	3.3	27.2	9.5	11.0
913c	"	"	Ovicaprid	humerus	-21.1	9.1	3.4	34.5	11.8	5.1
906b	"	Omnivore	Pig	femur	-16.4	11.7	3.3	40.5	14.3	2.6
907c	"	"	Pig	tibia	-19.2	8.9	3.4	33.8	11.6	2.5
912	"	"	Pig	metapodial	-21.2	8.0	3.3	34.2	12.0	8.6
936	Pontevedra	Marine fish	John Dory (<i>Zeus faber</i>)	jaw	-12.0	9.2	3.2	43.3	15.9	19.9
937	"	"	Hake	jaw	-11.8	15.1	3.1	38.8	14.6	15.8
938	"	"	Hake	jaw	-13.0	14.1	3.2	41.3	15.0	13.5
939	"	"	Red porgy (<i>Pagrus pagrus</i>)	jaw	-11.5	13.9	3.1	42.9	16.1	16.3
940	"	"	Tuna/Bonito	vertebra	-12.5	11.1	3.2	43.2	15.8	19.4
941	"	"	Tuna/Bonito	vertebra	-11.5	12.1	3.2	40.0	14.7	19.2
942	"	Marine mammal	Dolphin	vertebra	-11.7	11.9	3.2	40.5	14.6	21.6

TABLE 2. Statistical summary of the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ results for terrestrial animals from A Lanzada, NW Spain, and marine animals from a site 20 km away (Pontevedra).

	Cattle	Cattle/Horse	Sheep/goat	Suid	Marine fish	Dolphin
n	9	2	9	3	6	1
$\bar{X} \pm SD (\delta^{13}\text{C}\text{‰})$	-20.4 $\pm$ 0.9	-19.9, -21.3	-19.9 $\pm$ 0.6	-18.9 $\pm$ 2.4	-12.0 $\pm$ 0.6	-11.7
$\bar{X} \pm SD (\delta^{15}\text{N}\text{‰})$	7.1 $\pm$ 1.5	7.3, 10.0	7.5 $\pm$ 1.6	9.5 $\pm$ 1.9	12.6 $\pm$ 2.2	-11.9

TABLE 3. Carbon and nitrogen stable isotope ratios, collagen quality indicators, anthropological and archaeological information for A Lanzada humans.

Sample number	Period	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$	C/N	%C	%N	%Coll	Sex	Age group	Sampled bone	Site area	Orientation	Grave typology	Notes
201	Roman	-16.7	11.6	3.4	40.4	13.8	3.0	M	MA	jaw	N area	SW-NE	eg	H
202	R.	-17.5	12.3	3.6	26.6	8.7	4.5	M	*	jaw	N area	S-N	tg	G; H
203	R.	-16.5	13.0	3.3	40.5	14.3	2.7	M	YA	jaw	N area	S-N	tg	G; H
204	R.	-17.2	12.6	3.3	35.8	12.5	14.6	F	*	jaw	N area	S-N	tg	G
205	R.	-17.2	11.6	3.2	42.9	15.4	16.5	F	*	jaw	N area	S-N	tg	G
206	R.	-17.0	11.7	3.3	37.7	13.3	7.3	F	*	jaw	N area	S-N	eg	G
207	R.	-14.9	13.9	3.4	26.9	9.2	6.3	M	YA	jaw	N area	S-N	eg	
208	R.	-17.0	12.1	3.4	42.3	14.5	3.1	M	YA	jaw	N area	*	eg	
209	R.	-15.8	14.3	3.3	43.1	15.3	14.4	F	MA	jaw	N area	S-N	tg	G
210	R.	-15.3	13.1	3.3	41.1	14.4	3.9	F	YA	jaw	N area	NE-SW	eg	
211	R.	-16.8	11.3	3.3	23.7	8.3	3.5	M	OA	jaw	N area	S-N	eg	
212	R.	-18.7	11.5	3.5	29.8	9.8	4.1	M	MA	jaw	*	*	*	
213	R.	-16.2	12.4	3.2	42.3	15.4	19.7	M	OA	jaw	N area	SE-NW	tg	
214	R.	-17.7	11.2	3.3	41.9	14.6	4.7	F	*	fibula	*	*	*	
215	R.	-17.4	11.8	3.2	38.1	13.8	21.6	M	YA	fibula	N area	SE-NW	tg	G; H
216	R.	-16.4	12.9	3.3	38.4	13.7	12.3	M	MA	rib	N area	SE-NW	tg	G; H
217	R.	-16.6	12.2	3.3	43.5	15.6	17.6	M	MA	occipital b.	N area	SE-NW	eg	G
218	R.	-15.3	12.6	3.5	25.0	8.2	4.8	F	YA	fibula	N area	SE-NW	eg	G; H
219	R.	-17.1	11.5	3.4	41.8	14.5	3.8	F	YA	ulna	N area	SW-NE	sg	G
220	R.	-16.6	12.0	3.3	42.1	15.0	16.3	M	*	radius	N area	SW-NE	tg	S
221	R.	-15.0	12.3	3.6	24.2	7.6	5.1	M	YA	fibula	N area	S-N	eg	
222	R.	-15.2	12.4	3.5	22.8	7.6	4.6	F	MA	fibula	N area	S-N	eg	
223	R.	-15.6	13.6	3.6	18.9	6.1	7.4	F	YA	fibula	N area	S-N	eg	
224	R.	-13.2	14.4	3.4	33.6	11.6	9.2	F	YA	fibula	N area	S-N	sg	
225	R.	-17.1	12.2	3.5	19.0	6.3	4.3	M	MA	ulna	N area	S-N	sg	G
226	R.	-16.7	11.6	3.2	40.5	14.6	19.5	F	MA	radius	N area	S-N	eg	G; H
227	R.	-17.2	11.3	3.2	43.1	15.7	22.8	F	MA	fibula	N area	S-N	sg	G; H
228	R.	-16.3	12.4	3.4	23.8	8.2	8.1	M	MA	radius	N area	SE-NW	sg	
229	R.	-16.1	12.7	3.3	41.1	14.6	12.2	F	MA	fibula	N area	S-N	eg	
230	R.	-17.2	11.0	3.3	34.8	12.5	12.9	M	OA	ulna	N area	S-N	eg	G; H
231	R.	-18.2	10.9	3.6	31.2	10.1	4.8	M	YA	fibula	N area	*	*	
232	R.	-18.0	12.3	3.4	32.8	11.2	5.6	M	MA	fibula	N area	*	*	
233	R.	-16.6	11.2	3.4	24.7	8.4	4.3	M	YA	radius	N area	*	*	
234	R.	-18.1	13.1	3.6	20.8	6.8	3.7	M	YA	radius	N area	*	*	
235	R.	-17.9	11.4	3.3	31.3	11.0	5.8	F	YA	humerus	N area	*	*	
236	R.	-16.9	11.9	3.5	40.6	13.7	2.7	F	*	humerus	N area	*	*	
237	R.	-16.6	11.1	3.3	37.1	13.2	7.2	*	SA	ulna	N area	*	*	
238	R.	-17.2	12.0	3.3	32.5	11.5	7.7	*	SA	tibia	N area	S-N	eg	G
239	R.	-15.6	10.5	3.2	44.7	16.4	22.7	*	SA	humerus	N area	*	*	
241	R.	-17.4	12.6	3.3	42.0	15.1	19.9	M	YA	rib	N area	*	*	
243	R.	-17.4	11.1	3.3	41.7	14.9	6.9	*	SA	phalange	N area	*	*	
247	R.	-17.0	11.8	3.4	39.6	13.8	5.0	F	MA	coxal b.	S area	*	*	
254	R.	-17.7	11.0	3.4	28.8	10.0	6.7	M	YA	rib	N area	*	*	

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Sample number	Period	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$	C/N	%C	%N	%Coll	Sex	Age group	Sampled bone	Site area	Orientation	Grave typology	Notes
240	Post-Roman	-12.8	12.6	3.3	41.6	14.6	7.4	M	YA	rib	S area	*	*	
242	P-R	-13.8	12.3	3.3	40.5	14.4	4.5	M	YA	rib	S area	*	eg	
244	P-R	-14.4	12.4	3.3	35.7	12.5	7.1	F	YA	rib	S area	W-E	sts	
246	P-R	-13.1	13.0	3.2	41.2	14.8	14.9	M	MA	rib	S area	W-E	sts	
248	P-R	-15.1	12.0	3.3	36.1	12.6	8.6	F	OA	rib	S area	*	*	
249	P-R	-14.8	12.7	3.4	26.1	8.8	4.3	M	OA	occipital b.	S area	W-E	sts	
250	P-R	-13.7	12.6	3.4	35.7	12.2	8.5	F	MA	rib	S area	*	*	
251	P-R	-13.3	12.7	3.4	29.1	10.1	6.0	M	MA	rib	S area	W-E	sts	
252	P-R	-14.4	13.0	3.3	32.7	11.6	6.8	F	YA	rib	S area	N-S	eg	
253	P-R	-13.6	12.7	3.3	35.2	12.6	8.6	F	YA	scapula	S area	*	*	
255	P-R	-15.1	13.8	3.4	39.6	13.6	6.3	F	MA	occipital b.	S area	W-E	sts	
256	P-R	-13.7	13.4	3.3	40.5	14.2	6.4	F	MA	rib	S area	W-E	sts	
257	P-R	-14.7	13.0	3.4	27.6	9.5	5.7	M	YA	occipital b.	S area	W-E	sts	
258	P-R	-13.7	13.3	3.3	31.7	11.1	6.3	*	SA	rib	S area	W-E	sts	
259	P-R	-14.2	12.3	3.3	36.4	12.8	10.7	*	SA	scapula	S area	*	*	
245	Medieval	-16.5	12.9	3.6	40.3	13.1	1.6	M	YA	tibia	W area	*	eg	

Anthropological and archaeological data was extracted from López Costas thesis (2012).
* information on burial type is lost or cannot be determined.
Key: M=male; F=female. SA Subadult (13-20 years), there were no individuals younger than 12 years old; YA=young adult (20-35 years); MA=middle adult (35-50 years); OA=old adult (50+ years); eg=earth grave; sg=stones grave; sts=stone slabs tomb; tg=tegulae grave; G=with grave goods; H=hobnails.

TABLE 4. Statistical summary of the $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ results for Roman, Post-Roman and Medieval periods.

	Roman period	Post-Roman Period	Medieval
n	43	15	1
$\bar{X} \pm SD$ ($\delta^{13}\text{C}\text{‰}$)	-16.7 $\pm$ 1.0	-14.3 $\pm$ 0.7	-16.5
$\bar{X} \pm SD$ ($\delta^{15}\text{N}\text{‰}$)	12.1 $\pm$ 0.9	12.8 $\pm$ 0.5	12.9

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TABLE 5. Statistical summary of the human $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ according to grave typology

	Tegulae graves	Stone graves	Earth graves	Stone slabs tombs
n	9	5	18	8
$\bar{X} \pm \text{SD}$ ($\delta^{13}\text{C}\text{‰}$) (min, Max)	-16.8 $\pm$ 0.6 (-17.5,-15.8)	-16.2 $\pm$ 1.7 (-17.2,-13.2)	-16.0 $\pm$ 1.0 (-17.2,-13.8)	-14.1 $\pm$ 0.8 (-15.1,-13.1)
$\bar{X} \pm \text{SD}$ ($\delta^{15}\text{N}\text{‰}$) (min, Max)	12.5 $\pm$ 0.8 (11.6, 14.3)	12.3 $\pm$ 1.2 (11.4, 14.4)	12.4 $\pm$ 0.8 (11.0, 13.9)	13.0 $\pm$ 0.5 (12.4, 13.8)

TABLE 6. Statistical summary and inter-groups comparison analysis of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ arranged by estimated sex in Roman and Post-Roman phases.

	Male	Female	M-W-test
A Lanzada Roman			
n	22	17	
$\bar{X} \pm SD$ ($\delta^{13}\text{C}\text{‰}$)	-16.9 $\pm$ 0.9	-16.4 $\pm$ 1.2	U 230.0 p=0.22
$\bar{X} \pm SD$ ($\delta^{15}\text{N}\text{‰}$)	12.1 $\pm$ 0.8	12.3 $\pm$ 1.0	U 208.5 p=0.54
A LanzadaPost-Roman			
n	6	7	
$\bar{X} \pm SD$ ($\delta^{13}\text{C}\text{‰}$)	-13.8 $\pm$ 0.8	-14.3 $\pm$ 0.6	U 13.0 p=0.29
$\bar{X} \pm SD$ ($\delta^{15}\text{N}\text{‰}$)	12.7 $\pm$ 0.3	12.8 $\pm$ 0.6	U 22.5 p=0.83

TABLE 7. Statistical summary and inter-groups comparison analysis of $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ arranged by estimated age at death in Roman and Post-Roman phases.

	13-20 years	20-35 years	35-50 years	>50 years	K-W test
A Lanzada Roman					
n	4	16	13	3	
$\bar{X} \pm SD$ ($\delta^{13}\text{C}\text{‰}$)	-16.7 $\pm$ 0.8	-16.4 $\pm$ 1.4	-16.7 $\pm$ 0.9	-16.7 $\pm$ 0.5	H ₍₃₎ =0.08, p=0.99
$\bar{X} \pm SD$ ($\delta^{15}\text{N}\text{‰}$)	11.2 $\pm$ 0.6	12.4 $\pm$ 1.1	12.2 $\pm$ 0.8	11.6 $\pm$ 0.7	H ₍₃₎ =7.06, p=0.07
A LanzadaPost-Roman					
n	2	6	5	2	
$\bar{X} \pm SD$ ($\delta^{13}\text{C}\text{‰}$)	-14.2	-13.9 $\pm$ 0.7	-13.8 $\pm$ 0.8	-14.8 $\pm$ 0.2	H ₍₃₎ =4.13, p=0.25
$\bar{X} \pm SD$ ($\delta^{15}\text{N}\text{‰}$)	12.8	12.7 $\pm$ 0.3	13.1 $\pm$ 0.5	12.3 $\pm$ 0.5	H ₍₃₎ =3.41, p=0.33