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The 'Headless Romans': Multi-isotope investigations of an unusual burial ground from Roman Britain

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Abstract

Recent excavations at Driffield Terrace in York (Northern England) revealed an extremely unusual Romano-British cemetery of probably all male composition, more than half of the individuals decapitated and with high incidence of other peri- and antemortem trauma. This paper presents the results of multi- (carbon, nitrogen, oxygen and strontium) isotopic analyses of bone and dentine collagen (n=68) and tooth enamel (n=18) which were conducted to obtain further information on the identity of these individuals and, more generally, in order to investigate the relationship between burial rite and geographical origin in a Roman provincial capital. The results show that the childhood origins of the "Headless Romans" were significantly more diverse than those of humans from other cemeteries in Roman York, but they demonstrate also that similar, unusual burial rites do not necessarily indicate a common geographical origin. Of particular interest were two individuals whose diet contained a significant proportion of C_4-plant (probably millet) –based protein. These are the first such isotope values observed in Britain from any archaeological time-period. Millet was not cultivated in the British Isles in antiquity and the results therefore demonstrate the value of palaeodietary data for assisting in isotopic mobility studies.

Keywords: bone; tooth; isotope; millet; Roman; diet; migration

1. Introduction

The Roman Empire at its peak spanned the area from the Iberian Peninsula to Mesopotamia, from Britain to Sudan. It integrated a multitude of cultures, languages and religions and provided the context for long-distance migration, forced or voluntary, on a large scale. The extent, processes and effects of the resulting contact and possible mixing of different cultures, and their material manifestations, have long been of significant interest to archaeologists and historians, not the least because of resonances with similar themes in modern societies (e.g. Noy, 2000; Mattingly, 2006).

Recent excavations at Driffield Terrace in York (northern England), the northernmost of the Roman provincial capitals, revealed a highly unusual cemetery, with apparently all male individuals of which more than half had been decapitated. Detailed osteological and archaeological analysis is still ongoing. In popular discourse, however, the "Headless Romans", as they were quickly dubbed by the media, have been variably interpreted as the remains of slaves, foreign soldiers, gladiators or high status Roman citizens that had been executed during the power struggle that ensued following the death of the Emperor Septimius Severus at York in AD 211 (Potts, 2006; Gore and Tucker, 2005; Hunter-Mann, 2006; York Archaeological Trust, 2010).

Diversity in burial rites at Roman York has been suggested to be a reflection of the varied backgrounds and geographical origins of its inhabitants (Ottaway, 2004: 121). A straightforward link between burial and ethnicity or social status has of course long been challenged (see Pearce, 2000), and recent work on Romano-British burials has shown that the relationships between geographical origin and social or cultural identity as expressed in burial rite and grave goods are indeed very complex (Evans, et al., 2006; Eckardt, et al., 2009). Nevertheless, given the highly unusual nature of the cemetery at Driffield Terrace, the question of whether the "Headless Romans" were locals or incomers is not only central to the understanding of this important site, it also has implications for archaeological interpretations of burial rite evidence in general. A small study (n=6) conducted for a television programme had already hinted at diverse origins for a number of individuals (Montgomery, et al., in press-b). This paper presents the results of multi-isotopic analysis (strontium, oxygen, carbon and nitrogen) of a much larger sample which was carried out in order to investigate the geographical origins of the individuals buried here and to establish whether they were different from the wider population of Roman York, as defined by previous work on a number of other cemeteries (Leach, et al., 2009; Leach, et al., 2010). As will be shown, this work demonstrates the value of combining oxygen and strontium isotope analysis with carbon and nitrogen stable isotopes for the reconstruction of diet as these can provide crucial additional information in cases where origin cannot be clearly defined through the other elements.

2. The Site

York (*Eboracum*) in the North of England, founded around AD 71, was an important military base and major urban settlement, which became the northernmost of the Roman provincial capitals in the early third century AD. Despite its relatively peripheral location, archaeological and historical evidence attests the city's extensive connections throughout the Empire through the movement of people and goods (Ottaway, 2004). On two occasions York hosted the Emperor and Imperial Court, and Constantine I, famously the first Roman Emperor to openly embrace Christianity, was proclaimed *Augustus* here in 306 AD (Hartley, et al., 2006).

As typical for the Roman period, the cemeteries of York were located outside the settlement area, lining the roads leading away from the town (see Figure 1). A wide range of different burial rites have been observed and areas of varying status have been defined based on location and the number and quality of funerary monuments, coffins or grave goods (Ottaway, 2004). One of the most high-status areas was located around The Mount, an elevation c. 500 m southwest of the civilian settlement. Unfortunately, most of our knowledge of this important cemetery stems not from methodical excavations but from observations made during construction work in the 19th century (RCMY1 1962; Jones, 1984).

Two excavations by York Archaeological Trust in 2004 and 2005 in the area of The Mount revealed a previously undisturbed part of the cemetery (Figure 1). The excavations at Driffield Terrace (property numbers 3 and 6) immediately attracted significant attention because of the extremely unusual burials that were encountered here. The archaeologists recovered a total of 80 inhumation burials in various alignments, as well as about 16 cremations. Initial osteological assessment suggests that most, if not all individuals were male, and very predominately young or middle adults (c. 19 to 45 years of age) at death. At least 46 individuals had been decapitated, with their skulls placed by or between the knees or feet, sometimes by the torso. A fair number also exhibited other ante- and peri-mortem trauma, although detailed osteological analysis of lesions and fracture patterns is still ongoing. (Hunter-Mann, 2006; Tucker, 2006; M. Holst, pers. comm..).

Dating evidence divides the burials into several phases from the late 1st/2nd to at least the late 3rd and possibly continuing into the 4th century AD. Several graves contained disarticulated horse bones, some of them with clear butchery marks. Horse remains are rare finds in Romano-British burials, although horse bones were also associated with a small number of burials at Trentholme Drive, one of York's lower status cemetery areas (Hunter-Mann, 2006;

Wenham, 1968; see Philpott, 1991). In several cases multiple individuals appear to have been buried at the same time (the excavators count three double, one triple and one possible quadruple burial), sometimes on top of each other and encased in wooden boxes. One individual was buried with heavy iron rings around his lower legs; possibly to restrict movement, although the precise nature and function of them is still to be determined.

Decapitations are usually interpreted either as signs of capital punishment – in the Roman period they were regarded as the most honorable type of execution (Garnsey, 1968) - or as ritual acts, designed to keep the dead from haunting the living (see Philpott, 1991). While not uncommon in Roman Britain, decapitations usually make up only a small proportion (typically <10%) of the total burials, with males and females encountered in roughly equal numbers. In urban contexts they are often situated on the periphery of burial grounds (Philpott, 1991; Boylston, et al., 2000; Anderson, 2001). The discovery of an all-male group, more than 50% of them decapitated (a figure which rises to almost 80% if only individuals whose crania and cervical vertebrae are present are considered (see Montgomery, et al., in press-b), and buried in the midst of one of the most important cemeteries of a major town and provincial capital, is therefore extremely unusual and raises important questions about the identity of these individuals and how it was expressed in burial rites (Hunter-Mann, 2006).

3. Isotope Analysis of Human Remains

Strontium and oxygen form two independent isotopic systems which vary systematically according to local geology and climate respectively (Faure and Powell, 1972; Dansgaard, 1964). Oxygen and strontium isotopes are fixed in dental enamel at the time of tooth formation. Enamel undergoes little remodelling thereafter and therefore retains an isotopic "signature" of a person's place of residence in childhood, allowing archaeologists to reconstruct patterns of mobility in the past (Hillson, 1996; Price, et al., 2002; White, et al., 1998).

Oxygen in human skeletal tissues is derived primarily from ingested fluids, with other contributions from solid foods and atmospheric oxygen. Oxygen isotope ratios ($\delta^{18}O$) therefore indirectly reflect the isotopic value of available meteoric water (Longinelli, 1984, Luz, et al., 1984; Daux, et al., 2008). Like other light stable isotopes, oxygen is subject to several stages of metabolic fractionation, from ingested oxygen to body fluids and again from body fluids to biogenic phosphate. This fractionation is fairly well understood and therefore allows estimating the isotopic composition of the drinking water ($\delta^{18}O_w$) from the measured phosphate values ($\delta^{18}O_p$) by applying a water-to-phosphate conversion equation. The computed $\delta^{18}O_w$ can then be used to constrain an individual's place of origin, assuming that documented modern drinking water values are not significantly different from past values (Longinelli, 1984, Luz, et al., 1984; Levinson, et al., 1987; Daux, et al., 2008; see Chenery et al., 2010).

Strontium in skeletal tissues is derived from both solid and liquid foods and the strontium isotope composition ($^{87}Sr/^{86}Sr$) of bone and teeth directly relates to that of bioavailable strontium in the area where the food was produced, without metabolic fractionation (Price, et al., 2002). While most strontium isotope variation is dependent on age and type of the bedrock, differential weathering, sediment formation and drift as well as strontium transferred through dust or rainwater can have a marked effect on biosphere $^{87}Sr/^{86}Sr$ and consequently on local values (Sillen, et al., 1998; Price, et al., 2002; Montgomery, et al., 2003; Montgomery, et al., 2007).

The use of carbon and nitrogen stable isotopes for dietary reconstruction relies on the well-established relationship between the isotopic composition of the foods individuals consume and their body tissues. Carbon stable isotope ratios ($\delta^{13}C$) mainly reflect differences between plants using the C_3 or C_4 pathway of carbon fixation and their consumers, or between foods originating from C_3 plant-based terrestrial and marine ecosystems (Schwarcz and Schoeninger, 1991; Sealy, 2001). As a result of metabolic fractionation, nitrogen stable isotope ratios ($\delta^{15}N$), increase by several per mille each trophic level and are therefore used to gain information about the relative importance of plant and animal protein in the diet (Sealy, 2001; see Hedges and Reynard, 2007). Combined carbon and nitrogen isotope measurements of skeletal remains can be obtained either on dentine or bone collagen. These reflect the main sources of protein consumed at the time of tooth formation in childhood or, depending on the bone in question, over the last c. 10-30+ years of an individual's life (Sealy, et al., 1995; Hedges, et al., 2007).

4. Materials and Methods

4.1 Strontium and Oxygen Isotopes

Second premolars from 18 individuals from 6 Driffield Terrace were selected for sampling. These represent all individuals from this excavation with surviving dentitions. All were assessed 'male' or 'probably male' on the basis of skeletal morphology and 12 out of the 18 (67%) had been decapitated (see Table 1).

Enamel samples were cut longitudinally with the aid of a diamond edged dental saw and cleaned ultrasonically in ultrapure water for five minutes, then rinsed twice. Surface enamel and adhering dentine were removed with a tungsten carbide dental burr.

Phosphate samples for oxygen isotope analysis were prepared following the method of O'Neil et al. (1994) and briefly summarised here: Core enamel samples were crushed to a fine powder and soaked in hydrogen peroxide for 24 hours, then evaporated to dryness. Samples were dissolved in 2M HNO_3, neutralised with 2M KOH and taken up in 2M HF. Solutions were centrifuged and residues removed, before samples were added to buffered silver amine solutions. The resulting precipitate (Ag_3PO_4) was filtered, rinsed and dried, then weighed into silver capsules.

All samples were analyzed in triplicates on a TC/EA coupled to a Delta Plus XL isotope ratio mass spectrometer (ThermoFinnigan) using the method of Venneman et al. (2002). Data were corrected to an expected $\delta^{18}O_{SMOW}$ of 21.70‰ for the internal standard NBS120C (see Chenery, et al., 2010). Analytical error from repeat analysis of the reference material was ± 0.11‰ (1σ, n=13 over three runs), mean batch reproducibility was ±0.13‰ (1σ, n=12 over three precipitation batches).

Preparations for strontium isotope analysis were carried out in a clean laboratory according to methods described in Evans et al. (2006). Enamel samples were washed in acetone and ultrasonicated twice in ultrapure water, then dried and weighed into Teflon beakers. A known amount of ^{84}Sr tracer solution was added, before the samples were dissolved in 16M HNO_3, then converted to chloride using 6M HCL and taken up in 2.5M HCl. Strontium was collected using conventional Dowex® resin ion exchange methods.

Strontium isotope compositions and concentrations were determined by Thermal Ionisation Mass Spectrometry (TIMS) using a ThermoFinnigan Triton multi-collector mass spectrometer. Samples were loaded onto single RE filaments using TaF and run at *c* 5V following the method of Birck (1986). NBS987 was used as internal standard and all results were normalized to a value of 0.710250. Procedural blanks indicated strontium contributions of less than 100 pg.

4.2 Carbon and Nitrogen Stable Isotopes

For dietary reconstruction, bone samples (mostly rib) were obtained from every adult individual from both excavations (52 samples from 3 Driffield Terrace and 23 samples from 6 Driffield Terrace: total n = 75). In addition, dentinal collagen was extracted from the roots of the 18 teeth previously sampled for strontium and oxygen isotope analysis.

Samples were cleaned and all surfaces abraded with the aid of a dental drill. Collagen extraction followed the Longin (1971) method with modifications according to Collins and Galley (1998). Samples of c. 300 mg (<100 mg for dentine) were placed in refrigerated 0.5M HCl and ~~dematerialized~~ demineralised at low temperature for several days, then rinsed to neutrality with ultrapure water. HCl was added to give a pH of 3 and samples were gelatinized in sealed tubes at 70 degrees C for 48 hours. Residues were removed using an 8 µm Ezee® filter before the remaining solution was freeze-dried. Lyophilized "collagen" was weighed into tin capsules and analyzed in duplicates for $\delta^{13}C_{VPDB}$ and $\delta^{15}N_{AIR}$ on a Sercon Elemental Analyzer coupled to a Europa Geo 20-20 isotope ratio mass-spectrometer. Analytical error (1σ) was calculated from repeat analysis of an internal collagen standard calibrated against standard reference materials and determined at ±0.2 or better for both elements.

5. Results

5.1 Oxygen and Strontium Isotopes

Results are displayed in Table 1 and Figure 2. The $\delta^{18}O_p$ of the 18 individuals from 6 Driffield Terrace cover a broad range of 5.1‰, from 14.7‰ to 19.8‰ (mean 17.4±2.2‰, 2σ). $^{87}Sr/^{86}Sr$ range over 0.0041, from 0.7085 to 0.7126 (mean 0.7102±0.0022, 2σ). These values can be compared with strontium and oxygen isotope results for 51 individuals from other cemeteries in Roman York (mean $\delta^{18}O_p$ = 17.9±1.4‰; mean $^{87}Sr/^{86}Sr$ 0.7098±0.0025; both 2σ) as well as baseline data derived from other archaeological data-sets, modern vegetation and drinking water values, which can be used to define the local range (Leach, et al., 2009; Leach, et al., 2010; Chenery, et al., 2010).

A survey of human $\delta^{18}O_p$ data from archaeological sites in England and Scotland suggests that individuals growing up in Britain should exhibit a range of c. 16.8‰ to 18.6‰ (see Chenery, et al., 2010). Although these values may provide no absolute cut-off points, individuals with $\delta^{18}O_p$ outside this range are increasingly likely to have moved to Britain from areas with a different climate, abroad. Furthermore, humans from York and surroundings can be expected to plot towards the lower end of the bracket, on account of the most ^{18}O-depleted waters in the British Isles being found in Eastern England (Darling et al, 2003). This information is useful in a relative sense (see Chenery et al., 2010), although we do not, at this point, attempt a subdivision of the British range in terms of absolute δ^{18}Op values, since we acknowledge that there are still few empirical data on the magnitude of $\delta^{18}O_p$ variation in stationary populations as well as through time (but see White et al., 1998; Daux et al., 2005; Chenery et al., 2010).

Only two individuals from 6 Driffield Terrace plot well outside the estimated British range (and further than two standard deviations from the group mean): 6Drif-24 has a much lower $\delta^{18}O_p$ (14.7‰), indicating a childhood in a significantly cooler climate, at higher altitude or latitude or in a more continental setting (see Dansgaard, 1964). Conversely, 6Drif-21 has a $\delta^{18}O_p$ of 19.8‰ and probably originated in a warmer region, at lower latitude than Britain. Apart from these two clear outliers, a number of individuals plot on the margin or just outside the estimated U.K. range, on either side of the spectrum (6Drif-04, 14, 15, 20, 23 with slightly lower values, and 6Drif-18, 19, 22 with slightly higher $\delta^{18}O_p$ than is estimated to be consistent with Britain). Eight individuals (6Drif-01, 02, 06, 07, 08, 09, 12, 17) fall within the core British range for oxygen (see Figure 2).

Strontium data obtained from modern vegetation in the Vale of York suggest ^{87}Sr/^{86}Sr values between 0.7084 and 0.7102 for the major lithologies encountered within a 10 km radius around York (Leach, et al., 2009; Chenery, 2009). Analysis of dentine from York, which is expected to have assimilated mobile strontium from the burial soil (see Montgomery, 2002) gave values between 0.7093 and 0.7106 and available human enamel data from other Roman cemeteries in the city (n=51) suggest that foods grown on more radiogenic terrains (>~0.7105) indeed played no significant role in the city's food supply (see Leach, et al., 2009 and Figure 2). Of the 18 individuals from 6 Driffield Terrace, 11 therefore have strontium isotope ratios which are consistent with the biosphere around York or geologically similar areas (i.e. between 0.7084 and 0.7106). The remaining seven individuals exhibit more radiogenic values. Six of these (6Drif-02, 08, 14, 15, 20, 23) plot relatively close together, with ^{87}Sr/^{86}Sr between 0.7109 and 0.7114, which are consistent with origins on lower Mesozoic and Palaeozoic sediments (Chenery, et al., 2010; Evans, et al., 2010). One individual (6Drif-09) has a significantly higher strontium isotope value (0.7126) which indicates foods grown on older, Palaeozoic or even Precambrian rocks (Montgomery, et al., 2006; Chenery, et al., 2010; Evans, et al., 2010).

When the oxygen and strontium isotope data are considered in combination, it appears that only five individuals (6Drif-01, 06, 07, 12, 17) are easily consistent with a childhood spent locally. Their isotope values fall inside the expected ranges for Britain (oxygen) and York (strontium), respectively. Allowing for analytical error and uncertainty about variation in $\delta^{18}O_p$ between individuals sharing the same water, 6Drif-04, who exhibits a slightly lower oxygen isotope ratio than commonly found in Britain (16.6‰), could also be included here, although his isotopic profile would equally match a number of areas on the European continent with similar drinking water values, for example in parts of the Gallic or German provinces (IAEA/WISER, 2008, Bentley and Knipper, 2005; Daux et al. 2005). 6Drif-18, 19 and 22 also fall only just outside the estimated British range, but with higher $\delta^{18}O_p$ than expected, suggesting origins at lower latitude, in a warmer climate, although the possibility of origins in the "warm" south and west of Britain cannot be entirely excluded within the error of the method (Darling, et al., 2003, Darling and Talbot, 2003; see also Leach, et al., 2010). 6Drif-02, 08, 14, 15, 20, 23 all have $\delta^{18}O_p$ that are consistent with, or only a little lower than, expected for Northeast England. The associated $^{87}Sr/^{86}Sr$ (0.7109-0.7114) are more radiogenic than the foods typically consumed in York. The geographically closest match is in relatively close proximity, for example in the foothills and uplands of the Pennines mountain range, only 20-30 km or so further west (Montgomery, et al., 2006; Evans, et al., 2010), although as before, the same combination of strontium and oxygen isotope values could also be expected abroad, for example in parts of France, Germany or Central-Southern Europe, and possibly through mixing of strontium from older and younger rocks (see Asch 2005; Schweissing and Grupe, 2003; Price et al., 2004; Tütken et al., 2008; Bowen, 2010; see Bowen and Revenaugh, 2003) Only 6Drif-09 moved from significantly more radiogenic terrains which are, within Roman Britain, predominately found in Western England. Nevertheless, since these areas are not easily consistent with this individual's relatively low $\delta^{18}O_p$, areas of eastern Scotland or, indeed, continental Europe are more appropriate as suggested origins (Darling, et al., 2003; Chenery, et al., 2010; Evans, et al., 2010, see below).

6Drif-21 and 24 are the two individuals for which a British origin can be firmly excluded. With an oxygen isotope ratio of 14.7‰, 6Drif-24 exhibits one of the lowest $\delta^{18}O_p$ reported from Britain so far. There are a number of regression equations which can be used to relate this value to the likely source of drinking water in order to constrain geographical origin (Longinelli, 1984; Luz, et al., 1984; Levinson, et al., 1987; Daux, et al., 2008). Daux et al. (2008) have recently demonstrated that the confidence intervals for such estimates are often rather wide, while Chenery et al. (2010) have drawn attention to issues of method bias affecting data produced by different laboratories. The drinking water values computed by such equations should therefore not be taken too literally. Depending on the conversion equation used, drinking water values corresponding to 6Drif-24's $\delta^{18}O_p$ are between -10.3‰ (Luz, et al., 1984) and -13.3‰ (modified Levinson, see Chenery, et al., 2010). Daux et al.'s (2008) Equation 6 gives a value of -11.1±0.7 (95% CI). Corresponding modern water values are documented in parts of Central-Eastern Europe, although they would also be consistent with higher altitudes in other areas (IAEA/WISER, 2008; Bowen, 2010; Lecolle, 1985; Bentley & Knipper, 2005). 6Drif-24's strontium isotope signature of 0.7085 is consistent with a range of Mesozoic sediments which are encountered all over the European continent and are therefore unfortunately not useful for constraining his origins further (Price et al., 2004; Voerkelius, et al., 2010; see Asch, 2005). An almost identical combination of oxygen and strontium isotope values has, for example, been reported in a skeleton from Elsau (Kanton Zürich), in ~~pre-Alpine Switzerland~~the Swiss Alpine foreland (Tütken et al., 2008).

Conversely, 6Drif-21 has the highest $\delta^{18}O_p$ so far reported for a skeleton from Roman Britain (19.8‰). Corresponding water values can be estimated between -4.0‰ (Longinelli, 1984) and 2.2‰ (Chenery, et al., 2010; Daux Eq.6: -3.2±1.2‰), likely placing this individual in the southern Mediterranean or Northern Africa (Lykoudis and Argiriou, 2007; Longinelli and Selmo, 2003; IAEA/WISER, 2008). The strontium isotope value (0.7094) is unfortunately again not very helpful in constraining this area further, as it is consistent with a range of Mesozoic terrains, which can be found extensively around the Mediterranean Sea (Asch, 2005; Persits, et al., 2002).

5.2 Carbon and Nitrogen Stable Isotopes

Collagen extraction was successful for 61 of 75 bone and all 18 dentine samples. Pairs of bone and dentine data could be obtained for eleven individuals and the data presented here are therefore for 68 individuals in total (Tables 1-2). $\delta^{13}C$ values range between -20.9‰ and -15.8‰ (mean -19.5±0.8, 1σ), while $\delta^{15}N$ values fall between 9.3‰ and 14.8‰ (mean 11.0±0.9‰). These, for Roman Britain, relatively widely ranging δ-values are primarily the result of a number of outliers in the assemblage (Figure 3). While most individuals from Driffield Terrace are very similar to humans from other Roman cemeteries in York (Müldner and Richards, 2007a), two (3Drif-10 and 6Drif-9) stand out with uncommonly high $\delta^{13}C$ values (-15.8‰; -16.3‰), both further than three standard deviations from the population mean. Another two (3Drif-35 and 6Drif-1) plot just outside the 2σ range of the combined sample, while a fifth individual (6Drif-18) is unusual in terms of his high $\delta^{15}N$ (14.8‰), which again lies outside the population 3σ range (see Figure 3).

Isotopic evidence for the "typical" diet in Roman York, which was dominated by terrestrial C_3 ecosystem-based resources, has been discussed in detail previously (Müldner and Richards, 2007a). This paper will therefore focus on the outliers in the Driffield Terrace data-set and especially what their unusual dietary signals can contribute to the question of geographical origins of the individuals.

The stable isotope ratios observed for 3Drif-10 and 6Drif-9 are the most unusual in the assemblage and indeed, similar data have not yet been reported from any archaeological time-period in Britain (Fig. 3). The high $\delta^{13}C$ is combined with no noticeable enrichment in ^{15}N that would suggest the consumption of marine protein. It is therefore characteristic of a mixed diet of C_3 and C_4 plant-based foods, either by direct consumption of the plants themselves or from the products of animals feeding on them (Murray and Schoeninger, 1988; Cox, et al., 2001).

The only C_4 plant cultivated in Europe in antiquity is millet, *Panicum miliaceum* (broomcorn millet) and *Setaria italica* (foxtail millet*).* Although the earliest records of *Panicum* in England date from the Romano-British period (*Setaria italica* has not yet been reported), it is very scarce and so far only found in London and at a few military sites (van der Veen, et al., 2008; Wilcox, 1977; Hinton, 1988; Huntley, 1989; Sauer, 2005), but not yet in York (A. Hall and A. Schmidl, pers. comm.). Because of the paucity of these finds, they are usually interpreted as "exotic" imports, possibly parts of grain shipments - millet was sometimes mixed with larger-grained cereals in order to minimize voids and prevent infestation by grain mites during storage (de Hingh, 2000: 118). It is very unlikely that millet was actually grown in Roman Britain, especially since the wet British climate is not well suited to its cultivation (see Rösch, 1999; Zohary and Hopf, 2001). One must therefore very much doubt that 3Drif-10 and 6Drif-9 could have obtained enough millet in Britain to explain their significantly elevated carbon isotope ratios. Immigration from abroad, from a region where millet or other C_4 plants formed a regular part of human or animal diet, is much more likely. Indeed, comparison of the dietary data obtained from dentine and a fibula (no ribs were available for sampling) of 6Drif-9 revealed a decrease in $\delta^{13}C$ of 1‰, while for all other bone-dentine comparisons, differences were ≤0.5‰ (see Table 1). The bone of 6Drif-9 was therefore likely beginning to reflect a significant change in diet on moving to an exclusively C_3 environment (see Cox, et al., 2001).

The two individuals have very different but both relatively low oxygen isotope values. These exclude origins in semi-tropical or arid regions where C_4 grasses and crops other than millet are more widely spread and suggest an origin on the European continent (see Figure 2). In Europe millets are documented from the Early Neolithic, reaching a wide distribution in the prehistoric periods (Hunt, et al., 2008; Marinval, 1992; Rösch, 1999; van Zeist, et al., 1991). For the Roman period, recent overviews are missing. Nevertheless, palaeobotanic evidence, where available, attests the presence of millet, especially *Panicum* in Roman-date assemblages from across the European continent (van Zeist, et al., 1991; Rösch, 1998; Marinval, 1992). Cereal counts are usually low, but because of taphonomic factors which affect millet differently than most other crops – millet tends not to survive well in charred condition, only in water-logged deposits -this does not necessarily mean it was only of small importance for human subsistence (Rösch 1998; see Kroll, 2000). Still, stable isotope data which reflect consumption directly have so far not produced similar values to those of the two Driffield Terrace individuals in Roman-period populations (see Dupras et al., 2001; Jørkov, 2002; Prowse, et al., 2004; Garcia, et al., 2004; Craig, et al., 2009; Rutgers, et al., 2009; Keenleyside, et al., 2009; Jørkov et al., 2010; Fuller et al., 2010). The only exception is a single female from Late Roman Kletham (Bavaria), who was similarly interpreted as an incomer on account of her dietary signal being very unusual within the population context (Hakenbeck et al., 2010). Measurable consumption of C_4 plants or derived animal products has been reported in individuals from Bronze Age Northern Italy (Tafuri, et al., 2009) and Greece (Petroutsa and Manolis, 2010), Iron Age Central Europe (Murray and Schoeninger, 1988; Le Huray and Schutkowski, 2005), as well as, in the post-Roman period, early medieval Southern Germany (Schutkowski et al, 1999; Hakenbeck et al, 2010) and Islamic (Medieval) Spain (Mundee, 2009; Fuller, et al., 2010). Nevertheless, these data are of course not necessarily representative of Roman-period subsistence, even less so since it appears from a number of areas where good and continuous palaeobotanic records exist, that the importance of millet declined significantly after the establishment of Roman rule (see Matterne, 2001; Andrikopoulou-Strack, et al., 2000; Kreuz, 2000; Cooremans, 2008), or increased again thereafter (Rösch, 1998).

Greek and Roman classical authors refer to millet on numerous occasions, recommending it for animal foddering as well for human consumption, although it is sometimes derided as peasants' or famine food (Spurr, 1986; Grant, 2000; André, 1998). Pliny (*Hist. Nat.* XVIII, 100f.), writing before AD 79, mentions that millet is particularly common in the Po Valley of Northern Italy, in Gaul, especially *Aquitania* (southwest France), the Black Sea region, as well as Ethiopia and *Sarmatia*, the latter referring to a vast but variably defined area which could encompass parts of Central and Eastern Europe (up to the Vistula) but also extended into Asia, east of the river Don (see Brzezinski, et al., 2002). Theophrastus, around 300 BC, also describes millet as particularly suitable for growing at higher altitudes (Spurr, 1986:92). The extremely low $\delta^{18}O_p$ of one of the C_4 consumers (3Drif-10) would indeed be consistent with an Eastern European origin or somewhere with access to water from high altitudes (see Montgomery et al., in press-b).

While not nearly as unusual, 6Drif-01 and 3Drif-35 also stand out by their high carbon isotope ratios, which are outside the 2σ range for humans from Roman York (Figure 3). Their dietary signal is somewhat more ambiguous, as it could reflect the contribution of some, but relatively little, C_4-based protein to the diet, the consumption of large amounts of relatively low trophic level marine foods (Richards and Hedges, 1999) or simply differences in the isotopic composition of C_3 plants between areas of different climate (van Klinken, et al., 2000; see Richards, et al., 1998). Whatever their cause, these values are distinctive enough from the rest of the York humans to call into question whether these two individuals were really part of the same local population. Although dietary variations between individuals of the same community, motivated by differences in status, social group or gender, do, of course, occur, it is rare that such differences are substantial enough in isotopic terms to produce completely separate distributions within the same population (e.g. Richards et al., 1998; Le Huray & Schutkowski, 2005; Müldner & Richards, 2007b). Given the large sample size and the relatively narrow clustering of the bulk of the York humans, migration from elsewhere seems a good explanation for 6-Drif-01 and 3Drif-35's unusual isotope signals. Although their strontium and oxygen isotope signatures are consistent with a local origin (Figure 2), it is worth remembering that the "typical" values defined for York are relatively generic and would equally fit numerous regions of similar climate and geology on the European continent (see Leach, et al., 2009). Indeed, the results of lead isotope analysis conducted in a separate study indicate a non-British origin at least for 3Drif-35 (Montgomery, et al., in press-a).

The fifth outlier is 6Drif-18 with a $\delta^{15}N$ (14.8‰) more than 3σ higher than the population mean (Figure 3). Elevated nitrogen isotope values combined with 'terrestrial' (C_3) $\delta^{13}C$ values can have a number of explanations, namely dietary, environmental as well as physiological (see Hedges and Reynard, 2007). Although carbon and nitrogen isotope data for this individual are available only from dentine, not from bone, the ^{15}N-enrichment is unlikely to be due to breastfeeding: the roots of second premolars form between c. 7 and 13 years-of-age, well past the normal weaning age (Smith, 1991). Instead, one possible explanation may be origins in an area where aridity or soil salinity affected the nitrogen isotope composition of plants and animals (see Schwarcz, et al., 1999). Although the $\delta^{18}O_p$ of 6Drif-18 is only moderately high (18.6‰: see Fig. 2) and therefore does not fit easily with values reported for areas of extreme aridity, such as Egypt or Nubia (see Iacumin, et al., 1996; Dupras and Schwarcz, 2001), it is conceivable that 6-Drif18 spent his childhood in an area were similar factors played a role. An alternative possibility is a significant contribution from freshwater protein to 6Drif-18's diet (see Bonsall, et al., 2004), although again, there appear to be no Roman-period populations with similar isotope values reported so far. In any case, the singular isotopic signature of 6Drif-18 makes it very unlikely that he spent his childhood locally.

6. Discussion

Comparing the isotope values from Driffield Terrace (including the six individuals published by Montgomery et al. (in press-b) with other data from Roman York (Leach, et al., 2009; Leach, et al., 2010), it is immediately apparent that, despite the much smaller sample size (Driffield Terrace: n=24, other cemeteries: n=51,) the isotopic signals of the 'Headless Romans' have a different distribution than those of humans from cemeteries with less unusual burial rites (Figures 2-3). Especially the oxygen isotope values from Driffield Terrace have a much wider range from those of the other assemblages (two-sample Kolmogorov-Smirnov test Z=1.574, p=0.014) (Figure 2), indicating much more diverse, even 'exotic' geographical origins. The dietary isotopes for a number of outliers which are interpreted here in terms of geographical origin, lend another dimension to this analysis, identifying a number of additional individuals who would not necessarily have been recognized as non-British or even non-local on grounds of their strontium and oxygen isotopes. When all four isotopes are considered together, they give a more detailed characterization of this unusual population. For example, the two outliers with the lowest $\delta^{18}O_p$, 6Drif-24 and 3Drif-10, are relatively similar in terms of their oxygen and strontium isotope values; however, their dietary signatures are so different from each other, one reflecting an exclusively C_3 ecosystem-based diet, the other with a significant contribution from C_4 plant-derived protein, that a common origin for these two is extremely unlikely. Similarly, among three individuals with almost identical $\delta^{18}O_p$ and $^{87}Sr/^{86}Sr$ (6Drif-18, 19 and 22), 6Drif-18 stands out by his high nitrogen isotope ratio, indicating regular access to foods from a completely different trophic level or environment. These cases illustrate that diversity among the 'Headless Romans' is even greater than would be estimated by oxygen and strontium, the isotopic systems more traditionally employed to assess mobility.

Comparisons of the isotope data with the archaeological and osteological information reveal no consistent patterns: geographical origin appears to have had no bearing on whether individuals were decapitated and men from evidently very different geographical regions were buried together in multiple graves (6Drif-19, 22 and $\delta^{18}O_p$ outlier 6Drif-21; 6Drif-14, 17 and $\delta^{15}N$ outlier 6Drif-18; 3Drif-16 and $^{87}Sr/^{86}Sr$ outlier 3Drif-15, the latter see Montgomery, et al., in press-b). Part-skeletons of horses were deposited with a number of burials, including 6Drif-24 and 6Drif-21, the individuals with the lowest and highest $\delta^{18}O_p$, respectively, but also with the isotopically less remarkable 6Drif-23, for whom an upbringing in York is unlikely but who may well have come from Eastern England or an area with similar water values on the European continent or beyond (see above). If anything, it was therefore not a common origin, but rather the diversity of their backgrounds which was the defining feature for the Driffield Terrace Group.

Whatever else connected this remarkable mix of people, so that they came to be interred in one of Roman York's most prestigious cemeteries, sharing, at least outwardly, similarities in burial rite that rendered them so unusual, remains unknown. Dating evidence now available indicates that burial took place over at least the whole of the 2nd and 3rd century AD, possibly into the 4th (Hunter-Mann, 2006). This means that one of the earlier interpretations of a single event, such as a "mass execution" of members of the Imperial Court in the turbulent aftermath of Septimius Severus' death in AD 211 (see Montgomery, et al., in press-b) is at least not the whole story. A military connection of the cemetery may be most likely, given the all-male composition of the cemetery and the relatively high incidence of trauma related to interpersonal violence noted during the preliminary assessment of the remains (see Tucker, 2006; Hunter-Mann, 2006). The initially more far-fetched sounding theory of a gladiator cemetery has also recently gained support, based on possible similarities in trauma patterns with known gladiators (see Kanz and Grosschmidt, 2006) and especially the toothmarks of a large carnivore, possibly a bear, lion or tiger, found on one of the skeletons (York Archaeological Trust, 2010). Although there appears to be no evidence that decapitations were part of the ritual used for dispatching defeated gladiators (see Kanz and Grosschmidt, 2006; Dunkle, 2008), this possibility is certainly intriguing. Nevertheless, the jury is still out, and it is hoped that the complete skeletal analysis, which is still ongoing will shed further light on the identity of these individuals.

7. Conclusions

In summary, this study was conceived to explore the relationship between burial rite and geographical origins in Roman York. Similar to the results of other investigations (see Montgomery, et al., 2005; Evans, et al., 2006; Eckardt, et al., 2009) and in line with current expectations informed by archaeological theory, it has been shown that such connections are far from straightforward. At the same time, it would be unjustified to dismiss a meaningful relationship entirely: just as the burials at Driffield Terrace stood out as extremely unusual in terms of burial rite, they are also very distinctive isotopically, indicating a diversity of childhood origins unparalleled in other cemeteries at this provincial capital. This investigation has demonstrated the great value of analyzing carbon and nitrogen (dietary) isotopes alongside oxygen and strontium, as they can provide greater differentiation of geographic origins than is available by two isotopic systems alone. It is hoped that the eventual integration of these isotopic data with the results of the ongoing archaeological and anthropological analyses will go some way further towards solving the 'riddle of the Headless Romans'.

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Table and Figure Captions

Figure 1. The cemeteries of Roman York with Driffield Terrace to the southwest of the civilian settlement. (modified from original © YAT, reproduced with kind permission).

Figure 2. Oxygen and strontium stable isotope data from Driffield Terrace (data from 3 Driffield Terrace are replotted after Montgomery et al., in press a) in comparison with humans from other Roman cemeteries in York (Leach et al., 2009, 2010). The marker "Railway et al."includes samples from The Railway cemetery as well as Sycamore Terrace, Clifton, Castle Yard and Hospitium. Also indicated are the estimated range of $\delta^{18}O_p$ for humans from Britain (see Chenery et al, 2010) and the estimated local $^{87}Sr/^{86}Sr$ range for humans growing up in Roman York, as discussed in the text. Labels refer to skeleton numbers of individuals discussed in the text.

Figure 3. Carbon and nitrogen stable isotope values of bone and dentine collagen from Driffield Terrace (n=68) in comparison with other humans (n=59) and animal bone data (n=31) from Roman York (Müldner & Richards, 2007a). Stepped error bars are drawn to indicate two and three standard deviations of the mean of the combined sample (n=127). Labels refer to skeleton numbers of outliers discussed in the text.

Table 1. Isotope data, collagen quality indicators and context information for humans from 6 Driffield Terrace. For each individual, enamel (strontium and oxygen) and dentine (carbon and nitrogen) data is given in the top row (P2= 2nd premolar). Bone collagen $\delta^{13}C$ and $\delta^{15}N$ for the same individual (where available) in the row below (-- = no data available.). Age and sex are based on preliminary osteological assessment (Tucker, 2006). Age categories are adol= 13-18, YA = 19-25, MA=26-45, OA=46+).

Table 2. Carbon and nitrogen stable isotope data of rib collagen for humans from 3 Driffield Terrace. Age and sex are based on preliminary osteological assessment (Tucker, 2006).
Key to Comments: a): Strontium, oxygen and lead isotope data for these individuals is published in Montgomery et al, in press-a,b.

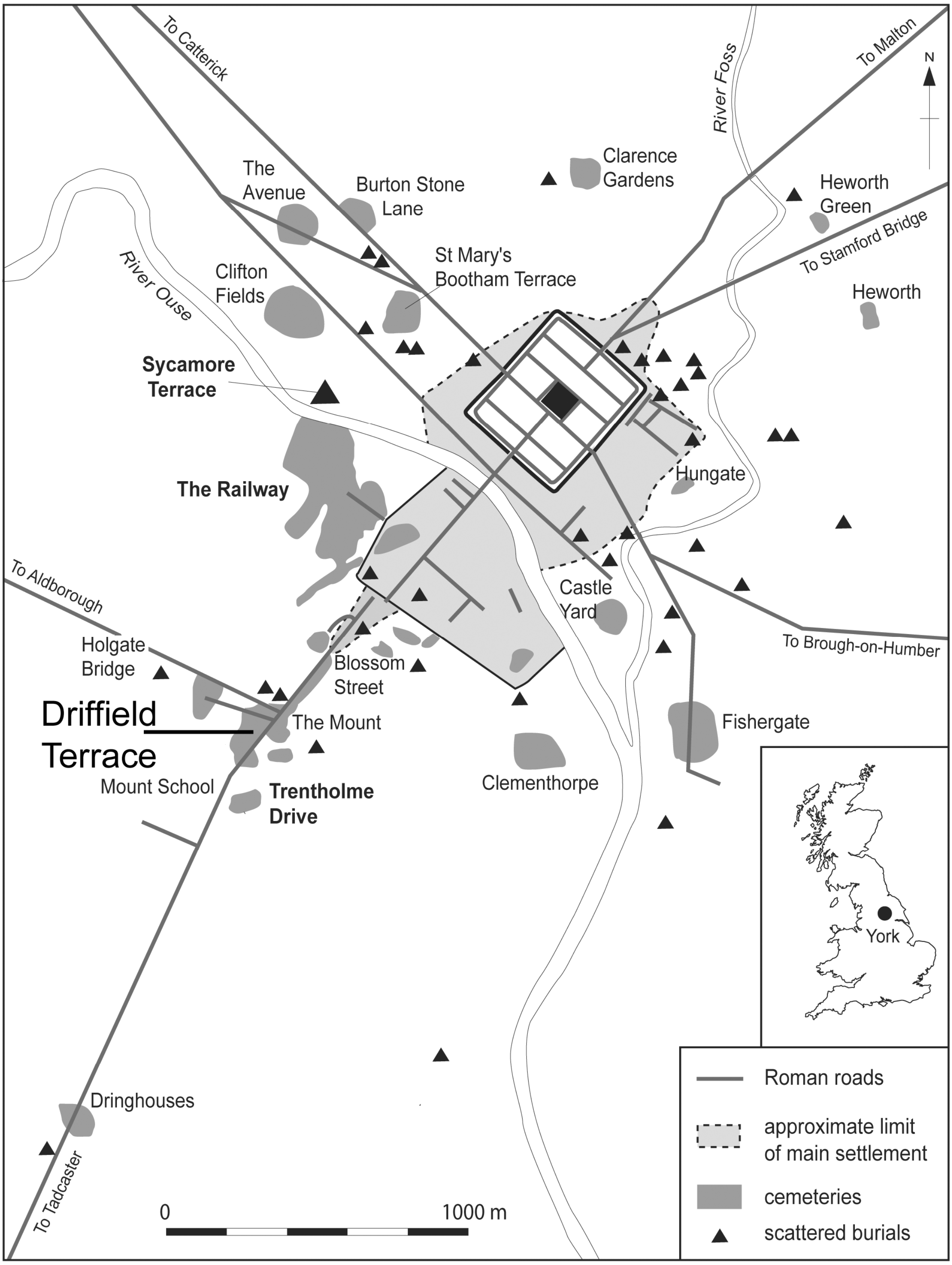
To Catterick
River Foss
To Malton
N
Clarence Gardens
The Avenue
Burton Stone Lane
Heworth Green
To Stamford Bridge
St Mary's Bootham Terrace
Clifton Fields
River Ouse
Heworth
Sycamore Terrace
The Railway
Hungate
To Aldborough
Castle Yard
Holgate Bridge
Blossom Street
To Brough-on-Humber
Driffield Terrace
The Mount
Fishergate
Mount School
Trentholme Drive
Clementhorpe
York
Dringhouses
To Tadcaster
0
1000 m
Roman roads
approximate limit of main settlement
cemeteries
scattered burials

Figure 1.

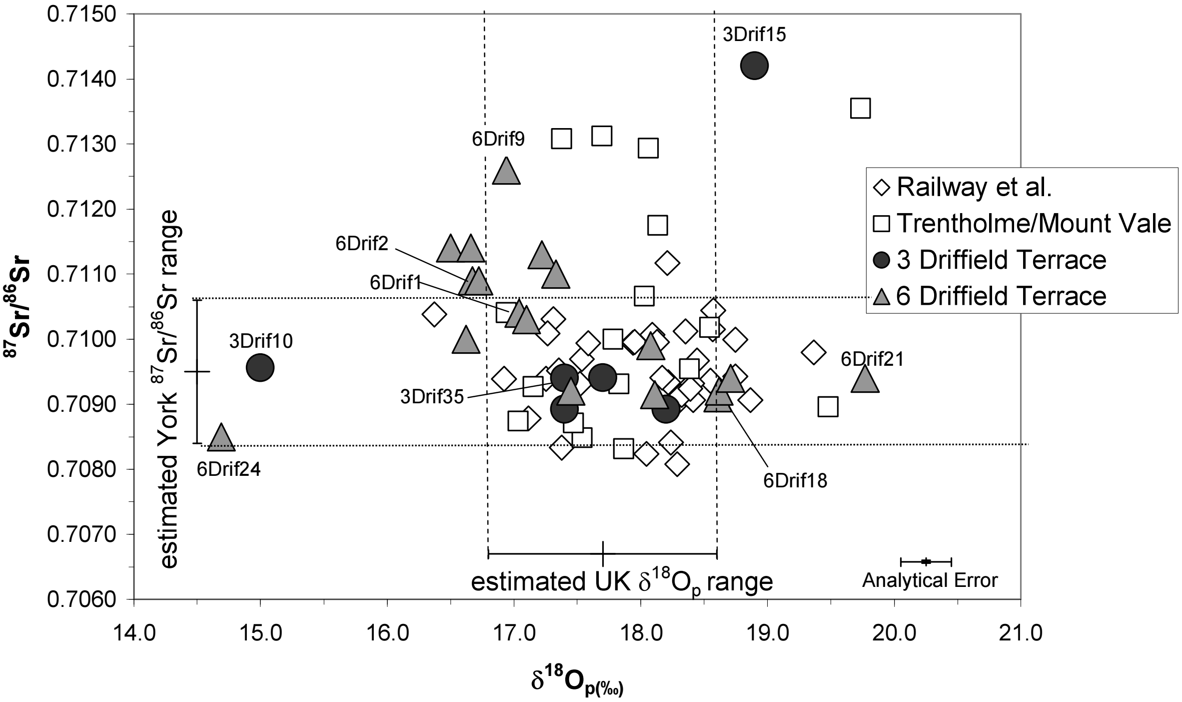

Figure 2.

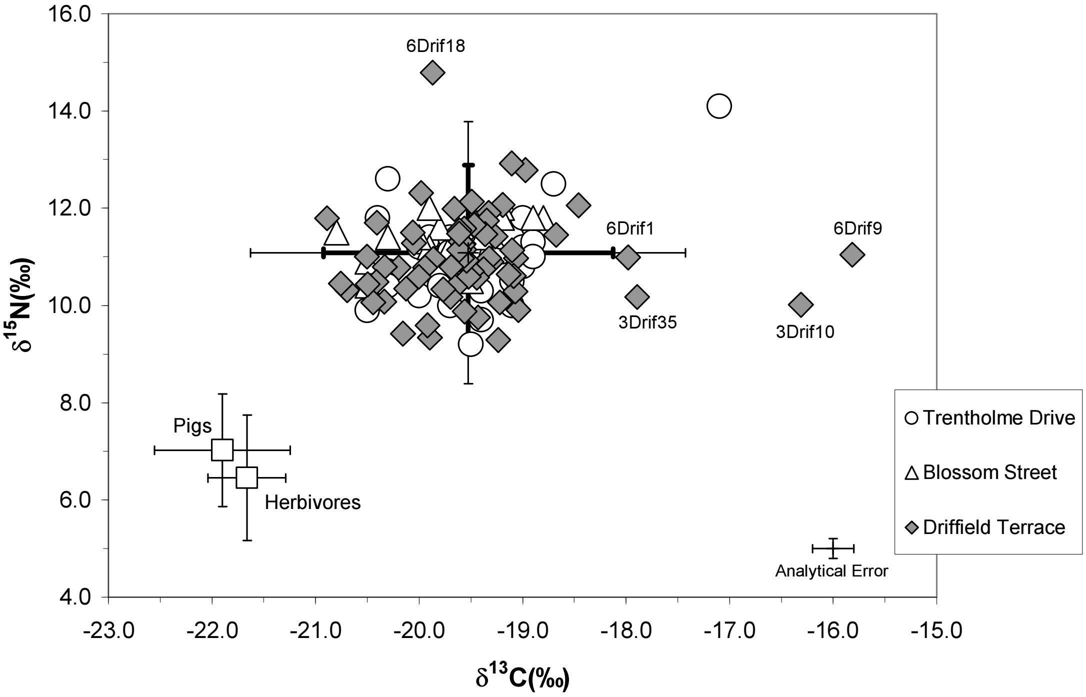

Figure 3.

Table 1.

Sample No	Sex	Age	Phase	^{87}Sr/^{86}Sr	Sr (ppm)	$\delta^{18}O_p$	2σ	$\delta^{13}C$	$\delta^{15}N$	%C	%N	C/N	%Coll	decap	Comments
6DRIF-1 P2 Rib	M	YA	5	0.7104	79	17.0	0.2	-18.0 --	11.0 --	43.9 --	15.9 --	3.2 --	16.0 nil	Y	
6DRIF-2 P2 Rib	M	OA	5	0.7113	113	17.2	0.3	-20.4 --	10.5 --	42.4 --	15.5 --	3.2 --	15.0 nil		possible hobnails
6DRIF-4 P2 Tibia	M	MA	5	0.7100	57	16.6	0.3	-19.6 -19.8	10.5 10.3	43.2 39.1	15.6 13.9	3.2 3.3	19.3 10.2	Y	
6DRIF-6 P2 Rib	M	MA	5	0.7092	68	17.5	0.0	-20.0 --	11.3 --	43.1 --	15.7 --	3.2 --	18.9 nil		
6DRIF-7 P2 Radius	M	MA	5	0.7099	62	18.1	0.1	-19.7 -19.6	11.4 11.3	43.3 41.9	16.0 14.9	3.2 3.3	13.2 3.5		possible marker mound
6DRIF-8 P2 Rib	M	MA	5	0.7110	55	17.3	0.2	-20.3 -20.2	10.7 10.8	43.7 41.5	15.8 14.6	3.2 3.3	17.7 3.8	Y	
6DRIF-9 P2 Fibula	?M	adult	5	0.7126	43	16.9	0.2	-15.8 -16.8	11.0 10.5	43.1 39.1	15.6 14.1	3.2 3.2	18.3 10.9	Y	
6DRIF-12 P2 Rib	?M	MA^{+}	2	0.7092	85	18.1	0.3	-19.1 -19.3	11.6 11.4	43.4 37.6	15.9 13.5	3.2 3.2	14.7 12.1	Y	
6DRIF-14 P2 Ulna	?M	MA	4	0.7109	60	16.7	0.1	-20.7 --	10.3 --	41.2 --	15.0 --	3.2 --	14.4 nil	Y	"box grave" with 17, 18
6DRIF-15 P2 Rib	M	YA	4	0.7114	83	16.5	0.3	-19.7 -19.6	11.8 11.5	43.8 39.3	16.2 13.9	3.2 3.3	18.2 3.6	Y	
6DRIF-17 P2 Rib	?M	MA^{+}	4	0.7103	51	17.1	0.2	-20.4 -20.5	11.1 11.0	42.6 40.4	15.5 14.0	3.2 3.4	18.3 1.6		"box grave" with 14, 18
6DRIF-18 P2 Rib	?M	YA	4	0.7091	62	18.6	0.2	-19.9 --	14.8 --	41.3 --	15.1 --	3.2 --	8.5 nil		"box grave" with 14, 17
6DRIF-19 P2 Rib	M	MA	4	0.7094	72	18.7	0.0	-19.2 -19.3	12.0 11.7	40.8 35.5	14.9 12.5	3.2 3.3	17.1 3.4	Y	"box grave" with 21, 22; possible marker mound; horse bones
6DRIF-20 P2 Rib	?M	MA	4	0.7114	34	16.7	0.3	-20.9 -20.8	10.8 10.5	44.1 42.3	16.0 15.3	3.2 3.2	18.0 11.8	Y	
6DRIF-21 P2 Rib	M	MA	4	0.7094	90	19.8	0.3	-18.5 --	12.1 --	42.1 --	15.4 --	3.2 --	16.0 nil	Y	"box grave" with 19, 22; possible marker mound; horse bones

6DRIF-22 P2 Rib	?M	MA	4	0.7092	104	18.6	0.1	-19.0 --	12.8 --	41.5 --	15.3 --	3.2 --	14.3 nil	Y	"box grave" with 19, 21; possible marker mound; horse bones
6DRIF-23 P2 Rib	M	YA	4	0.7109	65	16.7	0.3	-20.5 -20.9	11.3 11.8	40.4 40.4	14.8 14.0	3.2 3.4	13.4 1.8	Y	horse bones
6DRIF-24 P2 Rib	?M	YA	2	0.7085	56	14.7	0.2	-20.4 -19.9	9.3 9.6	40.9 41.3	14.8 14.9	3.2 3.2	11.9 15.0		hobnails, horsebones

Table 2.

Sample No	Sex	Age	δ^{13}C	δ^{15}N	%C	%N	C/N	%Coll	decap	Comments
3DRIF-1	?M	MA	-19.4	9.8	36.6	13.1	3.3	8.4		
3DRIF-2	M	MA	-19.1	10.3	39.5	14.3	3.2	12.0	Y	
3DRIF-3	M	MA	-19.9	10.8	41.8	15.0	3.2	5.7		
3DRIF-4	M	YA	-19.7	12.0	33.3	11.9	3.3	4.3	Y	
3DRIF-5	M	MA	-20.1	11.5	40.4	14.6	3.2	12.2	Y	
3DRIF-6	M	MA	-19.7	10.8	32.2	11.6	3.2	6.7	Y	
3DRIF-7	M	MA	-19.6	11.1	33.3	12.0	3.2	5.8	Y	
3DRIF-8	M	MA	-20.4	11.7	31.3	11.2	3.3	8.5	Y	prone
3DRIF-9	-	adult	-20.2	9.4	38.2	13.7	3.3	15.4		
3DRIF-10	M	MA	-16.3	10.0	38.8	14.2	3.2	17.7		a)
3DRIF-11	-	adult	-19.2	10.1	28.5	10.2	3.2	11.7		
3DRIF-12	M	MA	-19.5	10.9	35.7	12.7	3.3	9.7	Y	
3DRIF-13	?M	adol	-19.2	12.1	38.6	14.0	3.2	16.6		hobnails
3DRIF-15	M	MA	-19.6	11.3	38.2	13.7	3.3	7.0	Y	a); double burial with SK16
3DRIF-16	M	MA	-19.4	10.7	35.7	12.8	3.3	3.5	Y	a); double burial with SK15
3DRIF-17	M	YA	-19.3	11.0	35.7	12.6	3.3	2.1	Y	
3DRIF-18	?	adol	-19.6	11.1	40.3	14.6	3.2	10.8		
3DRIF-21	M	MA	-19.1	11.0	40.0	14.4	3.2	6.9	Y	
3DRIF-22	M	MA	-20.5	10.4	32.8	11.5	3.3	3.9		
3DRIF-23	M	MA	-19.1	12.9	41.2	14.9	3.2	15.4	Y	
3DRIF-25	-	older child	-19.9	9.3	35.5	12.7	3.3	7.4		
3DRIF-26	M	MA	-19.3	11.9	35.5	12.7	3.3	7.3	Y	
3DRIF-27	M	MA^{+}	-20.0	12.3	30.6	11.0	3.2	4.4	Y	
3DRIF-28	M	MA	-19.1	10.6	38.1	13.9	3.2	7.9	Y	
3DRIF-29	M	MA	-19.6	11.5	39.3	14.4	3.2	10.7		
3DRIF-30	M	MA	-18.7	11.5	35.9	12.8	3.3	7.7	Y	
3DRIF-31	M	MA	-20.1	10.3	38.4	14.0	3.2	9.5	Y	
3DRIF-32	M	adol/YA	-19.6	11.0	32.4	11.2	3.4	7.5		
3DRIF-33	M	MA	-19.7	10.2	31.9	11.2	3.3	9.2	Y	a)
3DRIF-34	M	adol/YA	-19.4	11.5	33.2	11.7	3.3	8.0		hobnails
3DRIF-35	M	MA	-17.9	10.2	38.8	14.3	3.2	15.9		a); hobnails
3DRIF-36	M	YA	-19.9	11.0	38.3	13.8	3.2	12.3		
3DRIF-37	M	MA	-19.6	11.2	37.5	13.5	3.3	8.1	Y	a); hobnails, iron "shackles"
3DRIF-38	M	MA	-19.5	11.7	34.1	12.1	3.3	7.5	Y	
3DRIF-40	M	YA	-20.0	10.6	33.4	12.0	3.2	8.0		horse bones
3DRIF-41	-	MA	-19.3	10.9	31.8	11.6	3.2	7.2	Y	
3DRIF-42	?	MA	-20.3	10.8	35.3	12.7	3.2	6.6		prone
3DRIF-43	M	YA	-19.6	10.4	36.8	13.1	3.3	6.5	Y	
3DRIF-44	M	MA	-19.5	10.6	33.0	11.9	3.2	10.2	Y	
3DRIF-45	M	MA	-19.2	9.3	38.6	13.8	3.3	11.2	Y	
3DRIF-46	M	MA	-19.1	11.1	43.7	16.1	3.2	14.2	Y	
3DRIF-47	M	MA	-19.1	10.6	43.3	15.8	3.2	13.1	Y	
3DRIF-48	M	MA	-19.0	9.9	44.1	16.1	3.2	9.3	Y	
3DRIF-50	-	adult	-19.6	9.9	36.6	12.9	3.3	5.5		
3DRIF-51	M	YA	-19.5	12.1	39.0	14.1	3.2	7.2	Y	
3DRIF-52	M	YA	-20.4	10.1	37.4	13.6	3.2	7.5		double burial with Sk52

3DRIF-53	M	YA	-20.3	10.1	42.2	15.4	3.2	11.5	Y	double burial with SK51
3DRIF-54	M	MA	-19.5	10.7	39.8	14.2	3.3	7.6		
3DRIF-55	M	MA	-19.4	10.6	37.6	13.3	3.3	7.3	Y	double burial with SK56
3DRIF-56	-	adult	-19.6	11.6	40.6	14.6	3.2	4.9		double burial with SK55