

# **Examining mortuary treatment in the Neolithic caves of south-west Britain: a taphonomic approach**

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**by**

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## Abstract

This doctoral research employs a multi-scalar taphonomic approach to Neolithic human remains from caves in southwest Britain to reconstruct mortuary practices and examine regional, chronological and demographic variation. Human remains from caves represent a rich resource for understanding Neolithic mortuary practices which are in turn central to understanding wide-ranging aspects of society. This research aims to identify diversity in practices of inhumation, exhumation and excarnation in caves in south-west Britain and explore the impact of cave taphonomy. To successfully understand the processes that affect human remains in caves and examine regional and chronological variation in practices between sites and individuals three main methods are used:

1. Macro- and microscopic taphonomic analysis of disarticulated material to examine pre- peri- and post-depositional processes and compare practices to Neolithic monumental burials
2. Osteological analysis of all available human remains from caves in Wales to investigate demographic patterns in mortuary treatment
3. Provision of new radiocarbon dating to examine chronological variation between sites and individuals and determine if methods are part of widespread practices in the Neolithic

The multi-level approach revealed differences in treatment and chronological variation between individuals, regions and sites across South Wales, north Wales and north Somerset. Practices of inhumation, excarnation and exhumation overlapped and human agency was identified in methods of curation and processing between individuals. Adoption and re-use of practices across regions showed a continuum in the use of caves and was characterised by various stages of manipulation and constant re-working of bone similar to Neolithic monumental burials. Use of this multi-scalar approach was unique in a Neolithic context and provided a new understanding of Neolithic mortuary treatment.

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## Abbreviations (in text)

### General

SNO	Specimen Number
NISP	Number of identified specimens
MNI	Minimum number of individuals
MNE	Minimum number of elements
N	Total element representation
ANAT	Anatomical element
L/R	Left or right side
PF/DF	Proximal/Distal fusion
QC	Quick comments

### Taphonomy/Macroscopic

WTH	Weathering
GN	Gnawing
EROS	Erosion
AB	Abrasion
STAIN	Staining
TRAMP	Trampling
FFI	Fracture Freshness Index
ANG	Fracture Angle
FST	Fracture surface texture
FO	Fracture outline
TOTAL	Total Fracture Freshness Score
Prox	Proximal
Dist	Distal

TRA	Trauma
TRA SHARP-CUT/BFT	Trauma - sharp (Cutmarks) or blunt force
TRA peri/ante	Trauma – peri-mortem (cutmarks) or ante-mortem (healed fractures)
LOC TRA	Location of trauma
BU	Burning
PATH	Pathology
LOC infectious/degenerative	Location of pathology
<b>Taphonomy/Microscopic</b>	
OHI	Oxford Histological Index
MFD	Micro-foci of destruction
BIREFR	Birefringence
ATTACK non-Wedl/Wedl	Attack non-Wedl MFD/Wedl MFD
BUDDDED	Budded
LAMEL	Lamellate
LINEAR L	Linear longitudinal
WEDL	Wedl MFD
W types 1, 2, cyanobact	Wedl types 1,2, cyanobacteria
INCL	Inclusions
INFIL	Infiltrations
STAIN/DIS	Staining/Discolouration
CRACK/MF	Cracking/Microfissures
Incl colour, Infil colour, Stain colour	Inclusion/Infiltration/Staining colour
Incl intensity, Infil intensity, Crack intensity	Inclusion/Infiltration/Cracking intensity

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## **Chapter 1: Introduction, structure and contribution**

This PhD undertakes a multi-scalar taphonomic approach to Neolithic human remains from caves in south-west Britain to reconstruct mortuary practices and address regional, chronological and demographic variation in burial treatment. The Neolithic (c. 4000BC – 2000BC) is the earliest period for which a large quantity of human bone (both articulated and disarticulated), from a variety of contexts, survives in Britain and provides vital information on early human practices.

Caves are one of the many contexts where Neolithic human remains have been discovered. A rich resource of unexamined human remains is available in Wales and forms the focus of this PhD research to investigate the diversity of Neolithic funerary practices in caves and compare those to mortuary practices documented in Neolithic monuments. An abundance of human remains is further available in the Mendips however full taphonomic evaluation of sites outside of Wales is beyond the scope of this analysis. A targeted histological analysis of already radiocarbon-dated remains (Neolithic) with available human remains for study from a single site (Backwell Cave) offers a good opportunity for a comparative study. Comparative analysis can identify funerary process or variations suggesting regional or even localised traditions. The selected study sites are located in south-central, south-east, south-west and north Wales and include sites that have already been directly radiocarbon dated as having Neolithic activity so data is more robust. Geographical division for study areas in Wales was based on where cave systems were clustered to identify whether funerary processes showed differences between these regions.

The aim of the research is to contribute to the understanding of mortuary practices during the Neolithic using macro- and microscopic analysis and new radiocarbon dates to:

- Examine mortuary practices (i.e. practices of inhumation, excarnation and exhumation) in caves through the analysis of pre-, peri and post-depositional processes
- Explore the impact of cave taphonomy and how human-mediated practices can be identified in bone evidence
- Investigate demographic patterns in mortuary treatment

- Explore intra- and inter-regional variation in practices and compare patterns between caves and monuments
- Examine chronological variation between sites and individuals
- Explore regional variations based on the consistency of post-mortem treatment

Macroscopic taphonomic analysis of 20 caves in Wales (with direct evidence of Neolithic activity) has been undertaken with a sample of nine of these sites analysed microscopically. Targeted histological analysis of a securely dated site with Neolithic activity from north Somerset (Backwell Cave) offered a good opportunity for a comparative case-study. Backwell Cave laid the groundwork for future research (further histological analysis, radiocarbon dating evidence, isotope analysis) by identifying burial patterns suggesting more widespread funerary processes in the Early/Middle Neolithic and comparative regional traditions to north Wales. Human remains of this period are interred as both articulated skeletons and disarticulated remains. Despite the latter being very common, extensive analysis on disarticulated human remains has not been thorough in cave contexts. Analysis of cave burials has lagged behind in mortuary research due to challenges of loss of stratigraphy in cave environments. A variety of parameters (e.g. water displacements, trampling, scavenging) affects depositions in cave environments resulting in loss of stratigraphic information. This has severely impacted current studies and has shifted the interest of research to more clearly defined contexts (i.e. monumental burials, articulated remains).

This project demonstrates the potential of a multi-level methodological approach that can be applied in various contexts, all periods and sites. This research provides a new understanding of cave burials as demonstrated by the peri- and post-mortem treatment of the remains. This is accomplished by examining the disarticulated remains and providing new radiocarbon dating evidence from ten of the sites examined in Wales. Acknowledgment of all burial contexts and practices throughout the Neolithic to the Early Bronze Age/Chalcolithic (transition) is vital to comprehend how cave burials ‘fit’ in this arena. Whilst a vast amount of human remains have been discovered in caves, these collections are often poorly preserved, disarticulated and fragmented (Smith and Brickley 2009: 11). Therefore, closer attention and priority has mainly been given to monumental burial, whilst disarticulated and commingled collections from caves often remain unexamined.

A corpus of information relating to Neolithic cave burials, including one hundred and sixty directly dated individuals to the Neolithic across Britain by Chamberlain (1996), and additional reports (e.g. Cullingford 1962; Jackson 1962; Ford 1989; Leach 2008; Hankinson 2015), provided an impetus for research on Neolithic cave burials. Nonetheless, previous research has been particularly biased towards regional and isotopic analyses. More specifically, researchers have sought to examine whether burial patterns in caves existed, primarily in northern England (e.g. Leach 2008, 2015), and characterise the dietary preferences of people in a number of areas, specifically Wales, Somerset and Devon (Schulting and Richards 2002; Schulting 2007; Schulting *et al.* 2013). However, the scattered and isolated nature of disarticulated remains means that more holistic and targeted analysis is needed to fully comprehend the depositional treatment of the individuals buried in caves. In particular, there is a rich resource of unexamined (disarticulated) human remains from caves in Wales, with many dating to the Neolithic that lacks focus on mortuary treatment and forms the focus of this thesis.

### **Structure of Thesis**

The thesis introduces a review of cave archaeology in Chapter 2 to examine the environments within which caves were formed in Britain and the parameters that altered their depositional history. This is pursued to understand how human bone can be impacted from agents other than human activity in subterranean environments as these are more complex than open-air sites and monuments. Chapter 3 further examines Neolithic burial practices in the study area to examine variation in burial contexts and later compare those with funerary practices in caves. A background on taphonomy and previous research on various taphonomic modifications in Chapter 4 provides great insight into the complexity of identifying multiple agents that affect human bone.

Methods of recording taphonomy employed in this research are further presented in Chapter 5 to guide the reader through the process of analysing human remains. Results are subsequently presented in Chapters 6 across regions and Chapter 7 on an individual basis (case studies) to cross-reference every proxy that impacted human remains examined in this research.

Chapter 8 further clarifies whether the multi-level analysis adopted for the purposes of this PhD research emphasizes regional or individual mortuary patterns amongst caves

and whether these methods of deposition shared a common link with typical Neolithic funerary practices. The diversity in depositional methods (8.2.) between sites and regions are categorized based on two broad groups including selected or removed body parts (residual bone assemblages) in south Wales and sequential deposits with larger, commingled and processed assemblages in north Wales and north Somerset. These broad sections are broken down to discuss different depositional methods across sites and regions based on taphonomic data. These include practices of inhumation, excarnation and exhumation. Demographic data, chronology and established theories are incorporated where possible. Based on available data research explores how cave burials fit into this arena when monumental burials were visibly developed from the Early to the Late Neolithic.

A summary of the overarching argument to investigate the diversity of Neolithic funerary practices in caves and compare those to mortuary practices documented in Neolithic monuments is presented in Chapter 9. Discussion on the methods, their limitations and future directions are further incorporated as part of the summary to establish the outcomes of this research.

Six Appendices are included at the end of the thesis and have been submitted as separate files due to their size. Data in appendices includes:

Appendix 1 – Sites, coding, histology, <sup>14</sup>C results, abbreviations, excluded sites

Appendix 2 – All sites statistical analysis

Appendix 3 – Example of regional statistical analysis

Appendix 4 – Example of case study statistical analysis

Appendix 5 – Site Backgrounds

Appendix 6 – Tables, figures and data from results

Appendices 1-4 have individual spreadsheets and form primary data that are referenced in text. Appendices 5-6 have been divided in sections and comprise of secondary data (site backgrounds and cave research – Appendix 5) and data from results (Appendix 6). Data that was not considered essential for the presentation and direct interpretation of results (Chapters 6 and 7) and discussion (Chapter 8) has not been included in the main

thesis. However, this data (including graphs and tables in Appendix 6) was the product of complex analysis and cross-referencing of proxies that could not be discarded and was therefore included as supporting information in the appendix. Details can be found in the ‘Table of contents’ or the ‘Appendices list’ at end of the thesis.

## **Chapter 2: Geomorphology and cave research**

This chapter provides a review of cave archaeology by examining the environments within which caves were formed in Britain and the parameters that altered their depositional history. Firstly, the landscape and geology in Britain is described more broadly and the study areas, Wales and north Somerset, in more detail. Secondly, current perceptions, associations and research on Neolithic burial and cave archaeology, are examined. A brief discussion outlines the parameters that affect archaeological depositions and current theories on the nature of cave burials. The chapter concludes with a discussion and review of previous cave research across Britain to underline the urgent need for more analyses on cave burials.

### **Caves and karst: Definition**

Caves are closed environments, limited spatially in three dimensions by the walls, a floor and a roof, features not usually present in open air sedimentary environments (Andrews 1990: 91). In this thesis, the term *cave* is taken to comprise any natural cavity in a rock formation large enough to accommodate a *person* (Last 2003: 1). The sites that form part of this analysis include caves, rock-shelters, fissures, vertical entries interconnected with caves, cave mouths, and caves with natural entrances that may have been altered by humans. Definitions of these cave types will be provided section 2.1. The term *cave burial* is used in this thesis to refer to the emplacement of any human remains in a cave.

Karst can be defined as a distinctive environment that is created by the erosion of a soluble rock where the topography and landforms are a consequence of efficient underwater drainage (Waltham *et al.* 1997: 3). Karstic caves form in a limestone bedrock through dissolution of the calcium carbonate matrix by water (Strauss 1990: 256). Caves therefore form inextricable parts of the karst landscape and involve complex underground erosional environments where each phase of erosion is captured and preserved through the accumulated sediments and depositions in the cave passages themselves (*ibid.*). All sites examined in this research are karstic caves, formed in areas of limestone.

## **2.1. Landscape and geology**

Cave sites have encapsulated and protected remains/materials throughout the millennia and have been key in our study of past human behaviour (Dinnis and Ebbs 2013: 28). Cave systems are shaped by different processes in many rock types and sediments. They are categorised as: solution caves (mainly occurring in limestone and gypsum formed due to erosional, hydraulic and gravitational movements); volcanic caves (formed from cooling of lava flows); glacier caves (formed by melting of the ice of glaciers); crevice caves (formed by ‘separation’ of rocks due to various forces); littoral caves (sea caves formed due to wave action and water abrasion); piping caves (formed in unstable sediments) and erosion caves (stream-cut caves formed in soft rocks by water streams) (Klimchouk 2004: 418-419). Study areas (Wales and north Somerset) are composed of limestone rocks (see 2.2) and mainly include solution caves.

Cave and karst studies include an array of distinct disciplines (e.g. archaeology, geomorphology, hydrology, palaeontology, biology) which underline the complexity of their deposits. The same sources of sedimentary infillings that can cause deposits in caves can also erode and remove important information and ultimately alter our understanding of their use. Processes that cause deposits in caves include disintegration of the rock ceiling and walls, colluviation from overlying slopes, aeolian deposition, alluviation from adjacent streams, humus depositions from plants and depositions by animals and/or humans (Strauss 1990: 258). Subsequently, human and animal remains can become severely affected by these processes between death and final burial (biostratinomy) with erosion, water displacements (causing moving of remains), human/animal disturbances (gnawing, fractures) and soil composition (soil acidity) (2.3.1-2.3.2.) ultimately affecting their surface preservation. These processes result in complex taphonomic trajectories that have been marginalised to some degree due to level of disarticulation and bad surface preservation of the remains and focus on above ground monuments. Therefore, it is important to carefully study the context in which caves are formed to decipher their history.

## 2.2. The karst of Great Britain and study areas

The karst of Great Britain is generally composed of five main types of soluble rocks (carbonate rocks and evaporates) – a number of limestones<sup>1</sup> which are distributed through the stratigraphical column, dolomite<sup>2</sup>, some systems of gypsum<sup>3</sup>, chalk<sup>4</sup>, and salt<sup>5</sup> (Waltham *et al.* 1997: 3; Last 2003: 4; Cooper *et al.* 2011: 118; www1). Other types of karst rocks, not prominent in the landscape, include marble (carbonate) and anhydrite (evaporate) (Last 2003: 4). The five main types of soluble rocks from the karst landscape in Great Britain and are largely dispersed across England, Wales and Scotland (however, rather sparsely in the latter) (Figure 1) (Waltham *et al.* 1997: 3).

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<sup>1</sup> A sedimentary rock composed of more than fifty per cent calcium carbonate and therefore soluble in weak acids including rain and soil water. Dolomitised limestone has been altered by the introduction of magnesium after deposition (Holderness *et al.* 2006: 110). This rock ‘assembles’ the karst landscape of the Mendip Hills, the Yorkshire Dales and the Derbyshire Peak District (www1).

<sup>2</sup> A carbonate rock in which more than fifty per cent of the mineral is composed of calcium magnesium carbonate (Holderness *et al.* 2006: 109).

<sup>3</sup> Karst in gypsum is mainly present in the Permian rocks of eastern and north-eastern England (particularly around Ripon and Darlington and in the Vale of Eden but also in Triassic strata in the Midlands). Gypsum karst can form water-filled cave systems, however, the karst is evolving on a human time scale due to the rapid solubility rate of the gypsum (www1).

<sup>4</sup> A very distinctive form of limestone which constitutes the most widespread carbonate rock in the country. It occurs across much of southern and eastern England and is of great importance for water supply (constitutes Britain’s most important aquifer). (www1).

<sup>5</sup> Mainly formed in the Permian and Triassic rocks of central and north-eastern England (www1).



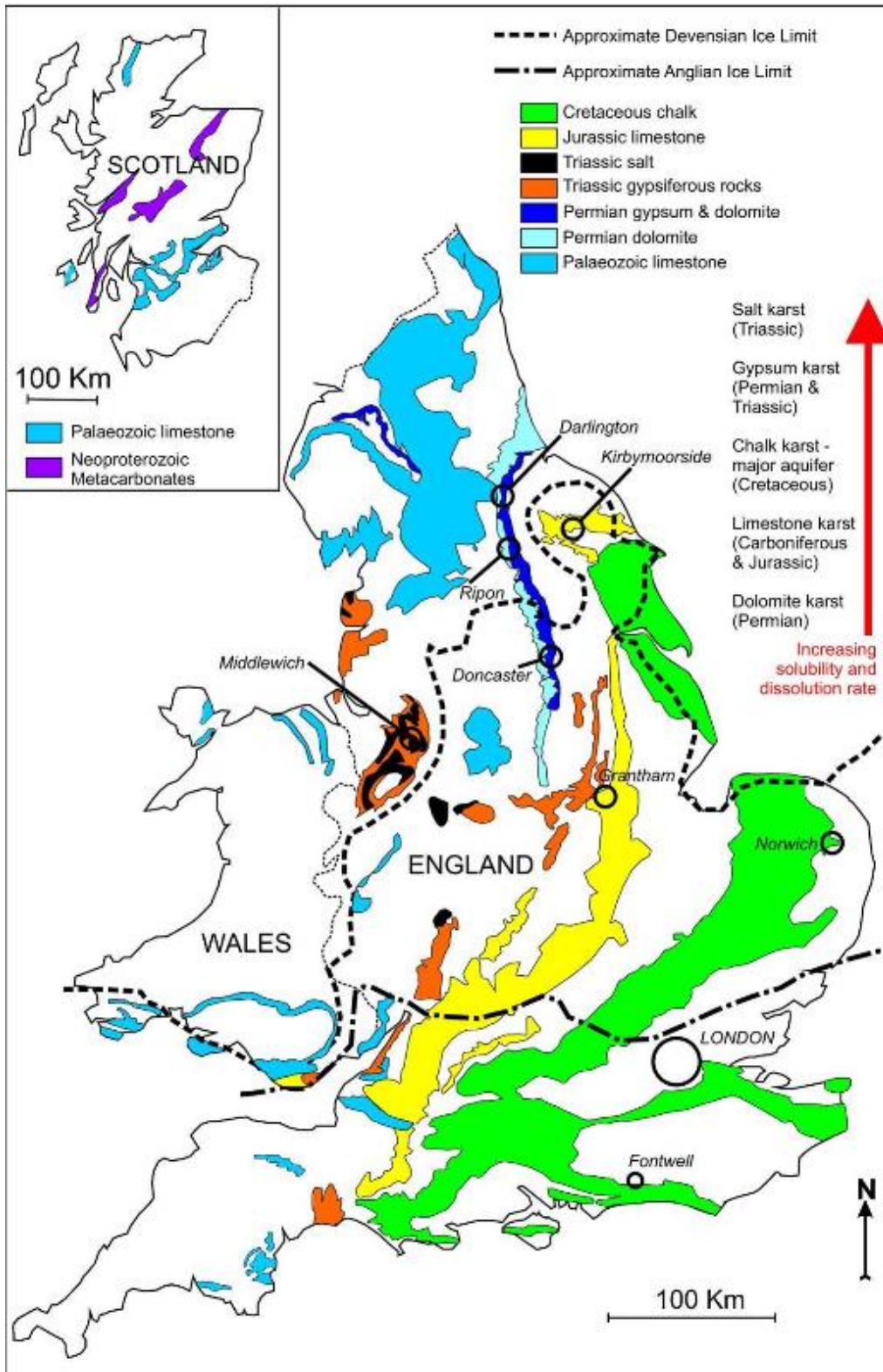


Figure 1. Distribution of soluble rock types in Great Britain (Cooper et al. 2011: 119)

Most of Britain's caves and karst landforms occur on the limestones of the Lower Carboniferous (Figures 2, 3) (Waltham *et al.* 1997: 16). The limestones of this age compose most of the Palaeozoic limestone in England and Wales and include the best-

developed karst landscapes as well as the longest cave systems (Cooper *et al.* 2011: 119). The major regions of cavernous karst of this period and this type of soluble rock across Britain therefore form in the Yorkshire Dales and north Pennines<sup>6</sup>, the Peak District<sup>7</sup>, the Mendip Hills and Bristol area<sup>8</sup> and last, the margins of South Wales<sup>9</sup> (*ibid.*, 120). A significant outlying area of cavernous karst includes South Devon and the Forest of Dean (Lowe 1989: 106; Last 2004: 4). Limestones outcrops of the Jurassic age do occur and extend from the Dorset coast up through the Cotswold Hills to the north York Moors (as seen in Figure 1), however, the limestones are quite thin and not notably karstic (Cooper *et al.* 2011: 120). Key karstic features in the abovementioned major karstic areas include caves<sup>10</sup>, fissures<sup>11</sup>, rock-shelters<sup>12</sup>, resurgences<sup>13</sup>, sinkholes/swallets<sup>14</sup> and limestone pavements<sup>15</sup>.

Each of the abovementioned regions show a distinct landform composition. The South Wales karst, for example, extends along the limestone outcrop which borders the coalfield syncline and whilst it does not comprise a prominent feature of the landscape, it entails long and deep cave systems (Waltham *et al.* 1997: 18). On the other hand, the Mendip Hills karst is formed of clearly defined upland areas, very prominent in the landscape (*ibid.*, 16). Hence, there is a series of factors that affect the karstination of

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<sup>6</sup> Famous sites include Malham Cove, Gaping Gill and Hutton Roof Crag (Waltham *et al.* 1997: 16; Cooper *et al.* 2011: 120).

<sup>7</sup> Examples include the dry valley of Dove Dale and the Peak Cavern cave system (Cooper *et al.* 2011: 120).

<sup>8</sup> Examples include the gorge at Cheddar and Wokey Hole (Waltham *et al.* 1997: 16; Cooper *et al.* 2011: 120).

<sup>9</sup> Examples include the caves of Dan-yr-Ogof and Porth-yr-Ogof (Cooper *et al.* 2011: 120).

<sup>10</sup> A natural underground cavity or passage large enough to be entered by a person. The term is often restricted to those cavities not requiring specialised equipment for exploration, as distinct from potholes (vertical cave passages) and sumps (flooded sections of cave passage). Caves in limestone are formed by dissolution, erosion and gravitational breakdown of the rock (Holderness *et al.* 2006: 109).

<sup>11</sup> A natural narrow but relatively high passage, often developed along a natural joint or fault and sometimes with roof open to the ground surface. Natural fissures with no dissolution are termed 'crevice caves', and these can develop in any type of massive rock (Holderness *et al.* 2006: 109).

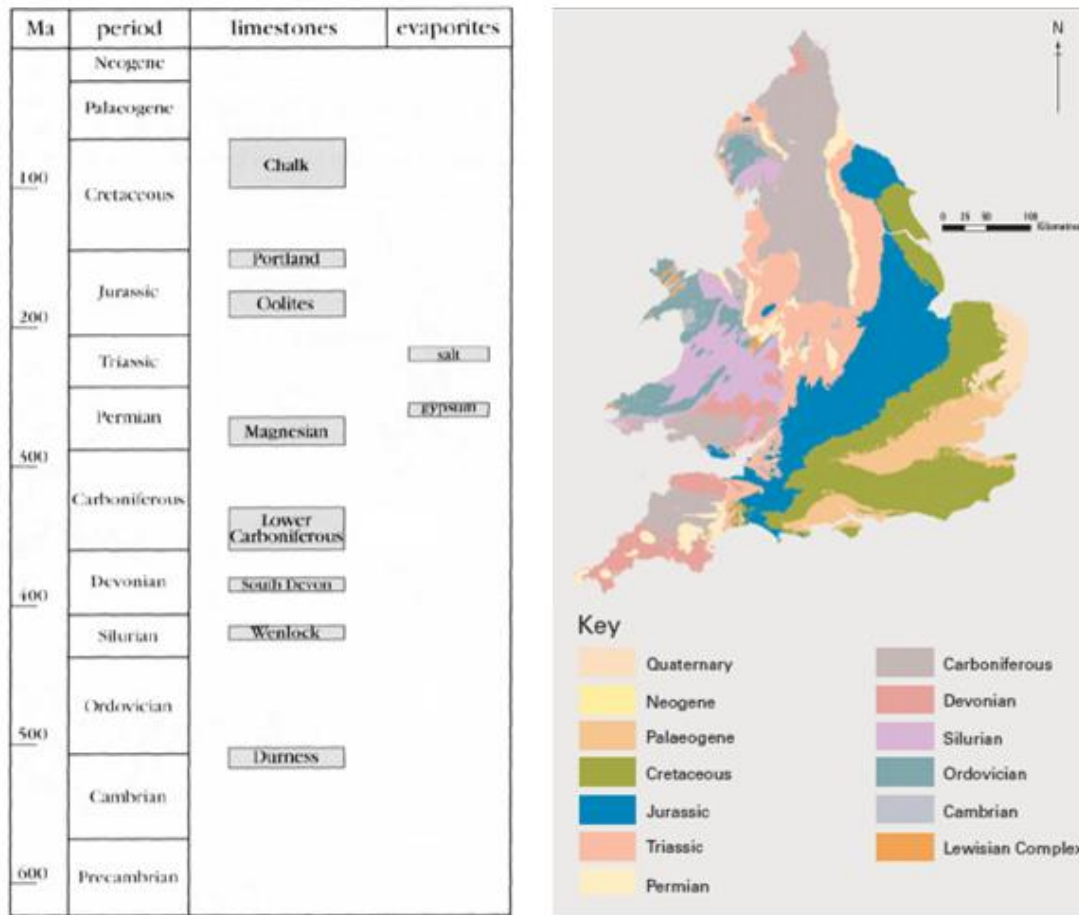
<sup>12</sup> A cave of shallow depth and broad entrance characterised by an overhanging roof and poorly defined side walls (Holderness *et al.* 2006: 110). They are formed by water, wind and thermal erosion and are not associated with long subterranean galleries (Strauss 1990: 257).

<sup>13</sup> The re-appearance of an underground stream at the surface. Technically the term is restricted to underground streams that are recharged from allogenic sources (Holderness *et al.* 2006: 110).

<sup>14</sup> Any place where water disappears underground or has done so in the past. Also referred to as swallet or swallow (Holderness *et al.* 2006: 110).

<sup>15</sup> Exposed bedding plane surface, usually scraped clean by glacial action, and subsequently carved by dissolution into clints and grykes. Best developed where the regional dip of both rock beds and ground surface is low (Holderness *et al.* 2006: 110).

the main soluble rocks in the UK – the soluble rock lithology, the geological setting, present topography and hydrology and past climatic history (Cooper *et al.* 2011: 119)<sup>16</sup>.



Figures 2 and 3. **Right (2):** Main limestones and evaporates with karstic features in Great Britain. The Lower Carboniferous constitutes the most important karstic rock in Britain as the major regions of cavernous karst<sup>17</sup> are formed on the thick and strong limestones of this succession (Waltham *et al.* 1997: 3). **Left (3):** major types of bedrock geology across England and Wales (Rawlins *et al.* 2012: 15).

<sup>16</sup> More specifically, the geomorphology of caves in the four main cavernous karsts has been reviewed individually due to these distinct characteristics of landscape formation (north-western England by Waltham 1974; the Peak District by Ford 1977; Mendip Hills by Smith 1975; Wales by Ford 1989).

<sup>17</sup> “Limestone landscape that includes both surface and karst features and also extensive underground cave systems” (Holderness *et al.* 2006: 109).

### 2.2.1. Study Area: Wales

In Wales, the karstic landscape is found on the Carboniferous Limestone outcrops that formed both in north and south Wales, however, the most prominent features, known as the North Crop, are located at the northern side of south Wales' coalfield borders (Figure 4) (Crowther 1989: 20; Waltham *et al.* 1997: 219). Carboniferous Limestone is further found across north and south Wales where different cave systems are formed (Ford 1989; Waltham *et al.* 1997: 219). Cave systems of carboniferous limestone include: the thick carbonates of Wye Valley around the Chepstow area, bordering east to England<sup>18</sup>; the limestones of Gower Peninsula<sup>19</sup>; South Glamorgan<sup>20</sup>; the limestones of South Dyfed in the south-western corner of Wales<sup>21</sup>; the Clwydian Hills limestone areas that form high grounds on both sides of the Vale of Clwyd with scattered outcrops from Llandudno westwards into Anglesey<sup>22</sup> (Figures 5, 6) (Waltham *et al.* 1997: 219-223).

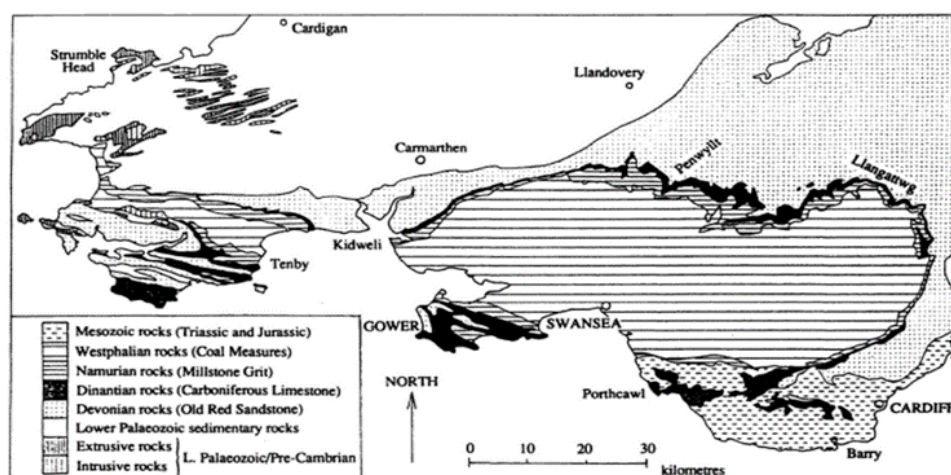


Figure 2. Geology of south Wales – Carboniferous Limestone outcrops (black) and other limestone successions in south Wales (Lowe 1989: 3)

<sup>18</sup> Including a few small stream sinks, shallow dry valleys and dolomite cliffs. The most outstanding cave system in this area is formed in the Lower Dinantian Lower Dolomite (Waltham *et al.* 1997: 219).

<sup>19</sup> Formed by the western side of the Gower Peninsula which contains the only notable karst features, and the Dinantian limestones to the south and west in south Wales that include dry valleys and small caves (Lowe 1989: 10).

<sup>20</sup> Most of the Carboniferous Limestones are covered by Triassic and Jurassic mudstones (east of Swansea Bay). Fissures, potholes and substance dolines have been recorded rather than major cave systems (Waltham *et al.* 1997: 219).

<sup>21</sup> A few small caves have been formed inland whilst numerous caves are part of the high cliffs of the south coast (Davies 1989a).

<sup>22</sup> Upper Dinantian limestones are mostly present in the outcrops of southern Anglesey (Waltham *et al.* 1997: 223). Divisions of the Carboniferous Limestone outcrops in North Wales are: Sandy Limestone or Black Limestone of northern Clwyd, Upper Grey Limestone, White Limestone, Lower Brown Limestone (Morton 1898; Appleton 1989: 218).

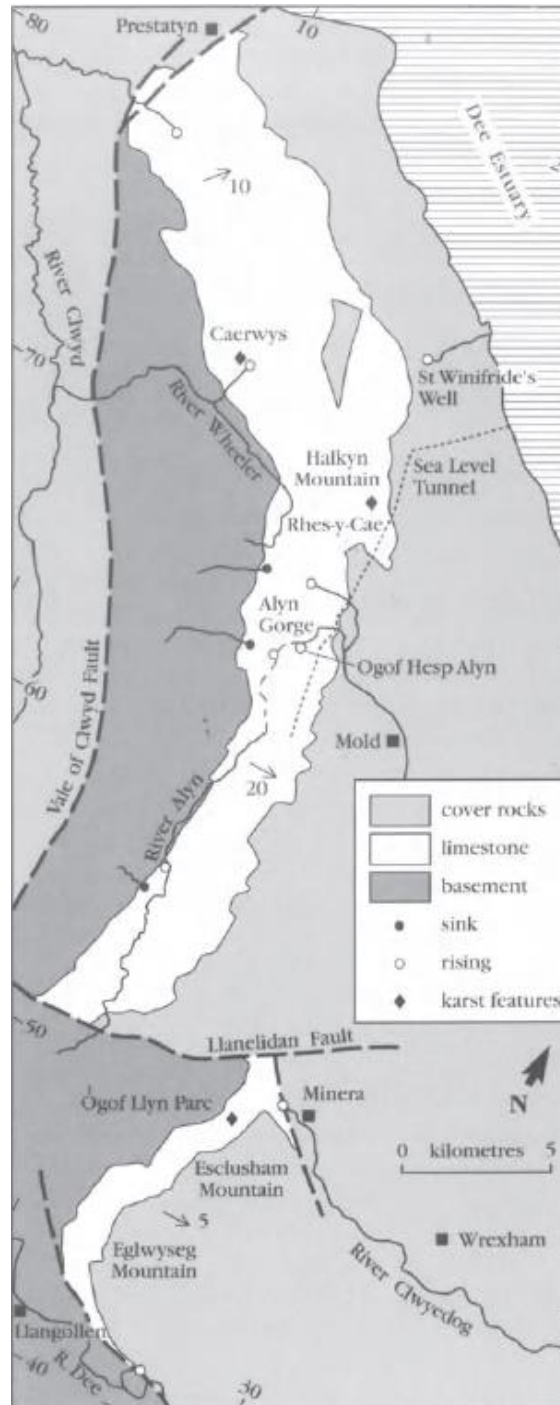


Figure 5. Karst features in the Carboniferous Limestone of the eastern Clwyd, north Wales. The cover rocks in the key include Upper Carboniferous and Triassic clastics (Waltham *et al.* 1997: 222).

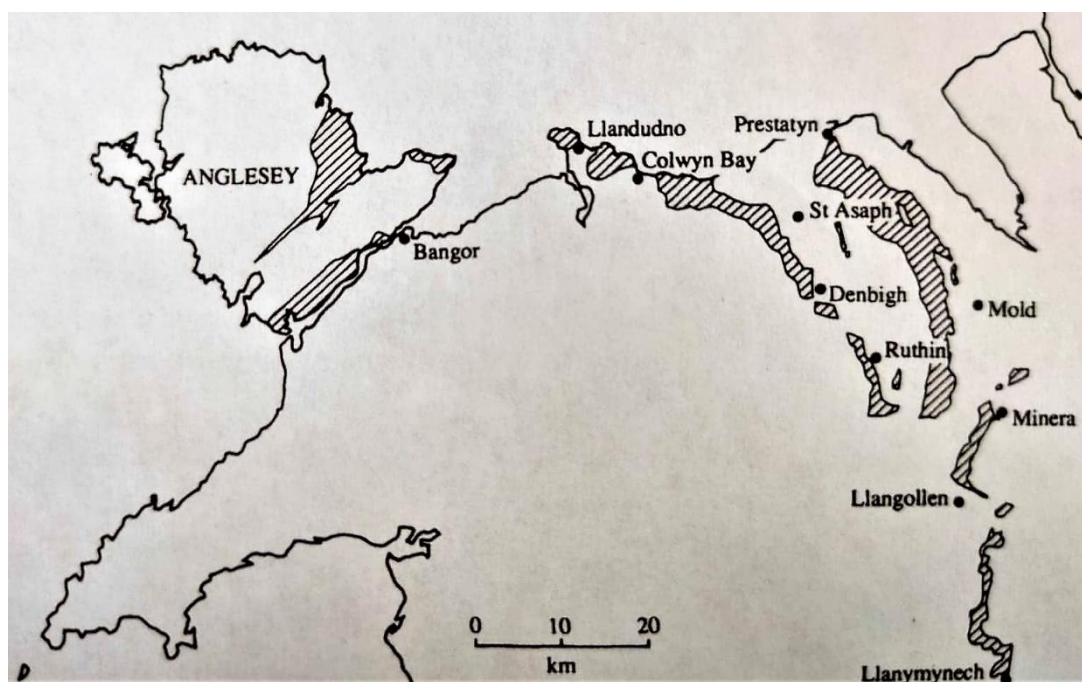


Figure 6. Distribution of Carboniferous Limestone (shaded) in North Wales – sketch map (Appleton 1989: 218).

### Site location

The selected study sites (Tables 1 and 2) are located in south-central, south-east, south-west and north Wales (Figure 7) and include sites that have already been directly radiocarbon dated as having Neolithic activity so data is more robust. See Chapter 5 (5.1.2) for more detail on selection criteria based on the level of analyses that has been undertaken for each site. Table 1 provides information for each study site, the name, region and analysis undertaken in this study. Figure 7 is a map of their location in Wales and north Somerset. Table 2 describes each site in more detail, i.e. broader regional and geomorphological group, individual cave morphology, a brief summary of the human remains and preservation.

SITE	REGION	ANALYSIS (PRIMARY)
Cathole Cave	Ilston, Swansea	Macroscopic
Spurge Hole	Pennard, Swansea	Macro- and microscopic
Red Fescue Hole	Rhossili, Swansea	Macroscopic
George Rock Shelter	Wenvoe, Vale of Glamorgan	Macro- and microscopic

Pitton Cliff Cave	Rhossili, Swansea	Macroscopic analysis
Ifton Quarry	Rogiet, Monmouthshire	Macro- and microscopic
Little Hoyle Cave (Longbury Bank Cave)	Penally, Pembrokeshire	Macro- and microscopic
Nanna's Cave	Tenby, Pembrokeshire	Macroscopic
Hoyle's Mouth Cave	Tenby, Pembrokeshire	Macroscopic
Ogof-y-Benglog (New Cave/Skull Cave)	Tenby, Pembrokeshire	Macroscopic
Priory Farm Cave	Monkton, Pembrokeshire	Macro- and microscopic
Ogof Garreg Hir	Stackpole, Pembrokeshire	Macroscopic
Ogof Brân Goesgoch	Stackpole, Pembrokeshire	Macroscopic
Cae Gronw Cave	Cefnmeiriadog, Denbighshire	Macroscopic
Ogof Colomendy	Gwernymynydd, Flintshire	Macro- and microscopic
Orchid Cave	Llanferres, Denbighshire	Macroscopic
Pontnewydd Cave, (Bont Newydd Cave)	Saint Asaph, Denbighshire	Macroscopic
Gop Cave	Trelawnyd & Gwaenysgor, Flintshire	Macro- and microscopic
Ogof Pant-y-Wennol	Llandudno, Conwy	Macroscopic analysis
Little Orme's Head Quarry	Llandudno, Conwy	Secondary data – remains not available for primary analysis

Table 1. Sites in Wales, including the regions they are located and nature of the analysis (primary)<sup>23</sup>.

<sup>23</sup>A table of all sites examined in this research can be found in Appendix 1/Sheet 1/Site list. Further justification for this selection can be found in the Chapter 5. Several sites were excluded from this study due to lack of direct chronology and/or unknown location for analysis. A table of the sites (across Wales) excluded from this study can also be found in Appendix 1/Sheet 7/Excluded sites.



Figure 7. Location/Distribution of sites across Wales and north Somerset: 1. Ifton Quarry, 2. George Rock Shelter, 3. Cathole Cave, 4. Spurge Hole, 5. Red Fescue Hole, 6. Pitton Cliff Cave, 7. Hoyle's Mouth Cave, 8. Little Hoyle Cave/Longbury Bank, 9. Priory Farm Cave, 10-11. Caldey Island – Nanna's Cave & Ogof y Benglog/New Cave, 12. Ogof Garreg Hir, 13. Ogof Brân Goesgoch, 14. Little Orme's Head Quarry, 15. Ogof Pant-y-Wennol, 16. Cae Gronw Cave, 17. Gop Cave, 18. Pontnewydd Cave, 19. Orchid Cave, 20. Ogof Colomendy, 21. Backwell Cave (drawing: author).



SITE	REGION	SUB-REGION	SITE TYPE	SITE GEO-MORPHOLOGY	STATE OF REMAINS	ISSUES AFFECTING PRESERVATION	CURRENT CONDITION
Cathole Cave	South-central Wales	Ilston Swansea	Cave	On dry limestone area, 2 km inland from the Gower	Unstratified -disarticulated human (and animal) bone	Series of excavation (possible backfilling and disturbances)	Near Intact
Spurge Hole		Pennard Swansea	Cave	In a steep cliff, near Southgate Gower and forms a water-worn, low, south-facing arch	Human remains of one skeleton were discovered across the entrance, close to the surface in the correct anatomical order. Context information is fragmentary (layers) with half the elements having no stratigraphy. On the basis of morphology c. 3 individuals are present	Series of excavation (backfilling and built wall across the entrance) and subsequent disturbances by scavengers	Intact
Red Fescue Hole		Rhossili Swansea	Rock Shelter	Low-roofed coastal cave in a sheltered dry valley with a stepped bedrock platform at the entrance	Unstratified and disturbed human remains. Only specification: upper disturbed layer containing animal bones and lower brown cave earth with sub-angular limestone fragments	Disturbances (e.g. trampling) and rock collapse	Highly disturbed
George rock shelter		Wenvoe Vale of Glamorgan	Rock shelter	Lies on the south-west site of Cwm George (on a limestone outcrop)	Stratified (five contexts) - Human bone excavated predominately in contexts 1002 and 1004.	Tufa deposits/residues on elements	Intact
Pitton Cliff Cave		Rhossili Swansea	Cave/rock shelter	Located in a small private sycamore wood along a path that leads to Mewslade. Part of a series of solution cavities, phreatic in nature	Unstratified - One element (human calcaneus) was discovered in the main chamber amongst animal bones and mussel shells at 20cm depth.	Stalagmite residues and disturbance (modern).	Originally blocked by rubble, now possibly intact

Ifton Quarry	South-east Wales	Rogiet Monmouthshire	Old rock shelter or fissure	Located at the south end of a carboniferous limestone area that incorporates the Forest of Dean and the Wye Valley	Unstratified - Human remains were recovered from a narrow area underneath a projecting shelf of limestone near the summit of a steep slope.	Erosion and quarrying. Excavated by a quarrying company and not professional archaeologists.	Destroyed from quarrying
Little Hoyle Cave (Longbury Bank Cave)	South-west Wales	Penally Pembrokeshire	Cave	Small cave, which lies on the NE end of the ridge of a promontory (26m OD) within a limestone ridge (Lonbury Bank). Collapsed (solution) doline rear entrance.	Unstratified - Human remains were discovered in an infilled chimney (roof depression) that connects the two cave entrances	Series of excavation (disturbances and possible backfilling), collapsed roof, and water wear.	Possibly disturbed after the series of excavations
Nanna's Cave		Caldey Island Pembrokeshire	Cave/rock shelter	Naturally hollowed in carboniferous limestone and lies near the top of coastal cliffs. Can also be found about 140m south-east of Den Point and the north coast of Caldey Island	Unstratified - Human remains were discovered from the lower part of layer b (no specification) and had patches of stalagmite. A few elements have given context information, however the majority is unstratified	Series of excavation, backfilling, stalagmite residues	Highly disturbed
Hoyle's Mouth cave		Penally Pembrokeshire	Cave	Lies in the outlier (younger rock formation amongst older) of carboniferous limestone in the parish of Penally approx. 21.3m above sea level	Unstratified - Human remains were discovered in different areas: (A) mouth of the cave and (C) chamber (rough estimates from 1882 plan of the cave) – no other record exists	Series of excavation, backfilling and disturbance. Stalagmite and angular fragments of limestone covered the passages and chambers	Unknown (possibly disturbed?)
Ogof-yr-Benglog (New Cave/Skull Cave)		Caldey Island Pembrokeshire	Cave/rock shelter	Small cave or rock shelter on the northeast corner of Caldey Island on carboniferous limestone	Unstratified - A human skull with the mandible missing that had entered the cave/rock shelter possibly by accident (rolling downslope) due to quarrying activity in the area. No record of the cranium exists, only vertebrae fragments (one vertebra)	Quarrying in the area and a nearby cave may have caused disturbances	Unknown/partly collapsed
Priory Farm Cave		Monkton Pembrokeshire	Cave	Located on a valley-side above the Pembroke River (about 9 km from the coast) in a heavily quarried outcrop of Carboniferous limestone. It forms an outer	Human remains were discovered within the cave (layer 2) amongst animal bones and a Middle or Late BA hoard. Four loose teeth (with the remaining	Disturbances from excavation, constructed wall in the inner tunnel, disturbance from scavengers (hyena den)	Unknown

				shelter/entrance, divided by a narrow-raised ridge of limestone from the inner tunnel	body eroded away) were found in the correct anatomical order at the bottom of a thick shell midden outside the cave		
Ogof Garreg Hir		Stackpole, Pembrokeshire	Cave	Situated approx. 21m down a sheer 46m high cliff on the Carboniferous Limestone outcrops of South Pembrokeshire; one of a series/group of caves along the Castlemartin Cliffs	Unstratified - Human remains (3 elements) discovered in the first 2.5m metres of the cave where excavation took place	Storm-wave action/disturbances, coastal erosion, stalagmite/concretion residues	Half disturbed/half intact
Ogof Brân Goesgoch		Stackpole, Pembrokeshire	Cave	Cave located in the Castlemartin Cliff on the Carboniferous Limestone outcrops of South Pembrokeshire (not far from Ogof Garreg Hir).	Unstratified – Human remains (3 elements) discovered after burrowing activity in the cave	Disturbances from scavenger activity, concretion residues	Disturbed and inaccessible
Cae Gronw Cave	North Wales	Cefnmeiriadog, Denbighshire	Cave/rock shelter	A shelter type cave on the north-east side of the Elwy valley on Carboniferous Limestone c.300m north of Pontnewydd Cave	Stratified – human remains were recovered from hillwash deposits (layer 1/heavily disturbed by burrowing animals and root action)	Backfilling and disturbance by scavengers	Intact
Ogof Colomendy		Gwernymynydd, Flintshire	Cave	Cave situated on a limestone outcrop (facing south), about 5km west of Mold with a triangular-shaped entrance, 1.4m high and 1m wide	Unstratified- Human remains were recovered from a small highly disturbed area (possibly no. 47 in recent 2015 excavations)	Disturbances (root action and possibly by scavengers) and quarrying	? Intact
Orchid Cave		Llanferris, Denbighshire	Cave	West facing cave situated near Big Covert at the base of a Limestone cliff running approx. north-south	Unstratified – excavations were conducted by cavers; no official reports or context	Disturbances by cavers (some elements were left in a plastic bag in the cave after being discovered) subsequently affecting preservation; scavenger activity	Disturbed
Pontnewydd Cave, (Bont Newydd Cave)		Saint Asaph, Denbighshire	Cave	Located at the Elwy Valley close to the western edge of the Vale of Clwyd where the main outcrop of Carboniferous Limestone in north Wales is situated	Unstratified (radiocarbon dated remains) – Area A/re-deposit material. Stratified – (Areas D, F).	Backfillings/debris from number of excavation, possible scavenger disturbance (abundance of faunal remains)	Inaccessible (to the public)
Gop Cave		Trelawnyd &	Cave (interco-	Natural limestone cave (interconnected rock shelter and	Unstratified- available human remains from 1908-1914 and	Series of excavations, blockage by debris, disturbances by	Intact/ Good

		Gwaeny sgor, Flintshire	nnected cave and rock shelter)	cave) located at the end of the line of hills and forms the east boundary of the Vale of Clwyd near Prestatyn approx. 50m to the south of the archaeological site of Gop cairn	possibly 1920-21 excavations (north-west cave passages, outside cave platform) – original 14 individuals in Chamber B (1968 excavations) lost	scavengers, stalagmite and stalactite residues, water wear from the roof	
Ogof Pant-y-Wennol		Llandudno, Conwy	Cave	Large coastal cave located at the Carboniferous Limestone outcrops of Llandudno with a wide entrance approx. 5.2m wide by 8.6m long and 3m high, protected by an overhanging rock	Unstratified – human remains discovered from disturbed areas inside and outside the cave as well as two fissures near the entrance of the cave (no plan/sections); several elements were scattered	Disturbances (landowner constructed a wall using tufaceous stalagmite from the cave floor as binding material); burials in fissures might have also been discovered prior excavations begun; stalagmite residues (some materials are completely embedded in stalagmite)	Disturbed?
Little Orme's Head Quarry		Llandudno, Conwy	Natural fissure	Situated at Little Orme's Head, Llandudno, formed of Carboniferous Limestone (Middle White Limestone) reaching an elevation of c.122m.	Unstratified – human remains discovered at c.46m OD after Little Orme's Head Limestone Company opened a large quarry on the north-eastern coast of the headland revealing a number of fissures	Area actively quarried; the remains however where in c.28m deep fissure and the individual must have accidentally fallen into the fissure remaining undisturbed from scavengers due to the position in the fissure	Inaccessible
Backwell Cave	North Somerset/Mendip	Backwell, North Somerset	Cave/ rock shelter	Small and almost rectangular in shape cave is situated in the Parish of Backwell (east), approx. and 10 miles to the north of Mendip (northern side of Broadfield Down) formed along the line of a wide calcite spar or vein in the limestone ridge	Unstratified- human remains were recovered from three different areas (O.S.H; D.B.D; undisturbed deposits) with no records of exact positioning of elements; the largest quantity of human remains was recovered from pits inside and at the mouth of the cave	Disturbances (possible successive depositions; burrowing animals, root erosion, quarrying)	Intact

Table 2. Sites examined in this research divided by region (south-central, south-west, south-east and north Wales and north Somerset), broader regional and geomorphological groups, individual cave morphology, state of remains and preservation (impacted by natural or human action).

### 2.2.2. Study area: North Somerset

The single site outside Wales lies in the Mendip Hills, near Bristol. The Mendip Hills extend east of the Bristol Channel, with the western end formed 200 meters above the Somerset levels and their eastern end ‘submerging’ beneath the Jurassic scarplands (ibid., 181). The karstic landscape of the Mendips’ carbonate succession mainly consists of sequences of the Lower Carboniferous limestones (Dinantian) (Figure 8) (Waltham *et al.* 1997: 181).

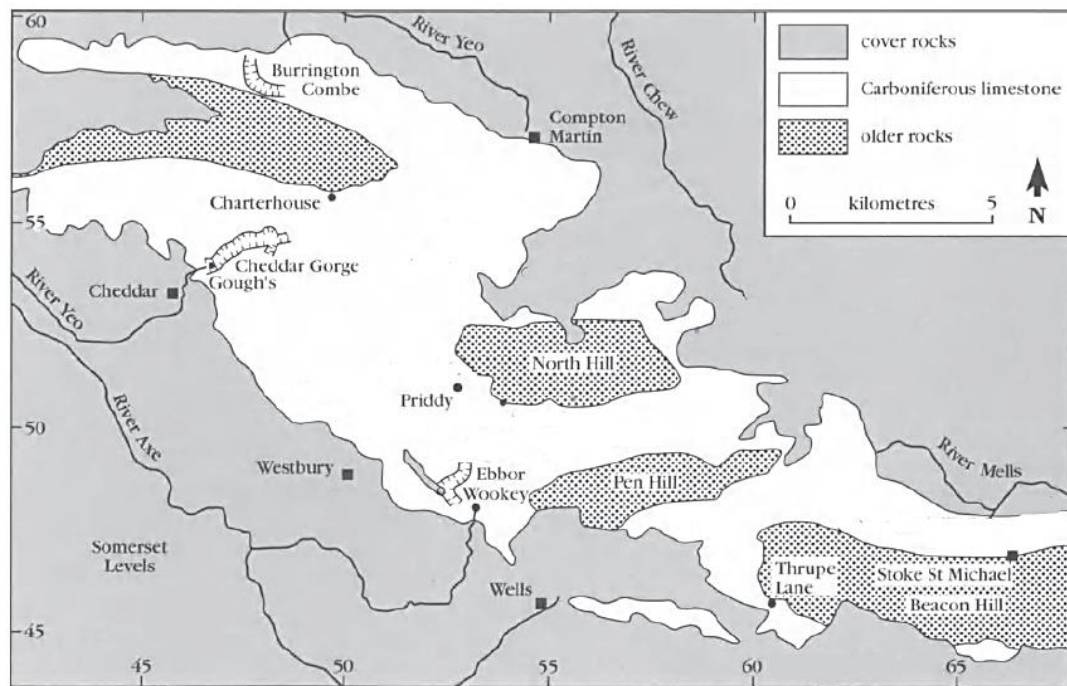


Figure 8. Map of the Mendip Hills’ karst showing the extent of carboniferous limestone covering the area. Characteristic caves groups of fluvial karst gorge mentioned in the text, are also illustrated (modified from Waltham *et al.* 1997: 181).

A large number of cave systems have been shaped in the Mendip karst due to the erosional nature of the limestone sandstones which further create drainage into the limestone down to the core of the karst (ibid., 182). These sinking streams connect underground and circulate through numerous caves, a phenomenon mostly prominent in the western ends of the Mendip plateau (ibid.). Resurgent caves, dolines (depressions) and swallet systems are then formed in the karst, displaying morphological varieties (ibid., 183). Known examples include swallets at Priddy and Charterhouse and sinkhole caves that drain to the resurgent caves at Cheddar and Wookey (ibid.). Examples of characteristic groups of fluvial karst gorge in the Mendip

Hills include: Burrington Combe<sup>24</sup>; Charterhouse caves<sup>25</sup>; Cheddar Gorge and Cheddar caves<sup>26</sup>; Priddy caves<sup>27</sup>; Wookey Hole caves<sup>28</sup> (ibid., 183-205).

Full taphonomic evaluation of sites outside of Wales is beyond the scope of this research, however this one site was selected for comparative study based on available radiocarbon dates (Neolithic) and availability of human remains for analysis targeted histological analysis (see Chapter 5/5.5.1 for more details).

The study site of Backwell is located in the modern county of north Somerset and comparative analysis can identify funerary process or variations suggesting regional or even localised traditions. Tables 2 and 3 provide data on site, region/geomorphology, analysis and preservation with the location indicated on Figures 7 and 9.

<b>SITE</b>	<b>REGION</b>	<b>ANALYSIS (PRIMARY)</b>
Backwell Cave	Backwell, north Somerset	Microscopic

Table 3. Site in north Somerset

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<sup>24</sup> Eroded dry valley with a large number of cave systems (e.g. Aveline's Hole) (Waltham *et al.* 1997: 183).

<sup>25</sup> Systems of underground swallet caves with varied morphologies and with a long history of detailed studies (e.g. Goddard 1944; Ford 1964; Atkinson *et al.* 1967; Barrington and Stanton 1977; Farrant 1995)

<sup>26</sup> Groups of astonishing limestone gorge (dry valleys) and sequences of resurgences that form cave systems (Waltham *et al.* 1997: 192).

<sup>27</sup> Outstanding examples of phreatic swallet caves in steeply limestone (Ford 1965; 1968; Waltham *et al.* 1997: 199).

<sup>28</sup> Wookey Hole is the only large cave in Britain formed of two distinct karst rocks (Carboniferous Limestone and Triassic Dolomite Conglomerate, a well-cemented fossil scree) and constitutes one of the first examples of deep phreatic cave development in Britain (Waltham *et al.* 1997: 203).

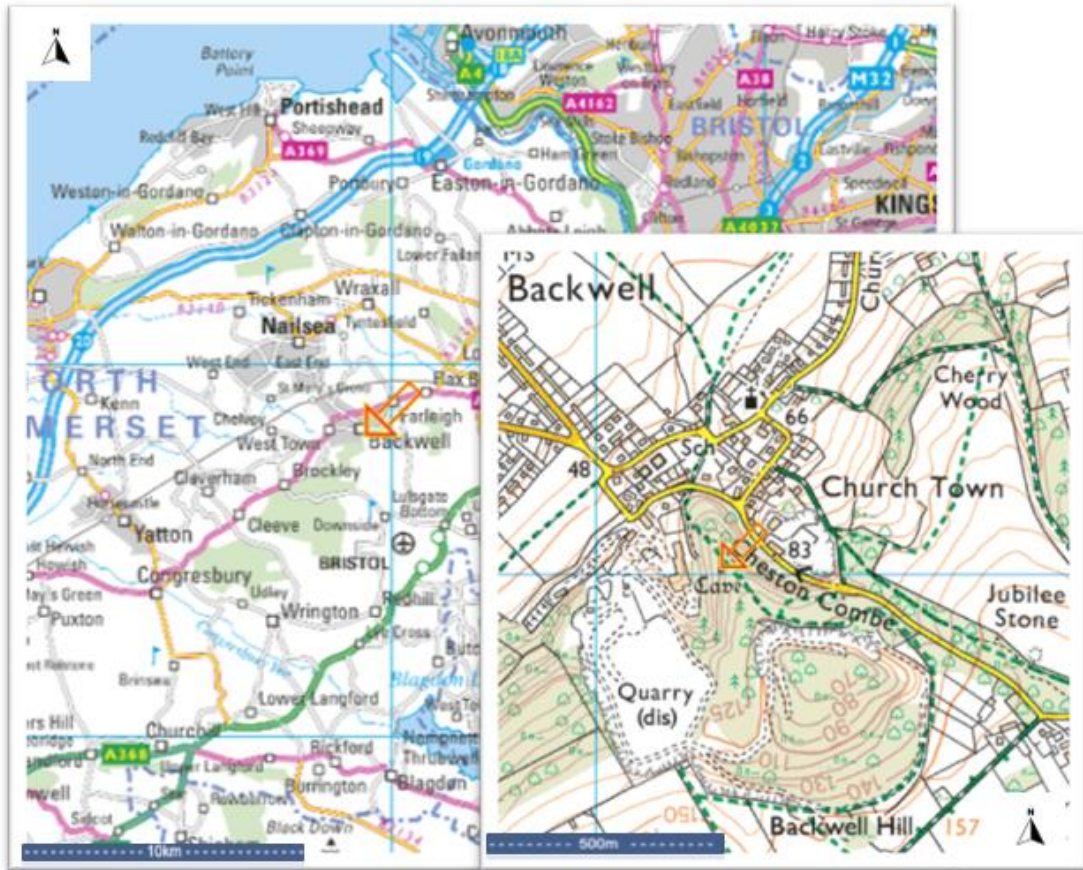


Figure 9. Location of Backwell cave, Backwell, north Somerset (www2)

### 2.3. Cave archaeology: parameters that affect archaeological deposition

Natural caves, rock-shelters and fissures are locations which can preserve and protect archaeological remains acting as ‘ready-made traps’ (Strauss 1990: 256; Holderness *et al.* 2006: 1). These naturally enclosed spaces could have acted as a shelter that allowed the occupants to observe their surroundings from a position of security (Holderness *et al.* 2006: 1) and have been associated with material (e.g. human and animal bone and artefacts) and their preservation. Caves and their assemblages are impacted by a variety of distinct factors including erosion, water displacement, soil composition and human/animal action (Klimchouk 2004: 420). Whereas human remains deposited in caves are insulated from extreme forces of erosion (Holderness *et al.* 2006: 1) compared to open-air locations, they are still very susceptible to the inconsistent fluctuations of cave environments. These factors are discussed in more detail below.

### **2.3.1. Erosion, water displacements and disturbances**

Caves, rock-shelters and fissures are subject to erosion and disturbances (Strauss 1990: 260). Many cave systems form horizontal and/or vertical shafts over time (ibid 257) due to water and erosive forces. Seismic activity can further cause breaching (rock fall, sediment and rock accumulations, collapses, even gradual blocking of entrances/shafts), resulting in gradual transformation of the caves (ibid.). Moreover, animal scavenging and displacements by trampling and ground movement result in movement and disturbance of interments and materials within the cave. This further impacts their preservation and creates a barrier to the reconstruction of their burial history.

Rainwater makes its way into the limestone rocks and cave systems through streams, where it can physically displace material (Williams 2004: 1022). The path of rainwater filtering can be affected by vegetation, soils, rock mineralogy and the volume of rain. The chemistry of rainwater can also result in the dissolution of the rock and is dependent on the degree of acidity. Autogenic waters are mainly acidified by carbonic acid and allogenic waters can obtain organic acid which can disarticulate and modify the bone in cave environments (ibid.).

### **2.3.2. Soil compositions**

Soil chemistry and temperature can impact the depositional history of a cave and the preservation of human, animal remains and associated artefacts (e.g. alkaline versus acidic soil pH) (Lowe 1989: 3). South-west Wales, for example, is generally composed of acidic soils which accelerates the rates of bone degradation, and have ultimately affected bone survival and preservation of remains and artefacts. Alkaline soils on the other hand, favour the preservation of human/animal remains. The soils in the caves located in south-west Wales (e.g. Spurge Hole and George Rock Shelter) have particularly impacted the survival of human remains and are discussed in Chapter 5. Human remains were severely impacted by erosive processes whilst soil acidity further led to the degradation of those remains.



## **2.4. Cave archaeology and human burial**

Caves constitute challenging study areas as their archaeological significance is often identified at the point when their deposits and contents are destructively and invasively examined (Holderness *et al.* 2006: 2; Chamberlain 2012: 81). The following sections will clarify the gaps in older and current approaches in cave archaeology whilst emphasizing that further research and more holistic and multi-level analyses are required to understand past human behaviour through the fragmentary archaeological record.

### **Cave archaeology and Neolithic mortuary practices**

A variety of different burial treatments have been noted throughout prehistory, and specifically throughout the Neolithic, however these were not isolated events but were part of a wider range of mortuary practices which need to be examined systematically and thoroughly before drawing definite conclusions. Studies on caves have primarily categorised them either as spaces of ritual activity (e.g. human burials, cave art, votive depositions) or human subsistence (e.g. storage, occupation) (Chamberlain 2012: 82).

There has been a long history of research that aims to understand the mysticism of caves either as domestic or ritual spaces (Moyes 2012: 1). Analyses and discussions on mortuary practices have been heavily influenced by anthropological and ethnographical research. Anthropological research, philosophy and ethnography were first used as a mean of deciphering ‘primitive religion’ and mortuary practices (e.g. Tylor 1871; Frazer 1886; Radcliffe-Brown 1922; Malinowski 1948; Hertz 1960)<sup>29</sup>. Anthropological research on death has been used as a mean of analysing past human behaviour (Binford 1971: 6; Bonsall and Tolan-Smith 1997; Galanidou 2000), such as a ritual use of caves (i.e. cave art, human burials and ‘votive’ depositions) or a subsistence related use (i.e. human occupation, activities and storage). Ethnographical parallels were further used to comprehend complex funerary practices at a time when interest in social anthropology was high (Parker Pearson 1999: 22).

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<sup>29</sup> Gennep 1960; Huntington and Metcalf 1979.

Themes and notions of mortuary treatment were developed by van Gennep (1960) and Hertz (1960) who established an association amongst liminality, transition, transformation (Parker Pearson 1999: 22). Rites involving separation, dispersal and mixing of bone were associated to van Gennep's (1960) rites of passage which involve separation, liminality and incorporation of the body in each original state. This notion was further adopted in cave research (e.g. Leach 2008; Moyes 2012) where the vast majority of human remains were discovered in a highly fragmentary and disarticulated state and were linked to the mysticism and the transformative nature of caves. Philosophers Alberto Casati and Achille Varzi (1994), considered that due to their distinct morphologies, from hollows to crevices and cavities with no access to light or twilight areas, caves could have been regarded as liminal spaces where humans interacted in the presence of death (Gunn 2004; Culver and White 2004: 81; Moyes 2012: 5).

Concurrent studies on monumental burials where disarticulated remains were discovered (e.g. Wysocki and Whittle 2000; Whittle *et al.* 2011) further discussed the existence of primitive religion and beliefs in the ancestors through genealogy (Whitley 2002). Researchers created associations between the notion of personhood and the transformative nature of human bone (Thomas 2000, 2002a; Fowler 2001, 2004, 2005)<sup>30</sup> which further enhanced different approaches and argumentation over distinct means of cave burial. Further work issued correlations amongst bone reworking and time and memory in 'open' versus more confined sites (e.g. caves) resulting in more robust theoretical scenarios over site selection for burial (e.g. Thomas 1991; Jones 2002, 2005b, 2007, 2008: 190-96).

The fragmentation of the body therefore has been acknowledged either as the result of multi-stage rite (i.e. disarticulation and circulation of human bones for reburial) or of taphonomic processes that impacted the bones throughout the Neolithic (Peterson 2019: 2). The latter argument has remained underdeveloped and a comprehensive and consistent examination of the remaining human deposits on a more holistic basis has lagged behind in cave research.

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<sup>30</sup> More examples include: Jones 2005a, 2005b; Pollard 2005.

As will be discussed later, studies of prehistoric funerary archaeology have created imprecise understandings about cave burials due to the fragmentary and disarticulated state of the human remains discovered in caves. Researchers still cannot draw definitive parallels between cave burials and other recorded mortuary patterns in this period (Peterson 2019: 2).

The next section is a brief history of cave studies and earlier research across Britain and, more specifically, in the Neolithic and emphasizes the urgent need for more detailed methods of analysis for the study of cave assemblages.

## **2.5. Cave research across Britain**

Neolithic cave burial, the focus of this study, emerges from an earlier tradition. The chronological pattern of human deposition in caves reveals early burial activity associated with the successive recolonizations of Britain by hunter-gatherers, during the Late Glacial Interstadial (c. 13.000 BP- 10.800 BP) and Early Holocene (c. 10.000 BP-8000 BP) (Chamberlain 2012: 82; 1996). This decreases in intensity during the seventh-fifth millennia BC (Late Mesolithic) (ibid.). A peak in cave burials followed around the fourth millennia BC (Early Neolithic) and continued into later prehistory (ibid.). Schulting (2007: 586) considers that the gap of two millennia between early Mesolithic and early Neolithic cave burial does not indicate any continuation of burial practices. However, a single human tooth (c.5730-5560 BC) from Foxhole Cave, Glamorgan (Pettitt 2000) and a human tibia (c.4490-4070BC) from Fox Hole Cave in Derbyshire (Chamberlain 2001) are exceptions to this theory (Schulting and Richards 2002; Schulting 2007: 586).

The term *cave burial* is generally defined the placing of human remains within a cave, including the deposition of intact bodies and disarticulated remains (e.g. Chamberlain 2012: 81). Cave burial has been used to refer to both the burial of bodies within cave sediments (inhumation) and to the placement of bodies on the surface of cave deposits (deposition). The term is analogous to similar usage when referring to other archaeological sites such as 'cist burial' or 'burial in chambered tomb'. In this context, the range of archaeological remains discovered within caves constitute amalgams of various activities that require thorough examination to decipher their origin.

The recovery of large amounts of disarticulated human remains from caves across Britain has led to a series of explorations and analyses of assemblages (e.g. Schulting and Richards 2002) that built on top of earlier research. During the 19th century (1816), Joseph Whidby conducted a systematic survey in a fissure at Oreston, near Plymouth (Jackson 1962: 255). His survey resulted in the identification of caves as unique environments that encompass archaeological and palaeoenvironmental material. Following explorations in 1821 by Dr Buckland, explorer of the Kirkdale cave near Helmsley north Yorkshire, laid the foundations for extended investigations of caves (ibid., 256). Subsequent reviews of cave archaeology in Britain created a more thorough portrayal of cave research (e.g. Boyd Dawkins 1874, 1901; Davies 1949, 1989a, 1989b)<sup>31</sup> compared to earlier audits and reports (Valdemar 1970; Barton and Colcutt 1986; Brook <sup>32</sup>.

Following Waltham *et al.*'s (1997) publication, which identified the five distinct areas in Britain with major cave systems of carboniferous limestone, interest in British caves developed. Older partial reports and initial surveys (Allen and Rutter 1948; Simpson 1938, 1950; Ashmead 1973; Gilks 1975)<sup>33</sup> laid the foundation for more comprehensive publications (Aldhouse-Green *et al.* 2012; Waltham and Lowe 2013; Hankinson 2015; Leach 2015; Peterson 2019) and online databases including Chamberlain's Gazetteer of English Caves, Fissures and Rock Shelters Containing Human Remains website (2014)<sup>34</sup>; the British Cave Research Association (www3); Caves of south Wales (www4); Caves of north Wales (www5). A great amount of material recorded in the first phases of cave excavations in Britain, nonetheless, was either been poorly documented, scattered in museums and private collections or lost (Gilks 1989: 13; Chamberlain 2012: 82; Leach 2015: 1) and therefore the depositional history of the excavated sites is inhibited by poor interpretative analyses.

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<sup>31</sup>More examples include Cullingford 1962; Jackson and Mattinson 1932; Jackson 1938, 1962; Waltham 1974; Oldham 1986, 1991.

<sup>32</sup> More include: Brook *et al.* 1991; Trent and Peak Archaeological Trust 1993; Brook *et al.* 1994; Chamberlain and Ray 1994; Tolan-Smith 2001; Holderness *et al.* 2007.

<sup>33</sup>More examples include Gilks 1976, 1988, 1989, 1995; Dowd 2001; Cant 2006.

<sup>34</sup> Which is part of the Cave Archaeology and Palaeontology Research Archive (CAPRA).

Caves are still not extensively considered a vital feature of the British landscape of equal archaeological importance to burial contexts (Holderness *et al.* 2006: 4). Of the 481 caves sites across Britain recorded on the NMR in 2001 (English Heritage 2003; Last 2003: 3; Holderness *et al.* 2006: 7) and/or on the Cave Database System, which is maintained by the International Geographical Union, most are still not extensively examined for burial. Distinct forms of art within Palaeolithic caves constituted the first examples of extended research on liminality and the use of caves as cult shrines which defined an interaction amongst death and art (Burkitt 1933: 117; Faulkner 1988; Hole and Heizer 1965: 47; Whitehouse 2001: 163; Moyes 2012: 7). This idiocracy, however, created gaps in cave research as focus on the transitional properties of the cave and lack of systematic research of human/animal remains and associated artefacts has only created more enigmas about the use of caves in prehistory. The older partial reports, the limited awareness of developing effective techniques for carefully controlling stratigraphy (e.g. Bordes 1975; Strauss 1990) and the immense issues in cave taphonomy has stunted research development on cave archaeology. No interpretation can be definite (Chamberlain 2012: 82) and more robust analyses (e.g. provision of new radiocarbon dating evidence, osteological analyses of commingled remains, isotope analyses) are required to decipher the origin of cave assemblages.

The next section discusses current archaeological research and the history of excavations on Neolithic cave burials across Britain. This review of earlier research across three major cave groups emphasises the urgent need for more detailed methods of analyses and reviews on cave assemblages. A combination of methods is therefore required to better understand cave burials (compared to other forms of burial).

## **2.6. Neolithic cave research across Britain**

The Neolithic period in Britain has been the subject of continuous controversies and debates (e.g. Dennell 1985; Pollard 1997; Thomas 1999, 2003, 2012)<sup>35</sup>. At this time human remains are recovered from various contexts across Britain (Thurnam 1872: 288; Chamberlain 1996; Bristow 1998; King 2001: 324) with monumental burials and

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<sup>35</sup> More examples include Whittle 1999; Whittle and Cummings 2007; Gronenborn and Petrasch 2010; Whittle *et al.* 2011; Deguilloux *et al.* 2012; Brace *et al.* 2019.

open-air sites the prime focus of archaeological research (e.g. Whittle 1999; Whittle 1999<sup>36</sup>; Cowell 2000; Ray and Thomas 2003; Whittle and Cummings 2007) with less attention paid to human remains discovered in caves.

Researchers have considered the relationship between the various burial rites at this time. Barnatt and Edmonds (2002: 114) concluded that Neolithic cave burials might have a link to monumental burial due to their formations (in rock outcrops), being reminiscent of monumental constructions. Malone (2001) and Oswald *et al.* (2001) however, suggest that the frequency of cave burials in specific regions might relate to the low prevalence of monumental burial. On the other hand, radiocarbon dating provides evidence for concurrent use of caves and other contexts for burial throughout the Neolithic (Chamberlain 1996, 1997: 6) with some examples in close proximity (e.g. Spurge Hole - Penywylod, Pipton and Ty Isaf long cairns). Therefore, Malone's (2001) and Oswald *et al.*'s (2001) argument is inconclusive.

Patterns of possible selectivity in above-ground and non-monumental burials have been examined (e.g. Kinnes 1992). Chamberlain (1997: 6) for example, examined the frequency of immature individuals discovered in caves (39%) versus those in long barrows (25%) which was based on the high mortality rates of early agricultural populations (40% mortality before adulthood). Results suggested that depositions in caves involved practices of selectivity of immature individuals compared to above-ground monuments where adults were preferably deposited (*ibid.*) Chamberlain (*ibid.*) proposed that a combination of easy access, uninterrupted and repeated use and the mysterious cave atmosphere might have been responsible for the higher rates of immature burials in caves. This argument however was inconclusive as comparisons between the demographic profiles of above-ground monumental versus cave burials have not been established holistically across Britain for this time (Schulting 2007: 8).

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<sup>36</sup> And Whittle *et al.* 2011.

Chamberlain's (1997: 6, 2012: 83) analysis of direct Neolithic radiocarbon dates from caves presents robust evidence for deliberate human depositions and not random and/or natural episodes that occurred in limestone<sup>37</sup> (Figure 10).



Figure 10. Examples of limestone areas where Neolithic cave burial activity has been detected: the Peak District, north and south Wales, Mendip and Devon (Chamberlain 2012: 82).

Cave burials are practiced through later prehistory and into the first millennium AD therefore, presence of human remains is not supported by accidental deaths or natural depositional processes (e.g. result of scavenger activity) (ibid.). Cave burials in prehistory are therefore an intended act, rather than coincidental or accidental deposition (Chamberlain 2012: 83). This conclusion is supported by earlier analysis from 100 caves from the limestone regions of the Peak District and Yorkshire Dales in central Britain (Holderness *et al.* 2006: 105-106). In this area finds of human/faunal remains, prehistoric artefacts and a separate assemblage of historical artefacts (glass, metalwork, worked bone and coins) further demonstrates the direct association of

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<sup>37</sup> Most of Britain's caves and karst landforms occur on the limestones of the Lower Carboniferous (Waltham *et al.* 1997: 16).

human remains and artefacts which suggests intentional and not accidental depositions (Chamberlain 2012: 83).

These results have raised more questions about cave burials. Reviews and analyses on Neolithic cave burial across Britain (discussed below), will clarify the approach of researchers on cave burials followed by examples of targeted analyses in three major regions.

## **2.7. Neolithic cave burials**

### **Background and gaps**

Archaeological assessment of caves in Britain has underlined the urgent need for a more consistent and holistic examination of caves and above-ground monuments (Bradley 2000: 43; Schulting 2007). The poor quality of previous research on caves and the lack of proper documentation has further emphasized that more systematic analyses are required to accurately interpret past human behaviour (Last 2003: 2; Chamberlain 2012: 82).

Several reviews (e.g. Boyd Dawkins 1874; Cullingford 1962; Jackson 1962; Waltham 1974) have contributed to current knowledge but all emphasized the lack of assessment of post-Palaeolithic sites compared to research on burials in Upper Palaeolithic caves (Aldhouse-Green and Pettitt 1998; Bahn *et al.* 2003; Lewis-Williams 2004; Jacobi and Higham 2009)<sup>38</sup>. Jackson's (1962) all-period review on caves, however, was followed by sparse excavation documentation and short audits on Neolithic cave burials (Valdemar 1970; Everton A. and Everton R. 1972; Waltham 1974; Barrington and Stanton 1977; Green *et al.* 1986)<sup>39</sup>. Gilks (1989) was the first researcher to examine prehistoric burials by comparing frequencies of skeletal remains and prehistoric artefacts excavated from caves in northern England (Chamberlain 2012: 82).

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<sup>38</sup>See also Boyd Dawkins and Busk 1870; Boyd Dawkins 1874; Paine and Keith 1928; Davies 1949; Beresford 2011; Dowd and Hensey 2016; Nash *et al.* 2012; 2013; 2016.

<sup>39</sup>See also Oldham 1986; Brook *et al.* 1988; Davies 1989a; b; Gilks 1989; Branigan and Dearne 1991; Brook *et al.* 1991; Brook *et al.* 1994; Chamberlain 1996; Holderness *et al.* 2006; Lord and Howard 2013; Dinnis and Ebbs 2013; Waltham and Lowe 2013, 2017; Simmonds 2014; Hankinson 2015; Leach 2008.



Older reports and surveys (e.g. Gilks 1988, 1989; Ford 1989; Dowd 2001; Cant 2006)<sup>40</sup> however, laid the foundation for more recent research including excavations (e.g. Aldhouse-Green *et al.* 2012) reviews (e.g. Waltham and Lowe 2013, 2017; Simmonds 2014; Hankinson 2015; Leach 2015; Peterson 2019) and online databases (Chamberlain 2014; www3; www4; www5; www6)<sup>41</sup>. These have revealed a wide range of uses of caves across Britain from domestic occupations to places of burial and possible ritual activity (Last 2003: 2). Chamberlain (1996, 1997) documented directly dated Neolithic human remains from caves across Britain. The provision of 160 radiocarbon dates<sup>42</sup> (e.g. Schulting *et al.* 2019; Schulting 2020) identified 60 Neolithic individuals with approximately 300 closely associated with this period and confirmed a peak in cave use for burial from about 4000 BC to 2200 BC (Chamberlain 1996, 1997, 2014: 82). These results underlined a clear chronological pattern of mortuary deposition in caves from the start of the Neolithic.

A few recent publications have particularly focused on certain regions and contexts (e.g. Leach 2015), however research is still undeveloped. The poorly documented reports, the unexamined human/faunal remains and material from caves have created a barrier for more holistic approaches. Researchers (e.g. Peterson 2019), however, have aimed to create a more thorough understanding of cave use in the Neolithic by combining different methodological approaches.

The creation of an online Gazetteer of English Caves, Fissures and Rock Shelters Containing Human Remains (Chamberlain 2014), compiled by Chamberlain, Williams and Strenski in 1999, improved knowledge on archaeological caves. The database consists of c. 174 sites of which 63 (37%) are either undated or given only a general chronology (e.g. Mesolithic, Late Neolithic or Early Bronze Age) (Last 2003: 8). However, the majority of cave burials within the database are either Neolithic or Bronze Age (*ibid.*) which makes research on prehistoric sites clearer.

Overall, due to the lack of systematic efforts to appraise post-Palaeolithic sites, only a small number of caves have been investigated thoroughly. The increase in dating

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<sup>40</sup> Allen and Rutter 1948; Simpson 1950; Ashmead 1973; Smith 1975.

<sup>41</sup> www7; www8.

<sup>42</sup>With more available – this PhD (see 5.2.5).

evidence (Hedges *et al.* 1993; Alhouse-Green *et al.* 1996; Schulting and Richards 2002; Leach 2008, 2015)<sup>43</sup> has encouraged research and analysis on certain aspects of Neolithic life (e.g. the use of cave burial versus burials in open-air sites) and a focus on the three major cave burial regions including northern England, Wales and Somerset. These pieces of research are presented below to examine prior approaches to underline current gaps in Neolithic cave burial research.

### *2.7.1. Northern England: The Peak District and Yorkshire Dales*

Research in northern England has focused on determining selectivity of the individuals for burial in caves based on age, taphonomy, pathology and processing of bone. Reviews, radiocarbon dating programs and short comparisons of above-ground monuments and caves have further endorsed more research on cave burials in this region.

Gilks's (1989: 14) initial survey of the Neolithic caves of northern England revealed that they were preferred sites for the burial of both corpses and skeletonized remains when compared to the small number of burials in chambered tombs and long cairns in the Peak District (Figure 11). Surviving human remains were originally considered either Late Neolithic or Early Bronze Age solely based on associations of surviving artefacts from the sites (Keith 1936; Raistrick 1936; Simpson 1950; Jackson 1962; King 1970)<sup>44</sup>. However, a radiocarbon dating programme by Ramsey in 1995 and 2001 provided a solid chronological framework for a complete analysis of human remains in northern England (Leach 2008: 37).

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<sup>43</sup>See also Schulting *et al.* 2010; Schulting *et al.* 2013; Schulting *et al.* 2019; Schulting 2020

<sup>44</sup>See also King 1974; Gilks 1975; 1976; 1888; 1989; Pierpoint 1984; White 1997; Manby *et al.* 2002.



Figure 11. Locations of the Peak District, the Yorkshire Dales and north York Moors

Leach (2006, 2008, 2015) reanalysed the skeletal remains, and associated material, from more than 20 caves located in the Yorkshire Dales and north York Moors (Figure 11). By examining a range of taphonomic modifications of the human remains she identified differentiation in treatment amongst Neolithic cave assemblages (e.g. Lesser Kelco, Sewell's Cave, Thaw Head Cave, Cave Ha, Jubilee Cave). Results suggested either seasonal depositions or deliberate manipulation of human remains (Leach 2008: 50). Diverse treatment amongst human remains was noted based on age, pathologies, element completeness and random/deliberate placement of the bones in parts of the caves (Leach 2008: 36). Leach (2008: 51) further suggested that the presence of granular tufa (actively forming in the limestone) retained the skeletal remains (e.g. in Cave Ha and Thaw Head Cave) and is therefore indicative of deliberate placement of the dead within the cave's formation as part of a mortuary practice to preserve human

remains and sustain memory throughout time. The same phenomenon was observed in Totty Pot (Schulding *et al.* 2010: 81; Peterson 2013: 269), Chelm's Coombe and Flint Jacks Cave, Somerset, in Nanna's Cave and Ogof-yr-Benglog, Caldey (Aldhouse-Green and Peterson 2013: 14) and George Rock Shelter, Glamorgan (Peterson 2013: 268).

Lord and Howard (2013: 243) further created a short review of all available archaeological excavations in the Yorkshire Dales including results from earlier research (e.g. Leach 2008). Signs of manipulation of human bones along with smashed domestic cattle bones were present in four Early Neolithic sites (Kinsey Cave, Sewell's Cave, Lesser Kelco Cave, Cave Ha 3) (Lord and Howard 2013: 244-5). A Late Neolithic smashed human femur (Greater Kelco Cave) possibly revealed unusual treatment of the body and signs of deliberate manipulation (*ibid.*). Analyses from subsequent archaeological surveys in the Peak District, suggested that human remains may have been deposited in caves that were positioned at higher altitudes (Chamberlain 2012: 83).

### 2.7.2. *Wales*

Archaeological research in Wales has focused on diet by examining spatial and chronological patterns amongst sites (e.g. caves themselves and caves and monuments). A study by Schulding and Richards (2002: 1021) used stable isotope analysis to compare the dietary preferences of people interred in monuments and caves, and patterns of food consumption between the Mesolithic and Neolithic periods (Schulding 2007: 12). Analysis on radiocarbon dated human remains (Hedges *et al.* 1993; 1997) showed minimal use of marine food consumption in the Neolithic (Schulding and Richards 2002: 1021-23; Schulding 2007: 12) and a shift in consumption from marine to terrestrial diet. Schulding (2007: 12) considered that a comparison of the isotope values between the people interred in monuments and caves could show differences in the amount of food consumption based on the separation of the individuals buried in each context. People who had been buried in monuments might have therefore been more privileged and have had access to novel food resources (domesticated plants and animals). Samples to support this result were taken from various contexts including: 27 from Caldey Island, Pembrokeshire, of both Neolithic (Nanna's Cave) and Mesolithic

ages (Potter's Cave, Daylight Rock, Ogof-yr-Ychen, Ogof-yr-Benglog and Eel Point); ten from Neolithic sites in South and south-east Wales (Red Fescue Hole, Little Hoyle Cave and Priory Farm Cave); four from Somerset (Hay Wood Cave) (Schulting and Richards 2002: 1013). Additional samples were taken from sites of Neolithic age from the Gower (Foxhole Cave, Spurge Hole and Cathole Cave) and Devon (Kitley Bob's Cave, Broken Cavern and Tornewton Cave (*ibid.*) (Figure 12).



Figure 12. Locations of Caldey Island, Gower, Glamorgan and Flintshire in Wales, Mendip (Somerset) and Devon in southwest England

Further insight on this hypothesis was provided by a direct comparison between data available from Parc le Breos Cwm, a Cotswold-Severn chambered tomb in the Gower, South Wales, and Cathole Cave, a Neolithic site located in close proximity to the tomb (Schulting 2007: 12) (Figure 12). Radiocarbon dating on a human mandible from Cathole Cave (c. 4645±40 BP) indicated that both sites were used for burial in the

Neolithic (ibid; Whittle and Wysocki 1998). Whereas some individuals from both types of sites displayed variation in stable carbon ( $\delta^{13}\text{C}$ ) and nitrogen values ( $\delta^{15}\text{N}$ ) there was no clear patterning of marine consumption between individuals from above-ground and caves and therefore patterns of selectivity in burial amongst both types of sites was not apparent (ibid., 13-14). Some individuals had lower values of marine protein and displayed a lower consumption of animal products which requires further research to clarify patterns of diet amongst monumental and cave contexts (ibid).

Research in north Wales has centred on the relationship between above-ground monumental and caves and their perception as spaces for burial from the Early Neolithic to the Bronze Age periods (Barnatt and Edmonds 2002). Neolithic Gop Cairn and Cave, in Flintshire, Wales (Figure 12) formed the focus of this analysis and was compared with a series of Neolithic caves from north Yorkshire (Fox Hole Cave, Dowel Cave and Calling Low rock shelter). The study however focused on the architectural and ritual aspects of above-ground monuments and caves rather than similarities amongst the human remains from the sites. In particular, the natural Gop Cairn and Cave (encapsulated within the cairn), were considered equivalent to constructed Neolithic chamber tombs whilst caves (Fox Hole Cave and Calling Low rock shelter) were understood as hidden and less prominent locations compared to above-ground monuments (ibid., 115, 119, 121-22).

Later research in north Wales explored signs of violence, using examples of Late Neolithic and Early Bronze Age crania from Rhosddigre Cave, Denbighshire (Schulting 2012). The Late Neolithic cranium showed evidence of peri-mortem trauma whilst the Early Bronze Age cranium did not exhibit any injuries or signs of trauma, therefore Schulting (ibid., 245-247) noted that despite their proximity in the cave ('seated burials') depositions must have been accidental. Interpretation of the possible peri-mortem injury remained inconclusive, however, associations of the cranium with similar fractured remains from caves located in north England were made (e.g. Lesser Kelco Cave, Feizor Nick Cave, Yorkshire) (ibid., 247). More examples are however required to verify pre- or post-mortem patterns in cave burials reinforced by comparative and holistic analyses.

Research in south Wales has focused on the comparative analysis of George Rock Shelter, Wenvoe, south Wales and a number of caves from Caldey (south-west Wales), Somerset and north Yorkshire (Aldhouse-Green and Peterson 2007: 70). A lime deposit from George Rock Shelter, recovered from earlier excavations at the site, was considered the result of cremation as part of practice at the site (Aldhouse-Green and Peterson 2007: 70). Following investigations of the rock shelter revealed a series of screes which had formed an assemblage of dispersed human remains, materials and granular tufa (Peterson 2013: 268). Peterson (*ibid.*) suggested that the production of granular tufa in the rock shelter must have related to mortuary practices similar to the substance discovered in caves in Somerset, Caldey and north Yorkshire. The presence of tufa was perceived as a symbol of ancestry that preserved bodies through time (Leach 2008: 51; Schulting *et al.* 2010: 81; Aldhouse-Green and Peterson 2013: 14; Peterson 2013: 269). The analysis was therefore heavily based on the geomorphological properties of the cave and which were considered an incentive for depositions in George Rock Shelter.

In conclusion, results from analyses across Wales remain scattered and limited to establish regional associations amongst sites. Lack of further radiocarbon dating creates gaps in the history of depositions in caves such as Little Hoyle Cave, Caldey, George Rock shelter, Glamorgan, Ogof Colomendy, Flintshire (see Chapter 5/5.1.2.2. and 6/6.2.5). More analyses are required to compare and contrast burial patterns across regions and caves. This PhD research therefore addresses this issue by employing a multi-level taphomic analysis with accompanying radiocarbon dates to fortify the period of deposition across sites in Wales.

### *2.7.3. South-west England: Somerset*

Research in southwest England has focused on radiocarbon dating analysis, studies on diet and assemblage associations between caves and monuments in the Mendips. Directly dated Neolithic human remains have been discovered in caves in the Mendip Hills (Aveline's Hole, Backwell Cave, Chelm's Combe, Flint Jack's Cave, Hay Wood Cave and Picken's Hole). Similarly, human remains have been discovered in above-ground Neolithic monuments (e.g. in Priddy Long Barrow, Stoney Littleton and Fairy's Toot), suggesting wider prehistoric activity in the region (Hedges *et al.* 1997; Ambers

and Bowman 2003; Schulting *et al.* 2010: 84; Schulting *et al.* 2013; Schulting *et al.* 2019).

Analysis of human remains and associated Neolithic material recovered from a swallet<sup>45</sup> in the Mendip Hills revealed early use of various contexts for burial (Figures 8, 12). Lewis (2000; 2005: 126; 2011: 104) considered that intentional deposition of human remains and associated artefacts took place in Brimble Pit swallet and Charterhouse Warren Farm, similar to that seen in Neolithic and Early Bronze Age caves. Archaeological evidence from these sites was compared to the spatial distribution of materials in monuments within the region. Unstratified human remains were recovered from one of the shafts of Brimble Pit swallet, comprising an adult skull of a probable male and several small fragments of ribs and radii (Lewis 2005: 129). Associated material included 42 sherds of Neolithic Grooved Ware pottery that were found in a fresh and unabraded form. The human remains and other material suggested deliberate placements in the swallet (*ibid.*). Whilst these results could support concurrent mortuary disposal practices taking place in the Mendip Hills (monuments, henges and pits), more comparative data and radiocarbon dating analysis are required to establish burial patterns in the region.

Subsequent research in the Mendip Hills by Schulting *et al.* (Schulting *et al.* 2010; Schulting *et al.* 2013; Schulting *et al.* 2019) comprised of a multilevel analysis of human remains from Cheddar (Totty Pot) and north Somerset (Hay Wood Cave and Aveline's Hole). Radiocarbon dating and stable isotopes analysis of individuals from Totty Pot was undertaken. Three adults and three children were dated (Schulting *et al.* 2010: 80). Five dated to the Neolithic including two (Late) Middle Neolithic adults, two (Late) Middle Neolithic children and a Late Neolithic older child, whereas one individual dated to the Mesolithic (*ibid.*, 80-81, 87). Associated artefacts were not present (*ibid.*, 81). Stable carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) analysis from five individuals revealed a terrestrial diet, similar to the Caldey caves (Schulting and Richards 2002; Schulting *et al.* 2010: 82-83). Macroscopic taphonomic analysis, also conducted by Schulting *et al.* (2010: 78), showed minor signs of surface erosion, animal

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<sup>45</sup> A swallet is usually formed by dissolution activity or ground collapse (Barrington and Stanton 1977: 22-223).



gnawing and degenerative changes in one adult vertebra. Schulting *et al.* (2010: 83, 86) considered that the majority of human remains from Totty Pot were deliberately placed in the cave.

Analysis of the large assemblage from Hay Wood Cave (c.10+ individuals) was an important addition to the database of Neolithic cave burials in Britain and emphasizes the need for further research on caves. Samples from nine crania (adults and one subadult), an unfused tibia shaft and a mandibular tooth (both belonging to an adolescent) from Hay Wood Cave provided direct dates to the Early Neolithic (Schulting *et al.* 2013: 15-17). Osteological re-analysis of the original 560 identifiable human fragments from the site (Hedges *et al.* 1997) showed evidence of completeness and articulation in burials based on the occurrence of a large number of small bones (hands and feet) (Schulting *et al.* 2013: 13). Stable isotopes analysis of carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) values from Hay Wood Cave further showed a lack of marine consumption similar to the individuals from Totty Pot and other caves from Wales (see 1.2.7.3) (Schulting *et al.* 2013:18). The fragmentary condition of the human remains was considered the result of later disturbances, re-arrangements in the cave during the Iron Age and natural occurrences (e.g. scavenging and post-mortem damage by rock fall) (*ibid.*, 13). Earlier analysis by Everton and Everton (1972: 17) suggested that the human remains had been exhumed or undergone prior sub-aerial exposure followed by later deposition in the cave (Everton and Everton 1972: 17). However, lack of direct evidence of multi-stage rites (Schulting *et al.* 2010: 87) and radiocarbon dating from above-ground monuments in the Mendip Hills has made Everton and Everton's (1972) argument inconclusive.

Recent re-analysis (Schulting *et al.* 2019) of the assemblage from Aveline's Hole, the largest well-known Mesolithic cemetery in Britain (c.21+ individuals), was accompanied by new radiocarbon dating and stable carbon ( $\delta^{13}\text{C}$ ) and nitrogen ( $\delta^{15}\text{N}$ ) analyses. Results indicated Early Neolithic burial activity (6 crania spanning from c. 3750 to 3470 BC) along with seven new Early Mesolithic dates and an approximate 50:50 cranial representation between the two periods (*ibid.*). Results from the stable carbon ( $\delta^{13}\text{C}$ ) and nitrogen values ( $\delta^{15}\text{N}$ ) between the Early Mesolithic and Early Neolithic did not show correlations between values (Schulting *et al.* 2019: 19). New Mesolithic isotope values formed robust evidence for further correlations between other

caves in the area and in Somerset as marine food consumption was not prevalent in the Mesolithic and Neolithic individuals that were analysed from Somerset (ibid., 47). Temporal bone from four individuals was further sampled for aDNA (ibid., 15, 24). The aDNA study deciphered the history of two (newly dated) Neolithic crania (both female) with genomes indicating a sharing ancestry with Iberian populations but no close relationships with each other (i.e. different maternal lineages) (ibid., 28-29). Schulting and colleagues (2019) concluded that the site must have served as burial depository and human remains (possible curated Neolithic crania) were deposited/left in the cave on a number of different visits (ibid., 17).

Schulting *et al's* (2019) latest study using multiple methods of analyses emphasised the great interpretative potential new avenues of research have and how re-analyses of cave assemblages can place cave burials into a broader comparative context. Other examples of directly dated Neolithic remains in the Mendip Hills include Backwell cave, Chelm's Combe, Picken's Hole, Flint Jack's Cave and Skeleton Cave (ibid., 41). Earthen long barrows in Somerset (e.g. Fairy Toot, Priddy long barrow) can further create comparative material for possible deliberate depositions, re-use of sites and selection of body parts.

## **2.8. Summary**

This chapter presents a review of cave formations in the British landscape and discusses important parameters that can alter the depositional history of a site. The state of cave research across Britain (more generally and in the Neolithic) is discussed whilst associations amongst above-ground Neolithic monuments and caves are considered.

Based on current research, the provision of new chronologies has endorsed more analysis for understanding depositions in caves (e.g. stable carbon and nitrogen analysis, updated radiocarbon dates, comparisons between the demographic profiles of burial monuments and caves). Direct associations amongst caves cannot be conclusive due to limitations in the availability of remains, the lack of proper documentation and stratigraphic information and the multi-period use of the caves followed by disturbances. However, all prior analyses share a common theme: results emphasised the need for more precise methods of analysis and highlighted the lack of extensive and holistic research in Neolithic cave burial. Based on the abovementioned themes, it

appears that research on caves in Wales is currently biased towards certain methods of analysis whereas in the rest of Britain, research is being conducted with more combined methods of analyses (e.g. Mendip Hills).

The following chapter presents a background of all Neolithic burial contexts across Wales and south-west England to establish the concurrent contexts that were used for burial. This is pursued to enable comparisons in Chapter 8.

### **Chapter 3: Neolithic mortuary practice in south-west Britain: The geographical and chronological context**

This chapter provides a short overview of the Neolithic period in Britain, in terms of new ideologies and forms of burial, followed by a review of the different burial contexts containing human remains from the Early Neolithic to the Chalcolithic/Early Bronze Age (transitioning period) in Wales and south-west England (c.4000BC – 2200BC). Examples of human remains recovered from each monument type are presented to establish different burial trends across regions (within Wales and south-west England) and different types of funerary monuments used for burial. Understanding variation in burial contexts is crucial for interpreting whether cave burials fit in this narrative.

#### **3.1. The Neolithic in Britain: A short review**

The emergence of the Neolithic impacted the Mesolithic landscape (c.8000BC – 4000BC). The native population was exposed to direct contacts and immigration of farmers from continental Europe (Brace *et al.* 2019). Whilst aDNA has identified these contacts, they may have been processes rather than single events (Thomas 2022). The Neolithic is associated with concepts such as the beginning of monumentality (Bradley 1993), the development of polished stone tool technology (Evans 1872; Kendrick 1925), the emergence of new farming economy across Britain (Piggott 1954) and the creation of new ideology (Whittle 1996) that ultimately affected both the landscape and the societies (Malone 2001: 16-18). Our knowledge of Neolithic mortuary practices is therefore largely based on monumental constructions (Schulting 1998: 249). Monumental burials began from the Early Neolithic onwards in the form of earthen barrows, wooden or stone chambered tombs (Figure 13) (*ibid.*, 252). Indeed, as Julian Thomas (2002b) states: “the dead seem more visible than the living”.

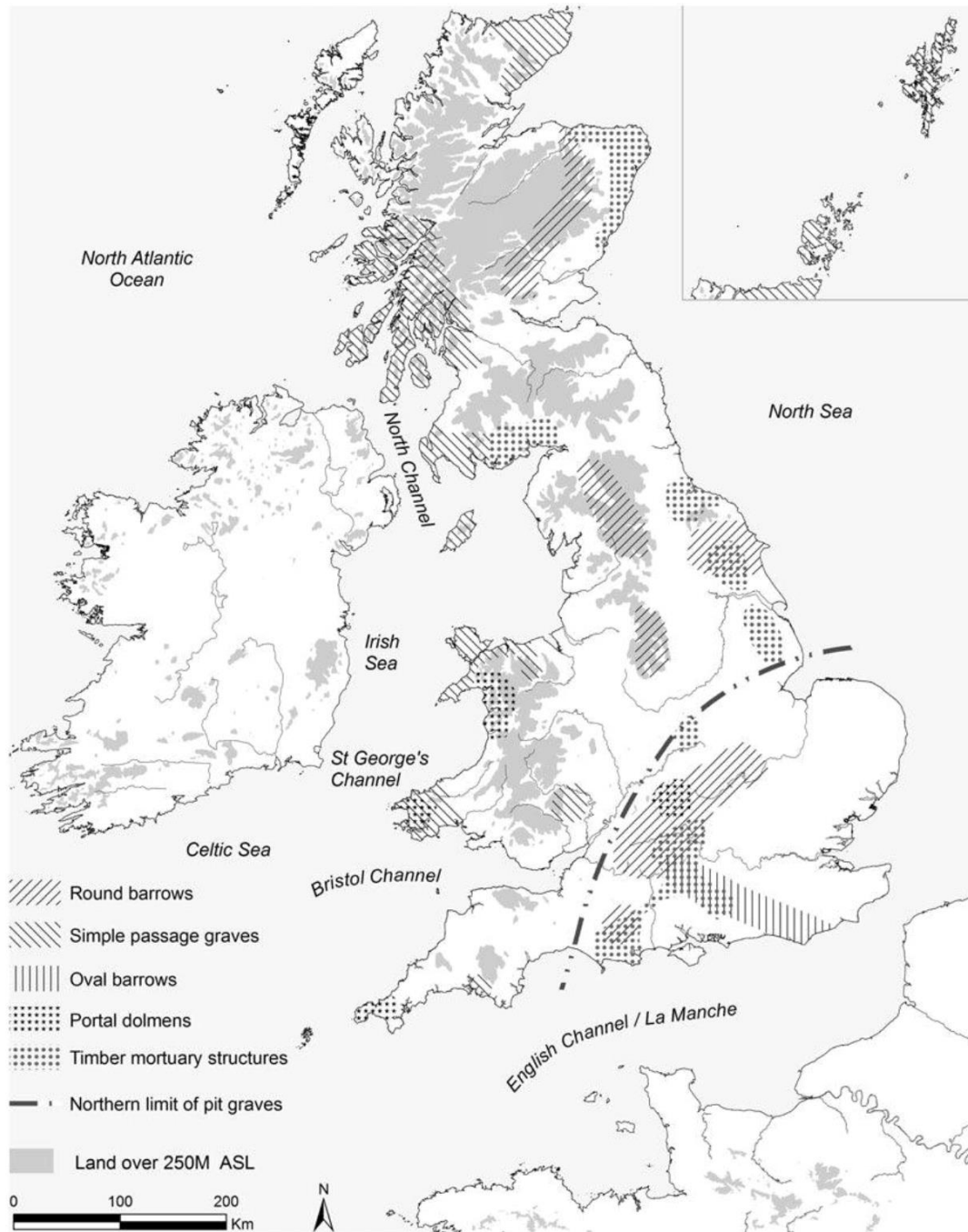


Figure 13. Distribution of prominent burial monuments across the British Isles during the fourth millennium [Darvill 2010: 104 (figure 37)]

### Structures and context

Surviving monuments in Neolithic Britain were constructed using earth and/or stone (Malone 2001: 107). Tombs were generally constructed from local stone in north and west Britain. Some tombs are described as ‘Megalithic’ due to the large stones used for the development of the chambers, passages and façades (ibid.). In east Britain, where

construction quality was rarer, earth, turf and timber, flint rubble and chalk were used (ibid.). Many tombs started as simple cairns/mounds (e.g. Wayland's Smithy, Oxfordshire), were re-used and remodelled over time. Cairns and mounds (chambered tombs and long barrows) were particularly common during the Early Neolithic with large concentrations across the British Isles (e.g. Wessex, along the shores of the Irish Sea and northern Scotland) (Cummings 2008: 136). More contexts were used for burials during this period including ditches, pits, enclosures and henges, rivers and caves, however, the major body of known data mainly derives from chambered tombs and long barrows (Andersen 1977; Bristow 1998; Chamberlain 1996; Malone 2001: 107; Jones 2008: 180).

### **Treatment and practices**

Continuous re-use of monuments from the Early Neolithic to the Late Bronze Age has provided substantial proof of a shift in burial traditions, from communal and disarticulated burials to single grave traditions (Cummings 2008: 139, 141). Chronological variation in monument types (as discussed above) is further reflected in distinct practices throughout the Neolithic. For example, single burials were very infrequent during the Early Neolithic but became more visible by the Late Neolithic in addition to constructed henges, palisades, timber and stone circles across the British Isles (Cummings 2008: 139). The number of individuals recovered from these aforementioned burial contexts is limited, however, when burials did occur in these sites, they were often the result of secondary depositions (ibid.).

During the Early Neolithic, bodies were sometimes left out to naturally deflesh (in the process of excarnation) with the disarticulated skeletal remains circulated and placed in collective tombs or caves and rock shelters (as part of a multi-stage rite for secondary burial) (Peterson 2019: 2) Collective burials depict one of the most common forms of Early Neolithic mortuary practice in these monuments (Fowler 2010: 2). These comprised of deposits laid out on platforms, paved areas or 'crematoria' trenches that were subsequently covered by barrows (ibid.). Most of the remains have been found in a disarticulated, fragmentary state and the number of individuals can vary greatly (Schulting 2007: 2). Collective deposits of intact bodies that derived from successive deposition have also been noted, however, a combination of intact and disarticulated

bodies is very commonly discovered in Neolithic deposits (Fowler 2010: 2). In the Middle Neolithic, bodies were often moved to make room for later interments in re-used tombs. Single burials and cremations appear in the Late Neolithic.

The small amount of human bone that has been recovered from the Early and Late phases of the Neolithic is considered to present only a portion of the population (Smith and Brickley 2009: 11). Variation in treatment is therefore similarly reflected in the different contexts used for burial throughout the Neolithic (Cummings 2017: 89) which will be discussed with particular focus on Wales and south-west Britain.

## **3.2. Burial activity in Wales**

### **3.2.1. Early to Middle Neolithic burial contexts (c.4000BC – 2900BC)**

There are diverse burial contexts throughout the Neolithic in Wales as well as variation in burial practices (e.g. disarticulated bone after excarnation, multiple burials and successive deposits).

#### **Type and Location**

Chambered tombs across Wales (stone-built monuments) are clustered in south-west, north-west and south-east Wales, bearing distinguishable traditions, specifically in the western parts, whilst mid- and eastern parts of Wales have a total absence of monumental construction (Cummings 2004: 5).

During the Early Neolithic (c.4000BC - 3600 BC), three main groups of burial tombs are apparent in the Welsh landscape. The complex Cotswold-Severn group (long barrow and chambered tomb tradition) are primarily found in south-east Wales and extend to north Wales (similarities in architecture). Portal dolmens are similar but simpler stone monuments in the west whilst the scattered passage graves extend up the Irish Sea coasts (Lynch 2000a: 64). These are described individually below. Other monumental constructions that are apparent in other regions across Britain during this time are missing from the Welsh landscape. These include classic causewayed enclosures and classic henges, cursus monuments and pre-megalithic wooden mortuary structures (Cummings 2004: 4).

## **Aspects of burial practices**

The burial area of these constructions is small, 5% of the total monumental area. Human remains are frequently moved (dismembered or piled up) (Darvill 2010: 113-114) and often comprise of multiple inhumations or individual bodies that might have been excarnated and then deposited in tombs (ibid., 113). Fragmentation and disarticulation can therefore result after excarnation, before remains are introduced in the chambers. Some skeletal remains might further be missing and were either never introduced to the tomb or were removed from the small chambers, perhaps as part of a ritual practice (ibid., 114). Items of personal adornment (e.g. beads, pendants and necklaces) and arrowheads sometimes accompanied these burials in small amounts (sparse evidence) (ibid., 114), as opposed to the disarticulated human remains discovered in caves.

## **Monument type - Welsh Long Barrows and Chambered tombs**

### **Cotswold-Severn tombs**

The characteristics of Cotswold-Severn tombs situate them as part of the long barrow and chambered tomb tradition. Cotswold-Severn tombs are trapezoidal stone cairns with ceremonial forecourts and rectangular chambers with entrance passages of varying size (Figure 14) (Savory 1980a: 219). There are 120-130 Cotswold-Severn tombs in total in Britain and these are mostly located in the Cotswolds, Gloucestershire, Somerset and Wales (Malone 2001: 129). Within Wales they appear in two main geographical regions where human remains have been discovered: a Glamorgan and Monmouthshire coastal group and a Breconshire group, which is centred on Talgarth (Lynch 2000a: 64-66). A third group (north Wales group) has been considered a later development however it does not appear in wide concentration (ibid., 66).

Each regional group of Cotswold-Severn tombs has different characteristics. The Glamorgan and Monmouthshire group comprises of cairns that vary in design from simple to transepted terminal chambers and laterally chambered cairns (Lynch 2000a: 65). These cairns further show similarities in construction to the tombs located in the Cotswold and Wessex regions and normally have a trapezoid shape (ibid.). Examples of these groups include the transepted chambered-cairns in Gower such as the famous Parc Le Breos Cwm and Penmaen Burrows and the simple terminal chambered-tombs e.g. Tikinswood and St Lythans. The remains that are discovered in these groups are



consistently fragmented and represent possible re-burials, which had either been deposited in other chambers or outside of the cairn (Savory 1980a: 219).

An example of interpretation of human remains is Parc Le Breos. At least 40 individuals including remains of both sexes, adults, sub-adults, children and infants were recovered (Whittle *et al.* 1998: 161). Human remains had been deposited in each chamber and passage of the monument in a fragmentary and disarticulated state (*ibid.*, 143). 11 cremated fragments were further discovered in the south-east chamber (*ibid.*, 161). The disarticulated nature of this assemblage, and the presence of single individuals unearthed from different chambers resulted in various interpretations based on skeletal remains. This included possible selection of body parts and secondary burials with prior excarnation (*ibid.*). Taphonomic analysis which compared chambers and passages revealed contradictory burial treatment. Within the chambers a number of long bones exhibited fresh fractures, animal scavenging and exposure to different degrees (*ibid.*, 158). On the contrary, lack of animal scavenging or weathering in the passage deposits, suggests that these might not have been exposed but directly deposited into the tomb in a partially articulated state (*ibid.*).

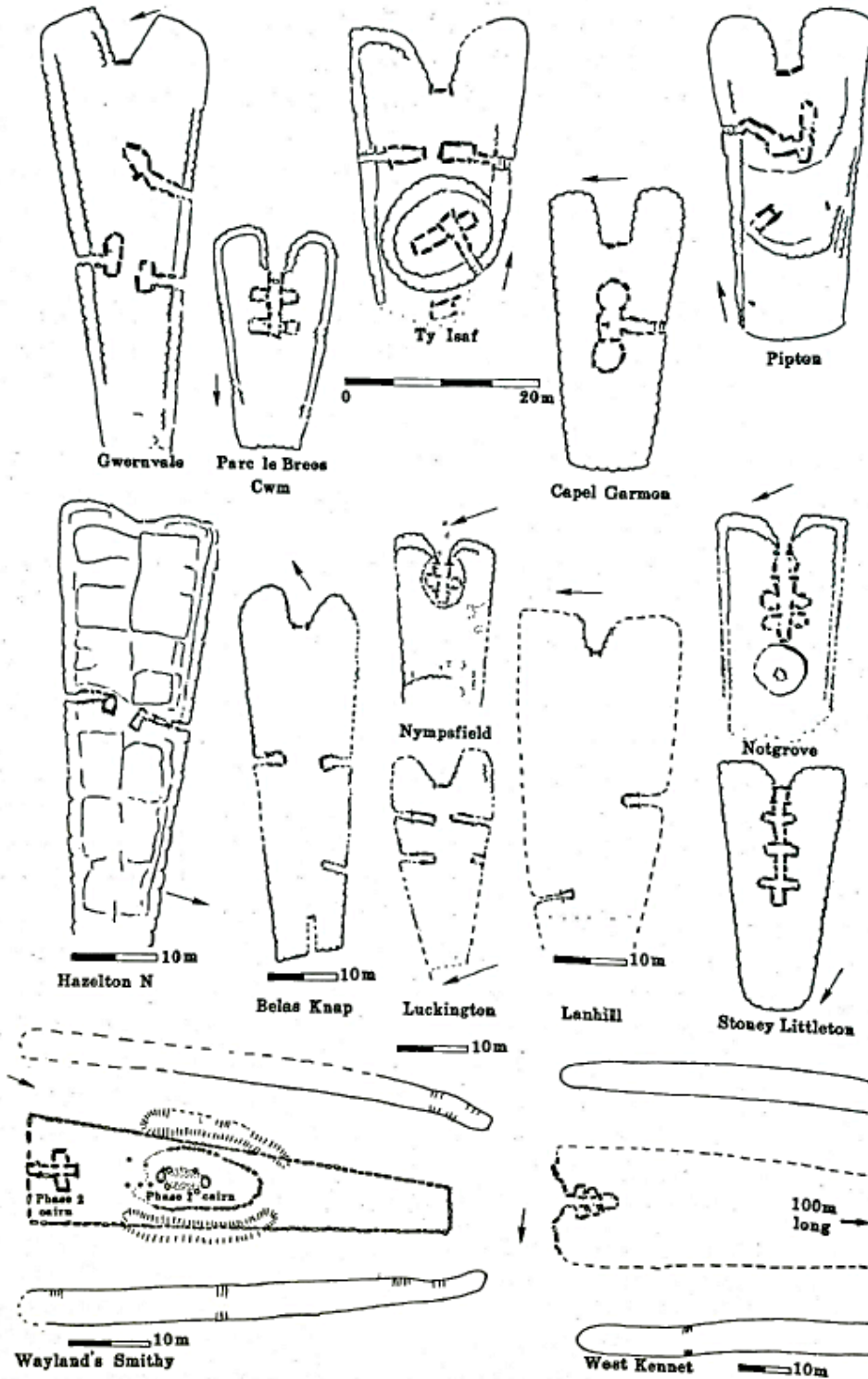


Figure 14. Examples of Cotswold-Severn tombs [Malone 2001: 120 (figure 730)]

The Breconshire or Black Mountains group displays regional variation but is generally the most cohesive group in Wales (Lynch 2000a: 69). This group has either transepted or angled chambers in a laterally organised walled trapezoid cairn (ibid., 66). They lack a terminal chamber but have forecourts and chambers with side access (ibid., 69). Their

shape varies across the region from simple rectangular boxes with passage access to polygonal to T-shaped or transepted constructions (ibid.). Examples of this group include the Little Lodge, Pipton, Gwernvale, Ty Isaf and Arthur's Stone (ibid.). Britnell and Savory (1984: 5) consider that the larger number of chambers found in this group might suggest variation in practices due the condition of skeletal remains discovered in them. An example of interpretation of human remains is Pipton. Seven separate piles of bones were discovered in one of the monument's chambers and comprised of the partial remains of 11 individuals (Burrow 2006: 93). Similar stacking of bones was evident at other cairns such as the Ty-Isaf where fragmented remains of over 30 individuals were discovered in several of its small chambers (Savory 1980a: 219; RCAHMW 1997: 29).

### **Portal Dolmens (and Rectangular Chambers)**

Portal dolmens are mostly in north-west Wales and the Nevern Valley in Pembrokeshire. This type of chambered tomb is a simple small 'box' single chamber of four or more large upright slabs topped with an enormous sloping capstone (Lynch 2000a: 70; Cummings and Richards 2014: 134; Cummings 2017: 113-114) (Figure 15). Once constructed using portal slabs, the chamber could not be easily re-entered as the capstone that covered the dolmen did not allow access through the roof, as opposed to early Neolithic chambered tombs' slim slabs that were moved (Cummings 2017: 114). Despite a lack of a more 'chambered'-like character, the massive capstones of dolmens in Britain and Ireland display a great level of engineering and their construction must have promoted participation of large numbers of people (Cummings and Richards 2014: 140).

Portal Dolmens are also referred to as 'portal tombs' in Ireland and these are comparable in form (Lynch 2000a: 70; Cummings 2017: 114). Whilst their stone shaped form may vary (e.g. cube like chambers in Trefignath, Anglesey; a rectangular East Chambein Dyffryn Ardudwy, Gwynedd) they all have distinctive evidence of a long period of use (e.g. Middle Neolithic Carreg Coetan Arthur, Pembrokeshire) (ibid., 72; Kytmanow 2008). Sites with a small number of upright slabs (e.g Pentre Ifan) that supported a capstone, however, were open to the elements and therefore, human remains might not have survived (Cummings 2017: 116).

Human remains are rarely recovered from Portal Dolmens (Darvill 1987: 64). This may be the result due to the open nature of the monument (not covered by a mound) and/or skeletal elements that are moved or eroded (Darvill 2010: 106; Malone 2001: 133). However, some monuments in Britain have shown evidence of human remains (Cummings and Richards 2014: 135). The Dyffryn Ardudwy Portal Dolmen for example is encapsulated within a rectangular mound similar to a sealed box, and therefore, cremation deposits must have either been included during its construction or pushed through the stones after construction (Darvill 1987: 64; Cummings 2017: 116).

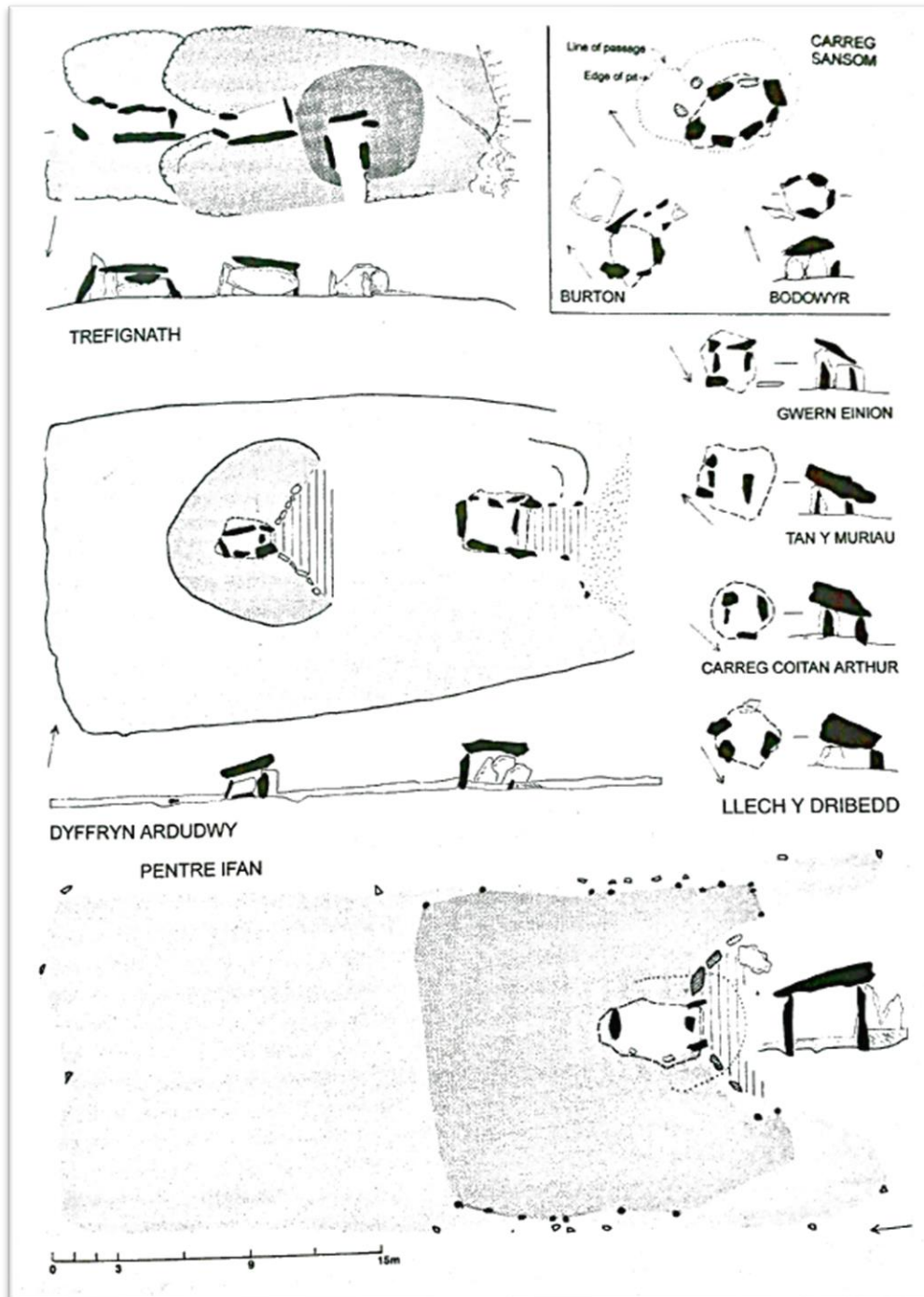


Figure 15. Examples of portal dolmens, rectangular chambers and small passage graves [Lynch 2000a: 70 (figure 2.12)], scale 1:30

### Passage Graves

Passage graves appear around the Middle Neolithic and were developed in different traditions across the British Isles (Malone 2001: 139; Cummings *et al.* 2015: 825). They are distributed from the Isles of Scilly to Scotland and represent renewed constructions

of chambered tombs. Whilst Cotswold-Severn tombs and Passage Graves have an architectural construction that includes entrances and forecourts, passage graves have a clearly defined passage between the outer area and the burial chamber and contain exceptional megalithic art (Lynch 2000a: 73).

In Wales, there are two distinct passage grave groups. A scattered group of seven small, isolated monuments in West Wales and Anglesey and a second group of later date in north Wales (e.g. the Late Neolithic Barclodiad Y Gawres and later Bryn Celli Ddu in Anglesey) (Lynch 2000a: 73). The first group has polygonal chambers (e.g. Carreg Samson, Pembrokeshire) and some monuments include shorter passages to the tomb (ibid.). The type of monument, common in mainland and some part of insular Scotland (e.g. Achnacreebeag, Argyll, the Western Isles), has similarities with the passage graves in Devon, Ireland and Brittany (ibid.).

The later constructions of passage graves, however, are more impressive in size and complexity. For example, Barclodiad Y Gawres (Figure 16) is a stone-built cruciform chamber and passage set within a round cairn (Powell and Daniel 1956) and one of the most impressively decorated monuments in north-west Europe (Nash 2006: 101). Beneath the cairn a long passage leads to a central corbelled chamber with three additional side-chambers within which cremated bone was recovered (Lynch 2001: 73). Curved decorations on the inner megalithic stones within the chambers suggest that the monument has both a funerary and ceremonial role (Nash 2006: 101). Barclodiad Y Gawres must have been built by people with very close ties to Ireland in the Middle Neolithic Lynch (2001: 74).

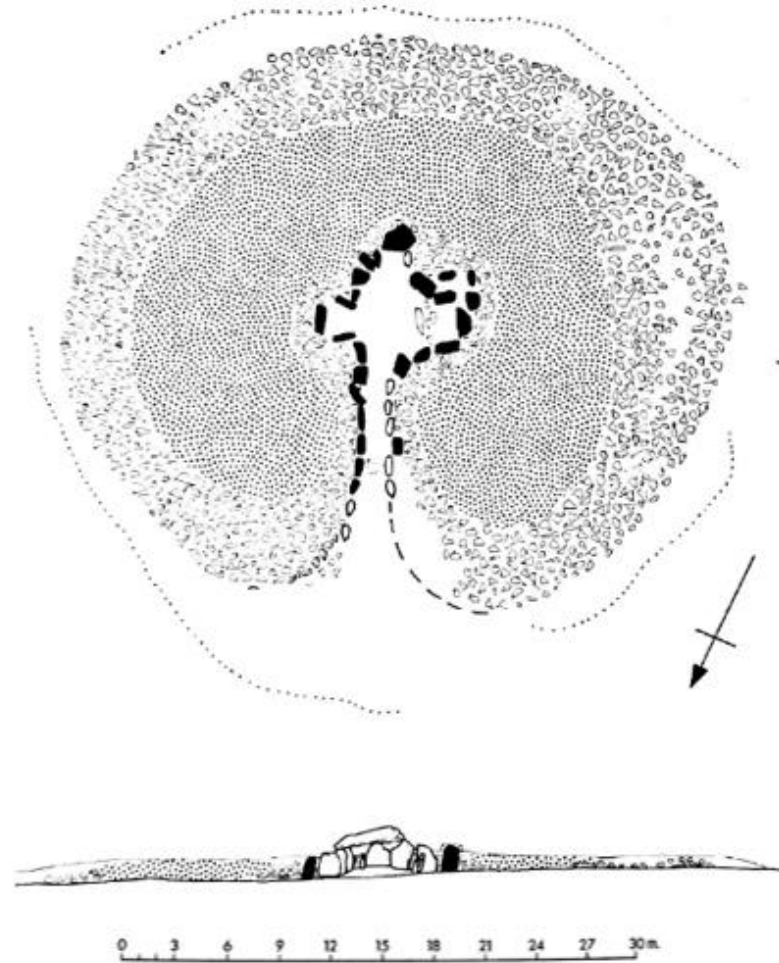


Figure 16. Late passage grave Barclodiad Y Gawres (Lynch 1976; Lynch 2000a: 76).

Across the Welsh landscape, Middle to Late Neolithic burial activity is present in the form of pit graves (five examples), circular enclosures (two examples) and the ‘formative henges’ (Tellier 2015: 34).

### **Pit graves**

These are large pits containing human remains, frequently discovered near Middle Neolithic (c.3600BC-2900BC) and some Bronze Age monuments in mid- (Powys) and north-west Wales (Gwynedd and Anglesey) (Gibson 1998: 5; Tellier 2015: 35). The earliest examples of burial activity in such contexts are at Four Crosses 5 and Trelystan II, Powys, Bryn Gwyn, Anglesey and Llandygai A, Gwynedd (Tellier 2015: 36). Unlike the Early Neolithic communal burials in tombs, human remains are present either as cremations (Llandygai A, Bryn Gwyn, Lower Luggy) or crouched inhumations (Four Crosses 5) (ibid., 35-36).

## **Circular enclosures and stone arc**

Circular enclosures were part of the Welsh landscape by the end of the fourth millennium and are associated with the deposition of cremated human remains (Tellier 2015: 37). Only two examples of this practice are known to date. The Meusydd I timber circle, Powys consists of a 7.2m wide circular enclosure with a single circle of six wooden posts and a cremation burial (c.3017BC – 2762BC) against the side of a posthole (posthole 19) (Jones 2009a; Tellier 2015: 37). At Bryn Celli Ddu, cremation deposits (c.3200BC – 3000BC) were discovered at the base of a stonehole that formed part of the Bryn Celli Ddu stone arc and in a nearby hollow stone (Tellier 2015: 38).

## **‘Formative’ henges**

These are large C-shaped circular enclosures, 80-107m in diameter, with an inner bank, an outer ditch and possibly narrow entrances. They are considered to be another distinct burial context in use during the late fourth millennium BC (Burrow 2010a: 184; Tellier 2015: 38). 14 formative henges have been identified in Wales but only four excavated (Burrow 2010a: 186) including: Llandygai A, Gwynedd; Castell Bryn Gwyn, Anglesey; Ysceifiog, Flintshire and Walton Court, Powys (Fox 1926; Wainwright 1962; Lynch and Musson 2001; Jones 2010). Limited amounts of contextual, radiocarbon and a range of artefactual evidence are recovered from these sites. For example, at Llandygai A the radiocarbon determinations were based on an oak charcoal sample (c.3518BC – 2681BC) excavated with associated Fengate pottery shreds (Peterborough Ware later sub-style) in a secondary ditch. A cremation burial radiocarbon dated to c.3359BC – 3013BC derived from a different deposit, south of the henge and closer to the inner henge bank (pit FA370) (Lynch and Musson 2001: 45; Gibson 2012: 14). Due to the lack of any stratigraphic correlations between the findings, no certain associations amongst the distinct pits, banks, human remains, and the actual construction of the henge can be confirmed (Gibson 2012: 14; Tellier 2015: 39). Similar issues have been reported at other excavated henges in Wales (e.g. undated inhumation burial at Ysceifiog). Thus, it is impossible to confirm if the structures and/or burial activities are of earlier or later date as they might have resulted from long-term activities throughout the Neolithic (Tellier 2015: 41).



### **3.2.2. Late Neolithic (c.2900BC – 2400BC), Chalcolithic (c.2500BC – 2200BC) to Early Bronze Age (c.2200BC – 1700BC)**

#### **Type and Location**

Four types of monuments have been identified in the Late Neolithic in Wales: Ring ditches, stone circles, henges and passage graves. These include: the Sarn-y-bryn-caled 2 ring ditch in Powys, the Bryn Gwyn, Anglesey and Dyffryn Lane I, Powys stone circles, a Class I henge also at Dyffryn Lane I, Powys and the Bryn Celli Ddu and Barclodiad-y-Gawres, Anglesey passage graves (Tellier 2015: 41).

#### **Aspects of burial practices and Beaker Burials**

The major difference between Early and Late Neolithic/Early Bronze Age traditions is the gradual shift from communal to individual burials with accompanying grave goods (Lynch 200b: 121). This transition to single inhumations and cremations (sometimes even multiple cremations) continued as a pattern throughout the Bronze Age (ibid., 122). During this period, barrows and cairns were re-used and new monuments were constructed e.g. in Anglesey and Breconshire (ibid.). Chalcolithic (Beaker) activity in Wales (c.2500BC – 2200BC) is apparent through the appearance of new burial forms and new styles of pottery (Darvill 2010: 167; Tellier 2015: 45). By 2000BC, radiocarbon dates and changes in pottery styles indicate that cemetery mounds became the standard burial context in most parts of Wales (ibid., 126). The continued re-use of barrows and cairns in upland and lowland regions may indicate the permanent occupation of settlements, with associated exploitation of resources and agricultural activities in Wales (ibid.).

#### **Beaker Burials**

Beaker burials across Britain were mostly inhumations, with the corpse laid out in a crouched position at the bottom of a rock-cut grave often sealed inside a round barrow and surrounded by a ditch (Darvill 2010: 170). These have been divided into three chronological stages, including the Early Bronze Age. In Wales only, the ‘pre-fission’<sup>46</sup>

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<sup>46</sup> Fission or Beaker represent a cultural phase when Beaker cultural values (e.g. materials and burial practices) became popular in Britain (Needham 2005: 209; Sheridan 2007: 92; Tellier 2015: 50). Pre-fission burials are single crouched inhumations, accompanied by Low-Carinated (LC) Beakers, copper

Beaker burials (c.2300/2250BC) have been identified (Tellier 2015: 46; Parker Pearson *et al.* 2016: 623-624). Three Beaker burials (Llantrithyd and Sutton 268, Glamorgan; Penderyn, Powys) have not been radiocarbon dated and have been considered to represent the ‘pre-fission’ phase based solely on their associated artefacts (Needham 2005: 205). The crouched inhumations were accompanied with Low-Carinated Beaker pottery [with Maritime-derived (MD) decoration], seven barbed-and-tanged arrowheads and a chert scraper (Fox 1943: 93-94).

Beaker inhumations were accompanied by distinct types of Beaker pottery [e.g. Long-Necked (LN), Short-Necked (SN), S-Profile (SP)] and artefacts (e.g. flint daggers, bronze flat daggers, stone sponge-fingers) (Needham 2005: 205). Beaker pottery and flints (barbed-and-tanged arrowheads, flakes, core and chip) were discovered at a rock-cut grave pit at Llanelwedd Ricks 2, Powys that, based on the radiocarbon dates from the charred material in the fill, probably included an inhumation (Britnell 2013: 219, 160-165). Similar examples of possible inhumations of this period were identified at Tandderwen and Ysgwennant in Powys and Nant Maden, Glamorgan based on charcoal samples extracted from the wooden coffin at Tandderwen (c.2195BC – 1767BC), the base of pit at Ysgwennant (c.1936BC – 1528BC) and from the surface of the central D-shaped stone structure at Nant Maden (c.2008BC – 1695BC) (Day and Savory 1972: 28; Burleigh and Hewson 1979: 344; Brassil *et al.* 1991: 72). These possible inhumations were accompanied by Beaker pottery and flints [e.g. LN Beaker, copper-alloy awl, flint flake and ox tooth at Welsh St Donats 3, Glamorgan (c.2109BC – 1528BC on charcoal sample)] (Ehrenberg *et al.* 1981: 814; Burrow and Williams 2008).

## **Monument type**

### **Ring ditches**

Late Neolithic cremation deposits have been discovered at Sarns-y-Bryn-Caled 2 monument, Powys which consists of an 8x7m wide penannular ring ditch (Gibson 1994: 159). Three cremation deposits dating to c.3013BC – 2888 BC (cremation 1), c.2918BC – 2861BC (cremation 2) and c.2875BC – 2624BC (cremation 3), were excavated along

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daggers, gold ornaments, stone wristguards and lithic barbed-and-tanged arrowheads (Needham 2005: 176; Tellier 2015: 46; Parker Pearson *et al.* 2016: 624).

with Impressed Ware shreds from the basal silts of the ditch and the fill of the ditch recut (Gibson 1994: 159; 2010: 354).

### **Stone circles**

A cremation burial was discovered during the first phase of activity, an arc of pits (numbered 131, 136 and 138) at Bryn Gwyn stone circles, Anglesey (Smith 2012: 27). The cremation in pit 138, dated to c.3019BC – 2886 BC. Other material, a hazel charcoal from the upper fill of pit 131 (c.2891BC – 2637BC), a sherd of Late Collared Urn in one of the fills of pit 138 and a later radiocarbon date (c.1762BC – 1562BC) from material found next to the standing stone of another pit inside the stone circle, indicate the long period of use in later prehistory (ibid., 34).

### **Henge and passage graves**

As noted in section 2.2.1, passage graves are found both in earlier and later Neolithic contexts. The latter group includes Bryn Celli Ddu Passage Grave, Anglesey, which shows evidence of continuous burial use (Cooney 2000: 112; Burrow 2010b: 257; Darvill 2010: 161-162). Small, token deposits of cremated bone of pre-monumental activity (c.3200BC – 3000BC) were discovered on site, with a Passage Grave (c. 3074BC – 2956BC) that further encapsulated a stone oval and a pair of decorated pillar-stones, was later constructed on top of the classic henge (Darvill 2010: 162; Tellier 2015: 44). Based on these results, the monument must have been used between c.3050BC – 2900BC (Tellier 2015: 44).

### **Burial Cairns and Round Barrows**

The few Beaker/Chalcolithic burials in Wales were followed by substantive Early Bronze Age funerary activity c.2200BC – 1700BC. Across Britain, a shift from communal burial in the Early Neolithic was verified with the appearance of single inhumations and multiple cremations in the Early Bronze Age (Grimes 1951; Savory 1980b; Burgess 2001) associated with monumental burial that included round barrows, burial cairns, cremation cemeteries and circular enclosures (hengés; timber circles; stone circles; pit circles) (Tellier 2015: 47). Burial mounds are the most prevalent type

of Bronze Age monument and in Wales, 1833 burial cairns (mostly located in upland areas) and 1080 round barrow (mostly found in lowland regions) have been recorded( *ibid.*) (Figure 17). These incorporated 112 inhumation burials in Wales, with ten associated with radiocarbon dates (Tellier 2015: 48).

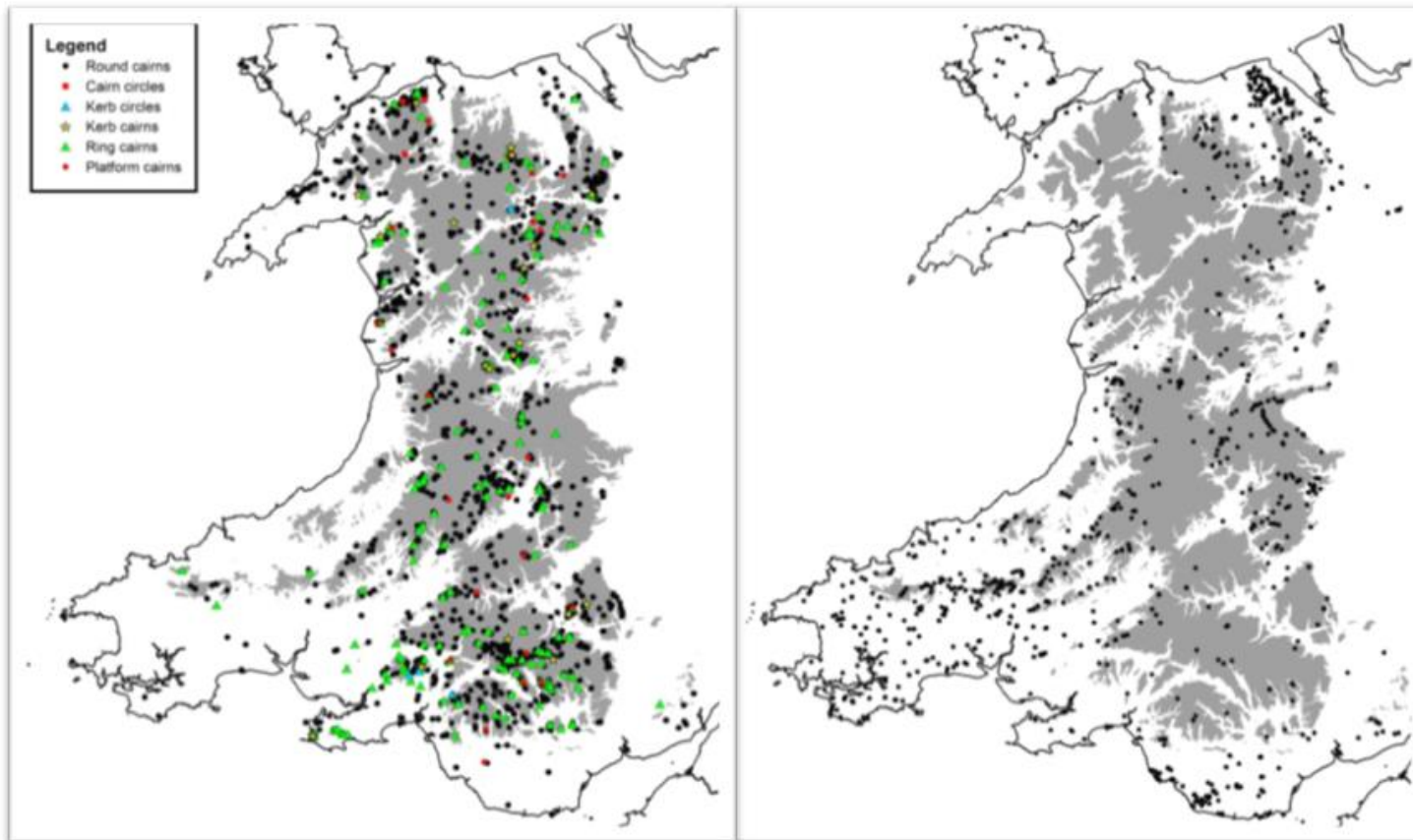


Figure 17. Distributions of burial cairns (left) and round barrows (right) across Wales during the Early Bronze Age [(Tellier 2015: 47, 48 (figures 3.10, 3.11)]

### **Cremation cemeteries**

Cremation cemeteries containing multiple cremation deposits in pottery vessels, inside small pits or cists, are also dominant during this period (Tellier 2015: 68). Multiple cremations during the Early Bronze Age are present at cremation cemeteries and are often discovered in pottery vessels that are further encapsulated in small pits or cists (ibid.). 16 have been excavated in north, west and south Wales. Capel Eithin, Anglesey represents the earliest radiocarbon dated cremation cemetery with five cremation burials in Collared Urns (White and Smith 1999: 53-58).

### **Other non-funerary context**

Human remains in these contexts have not been discovered however this could be subject to change. These are not discussed in detail but since they formed part of the wider constructions in the Neolithic they have are acknowledged in this section.

### **Stone circles**

Focus on larger burial circles in the Peak District, Cumbria, Wessex and Orkney (Burl 1979: 254; Bradley 1998; Cummings 2004: 5) resulted in limited investigations of stone circles in Wales. In addition, only three cursus monuments (each less than 1 km long) have been discovered in Wales, at Walton, Sarn-y-Bryn-Caled and Llandegai (e.g. Gibson 1999a; 1999b) (Cummings 2004: 5).

### **Causewayed enclosures**

Another well-known Neolithic burial context found sparsely in Wales is the causewayed enclosure (Figure 18). This Early Neolithic structure is mostly found in lowland areas and consists of disjointed concentric ditches with banks and pits (Burrow *et al.* 2001: 96; Jones 2008: 181). There are four examples of securely dated Early Neolithic enclosures including Lower Luggy, Womaston, Banc Du and Hill Croft Field (Whittle *et al.* 2011a: 6, fig. 1.1). There have been many attempts to find analogies of this type of burial context with monuments that comprise of interrupted circuits of bank and ditch in southern as well as northern and western Britain (Davis and Sharples 2017: 1). In particular, two excavated sites (Womaston, Powys and Banc Du, Pembrokeshire)

have been dated to the Neolithic based on comparable material (ceramics and stone tools) from English causewayed enclosures and eight radiocarbon dates that derive from the aforementioned material (Darvill *et al.* 2007; Jones 2009b; Bayliss *et al.* 2011; Darvill and Wainwright 2016). A recent excavation (2014-2015) at the hillfort of Caerau, Cardiff, revealed another Neolithic enclosure with at least five circuits inside an Iron Age hillfort and an array of ceramics, flints, polished stone axe fragments and ten radiocarbon dates from stratified contexts (Davis and Sharples 2017: 2). However no human remains have been excavated from these Early Neolithic enclosures which makes their burial use questionable.

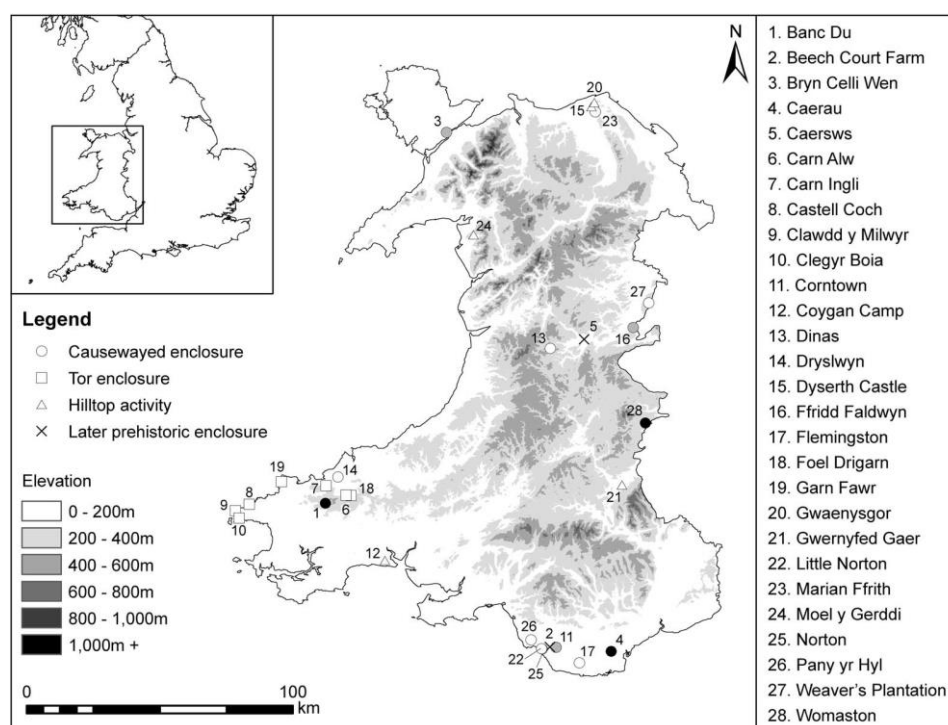


Figure 18. Potential early Neolithic enclosures in Wales (black: definite; grey: probable; white: possible) [Davies and Sharples 2017: 14 (figure 8)].

### 3.3. Burial activity in south-west England

#### 3.3.1. Early to Middle Neolithic burial contexts (c.4000BC – 2900BC)

##### Type and location

The Early Neolithic in southwest England is characterised by distinct monumental burial traditions: long barrows (Cotswold-Severn Tombs), earthwork enclosures (influenced by LBK and post-LBK traditions of central Europe), megalithic dolmens

and passage graves (influenced by a mixture of local Late Mesolithic and external Neolithic practices) (Pollard and Healy 2007: 96).

### **Aspects of burial practices**

Mortuary practices in southwest Britain are represented by collective deposits of semi-articulated and disarticulated human bone in Cotswold-Severn long barrows and chambered tombs. Examples of contexts where skeletal have been discovered in this state include Hazleton North, West Kennet, Lanhill and Fussell's Lodge (Pollard and Healy 2007: 100). The varying number of interred individuals in Cotswold Severn tombs vary which may suggest a practice of successive interments of complete bodies (ibid; Piggott 1962: 22-23).

Outside these dominant forms, individual inhumations, with accompanying artefacts (such as bowl pottery), have been discovered in caves (e.g. Tom Tivey's Hole and Chelm's Combe). These are less common and represent much smaller parts of the Neolithic community but suggest a greater diversity in burial deposition during this period (Pollard and Healy 2007: 100).

### **Monument type**

#### **Long barrows and chambered tombs**

Long barrows are mostly concentrated in eastern and southern Britain (c.230 Early Neolithic long barrows in southern England), primarily in Wessex. However, at least 54 long barrows have been recorded in Yorkshire and Lincolnshire with smaller numbers in Derbyshire and Cumbria (Figure 19) (Malone 2001: 112-113).

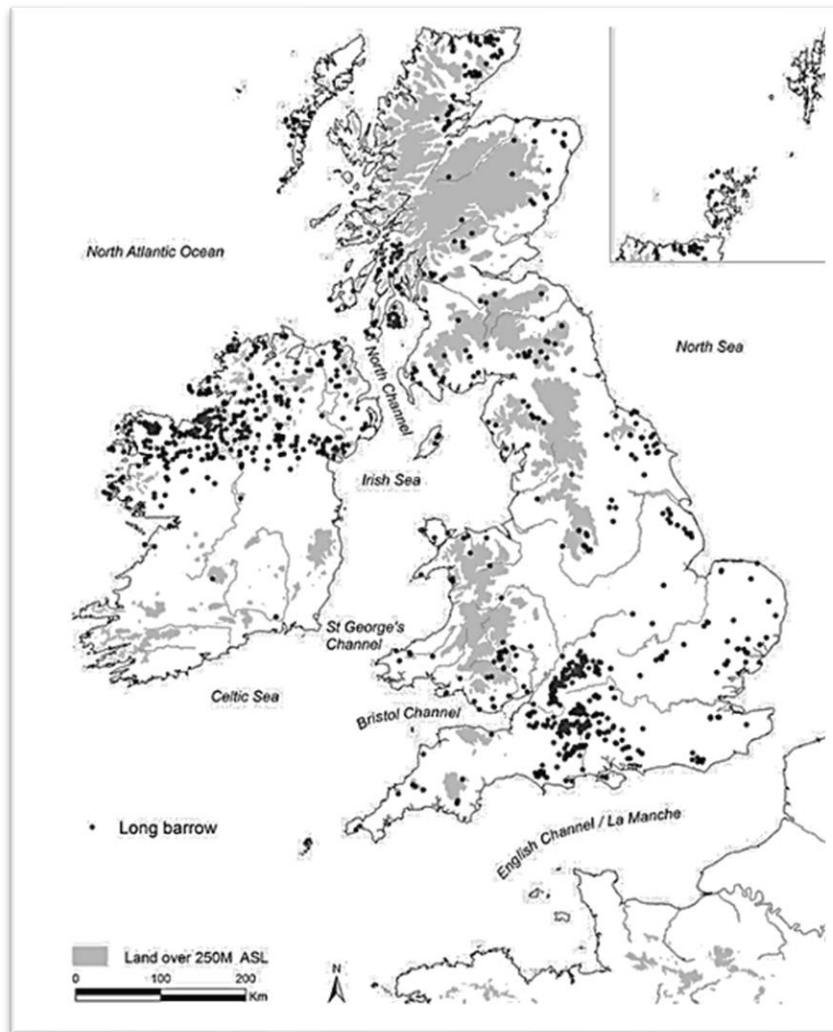


Figure 19. Distribution of long barrows in the British Isles [Darvill 2010: 110 (figure 39)].

These earthen, turf covered mounds (normally ranging from c.20m over 125m long) are generally long and trapezoidal in shape constructions usually covering one or more burial chambers and incorporating high wood plank façades with forecourts often used for ceremonial purposes (Malone 2001: 112-113; Darvill 2010: 111). Additional adjacent quarry ditches/pits are also present. The forecourt arrangement makes them distinctive and suggests that ritual activities were taking place in front of the monument (ibid., 113).

The variation in long barrow characteristics (e.g. shape and number of the chambers, their position in the structure itself, the size of the forecourt) (Figure 20), and the large-scale distribution across the country (c.3800BC and 3500BC) is thought to reflect the widespread expansion of Neolithic communities in the British Isles (Darvill 2010: 113).



This expansion resulted in broader regional groups of this type of monument including the Cotswold-Severn Group (Figure 14), also established in Wales (section 2.2.1), the north Wales Group, the Clyde Group, the north-eastern Group, the Midlands Group, the Wessex Group and the Medway Group (Darvill 2010: 113).

Burials in long barrows were normally placed at the entrance of the barrow, on the floor, in burial pits, paved platforms in cairns (of chalk, stone and flint) or wooden mortuary chambers (made of hurdles or stakes) (Malone 2001: 113). Some long barrows contained wooden buildings, enclosures or mortuary houses within their façades, passages and open areas possibly used during depositions (Malone 2001: 113).

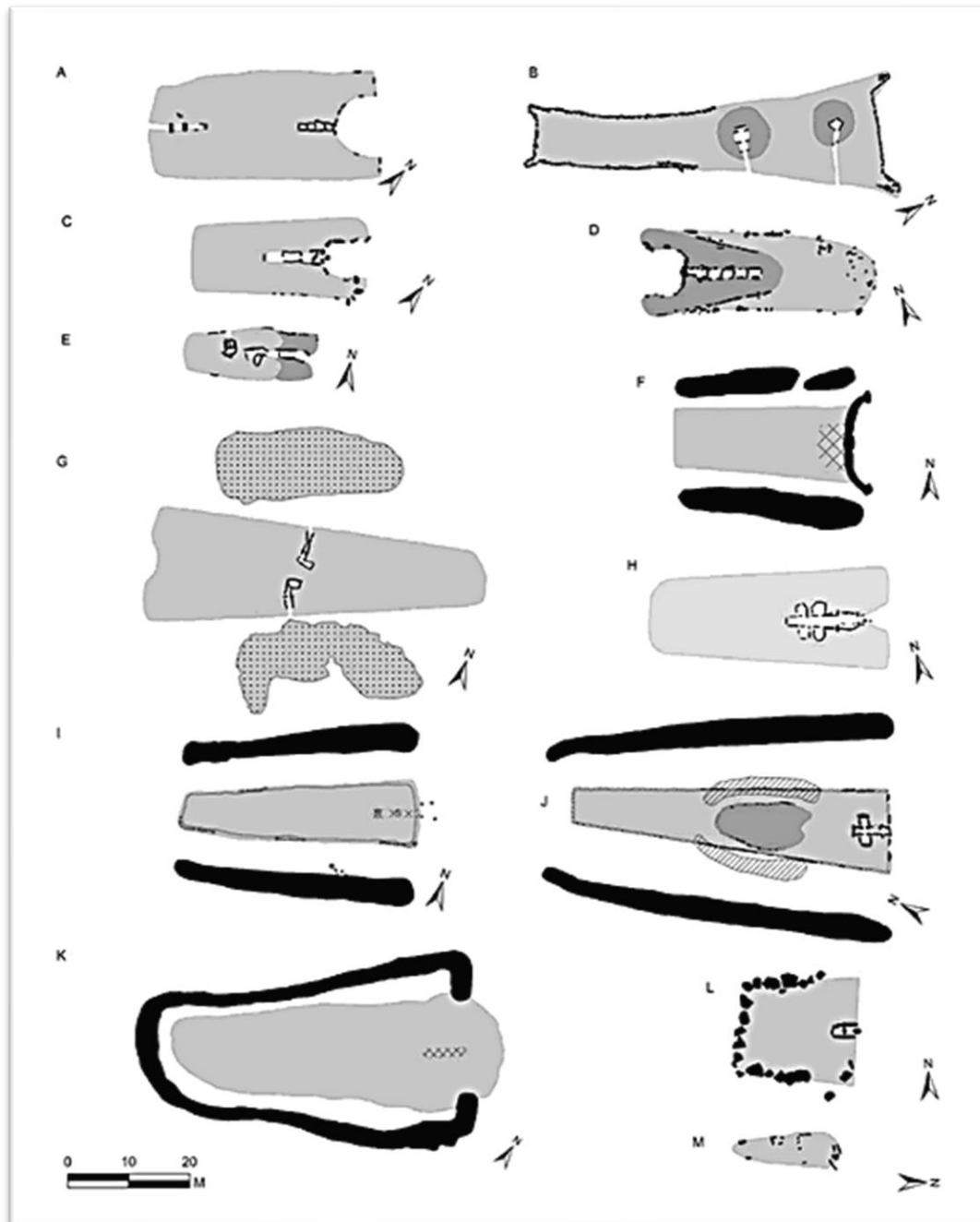


Figure 20. Examples of long barrows across the British Isles (ground plans). The black lining represents earlier phases of some monuments and the lighter toning represents later additions. A: Carn Ban, Arran, North Ayrshire; B: Camster Long Highland; C: Carn, Ireland; D: Cashtal yn Ard, Isle of Man; E: Trefignath, Isle of Anglesey; F: Raisthorpe, East Riding of Yorkshire; G: Hazleton North, Gloucestershire; H: Notgrove, Gloucestershire; I: Fussell's Lodge, Wiltshire; J: Wayland's Smithy, Oxfordshire; K: Haddenham, Cambridgeshire; L: Coldrum, Kent; M: Catshole, Cornwall [Darvill 2010: 112 (figure 40)].

Multiple inhumations from disarticulated remains have been discovered in long barrows, whilst articulated skeletal remains and accompanying grave goods are less frequent (Darvill 2010: 113). Disarticulated remains associated with excarnation (sub-

aerial exposure prior to final deposition) and secondary burials are both reported (ibid.). For example, in the timber mortuary house of Fussell's Lodge, Wiltshire the remains of a minimum of 51 individuals were recovered from three distinct piles (Malone 2001: 121). The old ground surface, along the central axis of the monument (Schulting 1998: 252), an inner construction partly burnt and possibly collapsed ('house') (Malone 2001: 121) and an inner 'box' contained selected remains (13 individuals and four children) with an underrepresentation of skulls and long bones (Schulting 1998: 252). Individuals were mixed. Evidence of erosion on some of the material and a number of missing elements suggests that bodies were first exposed and once disarticulated, subsequently gathered and arranged in piles within the barrow (Wysocki et al. 1997: 68-69).

Other burial monuments, such as West Kennet, a large Severn Cotswold tomb, have provided evidence for division of human remains associated with age and sex between chambers (Figure 21) (Malone 2001: 108). Smaller bones (e.g. vertebrae) were packed into crevices between stones whilst skulls or long bones were bundled together (ibid., 110). In addition, the cremated remains of an adult male and female were discovered spread over the most complete and intact burial in the barrow (Schulting 1998: 255). The skeletal deposits in West Kennet were mixed, however, it has been suggested that some individuals must have been interred when fleshed (primary burials), whilst others derived from secondary burials (fragmentary/disarticulated) (ibid.). Selection of bone based on age and sex has been reported amongst other assemblages such as at Hazleton North, Gloucestershire (Saville 1990) and bone bundles at Skendleby and Lanhill (Malone 2001: 110).

### **Passage Graves**

As noted in 3.2.1, simple passage graves have a central stone-built chamber that is covered by a rounded or slightly oval mound and are restricted in distribution to the western coasts and in a few inland areas, such as the North Cotswolds and the Peak District (Derbyshire) (Darvill 2010: 108). There is scattered evidence of burial practices in the south-west. Human remains were discovered in a passage grave at Broadsands, Torbay, Devon (c.3900BC – 3700BC), in four small groups alongside Carinated Bowl pottery and worked flint. Welsh equivalents of this type include Ty-Isaf, Powys and Bedd-yr Afanc, Pembrokeshire.

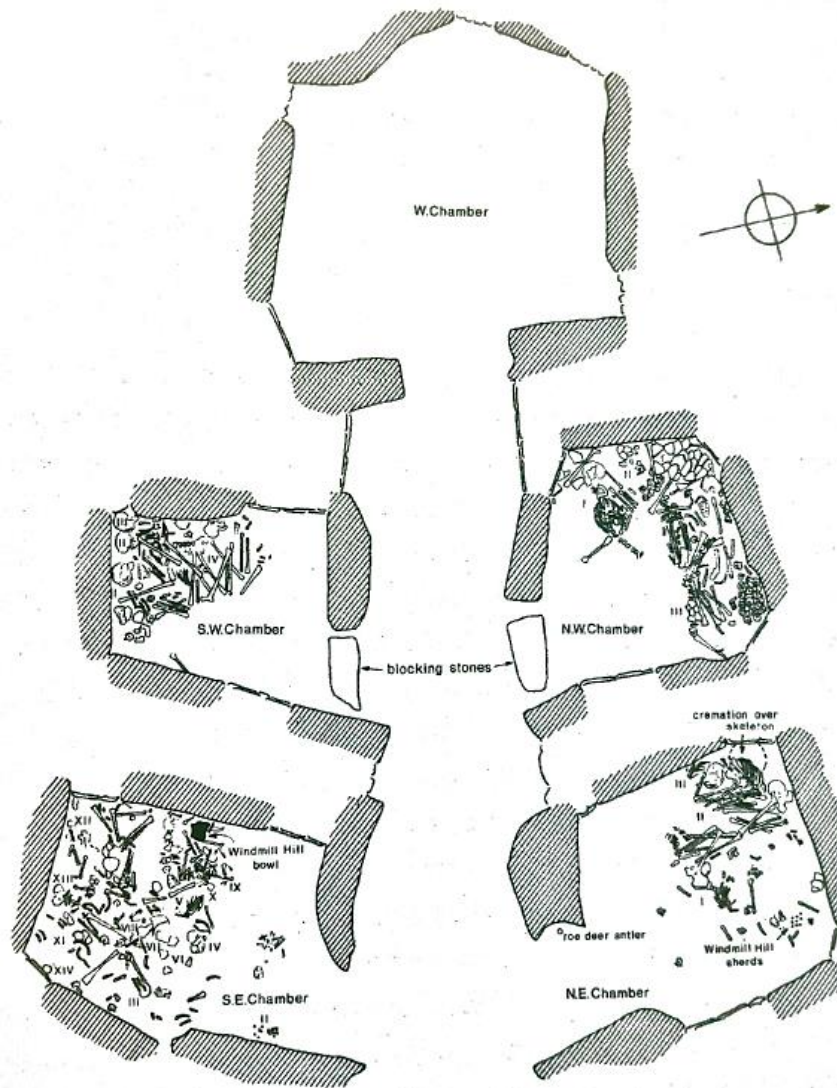


Figure 21. Arrangements of bones in the chambers of West Kennet [Malone 2001: 109 (figure 67)]

### Causewayed enclosures

Causewayed enclosures represent one of the largest earthworks of the early Neolithic in southern Britain and are often the context for the placement of human remains (Whittle *et al.* 2011a: 5). First recognised as Neolithic monuments in the 1920s, approximately 70+ sites have since been mapped, excavated and dated to this period in Britain (Figure 22) (Malone 2001: 71). Causewayed enclosures consist of single or multiple circuits (ranging from one to four), comprising interrupted ditches and internal banks with boundary ditches. They can vary in size and construction (Whittle 2009: 95; Darvill 2010: 97; Whittle *et al.* 2011a: 5). The enclosures are usually located in areas of light woodland or small clearances (e.g. on hilltops and promontory situations,

hillslopes or valley floors) and show regional variations (Darvill 2010: 97). The ditches usually contain a variety of deposits including human bone, food remains, artefacts and digging implements (Whittle *et al.* 2011a: 5). There are no signs of occupation to suggest settlement, however, the variety of deposits that accompanies these sites indicates multiple stages of activity and use of the ditches (Whittle 2009: 96; Malone 2001: 72). This evidence has led them to be interpreted as political statements of power in the landscape, places for social activities and ceremonies, centres of the elite, defensive sites, funerary and feasting centres, cult and religious centres (Malone 2001: 72, 73).

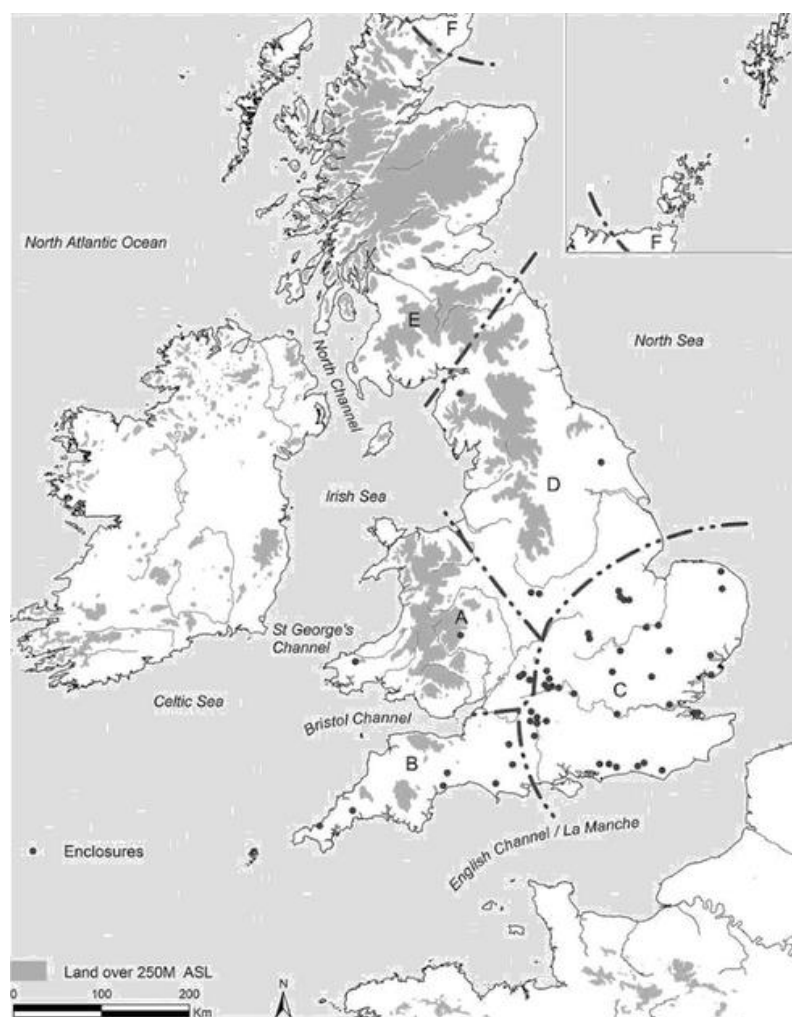


Figure 22. Distribution of mid fourth millennium (BC) enclosures in Britain. A-F: shows the spread of the main pottery families (A: eastern styles; B: south-western styles; C: southern decorated wares; D: eastern styles; E: north-western styles; F: north-eastern styles) [Darvill 2010: 98 (figure 33)].

The quantity of human remains found in causewayed enclosures is generally small with different numbers of individuals buried in distinct manners including disarticulated and fragmentary human remains. Remains have been discovered along with other finds (animal bone and artefacts). For example, a child's skull was unearthed in a primary ditch fill at Windmill Hill enclosure, Wiltshire alongside the frontal bones of an ox skull and selected cattle bones (Malone 2001: 81). The Windmill Hill enclosure (c.3600BC – 3000BC) is one of the largest enclosures recorded in Britain (Figure 23) with its circuits establishing different stages of activity. The circuits contain deposits with evidence of diverse treatment from the innermost circuit (large quantities of material and more highly processed bone) to the outmost circuit (unusual deposits, including infant burials) (Whittle 2009: 96). A dismembered adult male was further discovered in the ditch of the outer bank, amongst small animal bones (e.g. frogs, toads, rodents) suggesting excarnation was practiced at the site (Whittle *et al.* 2011b: 66). Diversity in the placement of human remains is further reflected amongst scattered artefacts in banks, food remains in pits and postholes and other finds such as pottery, worked bone and antler, querns, flint and stone tools (Malone 2001: 81).

A large number of human remains were recovered from Hambleton Hill, Dorset (c.225 individuals), in a fragmentary and scattered state (Schulting 2007: 582). Exposure within the enclosure and subsequent decomposition and incorporation of the remains into the banks could be responsible for this state of the skeletal remains (*ibid.*). Practices of deliberate depositions of isolated cranial remains at the bottom of a ditch have been recorded in several causewayed enclosures in Britain (e.g. Etton and Haddenham, Cambridgeshire; St Satines, Middlesex; Hambleton Hill, Dorset) (*ibid.*, 683).

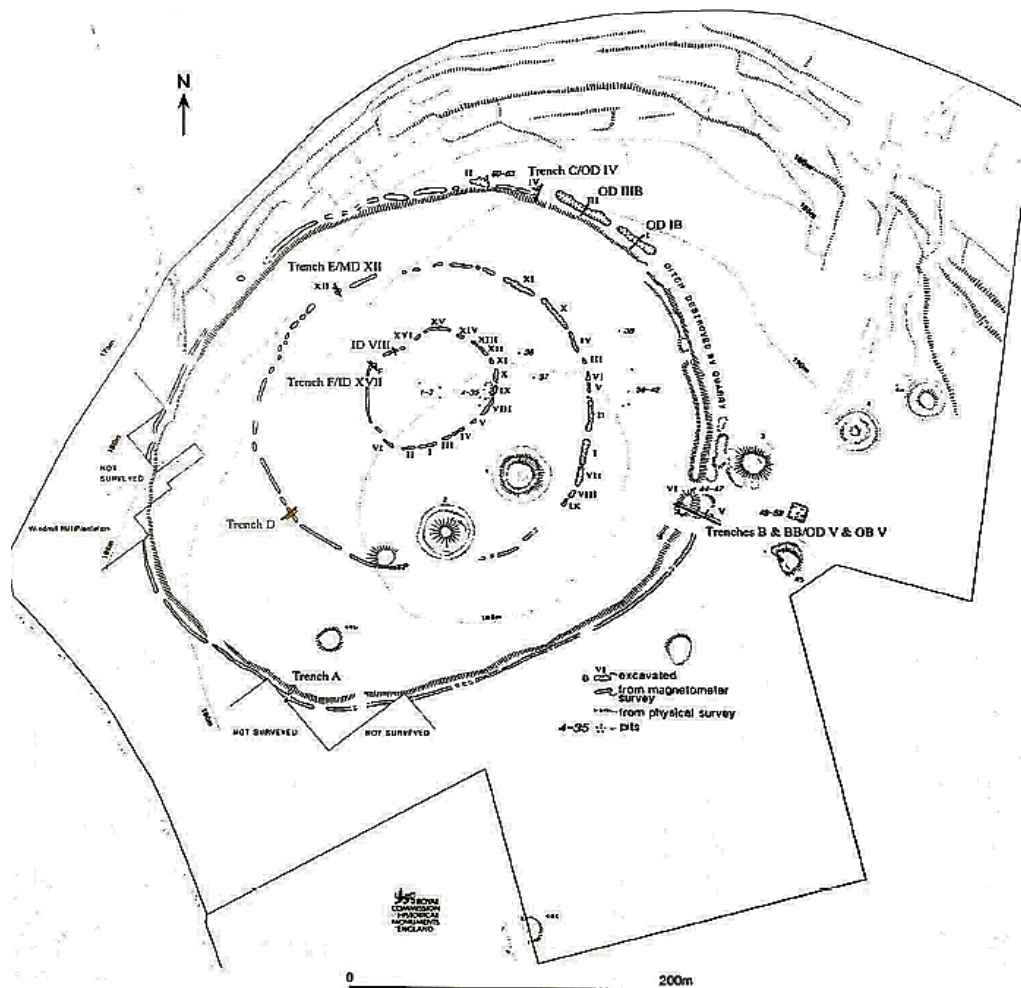


Figure 23. Plans of the excavation of the Windmill Hill causewayed enclosure: cuttings, earthwork, geophysical survey and location of sections [Whittle *et al.* 2011b: 62 (figure 3.2)]

### Middle to Late Neolithic context - Cursus monuments

Middle Neolithic cursus monuments are long rectangular enclosures that include ditches, banks and open terminals (Whittle 2009: 96; Darvill 2010: 119). Absent from the Welsh landscape, over fifty cursus monuments have been discovered in Britain, the largest being the Dorset Cursus (Figure 24) that extends for almost 10 km (Darvill 2010: 119). The unfinished nature of some of these sites suggests construction in stages and their size and length varies greatly (Harding and Barclay 1999: 2; Whittle 2009: 96). They have been interpreted as boundary markers (Whittle 2009: 97) an arena for religious and/or ceremonial purposes (Atkinson 1955: 9) or ritual centres of less importance than causewayed enclosures (Renfrew 1973). Human remains (right femoral shaft from an adult) were recently unearthed from a test pit/trench (topsoil),

above the western ditch of the Greater Cursus in Stonehenge with a radiocarbon date providing a Late Neolithic date c.2890BC – 2670BC (Chamberlain and Wills 2020: 134). Discovery of human remains in the Great Cursus suggests that more human remains could be excavated from other locations and more investigations are required.

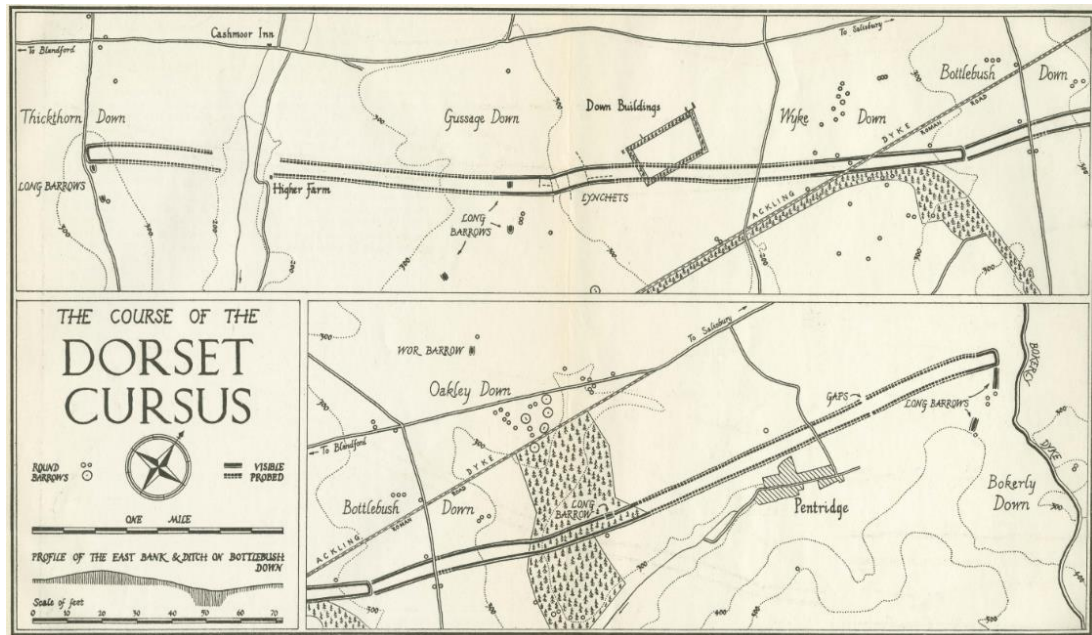


Figure 24. Dorset Cursus, Cranborne Chase, East Dorset (Atkinson 1955: figure 1).

## Non-funerary contexts

### Dolmens

As noted in 3.2.1., dolmens, characterised by megalithic upright stones that support a massive capstone (Malone 2001: 132), are present in Wales, southwest England (similar in form to Welsh Portal Dolmens) and Ireland. In Cornwall they are smaller than the Welsh Portal Dolmens but similar in structure (ibid.). Well-known examples of are those at Trethevy Quoit, Mulfra Quoit, Chun Quoit and Lanyon Quoit (ibid.). A number of these Portal Dolmens were explored archaeologically by antiquarians or early archaeologists, without producing any finds with very few re-excavated and examined in large-scale, mostly in Wales (Cummings and Richards 2014: 133).



### **3.3.2. Late Neolithic (c.2900BC – 2200BC), Chalcolithic (c.2500BC – 2200BC) to Early Bronze Age (c.2200BC – 1700BC)**

#### **Type and location**

Late Neolithic mortuary practices are not well represented in southern England, with the majority of information deriving from a few henges and henge enclosures (and caves) located in the Mendip Hills (Lewis 2005, 2011).

Henges are circular enclosures, diverse in size and most comprise of an external bank, an internal ditch and multiple entrances (Lewis 2011: 100). Other smaller structures that accompanied henges include stone and timber settings, stone circles, free-standing stones and circular or oval timber palisades that pre- and/or post-dated the construction itself (Whittle 2009: 98; Lewis 2011: 100).

Henges and “hengiform” monuments appear in several parts of southern Britain, primarily on the Wessex chalk. Examples of Late Neolithic henges include the Conygar Hill, Dorchester, a small monument that might have acted as a family shrine, the massive henge enclosure of Avebury and Durrington Walls (Wainwright and Longworth 1971; Gillings and Pollard 2004), the Priddy Circles in Somerset (Lewis 2005, 2011) and Stonehenge itself (Parker Pearson *et al.* 2007).

As noted in 3.2.2., the Chalcolithic in Britain was marked by the appearance of single burials deposited in round barrows and accompanied by a considerable amount of grave goods, possibly emphasizing wealth, power and identity (Darvill 2010: 170). In southwest England not all burials were marked by a mound as some were concealed with sarsen slabs or deposited at the base of standing stones (especially near the Avebury region) (Pollard and Reynolds 2002: 128-130).

The Early Bronze Age in southwest England is further dominated by megalithic constructions of round barrows and round cairns (Figure 26) (Pollard and Healy 2007: 99; Darvill 2010: 203). A large variety of round barrows that range from large turf-built ditched mounds to small stone cairns exists along with more complex burial deposits but display uneven distributions and dense concentrations (Pollard and Healy 2007: 99; Mullin 2011: 120). There are huge numbers of these burial monuments with over 6000 round barrows concentrated in Wessex (mostly Wiltshire and Dorset), over 700 in

Somerset (Grinsell 1969, 1971) and over 3000 in Cornwall (Pollard and Healy 2007: 99).

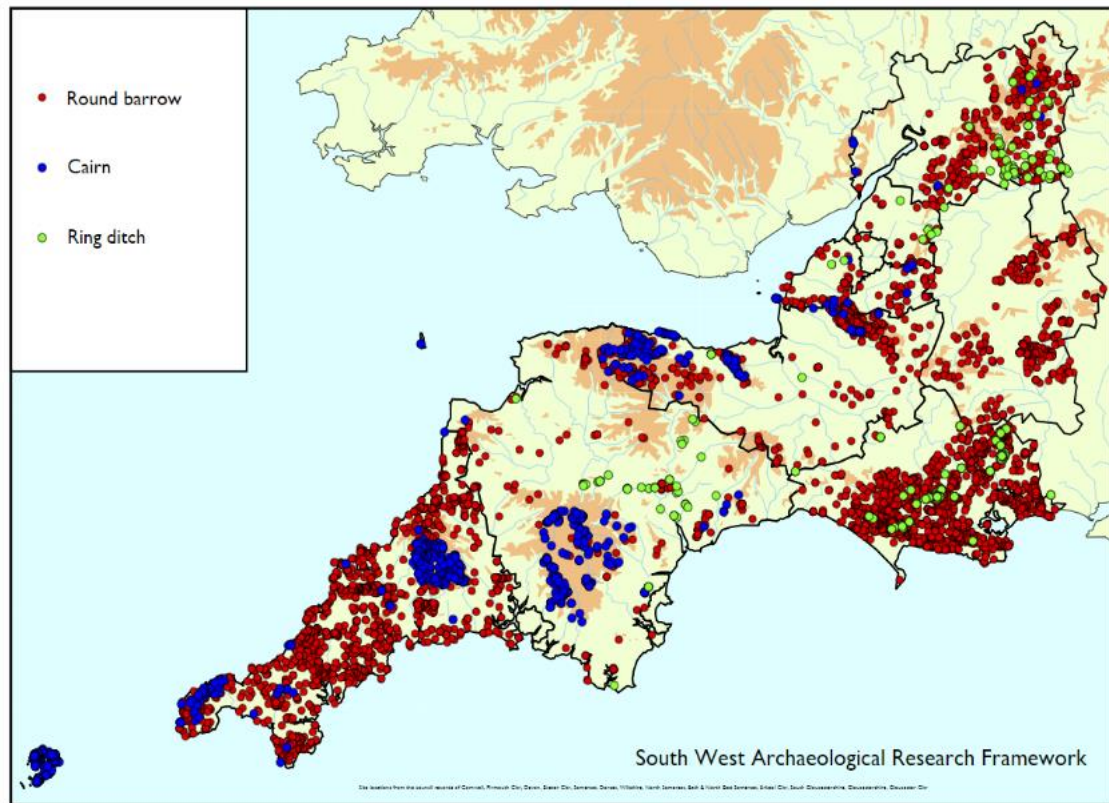


Figure 25. Distribution of round barrows, cairns and ring ditches in Southern Britain (HERs records) [Pollard and Healy 2007: 98 (Figure 13.2)].

### Aspects of burial practices

Human remains are not bountiful in henges in the Late Neolithic, however, researchers have argued that henges represent tangible evidence of human activity and ceremonial practice (Pollard and Healy 2007: 97).

Gorsey Bigbury in Cheddar for example, is the only henge that has been extensively excavated in northern Somerset (Figure 26) and forms a circular enclosure with an external bank, an internal ditch and a single entrance (Lewis 2005: 79; Lewis 2011: 101). The Gorsey Bigbury henge has four distinct phases of activity, from its initial construction and deposition of human remains, to the subsequent disposal of Beaker pottery sherds, flint and animal bones in the ditch. The site lacks stratigraphic information and secure dating on human bone (six radiocarbon dates c.2500BC to 1650BC from charcoal and bone samples). Human remains of a crouched burial of a

male adult (skull, mandible and limb bone fragments) and an adult female (apart from the skull) were discovered in two separate groups (west and east of the enclosure) in the a stone cist at the bottom of a ditch filling in the western part of the henge (Lewis 2005: 81). Part of an adult female cranial vault and a molar and a child's cranial fragments (c.5 years old) were discovered in the eastern group of bones (ibid.). Remains were unearthed in diverse states and locations within the henge however, finds do not reflect a burial practice noted elsewhere (Lewis 2005: 81; 2011: 101).

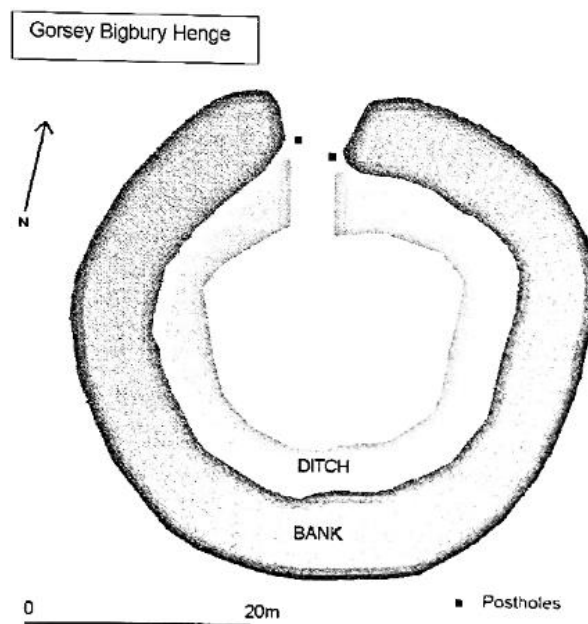


Figure 26. Gorse Bigbury Henge [Lewis 2005: 80 (figure 5.6)].

There is some evidence that the deceased may have been circulated in different locations during the Chalcolithic and Early Bronze Age. There is evidence for excarnations (e.g. human bone found in Units 6 and 5b at Brean Down, Somerset) (Bell 1990: 257), deposition in ditches (e.g. Avebury henge) (Pollard and Reynolds 2002: 127) and caves and swallets (Mendip Hills) (Lewis 2005). Elsewhere human remains are absent from some barrows (e.g. Clandon, Dorset and barrows of the Mendip Hills) suggesting a lack of settlement in certain regions (Parker Pearson 2009: 118; Mullin 2011: 125). Elsewhere there is some evidence for mummification or circulation of bone bundles as in the case of Shrewton 5K, Wiltshire where the body of an adult male was placed in a flexed position at the base of a 2.2 deep shaft grave. Items that accompanied depositions similar to the adult male from Shrewton 5K, were associated with rituals

that took place during burial. Items included grave goods (Beaker and small copper knife), animal bones (deer antler) and a small engraving of intersecting lines on the side wall (Darvill 2010: 171).

As earlier noted, in south-west England not all burials were marked by a mound. For example, the Beaker flat grave of the 'Amesbury Archer' Amesbury, Wiltshire, is a lavish single grave burial without a mound accompanied by over 100 grave goods (Parker Pearson 2009: 116; Darvill 2010: 170; Parker Pearson *et al.* 2016). This burial formed part of a distinctive group of burials (c.2000BC – 1800BC) in the Wessex area (Wessex I group) associated with luxurious artefacts (goldwork) and funerary deposits. Other examples include the elaborate Bush Barrow, Normanton Down cemetery, south of Stonehenge (Parker Pearson 2009: 118). Here, an adult male was accompanied by a gold lozenge, three large bronze daggers (one with a pommel inlaid with thousands of tiny gold pins) and a stone macehead and bone mounted wooden handle (*ibid.*).

The marking of territory in the Chalcolithic/Beaker and Early Bronze Age and the use of lavish grave goods (with possible gender biases) clearly defines a distinct burial tradition that distinguished itself from the Neolithic horizon. Single inhumations are crouched or flexed and are placed in stone cists, dug-out tree-trunk coffins or deposited within pitched-roofed timber mortuary houses [e.g. Amesbury G15 (Piggott 1973)] (Pollard and Healy 2007: 101). There is a diversity of burial traditions across regions from single to multiple burials and with cremations discovered together [e.g. Durrington 7 (Richards 1990) West Overton 6b (Smith and Simpson 1966) and Lousey Barrow (Christie 1985)] (*ibid.*).

### **3.4. Summary**

This chapter explored Early Neolithic and Early Bronze Age burial contexts in Wales and southwest England where skeletal remains have been discovered to understand and acknowledge the concurrent non-cave burial traditions prevalent in these regions.

The start of the Neolithic has a predominance of chambered tombs and long barrows with regional variations, accompanied by multiple commingled disarticulated, fragmented remains which point to differentiation in treatment amongst the individuals and across sites. Collective burials with evidence of distinct manipulation and series of

depositions are also visible in both regions. Despite the absence of some burial contexts in the Welsh landscape (e.g. causewayed enclosures), both regions show a common and slow disappearance of Early Neolithic collective-multiple burial trends with a move to individual single burials accompanied by grave goods during the Chalcolithic and Late Neolithic.

In Wales, long barrows and chambered tombs, including passage graves and some portal dolmens are the majority rite from the Early Neolithic onwards. Whilst portal dolmens are not extensively used, their appearance suggests greater exploitation of the landscape and resources. The communal, fragmented and mainly disarticulated burials of the Early Neolithic gradually become replaced by cremation deposits in pits and henges from the Middle Neolithic onwards. Single inhumations become more dominant during the Late Neolithic in re-used tombs. During the Chalcolithic these persist in new lavish burial mounds constructed across Wales. A steady and consistent use of monumental constructions is evident, as people systematically build, re-use and re-build similar structures across Wales. The nature of burial practice does, however, change.

Preference in burial context across south-west England is restricted to chambered tombs and causewayed enclosures compared to the variety of sites apparent in Wales. During the Early Neolithic, most burials in southwest England are long barrows and causewayed enclosures, with henge constructions dominant in the Late Neolithic. In south-west England, from the Chalcolithic, individual inhumations in round barrows sometimes with lavish grave goods, replace the earlier multiple commingled remains.

Evidence of various forms of human processing in separate contexts across both regions possibly suggests concurrent use of caves and monuments for depositions and is a theme that is explored in this PhD. Understanding of the variation in mortuary practices and contexts where human remains have been discovered is essential for the interpretation of commingled assemblages found in caves and comparison of above-ground monuments and caves in the Neolithic (Chapter 8).

The next chapter introduces a background of the methodology used in this research (Chapter 4) and the methods adopted for this PhD (Chapter 5).

## **Chapter 4: Methodological background**

### **4.1. Introduction**

This research employs new approaches to taphonomic data to study disarticulated human remains in caves. By exploring macroscopic taphonomic evidence alongside microscopic diagenesis of human bone it is possible to reconstruct mortuary practices. Burial practices and post-mortem processes can modify bone in various ways, for example through excarnation and exposure of the bone in different environments. Macroscopic analysis provides information on the degree and duration of exposure of the remains, the nature of manipulation and/or disturbance of the bones and the agents of these modifications impacted on the bones. Microscopic analysis provides insights into early post-mortem process and reveals the rate and nature of soft tissue decay.

In order to understand human burial practices, this chapter provides a review of previous research on taphonomy and the factors affecting bone preservation (4.2 – 4.4.) in general and more specifically in relation to the macroscopic identification of burial practices and post-mortem modifications with which this thesis is concerned. Modifications (4.5) are presented based on natural processes and anthropogenic and other causes of fragmentation. Natural processes include weathering, gnawing, insect wear, root etching/erosion, abrasion, staining and trampling. Anthropogenic or other causes (unintentional breakage) include fracture patterns, trauma (blunt/sharp force, cutmarks) and burning. Taphonomic modifications explicitly used in this research are presented in Chapter 5 in the same manner to compare and contrast and understand the processes and taphonomic changes the body goes through.

A complete review of each modification process is not the intention of this thesis and therefore only a summary of each is given. A review of microscopic analysis of bone microstructure (4.6) is also provided, but as this not the main area of research, only a review of relevant proxies is presented for understanding bone diagenesis.

### **4.2. Definitions and research timeline**

In order to reconstruct burial processes, it is important to understand the processes by which human remains are preserved, from death to their preservation and fossilization (Andrews and Fernández-Jalvo 2019: 2). Taphonomy broadly deals with all aspects of

the transition of remains from the biosphere to lithosphere and has been widely adopted in zooarchaeology and osteoarchaeology from general research to controlled experiments using new technologies in recent years<sup>47</sup>. A thorough analysis of taphonomic modifications can reveal information such as site formation process, the integrity of a deposit and pre-depositional treatment of body parts (or different taxa)<sup>48</sup> (Madgwick and Mulville 2012: 509).

## Definition

The term taphonomy was coined by the palaeontologist Efremov (1940: 3) who defined it as “the science of burial” (Pokines 2014: 3). Taphonomy derives from the Greek word *taphos* (i.e. burial) and *nomos* (i.e. law or system of rules) (Christensen *et al.* 2019: 145). Researchers offer a variety of definitions for this discipline. Some described it as the science that studies processes of accumulation and their sequence through time (Pinto Llona and Andrews 1999: 412), whereas others as the study concerned with the preservation, observation and recovery of dead organisms and the reconstruction of their biology (Haglund and Sorg 1997: 13).

Taphonomy can include the study of the processes which generate, modify and destroy bone assemblages (O’Connor 2000: 19), the study of post-mortem damage to animal bones (Bartosiewicz 2008: 69) or the study of the agents and processes that influence the body from the moment of death (biostratinomy)<sup>49</sup> until remains (if any survive) are recovered (Lyman 2008: 264). A broad definition is used in this research that is taphonomy is the study of factors that contribute to the process of decomposition by

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<sup>47</sup> Examples include Lyman 1994a; O’Connor 1996; Nicholson 2001; Blasco *et al.* 2008; Madgwick 2008, 2010; Martinelli *et al.* 2008; Pakosh and Rogers 2009; Moraitis and Spiliopoulou 2010; Fernández-Jalvo *et al.* 2011; Boschini and Grezzini 2012; González *et al.* 2012; Atici 2014; Sala *et al.* 2014; Fernández-Jalvo *et al.* 2014; Madgwick and Mulville 2015; Booth 2016; Knüsel and Robb 2016; Madgwick and Broderick 2016; Moutafi and Voutsaki 2016; Andrews and Fernández-Jalvo 2019; Bello and Galway-Witham 2019; López-Cisneros *et al.* 2019; Reynard and Henshilwood 2019; Rosell *et al.* 2019; Eriksen *et al.* 2020; Papakonstantinou *et al.* 2020; Littleton 2020.

<sup>48</sup> Examples include Serjeantson 1991, 1996; Bar-Oz and Munro 2004; Enloe 2004; Todisco and Monchot 2008; Madgwick 2008, 2010; Russell 2010; Osterholtz *et al.* 2014a; James and Thompson 2015; Moutafi and Voutsaki 2016; Osterholtz 2016; Crozier 2018.

<sup>49</sup> Term proposed by Weigelt 1927b and concepts and methods developed by Weigelt (1927a), Müller (1951; 1963; 1979) and Schäfer (1962, 1972).

modifying an archaeological assemblage. These may or may not change the original biological components of the assemblage during the process.

A taphonomic modification is defined as any feature that alters the character of a bone fragment (peri- or post-mortem), representing either destructive processes or favourable conditions of preservation (Fernández-Lopez 2006: 112; Lee-Thorp and Sealy 2008: 119). Modifications can be caused by natural process that have affected the material (e.g. gnawing, erosion, weathering, water displacements) (Pokines and Baker 2014a: 447) or other agents (i.e. human activity). Post-mortem, human remains are subject to a constant cycle of interaction with living organisms (e.g. scavengers) and other contemporary agents (e.g. weathering, erosion) that will imprint on these remains before or during burial.

Originally created as a sub-discipline to palaeoecology<sup>50</sup>, taphonomy gained increasingly popularity during the 1970s and 80s by anthropologists and archaeologists as a way of gaining further knowledge of human behaviour through the information recorded on fossils (Fernández-Jalvo *et al.* 2011: 1297). Use of taphonomy in osteoarchaeology was mainly used in vertebrate palaeontology and zooarchaeology (Knüsel and Robb 2016: 655). Use of taphonomy drove forward the recognition of various taphonomic agents and processes in faunal assemblages from older publications (Olson 1952, 1980; Shotwell 1955; Voorchies 1969), to further work in the 1970s and 80s such as the taphonomy of medium and large vertebrates (Behrensmeyer 1975a, 1978, 1984; Behrensmeyer and Kidwell 1985) and small mammal taphonomy (Brain 1981).

### **Focus on cave deposits**

Efremov (1940) first recognised the potential for taphonomy as the study of death assemblages and linked concepts and methodology interrelated with three disciplines (palaeontology, zooarchaeology and forensic anthropology). Earlier interest in cave

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<sup>50</sup>Small mammal taphonomy is also highly relevant to palaeoecology (Behrensmeyer 1978, 2007; Andrews *et al.* 1979; Fernández-Jalvo *et al.* 1998; Soligo and Andrews 2005; Behrensmeyer and Miller 2012) and essential to the interpretation of faunas from fossil sites (Mayhew 1977; Dodson 1973; Dodson and Wexler 1979; Korth 1979; Denys 1983; Andrews 1990; Fernández-Jalvo and Andrews 1992; Denys *et al.* 1995, 1996, 1997, 2007; Andrews and Fernández-Jalvo 1997).



archaeology however, encouraged its recognition as a sub-discipline. For example, Buckland (1823: 93), referred to an accumulation of animal bones of various birds and moles, water-rats and mice, even fish bones, in limestone caves by hawks and gulls and geologist Lyell (1830-33: 219-227) examined how animal remains can concentrate in caves and fissures that act as natural pit traps.

Whilst questions surrounding mysterious cave infillings and the level of involvement of human and animals were raised (e.g. Grayson 1983), barriers for extensive cave research existed (e.g. Lyell's principle of uniformitarianism<sup>51</sup> and the theory of evolution). New contributions started to emerge from the late 50s (Dart 1956, 1957, 1958; Klein 1975; Binford 1981; Brain 1981) but it was only in the 70s that the true significance of cave depositions was emphasized (along with the rediscovery of taphonomy).

This was due to two factors. Firstly, palaeontologists, archaeologists and zooarchaeologists started questioning agency in bone collections (e.g. faunal collections accumulating in caves as a result of human activity). Secondly, the need for a body of theory that connected remains to behaviour<sup>52</sup> was recognised (Binford 1977; Schiffer 1972, 1976; Strauss 1990: 261-2). This grew out of the work of Dart (1957) and Brain (1981) who both questioned the nature of cave faunas of South Africa and emphasized the importance of distinguishing the factors and agencies involved in bone accumulations within caves (e.g. faunal associations with human and non-human agency) (Strauss 1990: 262). As a result, more research was undertaken (e.g. Strauss 1976, 1982; Binford 1984; Klein 1982; Gamble 1983)<sup>53</sup>. These new studies mostly centred on the identification of scavenged animal remains but also on associations of behaviour between ancestral and modern humans. It gradually became clear that caves were complex sites affected by a variety of distinct agents and this drove new research

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<sup>51</sup> A geological phenomenon occurring in the same manner as in the past. Developed by Charles Lyell (1830-33) who suggested that the forces moulding the planet have operated in the same manner throughout history (e.g. an earthquake). Research shifted away from examining cave sediment formation since researchers considered that cave deposits were homogenous.

<sup>52</sup> Understanding the type of conditions, activities and situations that affected the depositions or that were responsible of their deposition (Strauss 1990: 261).

<sup>53</sup> More examples include Shipman 1983; Blumenschine 1987.

in archaeology and palaeontology to improve analysis of multiple depositions discovered in these locations (e.g. Andrews 1990).

Additional research on micro-taphonomy also proved fruitful to the development of the field. Wedl (1864) investigated postmortem microscopic changes to bone structure and discovered taphonomic changes occurring in the form of microtunneling referred to as Wedl tunnels. After an actualistic experiment, observing naturally occurring death assemblages and their depositions by the geologist and palaeontologist Weigelt (1927a) it became apparent that palaeontologists failed to comprehend the ecological relationships of species (Shotwell 1955). This was due to the lack of modern analogies (Pokines 2014a: 4). By the 1970s, taphonomic research was interrelated with the analysis of biological remains (Voorhies 1969; Miller 1969, 1975; Binford and Bertram 1977; Behrensmeyer 1978)<sup>54</sup>. This formed the basis for new research for example, into Pleistocene faunal assemblages (Knüsel and Robb 2016: 655).

From a forensic perspective, taphonomic analysis has been closely associated with estimated time periods. Establishing the time of modifications to human remains is a tool in forensic investigations. This can be achieved by mapping the process of decomposition in different environmental conditions (Galloway *et al.* 1989; Bass 1997; Clark *et al.* 1997; Pinheiro 2006; Damann and Carter 2014), the effects of burning (Symes *et al.* 2008; Symes *et al.* 2014a) and signs of animal activity (Haglund 1997a, 1997b; Pokines 2014b). Forensic methods developed for use on large assemblages and by using statistical analyses were not easily transferable to the field of archaeology (Knüsel and Robb 2016: 655). By merging forensic analysis to osteoarchaeology, new methods of analysis developed. This new field of funerary taphonomy employs taphonomic changes to assist in the clarification of funerary practices (*ibid.*). A series of case studies demonstrated the use of these techniques. For example, Ubelaker (1974) studied the treatment of the skeletal remains from the Nanjemoy Creek ossuaries in Maryland, USA, to associate statistical patterns in bone preservation and deposition by using ethnographical parallels for burial practices.

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<sup>54</sup> More examples include Weigelt 1927a; Behrensmeyer and Hill 1980; Behrensmeyer 1982; Shipman and Rose 1983; Olsen and Shipman 1988; Lyman and Fox 1989; Lyman 1994a.

In the 1980s, Boddington *et al.* (1987) compiled the first synthesis of taphonomic research in archaeology. This publication included works establishing a focus on the standard survival rates of different skeletal remains (Garland 1987; Henderson 1987; Waldron 1987) and the effects of disarticulation transport and delayed burials on human remains at the medieval Jewbury cemetery in York, UK (Brothwell 1987). The discipline gradually established a significant role in the analysis of archaeological assemblages with the first systematic investigations being published around the 1990s (Whittle and Wysocki 1998; Saville 1990; Buikstra and Ubelaker 1994; Duday 2006, 2009)<sup>55</sup>. Methods for recording fragmented human remains (Buikstra and Ubelaker 1994; Knüsel and Outram 2004), advances in methodological approaches of taphonomic data (Adams and Byrd 2014; Schotsmans *et al.* 2017), an atlas of bone modifications (Fernández-Jalvo and Andrews 2016) and case studies on skeletal assemblages in distinct regions and periods (Osterholtz *et al.* 2014; Osterholtz 2016; Crozier 2018; Tellier 2018; Andrews and Fernández-Jalvo 2019)<sup>56</sup> have all underlined the great potential of this discipline. The emerging field of funerary taphonomy has allowed researchers to link burials, element representation and preservation/condition of remains to their depositional environment and to funerary practices taking place (Knüsel and Robb 2016).

### 4.3. Complexity in the field of taphonomy

Analysis of human burial rites is complicated by the post-mortem trajectory of the body, from the initial deposition to archaeological analysis. Taphonomic analysis can help to understand the processes that have occurred, however there is no standardization in the recording of the taphonomic variables (Garland 1987: 109)<sup>57</sup>. There are further challenges in the time and the cost of collecting and analysing taphonomic data (see

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<sup>55</sup> More examples include Villa *et al.* 1985; Villa *et al.* 1986; Villa *et al.* 1986; Duday *et al.* 1990; White 1992; Turner and Turner 1995; 1999. In particular, Duday's work (2006, 2009) has mainly focused on *archaeothanatology* (the taphonomy of the body) meaning that "the position of skeletal remains upon recovery does not reflect the original placement of the fleshed corpse at the time of burial" (Knüsel 2014: 27). This method is being implemented more irregularly, however, its great potential for understanding the sequence of decomposition in burials should be noted. Examples using this method include Roksandic 2002; Nilsson Stutz 2003; Harris and Tayles 2012; Nilsson Stutz *et al.* 2013; Crevecoeur *et al.* 2015; Moutafi 2015, 2021; Moutafi and Voutsaki 2016.

<sup>56</sup> And Griffith 2017; Thompson 2019.

<sup>57</sup> Exceptions include Bar-Oz and Munro 2004; Bar-Oz and Adler 2005; Bar-Oz *et al.* 2005; Symmons 2005a; Thompson 2005; Atici 2006; Gál 2008; Madgwick 2008, 2010; Montalvo *et al.* 2008; Verzi *et al.* 2008; Randall 2010; Russell 2010.

Chapter 5/5.1.3). Additionally, many collections have not been subject to full taphonomic analysis as their disarticulated, small and/or too fragmented states has been considered a barrier to data collection (e.g. Armit *et al.* 2011).

There are numerous diverse variables that affect the rate and impact of different process on any skeletal remains and it is this complexity that makes taphonomic analysis challenging.

Death assemblages are altered by an array of natural process and agents that ultimately affect the survival rate of the bone from the moment of initial deposition to final excavation and removal of archaeological remains from their original contexts (Jans *et al.* 2002: 333). As a result, a gradual loss of individual characteristics can reduce the chance of reconstructing the biological profiles of the individuals discovered (Pokines 2014a: 6). Bones therefore go through a variety of taphonomic trajectories (*ibid.*, 7).

For example, bones may lie on a surface and be affected by subaerial exposure and weathering patterns (Miller 1975; Behrensmeyer 1978), become dispersed and transported by carnivore trampling or water during post-mortem processes (Voorhies 1969; Haglund 1997a; 1997b). Taphonomic processes will further reflect peri-mortem fracturing and scavenger activity (dispersed and/or patterned tooth marks can be distinguished from human activity) long after initial deposition. Elements may be buried (Pokines 2009) and subsequently modified by soil agents, erosion and staining and become commingled with unrelated remains (Gordon and Buikstra 1981; White and Hannus 1983; Andrews and Fernández-Jalvo 2019: 3).

Thus, any set of skeletal remains may display overlapping traces of some, if not all of these taphonomic processes, disguising traces of the original, short term or intended burial rite and location (Pokines 2014a: 7). Nevertheless, as Knüsel and Robb (2016: 656) consider, the less fragmented assemblages reveal information about biology whereas the more fragmented expose their taphonomic trajectories.

#### **4.4. Factors affecting bone preservation**

This section describes the factors that affect the disarticulation and preservation of remains pertinent to all taphonomic modifications. Bones are resistant enough to

survive in the archaeological record but also sufficiently soft and malleable to be affected by a range of processes and agents (Madgwick and Muville 2012: 509).

Some taphonomic characteristics are very distinct and limit our understanding of peri- and post-mortem events (Pokines 2014a: 11). For example, a primary burial is usually typified by the persistent articulation of elements, possible soil staining and root action/damage or erosion (in acidic soils) and a lack of weathering (ibid.). A secondary burial is characterised by additional disarticulation, re-burial and possible loss of smaller skeletal elements and involve fragmented, possibly weathered and more often eroded remains (ibid.). These taphonomic impacts do not occur in a linear process, as the distinct factors affect the preservation of skeletal remains between death and final burial (biostratinomy)<sup>58</sup>. Biostratinomic events affect the soft tissues of the body normally through microbial attack.

The following section provides an account of the key factors affecting the soft tissue preservation, bone preservation and the disarticulation of material. Element preservation is dependent on the rate of soft tissue decay, which is affected by environmental biological and cultural parameters. Environmental factors (4.4.1) include temperature, soil pH and humidity and are combined with biological factors (4.4.2) including bone mineral density. These factors affect the survival rate of the bones, can lead to further disarticulation (4.4.3) as bones are further impacted by various taphonomic modifications (4.5-4.6) and create complex taphonomic narratives.

#### *4.4.1. Environmental*

Temperature, soil pH and the bioavailable moisture, water, oxygen and organisms (Junkins and Carter 2017: 233) will affect decomposition and preservation of skeletal remains. Thus, disarticulation is affected by the rate of decay of ligaments and tendons (which take longer) (Mays 1988: 15) and percentages of body fats (e.g. individuals with less fat will skeletonise faster) (Mant 1987).

Buried remains generally decompose much slower than remains deposited/left on the surface in the same environment (Dix and Graham 2000). Exposure to warm, humid air

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<sup>58</sup> O'Connor (2000: 20) refers to such processes as perthotaxic.

upon death facilitates faster decomposition of the body, whereas cold temperatures and burial in soil decelerates the process (Galloway 1997; Pinheiro 2006; Junkins and Carter 2017: 233).

The rate of decomposition is affected by both internal changes, due to processes that see the body move from an alkaline to a more acidic state during early post-mortem period (Clark *et al.* 1997), and soil pH. A decrease in soil pH increases bone destruction of adult human remains (Gordon and Buikstra 1981: 569) as bones do not preserve well in acidic soils (pH<7) and can completely degrade (Bethell and Carver 1987; Mays 1988). Alkaline soils (pH>7) favour bone preservation due to the insolubility of hydroxyapatite of the alkaline pH (Mays 1998; Junkins and Carter 2017: 235). Non-adult remains are impacted by soil pH more severely, which possibly relates to different bone density rates (see below) (Gordon and Buikstra 1981: 569).

#### 4.4.2. Biological

Bone-mineral density, a measure of the inorganic mineral content in bone (Kranioti *et al.* 2019: 9), can affect the rate of degradation and resistance of an element to destruction<sup>59</sup>. Studies in zooarchaeology have found a correlation between bone mineral density and preserved skeletal remains referred to as “density-mediated attrition”, “post-depositional destruction” or “in situ attrition” of bones (Atici 2014: 229). Bone mineral varies in different skeletal elements, for example between upper to lower limb and epiphyseal to diaphyseal fragments (*ibid.*, 229-230). A range of methods have become available for measuring density values: computed tomography (CT), dual energy X-ray absorptiometry (DEXA) and digital photodensitometry (Stiner 2004; Gutiérrez *et al.* 2010; Sutlovic *et al.* 2016).

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<sup>59</sup> Examples include Brain 1967a, 1969, 1981; Behrensmeyer 1975b, 1978: 152; Binford 1978; Lyman 1982, 1984, 1985; Klein 1989; Marean 1991; Kreutzer 1992; Lyman *et al.* 1992; Marean *et al.* 1992; Elkin 1995; Lam *et al.* 1998; Marean and Kim 1998; Pavao and Stahl 1999; Dirrigl 2001; Kooyman, 2001; Costamagno, 2002; Stiner 2002; Ioannidou, 2003; Pickering *et al.* 2003; Lam and Pearson 2004; Bar-Oz and Adler 2005: 195; Marean *et al.*, 2004; Pickering *et al.* 2005; Symmons 2005a, 2005b, 2005c; Pickering & Egeland 2006; Yeshurun *et al.* 2007: 142; Karr and Outram 2012a; Tsegai *et al.* 2013; Atici 2014; Lyman 2014; Kendell and Willey 2014; Lerebours *et al.* 2015; Delannoy *et al.* 2016; Sutlovic *et al.* 2016; Holt *et al.* 2018; Lerebours *et al.* 2020, in press, and others.

Use of such methods has indicated that density can vary between individuals of the same species and it is not always possible to predict the level of density between elements (Gutiérrez *et al.* 2010). Bone density related attrition can impact different parts of a single element in different rates due to density variation (Kooyman 2001: 289) across bone of different size, shape and weight (Galloway *et al.* 1997: 313; Lam and Pearson 2004; Stiner 2004). Recent research identified that distinct patterns of bone distribution can exist in the same element (femur) as a result of differences in mineral accumulations of the cortical and trabecular bone (Lerebours *et al.* 2020, in press).

Lower bone density in immature individuals determines the rate of their survival in an assemblage, for example low bone mineral density non-adult human remains are often under-represented, compared to adult bones (e.g. at Crow Creek, Kendell and Willey 2014). Denser bone is generally more resistant to the effects of gnawing, trampling and fragmentation due to increased hardness and compressive strength of the bone (Bentzen *et al.* 1989; Esses *et al.* 1989; Lotz *et al.* 1990; Rogers 2000: 709). Experimental rockfall experiments by Karr and Outram (2012a) on bovid elements (fresh, frozen, semi-dried samples) aimed to investigate the different survival rates on different parts of the bones when these are subject to random breakage. Results demonstrated that low-density elements can withstand force by rock fall more frequently than those of higher density that are more likely to fragment.

Post-depositional processes, such as root etching and acid erosion, can potentially impact more severely on less dense bone and can also mask other modifications or destroy the bone in the process of taphonomic overprinting (e.g. Shahack-Gross *et al.* 2004; Phoca-Cosmetatou 2005: 139; Nielsen-Marsh *et al.* 2007: 1530). Whilst increased density offers some resistance to bone damage, the process of thermal shock and repeated drying and wetting of denser elements (teeth and diaphysis) will still have an effect (Conard *et al.* 2008).

#### 4.4.3. *Parameters affecting disarticulation*

After soft tissue degradation, skeletal elements begin the process of disarticulation with the loss of connective tissue. In undisturbed burials the bone is supported by the substrate to remain in position but if disturbed can be lost. Factors such as body size, weight, age and environmental conditions can affect the rate of disarticulation.

Monitoring in Amboseli, Kenya, showed that many taphonomic processes are affected by body size resulting in the discerning destruction of the remains of smaller species (Behrensmeyer 1981). It rises in terrestrial environments when combined with an augmentation of body size (Brand *et al.* 2003a: 78). Disarticulation processes are affected by climate, depositional environment and local fauna (Todd 1983; Galloway *et al.* 1989; Magoun and Valkenburg 2001; Brand *et al.* 2003a: 69; 2003b). The sequence of disarticulation varies in aqueous, terrestrial and brackish environments and is affected by temperature and climate (Hill 1979; Davis and Briggs 1998). Exposure to warm air and humidity after death accelerates decomposition whilst, colder temperatures and burial in soil delay the course of decomposition (Galloway 1997; Pinheiro 2006).

Lower temperatures and absence of large carnivores can also delay disarticulation and dispersal of elements (Andrews and Fernandez-Jalvo 2019: 115). Experiments in articulated small vertebrate skeletons in California showed that disarticulation occurred faster in water and fastest in environments with heavy rainfall, with initial disarticulation appearing in the separation of the limbs from the torso and resulting in the later separation of individual limb elements (Brand *et al.* 2003a: 79-80). Other experiments in aqueous environments, nonetheless, indicated that limb bones, cranial elements and small bones were the first to disarticulate (Haglund 1993). These results were based on experiments on flesh human skeletons (*ibid.*). Last, many taphonomic processes can result in bone dispersal across sites and contexts, once disarticulation occurs, fluvial action tends to transfer small and rounded elements (Lyman 1994a: 177), a factor that has been repeatedly encountered in research (e.g. Korth 1979; Denys 1983, 1985; Fernández-Jalvo and Andrews 2003; Thompson *et al.* 2011).

The main macroscopic taphonomic modifications (4.5) described above include natural process and anthropogenic or other causes of fragmentation. Natural processes include weathering (environmental degradation), animal gnawing or insect damage, root etching/erosion, soil and/or digestive corrosion, abrasion, staining/discolouration and trampling. Fragmentation can result from pre-, peri- and post-depositional natural and anthropogenic causes such as burning, fragmentation, human inflicted trauma (blunt/sharp force or cutmarks). Microscopic taphonomic modifications include



bioerosion, accelerated collagen hydrolysis, dissolution and fossilization. The most common diagenetic change discussed in this research is microbial bioerosion (4.6).

Each process will be described in detail in the next sections for understanding both peri- and post-mortem proxies that affect bone degradation and relate to mortuary practices in caves compared to open-air sites and/or above-ground monuments. Methods of recording each process can be found in Chapter 5.

## **4.5. Macroscopic agents**

### **Natural processes**

#### *4.5.1. Weathering*

Weathering is the exposure of skeletal remains to potentially destructive mechanical, physical and chemical effects of weather (e.g. fluctuating temperatures, humidity and solar radiation) (Atici 2014: 228).

Behrensmeyer (1978) considers that weathering can occur both pre- and post-burial in aboveground and underground environments. Recording of the effect of weathering processes on bone often follows a system developed by Behrensmeyer (*ibid.*). During her research at the Amboseli Basin in Kenya, she developed a five-stage method for recording weathering in medium and large-sized mammals, representing progressive destruction of the cortical surface (Stage 0 no weathering evidence to Stage 5 heavily splintered bone). The process is characterised by consecutive stages of surface cracking, flaking, exfoliation, splitting and disintegration of bone (*ibid.*, 151; Steele and Carson 1989; Fisher 1995: 31; White 2000: 411). Occasional warping (Tappen 1976: 377), edge rounding (Irving *et al.* 1989) and crumbling (Miller 1989) can also occur whilst, cracking is commonly observed longitudinally, most often on long-bone shafts and mandibulae, and can advance into split line fractures (Tappen 1969: 193, 1971, 1976: 375; Andrews and Fernández-Jalvo 1997: 191).

Recording and studying of this process provides insights into duration of exposure of the remains, history of accumulation and even tempo and timing of this depositional process (Lyman 1994a). For example, heavy weathering can indicate sub-aerial exposure prior to burial whilst, minor or absent weathering suggests rapid burial

(Andrews and Fernández-Jalvo 1997: 197). Lack of weathering cannot be taken to indicate a complete absence of exposure as trampling and disturbances can similarly expose remains (Andrews 1995; Behrensmeyer 1978). Conversely, other processes can mimic weathering. Micro-flaking, for example, can be confused with early stages of weathering. It more closely resembles superficial flaking or peeling from fragmentation through snapping (White 1992: 140-41; Laroulandie 2005: 25).

Research has indicated that the rates of osseous subaerial weathering vary across environments (e.g. sun exposure, wetting/drying, freeze/thaw) (Andrews and Fernández-Jalvo 2019: 76; Christensen *et al.* 2019: 153). Wide fluctuations in temperature and moisture result in quick bone degradation (Ricklefs 1973) as opposed to more stable environments where the effects of weathering are much less severe and the process is decelerated (Behrensmeyer 1978: 159; Hedges 2002: 352). Andrews (1995) noted that surface weathering is much slower in a temperate environment whilst, indications of cracking and flaking, can occur in highly alkaline or humid environments and exposure to dampness or sediment pressure (Fernández-Jalvo and Andrews 2016: 201).

Research on how weathered elements depend on the environmental conditions has been noted through many experiments. In Tsavo (East) National Park, Kenya (savanna environment), Coe (1978) reported that cortical flaking occurred within four years of exposure on the remains of two subadult and one adult African elephant carcasses that died at known times. Andrews and Cook (1985) did not report any weathering patterns from the remains of a single *Bos taurus* carcass which had been exposed (natural scree slope burial of elements) for 8 years in a temperate grassland environment in the UK. Tappen (1994) noted that bone weathering was significantly delayed and occasionally absent on the remains of eight *Loxodonta Africana* skeletons (killed and eaten by inhabitants of the Ituri) in the tropical Ituri Rain Forest in Zaire. Similarly, 10 individuals from an airplane crash in tropical Papua New Guinea showed no evidence of weathering after 58 years with the remains being largely buried at the surface or half exposed (Pokines 2009). Andrews and Whybrow (2005) further discovered that only a few remains of a single *Camelus dromedarius* in the desert environment of Abu Dhabi, United Arab Emirates, reached weathering stage three after 15 years of exposure whilst, bones that had become buried over time had little to no weathering after the same

period. More recently, Andrews and Fernández-Jalvo (2019) recorded no weathering on large mammal bones exposed for the first 4 years at the temperate environment at Neuadd, Wales, whereas after 30 years, more than half of the bones were still at stage one weathering (ibid., 68). The animal remains at Neuadd indicated differential weathering due to being partially exposed and protected and therefore protection from this modification (possibly by vegetation) can suggest that ultraviolet radiation from the sun impacted the bones more severely than other factors (ibid., 69).

Behrensmeyer's (1978) methodology is standard reference for British material with certain limitations (e.g. Tappen 1976: 377; Turner-Walker and Peacock 2008: 154). The Behrensmeyer 1978 method for recording bone surface weathering was modified for the use of British material by Brickley and MicKinley (2004) adding a seventh stage (Grade 5+) for the category of 'extensive penetrating erosion resulting in modification of profile'. Whilst weathering seems to follow the same pathway, regardless climatic and environmental shifts, severity of weathering cannot reflect duration of exposure (Tappen 1994; Fisher 1995: 32; Behrensmeyer and Miller 2012; Madgwick and Mulville 2012, 2015; Andrews and Fernández-Jalvo 2019: 68) (Figure 27)



Figure 27. Weathering stage 1 on clavicle (Ogof Pant-y-Wennol). Source: Author

Of particular relevance to this study is the fact that weathering can develop both in subterranean and sub-aerial contexts (Lyman 1994a). Bones rapidly deposited in

subterranean environments rarely demonstrate weathering marks, due to the exclusion of weathering agents, according to Ross and Cunnigham (2011: 126) and many remain static (Andrews 1995: 149). Bone recovered within these environments are likely to have been exposed in some way, prior to deposition due to human (excarnation) or natural events e.g. roof collapses and/or periodic inundation/humidity that causes minimal weathering (e.g. Fernández-Jalvo and Andrews 1992; Andrews and Fernández-Jalvo 1997: 191, 208; Thompson 2019: 198, 207; García-Sagastibelza 2020, in press). Weathering also appears to have a less severe effect where bones retain water for example when protected by vegetation, and/or other forms of cover (Behrensmeyer 1978; Junod and Pokines 2014: 296).

Evidence of weathering is most prominent in subaerial contexts (Madgwick and Mulville 2015) and is size dependant. Taphonomic re-elaboration (e.g. exhumations and reburials) can further dictate the impact of weathering and create complex patterns. Material may have been moving along the decay/preservational trajectory of one burial environment but as soon as bone becomes re-exposed, weathering will initiate (Fernández-Jalvo *et al.* 2002: 353). Mineralisation of bone as a result of taphonomic processes associated with long term burial will also affect the rate of weathering and can ameliorate the impact of weathering during secondary exposure (Littleton 2000: 17). Deposition in acidic subterranean environments can further cause demineralisation of the bone and greater impact by weathering (Gordon and Buikstra 1981; Pyatt *et al.* 1991; Nicholson 1996: 523; Stiner *et al.* 2001: 644; Schilling *et al.* 2008).

Taphonomic re-elaboration can result in complex taphonomic patterns (e.g. weathering) as the bone becomes re-exposed in different environments (i.e. possible exposure to water), impacted by corrosion, root action and abrasion and thus, thinning and rounding the bone, increasing porosity and the likelihood of fungal attacks. Bones rapidly deposited in subterranean environments rarely demonstrate weathering marks (e.g. Behrensmeyer 1978: 154) and trampling is generally very closely associated with abrasion (e.g. Blasco *et al.* 2008: 1613), thus, an absence of these processes can potentially clarify burial patterns (e.g. quick exposure and re-burial in cave or primary burial in cave).

#### 4.5.2. Gnawing

Animal damage is amongst the most common and earliest occurring taphonomic modification (Davis and Briggs 1998; Fernández-Jalvo *et al.* 2002: 35). A range of marks can be produced including striations, pits, punctures, furrows (v- or u-shaped in cross section), square-based grooves, linear marks and/or short parallel striations, ragged edges and even spiral fractures<sup>60</sup> (Buikstra and Ubelaker 1994: 98; Fisher 1995: 36; Pobiner and Blumenschine 2003: 121; Pokines 2014b: 210-212; Fernández-Jalvo and Andrews 2016: 32)<sup>61</sup> (Figure 28). Depending on the agent, the target species and element gnawing has the potential to dramatically alter or destroy the bone and overprint other processes, such as weathering (Fernández-Jalvo and Andrews 2016: 32).



Figure 28. Gnawing on distal end of tibia (Gop Cave). Source: author

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<sup>60</sup>The fracture type that results from gnawing (fresh spiral fractures/fresh bone) is similar to fractures resulting from trampling and marrow smashing.

<sup>61</sup>More include Miller 1969; Brothwell 1976; Haynes 1980, 1983; Richardson 1980; Brain 1981; Haglund 1997a; 1997b; Domínguez-Rodrigo 1999; Loe and Cox 2005; Smith 2006; Bochenski *et al.* 2009; Moraitis and Spiliopoulou 2010; Arriaza *et al.* 2017; Arriaza *et al.* 2019; Christensen *et al.* 2019: 157; Courtenay *et al.* 2019a; Maté-González *et al.* 2019; Yravedra *et al.* 2019; Jiménez-García *et al.* 2020.

Identification of agents causing gnawing marks often involves inspection and comparison with known agents of attack but is complex. Gnawing marks are approximately perpendicular to bones' long axes with parallel and closely spaced striations (Pokines 2012b: 212). Marks are generally smallest on long bone dense diaphyses and larger on less dense auricular and epiphyseal surfaces (Andrews and Fernández-Jalvo 1997; 2019: 91). New methods of analysis use computer vision technology of conventional neural networks (CNN), Geometric Morphometrics (GMM) and Machine Learning algorithms and high resolution techniques to securely identify bone surface modifications (BSM). They have been able to differentiate between tooth marks of different predators, further distinguishing the morphology of carnivore agency (tooth scores and pits) from anthropogenic parameters (butchering, cutmarks) (e.g. Arriaza and Domínguez-Rodrigo 2016; Domínguez-Rodrigo 2019; Courtenay *et al.* 2019a; Yravedra *et al.* 2019; Jiménez-García *et al.* 2020)<sup>62</sup>. Whilst higher resolution and accuracy can be achieved using such techniques (e.g. Yravedra *et al.* 2019) (e.g. Aramendi *et al.* 2019: 128; Arriaza *et al.* 2019: 85; Courtenay *et al.* 2019a: 37) the combined use of multiple criteria is crucial (tooth mark frequencies, skeletal profiles and fracture patterns along with the abovementioned techniques) to avoid equifinality (i.e. different processes producing identical end result) (von Bertalanffy 1956). Whilst gnawing cannot easily be confused with other marks<sup>63</sup>, under wet and sheltered conditions, weathering can produce similar patterns by corroding the epiphyses (Andrews 1995: 149).

Gnawing on fully fleshed articulated individuals is preferred by carnivorous scavengers such as wolves, dogs, coyotes and pigs that attack the visceral parts of the body leaving marks on the pelvis and ribs and fracturing axial elements (Galdikas 1978; Haglund *et al.* 1989; Berryman 2002: 492). Other reasons for bone gnawing, damage and dispersal of bone include dismemberment of prey. Scavenging on disarticulated elements occurs

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<sup>62</sup> More include Domínguez-Rodrigo and Baquedano 2018; Moclán and Domínguez-Rodrigo 2018.

<sup>63</sup> Miller 1969, 1975; Sutcliffe 1970; Bonnicksen 1973; 1979: 29; Hill 1975, 1976; Haynes 1980: 341, 1982; Payne and Munson 1985; Noe-Nygaard 1989; Moran and O'Connor 1992; Fisher 1995; Domínguez-Rodrigo 1999; Lupo 1995; Marean *et al.* 2004; Knüsel and Robb 2016: 661; Maté-González *et al.* 2019; Rossell *et al.* 2019.

in generally less dense areas, such as the epiphyses (Pokines 2012b: 207)<sup>64</sup>. Depending on the accessibility and nutritional value of the remains, shaft fragments can also exhibit signs of intense gnawing if scavengers seek to access marrow from long-bone diaphyses (ibid., 203).

Dry bone is particularly targeted by scavengers seeking to extract minerals by consuming the bone (osteophagia). This can see parts of bones e.g. shafts preferentially targeted (Pokines 2012b: 233; Fernández-Jalvo and Andrews 2016: 32). As for most destructive processes, less dense elements, such as immature bones and teeth, are more susceptible to destruction and may be completely destroyed (Pokines 2012b: 207, 210). This result poses a contradiction, also known as ‘taphonomomic paradox’ whereby it is the remains that withstand degrading processes, such as gnawing and weathering, that exhibit the greatest evidence of modification (Madgwick and Mulville 2012: 511, 2015: 2).

Small mammals attack bones for a range of reasons from incisor sharpening (Pokines 2012b: 203) to nutritional values (ibid.) and experiments have shown that weathered and dry<sup>65</sup> (ibid., 238, 2015: 16), defatted elements are favoured by most rodents because they are easier to gnaw (e.g. Andrews 1990; Lyman 1994a). By targeting epiphyses rodents can specifically create hollow, tubular shafts, and also gnaw through diaphyses creating a distinctive ‘windowing’ effect to obtain the soft tissue (Lyman 1994a: 195; Pokines 2015: 16). This latter effect can sometimes resemble windowing by digestive corrosion (Pokines 2014b: 213, fig. 9.11). Conversely, canids gnaw denser parts of elements, even teeth (ibid., 210). Small mammal gnawing can occur very often either

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<sup>64</sup>Johnson 1989; Moran and O’Connor 1992; Lyman 1993; Laudet and Fosse 2001; Bochenski and Tornberg 2003: 1668; Marean *et al.* 2004; Diedrich 2006; Pokines and Kerbis Peterhans 2007; Thompson and Lee-Gorishti 2007.

<sup>65</sup> Weathered bone is not as desirable for gnawing however, an experiment at the cave of Die Kelders in South Africa has demonstrated over one year of exposure bones can retain grease and subsequently, still attract scavengers. (Marean 1998: 128). Contradictive experiments have indicated that gnawing is not desirable after the elements have been exposed for a few days (Blumenschine 1986; Binford *et al.* 1988; Yellen 1991; Magoun and Valkenberg 2001: 296). Boiled and burned bone have been stripped of grease from the epiphysis and diaphysis and are overall not as desirable for gnawing since they do not have any nutritional value left (Lupo 1995; Roberts *et al.* 2002: 492; Thompson and Lee-Gorishti 2007).

in subterranean environments or below the surface ground and thus can be a very confusing source of information (Madgwick and Mulville 2015: 257).

Excarnation, exposure and reburial of human remains is likely to result in the presence of canid gnawing and absence of rodent gnawing due to short sub-aerial exposure and subsequent attack from larger scavengers prior to deposition (Møllerup *et al.* 2016). A recent study from a large (NISP 2335) Iron Age assemblage of human bones from a lake in Alken Enge, Denmark with a lack of rodent gnawing, of fractures in dry and weathered bone and no evidence of bacterial attack, concluded that limited subaerial exposure of the elements had occurred with subsequent dismemberment/defleshing before final deposition (Møllerup *et al.* 2016).

Overall, poorly preserved bone is not a reliable source of gnawing activity, gnawing is not necessary over-printed in such assemblages. Haynes (1980: 349) reported that beyond stage two weathering, no indication of gnawing can be identified on the bones due to the removal of the outer lamellar layer whereas more complete and well-preserved bones can potentially show more evidence of gnawing (Serjeantson 1991: 85; Phoca-Cosmetatou 2005: 141). Similar to trampling, gnawing is ultimately related to human/animal action and therefore, an absence of gnawing may be regarded as evidence of absence of exposure in specific environments and times (Madgwick and Mulville 2015: 261). Whilst gnaw-marks can confirm the level of intensity and extent of scavenging (Lupo 1995), they are still not a reliable source for indicating exposure of duration (Madgwick and Mulville 2015: 257; Andrews and Fernández-Jalvo 2019: 98). Consequently, the nature of the environment that elements are left/deposited in plays a crucial factor in determining the degree and nature of gnawing.

#### 4.5.3. *Insect damage*

Insect damage on skeletal remains is a relatively new field of study (funerary archaeoentomology) (Huchet 2014a; Vanin and Huchet 2017). Termites, wasps and wild bees, larvae and dermestid beetles (Vanin and Huchet 2017: 181) can attack the



surface of the bone if found in their preferred environment<sup>66</sup>. Recent work (Huchet *et al.* 2011; Huchet 2014a, 2014b) indicated that the cortical and cancellous bone surface in a Moche period female burial from Huaca de la Luna, Peru, was ‘ruptured’ from insect damage. Dermestid beetle tunneling was observed on the majority of bones of a single individual in a Levantine Bronze Age context, suggesting that remains were exposed before final burial (secondary deposition) (Hucket *et al.* 2013).

#### 4.5.4. Root etching and erosion

Contact with the ground and soil can cause general loss of bone, known as erosion, due to exposure to acidic/alkaline soil conditions (McKinley 2004: 15) (Figure 29). Erosion creates a rough surface texture, and this is often observed alongside root etching and acid soil corrosion as they all can result from contact with the ground (Pokines and Baker 2012b: 81; Evans 2014: 126, fig. 6.1).



Figure 29. **A:** Erosion on femur (Spurge Hole) and **B:** root marks on rib (Hoyle’s Mouth Cave).  
Source: author

<sup>66</sup> See Backwell *et al.* 2012 (termite gnawing); Pittoni 2009 (solitary bees and wasps); Hucket 2014a: 342 (larvae gnawing); Britt *et al.* 2008; Holden *et al.* 2013; Hucket *et al.* 2013 (dermestid gnawing) for examples.

Plant roots destroy bone and stain the surface leaving meandering, multi-directional, dendritic grooves and branches, with a U-shaped profile (Lyman 1994a: 376; Atici 2014: 229; Knüsel and Robb 2016: 661; Pokines and Baker 2014b: 81; Fernández-Jalvo and Andrews 2016: 89-90)<sup>67</sup>. Bone is a source of concentrated nutrients for plants, with buried trabecular bone releasing nutrients as it degrades. Pores within the bone expand through dissolution of the mineral content and the breakdown of organic content, potentially trapping water, and making remains overall very susceptible to plant roots (Pokines and Baker 2014b: 80). Roots produce damage through the secretion of acidic compounds and spread other bioactive materials (e.g. fungi) (Lyman 1994: 376; Walker *et al.* 2003; De-la-Peña *et al.* 2010).

The branching pattern that results from root etching is very distinct, however, research has shown that root etching has been mistaken for incised marking (e.g. butchery, accidental mechanical abrasion) (Morlan 1984; D’Errico and Villa 1997). Marking caused by such sharp objects leave V-shaped profiles and/or parallel striations which constitute different surface markings from root invasion (e.g. Pokines and Baker 2014b: 81-82, table 5.1; Schulting *et al.* 2015; Bello *et al.* 2016; Bello and Galway-Witham 2019; Maté-González *et al.* 2019).

#### 4.5.5. Corrosion

There are two types of this modification, digestive corrosion (Fernández-Jalvo and Andrews 1992: 407) and post-depositional corrosion which is linked to the acidity/alkalinity of the soil (*ibid.*; Pokines and Baker 2014b: 76). According to Fernández-Jalvo and Andrews (1992: 408), soil corrosion and digestive corrosion can be distinguished by the distinct marks they leave on dentine and bone and by the uniformity and lack of localization of surface alteration. A similar effect to acid soil corrosion appears in cave environments and can affect both teeth and bone (all parts of the bone equally) (*ibid.*, 411).

Digestive corrosion usually affects small elements (such as carpals and phalanges) that are consumed by carnivores (Pokines 2014b: 212), producing a diverse range of marks

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<sup>67</sup>Behrensmeyer 1978: 154, 81-82; Buikstra and Ubelaker 1994; Gabet *et al.* 2003: 251; Schultz *et al.* 2003; Schultz 2012; White *et al.* 2012; Dupras and Schultz 2014: 332; Fernández-Jalvo and Andrews 2016: 2, fig. 1.2.

and even cause overall destruction of elements (Jones 1986). The process is usually characterised by a sculpted appearance, thinning, and moderate dissolution of the bone surface from erosion, polishing and perforation (Fisher 1995: 42; Pokines 2014b: 212; Fernández-Jalvo and Andrews 2016: 260-261). Solution pits, ovoid depressions and fissures might also appear on the surface (Pinto Llona and Andrews 1999: 415). Acidic corrosion both in stomachs and environmental gradually thins out the bone cortex (Pokines and Baker 2014b: 76, fig. 77). Acidic soil results in etching of tooth enamel or the bone. High alkalinity may produce corrosion on bone and dentine (Fernández-Jalvo and Andrews 1992: 411; Fernández-Jalvo 1988). Whilst preferentially affecting small elements corrosion can be extremely difficult to detect on poorly preserved elements as other abrasive processes, such as erosion and root etching, can damage the element equally (Pokines 2014b: 214).

Whilst a diverse range of features result from corrosion, research has shown that the effects are not easily confused with other processes (e.g. Andrews 1990; Fernández-Jalvo and Andrews 1992; Fernández-Jalvo *et al.* 1998). Nonetheless, corrosion can mimic weathering, gnawing (windowing) and root etching<sup>68</sup>. Specifically, digestive corrosion (produce of digestion from scavengers' stomachs) can be mistaken for acidic corrosion (from the depositional environment) (Behrensmeyer 1978: 154; Fernández-Jalvo and Andrews 1992: 408; Lyman 1994a: 195; Fernández-Jalvo *et al.* 2014: 323; Pokines 2014b: 214).

#### 4.5.6. Abrasion

Similarly to erosion and root etching, abrasion is a process that can result from continuous exposure, repeated deposition and 'kicking around' on the surface (McKinley 2004: 15) and is closely linked to trampling (Madgwick 2014). Abrasion is defined as the erosion of a bone's surface by any agent resulting in a thinning of the surface, rounding of fracture edges and a polished appearance (Behrensmeyer 1982; Nawrocki *et al.* 1997; Pinto Llona and Andrews 1999: 420; Fernández-Jalvo and Andrews 2003; Evans 2014: 124)<sup>69</sup> (Figure 30).

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<sup>68</sup> Root marks can mimic digestion when they are densely concentrated on the bone surface (Andrews and Fernández-Jalvo 2019: 86, fig. A.233).

<sup>69</sup> Bromage 1984; Korth 1979.



Figure 30. Abrasion on cranial fragment (Gop Cave). Source: author

Rarely pitting, cracking and chipping is detected (Thompson *et al.* 2011; Evans 2014: 124). Abrasion can be caused by continued rubbing of the bone in a surface causing rounding and smoothness and loss of detail of surface (Behrensmeyer 1988, 1990; Fernández-Jalvo and Andrews 2003). Causes include: human and animal movement, trampling (Brain 1981: 1; Lyman 1994a: 381), carnivore licking (Haynes and Stanford 1984), exposure to acidic environments (Gordon and Buikstra 1981), water transport (Thompson *et al.* 2011; Griffith *et al.* 2016)<sup>70</sup>, pathological conditions (Bartosiewicz 2008: 75), earthworm activity (Armour-Chelu and Andrews 1994: 433), bioturbation (Haynes 1980: 350) and boiling (Fisher 1995: 31).

Abrasive processes cannot be identified on poorly preserved assemblages as erosion or weathering can alter the surface texture but the overall effect is mediated by the original state of the material and the type of abrasion. Research has indicated different taphonomic trajectories for bone subject to abrasive forces with the outcome dependant on abrasive environment (fluvial or not), soil/erosion and bone type (Behrensmeyer 1975; Nasti 2005; Fernández-Jalvo and Andrews 2003: 157).

Weathered bone is more susceptible to abrasion in general (Fernández-Jalvo and Andrews 2003: 157; Behrensmeyer 1990; Fernández-Jalvo 1992; Andrews 1995: 150; Cook 1995) but least impacted by abrasion through fluvial transport whereas, fossilized bone is the most modified (Thompson *et al.* 2011: 788). Fernández-Jalvo and Andrews

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<sup>70</sup> Bromage 1984; Parsons and Brett 1991; Nicholson 1992: 80; Denys 2002: 475; Fernández-Jalvo and Andrews 2003.

(2003: 160) discovered that abrasion does not necessarily mask weathering as splitting and cracking can still appear on bone.

River seeding experiments have demonstrated that abrasion does not relate to transport distance (Behrensmeyer *et al.* 1989: 116; Aslan and Behrensmeyer 1996: 414; Herrmann *et al.* 2004; Orden and Behrensmeyer 2010) as lighter bones can be carried away faster, hence, indicating less evidence of abrasion, with larger bones moved less and become damaged by sedimentary abrasion (Fernández-Jalvo and Andrews 2003: 157; Orden and Behrensmeyer 2010; Thompson *et al.* 2011). Abrasion by clay and silts in water can cause mild or absent bone rounding and polishing based on experiments on small mammal humeri and femora (Fernández-Jalvo and Andrews 2003; Fernández-Jalvo *et al.* 2014; García-Morato *et al.* 2019: 9).

Experiments by Griffith *et al.* (2016: 28) using SEM imaging, have shown that impact by different sediment classes (silt, sands and gravels) is also evident in the microstructure of bones, resulting in distinct levels of abrasion.

Analysis of bone abrasion can detect mixed and condensed fossil associations (e.g. similar/distinct patterns), and/ or taphonomic re-elaboration (i.e. secondary depositions after initial burial) (Fernández-López 1991; Fernández-Jalvo and Andrews 2003: 162).

#### 4.5.7. *Staining/Discolouration*

Taphonomic bone staining can occur from a variety of agents such as the sun, organic compounds (plant roots and fungus), metals and minerals and soil. The degree of alteration is affected by the amount of soft tissue and lipids in the bone, the degree of exposure and taphonomic re-elaboration. For example, discoloration from ultraviolet sunlight and ultraviolet radiation can cause bleaching on exposed bones and, subsequently, the level of bleaching will depend on the length of exposure (Dupras and Schultz 2014: 316).

Soil staining is common and is a result of the composition of the soil itself (Dupras and Schultz 2014: 323), the type of micro-organism impacting the bone and the nature of the depositional environment where the remains were deposited/left (Ascenzi and Silverstrini 1984; Bell *et al.* 1991). Micro-organism activity can vary based on the

microenvironment it inhabits, the moisture, temperature, chemistry and soil pH (Millard 1996; Littleton 2000: 15). Staining then occurs due the subsequent contact of the bone with the soil and the compounds and organisms it encompasses (Millard 1996).

Other causes of staining include adipocere, metal and organic staining. Adipocere is the remnants of the process of lipid hydrolysis during decomposition leaving white stains on the internal and external surfaces of bone (ibid., 318, 320, fig. 12.4; Fiedler *et al.* 2004; Forbes 2008: 210; Aufderheide 2011; Ubelaker and Zarenko 2011). Metal staining from artefacts, e.g. iron and coppers occurs due to corrosion in the burial environment (moisture corrodes the metal) (Buikstra and Ubelaker 1994; Schultz *et al.* 2003; Schultz 2012). Organic staining from plants, mosses and algae produce green, yellow, orange/red and darker (plant) stains (Dupras and Schultz 2014: 331-332) (Figure 31).



Figure 31. Green staining (from plants) on metacarpal (Ogof Pant-y-Wennol). Source: author

There are three common stain colours including black/brown, red and black/bluish which result from exposure to different soils. Dark soils (black or brown) result from organic matter (humus) and magnetite ( $\text{Fe}_3\text{O}_4$ ), bright red and brown derive from well-drained soils and oxidizing conditions (iron-bearing), whereas black or bluish soils are the result of reduced manganese ( $\text{Mn}^{2+}$ ) (ibid.). Staining with a reddish/brown colouration can occur in iron rich soils which are oxygenated active soils (Fernández-

Jalvo and Andrews 2016: 158). Similar stains can result from red ochre (covering of the body), often mirroring funerary rituals that took place (ibid.).

Black mould staining is a product of micro-organisms in the soil and is often affected by the environment and moisture (Fernández-Jalvo and Andrews 2016: 156) (Figure 32). The distribution of staining might exist either on one side of the bone, likely due to the bone resting on a wet and/or damp surface and even periodically submerged in water or appear on the whole surface of the bone (ibid.).



Figure 32. Black staining (manganese or mould) on metatarsal (Ogof Brân Goesgoch). Source: author

Weathering and mould staining have been associated with exposed elements in moist environments that allow the growth of micro-organisms (Nicholson 1996: 528). However, staining on bone can also occur in fully waterlogged environments (e.g. bogs) without any effects of sub-aerial exposure (Turner-Walker and Peacock 2008: 154). Teeth can also be stained, only on the surface that was in contact with the soil, however, this can involve detachment from the alveolus during decomposition and burial underground after this separation (Dupras and Schultz 2014: 323). Whilst soil staining can help determine if skeletal remains had been moved prior to discovery, it can be a problematic source of evidence in reconstructing a microenvironment and/or the depositional history of an element (Littleton 2000: 15). For example, if a soil-stained surface was facing up (i.e. not in contact with the ground) this would be a clear

indication that the remains had been disturbed (Dupras and Schultz 2014: 325). Manganese black staining is common from soil in subterranean environments (e.g. Fernández-Jalvo 1995: 178; Marín Arroyo *et al.* 2008; Ogórek *et al.* 2016; Randolph-Quinney *et al.* 2016; Thackeray 2016). It is associated with high levels of organic matter that increase metal solubility and the soil pH in manganese compounds which resulted in staining and is one of the most abundant metals in soil (Emsley 2001; Marín Arroyo *et al.* 2008: 812). Black staining occurred on skeletons of old individuals at Çatalhöyük, Turkey, with carbon accretions discovered in the inner surfaces of their ribs due to years of accumulation of carbon residues in their lungs (Andrews and Fernández-Jalvo 2012: 201). Although this case of staining is uncommon, black staining from fungal attack was further observed in the same site on multiple remains that were probably exposed to air after continuous disturbances from later interments (Andrews *et al.* 2005; Fernández-Jalvo and Andrews 2016: 157). Thus, it is crucial to interpret this taphonomic agent with caution and, most preferably, combine its indication with the presence of other taphonomic processes.

Patterns of black staining (mould) on the surface have been found on articulated and semi-articulated remains suggesting that staining does not necessarily occur as a result of sub-aerial exposure but possibly due to prior-exposure in a subterranean environment that resulted in staining before final deposition (Madgwick 2006).

Whilst it is difficult to confidently identify the aetiology of staining, it is worth noting that too little research has been undertaken to ensure the true value of staining in reconstructing taphonomic episodes. Whether black staining derives from mould or manganese, complications in the interpretative value of this process exist. Shifts in the micro-environments, periodical depositions and taphonomic re-elaborations, can create complex patterns, especially in the case of commingled remains.

#### 4.5.8. *Trampling*

Trampling is also a modification that can cause fracturing. Whilst, not extensively encountered in this research, a short summary is presented here.

Trampling is the process of bone being impacted by human or animal movement and typically results in shallow, sub-parallel striations due to abrasion by soil or other



elements (dragging of the bone) (Andrews 1995: 148; Andrews and Fernández-Jalvo 1997: 199; Madgwick 2014; Madgwick and Mulville 2015: 257). Trampling, however is complex to accurately identify (Brain 1967b; Fisher 1995: 36; Haynes 1980: 350). A variation of marks can be produced, from pitting to superficial scratching and pseudo-cut-marks, For example, sub-aerial exposure of disarticulated and isolated animal carcasses (30-year field research) at Newadd, Wales resulted in similar marks (Andrews and Fernández-Jalvo 2019: 48-49, 54). Blasco *et al.* (2008), recorded a series of ‘notches’ on animal elements after several experimentations, supporting that these are an indication of trampling action. After observing a series of these modification on some of the faunal remains discovered in Level XAA of Bolomore Cave, Valencia, Spain, Blasco *et al.* (2008: 1609, 1614) attempted to reproduce these marks on long bones from modern cattle, supporting that notches are another type of modification resulting from trampling. More experimentation is however required as similar processes can cause identical patterns (e.g. fractures).

Unburied or partially buried bones are more susceptible to trampling in sub-aerial contexts (Blasco *et al.* 2008: 1613; Andrews and Fernández-Jalvo 2019: 48) than those in subterranean contexts (Pinto Llonca and Andrews 1999: 413). Bone exposed in soft sediments with vegetation, for brief periods of time, may not show any evidence of trampling (Olsen and Shipman 1988: 542; Fiorillo 1989: 63). Surface modifications in the forms of pitting and trampling lines are more easily found in coastal environments (shelly deposits) (Reynard 2014) where sandy and abrasive sediments can cause a much more severe effect (e.g. Behrensmeyer *et al.* 1989; Denys 2002: 475; Courtenay *et al.* 2019b: 59). Exposure of elements in subterranean contexts, on the other hand, where movement by medium/large mammals and/or humans and contact with sediment particles can be avoided will not result in trampling of these elements.

Experiments have indicated that trampling can cause small fragments to become more deeply buried whilst leaving larger elements in more shallow contexts (Gifford-Gonzalez *et al.* 1985). Susceptibility to trampling has been associated with element size (e.g. Potts 1986: 28; Olsen and Shipman 1988: 543) but researchers have suggested that larger elements are either more (Yeshurun *et al.* 2007: 143-144) or less affected than smaller elements (Olsen and Shipman 1988: 536). Larger elements (e.g. skulls, long bones) can be more easily damaged but also more easily avoided by moving parties.

As for all taphonomic processes, damage (e.g. fragmentation) caused by trampling mostly affects bones that are either severely weathered, dry, with thin cortex or burnt (ibid., 537; Walters 1988; David 1990; Stiner *et al.* 1995; Blasco *et al.* 2008: 1613). Whilst trampling striations can possibly indicate prior to sub-aerial exposure of an element before deposition (e.g. in a cave environment) (Madgwick 2011; Madgwick and Mulville 2015: 257), it is difficult as taphonomy can be masked by other processes.

Earlier studies (e.g. Behrensmeier *et al.* 1986; Fiorillo 1989; Andrews 1995: 148; Ubelaker 1997: 78; Domínguez-Rodrigo *et al.* 2009) using Scanning Electron Microscopy (SEM) could not differentiate or found it tricky to securely identify striations from cutmarks (pseudo-cut-marks) (Andrews and Fernández-Jalvo 2019: 47). New methods of analysis, however show great promise. Use of micro-Computed Tomography ( $\mu$ CT) can distinguish between micro-fractures caused by trampling or by tools, however, this requires a high level of expertise and is expensive to acquire (Bello and Galway-Withman 2019: 29). New laser-scanners (e.g. the DAVID Structured-Light SLS-2 Scanner) have indicated distinct marks ('scratches' and 'grazes') both resulting from trampling (Courtenay *et al.* 2019b: 62). Nevertheless, research should not rely solely on the use of these machines as more experimentation is needed (ibid.).

### **Anthropogenic and other causes of fragmentation**

Fragmentation can result from pre-, peri- and post depositional natural and anthropogenic causes. It is possible to assess the degree of fragmentation of an assemblage by comparing the number of fragments with the number of elements or individuals (e.g. comparing ratios of NISP to either MNI or MNE)<sup>71</sup>. Identifying shaft fragments, element zone representation and percentage of completeness can have a greater interpretative potential (Dobney and Reilly 1988; Levitan 1990; Outram 2001; Knüsel and Outram 2006; Pickering *et al.* 2006)<sup>72</sup>.

Accurate recording of fractured patterns and distinction from other taphonomic process that can cause breakage is crucial (Behrensmeier 1978; Lyman 1989: 159; Marshall 1989: 9). Trampling for example, does not have any diagnostic patterns and therefore

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<sup>71</sup>NISP=number of identified specimens; MNI=minimum number of individuals; MNE=minimum number of elements.

<sup>72</sup> More include Watson 1979; Rackham 1986; Serjeantson 1996.

cannot be easily distinguished from post-depositional breakage. Whilst fracture analysis can reconstruct the processes that have affected the bone (e.g. potential patterns of later disturbances and secondary depositions) (Johnson *et al.* 2016: 623), the recording of breaks on top of other modifications can be challenging. This is particularly true for remains that are commingled, in subterranean environments or have survived several stages of exposure and re-burials. It is therefore important to note that the method used for recording fractures should always be tailored to the research aims.

#### 4.5.9. Fracture patterns

Bones fracture differently before death and around death (ante- and peri-mortem) depending on the organic components (Ubelaker 2015; Waldren *et al.* 2015; Knüsel and Robb 2016: 663). Overall, fracture types occur in a linear sequence – from fresh to dry and/or mineralised (ibid; Johnson *et al.* 2016) and are recognisable. Bone from recently deceased individuals is more flexible and fractures have a smooth, sharp and helical appearance. Dry fractures tend to transverse to the long axis of the bone and are straighter and commonly having jagged edges (Outram 2001, 2002; Knüsel and Outram



Figure 33. Fracture morphology patterns – **A**: fresh/helical, **B**: dry/perpendicular, **C**: mixture of both fresh and dry. Source: author

2006: 262; Johnson *et al.* 2016: 624; Johnson *et al.* 2018: 61) (Figure 33). Assessing the intensity and extent of fragmentation to estimate the state of the bone is complex (Outram 2002; Wieberg and Wescott 2008; Symes *et al.* 2014b).

Post-depositional breakage can result from incidental disturbances, bioturbation and frost-fracturing, and some dry, straight diagonal breaks can be confused with fresh helical breaks on small fragments (Bartosiewicz 1999; Smith 2003; Knüsel and Outram 2006: 262). Intentional peri-mortem breakage due to human manipulation can also produce spiral breaks. Deposition practices, taphonomic processes, disturbances and movement of bone can produce dry breaks (Knüsel and Robb 2016: 664; Johnson *et al.* 2018: 61). Recent fractures for example, excavation damage or curatorial breakage, are easily distinguishable either by their morphology, the colour of the break or lack of staining from the soil matrix (Knüsel and Robb 2016: 664).

Estimates of when bone damage occurred (Fracture Freshness Index) can be achieved by analysing the fracture angle, outline and surface texture (Villa and Mahieu 1991; Outram 2001, 2002; Pickering *et al.* 2005; Johnson *et al.* 2016)<sup>73</sup>. Any interpretation is complicated by the variety of fracture patterns, which can be exhibited (Villa and Mahieu 1991: 34). Johnson *et al.* (2016: 624-625) has addressed this with a method known as ‘fracture history profile’. This records all fracture types on an element (i.e. with evidence of multiple breaks), and allow the identification of the different activities and practices responsible for the breaks (e.g. fresh break for marrow extraction and subsequent dry break from gnawing). To date the method has only been applied to fractures on animal bones (*ibid*; Johnson *et al.* 2018) and research on the application to human material has not yet occurred.

### **Degree of fragmentation**

Factors affecting the degree of fragmentation include bone density, age of the individual, certain pathological conditions and element (Atici 2006: 123; Symes *et al.* 2012; Symes *et al.* 2014b). For example, Waldron (1987a) reported that the skull, coccyx, scapula blade and proximal fibula were the most susceptible to fragmentation with the vertebrae, mandibulae, metacarpal and proximal ulna, femur and humerus less affected. In general, all taphonomic processes can affect resistance to the bone to fragmentation. Any loss of collagen through boiling, weathering and/or exposure to subterranean environments can further reduce bone resistance to fragmentation (Villa

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<sup>73</sup> More include Bunn 1983; Morlan 1984; Johnson 1985; Bonnicksen 1989.

and Mahieu 1991: 29) whilst commingled, disarticulated and/or small in size material is also susceptible.

#### 4.5.10. Trauma

##### **Blunt/sharp force**

Fragmentation and radiating fractures can result from inflicted trauma and are generally associated with ante- and peri-mortem activities (e.g. Schulting and Fibiger 2012). A focused and short summary is presented here due to the limited examples of (ante- and peri-mortem) blunt/sharp force trauma recorded in this research.

Fracture patterns can be used to examine the cases of peri-mortem trauma (Wieberg and Wescott 2008: 2; Davidson *et al.* 2011: 188). Blunt force trauma occurs due excessive force, repeated stress under static or dynamic loading or abnormal weakening of the bone (e.g. indicative pathologies such as osteoporosis) (Davidson *et al.* 2011: 188). Sharp force trauma results from use of an instrument with a sharp edge or point. The former creates inward bone bending and radiating and concentric fractures and the latter well defined fracture edges and a flat, smooth, polished cut surface (*ibid.*, 192; Boylston 2000; Kimmerle and Baraybar 2008; Byers 2009).

Fracture morphology in peri-mortem or unhealed bone (lesions, outline, healed depressed circular surface appearance and angle) can determine the nature of trauma (ante-, peri- and post-mortem) (e.g. Schulting 2012) and ideally microscopic characteristics (Wieberg and Wescott 2008: 1). For example, blunt weapons cause depressed lesions with concentric and radiated fracture margins whilst sharp weapons (e.g. sword, hatchet) result in a cut (Davidson *et al.* 2011: 191; Licata and Armocida 2015: 256).

Research into blunt force trauma (Wheatley 2008; Wieberg and Wescott 2008; Karr and Outram 2012b) has indicated that bone shape does not have a significant effect with irregular and flat bones and lone bones reacting to stress by peri-mortem blunt force trauma in a similar manner (Moraitis *et al.* 2008).

## Cutmarks

Cut marks, scrape marks, knapping marks, percussion damage and engravings are other forms of deliberate manipulation of the surface of bones and teeth. For the purposes of this research, a shorter review of this modification is provided as only a few instances of cutmarks were recorded. The use of tools and sharp objects leaves traces on the bone surface in the form of cutmarks, whilst further taphonomic damage can be inflicted by percussion (percussion marks). Bladed and percussive damage have clear characteristics (e.g. Galán *et al.* 2009) (Figure 34).



Figure 34. Cutmarks on femur/medial epicondyle (Nanna's Cave). Source: author

In faunal assemblages, bladed tools (e.g. knives) are mostly associated with the utilisation of the animal carcass, for example carcass division, defleshing, tool production (Stampfli 1966), hunting (Smith 2003) and marrow extraction (e.g. Outram 2000, 2001; Johnson *et al.* 2016; Isaakidou *et al.* 2018; Johnson *et al.* 2018).

Whilst all of these may be factors in the utilisation of human remains light and heavy bladed tool marks on humans have been related to peri-mortem violence (e.g. force trauma above) and funerary practices (Knüsel and Outram 2016: 667). The latter activities such as defleshing, with marks focused on soft tissue attachment sites, and disarticulation, where tools are used to sever major ligaments and tendon attachments, (Bello *et al.* 2016) may result in subsequent fragmentation (Bello and Galway-Witham 2019: 16).

Deeper and wider bladed tool marks have a U-shaped profile and have been linked to the disarticulation and cutting of both fresh bodies, associated with processing and consumption of human flesh (e.g. Fernández-Jalvo *et al.* 1999; Andrews and

Fernández-Jalvo 2003; Boulestin *et al.* 2009; Boulestin and Coupey 2015; Bello *et al.* 2016: 732). Such marks have also been linked to the defleshing (of skeletonised remains) as part of secondary funerary rites (e.g. Schulting *et al.* 2015; Robb *et al.* 2015; Bello *et al.* 2016; Wallduck and Bello 2016; Bello and Galway-Witham 2019)<sup>74</sup>.

Lighter tools, such as knives leave V-shaped profiles and/or parallel striations (Greenfield 2006; Fernández-Jalvo and Andrews 2016: 26) and more often interpreted as relating to funerary practices (Bello *et al.* 2016; Smith and Brickley 2004).

Analysis of tool marks at a microscopic level, through the use of Scanning Electron Microscopy (SEM), micro-Computed Tomography ( $\mu$ CT), Focus Variation Microscopy (FVM), 2D and 3D geometric morphometric methods, 3D laser-scanning and micro-photogrammetrical imaging (MGP) has clarified different cutmark causes (e.g. Boschini and Crezzini 2012; Fernández-Jalvo and Andrews 2016: 13; Wallduck and Bello 2016; Bello and Galway-Witham 2019; Linares-Matás *et al.* 2019)<sup>75</sup>.

Examining the profiles of cutmarks has revealed distinct patterns from tools (Boschini and Crezzini 2012: 556; Maté-González *et al.* 2019: 9; Yravedra *et al.* 2019: 102), differentiations between human and animal tooth marks (Rossel *et al.* 2019: 72) and between the fracture pattern itself on human bone (Bello and Galway-Witham 2019: 29). These methods (e.g. Bello *et al.* 2015; Maté-González *et al.* 2019: 6) have however been critiqued as the effect that different variables can have (e.g. bone density) on cutmarks have not been assessed properly (e.g. Courtney *et al.* 2018; Maté-González *et al.* 2019: 11)<sup>76</sup>.

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<sup>74</sup> More include Smith and Brickley 2004; Chacon and Dye 2007; Bello *et al.* 2011; Toussaint 2011.

<sup>75</sup> More examples include Maté-González *et al.* 2015; Maté-González *et al.* 2017; Maté-González *et al.* 2017; Maté-González *et al.* 2017; Maté-González *et al.* 2018; Yravedra *et al.* 2017, 2017; Courtenay *et al.* 2018; Yravedra *et al.* 2018; López-Cisneros *et al.* 2019; Maté-González *et al.* 2019; Maté-González *et al.* 2019; Rosell *et al.* 2019; Yravedra *et al.* 2019 and more.

<sup>76</sup> More include Linares-Matás *et al.* 2019: 21; López-Cisneros *et al.* 2019: 110; Yravedra *et al.* 2019: 103.

## **Burning**

Changes in colour and texture of bone, other than mould/manganese staining, usually relate to exposure to fire. Different colours and bone changes are noted as a result of different temperatures and lengths of time and can result in different stages of burning (Stodder 2008: 97; Walker *et al.* 2008; Fernández-Jalvo *et al.* 2018). Low temperature bone charred bone is black or grey in colour whilst high temperature calcinated bone is often white and a range of colours might exist in between unburned and fully calcinated bone (Symes *et al.* 2014a; Fernández-Jalvo and Andrews 2016: 157, fig. 5.2).

The condition of the bone (fleshed/decomposed/skeletonized) and the organic composition of the environment prior to burning also contributes to the burn morphology (e.g. Baby 1954; Binford 1963; Symes *et al.* 2008; Ubelaker 2009; Keough *et al.* 2012; Symes *et al.* 2014a: 381). Characteristic features can be observed on bone through burning such as shape change (shrinking, warping), cracking of the burned surface and fractures for example and curved transverse fragmentation from heating and cracking of wet bone (Symes *et al.* 2014a: 382-383).

### **4.6. Microscopic modification of bone**

Macroscopic changes in bone are accompanied by a series of changes at a microscopic level that is alterations in physical, chemical and microstructural composition of the bone (Hedges 2002; Jans 2014: 19). These changes occur after soft tissue decay and are defined as bone diagenesis and are affected by various factors (e.g. groundwater pH, environmental conditions and acid soils in burial) (Nielsen-Marsh *et al.* 2000; Jans 2014: 19).

Bone components (collagen and mineral), which initially protect bone from degradation, ultimately become affected by diagenetic processes (Jans 2014: 19). The alteration of bones can lead to four diagenetic trajectories: accelerated collagen hydrolysis, bioerosion, dissolution and fossilization depending on burial environment (Collins *et al.* 2002; Smith *et al.* 2007).

Research by Wedl (1984), different degradation mechanisms e.g. microbial attack were explored and recognized and (semi) quantification of the bone quality was tested (*ibid*;



Garland 1989; Jans *et al.* 2002; Jans 2008). This has been employed in determining the rate of decay in different environments to exploring evidence of early post-mortem treatment or sample equality evaluation (Jans 2014: 20).

Histotaphonomic analysis can classify which microbes have altered the microstructure of bone and teeth (i.e. bacterial, fungi and/or cyanobacteria), evidence that can disentangle issues of peri-mortem treatment and treatment of the body before final burial (Marchiafava *et al.* 1974; Grupe and Dreses-Werringloer 1993; Bell *et al.* 1996; Jackes *et al.* 2001; Trueman and Martill 2002).

The significant changes that occurred in the microstructure of bones led to experiments on bone diagenesis (e.g. Hedges *et al.* 1995), holistic approaches<sup>77</sup> and wider investigations on how bone decays under certain environmental conditions<sup>78</sup>. Histology is a quick screening or research technique that can be used in most laboratories.

#### 4.6.1. Diagenetic changes in the microstructure

The most common diagenetic change observed in bones is microbial bioerosion (Booth 2016: 484)<sup>79</sup> by bacterial or fungal attack but, microcracking (microfissures), staining, the level of birefringence of the bone matrix<sup>80</sup>, infiltrations and inclusions can all be recognized using histology (Garland 1987; Jans 2014: 21). The degree of microbial attack (either bacterial or fungal) in the microstructure of an element (Jans *et al.* 2004; Smith *et al.* 2007; Jans 2014: 22; Kontopoulos 2016: 320; Kazarina *et al.* 2020) is assessed by identifying microscopic bioerosion (Figure 35). This can be micro-foci of destruction (MFD), the most common form of diagenesis, (also known as non-Wedl MFD) (Hackett 1981: 250; Turner-Walker *et al.* 2002), and Wedl tunnelling (Hackett 1981).

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<sup>77</sup>For example Colson *et al.* 1997; Nielsen-Marsh and Hedges 2000a; Gutiérrez 2001; Jans *et al.* 2002, 2004; Trueman and Martill 2002; Turner-Walker *et al.* 2002; Smith *et al.* 2005 and others.

<sup>78</sup> For example Karkanias 2000; Nielsen-Marsh and Hedges 2000b; Nielsen-Marsh *et al.* 2000; Pike *et al.* 2001; Roberts *et al.* 2002; Smith *et al.* 2002; Berna *et al.* 2004; Janes *et al.* 2004; Trueman *et al.* 2004; Gilbert *et al.* 2005; Smith *et al.* 2007; Fernández-Jalvo *et al.* 2010; White and Booth 2014; Booth 2016, 2020; Kontopoulos *et al.* 2016; Booth and Madgwick 2016; Kazarina *et al.* 2019 Booth and Brück 2020; Eriksen *et al.* 2020; Goren *et al.* 2020; Köhler *et al.* 2020; Papakonstantinou *et al.* 2020 and others.

<sup>79</sup> Hackett 1981; Nielsen-Marsh and Hedges 2000a; Hedges 2002; Turner-Walker *et al.* 2002; Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007.

<sup>80</sup> Discussed later in this section.

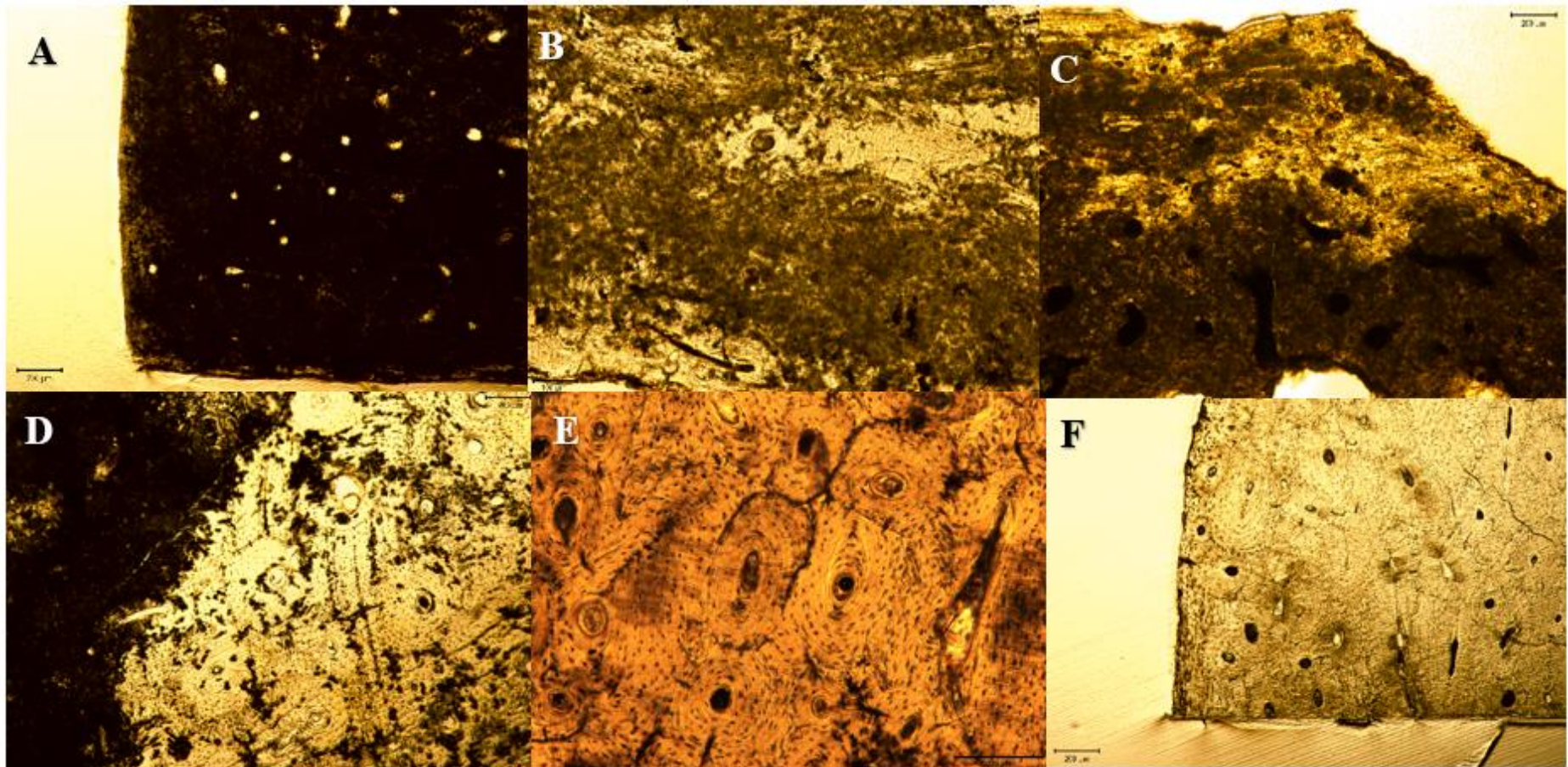


Figure 35. Different histological preservation based on OHI scores – **A:** OHI 0 (humerus – Gop Cave), **B:** OHI 1 (humerus – Ifton Quarry), **C:** OHI 2 (cranial fragment – Spurge Hole) **D:** OHI 3 (mandible – Little Hoyle Cave), **E:** OHI 4 (humerus – Backwell Cave), and **F:** OHI 5 (radius – Ogof Pant-y-Wennol). Source: author

There are three morphological types of former damage – bacterial MFD (non-Wedl) including linear longitudinal, budded and lamellate. Wedl tunneling (Wedl types 1 and 2) is related to fungal attack that results from the exposure to certain depositional environments and/or environmental conditions (e.g. aquatic/anoxic contexts and acidic soils) (ibid; Marchiafava *et al.* 1974; Balzer *et al.* 1997; Jackes *et al.* 2001; Turner-Walker *et al.* 2002)<sup>81</sup>. The type of attack can be evaluated under polarized light microscopy, high resolution scanning electron microscopy (SEM), backscattered electron scanning microscopy (BSE-SEM) or energy dispersive x-ray spectrometry (EDS) (Jans 2014: 21).

The presence or absence of microbial attack can be analysed using the Oxford Histological Index (OHI) (Hedges *et al.* 1995; Millard 2001), which contains a scale of six categories (ranging from 0 – no microstructure preservation – to 5 – perfect preservation) (Figure 35), or using the Bioerosion Index (BI) (Turner-Walker and Syversen 2002). The latter method is more precise as it offers information on the percentage of original bone matrix destroyed, however, it is more time-consuming (Jans 2014: 21). For the purposes of this research, the OHI index was preferred. The Oxford Histological Index is a quick method for assessing bone degradation and was considered a suitable method for this project. Brönnimann *et al.* (2018: 48) on the other hand, uses multiple indices to assess bacterial degradation in bone based on OHI scores (Hedges *et al.* 1995; Millard 2001) and their own system including the Bacterial-Attack-Index (BAI), the Wedl-Tunnel-Index (WTI), Cyanobacterial-Attack-Index (CAI), Crack-Index (CRI), Collagen-Index (COI) and Heat Index) HEI. Brönnimann and colleagues determined that endogenous gut bacteria are primarily responsible for bone degradation whilst bones with exposed surfaces can be affected by sediment types or processes (Wedl-tunnelling).

Bone diagenesis leads to collagen loss, which causes a reduction or loss of birefringence (Hackett 1981). This can be observed using thin section light microscopy, through which bone is examined using normal and polarised light (Booth 2014: 15). Microbial tunnelling affects the microstructure of the bone which subsequently influences

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<sup>81</sup> More include Yoshino *et al.* 1991; Grupe and Turban-Just 1998; Jackes *et al.* 2001; Dixon *et al.* 2008.

collagen birefringence (Nielsen-Marsh *et al.* 2007; Smith *et al.* 2007). Collagen birefringence is impacted by any agent responsible for removing protein from the bone (Hackett 1981). This can be observed under polarised light (Hackett 1981). Bone collagen fibres are orientated at 90° to one another and refract light at perpendicular planes which causes the collagen matrix to appear birefringent/shiny under polarised light (Junqueira *et al.* 1986; Schultz 1997). Collagen appears (rainbow) coloured under polarised light; the less coloured it appears the less collagen has preserved. Thus, the intensity of birefringence of the bone matrix can be expressed in a scale from 1 (comparable to fresh bone) to 0.5 (reduced intensity) and 0 (no birefringence present) (Jans *et al.* 2002: 348; Jans 2014: 21). The methods of thin section preparation and analysis (using the index) will be explained and discussed in Chapter 5 (section 5.4).

Microscopic cracking breaks in the bone's histology, usually irregularly spread across the bone microstructure (Jans 2014: 21), is associated with a number of different causes such as sediment movement, acidic degradation, heat and collagen hydrolysis (Garland 1987; Hanson and Buikstra 1987; Jans *et al.* 2002; Guarino *et al.* 2006; Turner-Walker and Jans 2008). Staining (discoloration of bone microstructure) can also be identified, and can be linked to interactions with the external environment that can result in a change of colour (see section 4.5.7) (Garland 1987; Shahack-Gross *et al.* 1997; Hanson and Cain 2007). This technique makes visible inclusions and infiltrations of foreign material (e.g. soil components, metal) that enter the natural bone microporosities (Jans 2014: 25). Inclusions are usually deposited through mineral precipitation during groundwater percolation (Garland 1987; Garland *et al.* 1988; Grupe and Dreses-Werringloer 1993) and infiltrations consist of extraneous material that lies in the bone matrix (Garland 1987; Grupe and Dreses-Weeingloer 1993; Booth 2014: 18).

#### *4.6.2. Aetiology of bioerosion*

Microbial attack (either bacterial or fungal) causes great loss of information. Experimental studies of bacterial bioerosion have discovered processes that relate to early taphonomic conditions and can affect the microstructure of an element shortly after death (Bell *et al.* 1996; Boaks *et al.* 2014; White and Booth 2014; Booth and

Madgwick 2016: 15; Kontopoulos *et al.* 2022)<sup>82</sup>. For example, butchered archaeological bone often exhibits no signs of bacterial bioerosion as opposed to complete and articulated skeletons that show signs of extensive bacterial attack (*ibid.*). The different levels of microbial attack have dichotomized researchers as to whether destruction of the microstructure reflects the extent of soft tissue decomposition during early stages of burial or solely results from endogenous causes. Recent research has underlined the importance of understanding the complexity in diagenetic mechanisms further impacted by environmental factors (e.g. soil pH, soil hydrology, temperature) to examine microbial attack (Kendall *et al.* 2018).

Earlier research has laid the foundation for discovering associations between histological preservation and patterns of funerary treatment (e.g. early post-mortem manipulation of the body based on the different preservation levels of the microstructure). This issue and has recently been underlined by more researchers (e.g. Booth 2016; Booth and Madgwick 2016; Kontopoulos *et al.* 2016; Goren *et al.* 2020; Papakonstantinou *et al.* 2020). Taphonomic analysis of cadaveric decomposition in caves and taphonomic analysis have suggested that if individuals were deposited as whole corpses, the levels of bacterial bioerosion would reflect this process (Chamberlain 1999; Papakonstantinou 2009). Variable levels of putrefactive bioerosion are expected in cave depositions (Terrell-Nield and MacDonald 1997). In Carsington Pasture Cave (discussed in page 119), higher histological preservation was recorded on elements that had been subjected to early post-mortem manipulation (cut-marks on articular areas indicative of dismemberment). This suggests that bacterial bioerosion can be affected by peri-mortem treatment which slows down the rate and effect of endogenous attack (Jans *et al.* 2004; Nielsen-Marsh *et al.* 2007; Booth 2014: 417). Bacterial bioerosion can thus be indicative of early post-mortem treatment which can assist in reconstructing patterns of mortuary treatment in past communities.

Experiments have shown that bones from modern excarnated corpses will not exhibit severe levels of bacterial tunnelling (either limited or none) (e.g. Bell *et al.* 1996; Fernández-Jalvo *et al.* 2010; White and Booth 2014). Excarnated bodies skeletonized

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<sup>82</sup> And Kontopoulos *et al.* 2019

as a result of scavenger activity, or a funerary practice, and butchered animal bones, discarded after use, will not show signs of bacterial tunnelling as soft tissue putrefaction was omitted or limited (Booth and Madgwick 2016: 15). Conversely, burial will ensure that prolonged bacterial attack will be achieved (*ibid.*). The impact of endogenous gut bacteria responsible for the destruction of the microstructure has a growing body of research which has established that putrefactive bacteria are the main cause of non-Wedl-MFD (e.g. Bell *et al.* 1996; Janes *et al.* 2004; Guarino *et al.* 2006; Nielsen-Marsh *et al.* 2007; Boaks *et al.* 2014)<sup>83</sup>.

Recent research has focused on investigating whether environmental bacteria can cause severe contamination in the bone microstructure, in the form of infiltrations, subsequently contaminating the DNA of archaeological remains (Kazarina *et al.* 2020). Early theories supported that soil micro-organisms were mainly dictated by the levels of bioerosion in bone (e.g. Marchiafava *et al.* 1974) whereas, following experiments suggested that non-Wedl MFD resulted from endogenous causes (i.e. gut bacteria that transmigrate in the immune system and mucosal membranes within the first few days after death) (e.g. Nielsen-Marsh *et al.* 2007; White and Booth 2014; Booth 2016).

Endogenous origin of bioerosion strictly depends on the survival of organic molecules in bone during early decomposition (Booth 2014: 42) and should indicate the extent a skeleton was exposed to putrefaction (Booth 2016: 485). Exogenous origin on the other hand, depends on the depositional environment and the fungi activity in the soil that attack the bones/teeth (Booth 2014: 42). An endogenous origin for microbial bioerosion has been considered indicative of early taphonomic events (e.g. mortuary processes) (Hollund *et al.* 2012). Bioerosion has been found to vary between skeletal elements (Jans *et al.* 2004; Hollund *et al.* 2015, 2019, 2022) with a number of causes been suggested. Ratios of cortical bone (i.e. exposure of bone surface) (Hanson and Buikstra 1987; Jans *et al.* 2004; Booth 2016) between long bone shafts (e.g. Booth 2014, 2016) and proximity to the abdominal area (Kontopoulos *et al.* 2016) have not confirmed the exact causes for this variation. Long-term experiments using de-fleshed cow bone by Turner-Walker (2019) showed that bacterial tunnelling developed over decades and not

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<sup>83</sup> White and Booth 2014; Booth 2020.

months in warm tropical soils. Results underline the complexity in distinguishing between an endogenous (gut bacteria) and exogenous (soil bacteria) origin of bioerosion.

Distinct burial contexts (e.g. aquatic environments, wetting-drying cycles, soil pH) have been examined for this purpose. Cyanobacteria (blue-green algae) and saprophytic fungi are responsible for Wedl tunnelling and have been found in aquatic environments (i.e. exogenous cause) (e.g. Marchiafava *et al.* 1974; Fernández-Jalvo *et al.* 2010) whilst, Non-Wedl MFD (bacterial origin) have been associated with terrestrial contexts (e.g. Balzer *et al.* 1997; Turner-Walker & Syversen 2002). No correlations between bacterial bioerosion and soil have been reported, which suggests that destruction of the microstructure by bacteria might be endogenous (e.g. Smith *et al.* 2007; Booth 2016). Wedl tunnelling was identified within 67% out of the 18 disarticulated bones of the Carsington pasture Cave's (Derbyshire) samples (Booth 2014: 363). Furthermore, five of the 18 samples indicated superficial or fair levels of microstructural staining (orange-coloured and yellow) and 14 displayed inclusions (*ibid.*, 365). Wedl MFD was anticipated for bones found in caves (*ibid.*, 363). According to Booth (*ibid.*, 413) the human bones from Carsington Pasture Cave had not been buried and indicated extensive levels of bacteria bioerosion (ranging from excellent to poor preservation) with the soil surrounding the bones not responsible for bacterial attack. Results suggested that bacterial bioerosion was endogenous and that the variation in the quality of sediments in the cave had no effect and did not interfere with the process of soft tissue decomposition (*ibid.*).

In contrast, Eriksen *et al.* (2020), observed that bacterial communities (both Wedl and non-Wedl MFD) in pig bone fragments (femur and humeri) from different depositional environments in Denmark (marine, coastal and tidal zones) were severely influenced by local microbial community and that microbial diversity increased with time after exposure. The animal bones were either boiled, baked or left to deflesh to mimic consumption and manipulation of animal bone by humans (*ibid.*, 3). Eriksen *et al.* (*ibid.*) discovered that the pig bones were ultimately affected by their depositional environment, with the elements left in anoxic and submerged contexts showing the most evidence of cyanobacteria attack (*ibid.*, 15) and non-Wedl tunneling appearing after one year of exposure in a boiled bone left in terrestrial sand (*ibid.*, 17). The experiment

was conducted twice and the bones were collected at different times (4, 14, 28 and 52 weeks) to test whether microbial colonies will emerge in different periods<sup>84</sup>. This repetition aimed to test whether time of exposure plays an integral role in the levels of microbial attack.

Booth (2016: 492) on the other hand, reported no correlations between bacterial bioerosion and depositional environment in the microstructure of 301 long bones from 25 European sites<sup>85</sup> (both disarticulated and articulated individuals from various depositional contexts). Distinct levels of histological preservation were observed between articulated and disarticulated bone of similar age found in close proximity within similar sediment (*ibid.*). No samples showed evidence of other diagenetic changes (inclusions and/or infiltrations).

More research is required to securely dictate the level of interference caused by the environment as multiple diagenetic pathways need to be examined to comprehend the effect the burial environment has on skeletal remains (Kendall *et al.* 2018). Evidence suggests that variations in bioerosion within archaeological bones that were discovered from contexts inhibited by bacterial activity (e.g. anoxic/waterlogged) mirror environmental fluctuations, not mortuary events (Turner-Walker and Jans 2008; Hollund *et al.* 2012; Sluis *et al.* 2014).

#### **4.7. Summary**

Understanding of how macro- and microscopic processes affect the analysis and interpretation of bone assemblages is crucial. It is complex to accurately assess the impact from distinct taphonomic agents as preservation and modifications cannot be determined based on a single method of analysis. On a macroscopic level, issues such as lack of standardisation, terminological vagueness (e.g. Lupo and O'Connell 2002:

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<sup>84</sup>Eriksen *et al.* (2020: 17) proposed that change in microbial community, could have resulted from 'waves' of degradation, with the first destroying the available collagen and lipid sources and the second the collagen embedded within the mineralised part of the bone structure. This could potentially explain why microbial activity differed when the samples were collected at different times.

<sup>85</sup>In particular, 42% of the thin sections came from disarticulated charnel bone recovered from grave fills or formal charnel deposits. Therefore, these remains represent individuals that were possibly buried and then disturbed after skeletonization (Booth 2016: 488; Daniel 1997).



104; Lyman 1994b) and multiple similarities between certain modifications (e.g. trampling, cutmarks) create an uneven representation of the assemblages. This results in poor understandings and incomplete interpretations of the archaeological record. Inter- and intra-observer reliability tests are crucial in assessing datasets, although not always achievable, especially in the case of small-scale research. Different taphonomic processes under different conditions can result in similar modification patterns (Knüsel and Outram 2006) which emphasize the great need for careful examination of all factors affecting degradation, whether it is on the external surface or the microstructure of the bone.

Use of more advanced techniques<sup>86</sup> can ‘decipher’ the levels of preservation and present more accurate results. Existing data underline the urgent need for more analysis and experimentation as researchers cannot rely on single methods of analysis. Use of new equipment however [e.g. 3D laser-scanning and micro-photogrammetrical imaging (MGP)], is not always available and thus methods need to be adjusted and tailored as not all techniques can be combined (due to costs, time constraints and/or level of expertise). Experiments in controlled and well-characterised environments (e.g. Andrews and Fernández-Jalvo 2019) are essential to establish trends and patterns of alteration in different burial environments (Jans 2014: 31). Identifying specific bioeroding microorganisms in different micro-environments and climates could potentially set some expected patterns in defleshed, exposed or buried remains (either human or animal) and establish the speed of diagenetic processes that can increase or be interrupted (ibid; Booth 2014: 417; Andrews and Fernández-Jalvo 2019; Eriksen *et al.* 2020). Therefore, a combination of macroscopic and histological studies can assist in creating a more standardised methodology for assessing taphonomic trajectories. These can establish differences in past mortuary treatments, as this PhD research aims to explore. Detailed methods of analysis employed for the purposes of this research follow in Chapter 5.

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<sup>86</sup>For example polarised light microscopy, biomolecular analysis, 3D virtual reconstruction of the micro-morphology, Scanning Electron Microscopy (SEM), micro-Computed Tomography ( $\mu$ CT), Focus Variation Microscopy (FVM), 3D laser-scanning and micro-photogrammetrical imaging (MGP).

## **Chapter 5: Recording methods**

This chapter outlines the methods used to record demographic data and taphonomic modifications for the analysis of human remains from caves in Wales and north Somerset. Both secondary and primary data were used (5.1. Materials) whilst methods for recording taphonomic variables were tailored to the needs of the research (5.2. Recording methods). These include recording of macroscopic modifications, sampling for microscopic analysis and/or radiocarbon dating and statistical analysis of macroscopic modifications.

### **5.1. Materials**

#### **5.1.1. Secondary analysis**

Consolidation of available demographic information and spatial distribution was achieved after a thorough review of: The Historic Environment Records (HERs) in Wales<sup>87</sup>, the Gazetteer of Caves, Fissures and Rock shelters in Britain containing human remains (Chamberlain 2014), the Caves of south and north Wales (www4, www5) and The Wales and Borders radiocarbon database (Burrow and Williams 2008). Sites comprise of only those with Neolithic human remains based on direct radiocarbon dating evidence and the availability of material. These include 20 across Wales (south-central, south-east, south-west and north) and one comparative cave from north Somerset. Geographical subdivisions in south Wales were based on karst morphology (see Chapter 2/2.2.1). Division for study areas in Wales was based on where cave systems were clustered to identify whether funerary processes show similarities/differences between regions. Sites in north Wales are all located in Clwyd and therefore subsequent subdivision was not considered necessary.

#### **5.1.2. Primary analysis**

Human remains examined in this research for macro- and microscopic taphonomic analyses were stored at the National Museum Wales (NMW), Tenby Museum and Art Gallery and Newport Museum and Art Gallery. An un-accessioned collection was

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<sup>87</sup>Clwyd-Powys Archaeological Trust, Dyfed Archaeological Trust, Glamorgan-Gwent Archaeological Trust and Gwynedd Archaeological Trust.

loaned by Dr Rick Peterson of University of Central Lancashire. Data collection was confined only to sites that had already provided (Neolithic) radiocarbon dating evidence, had accessible human skeletal remains for analysis and/or the storage of remains (museum curations) was known. This doctoral research therefore does not provide a holistic view of all available remains in Wales (see Limitations/ section 5.1.3).

This project employs an integrated taphonomic approach by examining all available elements from sites with Neolithic evidence (macroscopic analysis) and the microstructure of 63 elements (microscopic analysis) to cross-compare patterns from different parts of Wales and north Somerset. Furthermore, this research emphasises the great value of analysing disarticulated remains for understanding mortuary behaviour in this period and provides new radiocarbon dating evidence from ten sites in Wales. The multi-level methodological approach addresses issues relating to how bodies decompose and disarticulate under different circumstances and the chronology of mortuary deposition across Wales and north Somerset (provision of new radiocarbon dating results). By investigating pre- and post-depositional treatment and providing new radiocarbon dates, this research contributes to the wider understanding of mortuary practices in caves by examining regional, chronological and demographic variation in practices (Chapter 6/6.2 and 6.3). This multi-factorial approach is novel in British Neolithic cave archaeology and results (Chapters 6 and 7) were further used to explore depositional patterns compared to monumental burials (Chapter 6.4).

#### **5.1.2.1. Macroscopic analysis**

In total, 20 sites from Wales were subject to primary analysis with 1638 entries of human skeletal remains (including loose teeth)<sup>88</sup> (Table 4 below). As previously mentioned, data collection was confined to sites that had already been directly dated as having Neolithic activity. Sites from Wales excluded from this research (including justification) can be found in Appendix 1/Sheet 7/Excluded sites. These sites have been excluded due to lack of direct chronology and/or unknown location (museum) for analysis.

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<sup>88</sup> N=1438 excluding loose teeth (N=200).

<b>SITE</b>	<b>REGION</b>	<b>MNI</b>	<b>DATE</b>	<b><sup>14</sup>C</b>
Cathole Cave	Ilston, Swansea	2+	Middle Neolithic	4675±39BP
Spurge Hole	Pennard, Swansea	3+	Early to Middle/Late Neolithic	4830±100BP; 4648±26BP; 4425±26BP
Red Fescue Hole	Rhossili, Swansea	1+	Middle Neolithic	4634±29BP
George Rock Shelter	Wenvoe, Vale of Glamorgan	7+	Early Neolithic and post-Medieval	4929±33BP; 5083±38BP; 125 ±24BP
Pitton Cliff Cave	Rhossili, Swansea	1	Early Neolithic	4837±38BP
Ifton Quarry	Rogiet, Monmouthshire	7+	Middle and Late Neolithic	4640±29BP; 4624±29BP; 4350±90BP; 4178±28BP
Little Hoyle Cave (Longbury Bank Cave)	Penally, Pembrokeshire	c.11+	Early to Middle Neolithic	4660±80BP; 4930±80BP; 4750±75BP;

				4880±90BP; 4893±22BP
Nanna's Cave	Caldey Island Pembrokeshire	4+	Mesolithic and Middle Neolithic	8037±27BP; 4560±45BP; 4520±45BP
Hoyle's Mouth Cave	Penally, Pembrokeshire	2+	Late Neolithic/Early BA	4265±65BP; 4225±60BP
Ogof-y-Benglog (New Cave/Skull Cave)	Tenby, Pembrokeshire	1+	Middle Neolithic	4660±BP
Priory Farm Cave	Monkton, Pembrokeshire	5+	Middle Neolithic; Late BA and M/L Iron Age	4631±31BP; 2814±29BP; 2133±26BP
Ogof Garreg Hir	Stackpole, Pembrokeshire	1	Early Neolithic	5056±39BP
Ogof Brân Goesgoch	Stackpole, Pembrokeshire	2	Late Neolithic/Beaker	3939±35BP
Cae Gronw Cave	Cefnmeiriadog, Denbighshire	2	Early and Late Neolithic	3955±60BP; 4918±20BP

Ogof Colomendy	Gwernymynydd, Flintshire	5+	Middle to Late Neolithic and Early/Middle BA	4408±33BP; 4081±26BP; 3518±35BP; 3314±26BP
Orchid Cave	Llanferres, Denbighshire	4+	Late Neolithic/Early BA	4170±100BP; 4100±20BP
Pontnewydd Cave, (Bont Newydd Cave)	Saint Asaph, Denbighshire	3+ based on available remains (originally ?5+)	Mesolithic and Middle/Late Neolithic	4495±70BP; 7420±90BP
Gop Cave	Trelawnyd and Gwaenysgor, Flintshire	4+ based on available remains (originally 14+)	Middle/Late Neolithic	4414±30BP; 4381±29BP; 4357±30BP
Ogof Pant-y-Wennol	Llandudno, Conwy	5+	Early and Middle Neolithic	4982±36BP; 4962±32BP; 4657±32BP
Little Orme's Head Quarry (secondary data)	Llandudno, Conwy	1	Early Neolithic	4720±50BP

Table 4. Sites subject to macroscopic taphonomic analysis.

### 5.1.2.2. Microscopic analysis

Nine caves from Wales and one from north Somerset were examined as case studies (microscopic taphonomic analysis of 63 elements). Selection of case studies was based on the available radiocarbon dates already provided for these sites (suitable for targeted microscopic analysis of Neolithic human remains). The macroscopic taphonomic modifications recorded for each site in separate regions and the location of the sites (different cave systems across Wales and north Somerset) also played a major role for this selection. Justification for element selection can be found in Table 5/column F (below) and further details on site selection can be found in 5.1.2.4. Data produced for these sites gave the opportunity for a comparative study of funerary practices between regions within Wales and north Somerset. Raw results can be found in Appendix 1/Sheet 3/Histology.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
<b>SITE</b>	<b>REGION</b>	<b>MNI</b>	<b>DATE</b>	<b>14C</b>	<b>NUMBER OF ELEMENTS ANALYSED/ RATIONALE FOR ELEMENT SELECTION</b>
Spurge Hole	Pennard, Swansea	3+ (2 adults; 1 juvenile)	Early Neolithic	4830±100BP; 4648±26BP; 4425±26BP	9 elements. One individual found in correct anatomical order required sampling of both cranial and post-cranial elements as morphological characteristics varied
George Rock Shelter	Wenvoe, Vale of Glamorgan	7+ (3 adults, 1 perinate, 1 juvenile and 1 adolescent), 1 probable cremation	Early Neolithic and post-Medieval	4929±33BP; 5083±38BP; 125±24BP; 4954±22BP; 4969±22BP	6 elements. Long bone representation was very low and appeared unusual; cranial elements were sampled only from Neolithic horizons

Ifton Quarry	Rogiet, Monmouthshire	7+ (5 adults; 2 juveniles)	Middle and Late Neolithic	4640±29BP; 4624±29BP; 4350±90BP; 4178±28BP	6 elements. Both cranial and post-cranial remains were selected based on extensive evidence of human-inflected trauma that suggested pre-depositional manipulation
Little Hoyle Cave (Longbury Bank Cave)	Penally, Pembrokeshire	c.11+ (adults ranging from 17-25 to 35-45 years based on surface wearing scoring for molars, 1 juvenile)	Early to Middle Neolithic	4660±80BP; 4930±80BP; 4750±75BP; 4880±90BP; 4893±22 BP	16 elements. Mandibles, cranial and post-cranial elements were selected. The vast majority included mandibles
Priory Farm Cave	Monkton, Pembrokeshire	5+ (4 adults, 1 juvenile)	Middle Neolithic; Late BA and M/L Iron Age	4631±31BP; 2814±29BP; 2133±26BP	1 element. The collection showed good surface preservation however, due to lack of stratigraphy, only the Neolithic bone (mandible) was sampled for accurate results
Ogof Colomendy	Gwernymynydd, Flintshire	5+ (3 adults, 1 adolescent/adult, 1 younger adult or adolescent)	Middle Neolithic and Early/Middle BA	4408±33BP; 3518±35BP; 4081±26BP; 3314±26BP	1 element (femur). The majority of elements were loaned to the NMW and only two (long bones) were available for microscopic analysis.



Gop Cave	Trelawnyd & Gwaenysgor, Flintshire,	4+ (3 adults/1 younger adult, 1 juvenile)	Middle/Late Neolithic	4414±30BP; 4381±29BP; 4357±30BP	10 elements. Mandibles, cranial and post-cranial elements were selected to maximise results due to the level of disarticulation
Ogof Pant-y-Wennol	Llandudno, Conwy	5+ (5+ (2 adults, 1 adolescent/younger adult, 1 juvenile, 1 perinate)	Early and Middle Neolithic	4982±36BP; 4962±32BP; 4657±32BP	7 elements. Cranial and post-cranial elements were selected based on extensive evidence of weathering that suggested prior sub-aerial exposure before final deposition
Ogof Garreg Hir	Stackpole, Pembrokeshire	1 (? juvenile/adolescent)	Early Neolithic	5056±39BP	1 element (Neolithic ulna) selected for sampling (only 3 discovered). Cave affected by storm-wave action, therefore sample may indicate potential fungal attack (Wedl tunnelling)
Backwell Cave	Backwell, north Somerset	18+ (15 adults,? 3 juveniles)	Early and Middle Neolithic	4150BP; 4885±29BP	5 elements. Only right humeri were sampled to avoid duplicating individuals. Sampling was conducted by A.Bricking, Cardiff University.

Table 5. Sites subject to microscopic taphonomic analysis

### 5.1.2.3. Radiocarbon dating

Ten skeletal remains from seven sites were submitted for radiocarbon dating (Table 6 below). Raw results can be found in Appendix 1/Sheet 5/<sup>14</sup>C. Rational for this selection can be found in section Table 6/column F and section 5.1.2.4.

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
<b>SITE</b>	<b>REGION</b>	<b>MNI</b>	<b>DATE</b>	<b><sup>14</sup>C</b>	<b>NUMBER OF ELEMENTS SUBMITTED FOR RADIOCARBON DATING/ RATIONALE FOR SITE SELECTION</b>
Spurge Hole	Pennard, Swansea	3+ (2 adults; 1 juvenile)	Early to Middle/Late Neolithic	4830±100BP; New dates: 4648±26BP; 4425±26BP	2 elements (long-bones). Only one radiocarbon date was available. One skeleton was found in the correct anatomical order, however, on the basis of morphology, more than one individual was present and therefore further radiocarbon dating evidence was required
George Rock shelter	Wenvoe, Vale of Glamorgan	7+ (3 adults, 1 perinate, 1 juvenile and 1 adolescent), 1 probable cremation	Early Neolithic and post-Medieval	4929±33BP; 5083±38BP; 125±24BP; New dates: 4954±22BP; 4969±22BP	2 elements (cranial). Unique site with detailed stratigraphic information. Two additional radiocarbon dates from the Neolithic horizons where therefore selected to verify the period from which preserved remains derived as distinct treatment may be hinting intentional exposure between cranial and post-cranial remains

Little Hoyle Cave (Longbury Bank Cave)	Penally, Pembrokeshire	11+ (adults ranging from 17-25 to 35-45 years based on surface wearing scoring for molars, one juvenile)	Early to Middle Neolithic	4660±80BP; 4930±80BP; 4750±75BP; 4880±90BP; New date: 4893±22BP	1 element (long-bone). One additional radiocarbon date (only mandibles had been sampled) was considered essential to test whether patterns of mortuary deposition vary chronologically or retain a stable character
Nanna's Cave	Caldey Island, Pembrokeshire	4+ (3 adults, 1 juvenile)	Mesolithic and Middle Neolithic	4560±45BP; 4520±45BP; New date: 8037±27BP	1 element (tarsal). More evidence as to the length of occupation and time of depositions was required due to number of individuals buried in the site.
Orchid Cave	Llanferres, Denbighshire	4+ (2 adults, 1 adolescent, 1 perinate)	Late Neolithic/ Early BA	4170±100BP; New date: 4100±20BP	1 element (long bone). Duration of deposition remains unclear due to multiple disturbances in the cave. One additional radiocarbon date from the second younger individual discovered will therefore verify whether chronological variation is apparent in the heavily disturbed site
Ogof Colomendy	Gwernymynydd, Flintshire	c. 5+ (3 adults, 1 EBA adolescent/adult, 1 MN younger adult or adolescent)	Middle to Late Neolithic and Early/Middle BA	4408±33BP; 3518±35BP; New dates: 4081±26BP; 3314±26BP	2 elements (specific long bones only allowed to sample). Only one original radiocarbon date was identifiable to element (second original radiocarbon date from element had been lost from the records) when access for sampling was requested. Due to the

					number of individuals discovered and their highly disarticulated and fractured state, two more radiocarbon dates were required to verify the date of the individuals
Cae Gronw Cave	Cefnmeiriadog, Denbighshire	2 (adults)	Early and Late Neolithic	3955±60BP; New date: 4918±20BP	1 element. Human remains were discovered in heavily disturbed area of the cave however, no evidence of trampling/fractures was apparent (which would be expected). One additional radiocarbon date was considered essential to verify whether remains were deposited/left in the cave earlier than the previously considered

Table 6. Sites submitted for radiocarbon dating (further details can be found in Appendix 1/<sup>14</sup>C results)

#### 5.1.2.4. Sampling selection and justification

**Microscopic analysis:** Selection of sites (Table 5) was based on the following criteria:

- A large quantity of human remains (Ogof Colomendy, Gop Cave, Little Hoyle Cave, Ogof Pant y Wennol, Backwell Cave)
- Neolithic radiocarbon dates and evidence for unusual treatment (sharp/blunt force trauma, sub-aerial exposure based on advance stages of weathering and lack of corresponding cranial and/or post-cranial remains)
- Distinct taphonomic markers identified on the bones: root etching and black staining from Priory Farm Cave, Ifton Quarry and Little Hoyle Cave which results from contact of the bones to different soil surfaces; fresh and dry fractures on the majority of long bones from Ifton Quarry, Gop Cave and Ogof Colomendy, extensive evidence of weathering from Ogof Pant-y-Wennol that suggested prior sub-aerial exposure before final burial.
- Availability of demographic information (elements securely derived from different individuals)

Three multi-period sites (George Rock Shelter, Priory Farm Cave and Ogof Colomendy) were included in the analysis despite their varied chronological depositions. Remains could still be relevant to the Neolithic assemblage either due to lack of stratigraphy and the uncertain chronology of the context (Ogof Colomendy, Priory Farm Cave) or the taphonomic impact on a range of human remains of different ages that have been deposited in the same context. Sampling of elements from multi-period sites was conducted on either securely dated remains (Ogof Colomendy – Late Neolithic femur; Priory Farm Cave – Middle Neolithic mandible) or from Neolithic horizons (George Rock Shelter). George Rock Shelter, in particular, was one of the few sites that had been carefully recorded and available stratigraphic information allowed careful recording and sampling for microscopic analysis.

Ogof Garreg Hir presents a short case-study (see Appendix 5/Sheet 2/Coding) with very low element frequencies however, direct evidence of Neolithic activity. One element (Early Neolithic) was sampled for microscopic analysis and will therefore be included

as a case-study to complement the histological profile of elements discovered in caves in south-west Wales.

**Radiocarbon dating:** The provision of new dating evidence was essential to maximise the interpretative resolution of this research. Selection of sites and justification can be found in Table 6/columns A, F.

More specifically a targeted  $^{14}\text{C}$  programme addressed the following questions:

- What is the chronology of mortuary deposition at these sites and were multiple deposits made at the same time or was deposition temporally dispersed?
- How do patterns of mortuary practices (e.g. inhumations, exhumations and excarnation) vary chronologically?
- How does chronological variation in mortuary practice and post-depositional manipulation of remains differ between sites in Wales and regions (Wales versus north Somerset)?

### **5.1.3. Limitations**

Several limitations in compiling a holistic database and analysing all available human remains have been identified. One of the most crucial issues relates to the state of human remains analysed. All elements were disarticulated and fragmented with only a few examples showing total zone completeness (see Appendix 1/Sheet 2/Coding/State of remains and Zones 1-15 columns and section 5.2.1).

Out of 20 caves examined, 19 were either unstratified or lacked accurate recording (see Appendix 5/Site Backgrounds). George Rock Shelter presents the only exception to this case with thorough recording and context information provided for all elements (see Appendix 1/Sheet 2/Coding/Context column). A number of human remains from Nanna's Cave (MNI: 4+) stored at National Museum Wales were intermingled with Perthi Cwarrae Cave (one of the sites excluded from this research) and were therefore not examined.

Another important issue relates to the analysis of human remains from multi-period sites (with direct Neolithic evidence). These assemblages derive from Priory Farm Cave, George Rock Shelter, Ogof Colomendy, Nanna's Cave and Pontnewydd Cave

(Table 4). Despite the varied chronology in depositions these sites were examined as remains could still be relevant to the Neolithic assemblage either due to lack of stratigraphy (Ogof Colomendy) or the uncertain chronology of the context (George Rock Shelter layer 1009 – one post-Medieval radiocarbon date available). Preserved remains from Pontnewydd Cave included only one Neolithic and one Mesolithic element, therefore, identification was accurate. Further radiocarbon dating evidence was pursued for Nanna's Cave (one Mesolithic date), Ogof Colomendy (one Early BA and Late Neolithic) and George Rock Shelter (two Early Neolithic) (Table 6). Two sites (Hoyle's Mouth Cave and Ogof Brân Goesgoch) dated to the Late Neolithic/Beaker – Early BA have been subject to macroscopic analysis (results across Wales and regional results). The radiocarbon dates fall into the transitional period of the Late Neolithic/Chalcolithic (c.2500BC) in Britain with the appearance of new burial trends (Beaker burials) in Wales (see Chapter 2/section 2.3.4). The available dates from Hoyle's Mouth Cave however must be used with caution (pre-ultrafiltration dates).

Holistic analysis of all available human remains from caves across Wales was limited and 12 sites (primarily from north Wales) were not examined as part of this research. Reasons for this exclusion include early excavations in the 1980s, loss of collections, poor documentation or scattering in museums and/or private collections (unknown location). A table of the sites (across Wales) excluded from this study can also be found in Appendix 1/Sheet 7/Excluded sites.

Access to museums for conducting either macro- and/or microscopic analysis posed another important limitation to this research. More specifically, access at Llandudno Museum for conducting macroscopic analysis of the individual from Little Orme's Head Quarry (and one partial cranium from Ogof-Pant-y-Wennol possibly held at the same museum) was denied due to refurbishments. The human remains had been stored at another location and undergone repetitive handling which resulted in great loss of surface preservation and would have affected accurate recording. However, the individual presents a unique case study due to the extensive evidence of pathology including degenerative arthritis, possible metastatic carcinoma, lesions and ante-mortem tooth loss due to probable periodontal disease. Secondary data (osteology reports) were gathered and used for interpretation. Secondary data used for statistical analysis (across sites and regions/5.2 and 5.3) include element frequencies, age/sex

representation, zone completion (with caution), evidence of erosion and pathology. Available information can be found in Appendix 1/Coding.

Last, due to the pandemic outbreak, subsequent visits to museums for primary analysis were restricted. Human remains (small assemblage) from Cathole Cave (MNI: 2+) were stored both at National Museum of Wales (NMW) and National History Museum (NHM). However, due to COVID-19 restrictions, recording for this site was not pursued at NHM. Plans for visiting Manchester Museum to record remaining available elements from Gop Cave (c. 10 elements including 4 partial crania, a juvenile mandible, two pairs of left and right humeri and a right tibia) were disrupted due to the pandemic. However, when access was reinstated, it appeared that the four partial crania and the mandible were missing from Manchester Museum's collection; according to the curators the crania were part of a 2010 research project (unknown current location) and only five long bones were available for analysis. Recording of these four postcranial remains was not pursued as these survived from the 1986 excavation of the site whilst the elements held at NMW from the 1908-14 (and possibly 1920-1) excavations. These were conducted in different areas of the cave, therefore, recording of the elements would not have enhanced our understanding of the different burial episodes in the cave (see 5.4.7).

Destructive sampling (for microscopic analysis and radiocarbon dating) was carried at Tenby Museum and Newport Museum before the start of the pandemic, whilst remaining collections were loaned and sampling was carried at Cardiff University as access to NMW was not allowed due to the pandemic. This had an effect on the completion of primary analysis. Full descriptions of all sites examined can be found in Appendix 1/14C sites and Appendix 5.

## **5.2. Recording methods – Macroscopic analysis**

Macroscopic taphonomic analysis was carried using a hand-lens 30x magnification. Data recorded, as set out by McKinley (2004: 14), include minimum number of individuals (MNI), demographic data (age and sex), ancient modifications by natural forces (weathering, gnawing, erosion and surface preservation, abrasion, staining, fractures) and human inflicted trauma (cut-marks, burning, fractures, blunt-force



trauma). Abbreviations used in text can also be found in ‘Abbreviations list’ at the start of the thesis<sup>89</sup>.

### **5.2.1. Minimum number of individuals (MNI) and coding**

Minimum number of individuals at each site was based on the presence of duplicated sided skeletal elements and/or age-related differences. A zonation method was used as index of completeness and fragmentation for further identifying minimum number of individuals. Following Buikstra and Ubelaker’s (1994: 9) standard procedure for coding commingled or incomplete remains, elements were recorded by entering the state of remains (complete/not complete)<sup>90</sup>, anatomical element (ANAT), side (L/R) and proximal/distal fusion in long bones (PF/DF). Remains were given a separate entry with an identifiable specimen number (SNO), different from the museum code (Accession number). See Appendix 1/Sheet 1/Coding.

### **Zonation and quantification of elements (Z1-Z15)**

A zonation method was implemented (Knüsel and Outram 2004) as an index of completeness, parts present and fragmentation which is useful for taphonomic histories and estimation of minimum number of individuals (MNI) based on zone prevalence. By using this method, skeletal elements were divided into distinct zones and a presence/absence of each zone was recorded. Each record was made of a sample that had at least 50% zone completeness and each zone was given a separate entry (e.g. 7 zones= 7 rows) using a numbering system (i.e. 0=absence of zone; 1= zone present) (Appendix 2/Sheet 2/DATA-ZONES). However, if 50% of zone was not represented, separate entries were still given for recording taphonomy and/or demographic information (mandible/maxilla fragments with dental attrition). Limiting recording of fragments that did not show 50% zone completeness would have resulted in great loss of taphonomic narrative. The recording of no-zone specimens also provided important information on fragmentation. In particular, the vast majority of elements from Spurge Hole and George Rock Shelter did not make up 50% of one zone but had to be given

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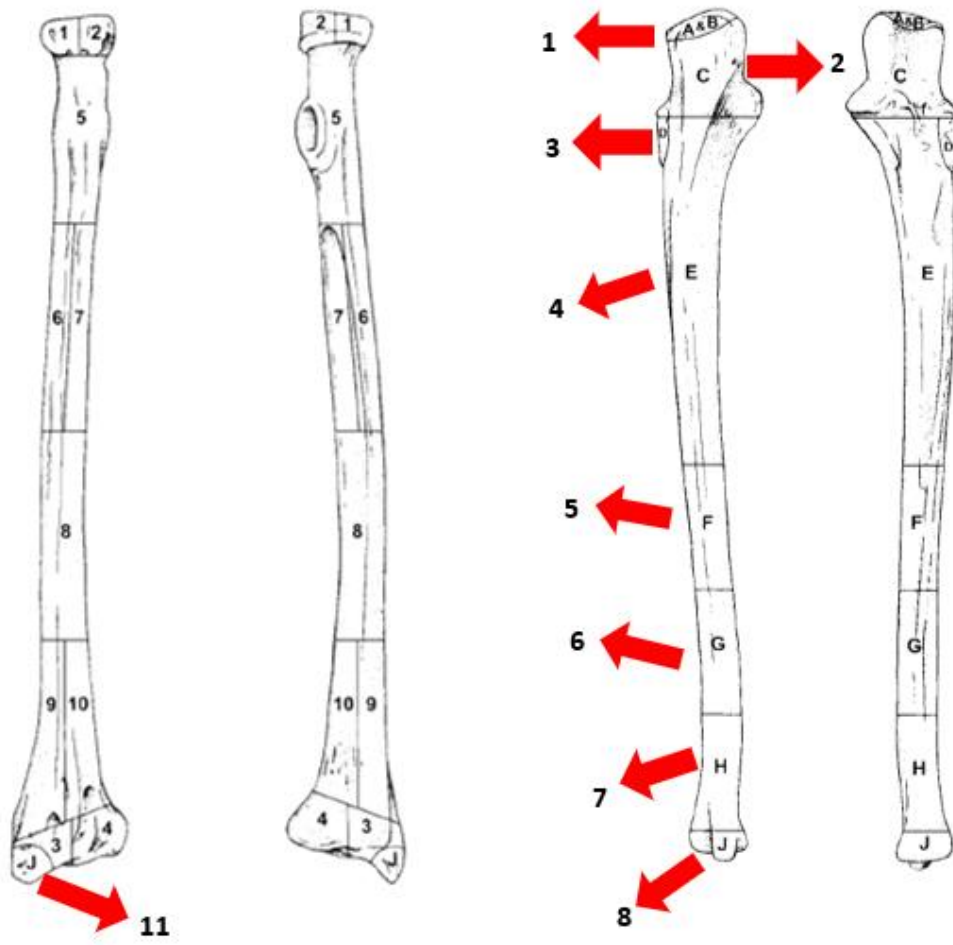
<sup>89</sup>Appendix 2/Sheet 6 also mentions all methods and abbreviations used in this research. Coding used for statistical analysis (Appendices 2-4) is provided in each individual sheet within these Appendices.

<sup>90</sup>Complete=all zones present; Not complete= fragmented/ no complete zone representation.

separate entries for recording taphonomic modifications. Grouped entries with miscellaneous, unidentified or very small fragments that either exhibited taphonomic modifications or not were still included in the statistical analysis (either as unidentified or other/miscellaneous remains) so results can be unbiased. Justification for separate entries of no-zone specimens or grouped entries can be found in the quick comments (QC) section (Appendix 1/Coding and Methods&Code abbreviations) for each individual entry.

Total element representation (N) is always provided in each section and graph (Chapters 6, 7 and Appendix 6). As mentioned in 5.1.3, secondary data from Little Orme's Head Quarry were used for summary statistics (across sites and regions/5.2 and 5.3) including element frequencies, age/sex representation, zone completion (with caution), evidence of erosion and pathology (N Total assemblage=1438). Little Orme's Head Quarry was excluded from all remaining taphonomic observations (weathering, gnawing, abrasion, trauma, FFI and surface preservation) that were used for statistical analysis (N=1387).

Zones for radii, ulnae and vertebrae (atlas and axis) (Figures 36-7) were adjusted. In particular, zones for cervical vertebrae were modified to correspond to zone representation for the atlas and axis as there was no specification for recording these elements in Knüsel and Outram's method (2004) (Figure 38). Zones of perinatal remains were not added as elements are not fully developed and zone division does not accurately correspond to bone segments.



Figures 36 (left) and 37(right). **36:** Radius - Zone J modified to number 11. **37:** Ulna - Zones A+B,C,D,E,F,G,H,J modified to 1-8 for consistency. Modified from Knüsel and Outram (2004: 90-91).

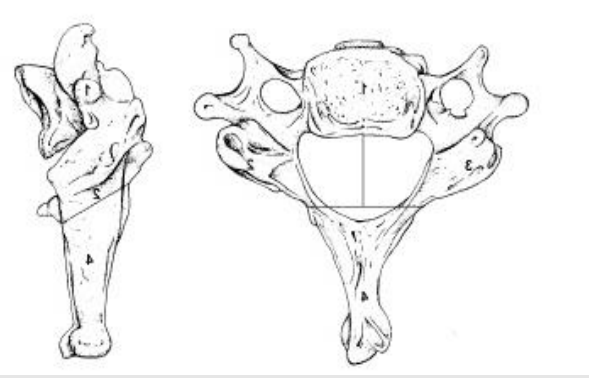


Figure 38. Zone division is cervical vertebra (superior and right lateral view). Atlas (C1): anterior arch=zone 1; superior and inferior articular facets and transverse processes= zones 2 and 3; lamina= zone 4. Axis (C2): odontoid process/body =zone 1; superior and inferior articular facets and transverse processes zones 2 and 3; lamina and spinous process=zone 4. Modified from Knüsel and Outram (2004: 88).

## 5.2.2 Age, sex and pathologies

Demographic information (estimation of age and sex, dental or skeletal pathology) was recorded when possible.

### Age

Age categories were modified from Buikstra and Ubelaker (1994: 9) (Table 7). Age of fusion for proximal and distal epiphyses on long bones, the iliac crest of the os coxae, the scapular acromion and/or medial border for various adult skeletal elements followed White *et al.* (2012: 395), McKern and Stewart (1957) and Steele and Bremablett (1988: figures 9.10 and 5.17) for immature individuals. Age estimations for infants and juveniles/children and adolescents followed Baker *et al.* (2005). Age estimations based on cranial suture closure followed Meindl and Lovejoy (1985: 58) and on the auricular surface of the adult ossa coxae from Lovejoy *et al.* (1985: 24-25).

Category	Age period
Foetal	<birth
Perinate	Around the time of birth
Juvenile/children	5-6 years
Adolescent	12-17/18 years
Young adult	c. 17/18-22/25
Adult	c. 22-25 and over
Immature individual or ?	partial skeletal identification not assigning an age category due to poorly preserved remains

Table 7. Age categories modified from Buikstra and Ubelaker (1994: 9). Young adult category: surface wear scoring (Brothwell 1981: 69) for c. 17-25 years was considered more appropriate for younger adults based on the available features used for age estimations.

Dental eruption for age estimation followed Ubelaker (1989: figure 71). Surface wear scoring for molars was modified from Brothwell (1981: 69) (see Table 8 below) and was also used for age estimations (Appendix 1/Sheet 4/Dentition). A more detailed scoring system was not implemented as age was not the main focus of this analysis. Therefore, broad ordinal scales sufficed for the purposes of this research. Surface scoring for dental attrition of permanent incisors, canines and premolars was used after Smith (1984: 45-46) and descriptions for deciduous teeth (immature individuals) were

based on Smith (1984: 45-46) and Scott (1979: 214). Due to low numbers of deciduous teeth recorded in the assemblages, no particular system of recording was considered necessary and therefore only qualitative descriptions of teeth wear were recorded. All information can be found in Appendix 1/Sheet 4/Dentition.

















AGE PERIOD (YEARS)	STAGE 1: ABOUT 17-25			STAGE 2: ABOUT 25-35			STAGE 3: ABOUT 40+		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Wear pattern			Dentine not exposed.				Any greater degree of wear than in the previous columns.  N.B. Very unequal wear sometimes occurs in the later stages.		
A			There might be slight enamel polishing						
B									
C									

Table 8. Surface wearing scoring for molars. Modified from Brothwell (1981: 69)

### Sex estimates

Sex assignment for adults/young adults used categories from Buikstra and Ubelaker (1994: 9) (Table 9 below). Sex estimates were assigned based on the scoring system for sexually dimorphic features (morphological/descriptive) of either the cranium (nuchal crest, mastoid process, supra-orbital margin, supra-orbital ridge/glabella and mental eminence) after Acsádi and Nemeskéri (1970: figure 16), or the os coxae (greater sciatic notch and/or the scoring system for the preauricular sulcus), following by Buikstra and Ubelaker (1994: 18-19). The level of fragmentation and preservation of the remains was high, therefore, sex estimates have a degree of uncertainty (e.g. not all cranial or pelvic features were recordable). Other scoring schemes (e.g. osteometrics/morphological for sex assignment of the distal humerus which survives reasonably well) were not used due to poor success rates and the varying preservation of the elements which would have affected accurate and consistent recording.

<b>SEX</b>	<b>INDICATION/SYMBOL</b>
Male	M
Probable Male	M?
Female	F
Probable Female	F?
Undiagnosed sex	?

Table 9. Sex estimate categories based on Buikstra and Ubelaker (1994: 9)

## **Pathologies**

Dental pathologies on loose teeth (caries, calculus, abscesses, periodontal disease observed) were recorded on a presence/absence basis (raw data in Appendix 1/Sheet 4/Dentition/Pathology column) as described in Buikstra and Ubelaker (1994: 54, 56). The high levels of fragmentation and taphonomic overprinting (most remains were impacted by erosive processes) affected accurate identification of infectious/degenerative changes. Infectious/degenerative and/or dental pathologies (for teeth still attached on mandibles/maxillas) were recorded in a separate column (Appendix 1/Sheet 2/Coding/PATH column) with specific indication of the location of infectious/degenerative pathology (Appendix 1/Sheet 2/Coding/LOC infectious/degenerative column) (Buikstra and Ubelaker 1994: 106-158; Roberts and Manchester 2005). Infectious pathologies were extensively encountered at one site (Little Orme's Head Quarry) and had already been recorded. A limited dataset was provided and recordable elements were incorporated in this analysis (Appendix 1/Sheet 2/Coding).

Following codes in sections 5.3-5.5 are from the spreadsheets (Appendix 1/Sheet 2/Coding and Sheet 3/Histology) that can also be found in the 'Abbreviations list' at the start of the thesis.

### 5.3. Taphonomy

#### Natural processes

##### 5.3.1. Weathering (WTH)

Presence of weathering was recorded using stages of weathering (1-5) from Behrensmeyer's system (1978) (Table 10 and Figure 39 below). This method has certain limitations (e.g. cranial weathering does not correspond to patterns described/illustrated by Behrensmeyer) however, it is a standard reference and technique for recording weathering modifications on British material, researching stages 1-3 (Chapter 3/section 3.5.1). Weathering patterns mainly included parallel cracking, splitting and flaking.

WEATHERING STAGE	DESCRIPTION
0	Bone surface shows no sign of cracking or flaking due to weathering
1	Bone shows cracking, normally parallel to the fiber structure (e.g., longitudinal in long bones). Articular surfaces may show mosaic cracking of covering tissue as well as in the bone itself
2	Outermost concentric thin layers of bone show flaking, usually associated with cracks, in that the bone edges along the cracks tend to separate and flake first. Long thin flakes, with one or more sides still attached to the bone, are common in the initial part of Stage 2. Deeper and more extensive flaking follows, until most of the outermost bone is gone. Crack edges are usually angular in cross-section.
3	Bone surface is characterized by patches of rough, homogeneously weathered compact bone, resulting in a fibrous texture. In these patches, all the external, concentrically layered bone has been removed. Gradually the patches extend to cover the entire bone surface. Weathering does not penetrate deeper than 1.0-1.5 mm at this stage, and bone fibers are still firmly attached to each other. Crack edges usually are rounded in cross-section.
4	Bone surface is coarsely fibrous and rough in texture; large and small splinters occur and may be loose enough to fall away from the bone when it is moved. Weathering penetrates into inner cavities. Cracks are open and have splintered or rounded edges
5	Bone is falling apart in situ, with large splinters lying around what remains of the whole, which is fragile and easily broken by moving. Original bone shape may be difficult to determine. Cancellous bone usually exposed, when present, and may outlast all traces of the former more compact, outer parts of the bones

Table 10. Weathering stages following Behrensmeyer's scoring system (1978)

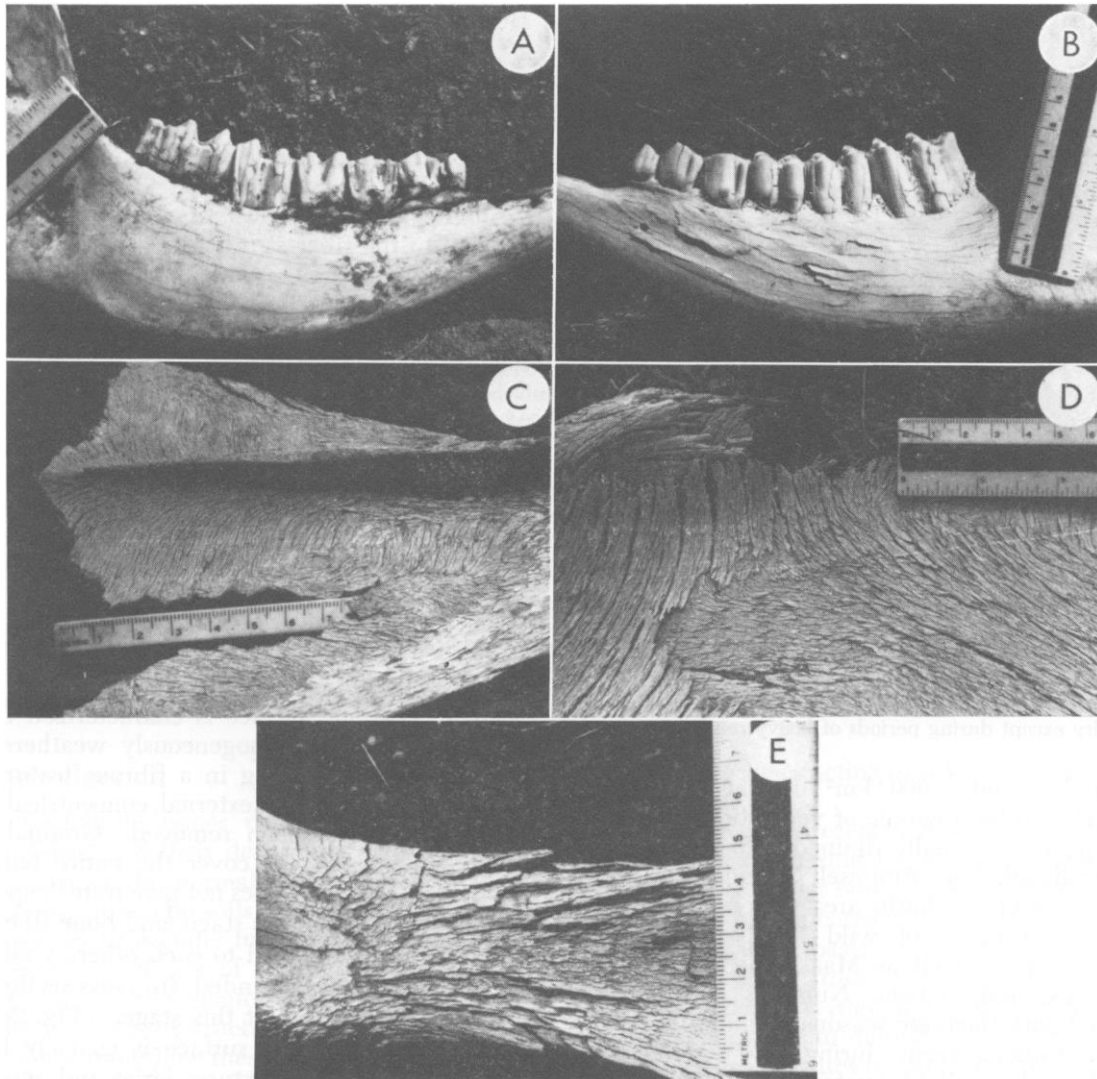


Figure 39. Indication of weathering stages (1-5/A-E) adopted in this research – Amboseli bone assemblage. A/Stage 1: cow mandible with initial cracking parallel to bone fibre structure; B/Stage 2: cow mandible flaking of outer bone fibre structure; C/Stage 3: bovid scapula with fibrous, rough texture and remnants of surface bone near lower right border; D/Stage 4: scapula with deep cracking, coarse layered fibre structure; E/Stage 5: scapula blade showing final stages of deep cracking and splitting (Behrensmeyer 1978: 152).

### 5.3.2. Gnawing (GN)

Animal gnawing was reported on a presence/absence basis and images by Fernández-Jalvo and Andrews (2016) were used as reference guide (Figure 40). Animal damage is amongst the common and earliest occurring modifications (Davis and Briggs 1998; Fernández-Jalvo *et al.* 2002: 35) and ultimately related to human/animal action (Chapter 4/ 4.5.2). An absence of gnawing may be regarded as evidence of absence of exposure in specific environments (Madgwick and Mulville 2015: 261). Therefore, a presence/absence scheme was considered more efficient to indicate exposure to



scavenger activity whilst gnawing severity using an ordinal system would not have been useful for the purposes of this research. In addition, the agent of modification was not important and was differentiated as marks can indicate either prior subaerial exposure or disturbances by scavengers in the caves. Detailed identification of the nature of marks and number of punctures/grooves, as proposed by McKinley (2004: 15), was therefore not pursued due the high levels of fragmentation, poor preservation and cases of possible taphonomic overprinting (most remains had been impacted by erosive processes).



Figure 40. Gnawed metacarpal (Little Hoyle Cave). Source: author

### 5.3.3. *Erosion (EROS)*

For the purposes of this research, any signs of rough texture, root etching and/or soil corrosion have been recorded as erosion as all can result from contact with the ground. Moreover, signs of erosion were recorded on a presence/absence basis due to high levels of poor preservation of most remains (Figure 41). The proposed system for recording erosion set out by McKinley (2004: 15) was not useful in this case. McKinley notes (ibid.) that different parts of the bone may be variously affected and it may be necessary to specify different grades for different parts of the bone. However, the elements examined in this research have endured different levels of exposure, including primary/secondary depositions, and have been impacted by different agents (abrasion

and/or root etching) that have possibly masked previous modifications. Also, the level of severity of erosion for different segments of the bone would not have provided additional information useful for the purposes of this research. Thus, a presence/absence scheme was used instead. Acidic soil corrosion has been recorded in the same cell as all modifications are erosive processes that result to general loss of bone and poor preservation from exposure to different soil conditions. Images by Fernández-Jalvo and Andrews (2016) were cross-compared for correct identification of these modifications.

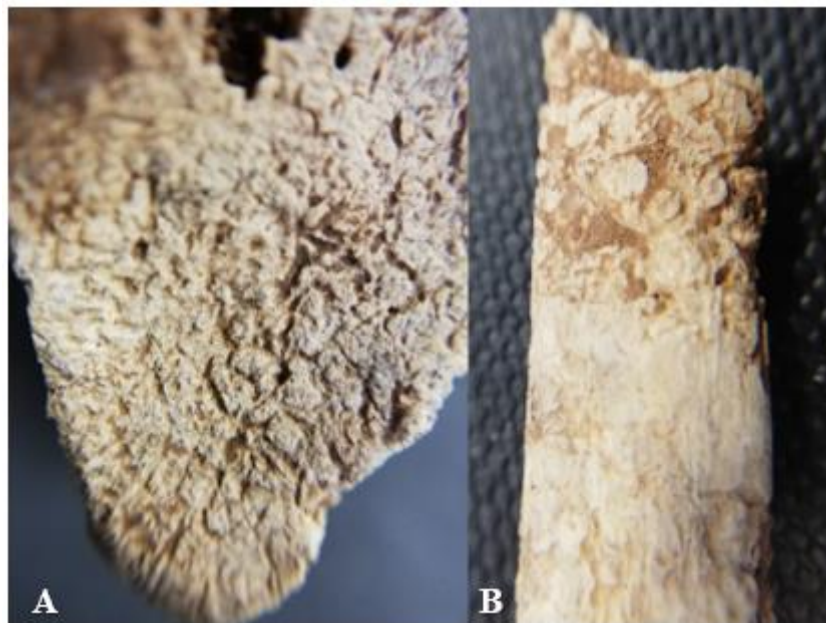


Figure 41. Root etching on talus (A) and rib (B) (George Rock Shelter).  
Source: author

#### 5.3.4. Abrasion (AB)

Abrasion (polishing of the bone surface) was also recorded on a presence/absence basis. A presence/absence indication was considered suited for the purposes of this research as the level of exposure to water wear, causing abrasion and polishing, was very high in most human remains (Figure 42). If polishing had resulted from handling/curating (adhesives on surface) and not from natural agents, a comment was added in the quick comments section (QC). When abrasion was not present, erosion (rough texture, root etching and potential soil corrosion) was mostly identified (e.g. Spurge Hole and George Rock Shelter). An indication of presence/absence (using an ordinal scheme)

seemed more appropriate in this case as the severity of abrasion should not be used as an index of exposure or transportation (Chapter 3/section 3.5.5). Moreover, a presence/absence of abrasion (closely associated with trampling) and weathering can potentially clarify means of exposure and burial patterns associated with depositions in caves. Images by Fernández-Jalvo and Andrews (2016) were cross-compared for confident identification of this modification.



Figure 42. Abrasion on radial diaphysis (arrows) (Gop Cave). Source: author

### 5.3.5. Staining (STAIN)

Soil staining was recorded on a presence/absence basis. Taphonomic bone staining can result from a variety of agents (sun, organic compounds, metals, mineral and soil). Due to the high level of disarticulation and consecutive disturbances of the bones (either from scavenger activity or mortuary treatment) a presence/absence scheme seemed more appropriate. Black staining (resulting from mould or manganese) was observed in the majority of assemblages (Figure 43).



Figure 43. Staining on mandible (Little Hoyle Cave). Source: author

Red/brown stains, possibly resulting from root action, and concretion residues were also identified (QC section). Staining resulting from burning was recorded in the trauma (TRA) section. Images by Fernández-Jalvo and Andrews (2016) were cross-compared for confident identification of this modification.

#### 5.3.6. *Trampling (TRAMP)*

Trampling was recorded on a presence/absence basis and was only identified in a few elements (<5). Absence of trampling in subterranean environments was expected. Similarly to other taphonomic markers, a presence/absence scheme was considered more suited for elements discovered in caves as trampling can easily be masked by other processes and/or not be present at all (wet subterranean conditions, movement by medium/large mammals can be avoided). Indication of trampling in caves would therefore suggest exposure to different environmental conditions prior final deposition. For more information see Chapter 3/section 3.5.11.

### **Anthropogenic and other causes of fragmentation**

#### 5.3.7. *Fracture Freshness analysis (FFI)*

Anthropogenic causes entail peri-mortem manipulation (fresh fractures, trauma) and unintentional disturbances (human or animal), usually resulting in dry fractures, and/or

circulation of bone. Results create a unique fracture history profile for the understanding and the level of manipulation of long bones.

Outram's (1998, 2001) Fracture Freshness Index (FFI) was adopted for recording fractures on long bones (fresh, dry). An updated version of Outram's FFI scoring system (1998, 2001) is Johnson's *et al.* (2016) 'fracture history profile' which was not selected for fracture analysis. Johnson *et al.* (2016: 264) note that a freshly fractured bone accompanied by a, later, dry fracture will have the same score as a single fracture on a drying bone. However, the method proposed has three different levels of analysis: FFI scores, first fracture scores and a subsequent fracture history profile (*ibid.*). The experiment that Johnson *et al.* (2016: 625) conducted, was more controlled and more variables were accounted (e.g. weighting of the elements, preferred element dimensions for analysis were chosen). Whereas the overall results create a more holistic image of the fracture history (e.g. preferred elements indicating fresh, spiral fractures made for marrow extraction with subsequent dry fractures), this method is not as time efficient as Outram's FFI method. Lastly, this method has specifically been applied to animal remains (accounting for weight, mass, species and zones) (e.g. Johnson *et al.* 2018: 61) and has been used to test levels of marrow extraction on elements. Whilst providing an in-depth understanding of the history of fractures on animal remains, the method is neither particularly efficient for human remains examined under certain time constraints and nor has it been tested/compared on/with human remains.

Outram's (1998, 2001) method included scoring (0-2) for fracture angle (ANG), surface texture (FST) and outline (FO). A total fracture freshness score (TOTAL) was used to determine the nature of the fracture (0-6 fresh to dry) (Figure 44)<sup>91</sup>. Modern breaks (e.g. excavation breaks, sampled fractured ends) were not given scores however, if a modern break was identified amongst a dry post-depositional break it was recorded as a note in the quick comments (QC) section and scoring was given only to the older (either fresh or dry) fracture. Modern fractures were easily identified having rough edges and different colouration from fresh breaks. Fractures on both proximal and distal fractures were recorded in the same columns (ANG, FST, FO & TOTAL) with an indication of

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<sup>91</sup>Abbreviations from are from the spreadsheets (Appendices 1-4) that can also be found in the 'Abbreviations list' at the start of the thesis.

proximal (prox) and distal (dist) scoring (Appendix 1/Sheet 2/Coding). This was pursued to create a holistic representation of the fracture morphology on a single long bone exhibiting multiple fractures.

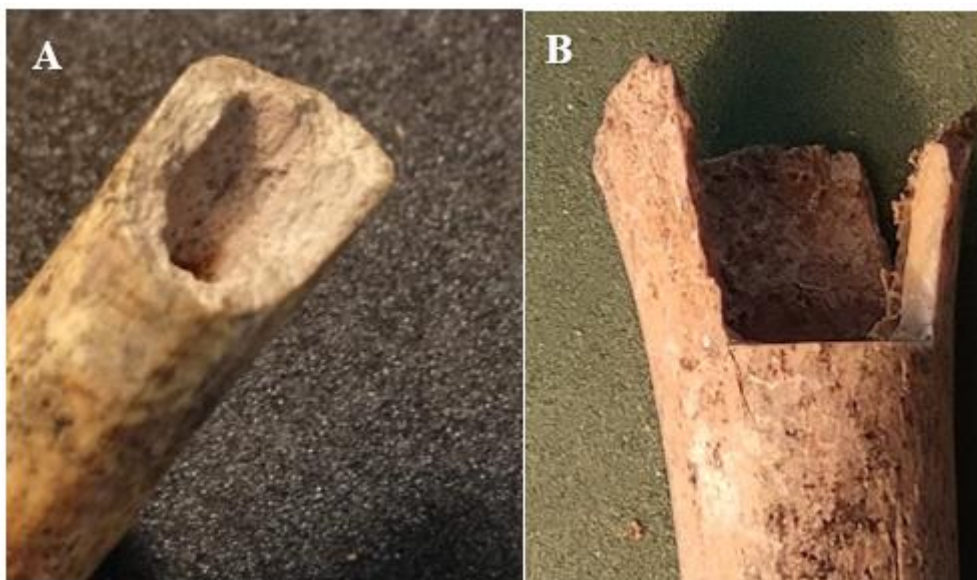


Figure 44. Fresh versus dry fracture – **A**: fresh FFI 2 and **B**: dry FFI 6 (with modern damage from sampling). Source: author

Fractured fibulae and ulnae were not given scores as the vast majority had very thin cortical bone surviving and therefore fractures on these elements were not recorded for consistency. Fractures on radii close to either proximal or distal epiphysis where the cortical bone is thin were not given scores as FFI proxies were therefore difficult to assess. Cutmarks can also cause fragmentation (and indicate deliberate manipulation), however, they were recorded separately (5.3.8) to indicate the location of the cutmark.

#### 5.3.8. Trauma (TRA)

Evidence of trauma was recorded on a presence/absence basis. Inflicted trauma included sharp force/cutmarks and blunt force trauma (TRA SHARP-CUT/BFT)<sup>92</sup>. Identification of peri- or ante-mortem trauma was also differentiated (TRA peri/ante) for accurately identifying healed fractures. Location for any type of aforementioned trauma was also recorded (LOC TRA). Burning (TRA BU) and stages of burning (BU

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<sup>92</sup> Abbreviations from are from the spreadsheets (Appendices 1-4) that can also be found in the 'Abbreviations list' at the start of the thesis.

Stage), had a separate column for more accurate identification. Stages of burning (Table 11 and Figure 45 below) were recorded based on descriptions by Cáceres (2002). Elements could show simultaneous presence of burning stages.

<b>BURNING STAGE</b>	<b>DESCRIPTION</b>
0 (Unburnt bone)	Original bone colour
1	Burning is marked by limited areas of brown staining
2	Early exposure to heat or burning, brownish bone, still intact and not cracked
3	Charring and dull black colour
4	Bone is drack grey with extensive cracking of the surface, shrinkage of the bone and some remineralization
5	Final stage with bright white colour which has become calcined

Table 11. Burning stages (from Cáceres 2002).

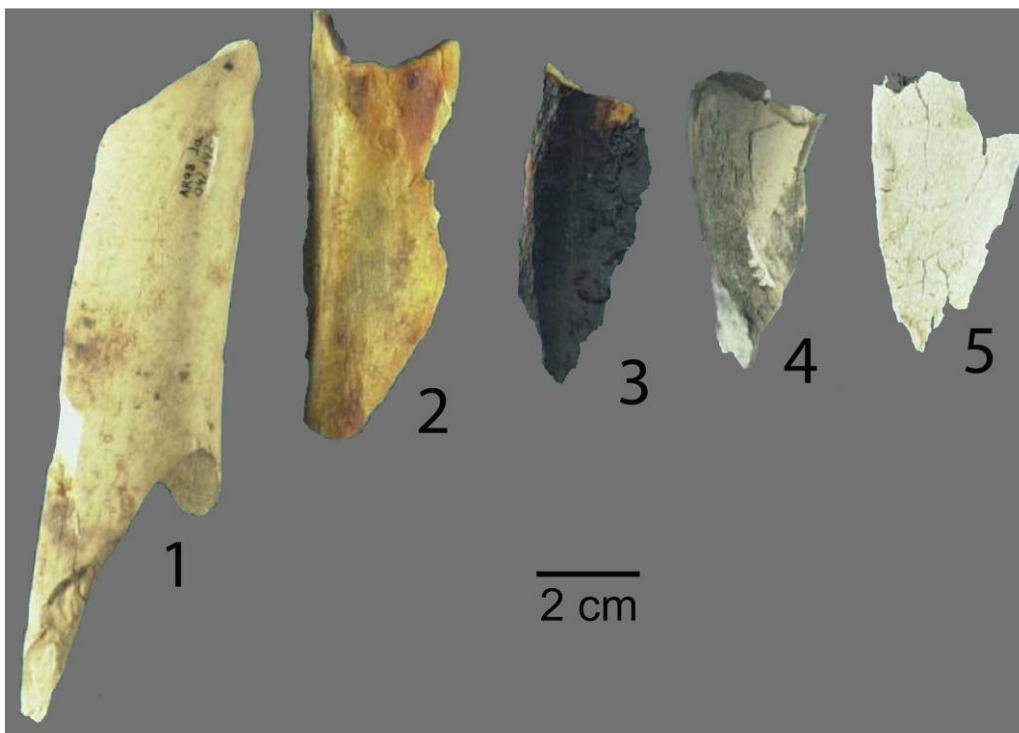


Figure 45. 1-5 burning stages (Fernández-Jalvo and Andrews 2016: 157, fig. 5.2)

#### **Remaining modifications - quick comments section (QC)**

Signs of digestive corrosion were recorded in the quick comments (QC) section (only a few cases were observed mostly in teeth). Probable sediment, water or insect wear

(low prevalence) was also recorded in the quick comments section. Images by Fernández-Jalvo and Andrews (2016) were cross-compared for correct identification of these modifications.

### **Recording of overall taphonomic impact**

#### *5.3.9. Surface preservation (PRES)*

Surface preservation was recorded using a grading system (0-5) from poor to good, modified by McKinley (2004: 16) (Figure 46). Preservation was scored based on the degree of any post-mortem taphonomic modification (weathering, gnawing, erosion, staining) that impacted the surface of the element. This scoring indicated the severity of the overall modifications and survival of an element on top of individual recording of the agent(s) that impacted the bone surface. The level of surface preservation was recorded to assess the condition of each element as remains were disarticulated. Description of the scores follows in table 12 (below).



Figure 46. Poor (score 0/A) versus good (score 5/B) surface preservation. Weathered (stage 4) humerus (left) and abraded metatarsal (right). Source: author



<b>SCORE</b>	<b>DESCRIPTION</b>
0	Poor preservation (no identifiable taphonomic modifications and surface severely impacted)
1	Heavy taphonomic modification but surface preservation still identifiable (not scored 0)
2	All of the surface affected however, general profile maintained and modification(s) not uniform across whole surface
3	Most of the surface affected by some degree of taphonomic modification (general morphology maintained but detail of parts of the surface masked)
4	Slight and patchy taphonomic modification (surface preservation visible (but not score 5)
5	Good preservation (surface preservation clearly visible despite modifications or no modifications)

Table 12. Scores for recording surface preservation (modified from McKinley 2004: 16)

## **5.4. Microscopic analysis**

### **Sampling for histological analysis**

Microscopic analysis of bone microstructure has become a useful tool in understanding early post-mortem treatment by exploring patterns of degradation through microbial attack (see Chapter 4/4.6). Small transverse sections (10mm x 5mm) of bone were made using a low vibration drill (STRONG 209A). Mandibles, cranial and post-cranial bones were selected as the preservation of the microstructure might be distinct due to the differentiation of treatment (see section 5.1.2.2). Sampling took place at Newport Museum and Art Gallery and Tenby Museum and Art Gallery. Collections from National Museum Wales were loaned (due to the pandemic outbreak) and sampling therefore took place at Cardiff University, John Percival Building, Bioarchaeology Lab (2.27a).

Subsequent analysis took place at Cardiff University by cutting transverse thin sections 50-120 microns thick from these samples using a diamond saw microtome (REHA – TECH RMS-16G3). Each undecalcified and unstained thin section was mounted onto a glass slide using Entellan mounting medium and glass cover slip. All thin sections were then analysed under normal and polarised light at 25, 40 and 100 x magnification using transmitted light binocular microscopes fitted with polarising filters (Nikon

ECLIPSE ME600 Research Microscope). Furthermore, all digital micrographs of bone thin sections were produced using an eye-piece mounted Lumera infinity digital microscopy camera in conjunction with Lumera Infinity Capture and Analyse software. Thin section light microscopy involved the examination of the bone microstructure under normal and polarised light (Appendix 1/Histology).

Bioerosion was assessed using the Oxford Histological Index (OHI) (Table 13) (Hedges *et al.* 1995; Millard 2001). The OHI translates the percentage of remaining unaltered bone microstructure into an ordinal grade ranging from 0 to 5, representing the worst and best-preserved microstructure respectively (Figure 47). The OHI is subjective, but has proven very effective and efficient (see Chapter 4/4.6). Scoring for bioerosion (SCORE OHI), type of attack (ATTACK non-Wedl/Wedl) and birefringence (BIREFR) were given separate columns<sup>93</sup>.

OHI SCORE	% OF REMAINING MICROSTRUCTURE	DESCRIPTION
0	<5%	No original features identifiable except Haversian canals
1	<15%	Small areas of well-preserved bone present, or the lamellate structure is preserved by the patterns of destructive foci
2	<50%	Some well-preserved bone present between destroyed areas
3	>50%	Larger areas of well-preserved bone present
4	>85%	Bone is fairly well-preserved with minor amounts of destroyed areas
5	>95%	Very well preserved, similar to modern bone

Table 13. Oxford Histological Index (OHI) for assessing bioerosion (Hedges *et al.* 1995: 203; Millard 2001: 640).

<sup>93</sup>Abbreviations from are from the spreadsheets (Appendix 1/Sheet 3/Histology) that can also be found in the ‘Abbreviations list’ at the start of the thesis.

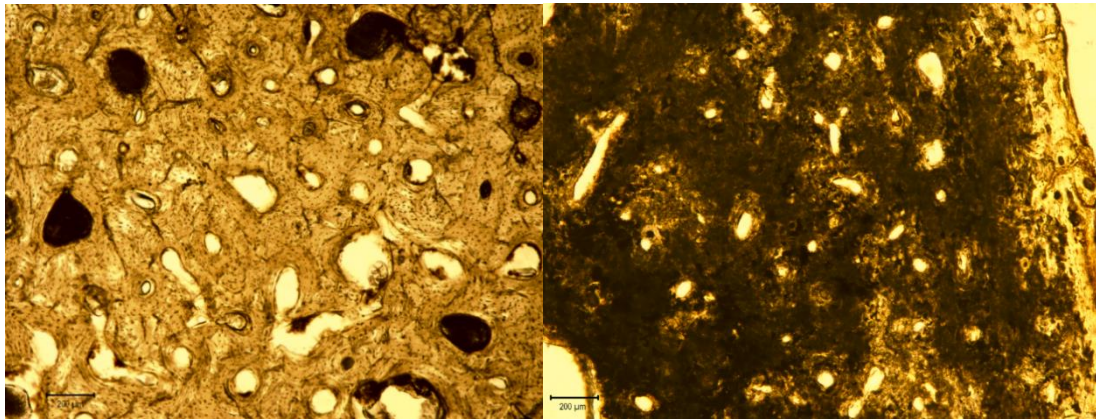


Figure 47. Transverse micrograph of the femoral bone structure under normal light showing – **left** – excellent histological preservation (OHI 5) (Spurge Hole) versus – **right** – humeral bone structure under normal light showing extensive MFD (OHI 1) (Ifton Quarry). Source: author

Types of (endogenous) bacterial MFD were also differentiated including bacterial MFD budded (BUDDED), lamellate (LAMEL), linear longitudinal (LINEAR L) and (exogenous) fungi MFD Wedl (WEDL) types 1,2 and/or cyanobacteria (Figure 48, Tables 14, 15 below). These were recorded on a presence/absence (1-0) basis as different types of attack appeared in the microstructure. Specification on Wedl types (1 and 2) and cyanobacteria were recorded in a separate column (W types 1, 2, cyanobact) (Table 16 below)<sup>94</sup>. Wedl type 2 was the most dominant with only a few examples of cyanobacteria.

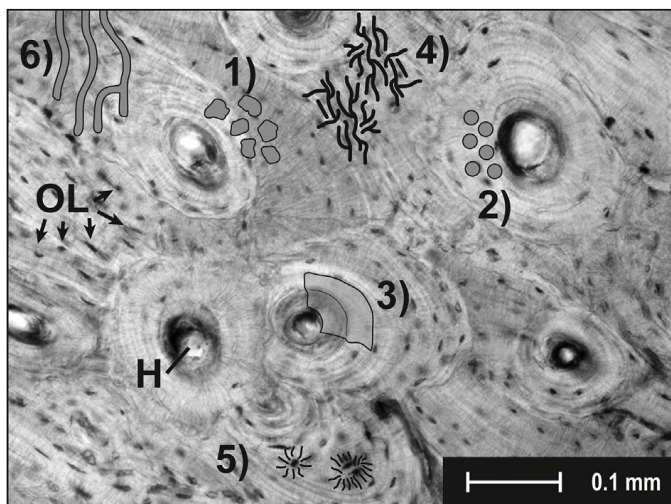


Figure 48. Types of MFD in a thin section: 1. budded; 2: linear longitudinal, 3: lamellate; 4: Wedl (Type 1); 5. Wedl (Type 2 enlarged canaliculi); 6. Cyanobacteria. H: Haversian canals and OL: osteocyte lacunae (Brönnimann *et al.* 2018: 46).

<sup>94</sup> Abbreviations from are from the spreadsheets (Appendix 1/Sheet 3/Histology) that can also be found in the ‘Abbreviations list’ at the start of the thesis.

<b>TYPES OF MFD</b>	<b>SCORING</b>
Non-Wedl	0
Wedl	1
Both NW and W	2
No MFD	3

Table 14. Types of MFD recorded.

<b>TYPE OF BACTERIAL ATTACK: BUDDED, LAMELLATE, LINEAR LONGITUDINAL AND FUNGAL ATTACK (WEDL)</b>	<b>SCORING</b>
Present	1
Absent	0

Table 15. Types of bacterial and fungal attack recorded.

<b>WEDL TYPES AND CYANOBACTERIA</b>	<b>SCORING</b>
Type 1	1
Type 2	2
Cyanobacteria	3
Absent	0

Table 16. Types of Wedl tunnelling and or cyanobacteria as indicated in Appendix 1/Sheet 3/Histology.

Similarly, evidence of inclusions (INCL), infiltrations (INFIL), staining/discolouration (STAIN/DIS), (micro)cracking/microfissures (CRACK/MF) were also given separate columns and recorded on a presence (1)/absence (0) basis (Figures 49-50). Description of staining, inclusions and infiltrations, colouration was provided in separate columns (Incl colour, Infil colour, Stain colour) similar to intensities given for inclusions, infiltrations and cracking/microfissures frequencies (Incl intensity, Infil intensity, Crack intensity)<sup>95</sup>. The latter were recorded using a scoring system (0-3/absent-high) (Table 17 below)

<sup>95</sup> Abbreviations from are from the spreadsheets (Appendix 1/Sheet 3/Histology) that can also be found in the 'Abbreviations list' at the start of the thesis

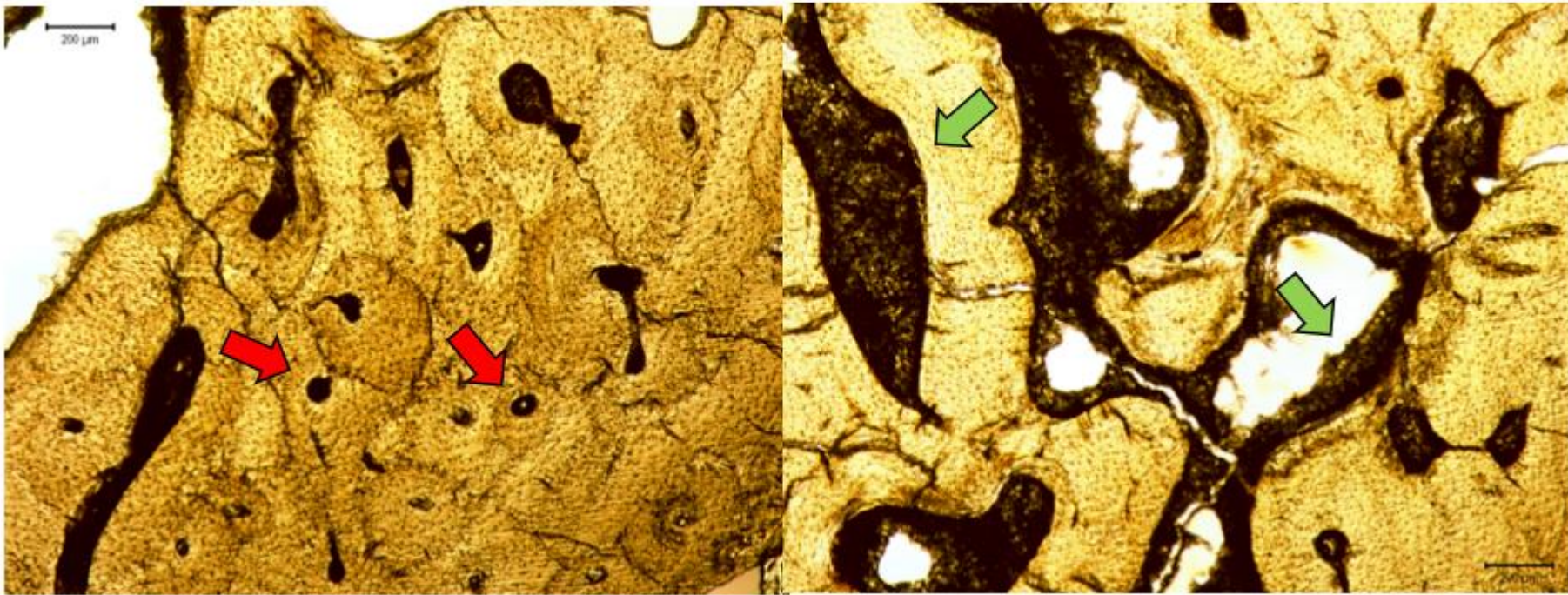


Figure 49. Dark brown inclusions within the Haversian canals (red arrows) and infiltrations (green arrow). Source: author

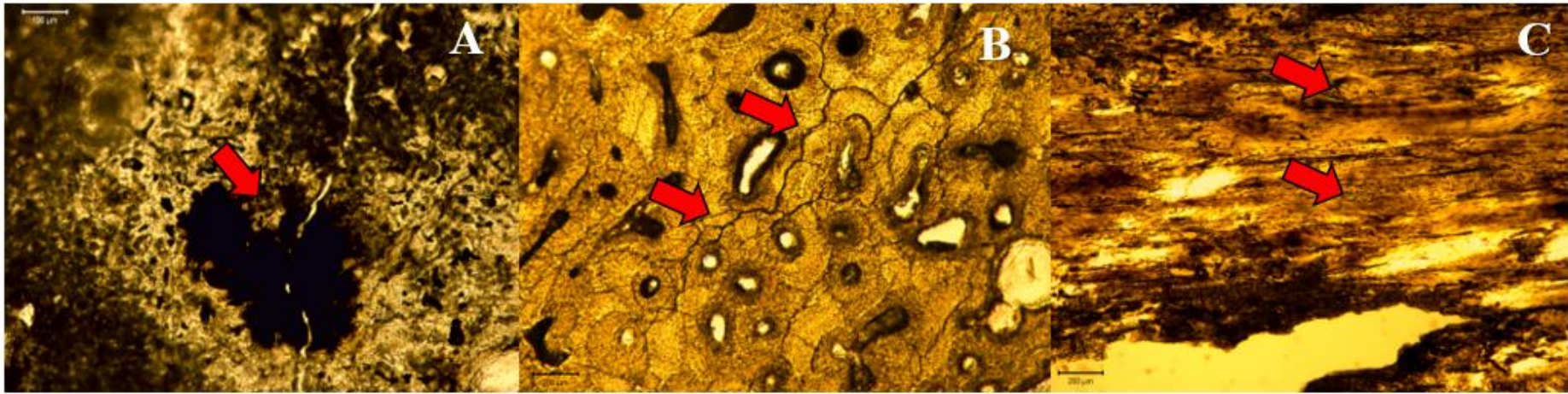


Figure 50. A: Infiltrations (arrow), B: microfissures/cracking (arrows) and C: brown/orange staining. Source: author

<b>INTENSITIES: INCLUSIONS, INFILTRATIONS, MICROCRACKING</b>	<b>SCORING</b>
Absent	0
Low	1
Medium	2
High	3

Table 17. Intensities recorded for inclusions (INCL), infiltrations (INFIL) and microcracking/microfissures (CRACK).

The colour and morphology of inclusions across samples was similar (primarily dark brown accumulations within the Haversian canals). Infiltrations (extraneous material within the bone structure) mostly consisted of dark brown/black-brown particles in the microstructure, often densely packed with inclusions (Garland 1989: 226). Different types of infiltrations using thin section light microscopy could not be identified, therefore a presence/absence scheme with an indication of intensity and colour in each sample seemed more appropriate. Ratios of fissured/non-fissured osteons and use of the Microcracking Index was considered time consuming and bone bioerosion has been mostly considered unrelated to the occurrence of microfissures (Hackett 1981; Jans *et al.* 2002). Any unusual occurrence or additional information was recorded in the comments section (Appendix 1/Sheet 3/Histology Comments column).

Collagen birefringence was measured using a modified method of the ordinal system (Birefringence Index) by Jans *et al.* 2002 (Table 18) using no birefringence/low/medium/high indications (Figure 51) Additional notes for each sample were reported in the quick comments section (QC). A complete record of all sampled elements (raw data) can be found in Appendix 1/Sheet 3/Histology).

<b>BIREFRINGENCE</b>	<b>DESCRIPTION</b>
High (3)	Collagen birefringence is bright, comparable to fresh bone and/or has survived in high rates on most of the microstructure
Medium (2)	Collagen birefringence is reduced
Low (1)	Collagen birefringence has survived in low rates
No birefringence (0)	No birefringence present

Table 18. Birefringence measurements (modified from Jans *et al.* 2002: 348).

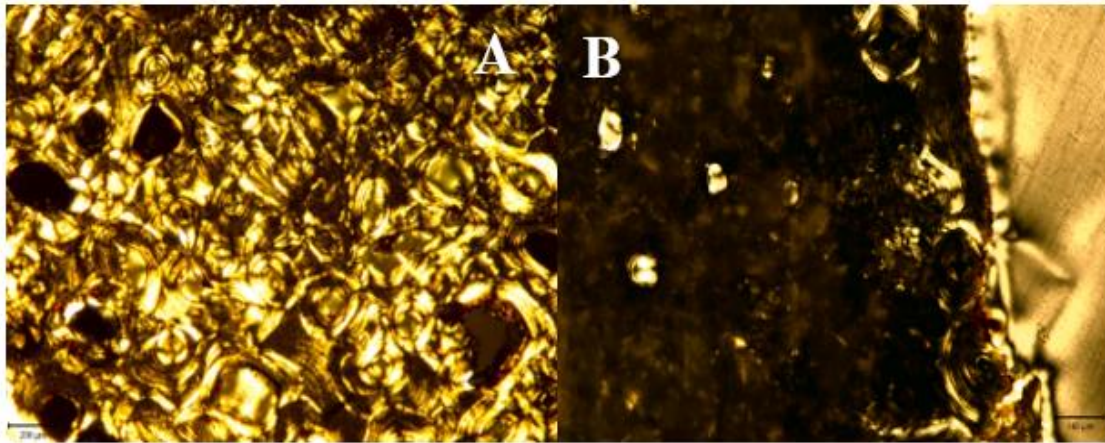


Figure 51. **A:** Transverse micrograph of the femoral bone structure (left) under polarised light showing high birefringence (score 3/high birefringence). **B:** Transverse micrograph of the humeral bone structure (right) under polarised light showing low (periosteal surface) to no birefringence (endosteal surface) (Score 1). Source: author.

## 5.5. Radiocarbon dating

### Sampling for radiocarbon dating

New radiocarbon dating evidence further contributed to the understanding of the history of depositions in caves in Wales. Small sections of 10mm x 5mm of bone were made using a low vibration drill. Between 380mg and 1g (mg varied) of bone were sent for radiocarbon dating. Either residue from a 10mm x 10mm cut (for histological analysis and radiocarbon dating) or a 10mm x 5mm cut was used. Elements were bagged separately and sent for analysis. Generous funding was provided from the Prehistoric Society, the British Cave Research Association (BCRA) and the National Environmental Isotope Facility (NEIF). Radiocarbon dating of ten elements (from seven sites in Wales) was carried at NEIF and Scottish Universities Environmental Research Centre (SUERC). A complete record of all sampled elements (raw data) can be found in Appendix 1/Sheet 5/<sup>14</sup>C results. The radiocarbon age of all samples was calibrated to the calendar timescale using Oxford Radiocarbon Accelerator Unit calibration program OxCal 4. Date ranges were calibrated using the IntCal20 atmospheric calibration curve.

## 5.6. Statistical analysis

Results from the macro- and microscopic analyses were recorded in Microsoft Excel. Values were then imported into IBM SPSS v.26 statistics programme (Raw data from



summary statistics in Appendix 2/Sheets 1-9); Appendix 3/Sheets 1-7; Appendix 4/1-8)<sup>96</sup>. Statistical analysis (summary statistics) of 1638 elements, including loose teeth, (from 20 sites) was carried out for macroscopic analysis with 63 (from 10 sites) elements further examined for microscopic analysis. All charts and tables were produced within Excel or IBM SPSS. Measurements from the statistics programme consisted of ordinal and nominal variables. Non-parametric tests (microscopic analysis) were used to investigate the relationship amongst two sets of samples. Tests (Mann-Whitney) demonstrated significance in histological preservation, which were further used to explore variation/differences in depositional patterns between sites. A standard p-value of 0.05 was applied.

Recent research by Halsey (2019) has questioned the validity of the p-value in statistical analysis with a number of alternative options. These approaches form an attempt for data standardization and model building as further explanatory variables might often be missed when solely focusing on the p-value (Halsey 2019: 6). Halsey refers to several new approaches. These include enhancement of the p-value with information that can be replicable in a study (based on confidence that a similar value will be produced), focus on frequent statistics with a certainty of correct/accurate effect sizes or development of the Bayes factor which directly addresses the likelihood of the null hypothesis and an alternative hypothesis (Cumming 2008; Halsey *et al.* 2015; Cumming *et al.* 2016; Halsey 2019: 3). Moreover, when using multiple variables, which build on top of prior analyses (growing data), Akaike information criterion (AIC) can replace the p-value by measuring an outcome variable and multiple potential explanatory variables (Sakamoto and Ishiguro 1986; Burnham *et al.* 2011; Gelman *et al.* 2014; Halsey 2019: 6).

These alternative statistical methods might be valuable for larger databases by investigating patterns in the data not only determined by the p-value. Statistical testing employed for this PhD nonetheless, concerns a very small sample where the size of the data (Chapter 7) can be easily monitored and reflect either a positive or negative

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<sup>96</sup> The data that was used for summary statistics can be found in these Appendices. These were coded and imported to IBM. Appendices 3 and 4 - one example of regional (Appendix 3) and case study (Appendix 4) was included for reference.

outcome. Therefore, no other approach was considered essential for the purposes of this PhD research as the use of the p-value was effective and quick. Significant differences were not relied on alone in interpretation but used to explore differences in data alongside descriptive statistics and qualitative analysis.

The following chapter (6) presents the results of both macro- microscopic analyses and radiocarbon dating for sites across Wales. Results are subsequently divided to regional analysis (south-east, south-central, south-west and north Wales) and case studies (Chapter 7) (Wales and north Somerset) to clarify whether overall patterns persist on a regional level.

## **Chapter 6: Results across sites and regions**

### **6.1. Overview**

This chapter presents the results of the macroscopic taphonomic analysis of twenty sites in Wales and the microscopic results of nine of these sites and one comparative cave from north Somerset. The radiocarbon dating results acquired from seven sites in Wales are also presented.

Justification for site and sample selection as well as limitations in recording can be found in Chapter 5. This section focuses only on results across sites (6.2) and regions (6.3) whilst shorter summaries (case studies) are included in Chapter 7. Overall results (summary statistics) for sites are first presented including frequency of skeletal elements to understand the representation of element survival in sites, element completeness (fragmented vs complete), MNI, demographic information, pathologies, taphonomic and radiocarbon dating results. Case studies are subsequently presented in Chapter 7 followed by non-parametric tests to verify whether differences in assemblages are statistically significant. Raw data can be found in Appendices (1-4). Data (including tables and figures) that was not considered essential for the presentation and direct interpretation of results (Chapters 6 and 7) and discussion (Chapter 8) has not been included in the main thesis and can be found in Appendix 6. However, this data was the product of complex analysis and cross-referencing of proxies that could not be discarded and was therefore included as supporting information in the appendix<sup>97</sup>.

Taphonomic analysis of the disarticulated remains from caves in Wales (N=1638 including loose teeth) was employed to:

1. Explore patterns of pre- and post-depositional Neolithic activities (i.e. practices of inhumation, exhumation and excarnation/range of funerary practices

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<sup>97</sup>A list of Appendices 1-4 and 6 can be found in 'The table of contents' and the Appendices list at the end of the thesis. Sections referenced in text have been given direct page numbers to guide the reader. SNO further refers to the specimen number of an element in Appendix 1/Sheets 2 and 3. N refers to the total element representation of an assemblage. Abbreviations can be found in the 'Abbreviations list' at the start of the thesis or in Appendix 1/Sheet 6/Methods and abbreviations.

employed) and differentiate treatment between individuals based on taphonomic data.

2. Create a better understanding of the chronology of the individuals (i.e. chronological variation in mortuary practice and post-depositional manipulation).
3. Reveal any regional variations based on the consistency of early post-mortem treatment

## **6.2. Results across sites**

### **Frequency of skeletal elements**

The combined dataset from all sites indicated a higher representation of postcranial (N=1060, 64.7%) than cranial/skull remains (N=213, 13%) (Figure 52). Bones of the hands/feet (N=363) and flat/irregular bones<sup>98</sup> (N=323) comprised almost half of the total assemblage with a much lower proportion of long bones (N=198) recorded (Figure 53).

Out of 200 loose teeth (12.2%, Figure 52), incisors (N=55, 27%) were most frequently preserved across sites (Figure 54). Further sub-division of teeth categories demonstrated a higher representation of canines (N=35, 17.5%), followed by the second upper premolar (N=26, 13%) and the second incisor (N=25, 12.5%) (Figure 55).

Unidentifiable fragments and other/miscellaneous bones<sup>99</sup> comprised a lower proportion of the assemblage. From a total of 1438 elements (excluding loose teeth), unidentified (N=33) and other/miscellaneous remains (N=65) represented only 2.3% and 4.5% respectively (Figure 53).

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<sup>98</sup> Bone type categorised and modified from Robb (2016: 690). Skull includes the cranium (and cranial fragments) and mandibulae/maxillae. Long bones include the humerus, radius, ulna, femur, tibia and fibula. Vertebrae include the cervical, thoracic and lumbar vertebrae. Flat bones/irregular comprise of ribs, scapula, clavicle, sternum, ossa coxae and sacrum. Hands/feet include all carpals/tarsals, MC/MT, phalanges and patella.

<sup>99</sup>Miscellaneous fragments include multiple highly fragmented identifiable or possibly identifiable elements grouped together with no zone representation and presence/absence of taphonomy depending on the element. More details can be found in Database/Coding/QC section.

Burnt human bone was included as a separate category under element and bone category figures to demonstrate variability amongst surviving remains as burnt bone elements (N=64, 4.8%) were extensively recorded in George Rock Shelter, with very few burnt fragments (N=3) identified from Ogof Colomendy. Similarly, to no zone representation (see Chapter 5/5.2), recording of burnt fragments provided important information on fragmentation, soil acidity and general taphonomic conditions with most unidentified to element and a few cranial fragments that were grouped under burnt (BU) to assess burning stages (see Chapter 5/5.3.9).

Skull elements (mainly cranial fragments, complete mandibulae or mandibular fragments) and long bones indicated similar representation (14.8% and 13.9% respectively)<sup>100</sup> across sites (Figure 53). Due to high susceptibility to fragmentation, cranial/skull (N=213, 14.8%) and flat/irregular (N=323, 22.5%) fragments were anticipated in these numbers with the presence of smaller bones (hands/feet) and mandibulae (fragments) that disarticulate from the body rapidly suggesting primary inhumations, disturbances, clearances and/or removal of certain elements.

Zone representation on long bones (N=204, Figure 31)<sup>101</sup> was analysed using either the proximal, the distal epiphysis or any zone from the shaft on a presence/absence basis (see Chapter 5/5.2.1) (Figure 56). Epiphyses fusion (N=109, 53.4%) were less dense and survived less frequently than shafts (N=141, 69.1%). Ulna shafts (N=37) and femur epiphyses (N=29) were more common compared to other limbs (Tables 19-20/Appendix 6)<sup>102</sup>.

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<sup>100</sup> Percentages here are different as these are further divided based on bone type (Figure 53) and not overall representation of cranial/skull versus post-cranial remains as presented in paragraph 1 (Figure 52).

<sup>101</sup> Presence/absence of epiphyses and shafts across sites - N does not include perinate long bones (N=4), however, unidentified long bones (miscellaneous category in frequencies) have been examined as zone completion was absent which further indicates that fragmentation in caves was notable. Similarly, unidentified shafts were incorporated in the 'zone section' across regional results and case studies, therefore, total N of long bones (frequencies) might be different from total N in zones' section. Epiphysis and/or shaft absence= less than 50% of the zone was present however, these fragmented shafts were identifiable to element and were included in this analysis to underline the level of fragmentation.

<sup>102</sup> See Appendix 6/6.2. Results across sites/Frequency of skeletal elements.

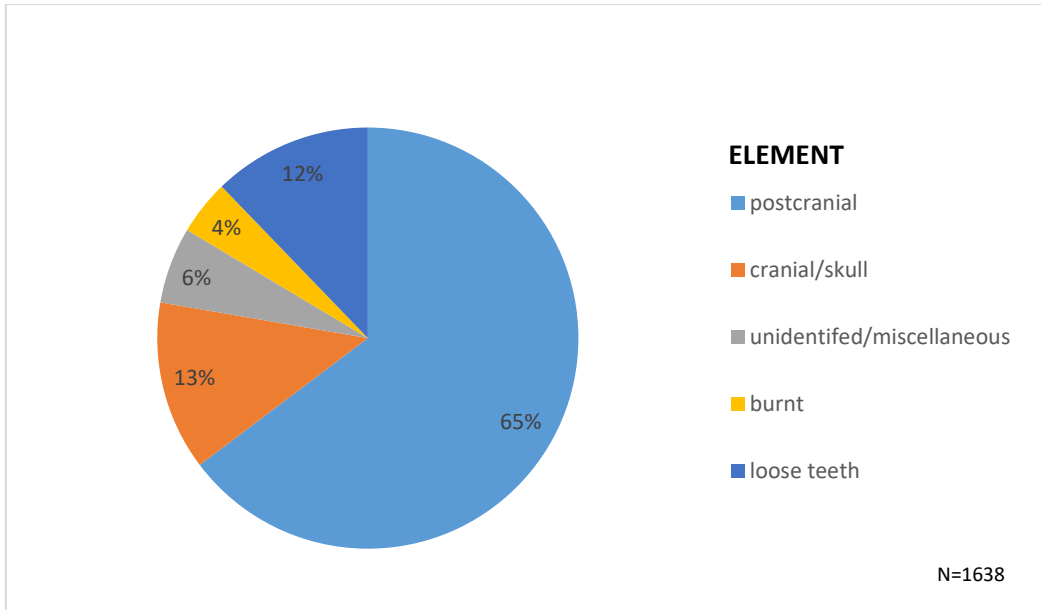


Figure 52. Element frequencies across sites (including loose teeth). See 6.2 for including burnt fragments in element category.

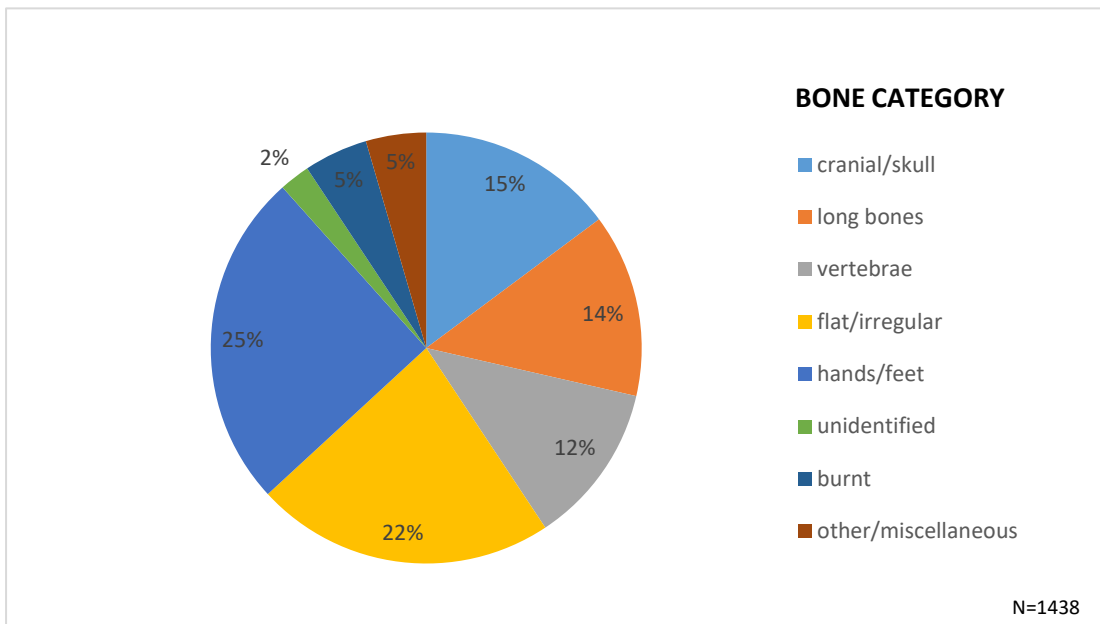


Figure 53. Element frequencies across sites based on bone category (excluding loose teeth). See 6.2 for including burnt fragments in bone category.

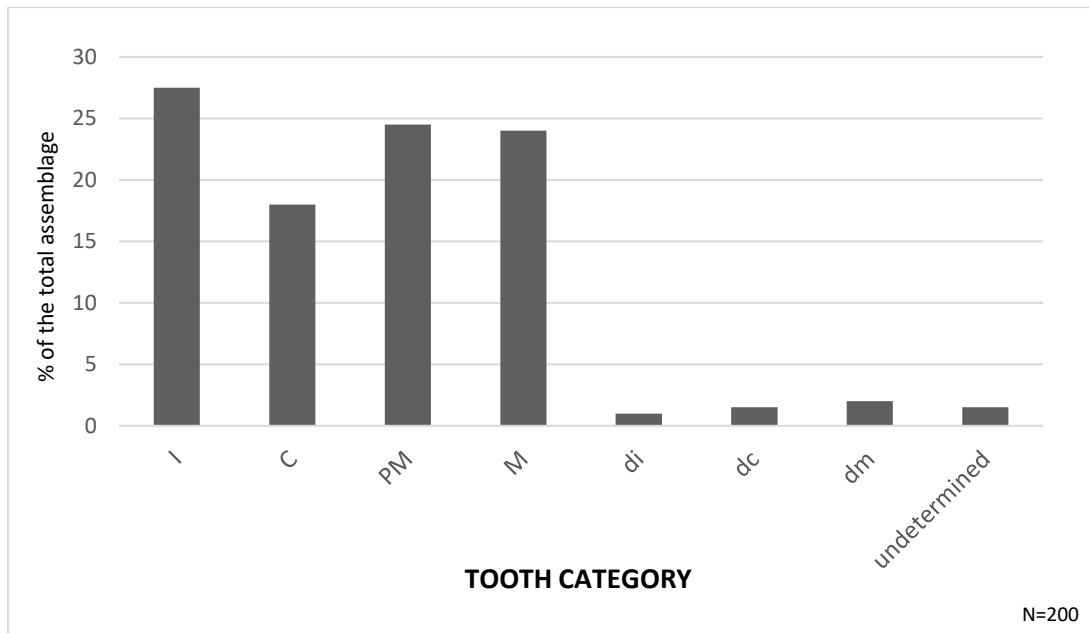


Figure 54. Frequency of loose teeth recorded across sites – I= incisor, C= canine, PM= premolar, M= molar, di= deciduous incisor, dc= deciduous canine, dm= deciduous molar, undetermined/ (N=3) = unidentifiable resulting from digestion (from Spurge Hole).

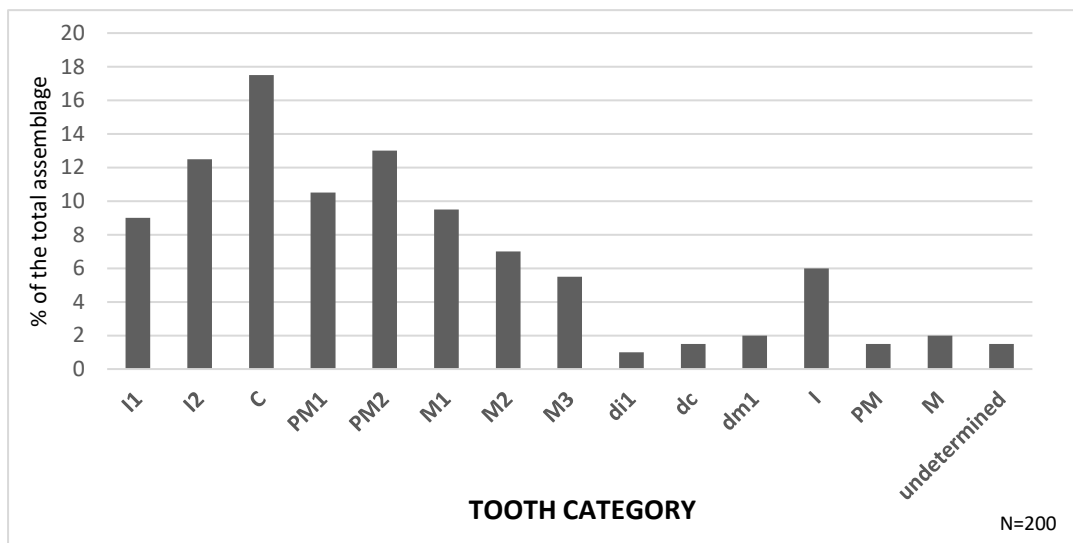


Figure 55. Frequency of loose teeth recorded across sites further sub-divided. I1= 1<sup>st</sup> incisor, I2= 2<sup>nd</sup> incisor, C= canine, PM1= 1<sup>st</sup> premolar, PM2= 2<sup>nd</sup> premolar, M1= 1<sup>st</sup> molar, M2= 2<sup>nd</sup> molar, M3= 3<sup>rd</sup> molar, di1= deciduous 1<sup>st</sup> incisor, dc= deciduous canine, dm1= deciduous 1<sup>st</sup> molar, I= incisor, PM= premolar, M= molar. I (N=12), PM (N=3) and M (N=4): no identification of exact tooth. Undermined (N=3): unidentifiable resulting from digestion (Spurge Hole).

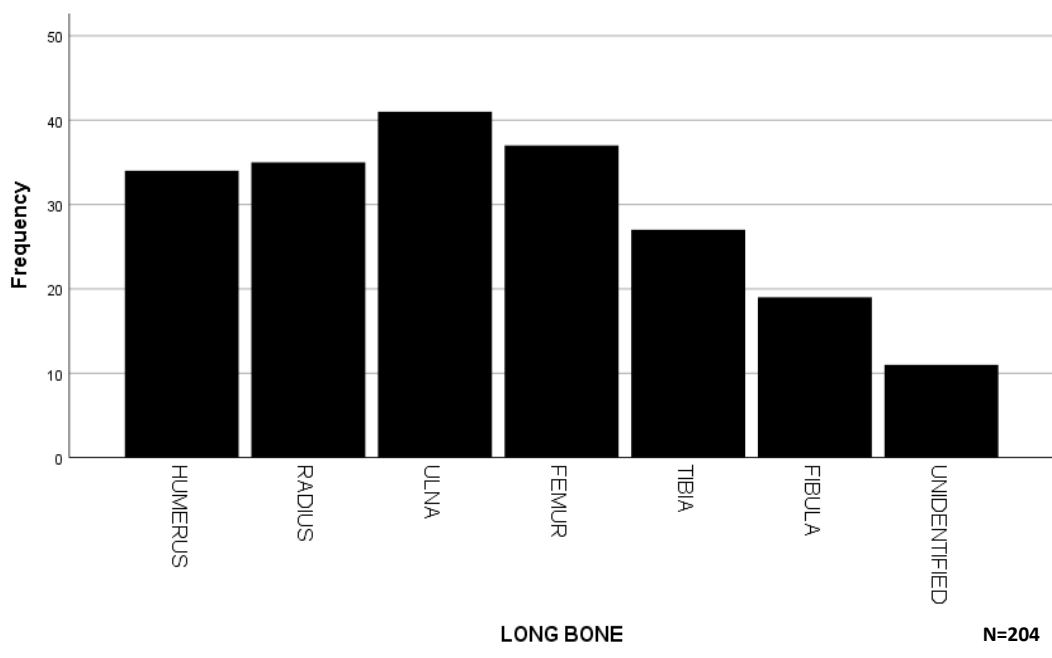


Figure 56. Frequencies of long bones examined based on shaft and/or epiphysis zone survival across sites. UNIDENTIFIED= shaft or epiphysis.

### Element completeness<sup>103</sup>

The vast majority of disarticulated remains (N=1428) were highly fragmented/not complete (N=1223, 85%) with only 14.3% complete (N=206) (Figure 57). Unknown level of completeness (0.6%, N=9) was limited to one site (Little Orme's Head Quarry) where primary analysis did not take place (see Chapter 5/5.1.3)<sup>104</sup>. The high proportion of fragmented/poorly preserved remains was anticipated (Figures 58-59) as caves are susceptible to a range of environmental factors, human and animal activity (see Chapter 4/4.4)<sup>105</sup>.

Different treatment could have been responsible for fluctuations in surface preservation between poorly preserved/fragmented (27.9% scoring 0) (Figures 58-59) and most complete elements. This pattern suggests different modes of deposition (e.g. selected

<sup>103</sup> State of remains (see Chapter 4/4.2.1). Complete=all zones present; Not complete= fragmented, no complete zone representation

<sup>104</sup> This is limited to 9 out of 51 elements recorded for this site (secondary data). Descriptions and a sketch of the elements discovered in the fissure (see Appendix 5) were provided in the skeleton inventory; this information was used to compile preserved zones on most elements for the purposes of this research.

<sup>105</sup> See Appendix 6/6.2. Results across sites/Element completeness for further examination of complete remains cross-referenced with other taphonomic modifications.



depositions, secondary burials) resulting in distinct preservation of human remains in caves.

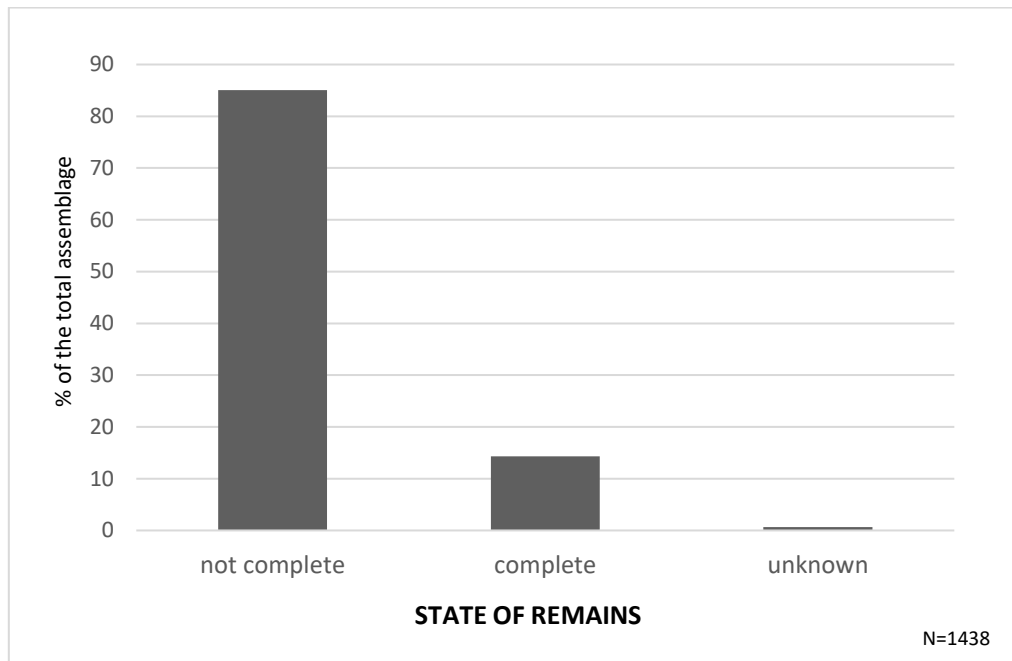


Figure 57. Percentages of complete, not complete/fragmented and unknown elements across sites (excluding loose teeth).

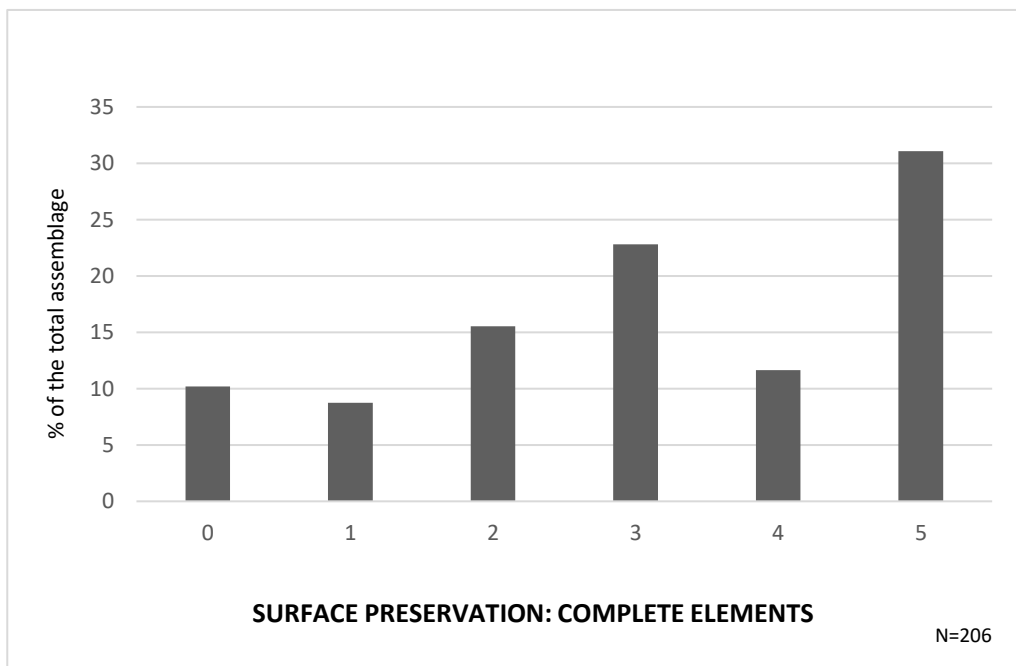


Figure 58. Surface preservation of complete elements across sites (0=poor – 5=good)

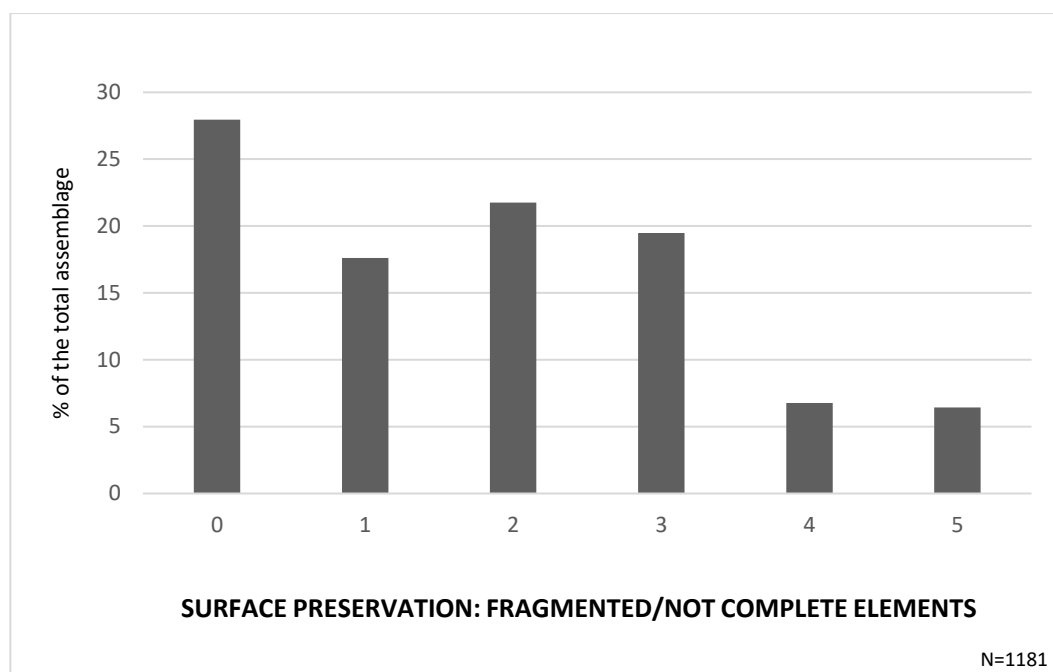


Figure 59. Surface preservation of incomplete/fragmented elements across sites (0=poor – 5=good).

### **MNI, demography and pathology<sup>106</sup>**

MNI, age and sex estimations are presented in Table 21. Immature individuals included perinates, juveniles and adolescents. Age estimations, duplicated elements and/or available radiocarbon dates are used to determine MNI in each site and therefore period of burial activity is also provided in Table 21. Where age-related differences are dominant, compared to element duplicates, they are used to determine MNI estimations. More details for MNI and demographic information (case studies) can be found in Chapter 7. Age, sex and chronology are used to establish whether demographic or chronological patterns relate to variation in practices across Wales and north Somerset (see Chapter 8).

Adults were the dominant age group (N=42) including younger adults (N=9) (c.17/18-25 years). Juveniles (N=11) and adolescents (N=5) comprised a lower proportion of the total assemblage (Figure 60). Perinate remains (N=3) were recorded in three sites

<sup>106</sup> See Appendix 6/6.2. Results across sites/MNI, demography and pathology for more details and Chapter 4 for MNI and age/sex estimations.

(Orchid Cave, George Rock Shelter and Ogof Pant-y-Wennol) and were well-preserved.

Sex estimations were provided where possible. Probable females (N=11) were mostly identified across sites followed by probable males (N=8), females (N=5) and males (N=4) (Figure 61). Identification was based on individual elements and can be found in Appendix 6/6.2 (MNI, demography and pathology).

SITE	MNI		SEX	PERIOD OF BURIAL ACTIVITY			
	ADULTS	IMMATURE INDIVIDUALS		EARLY NEOLITHIC	MIDDLE NEOLITHIC	LATE NEOLITHIC	OTHER PERIOD (EARLIER OF LATER USE)
Cathole Cave	2 adults (femur – fusion of epiphysis and based on secondary data) <sup>107</sup>				x		
Spurge Hole	2 adults (femora – fusion of epiphyses)	1 juvenile (deciduous tooth)	M? (pelvis)/ F (pelvis)	x	x (Middle/ Late Neolithic)		
Red Fescue Hole	1 adult (femur epiphysis)				x		
George Rock Shelter <sup>108</sup>	3 (1 post-Medieval) (calcanei) – element duplicates	3 [1 perinate (rib growth), 1 juvenile (iliac crest/epiphyseal fusion), 1 adolescent (ulna epiphysis)]		x			x (post-Medieval)
Ifton Quarry	5 adults (crania, loose frontal)	2 juveniles (loose occipital, loose parietal)	M? (frontal)/ M? (cranium)/ F? (cranium)/		x	x	

<sup>107</sup> Only three elements were held in National Museum Wales. MNI determinations were based on analysis by Schulting 2020: 24 (see Chapter 5/5.1.3).

<sup>108</sup> Plus one possible cremated individual (total MNI: 7+).

			F? (cranium)/ F (cranium) - c.35-45 years				
Little Hoyle Cave	10 adults (mandibulae – element duplicates and dental attrition) c.17-25 to 35-45 years	1 juvenile (mandible - tooth eruption) c.9-10 years	M (mandible)/ M? (mandible)/ M? (mandible)/ M? (mandible)/ F (cranium)/ F?(mandible)/ F? (frontal)/ F? (mandible)	x	x		
Nanna's Cave	3 (1 Mesolithic – calcaneus; 2 Neolithic – femur, patella) <sup>109</sup>	1 juvenile (maxilla – deciduous tooth) c.9+ years			x		x (Mesolithic)
Hoyle's Mouth Cave	2 adults (radii – fusion of epiphysis)	1 adolescent (radial epiphysis)				x (Late Neolithic/Early Bronze Age)	borderline
Ogof-yr-Benglog	1 adult (vertebra)				x		

<sup>109</sup> All radiocarbon dated.

Priory Farm Cave	4 (duplicates - mandibulae upper M3, loose upper M3 - 3 individuals c.17-25 years, mandible c.45+ years) <sup>110</sup>	1 juvenile (maxilla - dental eruption) c/9-10 years	M (cranium)/ F? (mandible)		x		x (Late Bronze Age and Middle/Late Iron Age)
Cae Gronw Cave	2 adults (radius – fusion of epiphysis, pelvis – fused) <sup>111</sup>			x		x	
Ogof Colomendy	4 (long bones – fusion of epiphyses, clavicle representation) c.17-25 to 35-45 years	1 (humerus – fusing and pelvis – iliac crest unfused/adolescent or younger adult) <sup>112</sup> c.15+ years	F? (cranium)		x (Middle to Late Neolithic)	x	x (Early/Middle Bronze Age)
Orchid Cave	2 adults (humeri – fused epiphyses) c.17-25 to 25-35 years	2 (1 adolescent – humerus – fusing epiphysis c.15+ years, 1 perinate – pelvis/ os coxa growth)	M (pelvis)/ M? (mandible)/ M? (mandible)			x (Late Neolithic/Early BA)	borderline

<sup>110</sup> Three radiocarbon dated (see Appendix 1/Sheet 1/Site list).

<sup>111</sup> Both radiocarbon dated (Late Neolithic radius and Early Neolithic pelvis).

<sup>112</sup> Radiocarbon dated individuals (Early/Middle Neolithic).

Pontnewydd Cave	2 (metatarsal, vertebra and secondary data) <sup>113</sup>	1 juvenile (mandible – tooth eruption) c.11-12 years			x		x (Mesolithic)
Gop Cave	3+ adults (mandibulae – element representation and dental attrition) c.17-25 to 35-45 years	1 juvenile (mandible – dental attrition) c.7-10 years	M? (mandible)/ F? (mandible) F? (frontal/fragment) <sup>114</sup>		x (Middle to Late)	x	
Little Orme's Head Quarry	1 adult (element representation/long bone – fused epiphyses, pelvis) c.54-63 years from secondary data) <sup>115</sup>		F (pelvis)	x (Early/Middle Neolithic)			
Ogof Pant-y-Wennol	2 adults (occipital, parietal) <sup>116</sup> (pelvis) c.55+ years (pelvis) c.35-38 years	3 [1 adolescent/younger adult (tibia fusing) c.17 years, 1 juvenile (unfused tibia) c.6-8+	M? (cranium) F (pelvis)/ F? (occipital)/ F? (temporal) <sup>117</sup>	x	x		

<sup>113</sup> Two radiocarbon dates available, originally 5+ individuals (see Appendix 1/Sheet 1/Sites and Chapter 5/5.1.3).

<sup>114</sup> All radiocarbon dated (Middle Neolithic).

<sup>115</sup> See Chapter 5/5.1.3.

<sup>116</sup> Both radiocarbon dated to the Early Neolithic.

<sup>117</sup> Occipital and temporal from different contexts/squares (see Appendix 1/Sheet 2/Coding).

		years, 1 perinate (tibia growth)]					
Ogof Brân Goesgoch	1 adult (metatarsal)	1 adolescent (metacarpal)				x (Beaker)	
Pitton Cliff Cave	1 adult (calcaneus)			x			
Ogof Garreg Hir		1 ?juvenile/adolescent (ulna and calcaneus unfused)		x			
Backwell Cave (no primary analysis) <sup>118</sup>	c.15+ adults (secondary data)	?3 juveniles (secondary data)		x	x		

Table 21. MNI, age (adults/immature individuals) and sex estimations (M=male, M?= probable male, F= female, F?= probable female) across all sites examined in this research and period of activity based on radiocarbon dates. Age and/or sex assignments based on element are included for clarification.

<sup>118</sup> See Appendix 1/Sheet 1/Site list.



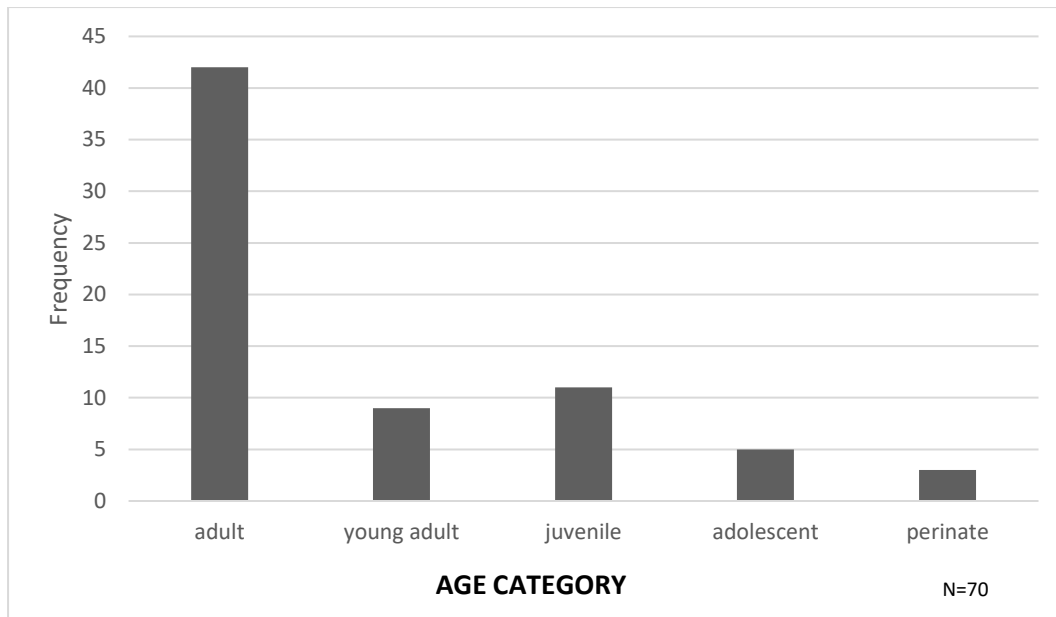


Figure 60. Frequencies of age distributions across sites (including Little Orme's Head Quarry) based on MNI. Younger adult category was included due to prevalence of adolescents/younger adults in several sites (c.17-22/25 years).

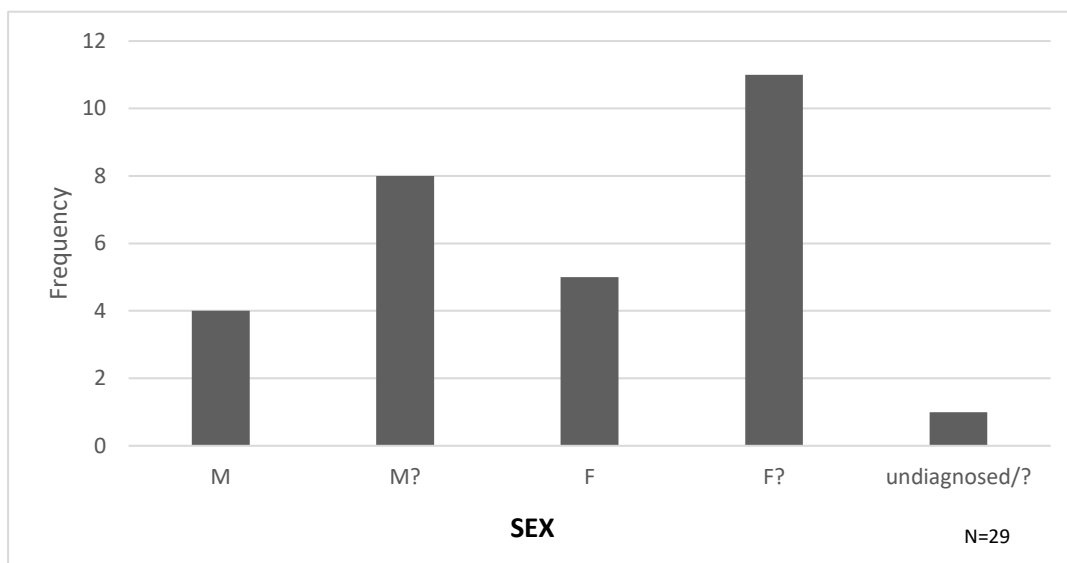


Figure 61. Frequencies of sex distributions across sites. M=male, M?= probable male, F= female, F?= probable female, undiagnosed/?= unknown sex

## Pathology

Evidence of pathology (or degenerative or dental) was observed on 3.8% of elements (N=55). Degenerative changes were recorded in 65.5% of the affected elements (N=36), with most noted in Little Orme's Head Quarry (N=27)<sup>119</sup>, Little Hoyle Cave (N=4), Orchid Cave (N=3) and Ifton Quarry (N=2) (Figure 62). Sites with larger assemblages and/or better surface preservation did not exhibit signs of degenerative pathology which suggests that they might not have affected early prehistoric populations in the study area.



Figure 62. Periostitis on rib (Orchid Cave). Source: author

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<sup>119</sup> See Appendix 6/6.2. Results across sites/MNI, demography and pathology for details on the single individual from Little Orme's Head Quarry that exhibited all degenerative changes.

Dental pathologies (34.5%/N=19 of the 55) included caries, calculus, periapical cavities, abscesses, ante-mortem tooth loss and periodontal disease (Figure 63). Affected teeth were still in the alveolar sockets on mandibulae/maxillae from Priory Farm Cave (N=3), Little Hoyle Cave (N=6), Ifton Quarry (N=2), Orchid Cave (N=2) Gop Cave (N=1) and Ogof Colomendy (N=5)<sup>120</sup>. Results suggest the early prehistoric populations were most often affected by dental pathologies than degenerative pathologies across sites (Figure 65). No patterns were identified across sites or on a regional and individual sites.



Figure 63. Dental pathologies – **A**: calculus on molar still attached on maxilla (Ifton Quarry), **B**: Abscess in alveoli of first molar (Little Hoyle Cave) and **C**: caries on canine (Ogof Colomendy). Source: author

<sup>120</sup> See Appendix 6/6.2. Results across sites/MNI, demography and pathology/Figure 64 for more information on dental pathologies.

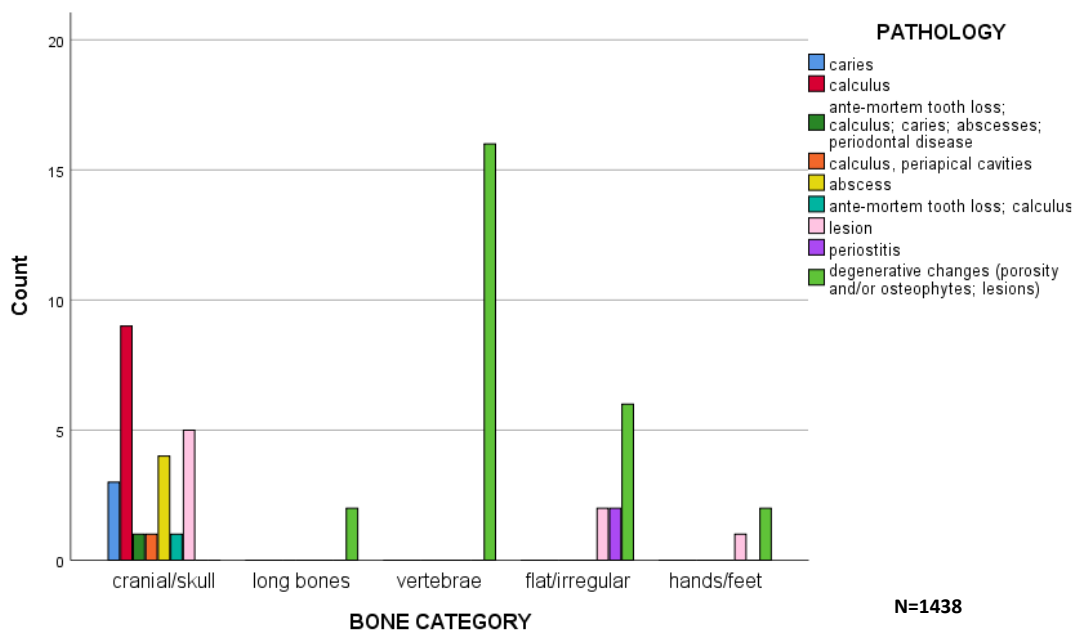


Figure 65. Pathologies identified across sites based on bone category (including Little Orme’s Head’s Quarry).

## 6.2.1. Taphonomy – Macroscopic results

### 6.2.1.1. Weathering

Evidence of weathering was observed on 114 elements (8.2%) of the total assemblage with 78.9% (N=90) reaching weathering stage 1 (Figures 66, 67). Absence of weathering in subterranean contexts was anticipated (see Chapter 4/4.5.1) however, advanced weathering on certain elements suggests these were involved in multi-stage burials (excarnation, circulation and secondary burial). Few elements reached weathering stage three (N=9) with a single element reaching stage four (Figure 68).

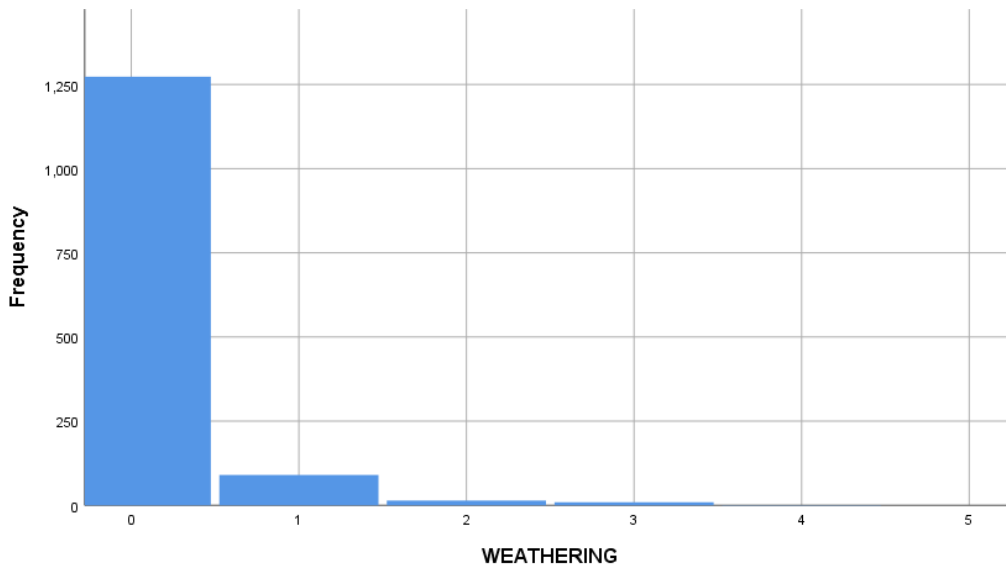


Figure 66. Weathering scores 0 to 5 (0= no weathering). N= excluding human remains from Little Orme's Head quarry (no primary analysis). N=1387.

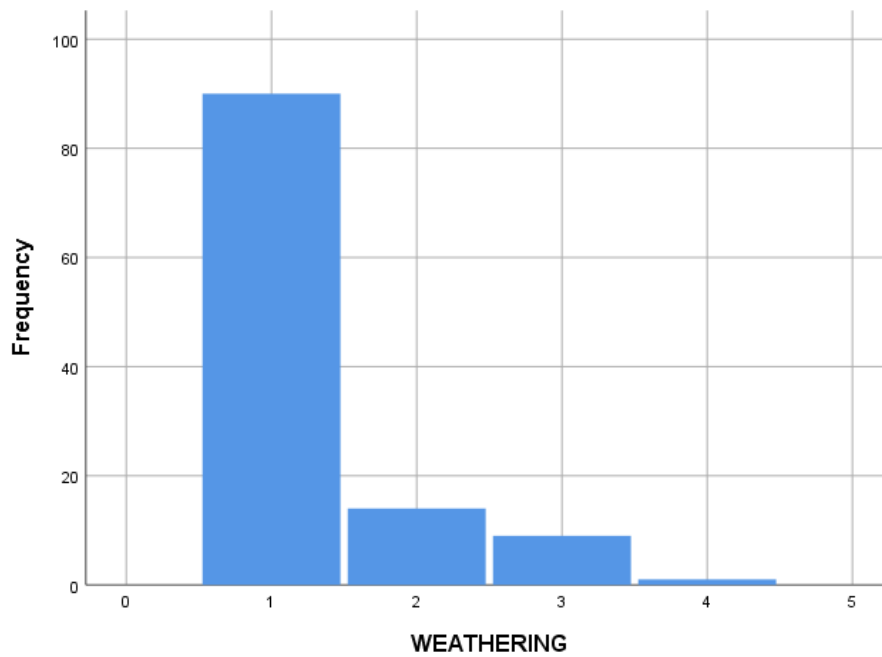


Figure 67. Weathering stages 1-5. N= 114 (includes only weathered remains)



Figure 68. Weathering – A: stage 3 (femur – Ogof Pant-y-Wennol) and B: stage 4 (humerus – Ogof Pant-y-Wennol). Source: author

Whereas higher weathering scores were rarely recorded, they might reflect different treatment between the individuals. Long bones exhibited the most weathering (N=34, 29.8%) followed by flat/irregular bones (N=28, 24.6%) and cranial/skull remains (N=27, 23.7%) (Figure 69). Weathering stage one was the most frequent score amongst all weathered bone categories (Figure 70 and Tables 22-24 in Appendix 6)<sup>121</sup>.

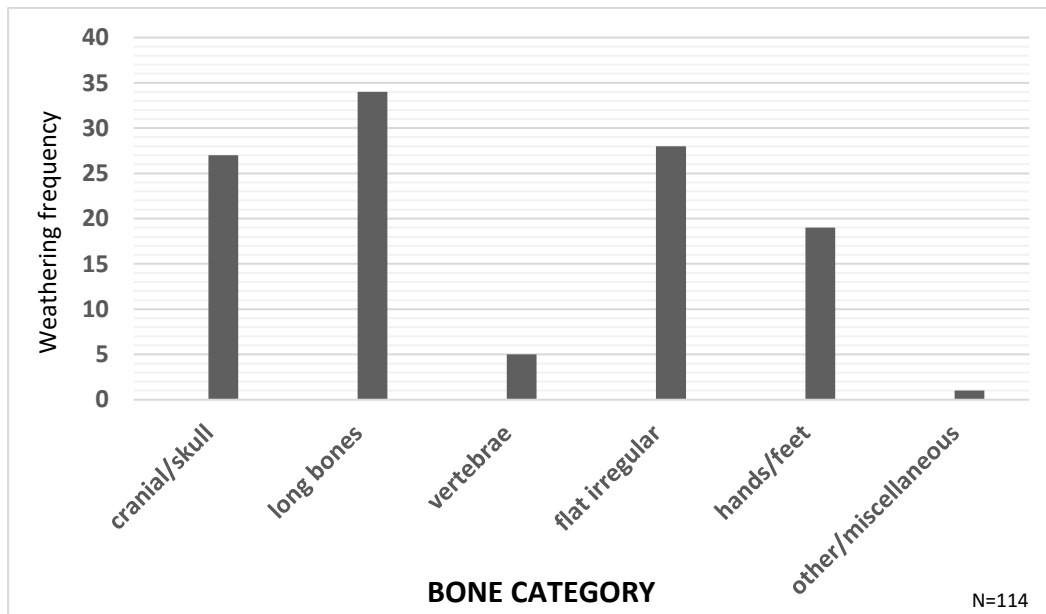


Figure 69. Weathering (presence) - overall frequencies based on bone type across sites.

<sup>121</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results /Weathering for more details and Tables 22-24 for cross-referenced modifications.

### 6.2.1.2. Gnawing

Gnawing was very scarce across sites (N=74, 5.3%). Gnawing marks were located on epiphysis but also diaphysis sometimes creating a ‘windowing’ effect on phalanges and included both rodent and canid gnawing (Figure 70). Gnawing was easily identified on elements, mainly long bones (N=47) and hands/feet (N=20) (Figure 71), from a number of sites with highest numbers observed in Ogof Colomendy and Gop Cave.

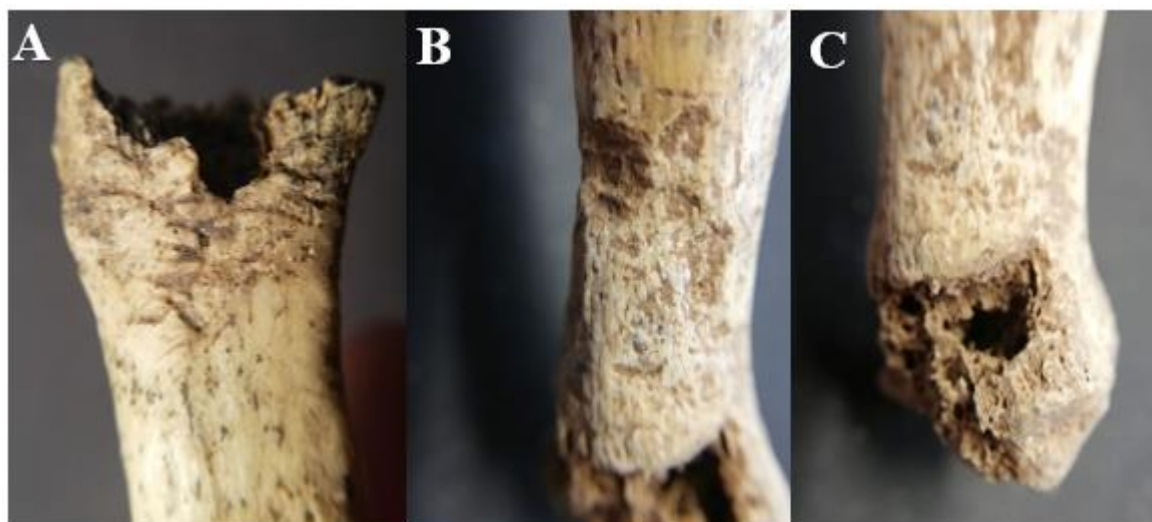


Figure 70. Gnawing – **A:** metatarsal (Hoyle’s Mouth Cave), **B:** metacarpal (Little Hoyle Cave) and **C:** metacarpal (Little Hoyle Cave).

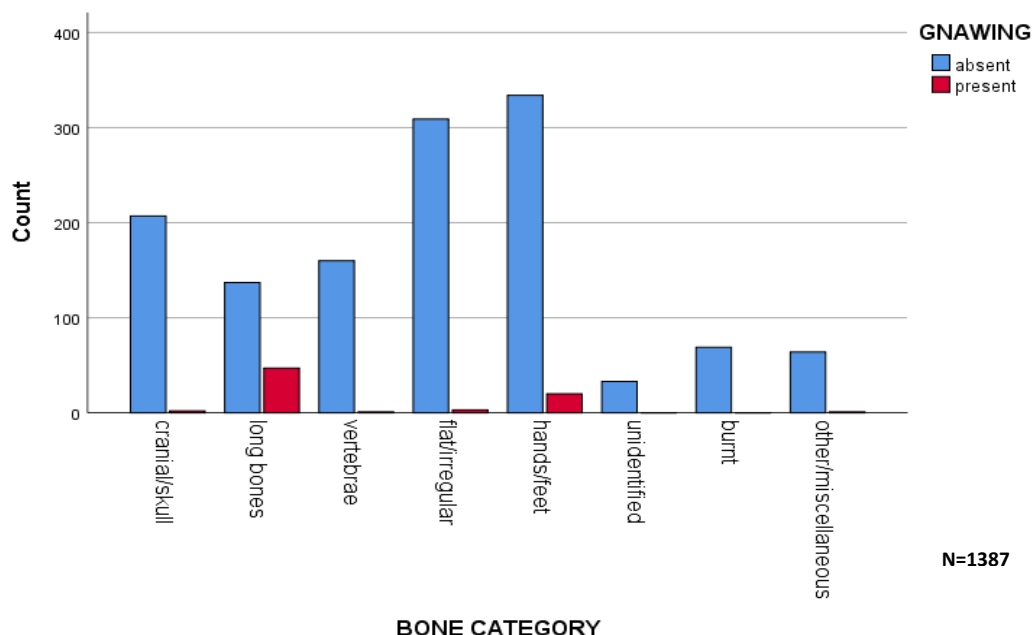


Figure 71. Gnawing presence/absence based on bone category. N=excluding Little Orme’s Head Quarry (no primary analysis).

Insect wear included small perforations, some of which resembled circular root perforations and must therefore be considered with caution (N=20) (Figure 72). Evidence of insect wear did not impact the overall preservation of the bone, was identified in rather small areas and was not extensively encountered across sites. No further examination was therefore considered necessary.



Figure 72. Insect wear on tibia (Ogof Colomendy). Source: author

Weathering was not recorded on many gnawed elements (N=9) and evidence of trauma was only identified on a single gnawed element from Ogof Colomendy. Absence of weathering and sharp force trauma/defleshing marks on gnawed elements could suggest that if sub-aerial exposure did occur, it might have not been followed by prolonged exposure of the disarticulated remains (low prevalence of weathering) and cannot be associated with human inflicted trauma (e.g. dismemberment/defleshing).

#### 6.2.1.3. Erosion (rough surface texture and/or root etching)

Erosion was present on more than half of the total bone assemblage (N=814, 56.6%), mainly on flat/irregular bones (N=227) and hands/feet (N=202) (Figure 73). Half of the loose teeth (N=100) also exhibited signs of erosion/root etching.

Root etching was the main erosive modification in the form of multi-directional dendritic grooves and branches sometimes accompanied by slight root staining (Figure 74). Brown or black (manganese or mould) staining was noted on a very high number



of eroded/root etched elements (N=436)<sup>122</sup>. Root etching severely affected the surface preservation on a number of elements with the highest percentage of eroded remains scoring 0-3 surface preservation (Figure 75).

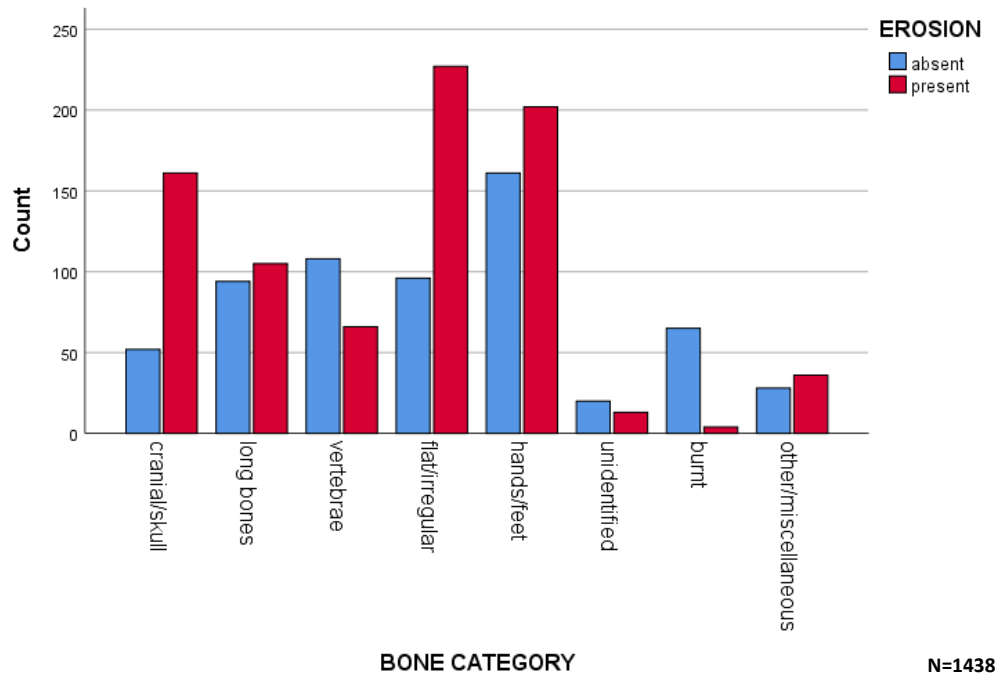


Figure 73. Frequency of erosion presence/absence based on bone category. N=including Little Orme's Head Quarry (secondary data/evidence of erosion).



Figure 74. Root etching on cranial fragment (Little Hoyle Cave). Source: author

<sup>122</sup> Total N for correlation, excluding Little Orme's Head Quarry (secondary data/evidence of staining unknown)

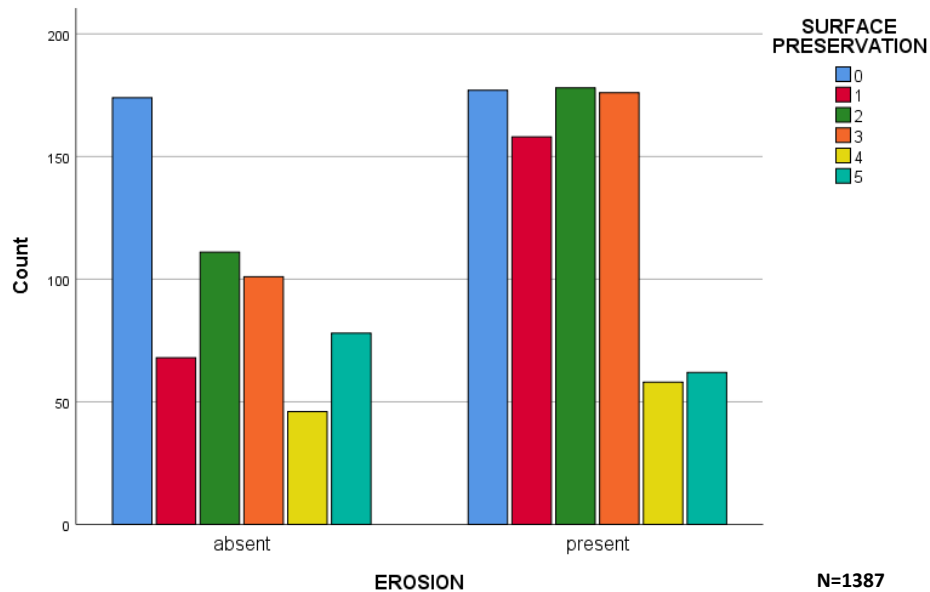


Figure 75. Frequency of surface preservation on eroded/non-eroded remains. N=excluding Little Orme’s Head Quarry (no primary analysis/surface preservation unknown).

#### 6.2.1.4. Abrasion

Abrasion was present on less than half of the total assemblage (N=403, 29.1%) and was mainly recorded on bones of the hands/feet (N=150) (76). The vast majority of disarticulated remains across sites exhibited a glossy appearance (polishing)<sup>123</sup>. Abraded elements were not severely impacted by other taphonomic modifications. Most taphonomic modifications were recorded on abraded hands/feet<sup>124</sup>. Eroded hands/feet (N=89), flat/irregular bones (N=62) and cranial/skull remains (N=54) often demonstrated polishing/shinning on their surface (N=62) (Table 25/Appendix 6)<sup>125</sup> however no pattern between erosion and abrasion was observed.

<sup>123</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results/Abrasion for more details.

<sup>124</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results/Abrasion for more details on cross-referenced taphonomy.

<sup>125</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results/Abrasion for more details.

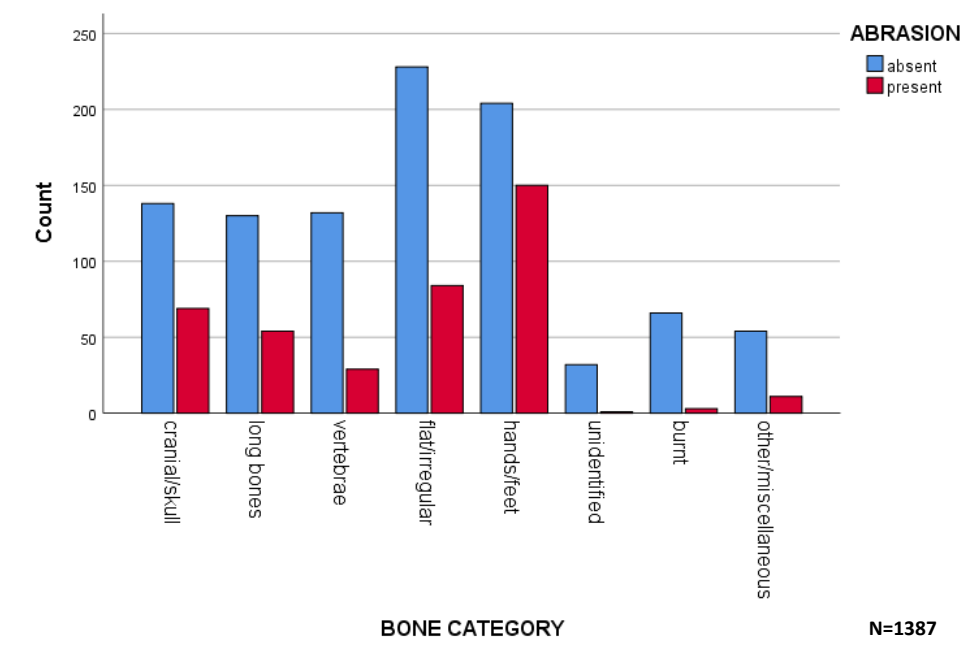


Figure 76. Frequency of abrasion presence/absence based on bone category. N=excluding Little Orme’s Head Quarry (no primary analysis/abrasion indication unknown).

#### 6.2.1.5. Staining

Staining was noted on almost half of the total assemblage (N=671, 48.4%) and primarily on flat/irregular bones (N=177) and hands/feet (N=171) (Figure 77). Staining was further recorded on 26 loose teeth. Taphonomic modifications on stained elements across sites did not indicate any patterns (Tables 28-30/Appendix 6)<sup>126</sup>.

<sup>126</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results /Staining for more details on taphonomy.

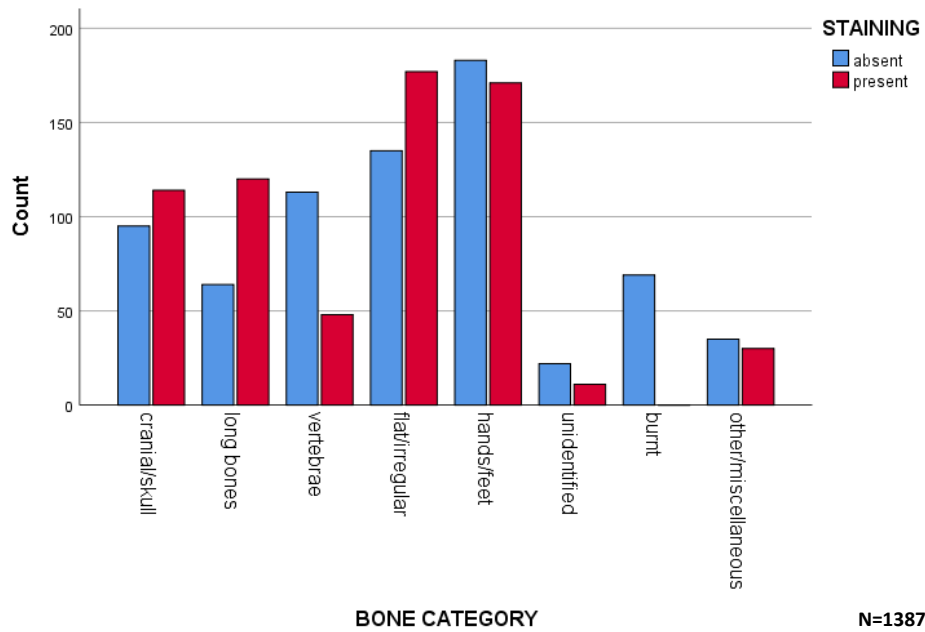


Figure 77. Frequency of staining presence/absence based on bone category. N=excluding Little Orme's Head Quarry (no primary analysis/staining indication unknown).

Stains were mostly black and brown with some elements exhibiting small red (N=11)<sup>127</sup> (pink and orange/red to brown and black/red), green (N=2) or purple (N=2) patches. Black mould/manganese marks were widely encountered across sites, either covering a portion of the bone or dispersed on the whole surface of the bone (Figure 78). Grey/white stains were noted on a number of elements (N=232) across 12 sites. These must have resulted from concretion (residues) in the caves (natural limestone) which was also noted on loose teeth from several sites. Purple stains included faded marks and were recorded on a single patella and a distal phalanx from Ogof Colomendy.

<sup>127</sup> N=including 2 loose teeth



Figure 78. Staining on scapula (Ogof Pant-y-Wennol).  
Source: author

#### 6.2.1.6. Trauma (*sharp/blunt force*)

Evidence of trauma was present on a very low number of elements (N=8). There was sharp and blunt force trauma (cutmarks, healed fracture, blunt fracture, scraping marks) on two crania and sharp force trauma (cutmarks, percussion marks) on one cranium and four long bones.

Crania that exhibited both sharp and blunt force trauma (Ifton Quarry) were relatively well preserved (score 3-4) whilst those displaying only sharp force trauma, scored lower (surface preservation 0-3).

#### 6.2.1.7. Burning

Burning was recorded on 70 small fragments (67 from George Rock Shelter and three from Ogof Colomendy). The vast majority were unidentifiable to element (N=61) with only eight burnt cranial fragments and one burnt triquetral recorded. A range of stages were present and fragments showed different burning stages (see Chapter 5/5.3.9) as shown in Table 31 and will be examined on an individual basis (case studies). Evidence of erosion was identified on five burnt fragments from George Rock Shelter with a very large proportion of remains recovered from this site had been severely eroded. Cranial fragments from Ogof Colomendy reached burning stages four to five and were slightly cracked and calcined (N=1) with a grey colour covering the whole cortex.

BURNING														
NO BU SEQ (TOTAL)		BU SEQ –MIN AND MAX STAGE											BU SEQ TOTAL	TOTAL (BURNT)
MAX BU		0-2	0-3	0-4	0-5	1-4	1-5	2-3	2-5	3-4	3-5	4-5		
1	3													3
2		1											1	1
3	4		3					4					7	11
4	15			3		1				11			15	30
5	8				1		1		2		4	9	17	25
TOTAL (BURNT)	30	1	3	3	1	1	1	4	2	11	4	9	40	BU N=70

Table 31. Evidence of burning – MAX BU= maximum burning stage; NO BU SEQ= no burning sequence (fragments reached their maximum burning stage); BU SEQ Min to Max= fragments exhibiting different burning stages. Minimum and maximum stages indicated here. BU SEQ Total=total of burned elements with different burning stages. N=70 burnt (Total N=1387), excluding Little Orme’s Head Quarry (no primary analysis/evidence of burning unknown).

#### 6.2.1.8. Fractures (fresh vs dry)

Fresh and dry fractures on long bones (N=75) were identified across a range of elements including humeri, radii, femora and tibiae. Fracture patterns identified on proximal and/or distal ends (shafts) included fresh, helical and sharp breaks and/or dry, straight breaks with jagged edges (see Chapter 3/3.5.8) (Figure 79).

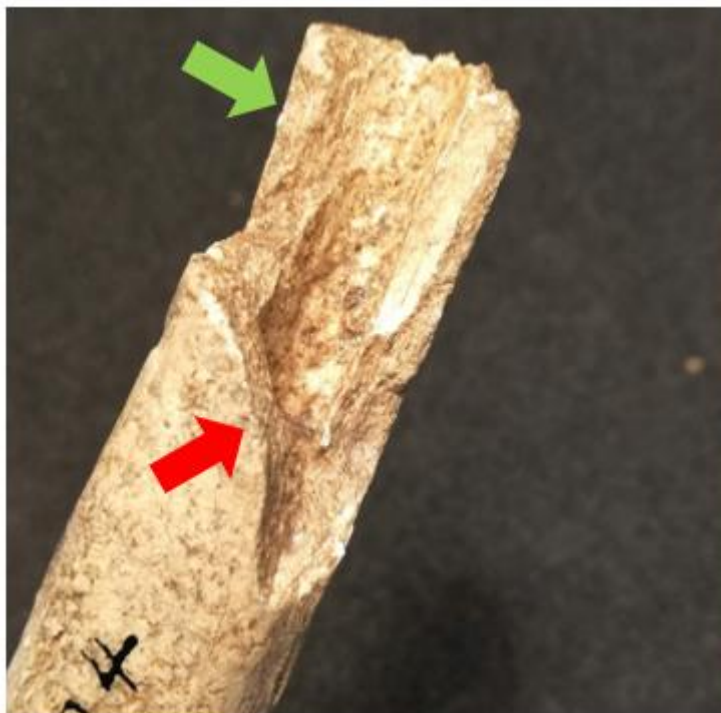


Figure 79. Mixture of fracture morphology – smooth and helical (red arrow), perpendicular (green arrow).

Fractures on proximal and distal ends (N=15) were first treated as different entries to identify fracture patterns, bringing the total number to 90 fractures. Dry fractures were noted on 54% (N=49) and fresh on 45% (N= 41) of the assemblage. Scores 2 (fresh break) and 6 (dry/mineralised break) were equally recorded (N=17, 18% for each) followed by values ranging 3-5 (N=16, 17% for each) and 0-1 (N=2, 2% and 6, 6% respectively) (Figure 80).

Evidence of weathering that could suggest deliberate peri-mortem manipulation and exposure prior to deposition on fresh breaks was apparent on three elements (Table 32/Appendix 6). In particular, one humerus (SNO: 1196/Ogof Pant-y-Wennol) with a fresh break (FFI score 2) reached weathering stage 4. Gnawing was apparent on a low

number of long bones (N=19) exhibiting both dry and fresh breaks in approximately equal numbers with the vast majority (N=16) deriving from Ogof Colomendy<sup>128</sup>. Fresh breaks (N=13) with signs of weathering (stages 1-4) were identified in the total assemblage (Table 32/Appendix 6) suggesting selection of elements with weathering stages 3-4 for sub-aerial. Gnawing on the other hand was primarily recorded on non-weathered fractured (dry) long bones (Table 33/Appendix 6)<sup>129</sup>.

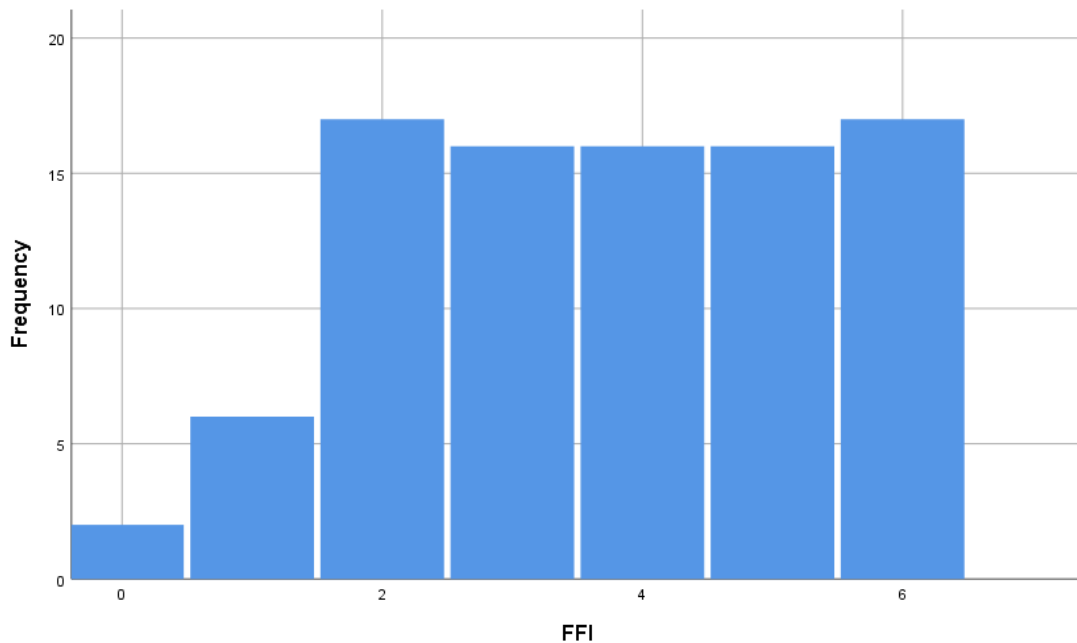


Figure 80. Total FFI (Fracture Freshness Index) scores across sites. N= 90 (double entries for fractures identified in both proximal and distal ends).

#### 6.2.1.9. Surface preservation

The majority of human remains across sites (N=1387) demonstrated very poor surface preservation (score 0/N=351, 25.3%) followed by poor to medium scores (2-3/N=289 and N=277, 20.8% and 20% respectively). Unidentified burnt fragments and vertebrae were the elements most highly affected (lowest preservation) (Figure 81). Flat/irregular bones also scored low on the scale (1-2) followed by hands/feet that demonstrated better surface preservation (3-4).

<sup>128</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results /Fractures (fresh vs dry) for more details.

<sup>129</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results/Fractures (fresh vs dry)/Table 33 for more details.



The highest surface preservation score (5) (N=140, 10.1%) was primarily identified on bones of the hands/feet. As mentioned in Chapter 4/4.3.4, surface preservation scores were given based on overall impact modification (Table 34/Appendix 6)<sup>130</sup>. Taphonomic modifications can severely alter the bone (especially less dense bone) and mask other modifications (i.e. taphonomic overprinting) (see Chapter 3/3.4).

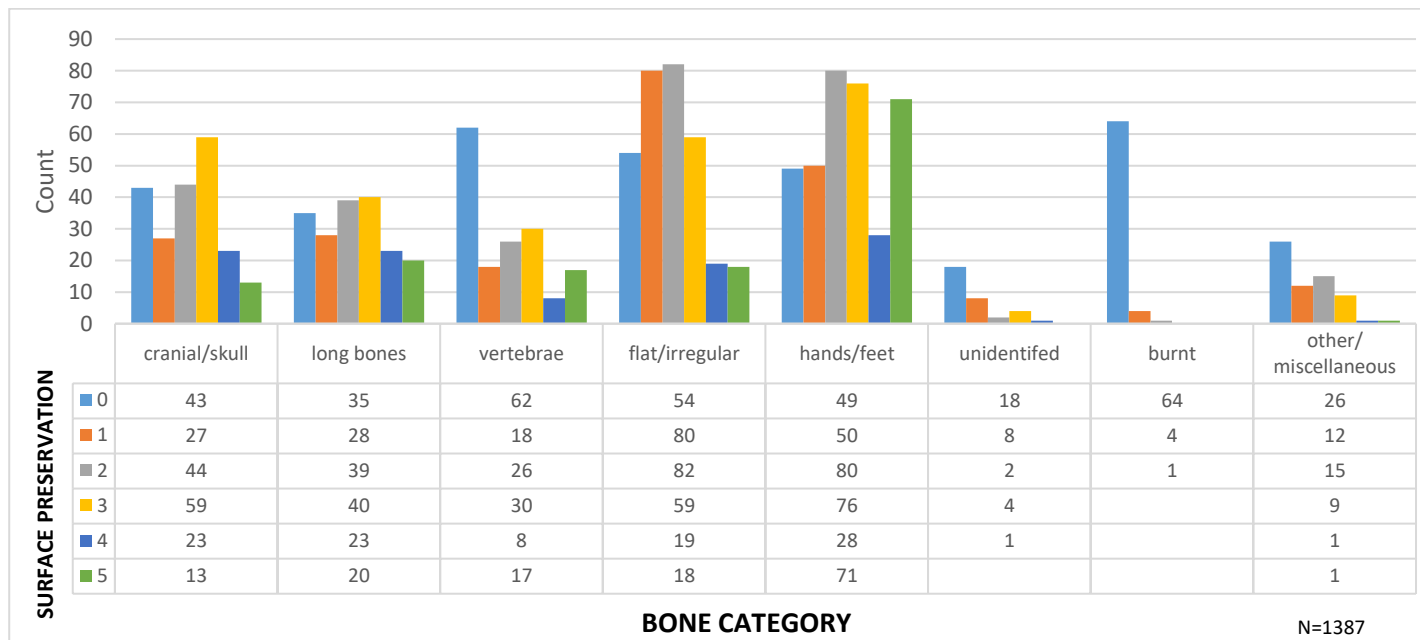


Figure 81. Frequencies of surface preservation scores across sites divided by bone category. N=excluding Little Orme's Head Quarry/unknown surface preservation (no primary analysis) (0-5/poor-good).

<sup>130</sup> See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results /Surface preservation and Tables 34-39 for details on taphonomy.

#### 6.2.1.10. Trampling

Evidence of trampling was recorded on seven elements across sites (0.4%) including three cranial fragments (SNOs: 128, 327 and 1276), a single rib (SNO: 1354) and three foot bones (talus, MT1 and distal foot phalanx) (SNOs: 591, 497, 827) (Figure 82).

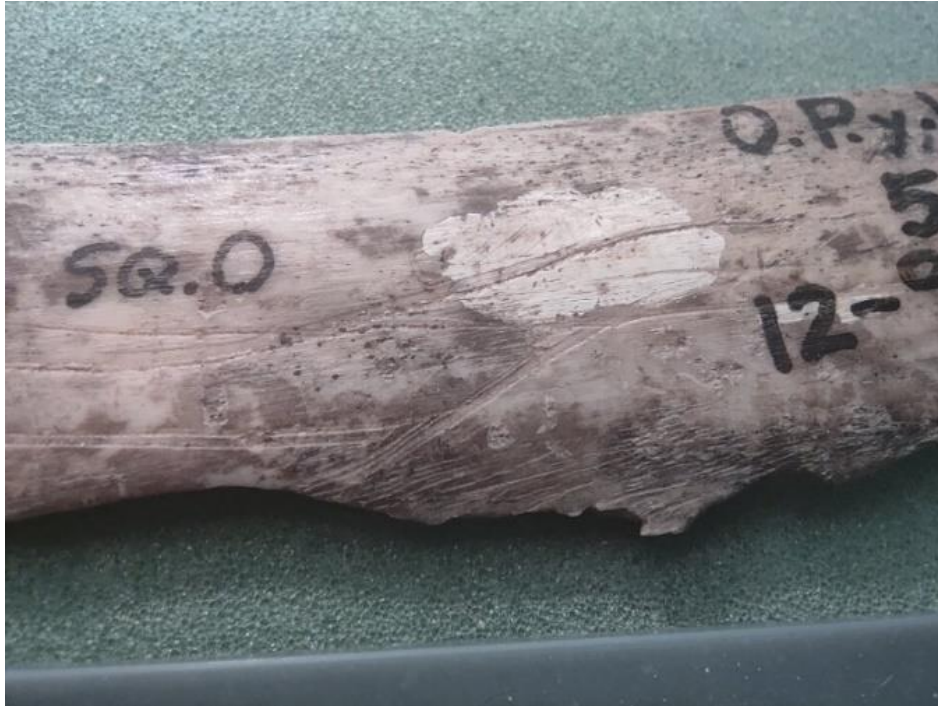


Figure 82. Trampling marks on gnawed rib fragment (Ogof Pant-y-Wennol).  
Source: author

Trampling was identified on smaller, mostly fragmented (N=5) remains with various surface preservation scores (1-3, 5). Trampled elements derived from five sites and no pattern was observed. This process can easily be misidentified and the low prevalence of trampling across sites must be interpreted with caution (see Chapter 5/5.3.7 and Table 40/Appendix 6)<sup>131</sup>.

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<sup>131</sup>See Appendix 6/6.2. Results across sites/ Taphonomy – Macroscopic results/Trampling/Table 40 for details on taphonomy.

### 6.2.2. Microscopic results

This section presents the results of the microscopic analysis undertaken for nine sites across Wales and one comparative case study from north Somerset (Table 41). OHI scores do not show homogeneity which suggests different practices between sites and individuals. Histological destruction of 62 samples (96.8%) resulted from bioerosion with 95% (N=60) destroyed by non-Wedl (bacterial) MFD, one element attacked by non-Wedl and, probable, Wedl (type 2) MFD and one element indicating no bacterial attack. Wedl type 2 MFD (enlarged canaliculi) was observed in a fibula microstructure (Gop Cave/SNO: 35) with high OHI score (4) and evidence of inclusions, infiltrations, fair-brown discolouration in places and microcracking (Figure 83).

Similarly, Wedl type 2 tunnelling was identified in one sample from Backwell Cave (humerus) with medium OHI score (3), inclusions, infiltrations and brown discolouration and microcracking (Figure 84). The enlarged canaliculi might resemble Wedl type 2 MFD due to soil acidity corrosion or the presence of inclusions and microcracking. This pattern did not affect the OHI score and did not destroy the surface of the bone (humerus), therefore, no further examination was pursued.

SITE	SAMPLE NO.	CONTEXT	STATE OF REMAINS	ELEMENT
LITTLE HOYLE CAVE	1	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT (TEMPORAL)
LITTLE HOYLE CAVE	2	NO CONTEXT	NOT COMPLETE	MANDIBLE
LITTLE HOYLE CAVE	3	NO CONTEXT	NOT COMPLETE	MANDIBLE
LITTLE HOYLE CAVE	4	NO CONTEXT	NOT COMPLETE	MANDIBLE
LITTLE HOYLE CAVE	5	NO CONTEXT	NOT COMPLETE	MANDIBLE

LITTLE HOYLE CAVE	6	NO CONTEXT	NOT COMPLETE	MANDIBLE
LITTLE HOYLE CAVE	7	NO CONTEXT	NOT COMPLETE	MANDIBLE
LITTLE HOYLE CAVE	8	NO CONTEXT	NOT COMPLETE	MANDIBLE
LITTLE HOYLE CAVE	9	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT (FRONTAL)
LITTLE HOYLE CAVE	10	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT
LITTLE HOYLE CAVE	11	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT
LITTLE HOYLE CAVE	12	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT
LITTLE HOYLE CAVE	13	NO CONTEXT	NOT COMPLETE	ULNA
LITTLE HOYLE CAVE	14	NO CONTEXT	NOT COMPLETE	FEMUR SHAFT
LITTLE HOYLE CAVE	15	NO CONTEXT	NOT COMPLETE	HUMERUS
LITTLE HOYLE CAVE	16	NO CONTEXT	NOT COMPLETE	ULNA
IFTON QUARRY	17	NO CONTEXT	NOT COMPLETE	HUMERUS
IFTON QUARRY	18	NO CONTEXT	NOT COMPLETE	HUMERUS
IFTON QUARRY	19	NO CONTEXT	NOT COMPLETE	TIBIA SHAFT
IFTON QUARRY	20	NO CONTEXT	NOT COMPLETE	TIBIA SHAFT
IFTON QUARRY	21	NO CONTEXT	NOT COMPLETE	FEMUR
IFTON QUARRY	22	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT (PARIETAL)
OGOF COLOMENDY	23	NO CONTEXT	NOT COMPLETE	FEMUR
SPURGE HOLE	24	NO CONTEXT	NOT COMPLETE	FEMUR
SPURGE HOLE	25	NO CONTEXT	NOT COMPLETE	FEMUR
SPURGE HOLE	26	NO CONTEXT	NOT COMPLETE	RADIUS

SPURGE HOLE	27	NO CONTEXT	NOT COMPLETE	HUMERUS
SPURGE HOLE	28	NO CONTEXT	NOT COMPLETE	HUMERUS (SHAFT)
SPURGE HOLE	29	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT
SPURGE HOLE	30	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT
SPURGE HOLE	31	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT
SPURGE HOLE	32	NO CONTEXT	NOT COMPLETE	SKULL FRAGMENT
GOP CAVE	33	NO CONTEXT	NOT COMPLETE	FIBULA (SHAFT)
GOP CAVE	34	NO CONTEXT	NOT COMPLETE	RADIUS
GOP CAVE	35	NO CONTEXT	NOT COMPLETE	RADIUS
GOP CAVE	36	NO CONTEXT	NOT COMPLETE	HUMERUS
GOP CAVE	37	NO CONTEXT	NOT COMPLETE	HUMERUS
GOP CAVE	38	NO CONTEXT	NOT COMPLETE	TIBIA
GOP CAVE	39	NO CONTEXT	NOT COMPLETE	MANDIBLE
GOP CAVE	40	NO CONTEXT	NOT COMPLETE	MANDIBLE
GOP CAVE	41	NO CONTEXT	NOT COMPLETE	CRANIAL FRAGMENT
GOP CAVE	42	NO CONTEXT	NOT COMPLETE	CRANIAL (OCCIPITAL)
PRIORY FARM CAVE	43	NO CONTEXT	NOT COMPLETE	MANDIBLE
GEORGE ROCK SHELTER	44	1002	NOT COMPLETE	CRANIAL FRAGMENT
GEORGE ROCK SHELTER	45	1002 (WET SIEVE)	NOT COMPLETE	CRANIAL FRAGMENT
GEORGE ROCK SHELTER	46	1003 (DRY SIEVE)	NOT COMPLETE	CRANIAL FRAGMENT
GEORGE ROCK SHELTER	47	1004 (SIEVE)	NOT COMPLETE	CRANIAL FRAGMENT
GEORGE ROCK SHELTER	48	1004 (SIEVE FINDS 1-2 M N)	NOT COMPLETE	CRANIAL FRAGMENT

GEORGE ROCK SHELTER	49	1004	NOT COMPLETE	CRANIAL FRAGMENT
GEORGE ROCK SHELTER	50	1003	NOT COMPLETE	CRANIAL FRAGMENT
OGOF GARREG HIR	51	NO CONTEXT	NOT COMPLETE	ULNA
OGOF PANT-Y-WENNOL	52	NO CONTEXT	NOT COMPLETE	CRANIUM
OGOF PANT-Y-WENNOL	53	SQ.6	NOT COMPLETE	FEMUR
OGOF PANT-Y-WENNOL	54	NO CONTEXT	NOT COMPLETE	HUMERUS
OGOF PANT-Y-WENNOL	55	NO CONTEXT	NOT COMPLETE	TIBIA
OGOF PANT-Y-WENNOL	56	NO CONTEXT	NOT COMPLETE	RADIUS
OGOF PANT-Y-WENNOL	57	SQ.10	NOT COMPLETE	CRANIAL FRAGMENT (PARIETAL)
OGOF PANT-Y-WENNOL	58	SQ.14	NOT COMPLETE	CRANIAL FRAGMENT (OCCIPITAL)
BACKWELL CAVE	59	NO CONTEXT	NOT COMPLETE	HUMERUS
BACKWELL CAVE	60	NO CONTEXT	NOT COMPLETE	HUMERUS
BACKWELL CAVE	61	NO CONTEXT	NOT COMPLETE	HUMERUS
BACKWELL CAVE	62	NO CONTEXT	NOT COMPLETE	HUMERUS
BACKWELL CAVE	63	NO CONTEXT	NOT COMPLETE	HUMERUS

Table 41. Elements sampled for microscopic analysis across sites including information on context and their state. N=63

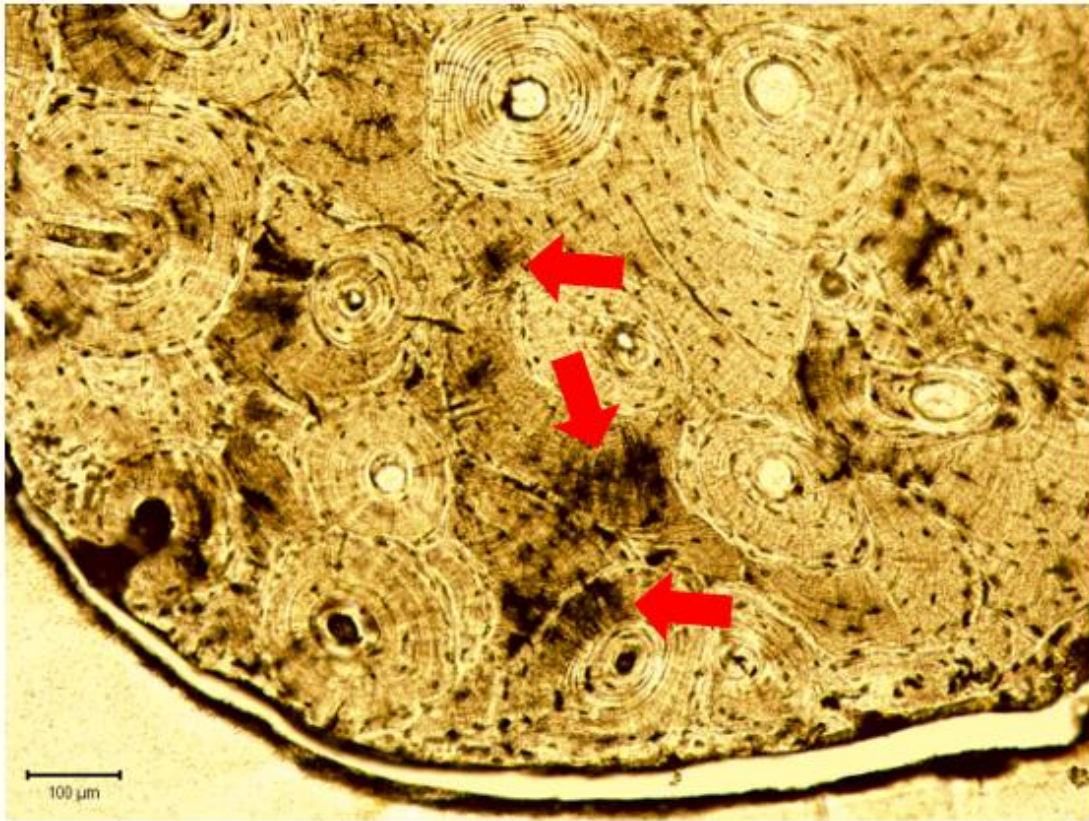


Figure 83. Transverse micrograph of a fibula (Gop Cave) with canaliculi resembling Wedl-type 2 attack (red arrows) around Haversian canals and close to the periosteal surface (OHI 4). Magnification x5. Source: author

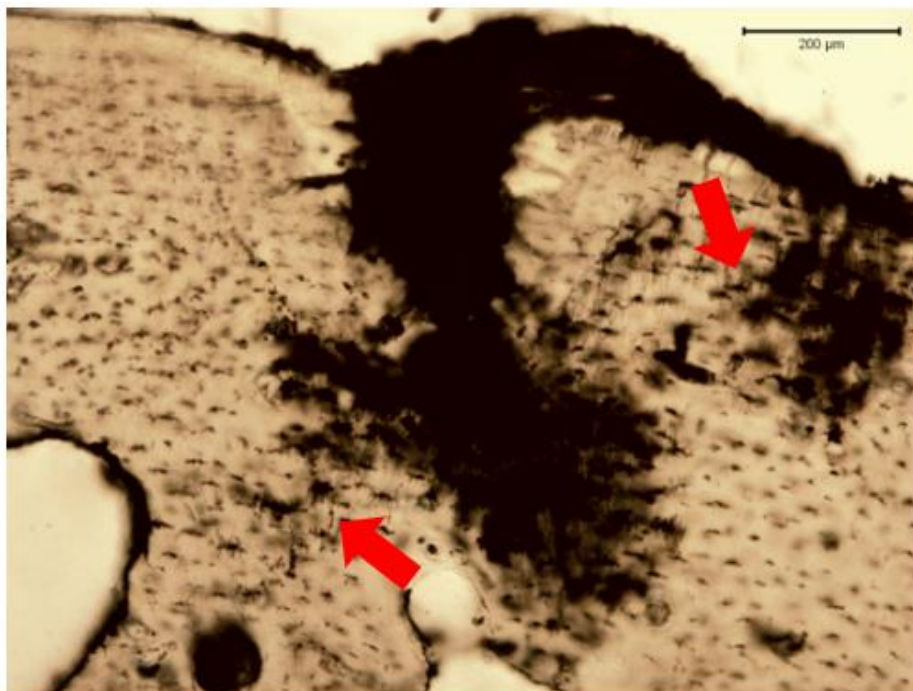


Figure 84. Transverse micrograph of a humerus from (Backwell Cave) with canaliculi resembling Wedl-type 2 attack (arrows) (OHI 3). Magnification x10. Source: author

## OHI scores and MFD

The primary measure of bacterial bioerosion in all samples was the OHI score with 39% (N=25) scoring one followed by 19% (N=12) scoring zero and 14% (N=9) scoring three (Figure 85). Seven samples (11%) demonstrated very good histological preservation (OHI score: 5) (Table 42) with minor non-Wedl MFD (N=7) and absent MFD (N=1). The aforementioned samples further exhibited inclusions and infiltrations (both appearing brown/black in colour), staining (brown and/or brown-orange/red), microcracking and medium to high birefringence (Table 42). Results suggest infiltration of extraneous material from microcracking/microfissures and collagen loss possibly relating to demineralization of the bone (e.g. surface erosion and/or weathering). Three more elements (SNOs: 35, 54 and 65) (4%) demonstrated high OHI scores (4) with large well-preserved areas where the initial features of the bones' microstructure had been retained.

Most common non-Wedl MFD was budded attack (N=60, 95%), followed by linear longitudinal (N=58, 92%) and lamellate attack (N=43, 68%). Wedl tunnelling (1.6%) was present in one sample (SNO: 35) that also included non-Wedl MFD (budded and linear longitudinal).

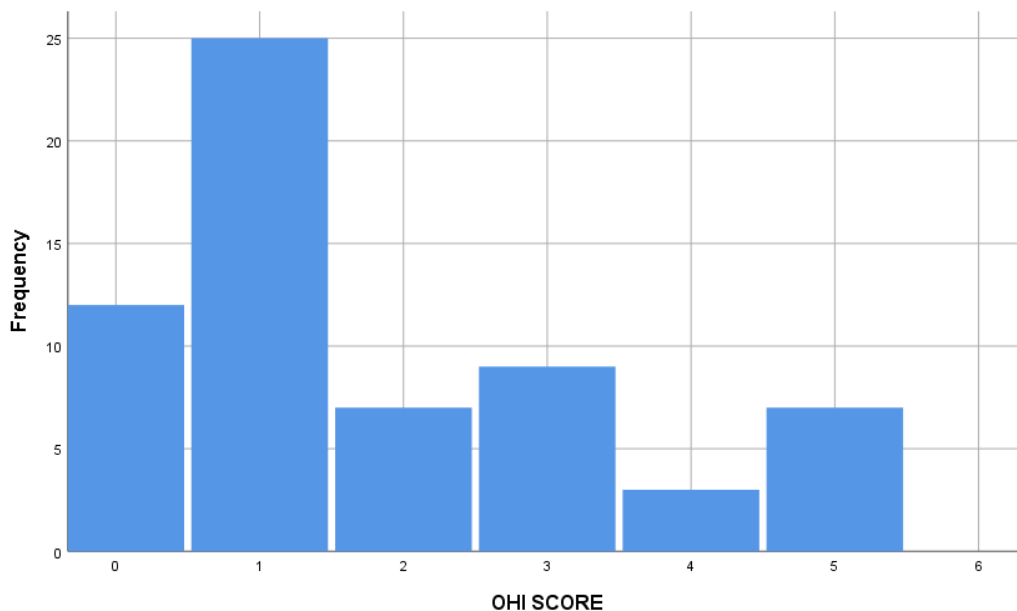


Figure 85. Histogram indicating OHI Scores across ten sites. N=63.



<b>SITE</b>	<b>OHI</b>	<b>AT</b>	<b>INCL INTENS</b>	<b>INCL COLOUR</b>	<b>INFIL INTENS</b>	<b>INFIL COLOUR</b>	<b>STAIN COLOUR</b>	<b>CRACK&amp; INTENS</b>	<b>BIREFR</b>
LITTLE HOYLE CAVE (SNO: 2)	5	NW	3	black/brown	3	brown - fair, dark	brown - orange	Present (1)	2
SPURGE HOLE (SNO: 26)	5	NW	3	brown - dark, fair	3	brown - dark, fair	brown – brown/red (under polar)	Present (3)	3
SPURGE HOLE (SNO: 27)	5	None	3	brown - dark, fair	3	brown- dark; black/brown	orange, brown - fair; red	Present (3)	2
SPURGE HOLE (SNO: 28)	5	NW	3	brown - dark, fair; red	3	brown - dark; black/brown	orange/brown - fair	Present (3)	2
O PANT-Y- WENNOL (SNO: 57)	5	NW	3	black; brown - fair	3	black	brown/orange - fair	Present (3)	2
O PANT-Y- WENNOL (SNO: 59)	5	NW	3	black	3	black/brown	brown - fair	Present (3)	3

O PANT-Y- WENNOL (SNO: 60)	5	NW	1	black; brown - dark	3	black/brown	brown - fair, dark; orange/brown - fair; red – fair	Present (3)	3
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Table 42. Samples (N=8) with very good histological preservation (OHI Score 5). Attack (AT) non-Wedl MFD (NW), inclusion (Incl)/infiltration (Infil) intensity (Intens), staining (Stain) discolouration, cracking/microfissures intensity (Crack & Intens) and birefringence scores (2=medium, 3=high)

### Taphonomy

The elements sampled by the author<sup>132</sup> exhibited signs of surface erosion and staining (N=39, 61% for each), abrasion (N=26, 41%) with some elements reaching weathering stage 1 (N=11 out of 16 weathered, 17%). Cranial fragments and mandibulae (N=8) showed higher representation amongst lower weathering stages (1) than long bones (N=3) with OHI scores 0-3 whilst several long bones (N=5) reaching weathering stages 3-4 demonstrated very good histological preservation (OHI score 5) (Figure 86). High OHI scores and advanced weathering suggest selection and prolonged sub-aerial exposure, followed by deposition in the cave.

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<sup>132</sup> N=58 samples analysed for taphonomy. Sampling of Backwell Cave (N=5) was not conducted by the author and therefore, macroscopic taphonomic modifications could not be identified correctly (based solely on photos).

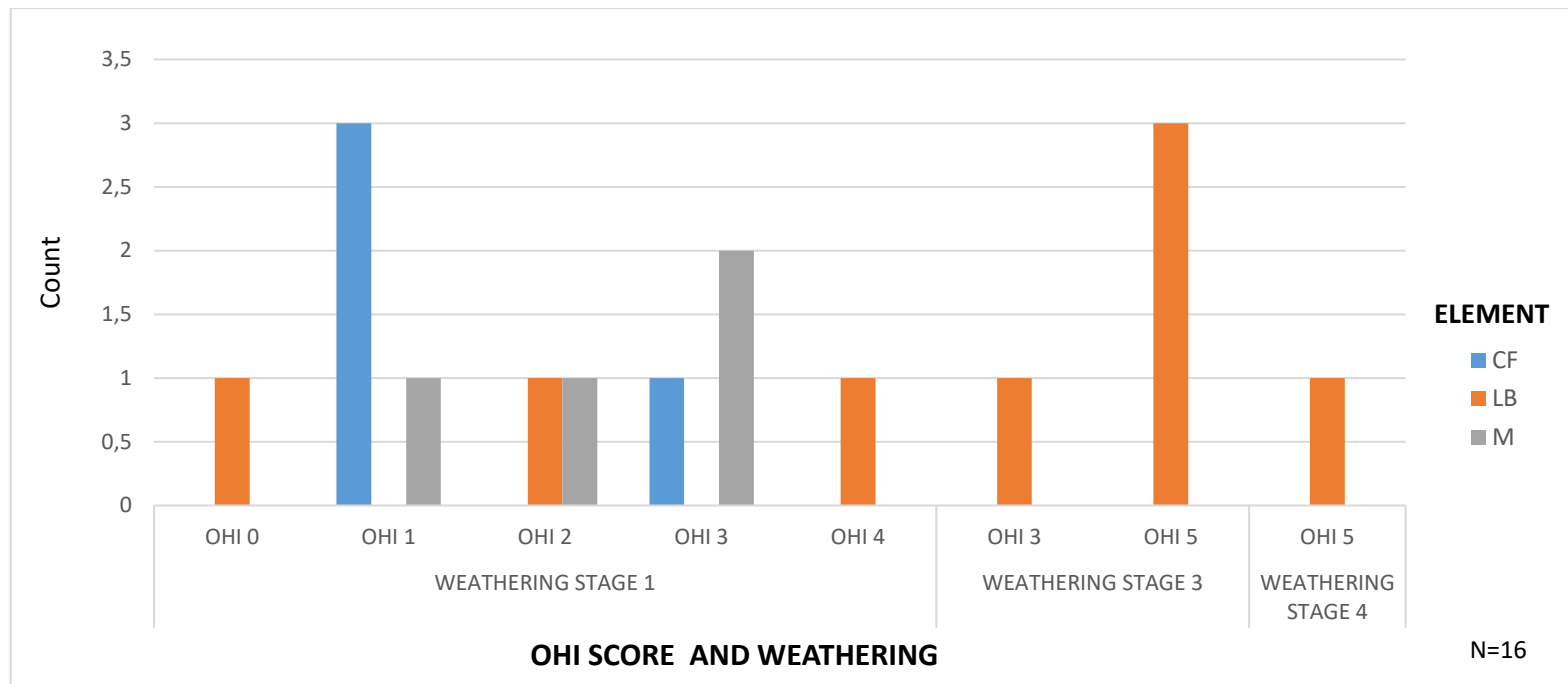


Figure 86. Weathering absence/presence of cranial fragments (CF), long bones (LB) and mandibulae (M) based on OHI Scores across sites. N=elements that only exhibited signs of weathering.

Dry (N=10, 15%) and fresh fractures (N=7, 11%) were also identified on most long bones (N=17 out of 26 long bones sampled). OHI scores varied with dry fractures indicating scores mainly ranging 0-2 and 5 and most fresh fractures scoring 0 (Table 43). Dry breakage can result from later disturbances, moving/circulation of bones that are exhumed or excarnated (high OHI scores) as enteric gut bacteria do not attack the microstructure of the bone after the individual(s) are buried. Fresh breaks with low OHI scores on the other hand, suggest peri-mortem manipulation of selected elements.

Furthermore, a low number of fractured long bones (N=4) exhibited signs of weathering and various OHI scores (0, 3 and 5) (Figure 87). One sample (SNO: 38, Gop Cave) exhibited percussion marks (sharp force trauma) on the diaphysis that was interrupted by weathering (stage 1), suggesting that the cutmark pre-dated weathering on the bone which was either exhumed after primary deposition (OHI score 0) or exposed near the surface at the mouth of the cave. The element exhibited a dry fracture, erosion and staining, which could have resulted from later disturbance and not while the bone was fresh.

The vast majority of the total samples across sites showed very poor surface preservation with most scoring 0 (N=16, 25%), followed by scores 3 and 2 (N=14, 22%; N=13, 20% respectively). Surface preservation was not strongly correlated with OHI Score. Out of the 16 samples demonstrating very poor surface preservation (0), five were given an OHI score of five and four an OHI score of one whereas elements with higher surface preservation scores, were mainly given lower OHI scores (Table 44).

<b>FRACTURE TYPE</b>			
<b>OHI SCORES</b>	<b>FRESH FRACTURE</b>	<b>DRY FRACTURE</b>	<b>TOTAL</b>
OHI 0	3	2	5
OHI 1	1	3	4
OHI 2	0	2	2
OHI 3	2	1	3
OHI 5	1	2	3
<b>TOTAL</b>	<b>7</b>	<b>10</b>	<b>17</b>

Table 43. Fresh and dry fractures cross-referenced with OHI Scores. N=only fractured long bones, excluding five elements from Backwell cave with unknown taphonomy.

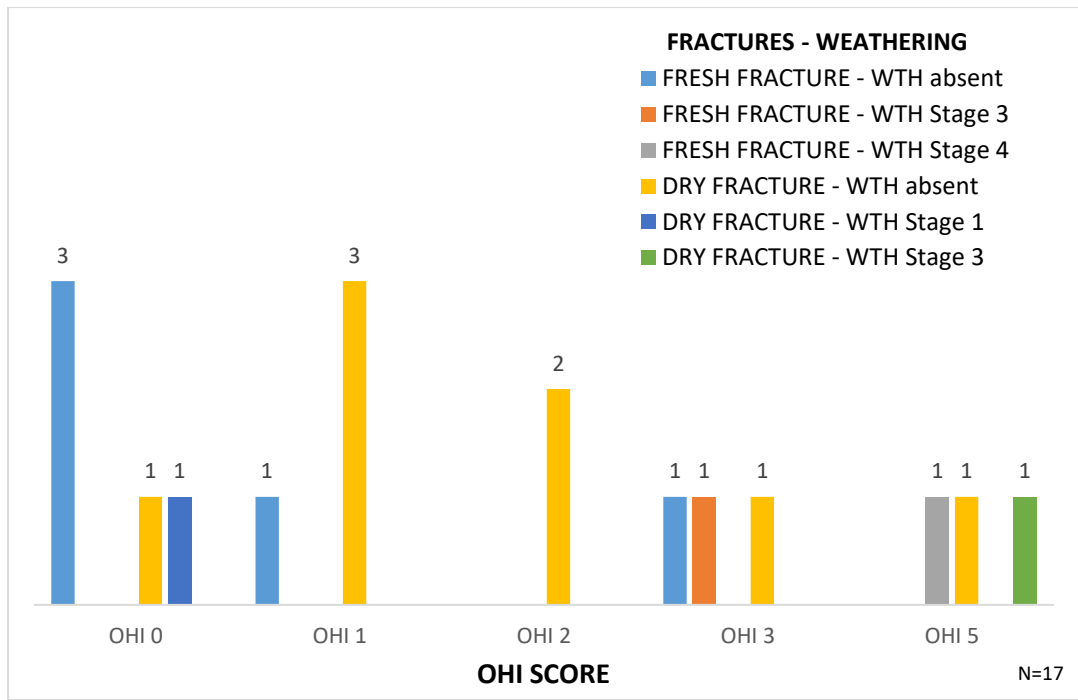


Figure 87. Fracture type and weathering absence/presence-scores. N=only fractured long bones, excluding 5 long bones from Backwell cave with unknown surface taphonomy.

SURFACE PRESERVATION							
OHI SCORE	0	1	2	3	4	5	TOTAL
OHI 0	1	3	3	5	0	0	12
OHI 1	4	4	5	6	4	0	23
OHI 2	3	1	2	1	0	0	7
OHI 3	2	0	3	2	0	0	7
OHI 4	1	0	0	0	1	0	2
OHI 5	5	1	0	0	0	1	7
TOTAL	16	9	13	14	5	1	58

Table 44. Surface preservation (0-5) and OHI Scores. N=58 in this table excluding five elements from Backwell cave with unknown surface preservation.

## Birefringence

Correlations between OHI scores and Birefringence Index (see Chapter 4/4.4) were frequently apparent (Table 45). Samples with high OHI scores overall demonstrated high birefringence scores and medium OHI scores (3) had mostly retained a medium birefringence level. Bones with low levels of histological preservation (OHI scores 0-

2) equally indicated low levels of collagen survival with overall 27 samples across sites (42%) scoring low on the Birefringence Index (Figure 88)<sup>133</sup>.

Results based on bone category showed cranial fragments (N=21) exhibited low to no birefringence and low OHI scores whilst long bones (N=31) and mandibulae (N=10) demonstrated larger variation amongst OHI scores that correlated with birefringence scores.

Loss of birefringence and low OHI scores were sometimes accompanied with microstructural staining (Figure 89/Appendix 6)<sup>134</sup>. These cases will be examined on a more fine-grained scale as site-specific results later in this chapter.

OHI SCORE		BIREFRINGENCE INDEX			
		NONE (0)	LOW (1)	MEDIUM (2)	HIGH (3)
0		6	6	0	0
1		7	17	1	0
2		1	3	3	0
3		0	1	6	2
4		0	0	0	3
5		0	0	4	3

Table 45. Birefringence scores across sites cross-referenced with OHI Scores. N=63 (all sampled elements).

<sup>133</sup> See Appendix 6/6.2. Results across sites/Microscopic results for more details.

<sup>134</sup> See Appendix 6/6.2. Results across sites/Microscopic results for more details.

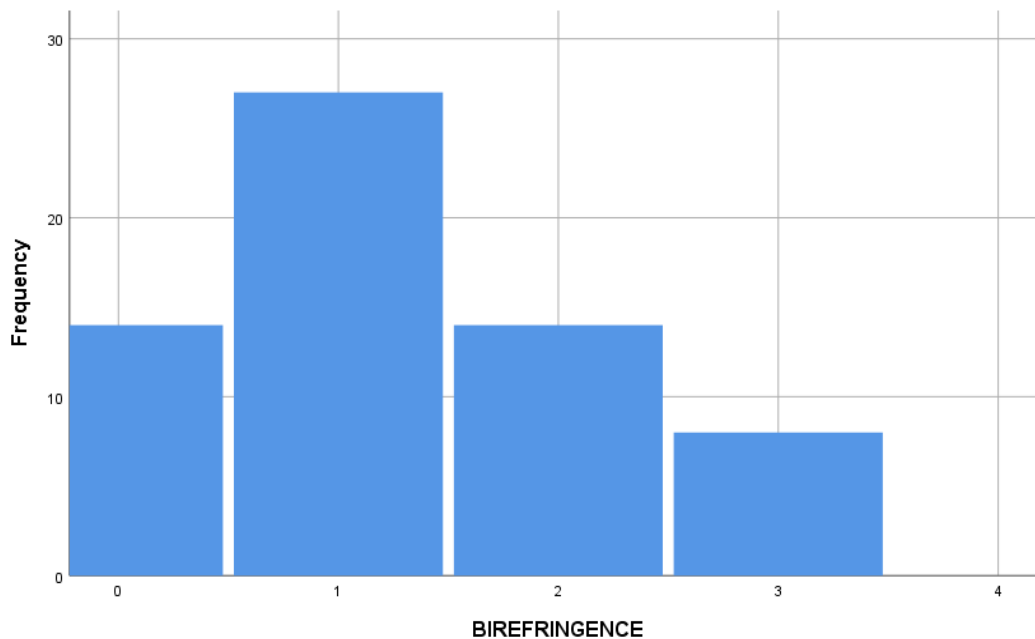


Figure 88. Frequency of birefringence scores (0= no birefringence, 1=low, 2=medium, 3=high – see Chapter 3/Table 18 for definition) across sites. N=63.

### Other microscopic observations

Inclusions (N=60, 95%), infiltrations (N=51, 81%), staining/discolouration (N=56, 88%) and microcracking/microfissures (N=35, 55%) were identified amongst samples. Inclusions and infiltrations were almost equally represented in samples across sites (Table 46/Appendix 6)<sup>135</sup>.

Inclusion, infiltration and microcracking intensities showed higher prevalence amongst low OHI scores (1) suggesting that poorly preserved remains could have been more susceptible to further deterioration of the microstructure by exogenous material (Table 47/Appendix 6)<sup>136</sup>.

A number of samples demonstrating microcracking showed prolonged weathering (stages 3-4) and high OHI scores (5) suggesting that splitting of the surface and microcracking could have resulted from weathering. Both erosion and weathering can cause internal splitting of the microstructure and cause infiltration of extraneous material and/or possible collagen loss.

<sup>135</sup> See Appendix 6/6.2. Results across sites/Microscopic results for more details.

<sup>136</sup> See Appendix 6/6.2. Results across sites/Microscopic results for more details.

### 6.2.3. Radiocarbon dating results

Results from radiocarbon dating of ten elements from seven sites are presented in this section (Table 48). Information on number of elements analysed and rationale for element selection and sampling and sampling can be found in Chapter 5/5.1.2.4 and 5.5<sup>137</sup>.

- *Nanna's Cave*: Results fundamentally altered the depositional narrative further contributing to the history of earlier (Mesolithic) use of Nanna's Cave on Caldey Island, Pembrokeshire.
- *Cae Grown Cave*: One additional radiocarbon date demonstrated the presence of a second individual, bringing the total MNI to two with an Early Neolithic radiocarbon date verifying earlier use of this site. The site might have been used periodically for burials.
- *Orchid Cave*: One additional Late Neolithic/Early Bronze Age date verified that two (out of four) depositions occurred simultaneously as the older radiocarbon date similarly fell at the Late Neolithic/Early Bronze Age transition.
- *Spurge Hole*: Two additional Early/Middle and Middle/Late Neolithic radiocarbon dates verified the multi-level nature of this burial. Results verify an MNI 3+ and ultimately transform the depositional trajectory of the site (see 7.2).
- *George Rock Shelter*: Two new radiocarbon dates verified four simultaneous depositions (MNI: 7+) during the Early Neolithic (see 7.3).
- *Little Hoyle Cave*: One additional radiocarbon date acquired from an Early Neolithic long bone (only mandibulae had been sampled) demonstrated a continuous use of the site from the Early to the Early/Middle Neolithic (see 7.4).
- *Ogof Colomendy*: Two additional radiocarbon dates (Late Neolithic and Early Bronze Age) demonstrated multi-period use of the site for burials (see 7.7).

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<sup>137</sup> Elements SNOs: 6-10 have also been sampled for histology however, sample no.8 (Early BA) has not been considered amongst N=63 samples (see 5.2.4.2).



<b>SITE</b>	<b>SNO</b>	<b>ACCESSION NUMBER</b>	<b>CONTEXT</b>	<b>STATE OF REMAINS</b>	<b>ELEMENT</b>	<b>TAPHONOMY</b>	<b>DATE</b>	<b>LAB NO.</b>	<b>14C RESULTS IN BP YEARS</b>	$\delta^{13}\text{C}$	$\delta^{15}\text{N}$
Nanna's Cave	1/499	91.9H/41	no context	almost complete	calcaneus	erosion	Mesolithic	OxA-41037	8037±27BP	-15.70	13.8
Cae Gronw Cave	2/143	86.32H/CG40	no context	not complete	pelvis	erosion, abrasion	Early Neolithic	OxA-41148	4918±20BP	-21.27	8.8
Orchid Cave	3/393	92.23H/3	no context	not complete	humerus	erosion, abrasion, staining, weathering stage 1	Late Neolithic	OxA-41149	4100±20BP	-20.98	10.8
George Rock Shelter	4/903	G1362	1004	not complete	cranial	erosion, staining	Early Neolithic	OxA-41106	4969±22BP	-20.93	8.6
George Rock Shelter	5/877	G1579	1002 (wet sieve)	not complete	cranial	erosion, staining	Early Neolithic	OxA-41093	4954±22BP	-20.83	8.5
Little Hoyle Cave	6/107	2435/5	no context	not complete	humerus	erosion, staining, fresh fracture	Early Neolithic	OxA-41033	4893±22BP	-20.01	9.3

Ogof Colomend y	7/699	2001.1H/5	no context	not complete	femur	erosion, abrasion, staining, fresh fracture	Late Neolithic	SUERC-97578 (GU57265)	4081±26BP	-21.2	9.5
Ogof Colomend y	8/698	2001.1H/4	no context	not complete	humerus	abrasion, staining, dry fracture	Early/Middle Bronze Age	SUERC-97579 (GU57266)	3314±26BP	-21.4	9.5
Spurge Hole	9/314	93.10H/7.1	no context	not complete	humerus	erosion, dry fracture	Early/Middle Neolithic (borderline)	SUERC-97583 (GU57267)	4648±26BP	-21.1	10.8
Spurge Hole	10/190	92.11H/1.4	no context	not complete	cranial	erosion	Middle/Late Neolithic	SUERC-97584 (GU57268)	4425±26BP	-21.1	10.8

Table 48. Radiocarbon dating results from ten elements (seven sites) in BP years and stable isotope values (provided along radiocarbon dating results for each sample). SNOs: first number is the specimen number from Appendix 1/Sheet 3/Histology and second number from Appendix 1/Sheet 2/Coding.

#### **6.2.4. Summary – Results across sites**

Human remains across caves in Wales demonstrated a large concentration (high frequencies) of fragmented flat/irregular bones and hands/feet (largely complete amongst the assemblage) with the vast majority of human remains being fragmentary. Environmental conditions or disturbances by scavengers and humans possibly resulted in further fragmentation of these remains.

Key taphonomic modifications recorded on the majority of human remains included erosion, abrasion and staining primarily identified on hands/feet and flat/irregular bones whilst evidence of weathering (suggesting prior-subaerial exposure) and gnawing caused by scavengers was apparent on a lower proportion of disarticulated elements.

In particular, weathering was mostly identified on long bones, flat/irregular bones and cranial/skull fragments with stage one being the most dominant. Higher weathering stages (3-4) recorded on long bones suggests different treatment, possible selection of body parts undergoing separate practices prior to deposition (e.g. exhumation, sub-aerial exposure and re-deposition for final burial).

Gnawing was further noted on long bones (primarily from north Wales) with a lower number of hands/feet showing gnawing marks on their surface. The level of disturbance in caves by scavenger activity suggests some sites being easily accessible resulting in several stages of peri- and post-mortem manipulation (Ogof Colomendy) and multiple and multi-period depositions (e.g. Priory Farm, Cave, Ogof Colomendy, Nanna's Cave, George Rock Shelter).

The presence of both dry and fresh fractures across sites further supported different treatment with remains undergoing both peri- and post-mortem manipulation. Advanced weathering (stages 3-4) on three long bones exhibiting fresh breaks from three sites further indicated that specific elements might have been selected after peri-mortem manipulation, subsequently sub-aerially exposed, collected and then brought to the caves for final deposition.

The majority of human remains demonstrated poor to medium surface preservation with smaller elements (hands/feet) showing medium to high scores (3-5). This pattern could

support primary burials taking place on site, extremities buried further or deeper in the cave avoiding larger disturbances and fragmentation and larger elements (in the case of unbalanced frequencies in an assemblage) selectively removed from the site for secondary deposition (e.g. George Rock Shelter).

Microscopic analysis of 63 samples further demonstrated that the majority of individuals were fully articulated (either as part of primary burials in caves or elsewhere and brought collectively disarticulated in caves as part of secondary practice) when enteric gut bacteria released into their bodies (low OHI scores). A lower proportion of selected individuals on the other hand, underwent a series of processing involving rapid disarticulation, possible excarnation and re-burial as secondary deposits (e.g. Spurge Hole).

Different treatment in practices was further supported by radiocarbon dating results. Results demonstrated separate depositional patterns including:

- Earlier/later use of a site (Nanna's Cave, Cave Gronw Cave)
- Concurrent/simultaneous burials (single burial episodes) (Orchid Cave) followed by possible selective removal of larger elements (George Rock Shelter)
- Continuous use for a longer period of time with over-representation of body parts (Little Hoyle Cave)
- Multi-period deposits of different ages showing possible continuation of practices (Ogof Colomendy) and selective deposition (Spurge Hole)

### **6.3. Regional results – South-central Wales**

This section presents the results from all sites examined in this research based on the region they are located. Regions explored include south-central Wales, south-east Wales, south-west Wales, north Wales and north Somerset/Mendip. These areas were disaggregated in this manner based on karst, geomorphology and regional cave morphology. A sub-division of overall results was considered essential to further investigate whether correlations observed on a large scale persisted on a smaller level. This will be accompanied by individual case studies (Chapter 7) and non-parametric tests to verify whether differences in histological preservation of human remains based on OHI scores are significant between sites.

#### **Frequency of skeletal elements**

Sites examined in this section are presented in Table 49. Results from five caves primarily comprised of postcranial (N=266, 49.1%) and cranial/skull remains (N=92, 17%) (Figure 90). Human remains recorded from Cathole Cave, Red Fescue Hole and Pitton Cliff cave represent a very low proportion of this assemblage (N=9) and therefore results are mainly dictated from Spurge Hole and George Rock Shelter. Elements recovered from these latter sites were both similarly preserved with erosive process and/or soil acidity severely impacting their surface preservation. Unidentified/miscellaneous remains were therefore substantial in numbers (N=67 entries, 12.1%) with burnt fragments (N=64) recorded from George Rock Shelter and loose teeth (N=64, 11.5%) only recorded from Cathole Cave, Spurge Hole and George Rock Shelter.

Further sub-division of elements based on bone category demonstrated frequencies of flat/irregular bones (N=110, 22.4%) followed by cranial/skull remains (N=92, 18.7%) bones of the hands/feet (N=83, 16.9%) and long bones (N=21, 4.3%). Canines were the most frequent tooth (N=11, 17.2%) (Figure 91/Appendix 6)<sup>138</sup>.

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<sup>138</sup> Teeth distributions across south-central Wales in Appendix 6.

<b>SITE NAME</b>	<b>SITE TYPE</b>	<b>REGION</b>	<b>SITE DESCRIPTION</b>	<b>CONDITION</b>	<b>DATE/ PERIOD</b>	<b>BURIALS/ MNI</b>	<b>NEO 14C IN BP YEARS WITH ERROR</b>
Cathole Cave	Cave	Ilston, Swansea	Situated at Parc Cwm near Parkmill, parish of Ilston, about 2 km inland from the modern Gower coast	Near Intact (HER)	Middle Neolithic	2+ (adults)	4675±39BP
Spurge Hole	Cave	Pennard, Swansea	Located in a steep cliff near Southgate Gower and forms a water-worn, low, south-facing arch 1.2 m wide and 0.5 m high	Intact (HER)	Early to Middle/Late Neolithic	3+ (2 adults, 1 juvenile)	4830±100BP; 4648±26BP; 4425±26BP
Red Fescue Hole	Rock Shelter	Rhossili, Swansea	Low-roofed coastal cave found at 30m above sea level (OD) in a sheltered dry valley	Highly disturbed (from excavation) and recent use of the cave as shelter	Middle Neolithic	MNI: 1	4634±29BP

George Rock Shelter	Rock Shelter	Wenvoe, Vale of Glamorgan	Lies on the south-west site of Cwm George (limestone outcrop)	Intact (HER)	Early Neolithic and post-Medieval	MNI: 7+ [3 adults (1 post Medieval)], 1 perinate, 1 juvenile and 1 adolescent), 1 probable cremation	4929±33BP; 4954±22BP; 4969±22BP; 5083± 38BP; 125±24AD
Pitton cave	Cliff Cave/rock shelter	Rhossili, Swansea	Located in a small private sycamore wood along a path that leads to Mewslade. Part of a series of solution cavities, phreatic in nature	Originally blocked by rubble, now possibly intact	Early Neolithic	1 (adult)	4837±38BP

Table 49. Summary of sites in south-central Wales recorded and analysed in this research (see Appendix 5 for a complete review of each site).

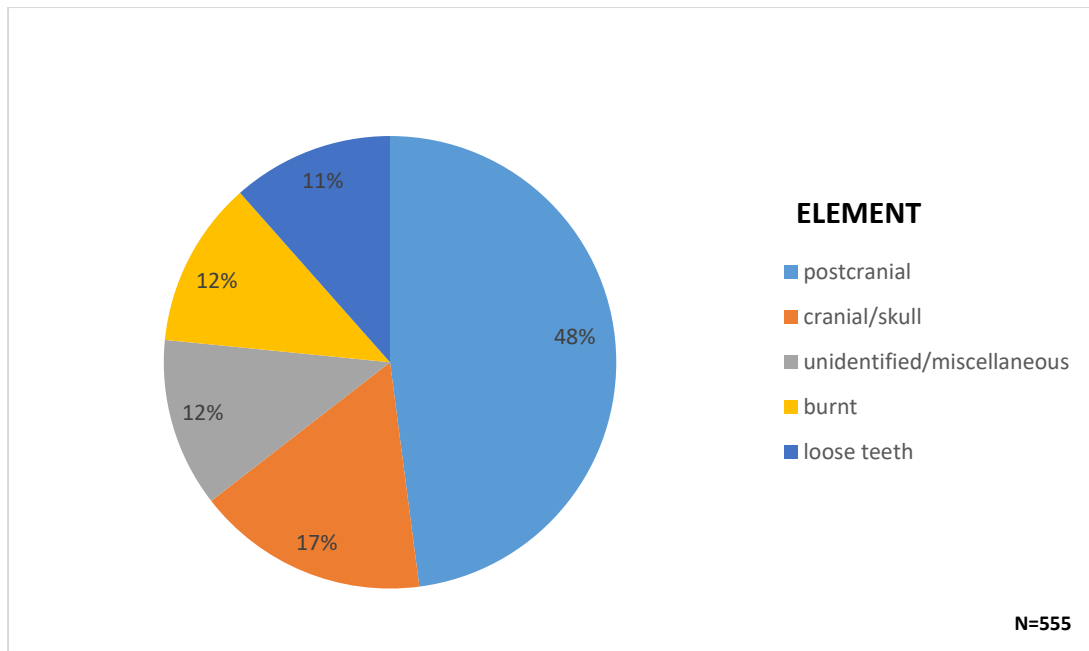


Figure 90. Element frequencies across sites located in south-central Wales (including loose teeth). See 6.2 for including burnt fragments in element category.

Zone representation on long bones (N=26/including unidentified shafts) using the proximal and/or the distal epiphysis indicated a marginal difference between shaft (N=10, 38.5%) and epiphysis (N=8, 30.8%) survival with femur epiphyses (N=4) more commonly represented compared to other limbs. Humeri, radii, ulnae, femora and fibulae shafts were all similarly represented (N=2). The most severe taphonomic modification recorded amongst long bones was erosion (N=20) followed by staining (N=7), abrasion (N=4) and weathering (N=4) (Table 50/Appendix 6). No evidence of trauma (sharp and/or blunt force) or trampling was noted on these elements; however, as previously mentioned, their surface preservation was poor and therefore, some taphonomic modifications could have been masked.

### **Element completeness**

Almost all of the assemblage of disarticulated remains across south-central Wales were fragmented (N=474, 96.5%) with only 17 (3.5%) elements (including N=15 hands/feet and N=2 vertebrae) demonstrating full zone completeness (Figure 92/Appendix 6). No pattern was observed in relation to specific elements.



## **MNI, demography and pathology<sup>139</sup>**

Results demonstrated a predominance of adults (N=8) with adolescent, juvenile and perinate remains similarly represented (N=1). One probable male and one female were identified from Spurge Hole based on pelvic features.

### **Pathology**

No evidence of pathology (degenerative) was recorded. Dental pathologies (caries, calculus) were observed on seven loose teeth whilst signs of pathology on 25 loose teeth could not be determined due to heavy digestion, erosion and/or cave concretion residues covering or affecting the surface (Figure 93 and Table 51/Appendix 6).

### **6.3.1. Taphonomy – Macroscopic results**

#### *6.3.1.1. Weathering*

Weathering was recorded on five elements (1.0%) reaching stages one (N=2) and three (N=3) including three long bones from Spurge Hole, a probable metatarsal and an ulna from George Rock Shelter. Evidence of this modification was recorded on a very low proportion of the assemblage in south-central Wales, which suggests that these cases need to be examined individually as they possibly indicate different treatment between individuals in each site<sup>140</sup>.

#### *6.3.1.2. Gnawing*

Gnawing was identified on a very small proportion of the assemblage (N=3, 0.6%) from George Rock Shelter<sup>141</sup>.

#### *6.3.1.3. Erosion (rough surface texture and/or root etching)*

Erosion was present on more than half of the assemblage from south-central Wales (N=357, 72.7%) primarily on flat/irregular bones (N=107), cranial/skull fragments

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<sup>139</sup> See Chapter 5 for MNI and age/sex estimations.

<sup>140</sup> See Appendix 6/6.3. South-central Wales/Taphonomy – Macroscopic results/Weathering for more details.

<sup>141</sup> See Appendix 6/6.3. South-central Wales/Taphonomy – Macroscopic results/Gnawing for more details.

(N=82) and hands/feet (N=70) (Figure 94). No particular pattern can be highlighted (Figure 95 and Table 52/Appendix 6)<sup>142</sup>.

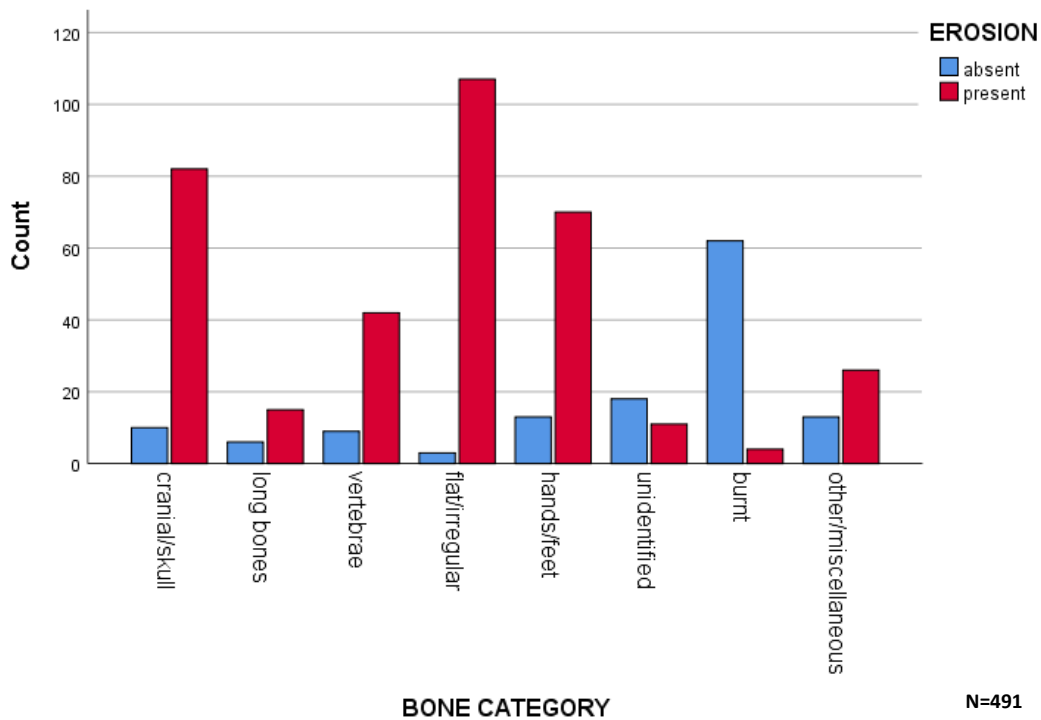


Figure 94. Frequency of erosion absence/presence based on bone category across sites in south-central Wales.

#### 6.3.1.4. Abrasion

Abrasion was identified on a very low number of elements (N=37, 7.5%) from George Rock Shelter. These included bones of the hands/feet (N=12), cranial/skull (N=10) remains and flat/irregular bones (N=8) (Figure 96 and Table 53/Appendix 6)<sup>143</sup>.

<sup>142</sup> See Appendix 6/6.3. South-central Wales/Taphonomy – Macroscopic results/Erosion for details including Figure 67 for surface preservation and Table 52 for cross-referenced modifications.

<sup>143</sup> See Appendix 6/6.3. South-central Wales/Taphonomy – Macroscopic results/Abrasion for more details.

#### 6.3.1.5. *Staining*

Staining was noted on less than half of the assemblage (N=155, 31.6%). Stained elements mainly derived from George Rock Shelter (N=154) and no particular pattern can be highlighted (Table 54/Appendix 6)<sup>144</sup>.

#### 6.3.1.6. *Trauma (sharp/blunt force)*

No trauma was identified on elements recovered from south-central Wales.

#### 6.3.1.7. *Burning*

Evidence of burning was present on a low 67 fragments (13.6%) from George Rock Shelter. Burnt fragments were recovered from different contexts (1000-1004/1007-9) with ash deposits and a possible cremation pyre justifying their presence. Further analysis (burning sequences) was not included in this section as these have been presented in Table 31 with only three burnt elements recorded from Ogof Colomendy (overall N=70 burnt specimens across sites in Wales). Different burning stages were identified throughout the assemblage which can be interpreted by distinct contact of these elements with fire flames/higher temperatures. Abrasion/polishing was present on two fragments and erosion on five burnt elements.

#### 6.3.1.8. *Fractures (fresh vs dry)*

Fractures were recorded on four long bones due to erosion resulting in loss of cortical bone and original features of the fracture. Fractures were primarily dry (N=3, Spurge Hole), with low surface preservation (score 0) and eroded. Two shafts exhibited dry breaks on both proximal and distal ends. A single fresh fracture on a proximal epiphysis was apparent amongst human remains from Red Fescue Hole. The low presence of fractured long bones and lack of peri- or post-mortem trauma suggests minor disturbances, most resulting at a long time after death (dry fractures).

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<sup>144</sup> See Appendix 6/6.3. South-central Wales/Taphonomy – Macroscopic results/Staining for more details.

#### 6.3.1.9. *Surface preservation*

Almost half of the total assemblage (N=233, 45.4%) showed very poor surface preservation (score 0) followed by low scores 2 (N=99, 20.2%) and 1 (N=87, 17.7%). Flat/irregular bones (N=110, 22.4%) had the highest representation between sites with the vast majority equally scoring zero to one (Figure 97/Appendix 6)<sup>145</sup>. As the overall results in south-central Wales were primarily dictated by elements discovered in Spurge Hole and George Rock Shelter low preservation scores can be justified but do not represent the overall survival pattern from this region.

#### 6.3.1.10. *Trampling*

No evidence of trampling was recorded on any elements from south-central Wales.

### 6.3.2. **Microscopic results in south-central Wales**

Results from the microscopic analysis of two sites (N=16/Spurge Hole and George Rock Shelter) are presented in this section.

#### **OHI scores and MFD**

Histological destruction of 15 samples resulted from bioerosion (93.8%) and non-Wedl attack. A single element (SNO: 27) showed no signs of MFD (Figure 98). Equal numbers of samples (N=5, 31%) scored low on the Oxford Histological Index (OHI Scores 0 and 1 respectively) (Figure 99) followed by good histological preservation (OHI score 5/N=3, 18%) (Figure 100). Samples with high OHI score (5) derived from Spurge Hole (Table 55/Appendix 6)<sup>146</sup> with all samples from George Rock Shelter showing extensive MFD (Figure 101). Most common non-Wedl attack amongst bioeroded samples was linear longitudinal (N=14, 87.5%) followed by budded attack (N=14, 87%) and lamellate MFD (N=10, 62%). Wedl tunnelling was absent.

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<sup>145</sup> See Appendix 6/6.3. South-central Wales/Taphonomy – Macroscopic results /Figure 97/ for surface scores amongst bone categories.

<sup>146</sup> See Appendix 6/6.3. South-central Wales /Microscopic results for details and Table 55.

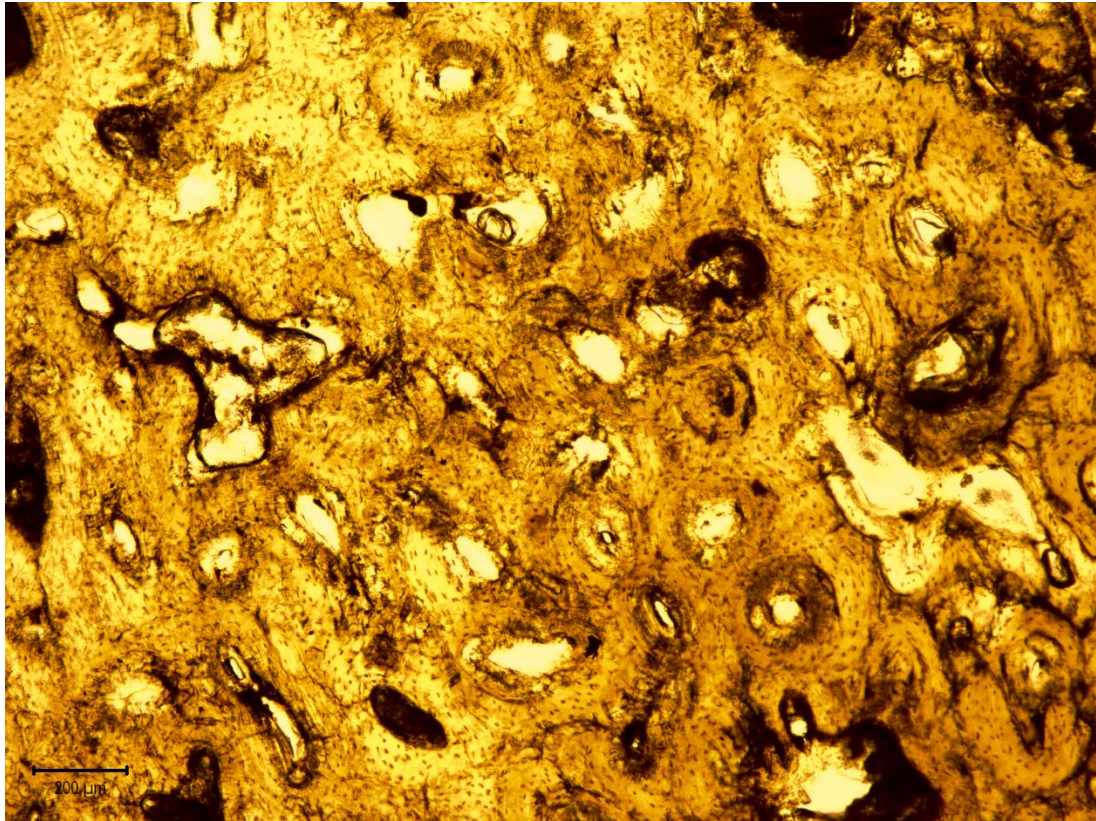


Figure 98. Femur with no signs of MFD from Spurge Hole (OHI 5). Magnification x5. Source: author

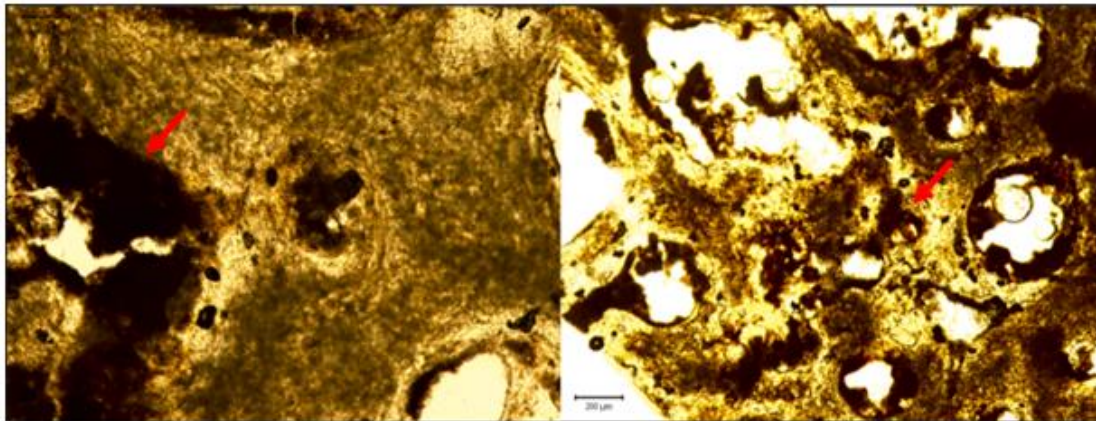


Figure 99. Cranial fragment (Spurge Hole) showing extensive MFD (OHI 1). Magnification x10 – left and x5 right. Very small areas of preserved bone and infiltrations (arrow). Source: author

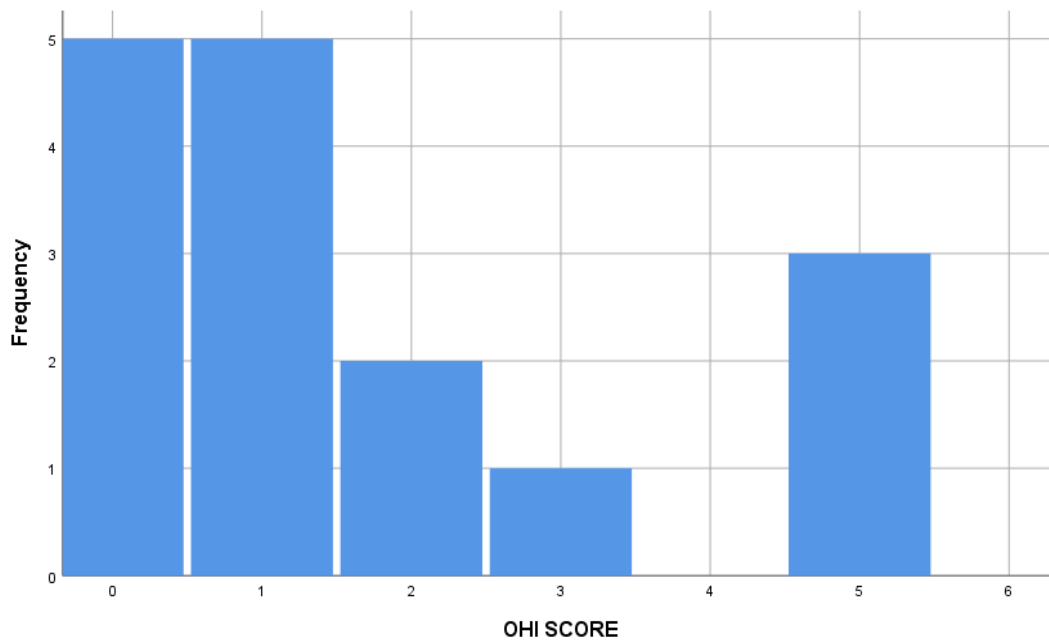


Figure 100. Histogram indicating OHI Scores across south-central Wales (Spurge Hole and George Rock Shelter). N=16

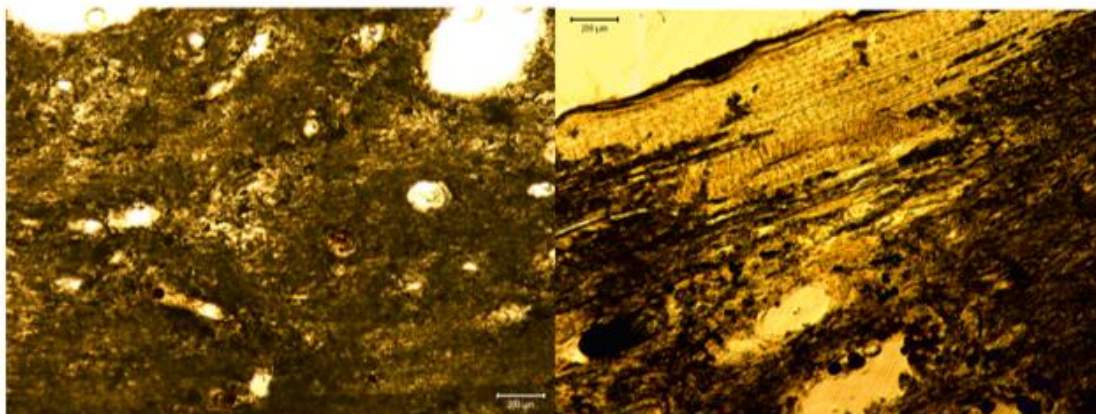


Figure 101. Cranial fragments (George Rock Shelter) showing extensive MFD – left: OHI 0 and right: OHI 1. Magnification x5. Source: author

### Taphonomy

Signs of surface erosion (N=12, 75%), staining (N=6, 37%) were recorded whilst surface preservation between samples was primarily low (score 0) (N=9, 56%). Overall surface preservation in samples did not exceed medium scores. Samples demonstrating high OHI Scores (scoring 5) also exhibited poor surface preservation (surface score 0) and were the only samples indicating signs of weathering in the assemblage (score 3).

Dry fractures were identified on three sampled long bones (SNOs: 27, 29-30/Spurge Hole). Element 27 demonstrated high microstructural preservation (OHI score 5), exhibited advanced weathering (stage 3) and a dry fracture that resulted from later disturbance and suggests exposure prior to final deposition. Long bones SNOs 29 and 30 on the other hand, scored lower on the OHI scale (2 and 1 respectively) with one being more robust than the other. Different histological preservation was anticipated based on morphological characteristics, human remains derived from separate individuals (see Appendix 5). Different OHI scores were further identified between cranial and post-cranial remains.

Histological preservation in cranial samples from George Rock Shelter was poor (with most OHI scores demonstrating complete or almost complete microstructural destruction (five samples scored 0 and two scores 1 on the OHI scale). Surface preservation on these cranial fragments ranged from medium to poor whilst surface erosion (N= 5) staining (N=6) impacted almost all samples.

### **Birefringence**

Correlations between OHI scores and the Birefringence Index were apparent (Table 56/Appendix 6)<sup>147</sup>. The vast majority of sampled elements (N=7, 43.8%) indicated no birefringence to low (N=6, 37%) collagen survival (Figure 702/Appendix 6)<sup>148</sup>. Loss of birefringence and low OHI scores were accompanied by microstructural staining (Figure 103/Appendix 6)<sup>149</sup>. Samples with high OHI scores demonstrated medium to high birefringence with lower OHI scores showing low to no collagen survival (Figure 104 below).

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<sup>147</sup> See Appendix 6/6.3. South-central Wales /Microscopic results/Table 56.

<sup>148</sup> See Appendix 6/6.3. South-central Wales /Microscopic results/Figure 702 for details.

<sup>149</sup> See Appendix 6/6.3. South-central Wales /Microscopic results/Figure 103 for details.

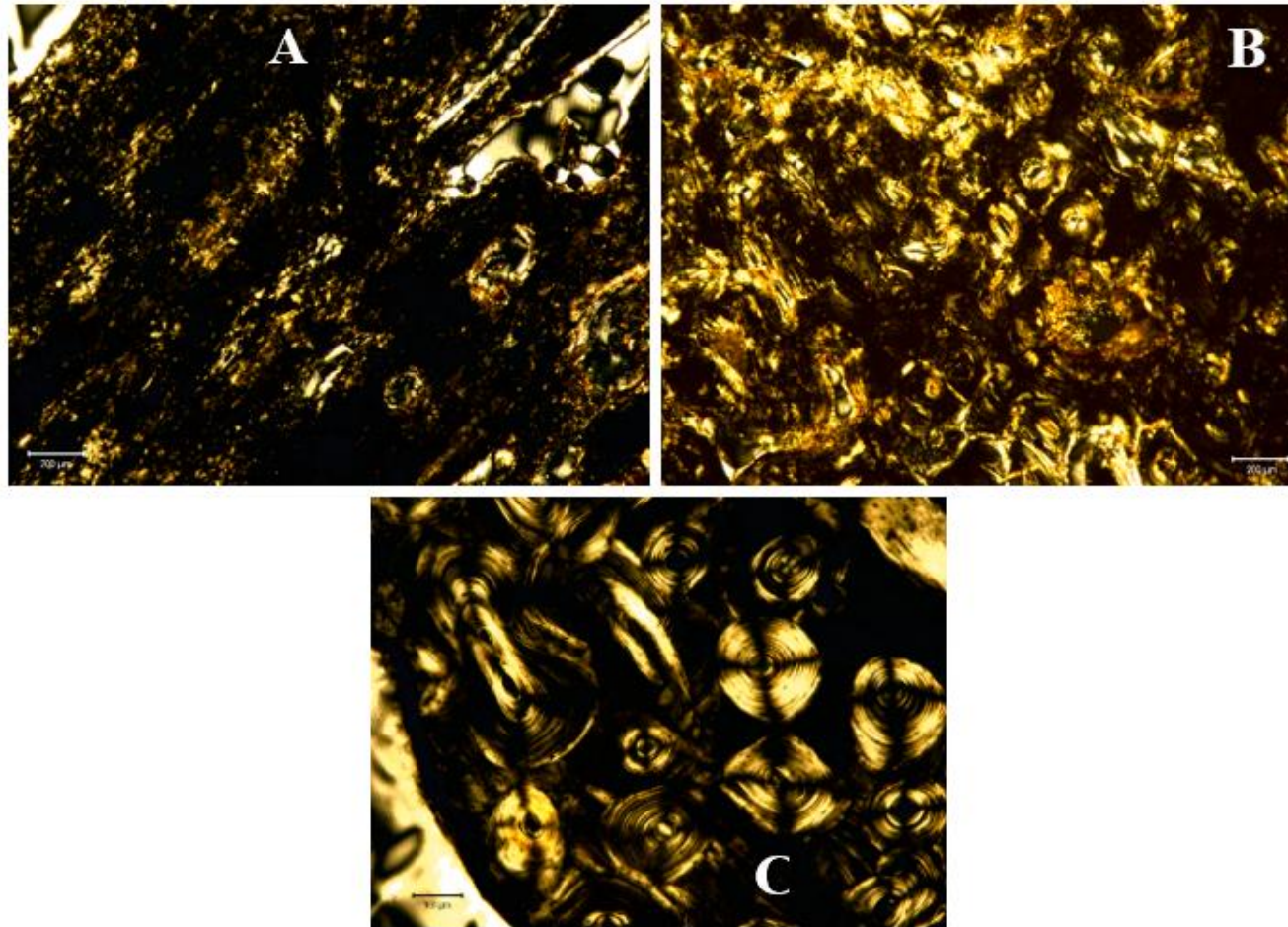


Figure 104. Birefringence levels – **A**: cranial fragment with very low to almost complete absence of collagen survival (OHI 1 – George Rock Shelter), **B**: femur with medium birefringence (OHI 5 – Spurge Hole) and **C**: fibula with high collagen survival (OHI 4 – Gop Cave). Magnification x5 in A-B and x10 in C. Source: author



### **Other microscopic observations**

Inclusions (N= 13, 81%), infiltrations (N=12, 75%), staining/discolouration (N=15, 93.8%) and microcracking (N=8, 50%) were recorded amongst samples. Inclusions and infiltrations were equally observed in samples with low and high OHI scores (0-1, 5) whilst microstructural staining was most prominent in samples with low OHI scores (0-1) (Table 57/Appendix 6)<sup>150</sup>. Weathering and microcracking were observed in samples with high OHI scores (5) suggesting that prolonged exposure and evidence of 8an result in high intensity cracking in the microstructure of the bones (Tables 58-59/Appendix 6)<sup>151</sup>.

### **6.3.3. Radiocarbon dating results**

Radiocarbon dating results from Spurge Hole and George Rock Shelter can be found in section 6.2.3. Evidence of Early Neolithic depositions from two radiocarbon dates (George Rock Shelter) add to the existing known period of activity and suggest primary depositions further supported by low OHI scores.

Radiocarbon dating results from Spurge Hole demonstrate chronologically different depositions ranging from the Early (existing date) to the Middle/Late Neolithic and suggest a separate depositional narrative in south-central Wales. Distinct morphological characteristics on skeletal remains recovered from this site (see Appendix 5), OHI scores ranging from very poor to high microstructural preservation and varying radiocarbon dating results suggest selection of body parts for secondary depositions in this site. Further discussion on an individual basis (both sites) is presented later in Chapter 7.

### **6.3.4. Short summary of burial depositions in south-central Wales**

The depositional history in south-central Wales demonstrates variation in the way the dead were treated supported by two opposing burial patterns from George Rock Shelter

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<sup>150</sup> See Appendix 6/6.3. South-central Wales /Microscopic results/Table 157 for inclusion, infiltration, microcracking intensities

<sup>151</sup> See Appendix 6/6.3. South-central Wales /Microscopic results/Table 58-59 for correlations with OHI scores and other taphonomic modifications.

and Spurge Hole<sup>152</sup>. Primary depositions appear to have taken place in George Rock Shelter, with hands/feet comprising most of the assemblage. Low OHI scores from small cranial fragments also suggest primary burials that were later disturbed for possible selective removal of larger elements and further depositions during the post-Medieval period.

Spurge Hole however followed a different taphonomic trajectory. Selection of body parts is supported by distinct morphological features in some elements (see Appendix 5), radiocarbon dates ranging from the Early to the Middle/Late Neolithic and separate OHI scores. Results suggest different treatment between individuals. Distinct levels of bacterial attack mirror either primary depositions or early manipulation (disarticulation either by dismemberment or excarnation) followed by sub-aerial exposure (presence of advanced weathering stages), collection and final deposition.

Sites in south-central Wales support use throughout the Neolithic, including Cathole Cave, Pitton Cliff Cave and Red Fescue Hole, with radiocarbon dates ranging from the Early to the Middle Neolithic. Whilst use of the sites throughout the Neolithic was common, deposition patterns varied and were executed irregularly.

#### **6.4. South-east Wales**

##### **Frequency of skeletal elements**

The single site examined in this section is presented in Table 60 (see Appendix 5). This analysis substitutes a complete case-study examination of the site and will therefore not be re-visited in Chapter 7. Elements from Ifton Quarry (south-east Wales) primarily comprised of postcranial (N=52, 72%), cranial/skull remains (N=18, 25%) and unidentified/miscellaneous fragments (N=2, 2%) (Figure 105, Table 61). Further subdivision based on bone category demonstrated that long bones (N=12, 16%), flat/irregular bones (N=17, 23%) and hands/feet (N=14, 19%) were almost equally represented with a lower number of vertebrae (N=9, 12%) and other/miscellaneous remains (N=2, 2%) (Figure 106). Representation of crania and skull fragments (N=18, 25%) of both adults and juveniles does not correspond to the number of post-cranial

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<sup>152</sup> Results from south-central Wales were ultimately dictated by data collected from these two sites.

remains recovered. Loose teeth were not recorded from this site suggesting they were either lost/disturbed during quarrying, as those surviving were still attached on one mandible and one maxilla or decomposed. Zone representation on long bones (N=12) using the proximal and/or the distal epiphysis indicated an apparent difference between shaft (N=11, 91.7%) and epiphysis (N=6, 50%) survival. Shaft representation on all surviving long bones was notable compared to epiphyses (e.g. humeri/Table 62/Appendix 6)<sup>153</sup>.

<b>SITE NAME</b>	<b>SITE TYPE</b>	<b>REGION</b>	<b>SITE DESCRIPTION</b>	<b>CONDITION</b>	<b>DATE/ PERIOD</b>	<b>BURIALS/MNI</b>	<b>NEO 14C IN BP YEARS WITH ERROR</b>
Ifton Quarry	Old rock shelter or fissure	Rogiet Monmouthshire	Located at the south end of a carboniferous limestone area that incorporates the Forest of Dean and the Wye Valley	Destroyed from quarrying	Middle to Late Neolithic	7+ (5 adults; 2 juveniles)	4640±29BP; 4624±29BP; 4350±90BP; 4178±28BP

Table 60. Site in south-east Wales recorded and analysed in this research (see Appendix 5 for a complete review).

<sup>153</sup> See Appendix 6/6.4.South-east Wales/Frequency of skeletal elements for more details on recorded taphonomy.

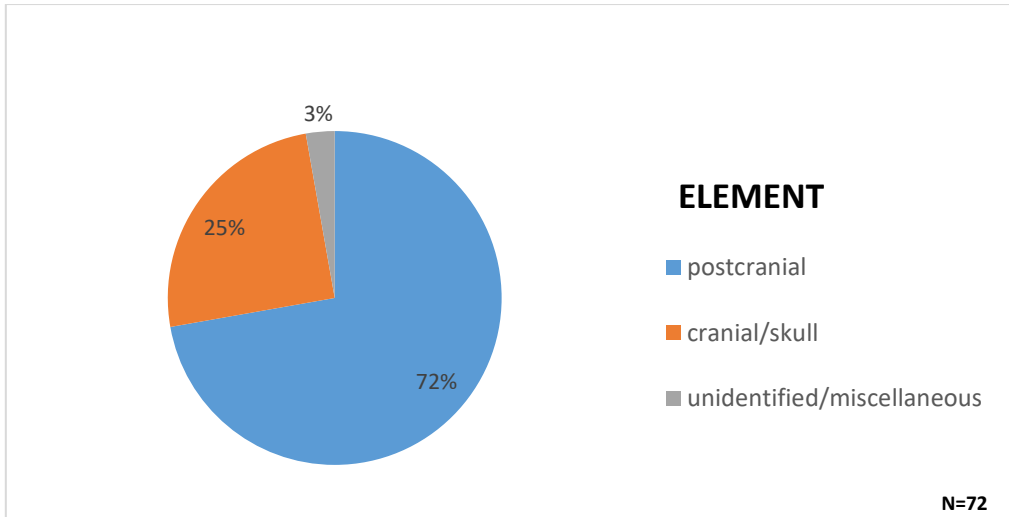


Figure 105. Element frequencies in south-east Wales (Ifton Quarry). No loose teeth survived/discovered.

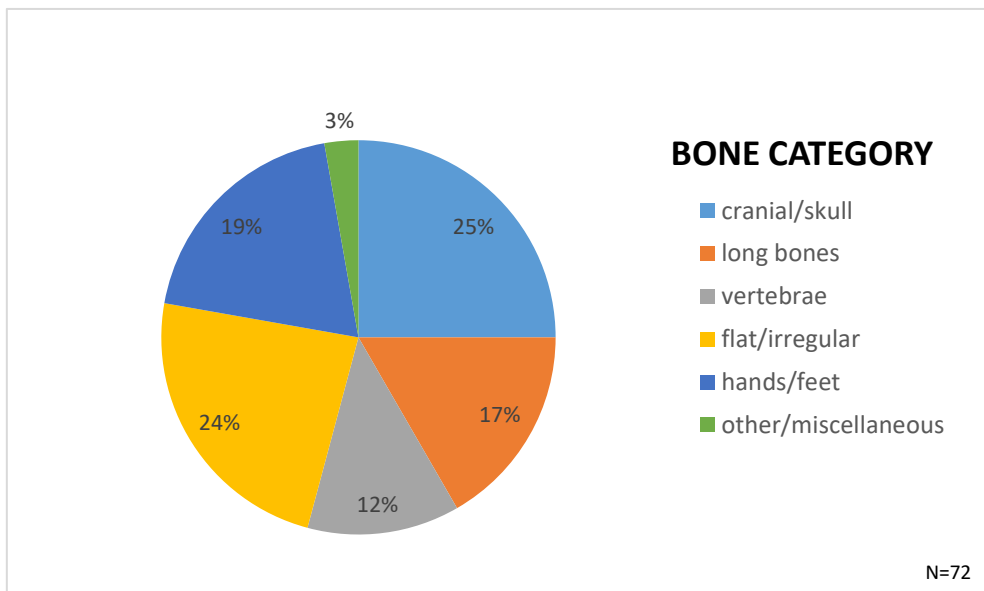


Figure 106. Element frequencies in south-east Wales (Ifton Quarry) based on bone category. No loose teeth survived/were discovered.

ELEMENT	COUNT
AXIS (C-2)	1
CALCANEUS	2
CLAVICLE FRAGMENT	1
CRANIAL FRAGMENT - (RIGHT ZYGOMATIC BONE)	1
CRANIAL FRAGMENTS	3
CRANIAL FRAGMENTS (PARIETAL)	1
CRANIUM	4
FEMUR	3

FIBULA	1
FIBULA FRAGMENT	1
FIRST RIB FRAGMENT	3
FRONTAL	3
HAND PHALANX FRAGMENT	1
HUMERUS	4
LUMBAR VERTEBRA	5
MANDIBLE	1
METACARPAL	1
METACARPAL (MC2)	1
METACARPAL (MC3)	1
METATARSAL (MT2)	2
METATARSAL (MT4)	1
MISCELLANEOUS REMAINS	1
MISCELLANEOUS/VERTEBRAE FRAGMENTS	1
OCCIPITAL	1
PARIETAL	2
PARIETAL FRAGMENT	2
PROXIMAL FOOT PHALANX	4
RADIUS	1
RIB	5
RIB FRAGMENTs	4
SCAPULA	2
SCAPULA FRAGMENT	2
TALUS	1
THORACIC VERTEBRA	3
TIBIA	2
(N) TOTAL	72

Table 61. Element representation in Ifton Quarry (south-east Wales). Miscellaneous remains includes small unidentified fragments (possibly scapular, cranial and rib fragments) with no zone representation and no taphonomy (N=21). These were counted as one entry (with absent taphonomy) as small fragments could have easily derived from already fragmented ribs, cranial and scapulae identified in the assemblage and did not have any significance for separate recording/would not add any taphonomic value and do not impact the overall taphonomic trajectory.

## **Element completeness**

The vast majority (N=65, 90.3%) of disarticulated remains recovered from Ifton Quarry were fragmented/not complete with only seven (9.7%) elements (N=6 hands/feet, N=1 lumbar vertebra) demonstrating full zone completeness (Figure 107 and Table 63/Appendix 6)<sup>154</sup>.

## **MNI, demography and pathology<sup>155</sup>**

Results demonstrated a predominance of adults (N=5) and two juveniles. Crania and cranial fragments were used to determine age (suture closure, growth) and sex patterns (N=6) between the individuals. Two probable females, one female and two probable males were identified.

## **Pathology**

Pathology (dental and degenerative) was recorded on four elements including one maxilla (attached on cranium), one mandible<sup>156</sup>, and two lumbar vertebrae (Table 64/Appendix 6)<sup>157</sup>.

### **6.4.1. Taphonomy – Macroscopic results**

#### *6.4.1.1 Weathering*

Weathering was recorded on two elements (SNOs: 336, 346) reaching stage one (2.8%), including one scapula and one humerus. Remaining elements with no signs of weathering demonstrated presence of peri- and post-mortem activity (i.e. sharp force trauma/defleshing marks on skulls, dry fractures on long bones) which possibly reflects different treatment.

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<sup>154</sup> See Appendix 6/6.4. South-east Wales/Element completeness/Table 63 for taphonomic modifications on surviving elements.

<sup>155</sup> See Chapter 5 for MNI and age/sex estimations.

<sup>156</sup> Possibly derives from cranium 324.

<sup>157</sup> See Appendix 6/6.4. South-east Wales/MNI, demography and pathology for details.

#### 6.4.1.2. Gnawing

Gnawing was recorded on three elements (4%) including one parietal, one humerus and one femur<sup>158</sup> (SNOs: 320, 344 and 351 respectively). All elements were eroded and stained however their surface preservation varied. A dry fracture was identified on the proximal end of the humerus suggesting that gnawing might have similarly resulted from later disturbances and/or when remains were circulated.

#### 6.4.1.3. Erosion (rough surface texture and/or root etching)

Erosion was present on a larger number of bones (N=26, 36%), primarily on skull elements (N=15) and long bones (N=6) (Figure 108). Results correlated with the frequency of element representation in Ifton Quarry and therefore no particular pattern was observed (Figure 109 and Table 65/Appendix 6)<sup>159</sup>. Evidence of erosion and root marks could have resulted from exposure to any environment, however the absence of this modification on the majority of elements may reflect that the crania derived from separate contexts and remains were in fact collected, circulated and deposited in the site (Figure 110).

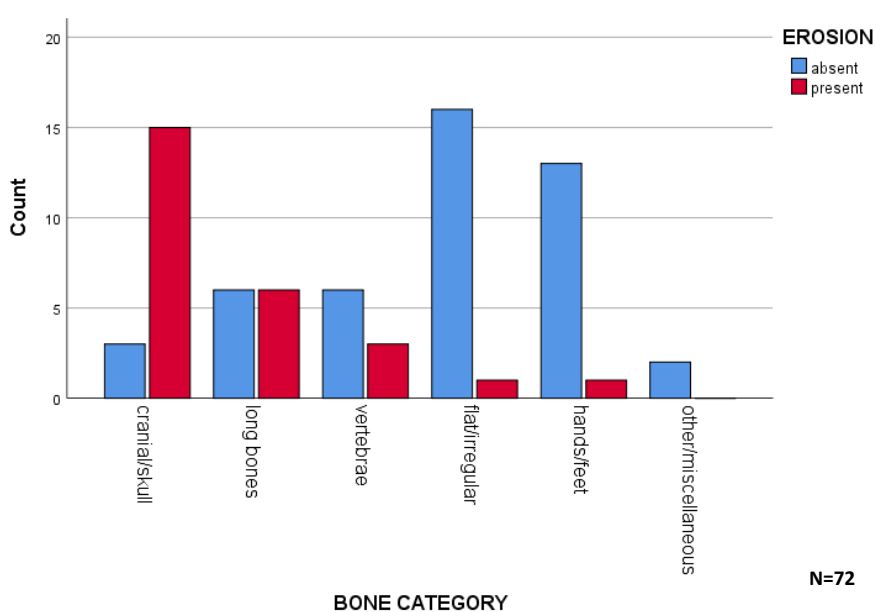


Figure 108. Frequency of erosion absence/presence based on bone category in Ifton Quarry.

<sup>158</sup> Modern and/or sampling damage on long bones which interfered with correct identification of their fracture morphology (see Appendix 1/Coding/QC).

<sup>159</sup> See Appendix 6/6.4. South-east Wales/Erosion/Figure 80 for surface preservation and Table 66 for taphonomic associations.

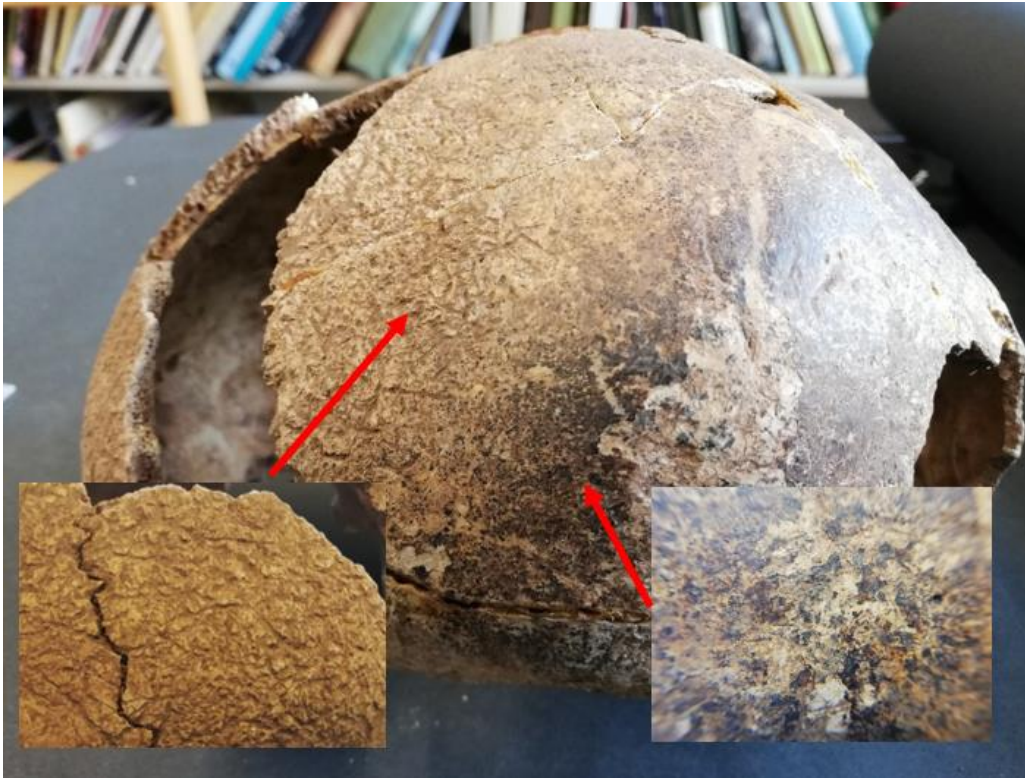


Figure 110. Cranium displaying root etching and staining on the surface. Source: author

#### 6.4.1.4. Abrasion

Abrasion was identified on a very low number of elements (N=13, 18%) from Ifton Quarry. Abraded bones primarily consist of cranial/skull remains (N=11) and two long bones (Figure 111 and Table 66/Appendix 6)<sup>160</sup>.

#### 6.4.1.5. Staining

Evidence of black (manganese and/or mould) staining was noted on just over half of the assemblage (N=37, 51%) that was primarily recorded on cranial/skull remains (N=14), long bones (N=10) and flat/irregular bones and hands/feet (N=6 for each) (Figure 112 and Table 67/Appendix 6)<sup>161</sup> (Figure 113).

<sup>160</sup> See Appendix 6/6.4. South-east Wales/ Taphonomy – Macroscopic results/Abrasion/Table 66 for other modifications affecting abraded remains.

<sup>161</sup> See Appendix 6/6.4. South-east Wales/ Taphonomy – Macroscopic results/Staining/Table 67 for other modifications affecting stained remains.





Figure 113. Staining on cranium (occipital bone). Source: author

#### 6.4.1.6. Trauma (sharp/blunt force)

Evidence of trauma was recorded on three elements from Ifton Quarry and included both sharp and blunt force on two crania (2%) and sharp force on a single cranium (SNO: 324) (1%). Sharp and blunt force trauma were both identified on adult crania (SNOs: 322, 326). Cranium 322 belonged to a possible male adult and exhibited a cutmark (peri-mortem) on the left parietal and an ante-mortem/healed fracture on the right parietal (close to occipital bone) (Figure 114). The cranium demonstrated medium surface preservation (score 3) with signs of erosion, abrasion and staining and was fragmented.



Figure 114. Cutmark on right parietal (**left**), healed fracture on occipital bone (**right**). Source: author

Cranium 326 on the other hand, belonged to a possible adult female with signs of probable scraping/defleshing marks on the left parietal and blunt force trauma on the right parietal (Figure 115). Scraping marks resemble signs of trampling however, the marks were pronounced and as deep as cutmark notches. The cranium also exhibited signs of erosion, abrasion and staining and medium surface preservation (score 3). Signs of concretion were also noted close to the nasal cavity.



Figure 115. Blunt force trauma on the right parietal (A) and scraping/defleshing marks on the left parietal (B). Source: author.

Cranium 324 demonstrated evidence of sharp force trauma on the frontal bone (zone 1) which belonged to an older adult female (c. 35-45 years) with signs of erosion and staining and medium surface preservation (score 3) (Figure 116). Abnormal surface texture on the left orbit (possible concretion or erosion) was noted whilst wear (with heavy attrition) on surviving molars attached to the maxilla demonstrated signs of pathology (ante-mortem tooth loss, severe calculus, caries and possible periodontal disease). Whilst evidence of trauma was not extensively identified on elements in Wales, these three crania represent the most severe cases of trauma recorded in a single site and suggest that intentional manipulation occurred prior to burial.

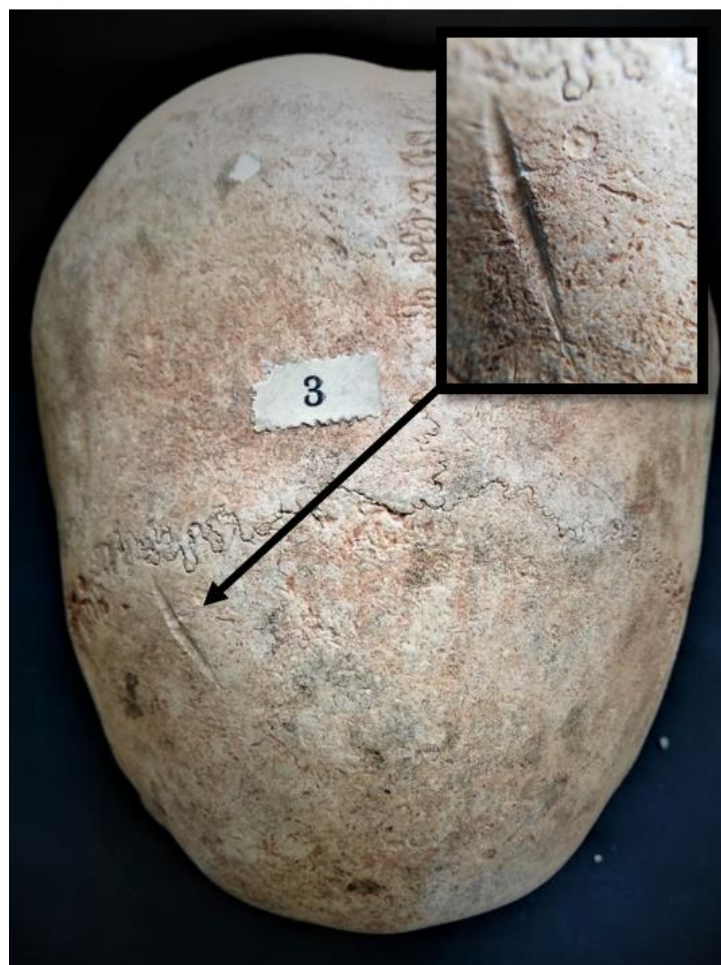


Figure 116. Cutmark on the right frontal bone. Source: author

#### 6.4.1.7. *Burning*

Evidence of burning was not identified on any elements from Ifton Quarry.

#### *6.4.1.8. Fractures (fresh vs dry)*

Fractures were recorded on five long bones (two humeri, one radius, one femur and one tibia) and solely include dry breaks which resulted at a later stage (FFI scores 5 and 6) (SNOs: 344-45, 347, 353 and 348). Tibia 348 (FFI scores: proximal=6, distal=5) exhibited fractures on both proximal and distal epiphyses whilst evidence of modern damage (some resulting from sampling) interfered with the fracture morphology on the long bones (see Appendix 1/Sheet 2/Coding/QC section). Surface preservation fluctuated (each element scored differently) from zero to four. Humerus 345 (FFI score: 6) exhibited signs of gnawing whilst signs of abrasion were noted on tibia 348.

#### *6.4.1.9. Surface preservation*

The vast majority of disarticulated remains from Ifton Quarry showed medium (score 3/N=33, 45%) to poor (score 2/N=21, 29.2%) surface preservation however taphonomic modifications had not severely impacted the surface of the bones. Staining (N=37) and erosion (N=26) affected most surviving elements. Cranial/skull elements and hands/feet overall showed the higher surface preservation scores (3-4) (Figure 117/Appendix 6)<sup>162</sup>.

#### *6.4.1.10. Trampling*

Trampling was recorded on a juvenile cranial fragment (SNO: 327) that further indicated signs of erosion, staining, abrasion and medium surface preservation (score 3). The low prevalence of this modification appears circumstantial, possibly caused by disturbances (e.g. scavenger activity, moving of interments, dragging of bone on rough surface).

### **6.4.2. Microscopic results in south-east Wales**

Results from the microscopic analysis of Ifton Quarry (south-east Wales) are presented in this section.

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<sup>162</sup> See Appendix 6/6.4. South-east Wales/ Taphonomy – Macroscopic results/Surface preservation/Figure 117 for details.

## OHI scores and MFD

Histological destruction of all samples resulted from bioerosion and non-Wedl attack. OHI scores ranged from 0 (N=2, 33%) to 1 (N=4, 66%) (Figure 118/Appendix 6)<sup>163</sup>. Low OHI scores suggest that elements must have undergone primary deposition (Figures 119-120) that resulted in complete/almost complete loss of the microstructure. Types of bacterial attack identified in the microstructure of the samples included budded and linear longitudinal (N=6/all samples) and lamellate MFD (N=3, 50% of samples). Wedl tunnelling was not identified in any samples.

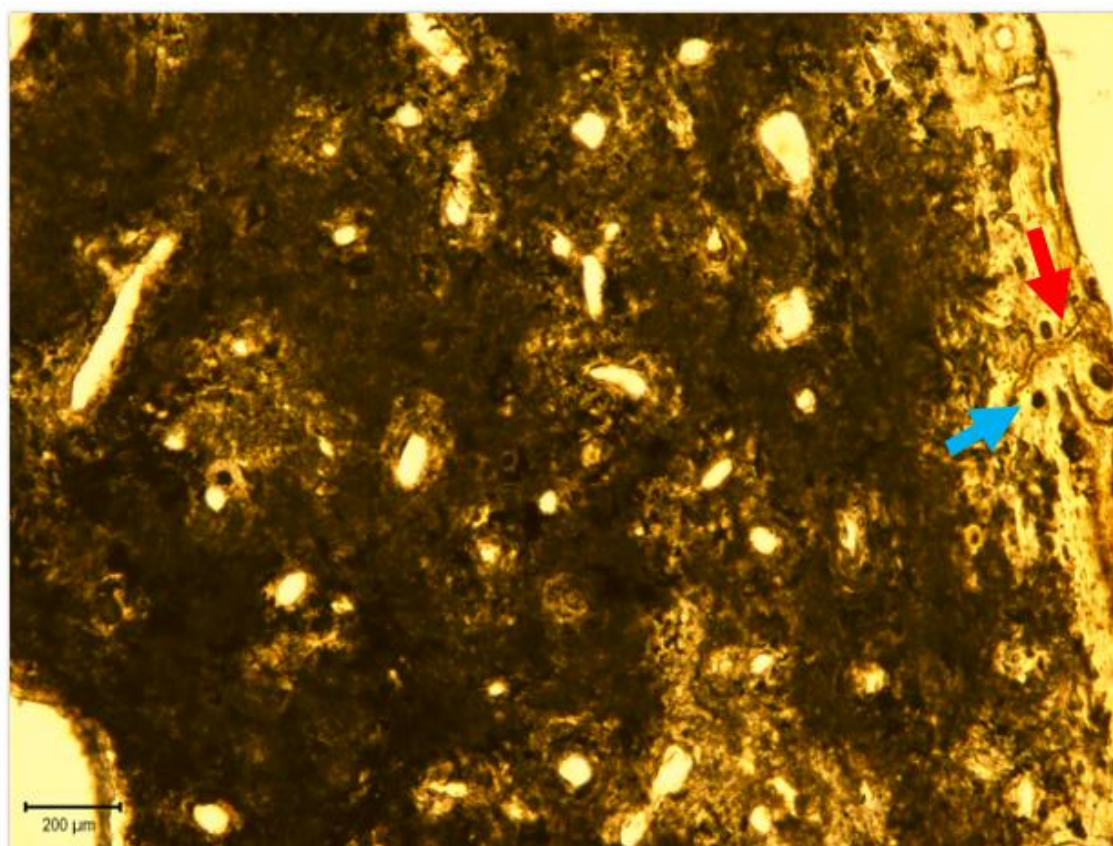


Figure 119. Non-Wedl MFD (OHI 1) – humerus with microfissures (red arrow) near the lamellate structure and inclusions (blue arrow). Magnification x5. Source: author

<sup>163</sup> See Appendix 6/6.4. Regional – south-east Wales/Microscopic results/Figure 118.

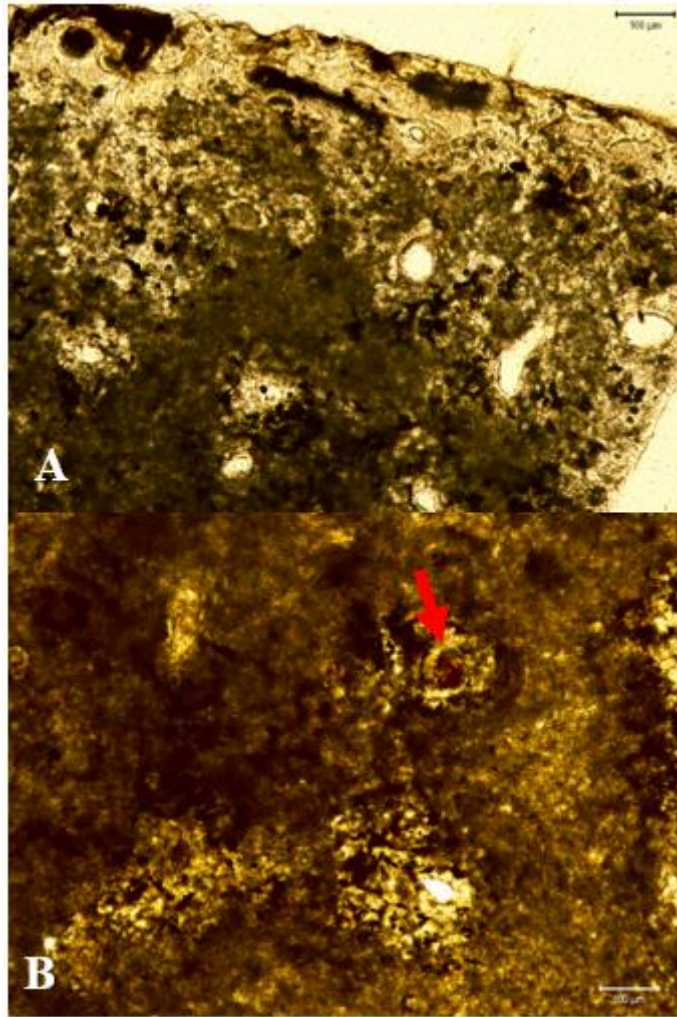


Figure 120. Low histological preservation – **A**. Tibia showing non-Wedl attack (OHI 1) with preserved areas near the periosteum and **B**. Tibia showing extensive MFD (OHI 0). Red inclusion in B (arrow). Magnification x10. Source: author

### **Taphonomy**

Histological preservation did not correlate with surface preservation scores. Whilst differences between low OHI scores and surface preservation were not as notable as in samples from south-central Wales, taphonomic modifications did not severely impact the elements (e.g. erosion, no evidence of weathering).

## Birefringence

Correlations between OHI scores and the Birefringence Index (Figure 121/Appendix 6)<sup>164</sup> were apparent amongst samples that demonstrated low (N=4, 66%) to no collagen survival (66%). Samples with the lowest OHI scores (0) showed no collagen survival in the microstructure whilst those demonstrating small preserved areas (OHI score 1) exhibited low birefringence levels<sup>165</sup>.

Surface taphonomy did not show clear associations with the preservation of the microstructure suggesting that elements withstood extensive surface degradation (low to medium scores) despite possible movements and circulation.

## Other microscopic observations

Inclusions were present in all samples, infiltrations were recorded in a single long bone sample (SNO: 20/16%), microstructural staining had affected half the samples (N=3, 50%) and minor signs of microcracking were noted in two long bones (33%) (Table 68 below and Tables 69-70/Appendix 6)<sup>166</sup>.

No patterns were evident amongst cranial and long bone survival with all demonstrating extensive bacterial attack. Remains were therefore articulated when bacterial attack was initiated and must have been exhumed at a later stage.

SNO	ELEM	OHI SCORE	INCL COLOUR	INFIL COLOUR	STAIN COLOUR	BIREFR
17	LB	1	brown - fair	no infiltrations identified	no staining identified	1
18	LB	1	brown - fair	no infiltrations identified	brown - dark (trabecular bone)	1
19	LB	0	red; red/brown - fair	no infiltrations identified	no staining identified/destroyed microstructure	0

<sup>164</sup> See Appendix 6/6.4. Regional – south-east Wales/Microscopic results/Figure 121.

<sup>165</sup> See Appendix 6/6.4. Regional – south-east Wales/Microscopic results for comparison between loss of birefringence and microstructural staining.

<sup>166</sup> See Appendix 6/6.4. Regional – south-east Wales/Microscopic results for discussion and Table 71 for intensity patterns.



20	LB	1	brown - dark, fair	black; brown/black	brown - fair (polar); red/brown (polar - periosteal surface)	1
21	LB	1	brown - fair	no infiltrations identified	no staining identified	1
22	CF	0	brown - dark	no infiltrations identified	brown/grey - fair(polar)	0

Table 68. Samples (N=9) from Ifton Quarry. Indication of element (ELEM) – cranial fragment (CF) and long bone (LB), OHI score, inclusion (INCL), infiltration (INFIL), microstructural staining (STAIN) colours and birefringence (BIREFR) scores (0=absent, 1=low).

#### 6.4.3. Short summary of burial depositions in south-east Wales

Overall results from south-east Wales (Ifton Quarry) support different treatment amongst individuals of different ages (based on radiocarbon dating results – Middle to Late Neolithic). Presence of dry fractures on several long bones suggests selection and circulation of body parts. Low OHI scores, suggest prior fully articulated burials that were subsequently exhumed and brought to the site for secondary burial. Selective deposition based on probable selection (crania with evidence of trauma) could have been responsible for the imbalances of the element frequencies (discussed in Chapter 8).

Absence of weathering and gnawing on remains suggests that remains were not exposed (sub-aerial exposure resulting in weathering) and access to the rock shelter from scavenger activity must have been limited (see Appendix 5). Different surface preservation and lack of correspondence between post-cranial and cranial/skull remains (e.g. mandibulae, vertebrae remains, ribs, loose teeth etc.) indicate that primary depositions might not have taken place on the site.

Whilst several, less robust and dense, bones could have degraded (e.g. juvenile remains), given surface preservation scores do not solely support this trajectory as taphonomic modification did not impact all remains severely. Evidence of dismemberment on long bones is absent whilst cranial remains appear manipulated with three skulls exhibiting signs of blunt and/or sharp force trauma. Nonetheless, as previous sampling was conducted on long bones (fractured ends sampled), it might have destroyed previous fracture morphology (possible fresh breaks).

Two crania (one adult and one juvenile) derive from separate periods in the Neolithic (Late Neolithic adult cranium and Middle Neolithic juvenile cranium) whilst dates from two separate femora ranged from the Middle to the Middle/Late Neolithic. These separate depositions further suggest that human remains might have been intentionally selected after manipulation and circulated/brought to the site for final deposition (see Chapter 8).

## **6.5. South-west Wales**

### **Frequency of skeletal elements**

Seven sites from south-west Wales examined in this section are presented in Table 71. Results primarily comprised of postcranial remains (N=182, 60.9%) accompanied by a number of skull elements (N=55, 18.4%), loose teeth (N=56, 18.7%) and a very low number of unidentified/miscellaneous fragments (N=6, 2%) (Figure 122). Further subdivision of elements based on bone category demonstrated that bones of the hands/feet (N=104, 42.8%) comprised a high proportion of the assemblage followed by skull elements (N=55, 22.6%), long bones (N=30, 12.3%), flat/irregular bones (N=28, 11.5) and vertebrae remains (N=20, 8.2%) (Figure 123). Canines were mostly represented amongst loose teeth (N=12, 21.4%). (Figure 124/Appendix 6)<sup>167</sup>.

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<sup>167</sup> See Appendix 6/6.5. South-west Wales/ Frequency of skeletal elements/Figure 124 in same section for details.

<b>SITE NAME</b>	<b>SITE TYPE</b>	<b>REGION</b>	<b>SITE DESCRIPTION</b>	<b>CONDITION</b>	<b>DATE/ PERIOD</b>	<b>BURIALS/MNI</b>	<b>NEO 14C IN BP YEARS WITH ERROR</b>
Little Hoyle Cave (Longbury Bank Cave)	Cave	Penally Pembrokeshire	Small cave, which lies on the NE end of the ridge of a promontory (26m OD) within a limestone ridge known as Longbury Bank	? Possibly disturbed after the series of excavations	Early to Middle Neolithic	MNI: c.11+ (adults ranging from 17-25 to 35-45 years based on surface wearing scoring for molars and one juvenile)	4660±80BP; 4930±80BP; 4750±75BP; 4880±90BP; 4893±22BP
Nanna's Cave	Cave/rock shelter	Caldey Island, Pembrokeshire	East facing rectangular cave/rock shelter, 1m wide by 3.5m high and c. 5m deep. The site is naturally hollowed in carboniferous limestone and lies near the top of coastal cliffs	Highly disturbed (series of excavations)	Mesolithic; Middle Neolithic	MNI: c.4+ (3 adults -1 Mesolithic-&1 juvenile)	8037±27BP; 4560±45BP; 4520±45BP

Hoyle's Mouth Cave	Cave	Penally, Pembrokeshire	Cave that lies in the outlier (younger rock formation amongst older) of carboniferous limestone in the parish of Penally	Unknown (possibly disturbed?)	Late Neo/Early BA	MNI: 3+ (2 adults, 1 adolescent)	4265 ± 65BP; 4225 ± 60BP
Ogof-yr-Benglog (New Cave/Skull Cave)	Cave/rock shelter	Caldey Island, Pembrokeshire	Small cave or rock shelter on the northeast corner of Caldey Island on carboniferous limestone.	Unknown/partially collapsed	Middle Neolithic	MNI: 1 (adult)	4660±45BP
Priory Farm Cave	Cave	Monkton, Pembrokeshire	Cave located on a valley-side above the Pembroke River (about 9 km from the coast) in a heavily quarried outcrop of Carboniferous limestone	Unknown	Middle Neolithic, Late BA and M/L Iron Age	MNI: 5+ (4 adults (1 Mid-Late Iron Age adult, 1 LBA), 1 juvenile)	4631±31BP; 2814±29BP; 2133±26BP

Ogof Garreg Hir	Cave	Stackpole, Pembrokeshire	Situated approx. 21m down a sheer 46m high cliff on the Carboniferous Limestone outcrops of south Pembrokeshire; one of a series/group of caves along the Castlemartin Cliffs	Half disturbed/half intact	Early Neolithic	1 (? juvenile/adolescent)	5056±39BP
Ogof Brân Goesgoch	Cave	Stackpole, Pembrokeshire	Cave located in the Castlemartin Cliff on the Carboniferous Limestone outcrops of south Pembrokeshire	Disturbed and inaccessible	Late Neolithic/Beaker	MNI: 2 (1 adult, 1 adolescent)	3939±35BP

Table 71. Sites in south-west Wales recorded and analysed in this research (see Appendix 5 for a complete review of each site).

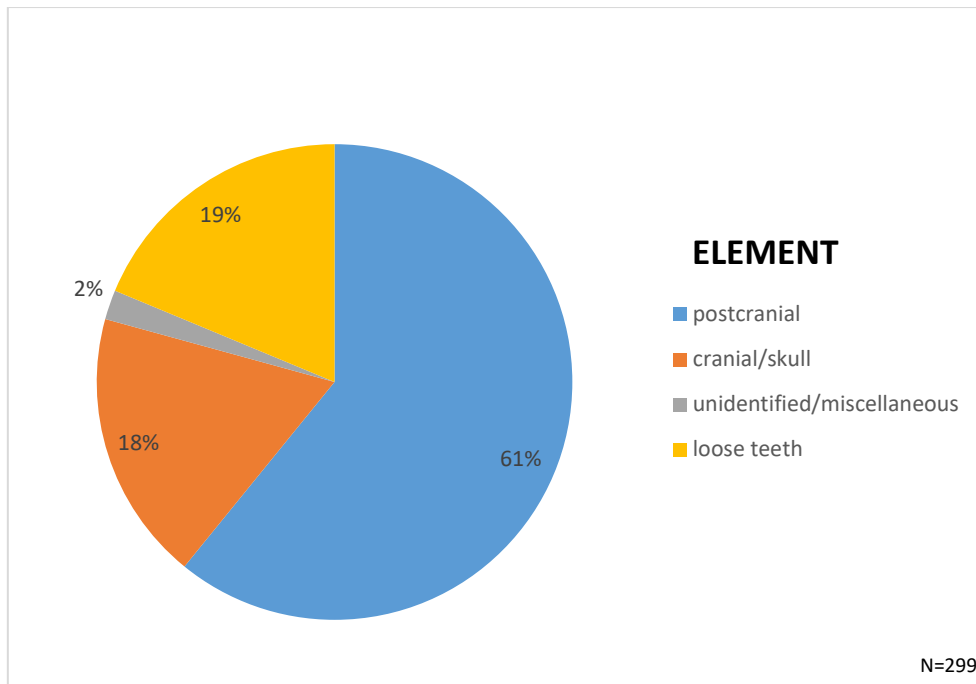


Figure 122. Element frequencies across sites located in south-west Wales (including loose teeth).

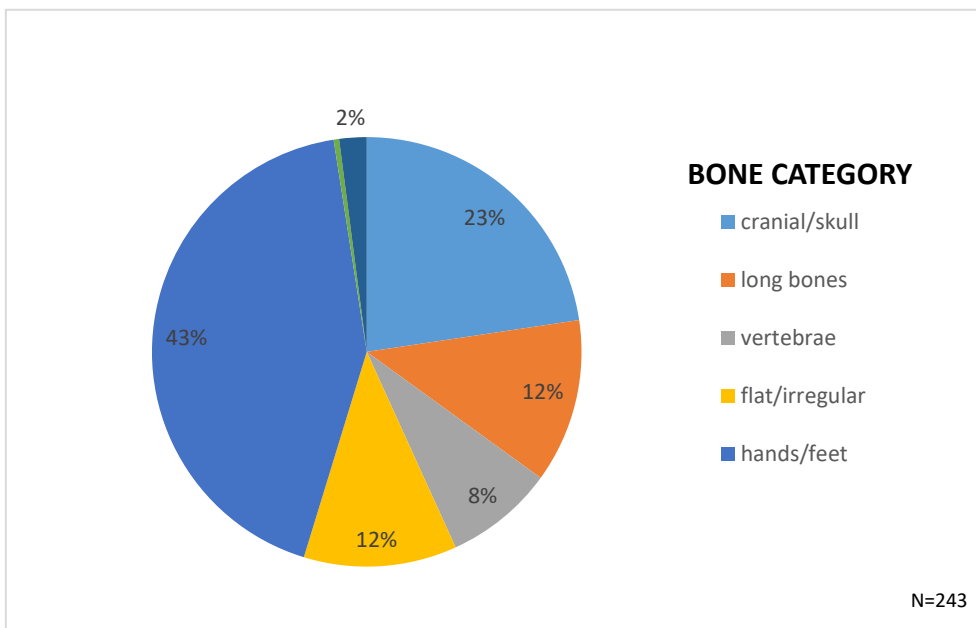


Figure 123. Element frequencies in south-west Wales based on bone category (excluding loose teeth).

Zone representation on long bones (N=30) using the proximal and/or the distal epiphysis indicates distinct patterns between shaft (N=22, 73.3%) and epiphyses (N=18, 60%) survival. Radii shafts (N=8) and femora epiphyses (N=5) are better represented compared to other long bones (Table 73/Appendix 6)<sup>168</sup>. Just over half of the assemblage (long bones) is impacted by surface erosion and staining (N=16, 53.3% for each) with some demonstrating signs of weathering (N=9) (Table 73 and Figure 125/Appendix 6)<sup>169</sup>.

### **Element completeness**

The vast majority (N=175, 72%) of disarticulated remains were fragmented/not complete with 68 elements (28%) demonstrating full zone completeness. Complete elements (primarily hands/feet, N=64) were notably well preserved with all other bone categories showing fluctuations in preservation (Figure 126 below and Table 74/Appendix 6)<sup>170</sup>. Different depositional patterns across sites throughout the Neolithic and differentiations between areas in south-west Wales (see Appendix 5) could justify distinct patterns of surface preservation and completeness.

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<sup>168</sup> See Appendix 6/6.5. South-west Wales/Frequency of skeletal elements/Table 73 for details.

<sup>169</sup> See Appendix 6/6.5. South-west Wales/Frequency of skeletal elements/ Figure 125 for surface preservation scores amongst long bones.

<sup>170</sup> See Appendix 6/6.5. South-west Wales/Element completeness for more details on hands/feet taphonomy and Table 74 for more observations on complete hands/feet and taphonomic modifications.

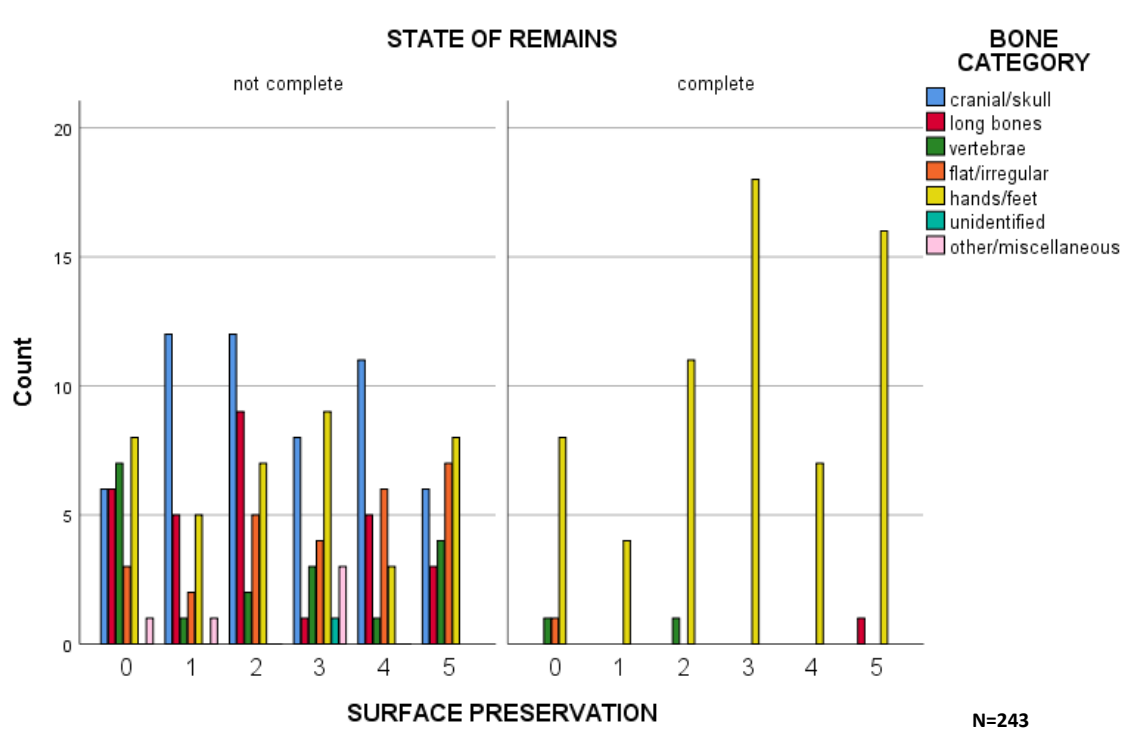


Figure 126. State or remains (complete vs fragmented/not complete) across sites in south-west Wales based on bone category and surface preservation. N=excluding loose teeth.

### MNI, demography and pathology<sup>171</sup>

Results across sites demonstrated a predominance of adults (N=20)<sup>172</sup>. Two adolescents and four juveniles were also noted. Three probable males, four probable females, two males and one female were recorded across sites.

### Pathology

Evidence of pathology (dental and/or degenerative) was identified on 13 elements and no patterns were observed (Figure 127-128/Appendix 6)<sup>173</sup>.

<sup>171</sup> See Chapter 5 for MNI and age/sex estimations.

<sup>172</sup> With younger adults also present.

<sup>173</sup> See Appendix 6/6.5. South-west Wales/MNI, demography and pathology for details including Figures 127-128.



## 6.5.1. Taphonomy – Macroscopic results

### 6.5.1.1. Weathering

Signs of weathering were recorded on 45 elements (18.5%) (Figure 129/Appendix 6)<sup>174</sup>. The number of weathered elements from south-west Wales was much higher than those from south-central and south-east Wales. Weathered elements included 36 bones (14.8%) reaching stage one, seven (2.9%) reaching stage two weathering and two reaching stage three (0.8%) (Figure 130 below and Figure 131/Appendix 6)<sup>175</sup>. The number of fragmented cranial/skull remains exhibiting weathering modifications (N=19/stage 1) was notable whilst complete hands/feet also reached stages 1 and 2 (N=5 and 6 respectively). Affected bones showed further signs of erosion, staining and abrasion (Table 75/Appendix 6)<sup>176</sup>. Presence of weathering could therefore indicate signs of sub-aerial exposure prior to final deposition as disturbances from burrowing animals (gnawing) were insignificant.

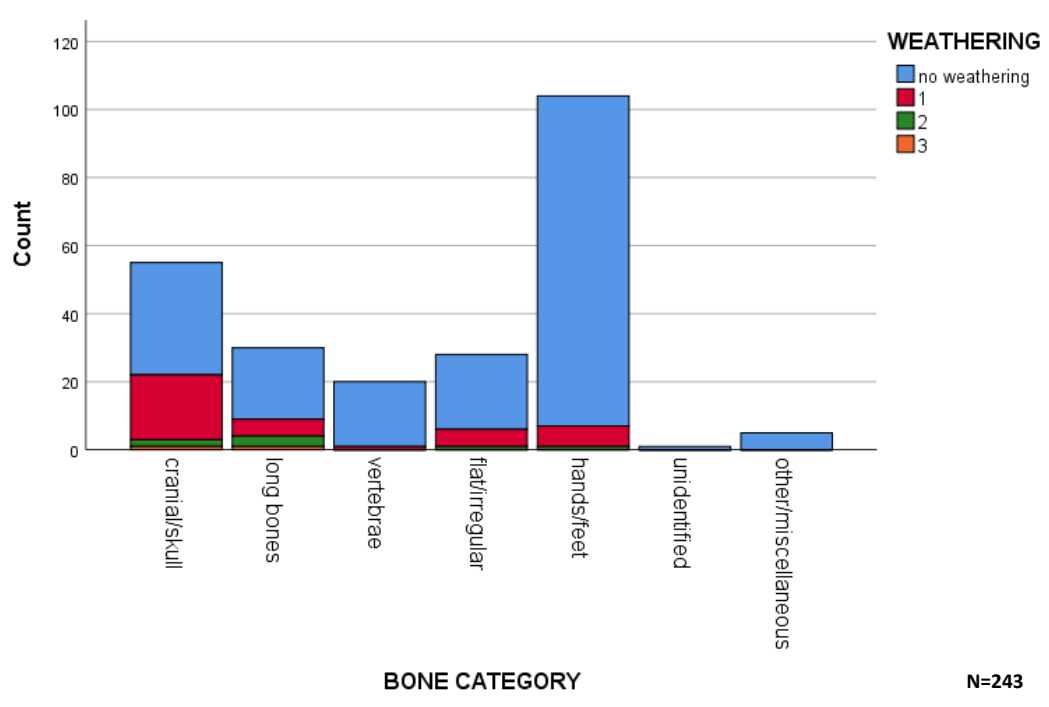


Figure 130. Weathering (WTH) absence/presence (stages 1-3) based on bone category

<sup>174</sup> See Appendix 6/6.5. South-west Wales/Taphonomy – Macroscopic results/Weathering/Figure 129 for more details.

<sup>175</sup> See Appendix 6/6.5. South-west Wales/Taphonomy – Macroscopic results/Weathering/Figure 131/Appendix 6 for specification of surface preservation scores of weathered elements.

<sup>176</sup> See Appendix 6/6.5. South-west Wales/Taphonomy – Macroscopic results/Weathering/Table 75 for more details.

### 6.5.1.2. Gnawing

Gnawing was present on a low number of human remains (N=9, 3.7%). See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results/Gnawing.

### 6.5.1.3. Erosion (rough surface texture and/or root etching)

Evidence of erosion (Figure 132) was present on just over half of the total assemblage across south-west Wales (N=129, 53.1%) primarily on bones of the hands/feet (N=50) and skull remains (N=41) (Figure 133 below, and Figure 134/Table 76 in Appendix 6)<sup>177</sup>.



Figure 132. Erosion and staining on humerus (Hoyle's Mouth Cave).  
Source: author

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<sup>177</sup> See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results/Erosion/Figure 134 and Table 76 for associations with surface preservation scores and other taphonomic modifications. Details and short presentation of these results were omitted in text as remains are mixed with multi-period deposits (e.g. Priory Farm Cave) and results did not have any interpretative potential for the discussion. This also applies to abrasion and staining and is mentioned in footnotes.

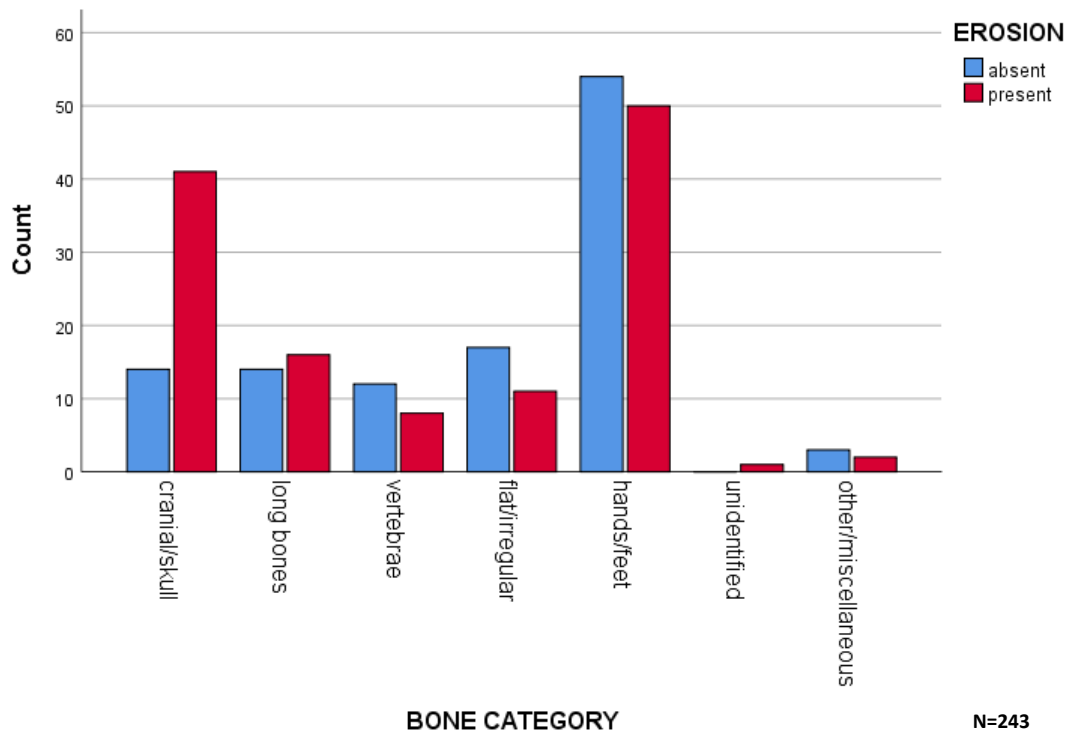


Figure 133. Frequency of erosion absence/presence based on bone category across sites in south-west Wales.

#### 6.5.1.4. Abrasion

Abrasion was identified on a lower proportion of the assemblage (N=89, 36.6%) across sites in south-west Wales primarily on hands/feet (N=39) and skull remains (N=23) (Figure 100 below, Figures 101-2 and Table 77/Appendix 6)<sup>178</sup>.

<sup>178</sup> See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results/Abrasion/ Figures 101-102 and Table 79/Appendix 6 for associations with surface preservation scores and other taphonomic modifications. Details and short presentation of these results were omitted in text as remains are mixed with multi-period deposits (e.g. Priory Farm Cave) and results did not have any interpretative potential for the discussion.

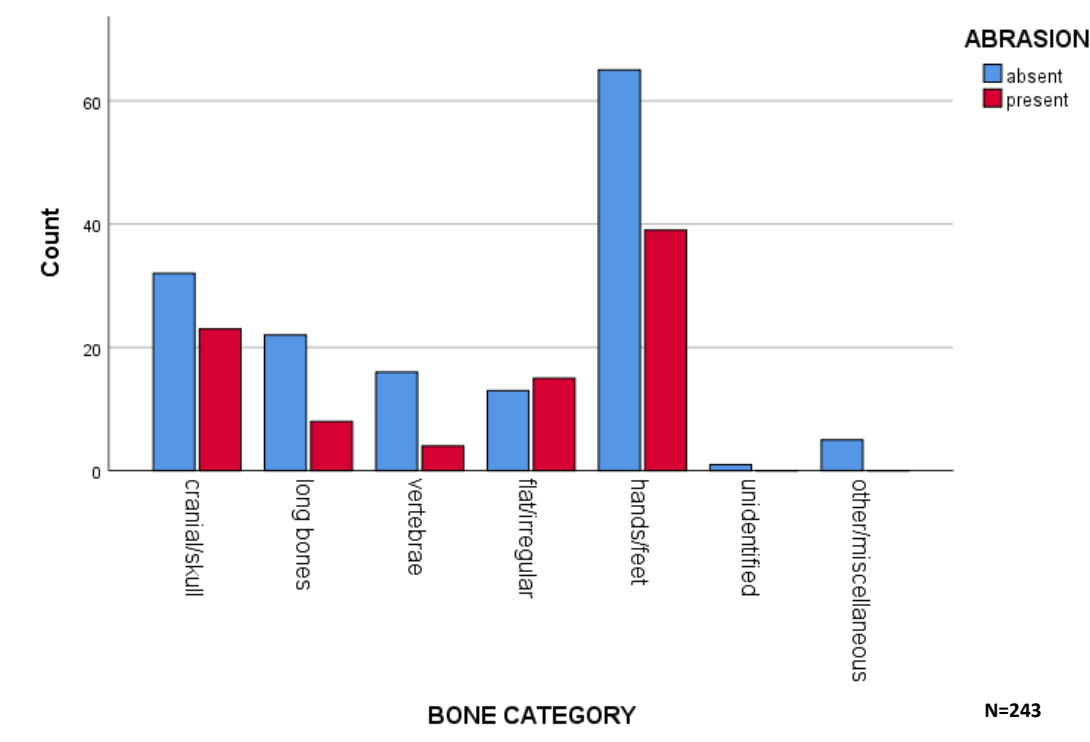


Figure 100. Presence/absence of abrasion based on bone category across south-central Wales.

#### 6.5.1. 5. Staining

Evidence of staining was noted on less than half of the assemblage across south-west Wales (N=91, 37.4%) primarily on fragmented skull elements (N=39) and complete bones of the hands/feet (N= 10) (Figures 135-136 and Table 78/Appendix 6)<sup>179</sup>. No particular pattern can be highlighted and no irregularities in staining patterns were visible.

#### 6.5.1.6. Trauma (*sharp/blunt force*)

Sharp force trauma was solely recorded on two long bones (SNOs: 460, 462/ Nanna's Cave). Defleshing marks on the medial epicondyle of an adult Middle Neolithic femur (SNO: 460) (Figure 137) were accompanied by heavy concretion, poor surface preservation (score 0) and modern damage. An adult humerus (SNO: 462) with a peri-mortem cutmark on the head was further impacted by erosion and concretion (surface

<sup>179</sup> See Figures 135-136 and Table 78 for staining presence/absence based on bone category, associations with surface preservation scores and other taphonomic modifications. Details and short presentation of these results were omitted in text as remains are mixed with multi-period deposits (e.g. Priory Farm Cave) and results did not have any interpretative potential for the discussion.

preservation score 2) and exhibited a fresh fracture (FFI score: 3). Taphonomic modifications resulted at an early stage, prior to burial and suggest evidence of manipulation. Evidence of peri-mortem manipulation was possibly practised during the Middle Neolithic, supporting violence and defleshing shortly after death<sup>180</sup>.



Figure 137. Cutmarks on Middle Neolithic femur (Nanna's Cave). Source: author

#### 6.5.1.7. *Burning*

No evidence of burning was identified on elements recovered from south-west Wales.

#### 6.5.1.8. *Fractures (fresh vs dry)*

Fractures were recorded on 14 long bones. The vast majority of identifiable fractures were fresh (N=11, 36%) with only two exhibiting dry fractures (6%) and one shaft exhibiting dry breaks on both proximal and distal ends (3%). Fractures on both ends were first treated as different entries to identify any separate fracture patterns, bringing the total number to 15 (Figure 138). Score two (fresh breaks) was most commonly

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<sup>180</sup> See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results/Fractures (fresh vs dry) for more details

recorded (26.7%) whilst scores one, three and six (20% for each) and zero, five (6.7% for each) demonstrated equal frequencies (Figure 138 below and Figure 139/Appendix 6)<sup>181</sup>. Evidence of weathering (stages 1 and 3) was noted only on fresh breaks (N=3) suggesting sub-aerial exposure after deliberate breakage (score 3) (Table 79)<sup>182</sup>.

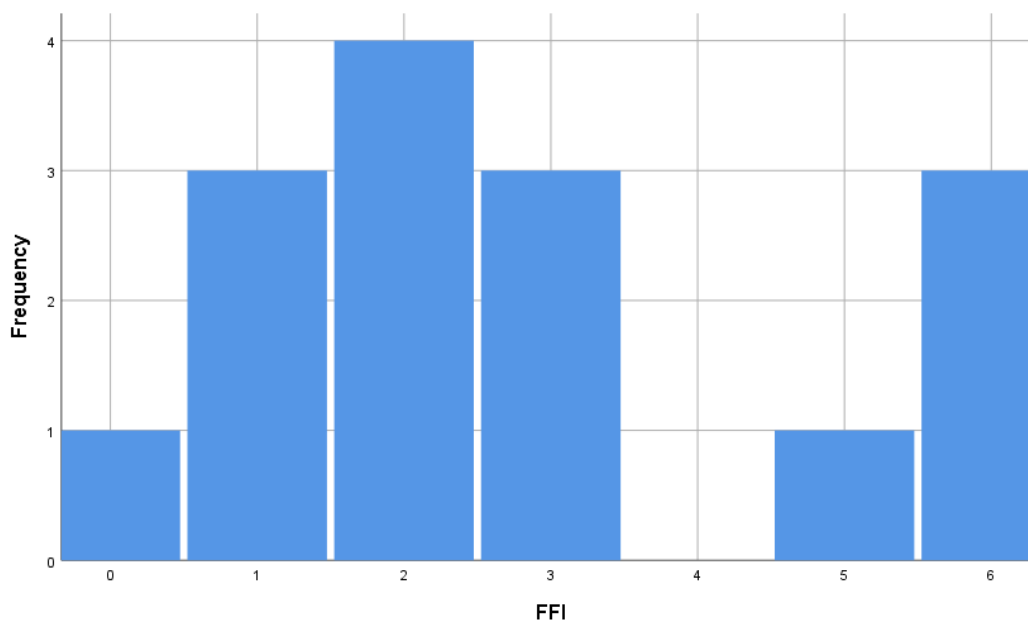


Figure 138. Total FFI (Fracture Freshness Index) scores across sites in south-west Wales. N=15 [double entries (N=1) for fractures identified in both proximal and distal epiphyses].

#### 6.5.1.9. Surface preservation

Surface preservation scores demonstrated abnormal distribution. Most elements scored medium/poor surface preservation (scores 3-2/N=47, 19.3% for each) followed by higher scores (score 5/N=45, 18.5%) and very poor preservation (score 0/N=41, 16.9%). Surface preservation based on bone category displayed irregularities with most hands/feet and flat/irregular bones demonstrating higher scores and the majority of cranial/skull remains, long bones and vertebrae fragments not surviving as intact

<sup>181</sup> See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results/Fractures (fresh vs dry) /Figure 139 for correlations with surface preservation.

<sup>182</sup> See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results /Fractures (fresh vs dry) for more details.

(Figure 140/Appendix 6)<sup>183</sup>. Different surface preservation scores and multi-use of sites (multi-period) suggest separate modes of deposition.

#### *6.5.1.10. Trampling*

Evidence of trampling was recorded on two elements (0.8%) (SNOs: 128/cranial fragment and 497/metatarsal) from two separate contexts (Little Hoyle's Cave and Nanna's Cave). This modification was not common amongst cave assemblages and is therefore considered circumstantial in south-west Wales<sup>184</sup>.

### **6.5.2. Microscopic results in south-west Wales**

Results from the microscopic analysis of three sites (N=18) (Little Hoyle Cave, Priory Farm Cave and Ogof Garreg Hir) are presented in this section. One mandible (Middle Neolithic, SNO: 45) was sampled from Priory Farm Cave due to the multi-period nature of this site and one ulna (Early Neolithic, SNO: 54) was sampled from Ogof Garreg Hir to compare samples across the board in south-west Wales. Results are therefore primarily dictated by Little Hoyle Cave.

#### **OHI scores and types of bacterial attack**

Histological destruction of all samples (N=18) resulted from bioerosion and non-Wedl attack. Almost half of the elements demonstrated poor histological preservation (score 1/N=8, 44%) (Figures 141-142) followed by higher scores (scores 2 and 3/N=4, 22% and N=3, 16% respectively) (Figure 143).

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<sup>183</sup> <sup>183</sup> See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results/Fractures (fresh vs dry) /Figure 140.

<sup>184</sup> See Appendix 6/6.5. South-west Wales/ Taphonomy – Macroscopic results /Trampling for details.

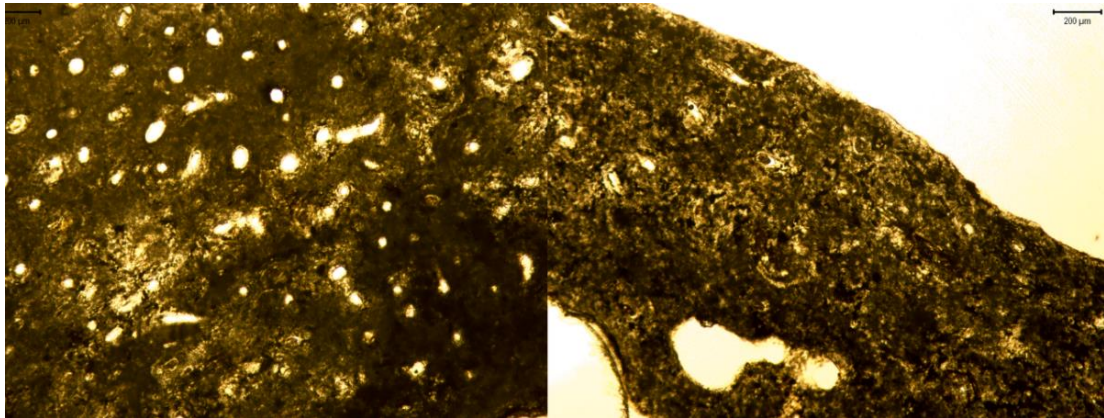


Figure 142. Extensive MFD in mandibulae samples – **A**: Little Hoyle Cave OHI 1 and **B**: Priory Farm Cave OHI 1. Magnification x5. Source: author

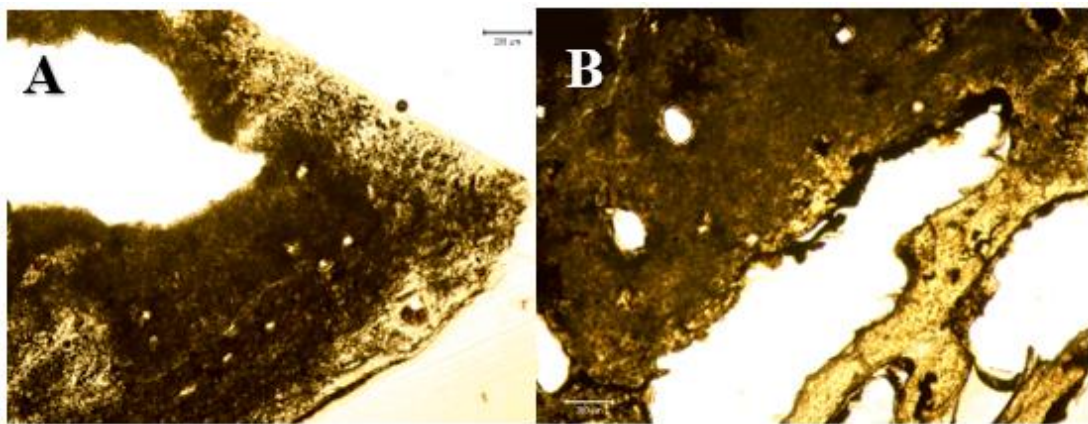


Figure 141. Extensive MFD (OHI 0) in humerus (Little Hoyle Cave). Magnification x5. Source: author

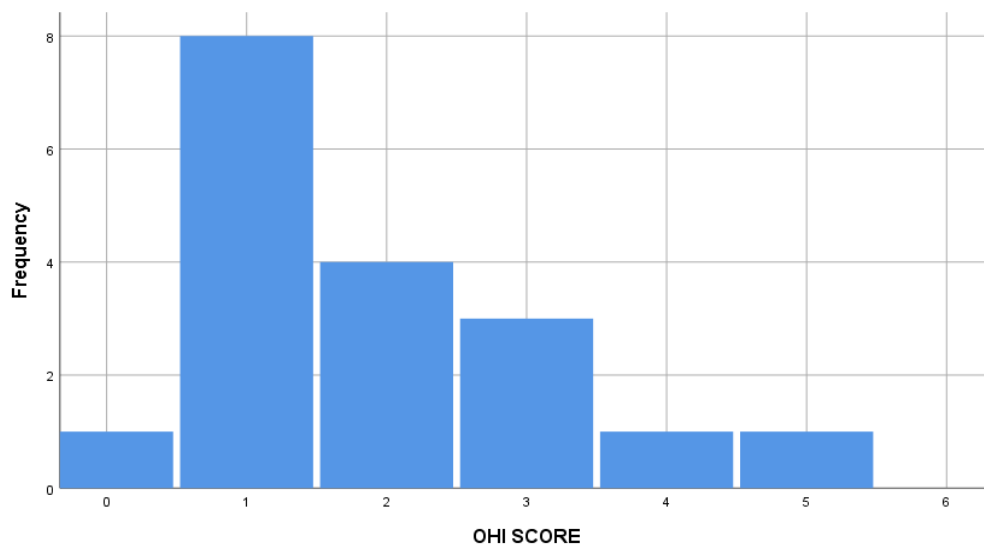


Figure 143. Histogram indicating OHI Scores across south-west Wales (Little Hoyle Cave and Priory Farm Cave). N=18.



A single mandible displayed perfect histological preservation (SNO: 2/score 5) whilst the microstructure of a long bone (SNO: 15) was completely destroyed by bacterial attack (score 0). Both elements derived from Little Hoyle Cave which was used from the Early to Middle Neolithic and suggests that treatment of the individuals must have differed. Mandible 2 (SNO/Database/Histology) demonstrated slight bacterial attack which did not affect the microstructural preservation (OHI 5) (Table 80/Appendix 6)<sup>185</sup>. Variation in bacterial attack demonstrates that the individuals were not all fully articulated when resulting in various MFD patterns. Most common non-Wedl attack was linear longitudinal (N=18) followed by budded (N=17, 94%) and lamellate MFD (N=12, 66%). Wedl tunnelling was absent.

### **Taphonomy**

Loss of collagen preservation could relate to demineralisation of bone from weathering and erosion as the vast majority of samples demonstrated signs of surface staining (N=15, 83%) and erosion (N=12, 66%). Elements exhibiting weathering (stage 1), erosion and surface staining (N=9) demonstrated medium to low OHI scores (3-1) and medium/low birefringence scores (2-1) scores. A single weathered, eroded and stained long bone (ulna SNO: 54) displayed high OHI (4) and birefringence (3) scores<sup>186</sup>. Overall, histological preservation did not necessarily correlate with surface preservation scores (Figure 144/Appendix 6)<sup>187</sup>. Surface preservation from samples with high microstructural destruction (OHI score: 1) varied (0-4).

Long bones (SNOs: 14/15) exhibiting fractures had not been weathered, however the microstructure of SNO 14 (dry fracture) was better preserved (OHI score: 3) compared to SNO 15 (fresh fracture/OHI score: 0). Results amongst OHI scores and fracture morphology support differentiation during peri- and post-mortem manipulation involving possible exhumation that did not allow the bacteria to destroy the whole microstructure (OHI score: 3). On the contrary, a dry fracture could have been caused by disturbances or circulation. All abovementioned samples derive from Little Hoyle

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<sup>185</sup> See Appendix 6/6.5. South-west Wales/Microscopic results for further comparison (ulna SNO: 54).

<sup>186</sup> See Appendix 6/6.5. South-west Wales/Microscopic results for more details on taphonomy,

<sup>187</sup> Excluding SNO: 2 (OHI score: 5 OHI/surface preservation score 5).

Cave which further supports separate taphonomic trajectories of the individuals discovered<sup>188</sup>.

## **Birefringence**

Correlations between OHI scores and the Birefringence Index were apparent (Table 81). The element with the highest OHI score indicated overall high collagen preservation however, small collagen loss and areas with low to no birefringence were observed in places within the microstructure. Ulna 54 (OHI score: 4) was the single sample with high collagen preservation. The majority of the samples scored medium (2) (N=8, 44%) to low (N=7, 38%) on the Birefringence Index (Figure 145/Appendix 6). Loss of collagen birefringence and low preservation were therefore associated with low OHI scores (primarily OHI score 1) amongst the assemblage (long bones, mandibulae and cranial fragments) whilst medium birefringence scores were correlated with medium/high OHI scores (4-5)<sup>189</sup>.

<b>OHI SCORE</b>	<b>BIREFRINGENCE INDEX</b>			
	<b>NONE (0)</b>	<b>LOW (1)</b>	<b>MEDIUM (2)</b>	<b>HIGH (3)</b>
0	0	1	0	0
1	2	5	1	0
2	0	1	3	0
3	0	0	3	0
4	0	0	0	1
5	0	0	1	0

Table 81. Birefringence scores from Little Hoyle Cave and Priory Farm Cave cross-referenced with OHI Scores. N=18.

<sup>188</sup> See Appendix 6/6.5. South-west Wales/Microscopic results for comparison with mandible from Priory Farm Cave (SNO: 45/Appendix 1/Sheet 3/Histology)

<sup>189</sup> See Appendix 6/6.5. South-west Wales/Microscopic results for comparison between loss of birefringence and microstructural staining.

### **Other microscopic observations**

Inclusions, infiltrations and microstructural staining/discolouration were observed in all samples with microcracking also identified in the microstructure of most samples (N=13, 72%) (Table 83/Appendix 6)<sup>190</sup>. Microstructural staining was further correlated with surface staining in the majority of samples (N=15) with microcracking and erosion (N=9)/weathering (N=9) not affecting all elements (Table 84/Appendix 6). No particular pattern resulted from this analysis as the majority of most affected elements were given low OHI scores (OHI score 1 most frequent score amongst the assemblage).

### **6.5.3 Radiocarbon dating results**

The Early Neolithic date ( $4893 \pm 22$  BP) from Little Hoyle Cave verified a continuous use of the site from the Early to the Middle Neolithic (based on the four available radiocarbon dates) with separate depositions taking place in the cave, either as parts of different episodes using the chimney infilling for discarding human remains, or after collection and deposition in the infilling. Whilst stratigraphic information is not available for the vast majority of the assemblage, accurate recording, taphonomic analysis and radiocarbon dating results have created a much clearer narrative for the history of deposition at this site.

### **6.5.4. Short summary of burial depositions in south-west Wales**

Depositions from the Early to the Late Neolithic/Beaker periods (including two sites with earlier/Mesolithic and later/Bronze Age and Iron Age activity) in south-west Wales demonstrate temporal variation in burial treatment. Multi-period use of sites (Nanna's Cave and Priory Farm Cave) with two more demonstrating borderline Late Neolithic/Early Bronze Age-Beaker depositions (Hoyle's Mouth Cave, Ogof Brân Goesgoch) might be responsible for differentiations in preservation between elements.

Presence of weathering solely on fresh and not dry fractures further supports those different modes of deposition and manipulation of the remains took place. Elements

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<sup>190</sup>See Appendix 6/6.5. South-west Wales/Microscopic results/Table 82 for pattern intensities and discussion discolouration patterns in the microstructure.

were not extensively disturbed and whilst dry breaks on long bones were apparent, variation in surface preservation scores amongst fresh breaks and presence of sharp force trauma on two limbs from Nanna's Cave support patterns of early manipulation prior to deposition.

Survival of smaller elements such as hands/feet suggests presence of primary burials. The extremities disarticulate from the body rapidly and become buried deeper in the cave avoiding subsequent disturbances. This could justify the higher surface preservation scores of smaller elements (hands/feet) with some buried deeper/further in the cave avoiding further fragmentation. Amongst these elements however, a range of different body parts appear to have been manipulated, exposed and/or buried in separate parts of the cave or in separate periods. Possible selection of burial areas in caves are supported by the presence/absence of agents such as abrasion, weathering, erosion and staining. Therefore, burials in caves of south-west Wales suggest complex and multi-stage events comprising of both primary and secondary/final burials.

## **6.6. North Wales**

### **Frequency of skeletal elements**

Seven sites examined in this section are presented in Table 85. Results largely comprised of postcranial remains (N=560, 77.8%), cranial/skull (N=48, 6.8%), unidentified/miscellaneous remains (N=21, 3%), loose teeth (N=79) and three burnt fragments (0.4%) (Figure 146).

Further sub-division of elements based on bone category demonstrated that flat/irregular bones (N=168, 26.6%), hands/feet (N=162, 25.6%) and long bones (N=135, 21.4%) had the highest representation (Figure 147). Vertebrae remains comprised a lower proportion of the assemblage (N=94, 14.9%) followed by cranial/skull remains (N=48, 7.6%), other/miscellaneous remains (N=19, 3.0%) and unidentified and burnt fragments (N=3, 0.5% for each). Incisors and premolars survived almost equally across sites (N=24 and 23 respectively) followed by molars (N=18) and canines (N=12) (Figure 148/Appendix 6)<sup>191</sup>.

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<sup>191</sup> See Appendix 6/6.6. North Wales/Frequency of skeletal elements/Figure 148.

<b>SITE NAME</b>	<b>SITE TYPE</b>	<b>REGION</b>	<b>SITE DESCRIPTION</b>	<b>CONDITION</b>	<b>DATE/ PERIOD</b>	<b>BURIALS/MNI</b>	<b>NEO 14C IN BP YEARS WITH ERROR</b>
Cae Gronw Cave	Cave/ rock shelter	Cefnmeiriadog, Denbighshire	A shelter type cave on the north-east side of the Elwy valley (on Carboniferous Limestone outcrop) about 300m north of Pontnewydd cave	Intact (backfilling)	Early and Late Neolithic	2 (adults)	3955±60BP; 4918±20BP
Ogof Colomendy	Cave	Gwernymynydd, Flintshire	Cave situated on a limestone outcrop (facing south), about 5km west of Mold with a triangular-shaped entrance, 1.4m high and 1m wide	? Intact	Middle to Late Neolithic and E/M BA	c. 5+ (3 adults, 1 EBA adolescent/adult, 1 M/Neolithic younger adult or adolescent)	4408±33BP; 4081±26BP; 3518±35BP; 3314±26BP

Orchid Cave	Cave	Llanferres, Denbighshire	West facing cave situated near Big Covert at the base of a Limestone cliff running approx. North-South	Disturbed	Late Neolithic/Early BA	4+ (2 adults, 1 adolescent, 1 perinate)	4170±100BP; 4100±20BP
Pontnewydd Cave (Bont Newydd Cave)	Cave	Saint Asaph, Denbighshire	Cave located at the Elwy Valley close to the western edge of the Vale of Clwyd where the main outcrop of Carboniferous Limestone in north Wales is situated	Inaccessible (to the public)	Mesolithic and Middle Neolithic	?5+ (two adults, three juveniles); (3+ including two juveniles and one adult based on available remains)	7420±90BP; 4495±70BP
Gop Cave	Cave (interconnected cave and rock-shelter)	Trelawnyd & Gwaenysgor, Flintshire	Natural limestone cave (interconnected rock-shelter and cave) with two entrances located at the end of the line of hills and	Intact/Good	Middle (to Late) Neolithic	4+ [3 adults (1 younger adult), 1 juvenile]	4414±30BP; 4381±29BP; 4357±30BP

			forms the east boundary of the Vale of Clwyd near Prestatyn approx. 50m to the south of the archaeological site of Gop cairn				
Ogof Pant-y-Wennol	Cave	Llandudno, Conwy	Large coastal cave located at the Carboniferous Limestone outcrops of Llandudno with a wide entrance approx. 5.2m wide by 8.6m long and 3m high, protected by an overhanging rock	Disturbed?	Early and Middle Neolithic	5+ (2 adults, 1 adolescent/younger adult, 1 juvenile, 1 perinate)	4982±36BP; 4962±32BP; 4657±32BP
Little Orme's Head Quarry	Natural fissure; Quarring took	Llandudno, Conwy	A natural fissure situated at Little Orme's Head, Llandudno, formed	Inaccessible	Early/Middle Neolithic	1 (adult/female)	4720±50BP

	place in the area		of Carboniferous Limestone (Middle White Limestone) reaching an elevation of c.122m.				
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Table 85. Sites in north Wales analysed in this research (see Appendix 5 for a complete review of each site).



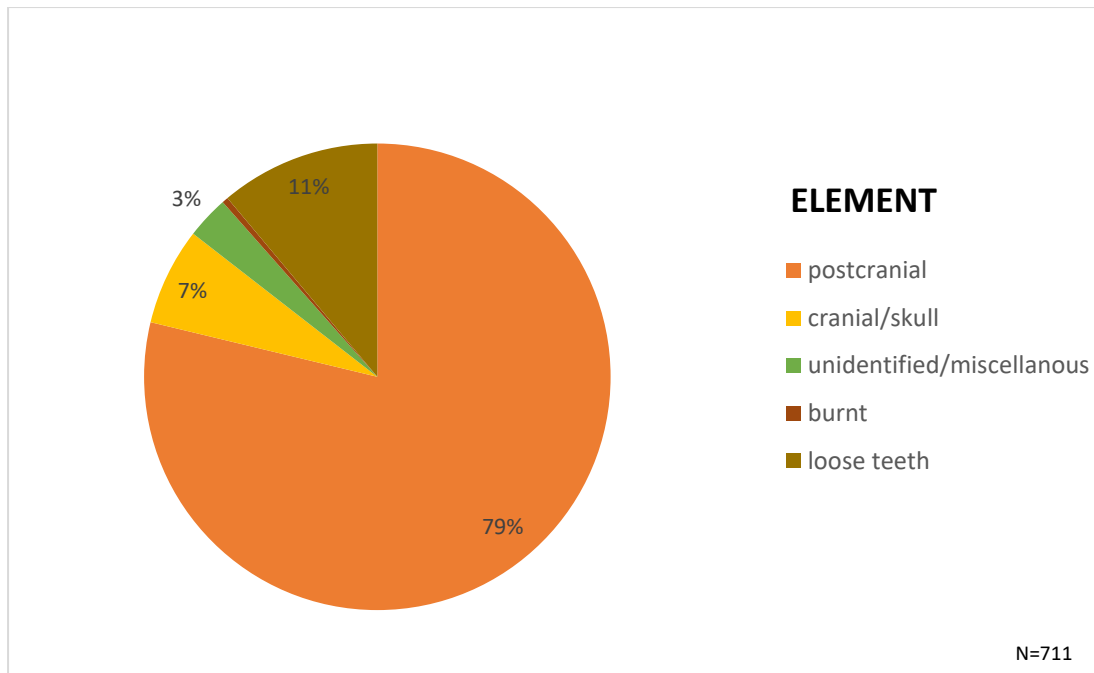


Figure 146. Element frequencies across sites located in north Wales (including loose teeth and Little Orme's Head Quarry's assemblage). See 6.2 for including burnt fragments in element category.

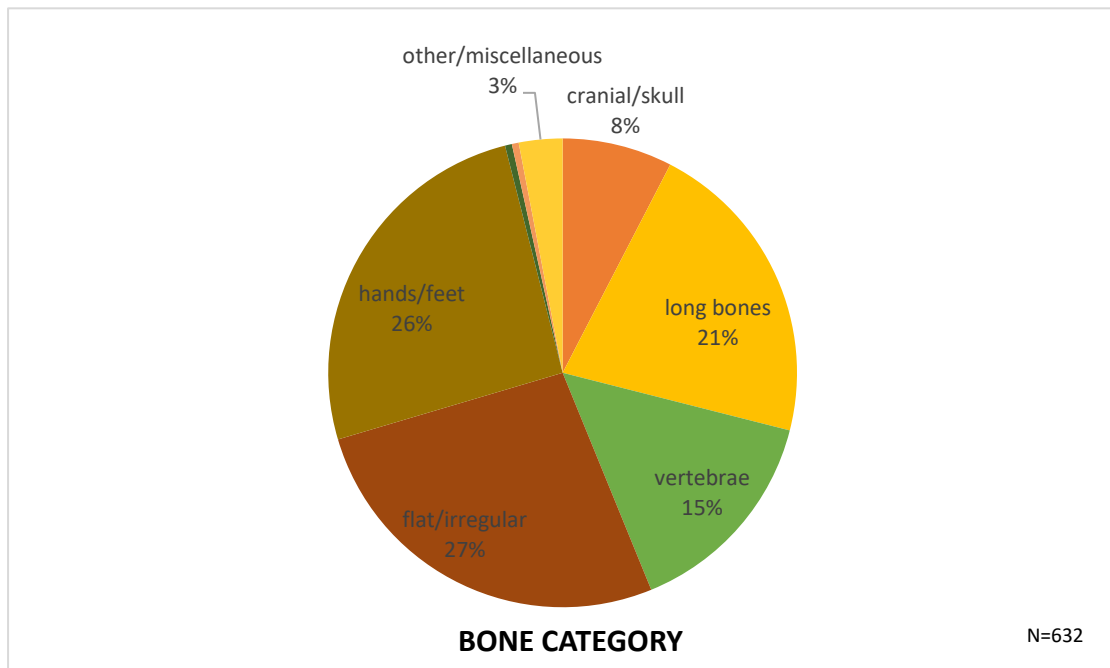


Figure 147. Element frequencies across sites in north Wales based on bone category (excluding loose teeth and Little Orme's Head Quarry's assemblage). See 6.2 for including burnt fragments in bone category.

Zone representation on long bones (N=136)<sup>192</sup> using the proximal and/or the distal epiphysis demonstrated higher shaft (N=98) than epiphysis survival (N=77) (Table 86). The rate of survival of both epiphysis and shafts was overall significantly higher in north Wales compared to other regions. Femora (N=18), tibiae (N=17) and humeri (N=16) epiphysis survival was approximately equal whilst ulnae shafts (N=30) were considerably more common than other limbs (Table 86). The majority of long bones demonstrated medium surface preservation (N=34, 25%) followed by lower scores (0-2) across north Wales (Figure 149/Appendix 6)<sup>193</sup>.

LONG BONE	EPIPHYSIS	EPIPHYSIS	SHAFT	SHAFT
	ABSENT	PRESENT	ABSENT	PRESENT
HUMERUS	4	16	7	13
RADIUS	11	11	7	15
ULNA	22	11	3	30
FEMUR	5	18	8	15
TIBIA	7	17	6	18
FIBULA	6	4	3	7
SHAFT UN	4	0	4	0

Table 86. Long bone representation across north Wales. Unidentified shaft (SHAFT UN) N=136.

The frequency of gnawing identified on long bones in north Wales was the highest amongst all other assemblages. Half of the assemblage had been impacted by surface erosion (N=68, 50%)<sup>194</sup>. Weathering was identified on 20 long bones with most demonstrating low stages of weathering (stage 1) (N=14) (Table 87/Appendix 6)<sup>195</sup>.

<sup>192</sup> N= SNO 668 (unidentified shaft) added in zone frequencies, recorded as miscellaneous/unidentified shaft fragment (ulna or radius) in frequencies, bringing the total N to 136 compared to 135 (frequencies result).

<sup>193</sup> See Appendix 6/6.6. North Wales/Frequency of skeletal elements/Figure 149.

<sup>194</sup> Including Little Orme's Head Quarry (secondary data/erosion recorded). However, all other taphonomic modifications (weathering, abrasion, staining and surface preservation) excluding Little Orme's Head Quarry and total N=122.

<sup>195</sup> See Appendix 6/6.6. North Wales/Frequency of skeletal elements and Table 87 for more details on surface taphonomy.

## **Element completeness**

The vast majority (N=518, 82%) of disarticulated remains in caves across north Wales were fragmented/not complete with only 114 elements (18%) demonstrating full zone completeness (Figure 150 and Tables 88-90/Appendix 6)<sup>196</sup>.

## **MNI, demography and pathology<sup>197</sup>**

Results demonstrated a predominance of adults (N=14). Two adolescents, three juveniles and two perinates were further recorded. Probable females had the highest representation amongst sites (N=5) whereas females, males and probable males were noted in equal frequencies (N=2 for each).

## **Pathology**

Evidence of pathology was present on 38 elements including both dental (caries/calculus/absences) (Figure 151/Appendix 6) (N=8) and degenerative disorders (lesions, periostitis, porosity and/or osteophytes) (N=30)<sup>198</sup>.

### **6.6.1. Taphonomy – Macroscopic results**

#### *6.6.1.1. Weathering*

Weathering was recorded on 62 elements across sites (10.7%) (Figure 152/Appendix 6) with the vast majority reaching stage one (N=50, 8.6%) (Figure 153). Advanced stages of weathering were further identified in smaller frequencies (N=12) reaching stages two (N=7, 1.2%), three (N=4, 0.7%) and four (N=1, 0.2%). Flat/irregular bones had been most affected by weathering (stage 1/N=17) followed by long bones (stage 1/N=14) and bones of the hands/feet (stage 1/N=11) (Figure 154 below, Table 91 and Figure 155/Appendix 6)<sup>199</sup>.

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<sup>196</sup> See Appendix 6/6.6. North Wales/Element completeness/Figure 150 for surface preservation scores and Tables 88-90 for further discussion on elements completeness amongst bone categories and taphonomy.

<sup>197</sup> See Chapter 5 for MNI and age/sex estimations.

<sup>198</sup> See Appendix 6/6.6. North Wales/MNI, demography and pathology for details on affected remains from Little Orme's Head Quarry and Figure 151 for dental pathology.

<sup>199</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Table 91 for correlations with other taphonomic modifications and Figure 155 for overall surface preservation on weathered elements.



Figure 153. Weathering stage one on ulna (Orchid Cave). Source: autor

Gnawing marks were recorded on seven elements reaching weathering stage one (four long bones, two hand bones and one rib) from Gop Cave (SNOs: 538, 553), Ogof Colomendy (SNOs: 653, 679, 792, 823) and Ogof Pant-y-Wennol (SNO: 1337) and one metacarpal (Gop cave/ SNO: 565) reaching stage two. Surface preservation scores on gnawed and weathered elements fluctuated from very low (0) to high (5). This variation possibly indicates short sub-aerial exposure prior to burial with subsequent disturbances or deposition close to cave entrances resulting in further degradation and poor surface preservation scores<sup>200</sup>.

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<sup>200</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Weathering for more details on well-preserved elements from Pontnewydd Cave, Orchid Cave, Gop Cave and Ogof Colomendy which present a minority amongst the surviving assemblages.

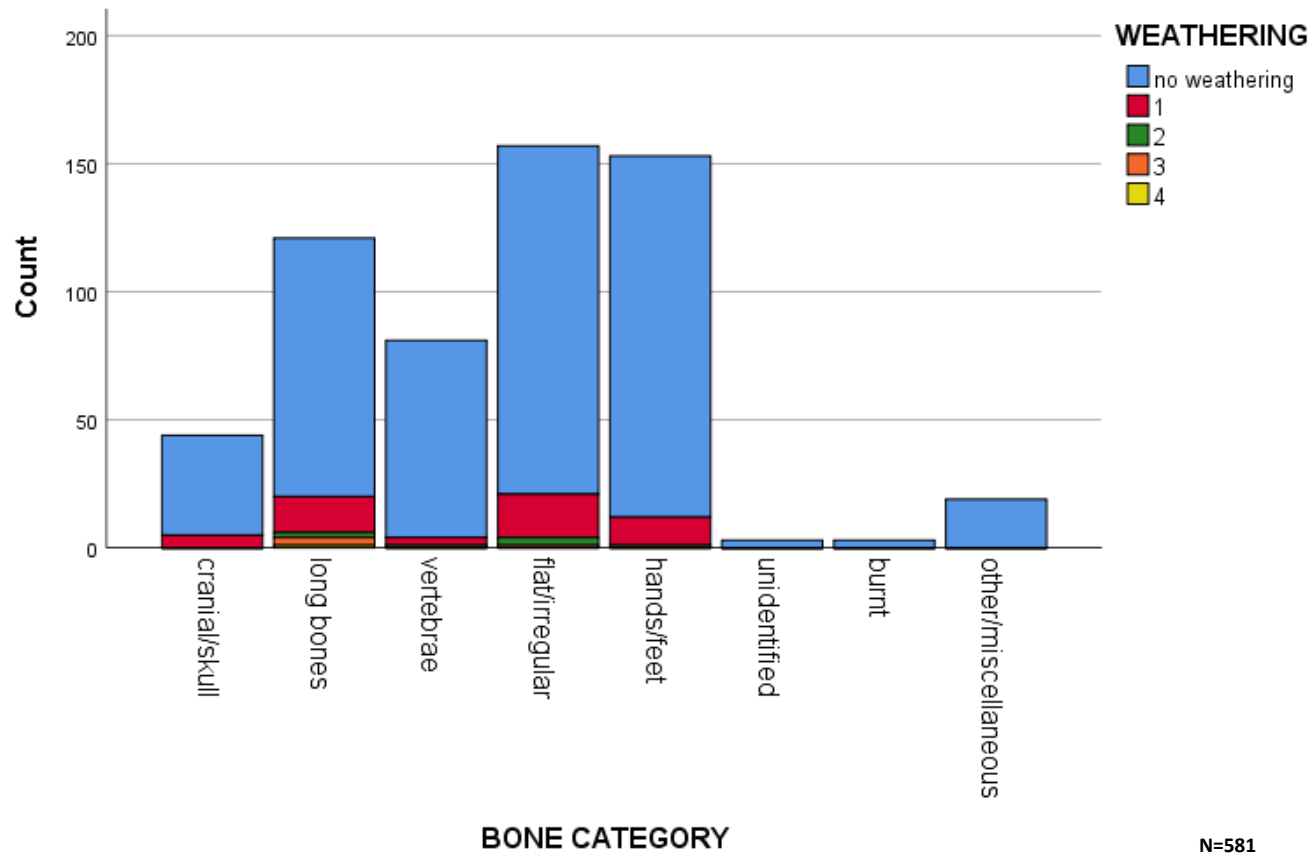


Figure 154. Weathering absence/presence (stages 1-4) based on bone category. N= excluding human remains from Little Orme's Head quarry (no primary analysis).

### 6.6.1.2. Gnawing

Evidence of gnawing (Figure 156) was recorded on a high number of elements (N=59, 10.2%), compared to sites in south Wales, primarily on long bones (N=42) (Figure 157). Hands/feet (N=12), flat/irregular bones (N=3), skull (N=1) and a single vertebra also exhibited gnawing marks. Other taphonomic modification correlated with gnawing include surface erosion, (N=31) staining (N=46) and abrasion (N=22) (Table 92/Appendix 6)<sup>201</sup>.



Figure 156. Gnawing on ulna (Orchid Cave). Source: author

Weathering stage one was recorded on seven gnawed elements from Gop Cave (SNOs: 538, 553), Ogof Colomendy (SNOs: 653, 679, 792, 823) and Ogof Pant-y-Wennol (SNO: 337) whilst a single metacarpal (Gop Cave/ SNO: 565) reached weathering stage two. Surface preservation scores on all gnawed and weathered elements fluctuated (0-5) suggesting that these resulted from either short-length disturbances (higher surface preservation), or disturbances prior to exposure (weathering). One gnawed humerus (SNO: 686/Ogof Colomendy) exhibited a cutmark under the femoral head, evidence of staining and low surface preservation (score 1) which suggests peri-mortem manipulation either on-site or prior to deposition followed by scavenger disturbances.

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<sup>201</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Gnawing/Table 92.

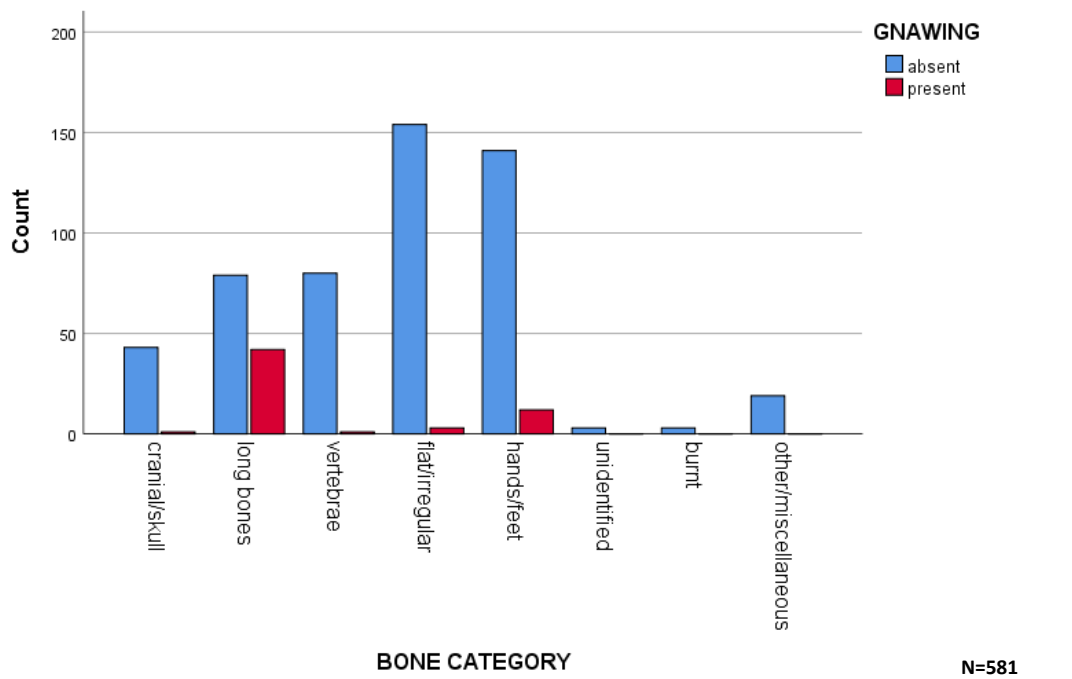


Figure 157. Frequency of gnawing based on bone category across sites in north Wales (excluding Little Orme’s Head Quarry/unknown modification).

### 6.6.1.3. Erosion (rough surface texture and/or root etching)

Signs of surface erosion were recorded on almost half of the assemblage (N=302/47.8%) including elements recovered from Little Orme’s Head Quarry (secondary data). Erosion was widely identified on flat/irregular bones (N=108) whilst hands/feet (N=81), long bones (N=67) and cranial/skull fragments (N=23) demonstrated similar frequencies between eroded and non-eroded remains.

Results could suggest different treatment and/or deposition in separate parts of the cave (Figure 158). However, due to the multi-period nature of two sites<sup>202</sup>, results could reflect separate episodes of deposition from the Middle/Late Neolithic to the Early/Middle Bronze Age. A high number of eroded elements showed signs of weathering stage one (N=36), staining (N=222) and abrasion (N=165) (Table 93 and Figure 159/Appendix 6)<sup>203</sup>.

<sup>202</sup> Primarily from Ogof Colomendy as Pontnewydd Cave’s assemblage consists of 3 elements.

<sup>203</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Erosion/Table 93 for details amongst eroded remains and other taphonomic agents and Figure 159 for surface preservation amongst eroded and non-eroded remains.

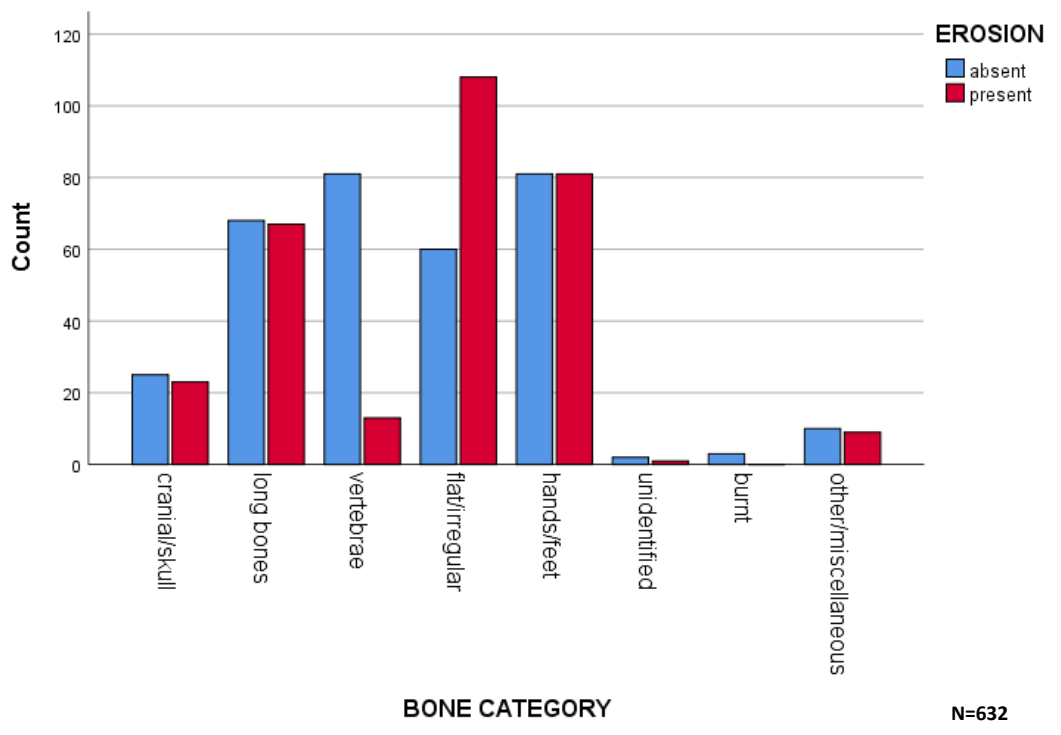


Figure 158. Frequency of erosion absence/presence based on bone category across sites in north Wales (including Little Orme’s Head Quarry/secondary data).

#### 6.6.1.4. Abrasion

Abrasion was recorded on almost half of the assemblage (N=388, 66.8%) and was largely identified on bones of the hands/feet (N=99) and flat/irregular bones (N=61) (Figure 160). Weathering (stage 1) and erosion were often accompanied by abrasion (N=33 and 165 respectively) whilst staining and gnawing were almost equally identified on both abraded and non-abraded remains (Figure 161 and Tables 94-95/Appendix 6)<sup>204</sup>.

<sup>204</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Abrasion for Figure 161 and Tables 94-95.



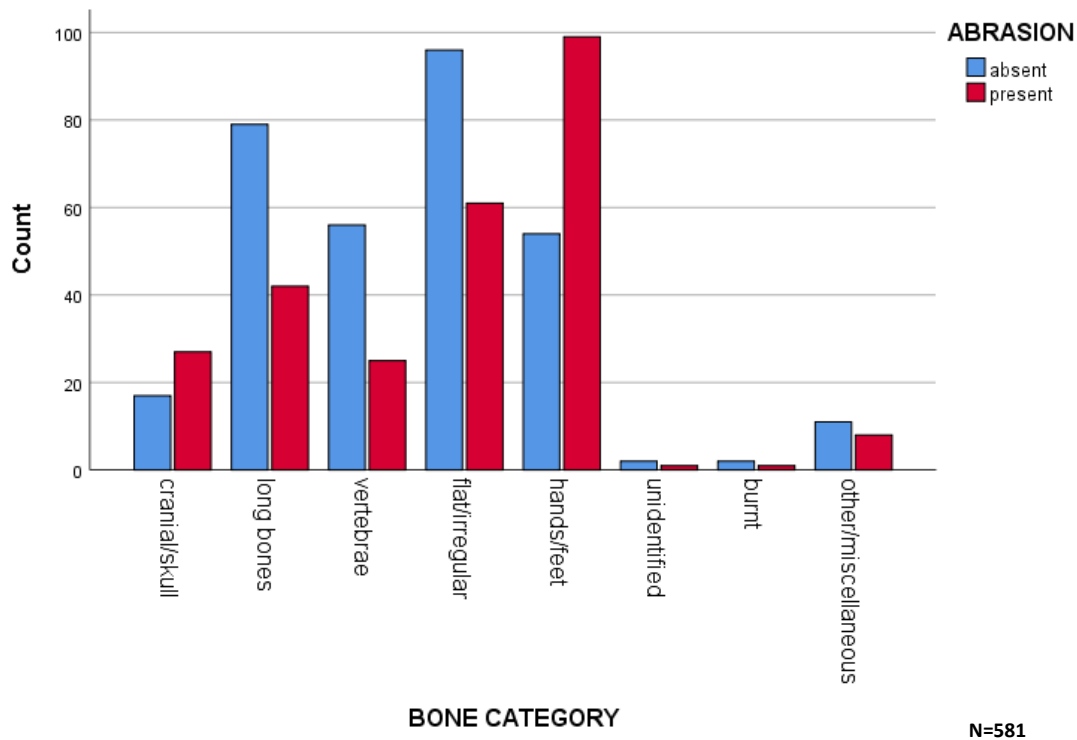


Figure 160. Presence/absence of abrasion based on bone category across north Wales. N=excluding Little Orme's Head Quarry (unknown modification).

#### 6.6.1.5. Staining

Evidence of staining was noted on a high number of elements (N=388, 66.8%) across north Wales primarily on fragmented/not complete flat/irregular bones (N=127) and long bones (N=83) (Figure 162 below and Figure 163/Appendix 6)<sup>205</sup>. As with elements recovered from south-west Wales, staining was noted on the vast majority of weathered bones (stage 1/N=45) which could have resulted either during short sub-aerial exposure or after deposition (in caves). Erosion was further reported on a higher number of stained bones (N=222) whilst abrasion and gnawing were almost equal in ratios amongst stained and unstained elements (Table 95/Appendix 6)<sup>206</sup>. The combination of weathering, erosion, staining with low surface preservation scores (Figure 164/Appendix 6)<sup>207</sup> suggests that a number of disarticulated and fragmented elements were exposed prior to deposition or selectively positioned close to cave entrances.

<sup>205</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Staining/ Figure 163 for surface preservation scores.

<sup>206</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Staining/Table 95 for details.

<sup>207</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Staining/Figure 164 for details.

Elements might have been subsequently impacted by more taphonomic agents which led to further degradation and lower surface preservation scores.

Discolouration on the surface of bones included black and brown stains with occasional grey staining (possibly stalagmite/cave concretion residues and/or plant or fungi). Pink/red stains were further identified on a lower number of bones across north Wales whilst purple (SNO: 687, 827) and green (SNO: 768) stains were specifically identified amongst remains from Ogof Colomendy. Staining was further recorded on sixteen loose teeth with the vast majority not indicating any signs of this modification. Exposure to different environments (e.g. in terms of hydrology) might have been the cause for the staining.

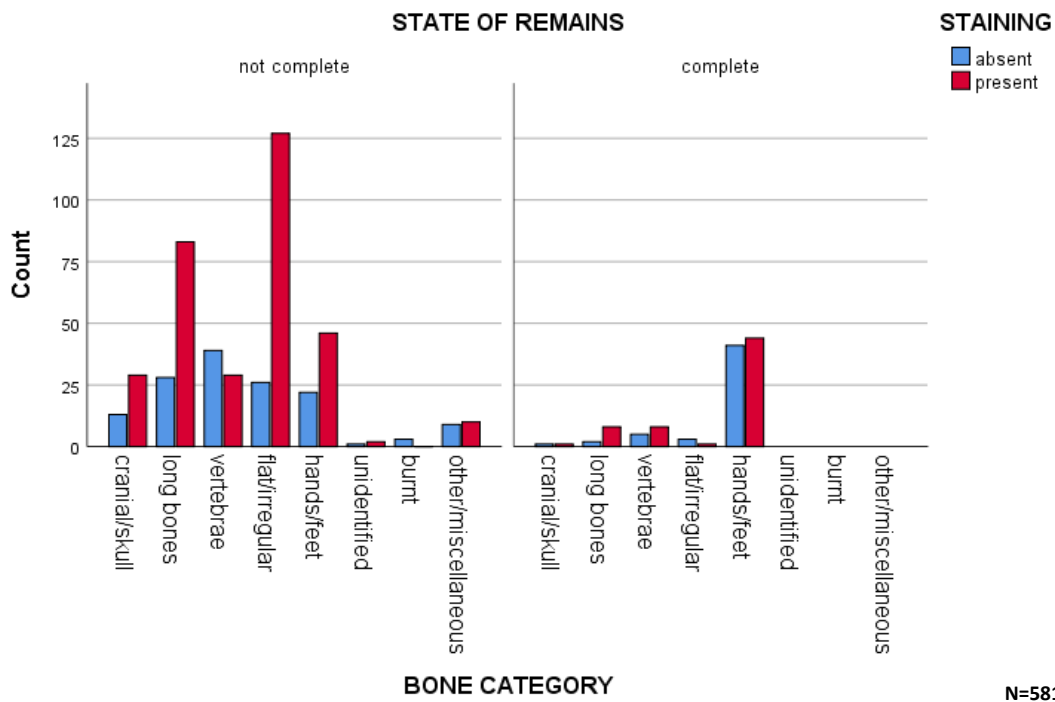


Figure 162. Staining presence/absence based on bone category and level of completeness across sites in north Wales. N=excluding Little Orme’s Head Quarry (unknown modification).

#### 6.6.1.6. Trauma (sharp/blunt force)

Sharp force trauma was recorded on two long bones (SNOs: 543/Gop Cave, 686/Ogof Colomendy). A percussion mark was noted on the diaphysis of humerus 543 that was interrupted by weathering (stage 1) (Figure 165). Humerus 543 further exhibited a dry fracture (FFI score: 6) and was impacted by staining and erosion (surface preservation

score: 3)<sup>208</sup>. Humerus 686 on the other hand, exhibited a cutmark on the diaphysis close to the head and was accompanied by gnawing and staining (surface preservation score: 1). Taphonomic modifications resulted at an early stage, prior to burial, which demonstrates evidence of peri-mortem manipulation of these specific individuals.



Figure 165. Cutmark on humeral diaphysis (arrow) and weathering stage 1 (Gop Cave). Source: author

#### 6.6.1.7. *Burning*

Evidence of burning was recorded on three cranial fragments recovered from Ogof Colomendy (SNOs: 753-765)<sup>209</sup>.

#### 6.6.1.8. *Fractures (fresh vs dry)*

Fractures were recorded on 52 long bones across north Wales and included both dry and fresh fractures (almost equally represented) (Figure 166). Fractures on both proximal and distal ends (N=11) were first treated as different entries to identify any separate fracture patterns, bringing the total N to 63 fractures. The mean total FFI across sites was 3.6 (std. dev. 1.533) (Figure 167). Scores three (fresh break) and four (dry/mineralised break) were equally represented (20%) similarly to scores two (fresh) and five (dry/mineralised break) (19%).

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<sup>208</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Trauma (sharp/blunt force) for more details.

<sup>209</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Trauma (burning) for more details.

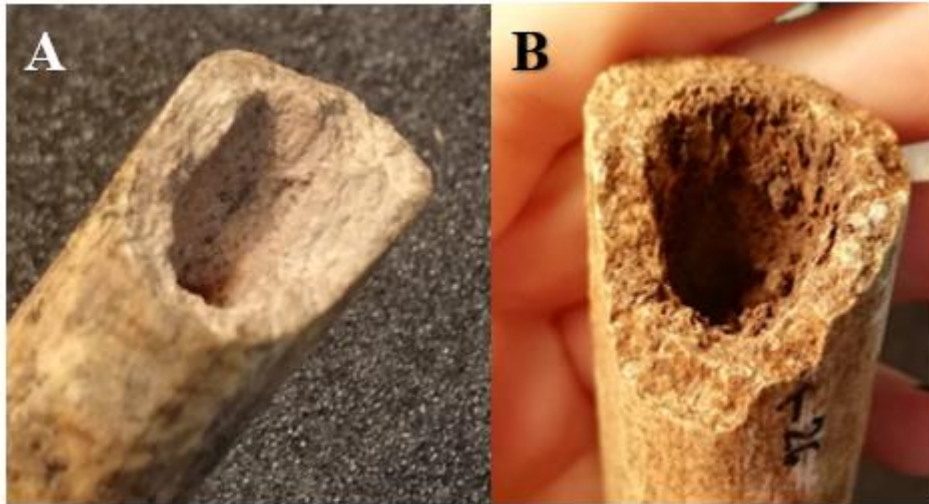


Figure 166. Fresh breaks on abraded radius (A) and femur (B) (Gop Cave).  
Source: author

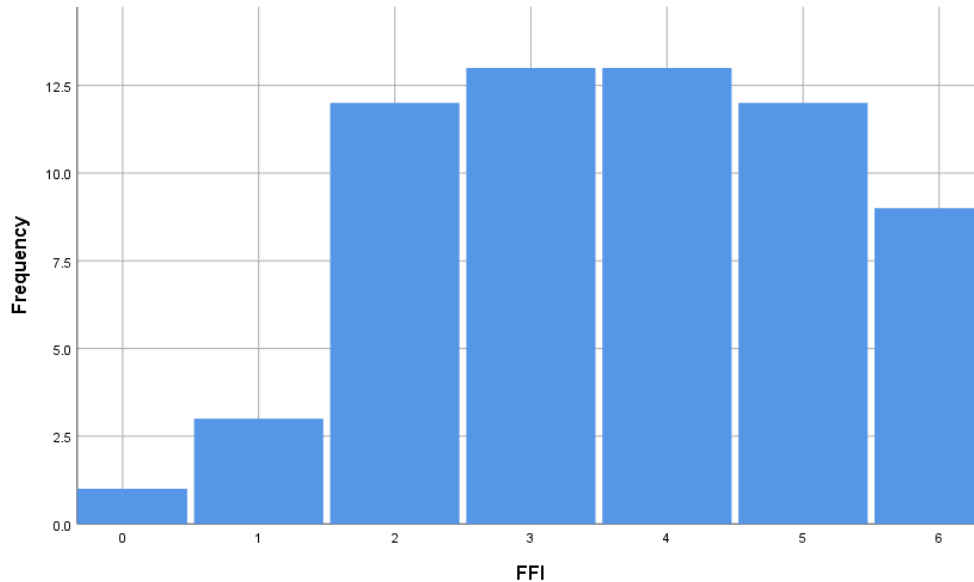


Figure 167. Total FFI (Fracture Freshness Index) scores across sites in north Wales. N=63 (double entries for fractures identified in both proximal and distal epiphyses).

Dry (N=21, 40%) and fresh (N=20, 38.5%) fractures on either proximal or distal ends were almost equally represented. Fractures on both proximal and distal ends of shafts were fresh and dry (N=3, 5%) on either end, fresh (N=3, 5%) on both ends and dry (N=5, 9%) on both ends. This pattern suggests different treatment between individuals with 26 breaks resulting at a later stage (dry), 23 during peri-mortem interval (fresh)

and three shafts exhibiting both fresh and dry breaks suggesting both peri- and post-mortem manipulation (Figure 168/Appendix 6)<sup>210</sup>.

Weathering was recorded on both dry and fresh fractures<sup>211</sup> (Table 96/Appendix 6)<sup>212</sup> and results suggest early-stage manipulation, sub-aerial exposure and followed by disturbance. Different treatment between the individuals is apparent as advanced stages of weathering cannot occur whilst remains are buried in caves.

#### *6.6.1.9. Surface preservation*

Results demonstrated a prevalence of medium to low scores (score 3/N=137, 23.6%; score 2/N=122, 21%; score 1/N=106, 18.2%). Higher surface preservation scores (4/N=48, 8.3%; 5/N=90/15.5%) were present from a lower proportion of the assemblage, with hands/feet demonstrating the highest surface preservation score (Figure 169/Appendix 6). Surface preservation scores amongst other bone categories were overall normally distributed with most scoring medium to low scores.

Bones of the hands/feet however were either poorly preserved (scores 2-1) or had survived severe degradation and impact from other taphonomic agents (score 5). If primary burials took place, any manipulation amongst other bone categories (e.g. advanced weathering) must have taken place prior to deposition followed by collection and deposition in caves, which further reflects separate depositional patterns.

#### *6.6.1.10. Trampling*

Evidence of trampling was recorded on four elements (0.7%)<sup>213</sup> including one talus (SNO: 591/Gop Cave), one distal phalanx (SNO: 827/Ogof Colomendy), one cranial and one rib fragment (SNOs: 1276, 1354/Ogof Pant-y-Wennol). This modification was

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<sup>210</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Fractures (fresh vs dry)/Figure 169 for surface preservation patterns and weathering presence.

<sup>211</sup> Humerus 1196/Ogof Pant-y-Wennol reached weathering stage 4.

<sup>212</sup> And details on other taphonomic modifications.

<sup>213</sup> N=581 excluding Little Orme's Head Quarry (unknown taphonomic modification/no primary analysis).

not common amongst cave assemblages and is therefore considered circumstantial (i.e. of limited interpretative potential) in north Wales<sup>214</sup>.

### 6.6.2. Microscopic results

Results from the microscopic analysis of three sites (N=18) from north Wales (Ogof Colomendy, Gop Cave and Ogof Pant-y-Wennol) are presented in this section. Only one element from Ogof Colomendy has been examined (Late Neolithic) due to the multi-period nature of this site.

#### OHI scores and types of bacterial attack

Histological destruction of 94% (N=17) of samples resulted from bioerosion and non-Wedl attack whilst one fibula (SNO: 35/Gop Cave) demonstrated tunnelling resembling Wedl type 2 along with minor non-Wedl tunnelling (5%) (Figure 170). Overall results indicated poor histological preservation of the microstructure (score 1/N=6, 33%; score 0/N=4; 22.2%). Distribution of remaining OHI scores showed variation with medium (OHI score 3) and higher (OHI score 5) preservation in equal ratios (N=3, 16% for each). Lower (OHI score 2) and higher (OHI score 4) histological preservation similarly indicated equal distributions (N=1, 5%) which suggests different treatment between individuals (Figure 171).

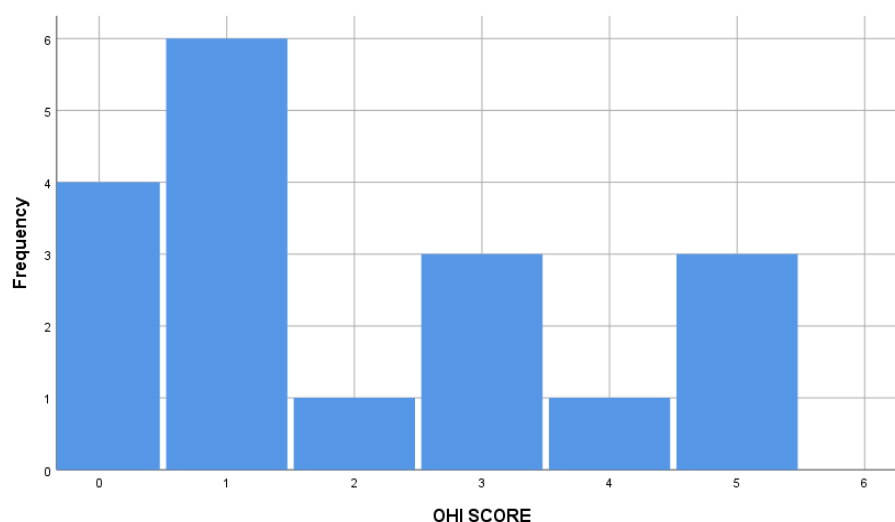


Figure 170. Histogram indicating OHI Scores across north Wales. N=18

<sup>214</sup> See Appendix 6/6.6. North Wales/Taphonomy – Macroscopic results/Trampling for details on taphonomy recorded on trampled elements.

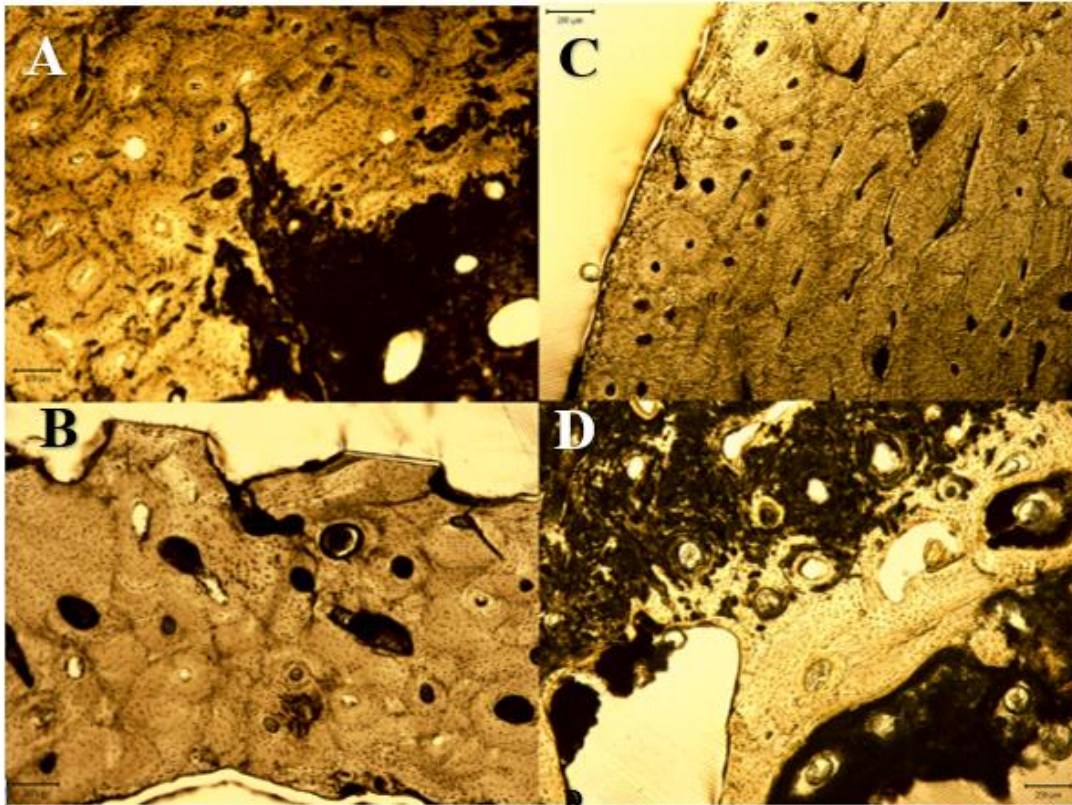


Figure 171. Different histological preservation – Gop Cave - A: non-Wedl MFD in radius (OHI 3) and B: non-Wedl and Wedl in fibula (OHI 4). Ogof Pant-y-Wennol - C: slight non-Wedl in radius (OHI 5) and D: non-Wedl in femur (OHI 2). Magnification x5. Source: author

High OHI scores were observed in three samples (SNOs: 57/humerus; 59/radius; 60/cranial fragment) from Ogof Pant-y-Wennol (Table 97/Appendix 6) accompanied by slight non-Wedl tunnelling and medium/high birefringence. Bacterial attack observed in the aforementioned samples did not interfere with the overall microstructure and therefore an OHI score of five was assigned.

Variation in OHI scores across sites in north Wales suggests that individuals were treated differently and despite exhibiting similar taphonomic characteristics (e.g. abrasion, staining, fresh breaks) histological preservation varied. Budded non-Wedl attack was recorded on all samples (N=18), followed by linear longitudinal (N=16, 88%) and lamellate (N=14, 77%) attacks.

Wedl tunnelling (type 2) resembled microstructural staining patterns in cracked areas (Gop Cave/SNO: 35) and must therefore be interpreted with caution (see Chapter 4/4.6.1).

## **Taphonomy**

The majority of elements had been impacted by erosion (N=12, 66%), abrasion (N=14, 77%) and surface staining (N=13, 72%) whilst weathering was recorded in lower numbers reaching stages one (N=2, 11.1%), three and four (N=1, 5% for each). Fresh (N=6, 33%) and dry fractures (N=4, 22%) were further identified amongst sampled long bones. Histological preservation did not correlate with surface preservation scores (Figure 172/Appendix 6)<sup>215</sup>.

Elements exhibiting weathering one to four (N=4) demonstrated different levels of bacterial attack (OHI scores: 0, 3, 5). A single humerus (SNO: 38/OHI score: 0) from Gop Cave exhibited a cutmark, a dry fracture and weathering stage one. The element underwent a series of processing both peri- and post-mortem including early manipulation resulting (sharp force trauma/cutmark), possible exhumation/disturbances (dry fracture) and sub-aerial exposure or burial close to the cave entrance (weathering). Humerus SNO 57 from Ogof Pant-y-Wennol on the other hand, reached an advanced stage of weathering (4), exhibited a fresh fracture and had very good histological preservation (score 5). Results suggest peri-mortem manipulation, whilst the bone was still fresh, prolonged sub-aerial exposure resulting in advanced weathering and final deposition in the cave. Whilst histological preservation between these two samples differed, Neolithic cave burials in north Wales might have involved multi-stage practices with deposition in caves.

Results further demonstrate differentiation between the individuals involving several stages of manipulation. The majority of long bones exhibited fresh fractures and ranging OHI scores (0-3/5) which suggests that peri-mortem manipulation was either followed by sub-aerial exposure (SNOs: 40, 57/ weathering stages 3, 4 respectively) or immediate deposition in the cave amongst other elements. Dry fractures correlating with similar variation in OHI scores (0-2/5) either resulted from later disturbances in the cave (OHI scores 0-2) or elements were exhumed (OHI score 5) and brought to the site collectively along with fresh fractured long bones.

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<sup>215</sup> See Appendix 6/6.6. North Wales/Microscopic results/Figure 172.



## **Birefringence**

Correlations between OHI scores and the Birefringence Index were apparent amongst samples (Table 98/Appendix 6)<sup>216</sup>. Most elements demonstrated low (N=8, 44%) to medium collagen preservation (N=4, 22%) whilst remaining elements either scored high on the birefringence scale or showed absence of collagen preservation (N=3, 16.7% for each) (Figure 173/Appendix 6)<sup>217</sup>. No particular pattern between skull elements and post-cranial (long bones) can be highlighted as varied OHI scores and loss of birefringence was observed throughout the assemblage<sup>218</sup>.

High OHI scores were associated with high birefringence scores with only one humerus (SNO: 57/Ogof Panty-y-Wennol) displaying a medium score (Table 98/Appendix 6). Lower OHI scores were further associated with low birefringence scores as demonstrated in Table 98 (Appendix 6) a result which must have been dictated by the extensive bacterial attack, causing collagen loss.

## **Other microscopic observations**

Inclusions (N=18), infiltrations and microstructural staining (N=15, 83% for each) were recorded with half the samples demonstrating evidence of microcracking (N=9) (Tables 99-100/Appendix 6)<sup>219</sup>.

Microstructural staining recorded in samples from north Wales was correlated with surface staining (N=11) whereas microcracking was not affiliated with erosion (N=5) and/or weathering (N=2) amongst all samples (Table 101/Appendix 6)<sup>220</sup>. Weathered elements with signs of microcracking displayed similar surface preservation (score 0), with one element exhibiting advanced stage of weathering and different levels of histological preservation (OHI scores 3 and 5).

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<sup>216</sup>See Appendix 6/6.6. North Wales/Microscopic results/Table 98 for details.

<sup>217</sup> See Appendix 6/6.6. North Wales/Microscopic results/Figure 173.

<sup>218</sup>See Appendix 6/6.6. North Wales/Microscopic results for details.

<sup>219</sup>See Appendix 6/6.6. North Wales/Microscopic results for inclusion/infiltration/microstructural staining details on intensity patterns (Tables 99-100).

<sup>220</sup> See Appendix 6/6.6. North Wales/Microscopic results/Table 101 for details.

### **6.6.3. Radiocarbon dating results**

Results from two sites demonstrated Early (Cae Gronw Cave/4918±20 BP) to Late Neolithic (4081 ± 26 BP) and Early to Middle Bronze Age (3314±26 BP) activity (Ogof Colomendy). Results from Ogof Colomendy combined with available Middle/Late Neolithic and Early Bronze Age dates, demonstrate that burials were part of a series of depositions with both peri- and post-mortem processing.

### **6.6.4. Short summary of burial depositions in North Wales**

Depositions across North Wales were noted throughout the Neolithic (Early to Late) with the presence of earlier (Mesolithic) and later (Early/Middle Bronze Age) burial activity. Element frequencies, including extremities and mandibulae, that disarticulate from the body rapidly might be an indicator for primary burials in caves. Nonetheless, this must not have been the single preferred burial method as differentiation between the individuals. Presence of various weathering stages suggests sub-aerial exposure either prior to (advanced weathering) or after disturbances or the movement of interments (lower weathering stages resulting from proximity to cave entrances). A large number of fractured bones (both fresh and dry) supports early manipulation and later disturbances in the caves which further supports a series of burial stages (both peri- and post-mortem) involved. This strategy either involved repeated depositions and revisits in the cave which could justify separate radiocarbon dates and/or multi-period sites or collection of body parts for final deposition in the cave. Variation in OHI scores (0-5) with a number of elements demonstrating minor MFD support early manipulation of certain elements and different treatment between individuals.

## **6.7. Summary – Regional Results**

Multi-stage burials from sites across Wales were identified in south-central, south-east, south-west and north Wales. Separate depositional patterns were identified within regional groups including practices of inhumation (primary burials), exhumation, excarnation and secondary burials.

South-central Wales was defined by both primary and secondary burials. These included large concentrations of hands/feet, low OHI scores, possible scattering of

burnt bone and selective removal of larger elements (e.g. long bones) (George Rock Shelter). Secondary burials on the other hand, entailed early manipulation, excarnation, collection and final deposition in the cave (Spurge Hole). Different OHI scores and chronological variation between elements further suggested multiple trajectories between individuals.

South-east Wales was further characterised by various depositional stages including circulation of long bones (dry fractures), low OHI scores suggesting fully articulated burials, lack of corresponding elements, and evidence of both sharp and blunt force trauma on skulls. Chronological variation between crania and long bones (Middle to Late Neolithic) suggested that the multiple taphonomic trajectories between elements evidenced selective deposition of human remains (crania).

Multi-period use of sites in south-west Wales (e.g. Nanna's Cave, Priory Farm Cave) was accompanied by variation in treatment in caves and between individuals. Smaller elements (hands/feet) with high preservation scores and zone completeness suggested presence of primary burials taking. Selected elements (e.g. long bones) however, showed signs of weathering, suggesting sub-aerial exposure after peri-mortem processing (weathering on fresh fractures) and even separation in caves using distinct areas for burial within the cave.

North Wales was further characterised by larger (Early to Late) Neolithic assemblages with evidence of earlier (Mesolithic) and later use (Early/Middle Bronze Age). Primary burials were identified by the large frequencies of hands/feet, however, practices of excarnation with short or prolonged sub-aerial exposure were part of this process (primary and secondary burials). Various levels of MFD (0-5) suggested different taphonomic trajectories between individuals with re-visits of collection of body parts taking place for final deposition (secondary) in caves.

The next chapter introduces the results of nine case studies (Ifton Quarry is presented in regional analyses/see section 6.4) to identify methods of deposition between sites across Wales and north Somerset.

## Chapter 7: Case studies

### 7.1. Introduction

This chapter presents the results of nine case studies across Wales and one from north Somerset (Table 102)<sup>221</sup>. As mentioned in Chapter 5, case studies were selected based on: direct radiocarbon dating evidence (Neolithic), the quantity of human remains available for study (majority of sites), the results of the macroscopic analysis the suggested different treatment between the individuals and sites and the available demographic patterns (selection of different individuals for sampling). Descriptions and reports of these sites can be found in Appendix 5. Results are accompanied by non-parametric tests to explore significant differences of element and histological preservation amongst case studies. One case study from south-west Wales (6.4/Ifton Quarry) has already been examined as it represented the only site from south-east Wales and was included in regional analyses. Methods of deposition are examined to understand whether patterns analysed across sites and on a regional basis persist on a smaller scale<sup>222</sup>.

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<sup>221</sup> See Chapter 5/5.1.2.4 for sample selection justification.

<sup>222</sup> A list of Appendices 5 and 6 (referenced in text) can be found in ‘The table of contents’ and the Appendices list at the end of the thesis. Sections referenced in text have been given direct page numbers to guide the reader. SNO further refers to the specimen number of an element in Appendix 1/Sheets 2 and 3. N refers to the total element representation of an assemblage. Abbreviations can be found in the ‘Abbreviations list’ at the start of the thesis or in Appendix 1/Sheet 6/Methods and abbreviations

SITE NAME	SITE TYPE	REGION	SITE DESCRIPTION	CONDITION	DATE/ PERIOD	BURIALS/ MNI	NEO 14C IN BP YEARS WITH ERROR
Spurge Hole	Cave	South-central Wales: Pennard, Swansea	Located in a steep cliff near Southgate Gower and forms a water-worn, low, south-facing arch 1.2 m wide and 0.5 m high	Intact (HER)	Early to Middle/Late Neolithic	3+ (2 adults, 1 juvenile)	4830±100 BP;  New dates: 4648±26BP; 4425±26BP
George Shelter	Rock Shelter	South-central Wales: Wenvoe, Vale of Glamorgan	Lies on the south-west site of Cwm George (limestone outcrop)	Intact (HER)	Early Neolithic and post-Medieval	MNI: 7+ (3 adults (1 post Medieval), 1 perinate, 1 juvenile and 1 adolescent), 1 probable cremation	4929±33BP; 5083± 38BP; 125±24AD  New dates: 4954±22BP 4969±22BP;

Ifton Quarry	Old rock shelter or fissure	South-east Wales: Rogiet Monmouthshire	Located at the south end of a carboniferous limestone area that incorporates the Forest of Dean and the Wye Valley	Destroyed from quarrying	Middle to Late Neolithic	7+ (5 adults; 2 juveniles)	4640±29BP; 4624±29BP; 4350±90BP; 4178±28BP
Little Hoyle Cave (Longbury Bank Cave)	Cave	South-west Wales: Penally Pembrokeshire	Small cave, which lies on the NE end of the ridge of a promontory (26m OD) within a limestone ridge known as Longbury Bank	? Possibly disturbed after series of excavations	Early to Middle Neolithic	MNI: c.11+ (adults ranging from 17-25 to 35-45 years based on surface wearing scoring for molars and one juvenile)	4660±80BP; 4930±80BP; 4750±75BP; 4880±90BP;  New date: 4893±22BP
Priory Farm Cave	Cave	South-west Wales: Monkton, Pembrokeshire	Cave located on a valley-side above the Pembroke River (about 9 km from the coast) in a heavily quarried outcrop of Carboniferous limestone	Unknown	Middle Neolithic, Late BA and M/L Iron Age	MNI: 5+ (4 adults - 1 Mid/Late Iron Age adult- 1 LBA), 1 juvenile)	4631±31BP; 2814±29BP; 2133±26BP

Ogof Garreg Hir	Cave	South-west: Stackpole, Pembrokeshire	Situated approx. 21m down a sheer 46m high cliff on the Carboniferous Limestone outcrops of south Pembrokeshire; one of a series/group of caves along the Castlemartin Cliffs	Half disturbed/half intact	Early Neolithic	1 (? juvenile/adolescent)	5056±39BP
Ogof Colomendy	Cave	North Wales: Gwernymynydd, Flintshire	Cave situated on a limestone outcrop (facing south), about 5km west of Mold with a triangular-shaped entrance, 1.4m high and 1m wide	? Intact	Middle to Late Neolithic and E/M BA	c. 5+ (3 adults, 1 EBA adolescent/adult, 1 MN younger adult or adolescent)	4408±33BP; 3518±35BP; New dates: 4081±26BP; 3314±26BP

Gop Cave	Cave (interconnected cave and rock-shelter)	North Wales: Trelawnyd & Gwaenysgor, Flintshire	Natural limestone cave (interconnected rock-shelter and cave) with two entrances located at the end of the line of hills and forms the east boundary of the Vale of Clwyd near Prestatyn approx. 50m to the south of the archaeological site of Gop cairn	Intact/Good	Middle to Late Neolithic	4+ [3 adults (1 younger adult), 1 juvenile]	4414±30BP; 4381±29BP; 4357±30BP
Ogof Pant-y-Wennol	Cave	North Wales: Llandudno, Conwy	Large coastal cave located at the Carboniferous Limestone outcrops of Llandudno with a wide entrance approx. 5.2m wide by 8.6m long and 3m high, protected by an overhanging rock	Disturbed?	Early and Middle Neolithic	5+ (2 adults, 1 adolescent/younger adult, 1 juvenile, 1 perinate)	4982±36 BP; 4962±32 BP; 4657±32 BP



Backwell Cave	Cave/rock shelter	South-west England: Backwell, North Somerset	Small and almost rectangular in shape cave is situated in the Parish of Backwell (east), approx. and 10 miles to the north of Mendip (northern side of Broadfield Down) formed along the line of a wide calcite spar or vein in the limestone ridge	Intact (previously destroyed during disturbances/excavations – now a rock shelter)	Early and Middle Neolithic	18+ (15 adults, 3 juveniles?)	4885±29BP; 4510±40BP
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Table 102. Case studies from Wales and north Somerset (south-west England) analysed in this research.

## 7.2. Spurge Hole

### Frequency of skeletal elements

Results demonstrated a prevalence of postcranial (N=91, 55.5%) versus cranial remains (N=26, 15.9%) with the remaining assemblage comprised of miscellaneous and/or unidentified remains (N=25, 15.2%)<sup>223</sup> and loose teeth (N=22, 13.4%) (Figure 174). Flat/irregular bones (N=53, 37.3%), vertebrae (N=28, 19.7%) and cranial/skull remains (N=26, 18.3%) constituted the majority of the total assemblage (N=42/excluding loose teeth), whilst long bones (N=8, 5.6%) and hands/feet (N=2, 1.4%) were more poorly represented (Figure 175, Table 103). Loose teeth indicated an MNI of two including, one older male and a juvenile (deciduous first incisor) (Figures 176-177/Appendix 6)<sup>224</sup>.

Zone representation on long bones (N=8) using the proximal and/or the distal epiphysis indicated an apparent difference between shafts (N=7, 87%) and epiphyses (N=2, 25%) survival in Spurge Hole. Long bones included one pair of right and left humeri, one right ulna, two radii (left and unidentified) and three femora (left and right with one femur head possibly deriving from the right femur) (Table 104/Appendix 6)<sup>225</sup>. Elements were severely eroded with three long bones (SNOS: 177-8, 307) (left and right femur and left radius) demonstrating advanced stages of weathering (splitting/stage 3). Femur shaft SNO 178, exhibited dry fractures on both ends (FFI score: 4) which suggests prolonged sub-aerial exposure and circulation of bone that resulted in dry fractures at a later stage. Humerus SNO 314 similarly exhibited a dry break (FFI score: 6) whilst shaft SNO 315 demonstrated dry fractures on both proximal and distal ends (FFI scores: proximal=5/distal=6)<sup>226</sup>.

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<sup>223</sup> See justification in Chapter 5/5.2.1. for including fragments with no zone identification from this site.

<sup>224</sup> See Appendix 6/7.2. Spurge Hole/Frequency of skeletal elements.

<sup>225</sup> See Appendix 6/7.2. Spurge Hole/Frequency of skeletal elements.

<sup>226</sup> See Appendix 6/7.2. Spurge Hole/Frequency of skeletal elements for more details.

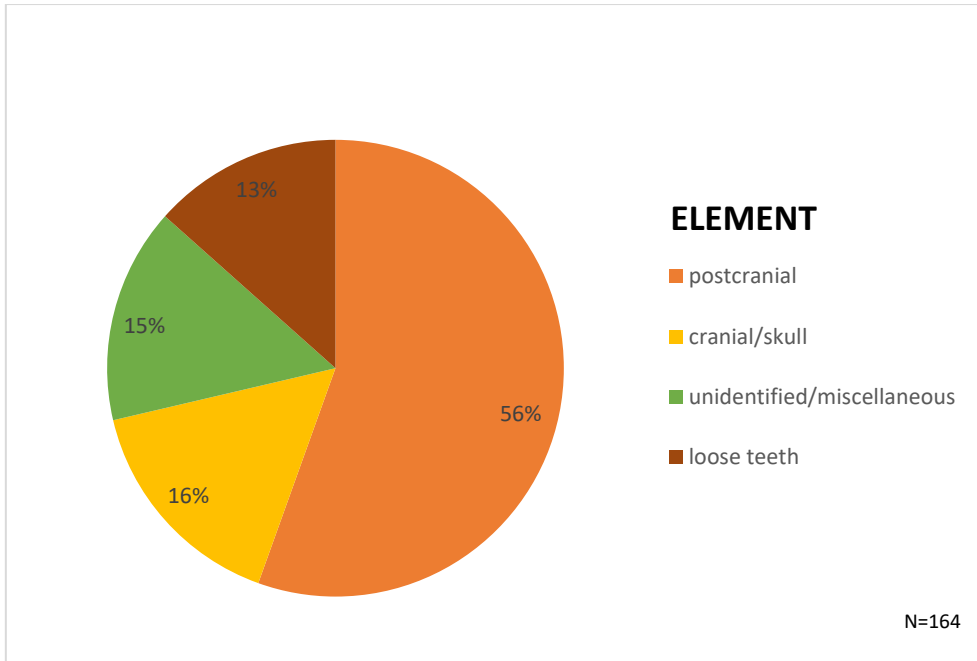


Figure 174. Element frequency amongst the assemblage from Spurge Hole. N=including loose teeth.

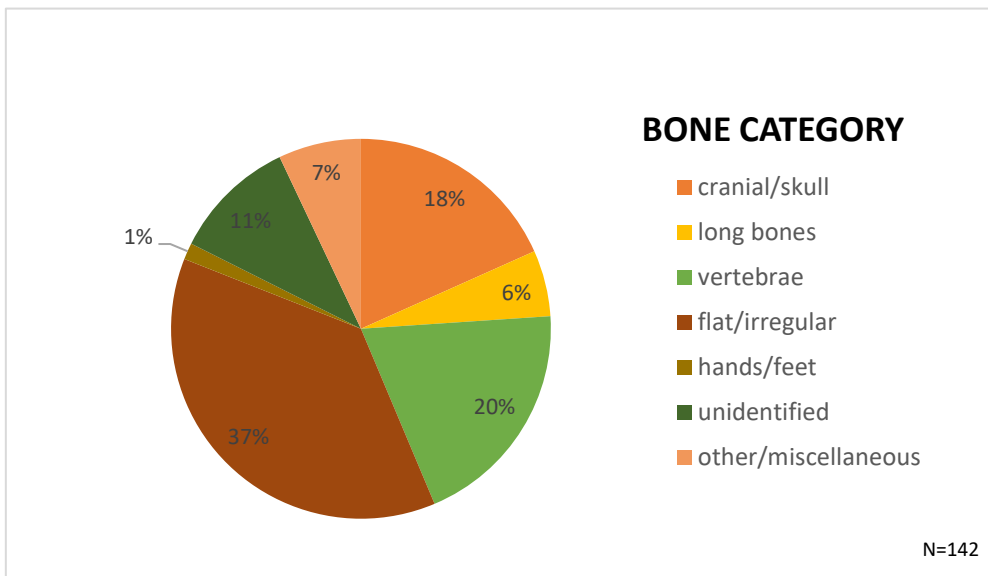


Figure 175. Element frequencies in Spurge Hole based on bone category (excluding loose teeth).

ELEMENT	COUNT
ATLAS (C-1)	1
AXIS (C-2)	1
CRANIAL FRAGMENTS	20
FEMUR	3
HUMERUS	2
INTERMEDIATE HAND PHALANX FRAGMENT (5)	1

LOOSE TEETH	22
MANDIBLE FRAGMENTS	5
METACARPAL	1
MISCELLANEOUS/RIB FRAGMENTS	2
MISCELLANEOUS/SACRAL FRAGMENTS	2
MISCELLANEOUS/UNIDENTIFIED REMAINS	17
MISCELLANEOUS/VERTEBRAE FRAGMENTS	6
PELVIS	4
RADIUS	2
RIB FRAGMENTS	42
SACRUM	1
SCAPULA FRAGMENTS	6
TEMPORAL BONE FRAGMENT	1
THORACIC VERTEBRA	1
ULNA	1
VERTEBRA FRAGMENT (THORACIC)	1
VERTEBRAE FRAGMENTS (LUMBAR)	2
(N) TOTAL	164

Table 103. Element representation in Spurge Hole. Miscellaneous/unidentified and/or miscellaneous identified remains includes small fragments with no zone representation. Chapter 7 would impact the taphonomic trajectory of the site (see Chapter 5/5.2.1). N=including loose teeth.

### **Element completeness**

All surviving elements from Spurge Hole were fragmented, with most exhibiting signs of erosion and poor surface preservation (see Appendix 6//Figure 178 and Table 104)<sup>227</sup>.

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<sup>227</sup> See Appendix 6/7.2. Spurge Hole/Element completeness.

## MNI, demography and pathology<sup>228</sup>

Results demonstrated the presence of two adults and one juvenile. Dental attrition based on surviving molars determined an age group of c.35-45+ years and one deciduous tooth indicated the presence of one juvenile. Sex estimations determined one right female pelvis (SNO: 199) and one left (probable) male pelvis (SNO: 198). On the basis of morphology more than one individual is represented with both right and left femora and ossa coxae deriving from separate individuals (Figures 179-180).

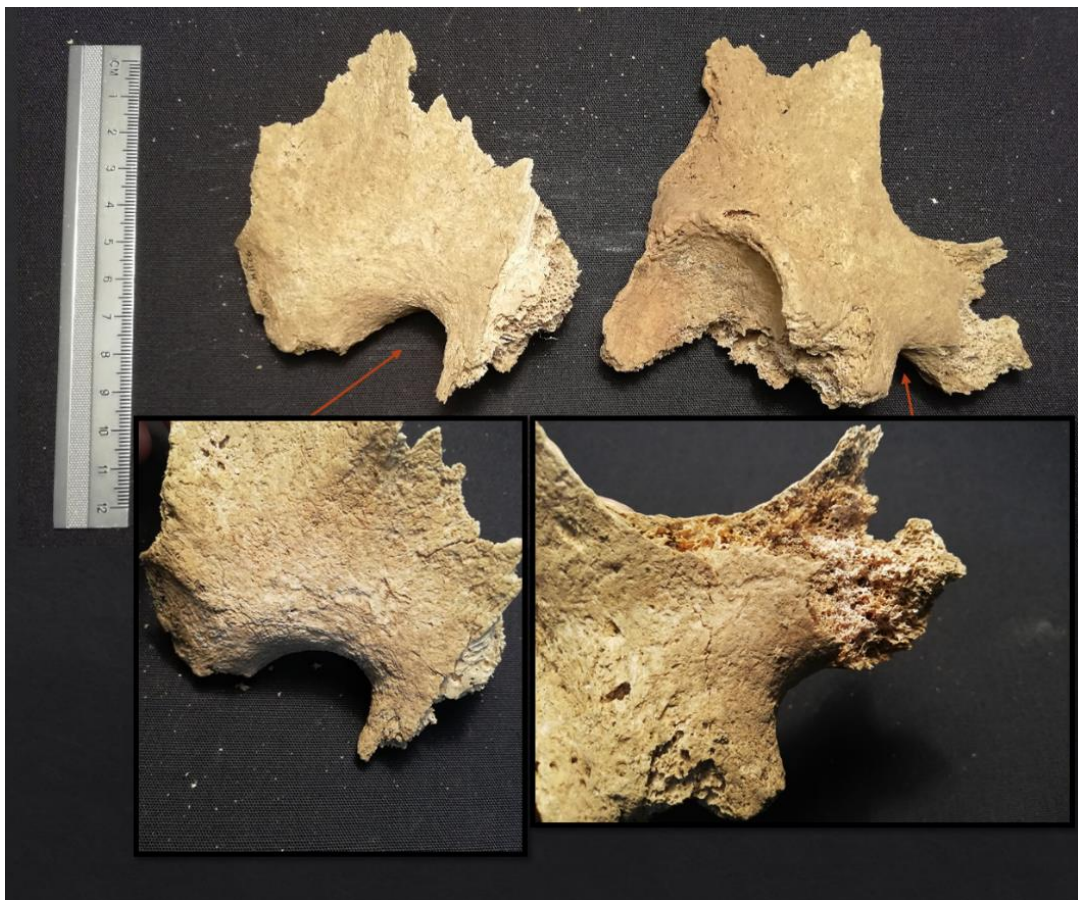


Figure 179. Right female pelvis (left) and left male pelvis (right). Source: author

<sup>228</sup> See Appendix 6/7.2. Spurge Hole/Element completeness for specification on femur head 179 and femur shaft 178.

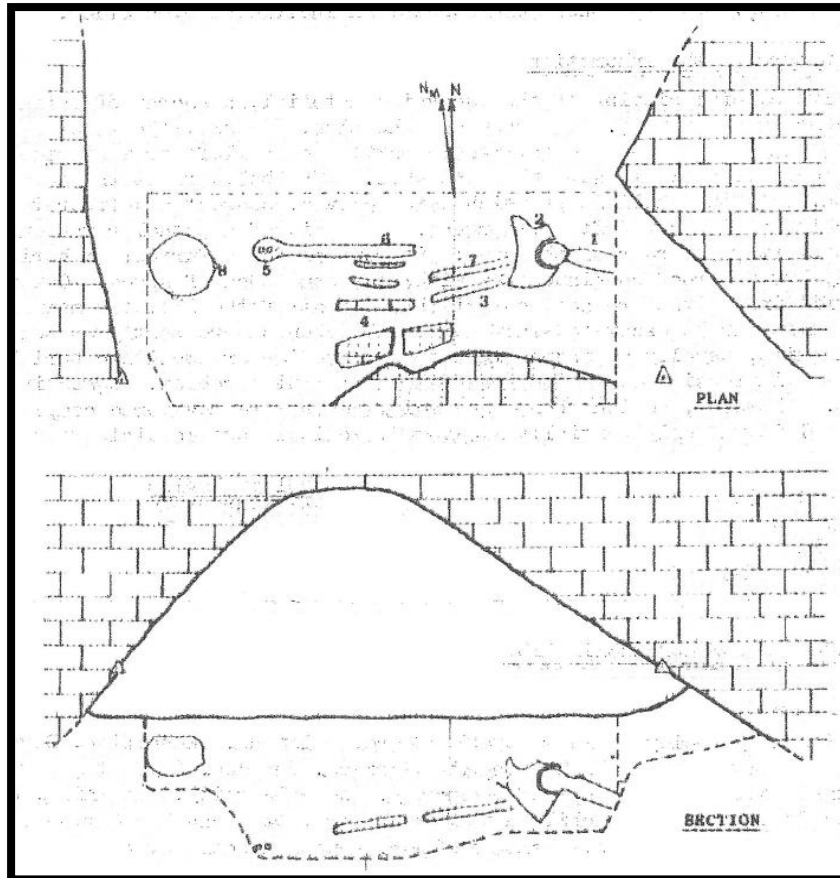


Figure 180. Plan and section of the cave: 1) left femur articulated with pelvis 2) pelvis 3) right ulna 4) left humerus- shaft fragment 5) two mandibular molars; maxillary molars with other teeth nearby 6) right humerus- distal piece 7) right radius 8) cranium with left mastoid process near the cranium (Davies 1985: 3).

## Pathology

No evidence of pathology (degenerative) was identified with two loose teeth (SNOs/Dentition: 65-6) demonstrating signs of caries and 18 loose teeth indicating signs of digestion and root etching.

### 7.2.1. Taphonomy – Macroscopic results

#### 7.2.1.1. Weathering

Signs of weathering amongst the assemblage were recorded on three long bones (SNOs: 177-8, 307) (2.1%) reaching stage three (Figure 181). These had been impacted by

erosion and demonstrated low surface preservation (score 0)<sup>229</sup>. All weathered long bones were given high OHI scores (5) whilst remaining sampled elements (including two more long bones and four cranial/skull fragments) demonstrated lower OHI scores. Remains must have derived from separate individuals that were possibly manipulated differently during peri-mortem phases (e.g. excarnation followed by circulation to the site).



Figure 181. Weathering stage 3 on femur. Source: author

#### 7.2.1.2. *Gnawing*

Evidence of gnawing was not recorded on human remains from Spurge Hole. Signs of erosion might have masked previous taphonomic modifications including staining, abrasion, trauma (cutmarks), fresh fractures and trampling.

#### 7.2.1.3. *Erosion*

Signs of erosion were recorded on the vast majority of skeletal elements from Spurge Hole (N=120, 84.5%) (Figure 182) including all surviving flat/irregular bones (N=53) and almost all cranial/skull and vertebrae remains (N=25 for each) (Figure 183). Results correlate with the frequency of element representation in Spurge Hole and no particular pattern can be observed (Figure 184/Appendix 6)<sup>230</sup>.

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<sup>229</sup> See Appendix 6/7.2. Spurge Hole/Taphonomy-Macroscopic results/Weathering for more details.

<sup>230</sup> See Appendix 6/7.2. Spurge Hole/ Taphonomy-Macroscopic results /Erosion for more details and Figure 184 for details on surface preservation.



Figure 182. Erosion on femur with poor surface preservation. Source: author

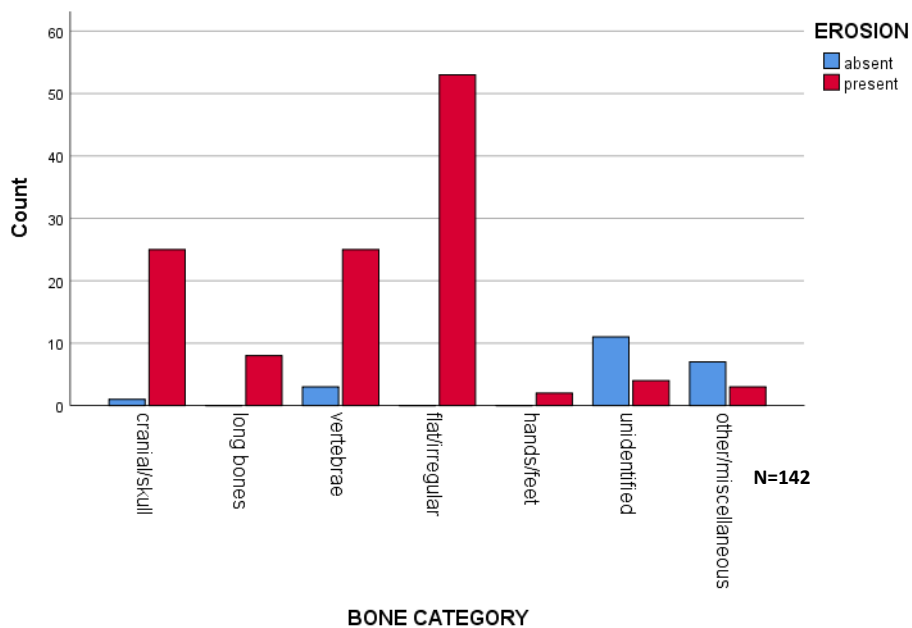


Figure 183. Frequency of erosion based on bone category in Spurge Hole.

#### 7.2.1.4. Abrasion

Abrasion was not recorded on any elements from Spurge Hole. The cortical bone of most elements had disintegrated. Erosion could have obscured other taphonomic modifications.



#### 7.2.1.5. *Staining*

Evidence of staining was not recorded on any elements from Spurge Hole. Erosion could have obscured other taphonomic modifications.

#### 7.2.1.6. *Trauma (sharp/blunt force)*

Signs of trauma, including sharp and/or blunt force were not recorded on any elements from Spurge Hole. Erosion might have obscured other taphonomic modifications.

#### 7.2.1.7. *Burning*

No signs of burning were recorded in Spurge Hole.

#### 7.2.1.8. *Fractures (fresh vs dry)*

Dry/mineralised fractures were recorded on three long bones (SNOs: 314-5, 178) including one right femur, one right and one left humeri. Femur shaft 314 exhibited dry breaks in both ends (FFI: 4 for both proximal and distal) however, part of the distal break appeared modern (excavation damage). Extensive erosion had disintegrated the surface and therefore no other signs of taphonomy were recorded. The femur had been further impacted by weathering (stage 3) and demonstrated very good histological preservation of the microstructure (OHI score: 5) which suggests sub-aerial exposure shortly after death.

Humerus 315 (Early to Middle Neolithic date) exhibited a dry break (FFI score: 6) with signs of modern damage and erosion whilst part of the proximal end of diaphysis had been reconstructed (with adhesive). Fractures on humerus shaft 178 (FFI scores proximal: 5 and distal: 6) similarly showed signs of modern damage and erosion. The distal and proximal ends of the diaphysis had been reconstructed (with adhesive)<sup>231</sup>. Both humeri demonstrated extensive bacterial attack (OHI score: 2 for each) which contrasts with the high OHI score given for femur 314 suggesting separate taphonomic trajectories amongst human remains.

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<sup>231</sup> FFI scores assigned with caution.

#### 7.2.1.9. *Surface preservation*

69% of the total assemblage (N=98) scored zero on the surface preservation scale with a lower number of skeletal remains (N=16, 11.6%; N=15, 10.6%) demonstrating medium to poor surface preservation (scores 3-2) (Figure 185/Appendix 6)<sup>232</sup>. Flat/irregular bones (higher element frequency in Spurge Hole) demonstrated low scores (N=30/score 0) with vertebrae remains and cranial/skull fragments following a similar pattern (Figure 185/Appendix 6). The depositional environment in Spurge Hole completely dictated the surface preservation of the vast majority of human remains, however presence of prolonged weathering and wide variation in histological preservation (discussed in section 5.4.1.4.2) between scores zero and five, supports different treatment amongst human remains.

#### 7.2.1.10. *Trampling*

No evidence of trampling was recorded on any elements from Spurge Hole.

### **7.2.2. Microscopic results**

#### **OHI scores MFD**

Results from the microscopic analysis of nine samples are presented in this section. Histological destruction of eight samples resulted from bioerosion and non-Wedl attack (88%) and a single sample (11%) had no sign of MFD.

OHI score distributions showed variations with three elements (33%) demonstrating high OHI scores (5) and three (33%) showing extensive bacterial attack (OHI score 1) (Figure 186/Appendix 6<sup>233</sup> and 187 below). Remaining samples ranged from OHI score two (N=2, 22.2%) to three (N=1, 11%) further suggesting that treatment between the individuals (body parts deriving from separate individuals) differed. Types of bacterial attack identified in the microstructure of the samples included linear longitudinal (N=7, 77%), budded (N=7, 77%) and lamellate attack (N=5, 55%).

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<sup>232</sup> See Appendix 6/7.2. Spurge Hole/ Taphonomy-Macroscopic results/Surface preservation for Figure 185.

<sup>233</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results.

OHI scores amongst cranial remains ranged from one to three whilst long bone histological preservation ranged between one/two and five with three long bones showing minor bacterial attack (Table 106/Appendix 6)<sup>234</sup>. Variation in long bone OHI scores suggests that the history of preservation amongst cranial remains and long bones must have differed due to remains having been collected from separate individuals with different pathways of decomposition.

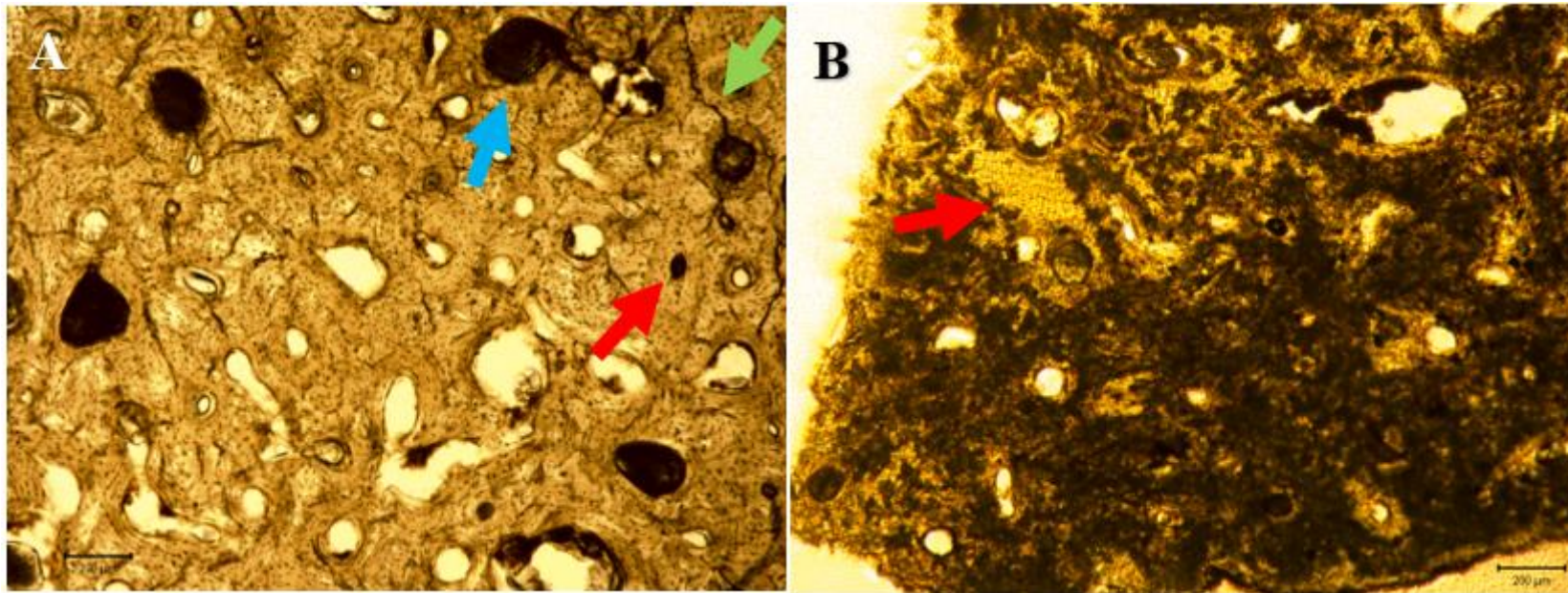


Figure 187. **A:** Femur showing high histological preservation (OHI 5), inclusions (red arrow), infiltrations (blue) and cracking (green). **B:** Humerus showing extensive non-Wedl MFD (OHI 1) with a preserved area (red arrow). Magnification x5. Source: author

<sup>234</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results.

## **Taphonomy**

Evidence of surface erosion was recorded on most samples (N=7, 77%) and signs of weathering (stage 3) were identified on three long bones (SNOs: 26-28) (33.3%) with high OHI scores. High OHI scores suggest rapid disarticulation, sub-aerial exposure (advance weathering on all three limbs), collection and deposition.

Dry fractures were further identified on three long bones (SNOS: 27, 29-30)<sup>235</sup> that demonstrated distinct OHI scores. Histological preservation of long bone 27 was very good (OHI score: 5) although the bone also exhibited high intensity microcracking. Microcracking could have resulted from the high demineralization of the bone due to prolonged exposure, resulting in advance stage of weathering (3) and erosion. These hallmarks of exposure are often coupled with well-preserved histology.

Overall results indicate that long bones were possibly collected from different deposits and subsequently deposited in the cave. Cranial fragments do not evidence major differences in OHI scores (as opposed to long bones); however, given the nature of this burial, cranial fragments could have been similarly collected and brought to the site.

## **Birefringence**

Birefringence scores demonstrated slight irregularities with four samples (33%) showing no collagen survival, four samples scoring low to medium on the Birefringence Index (scores 1 and 2 respectively) and a single sample (weathered long bone 26) scoring high (3) (Figure 188/Appendix 6)<sup>236</sup>. OHI and Birefringence scores did not correlate often (Table 107/Appendix 6)<sup>237</sup>. Overall collagen preservation amongst samples was low. Visual diagenetic parameters did not show any patterns between samples<sup>238</sup>.

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<sup>235</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results for details on extraneous material and birefringence scores on long bones 27, 29-30.

<sup>236</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results.

<sup>237</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results.

<sup>238</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results for details.

## **Other microscopic observations**

Inclusions were apparent in the microstructure of all samples, infiltrations and microstructural staining were present in eight samples (88% for each) and signs of microfissures/cracking were identified in seven samples (77%) (Tables 108-109/Appendix 6)<sup>239</sup>. Inclusion and infiltration intensities (Table 110/Appendix 6)<sup>240</sup> were primarily high, suggesting high ratios of extraneous material infiltrating the bones, whilst high microcracking intensities were identified in samples with high OHI scores (N=3, 33.3%).

Samples with high OHI scores (5) indicated high concentrations of both inclusions and infiltrations which could have resulted from wetting/drying conditions, sub-aerial exposure, splitting of the bone and cracking allowing extraneous material to infiltrate the bone (Table 110/Appendix 6<sup>241</sup>; Figure 189 below). No pattern amongst microstructural staining colours was identified<sup>242</sup>.

Correlations amongst surface taphonomy were apparent in microcracking (N=7), erosion (N=8) and/or weathering (N=3) presence. Signs of weathering were accompanied by high intensity cracking and erosion whilst most eroded remains similarly demonstrated signs of cracking/microfissures. Prolonged weathering and demineralization of the bone can result in splitting and cracking of the bone which is subsequently mirrored in microstructure and potentially causes collagen loss.

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<sup>239</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results.

<sup>240</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results.

<sup>241</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results.

<sup>242</sup> See Appendix 6/7.2. Spurge Hole/Microscopic results for details.

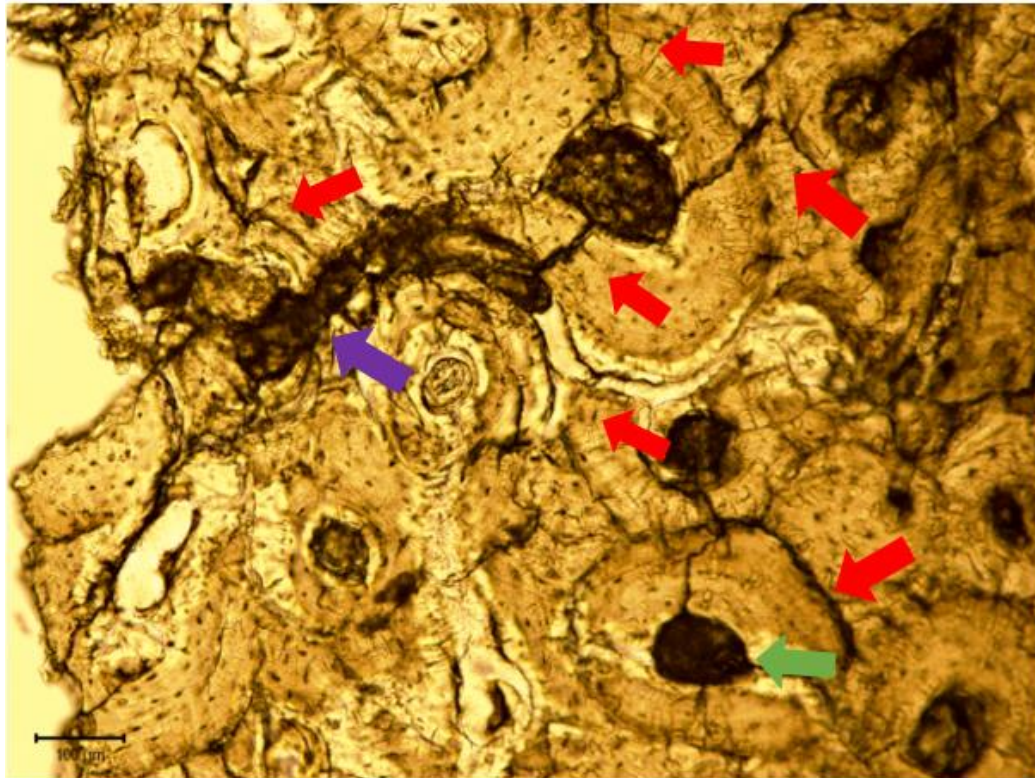


Figure 189. Extensive cracking/microfissures (red arrows), inclusion (green arrow) and infiltration (purple arrow) in the microstructure of a femur. Magnification x5. Source: author

### 7.2.3. Short summary of burial depositions in Spurge Hole

Depositions of the reconstituted individual from Spurge Hole did not follow a similar taphonomic trajectory. Elements dated from the Early to the Middle/Late Neolithic, exhibited different morphological characteristics amongst limbs and pelvis and demonstrated distinct taphonomy patterns suggesting selection, collection and deposition of different body parts. All elements were found disarticulated in the correct anatomical order and were previously considered the remains of a single individual. Elements underwent different stages of processing, some derived from possible complete primary burials (which could justify the low OHI scores), were subsequently exhumed and brought to the site for final deposition. Other elements were possibly collected after sub-aerial exposure. The presence of both male and female morphological characteristics, separate ages in surviving loose teeth (juvenile tooth and teeth of an older individual) and distinct taphonomic modifications suggest a multi-stage burial of selected human remains. Separate modes of deposition including exhumation, excarnation, collection of body parts and secondary burial were used to

‘compose’ a new individual in the cave. This involved practices of selection and separation for body curation and sub-aerial exposure (see Chapter 8).

### **7.3. George Rock Shelter**

#### **Frequency of skeletal element**

The site includes multi-period deposits (Early Neolithic and post-Medieval) based on five available radiocarbon dates. Available stratigraphic information and recording from the excavation of George Rock Shelter has increased the potential of understanding variations in practices.

Results demonstrated a prevalence of postcranial (N=166, 44.5%) rather than cranial/skull remains (N=66, 17.7%) with the remaining assemblage comprising of unidentified and/or miscellaneous remains (N=42, 11.3%), burnt fragments (N=66, 17.7%) and loose teeth (N=33, 8.8%) (Figure 190). Hands/feet (N=77, 22.6%), cranial/skull and burnt fragments (N=66, 19.4%, for each) and flat/irregular bones (N=55, 16.2%) were mostly identified (Figure 191, Table 111).

Remaining elements recovered from George Rock Shelter include miscellaneous<sup>243</sup> fragments (N=43, 12.6%), vertebrae remains (N=23, 6.8%) and a very small number of fragmented long bones (N=10, 2.9%). Loose teeth primarily included canines (N=8, 24%), 1<sup>st</sup> and 2<sup>nd</sup> incisors (N=7, 21% and N=4, 12% respectively) followed by the 1<sup>st</sup> and 2<sup>nd</sup> premolars and 1<sup>st</sup> molars (N=3, 9% for each) (Figure 192/Appendix 6)<sup>244</sup>.

Zone representation on long bones (N=15)<sup>245</sup> using the proximal and/or the distal epiphysis demonstrated low survival frequencies of both epiphyses (N=4, 26%) and shafts (N=2, 13.3%). Long bones comprised of equal numbers (N=2, 13%) of humeri, radii, ulnae and fibulae whilst seven shafts were unidentifiable to element (46.7%)

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<sup>243</sup> Miscellaneous entries include either small identifiable or unidentifiable small bone fragments with no zone representation. Several entries were grouped (see Database/Coding). Similarly to Spurge Hole, excluding miscellaneous entries would impact the overall taphonomic trajectory of the site (see Chapter 4/4.3.8).

<sup>244</sup> See Appendix 6/7.3. George Rock Shelter/Frequency of skeletal elements for details.

<sup>245</sup> N different from long bone total – includes six unidentified long bone fragments or epiphysis. One perinate fibula (SNO: 1068) was excluded and one unidentified epiphysis (long bone category amongst frequencies), was substituted for unidentified epiphysis.

(Table 112/Appendix 6)<sup>246</sup>. Long bones were extremely fragmented and impacted by either erosive forces and/or cave concretion. Overall long bone survival was limited (MNI: 6+).

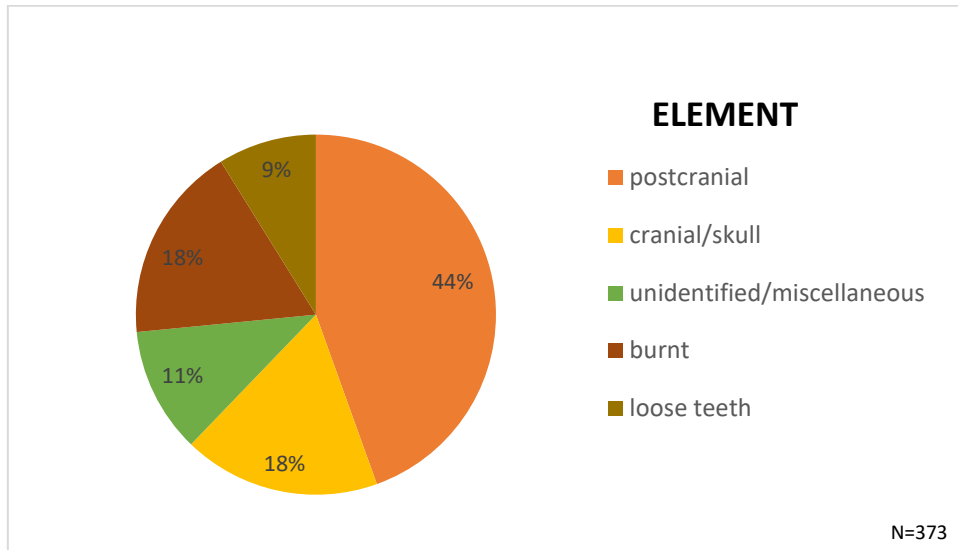


Figure 190. Element frequency amongst the assemblage from George Rock Shelter. N=including loose teeth. See 6.2. for including burnt fragments in element category.

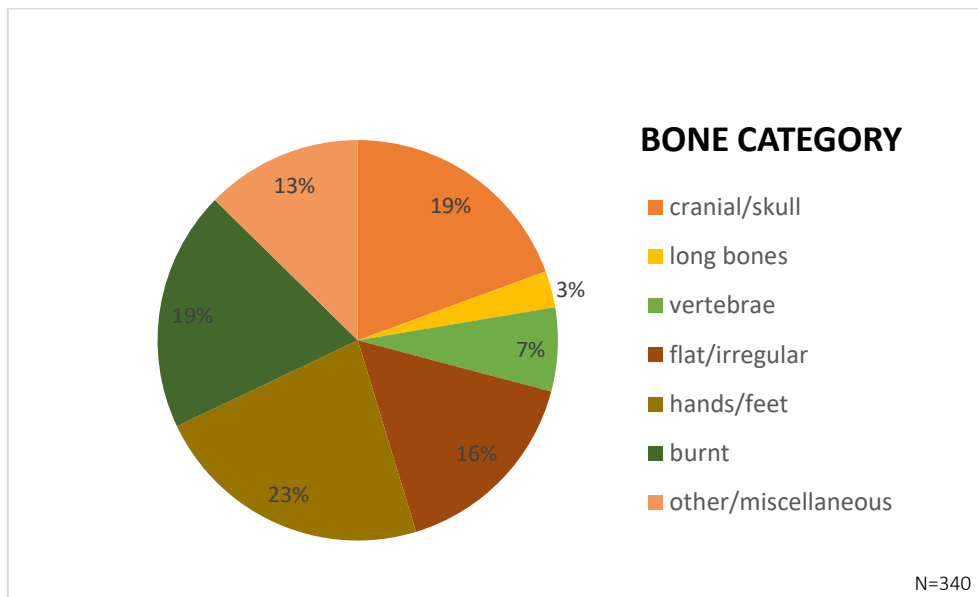


Figure 191. Element frequencies in George Rock Shelter based on bone category (excluding loose teeth). See 6.2. for including burnt fragments in bone category.

<sup>246</sup> See Appendix 6/7.3. George Rock Shelter/Frequency of skeletal elements for details.



<b>ELEMENT</b>	<b>COUNT</b>
ATLAS (C-1)	1
ATLAS FRAGMENT	1
BURNT BONE FRAGMENTS	66
CALCANEUS	3
CARPAL	1
CLAVICLE	1
CRANIA FRAGMENT (TEMPORAL)	2
CRANIAL (ZYGOMATIC BONE)	1
CRANIAL FRAGMENT	24
CRANIAL FRAGMENT (FRONTAL)	3
CRANIAL FRAGMENT (PARIETAL)	1
CRANIAL FRAGMENT (TEMPORAL)	2
CRANIUM (IN FRAGMENTS)	1
CUBOID (CUB)	1
CUINEIFORM (CU)	1
DISTAL FOOT PHALANX	1
DISTAL FOOT PHALANX (1)	1
DISTAL HAND PHALANX (1)	2
DISTAL HAND PHALANX (2)	1
EPIPHYSEAL FUSION/? ILIAC CREST	1
EPIPHYSIS	1
FIBULA	2
FIBULA FRAGMENT	1
HAMATE	1
HAND PHALANX	1
HUMERUS	1
HUMERUS (IN FRAGMENTS)	1
INTERMEDIATE CUNEIFORM (CU2)	2
INTERMEDIATE FOOT PHALANX	2
INTERMEDIATE FOOT PHALANX (3)	1
INTERMEDIATE HAND PHALANX	3
INTERMEDIATE HAND PHALANX (2)	1
INTERMEDIATE HAND PHALANX (5)	1
INTERMEDIATE PHALANX (3)	1
LATERAL CUNEIFORM (CU3)	2
LOOSE TEETH	33
LUMBAR VERTEBRA	1

LUMBAR VERTEBRA FRAGMENTS	2
LUNATE	1
MANDIBLE FRAGMENT (GONIAL ANGLE)	1
MAXILLA FRAGMENTS	24
MEDIAL CUNEIFORM (CU1)	2
METACARPAL	5
METACARPAL (MC2)	1
METACARPAL (MC4)	1
METATARSAL	6
METATARSAL (MT1)	4
METATARSAL (MT2 OR MT3)	1
METATARSAL (MT2)	2
METATARSAL (MT3)	1
METATARSAL (MT4)	2
METATARSAL (MT5)	4
METATARSAL FRAGMENT	2
MISCELLANEOUS/CRANIAL REMAINS	2
MISCELLANEOUS/UNIDENTIFIED	40
MISCELLANEOUS/EPIPHYSIS	1
NAVICULAR (NAV)	1
OCCIPITAL	1
OCCIPITAL FRAGMENT	1
PARIETAL (IN FRAGMENTS)	1
PROXIMAL FOOT PHALANX	3
PROXIMAL FOOT PHALANX (1)	3
PROXIMAL FOOT PHALANX (3)	1
PROXIMAL HAND PHALANX	2
PROXIMAL HAND PHALANX (1)	1
PROXIMAL HAND PHALANX (2)	1
PROXIMAL HAND PHALANX (5)	1
RADIAL EPIPHYSIS	1
RADIUS	1
RIB	5
RIB FRAGMENTS	48
SPHENOID FRAGMENT	2
TALUS	3
TEMPORAL FRAGMENT	2
THORACIC VERTEBRA FRAGMENT	3

TRAPEZIUM (TPM)	1
TRIQUETRAL (TRI)	1
ULNA	1
ULNA EPIPHYSIS	1
UNFUSED EPIPHYSIS/ HAND PHALANX	1
VERTEBRA FRAGMENT (THORACIC)	1
VERTEBRA FRAGMENTS	14
(N) TOTAL	373

Table 111. Element representation in George Rock Shelter (south-central Wales). Miscellaneous/unidentified and/or miscellaneous identified remains includes small fragments with no zone representation. Excluding these would impact the taphonomic trajectory of the site (see Chapter 5/5.2.1). N=including loose teeth.

### **Element completeness**

The majority of disarticulated remains from George Rock Shelter were severely fragmented (N=326, 95.9%) with only 14 elements (4.1%) demonstrating full zone completeness (Figure 193, Table 113/Appendix 6)<sup>247</sup>. Complete remains were discovered from distinct layers (1002/1004 Neolithic horizons and 1009 post-Medieval) and their survival must be circumstantial as the assemblage was overall extremely fragmented.

### **MNI, demography and pathology<sup>248</sup>**

Three adults, one perinate, one juvenile, one adolescent and one probable cremation, primarily from contexts 1002 and 1004 (Figure 194)<sup>249</sup>, (MNI: 7+) were recorded. Dental attrition based on surviving molars determined one age group of c.17-25+ years whilst deciduous teeth evidenced the presence of one juvenile. Sex assignments from surviving fragments could not be determined as sexually dimorphic features had not survived.

<sup>247</sup> See Appendix 6/7.3. George Rock Shelter/Element completeness for details and Figure 193/Table 113.

<sup>248</sup> See Chapter 4 for MNI and age/sex estimations.

<sup>249</sup> See Appendix 6/7.3. George Rock Shelter/MNI, demography and pathology for details on recovered horizons with cremated remains.

## Pathology

Evidence of dental pathology was present on five loose teeth (caries N=1 and calculus N=4) and no patterns were observed. Extensive erosion and/or digestion could have masked previous modifications. No signs of degenerative pathologies were present<sup>250</sup>.

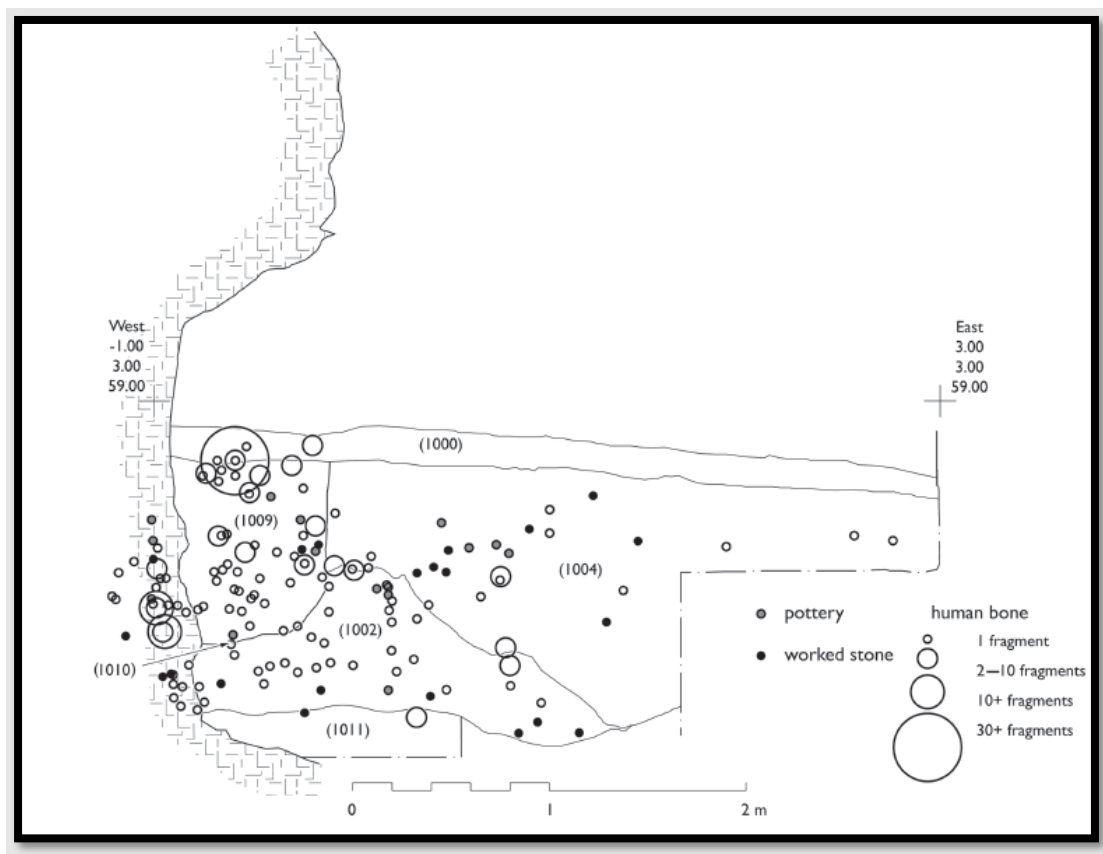


Figure 194. Depositions in George Rock Shelter. South facing section. Dated human remains derived from layers 1002 (Early Neolithic), 1004 (Early Neolithic) and 1009 (post-Medieval). 1002/1007 was given 2 different context numbers as it was originally encountered in separate patches on either side of a temporary baulk (Peterson 2019: 87).

### 7.3.1. Taphonomy – Macroscopic results

#### 7.3.1.1. Weathering

Signs of weathering (stage 1) were recorded on two elements (SNOs: 1037, 1039) including one possible metatarsal and one right ulna from context 1009 (later deposit/fill – post/Medieval)<sup>251</sup>. The large absence of this agent suggests that

<sup>250</sup> See Appendix 6/7.3. George Rock Shelter/MNI, demography and pathology for details.

<sup>251</sup> See Appendix 6/7.3. George Rock Shelter/ Taphonomy-Macroscopic results/Weathering for details.

weathering was circumstantial and resulted from disturbances/turbation of these elements that were possibly buried/deposited close to the surface and were subsequently exposed due to possible disturbance, moving of the ground or water displacements (resulting in polishing on the surface of the bone).

#### 7.3.1.2. *Gnawing*

Gnawing was present on three elements (SNOs: 938, 1080, 1113) including one intermediate hand phalanx (context 1004), one metacarpal (context 1009) and one long bone fragment (context 1002/surface of cremation)<sup>252</sup>. Absence of gnawing amongst the remaining assemblage and presence of gnaw marks on small elements that derived from different contexts suggests post-depositional seasonal disturbances.

#### 7.3.1.3. *Erosion*

Signs of erosion were recorded on more than half of the assemblage (N=234, 68.8%) including hands/feet (N=66), flat/irregular bones (N=54) and cranial/skull remains (N=57) (Figure 195). Erosion similarly recorded on the majority of surviving loose teeth (N=20, 83%). Few loose teeth had evidence of cave concretion/stalagmite-tufa residues (N=3, 12%) and digestion (N=4, 16%). Digested teeth were recovered from different layers including 1003, 1004 and 1007 suggesting that depositions were subsequently followed by disturbances from scavengers (as noted by the scattered gnawed elements).

Surface preservation scores amongst eroded remains were poor (2-0) similarly to non-eroded remains (Figure 195/Appendix 6)<sup>253</sup>. Non-eroded elements were recovered from several contexts (1001-4, 1007-9) including all cremated remains and small fragments (e.g. foot tarsals)<sup>254</sup>.

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<sup>252</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy – Macroscopic results/Gnawing for details.

<sup>253</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy-Macroscopic results.

<sup>254</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy-Macroscopic results/Erosion for correlation with Spurge Hole.

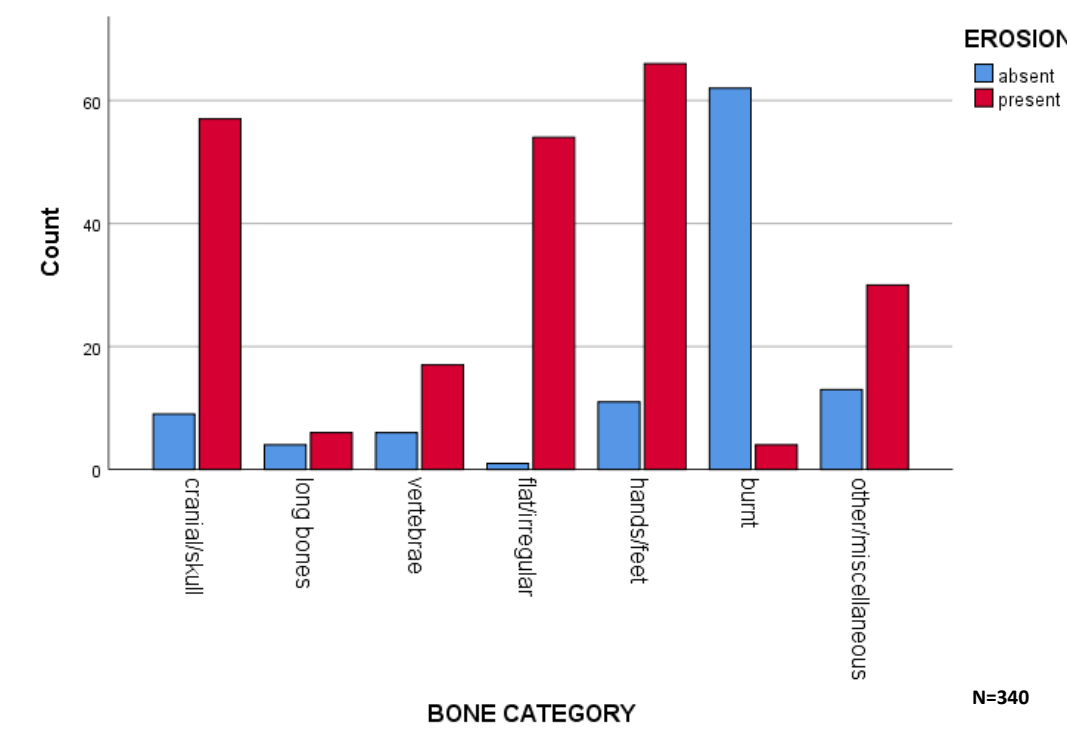


Figure 195. Frequency of erosion absence/presence based on bone category in George Rock Shelter.

#### 7.3.1.4. Abrasion

Abrasion was recorded on 37 elements (10.9%) including hands/feet (N=12, cranial/skull remains (N=10), flat/irregular bones (N=8), two long bones and burnt fragments and three miscellaneous remains (possible ulna, fibula and metatarsal) (Figure 197 below and Figure 198/Appendix 6)<sup>255</sup>.

Abraded elements derived from different layers/contexts (1002, 1004, 1007 and 1009) however most had been recovered from context 1009 (later fill of post-Medieval date) (Table 114/Appendix 6)<sup>256</sup>. Abrasion on earlier interments could have resulted from continuous rubbing of the bone on sediments causing slight rounding and smoothness whilst water abrasion/rainwater could have been responsible for polishing on the surface of some fragments that were later deposited on top of earlier interments.

<sup>255</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy - Macroscopic results/Abrasion/Figure 198 for surface preservation associations. <sup>255</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy - Macroscopic results/Abrasion

<sup>256</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy - Macroscopic results/Abrasion and Table 114 for associations with other taphonomic modifications.

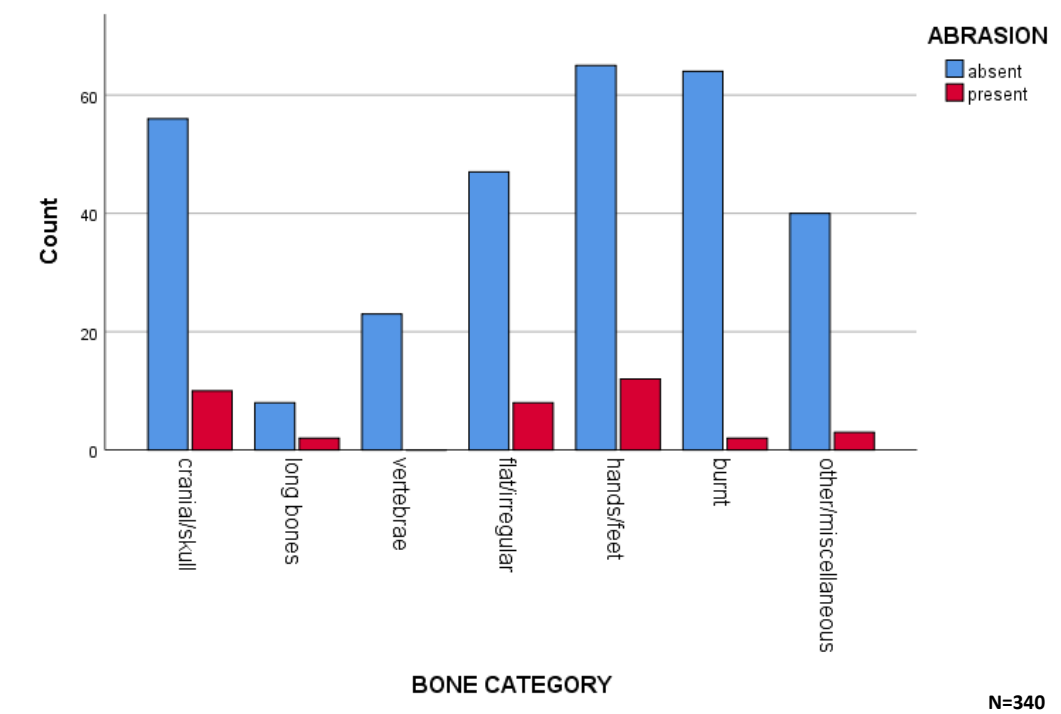


Figure 197. Presence/absence of abrasion based on bone category in George Rock Shelter.

#### 7.3.1.5. Staining

Evidence of staining was observed on 154 elements (45.3%) and included black manganese and/or mould staining that had not severely affected the surface of the bones (Figure 199). Staining was sometimes accompanied by white stalagmite/tufa residues whilst one cranial fragment (SNO: 899/context 1004) exhibited a red stain. Hands/feet (N=53), flat/irregular bones (N=32) and cranial/skull remains (N=31) were most frequently affected (Figure 200 and Table 115/Appendix 6)<sup>257</sup>.

<sup>257</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy – Macroscopic results/Staining/Figure 158 for surface preservation and Table 116 for associations with other taphonomic modifications.

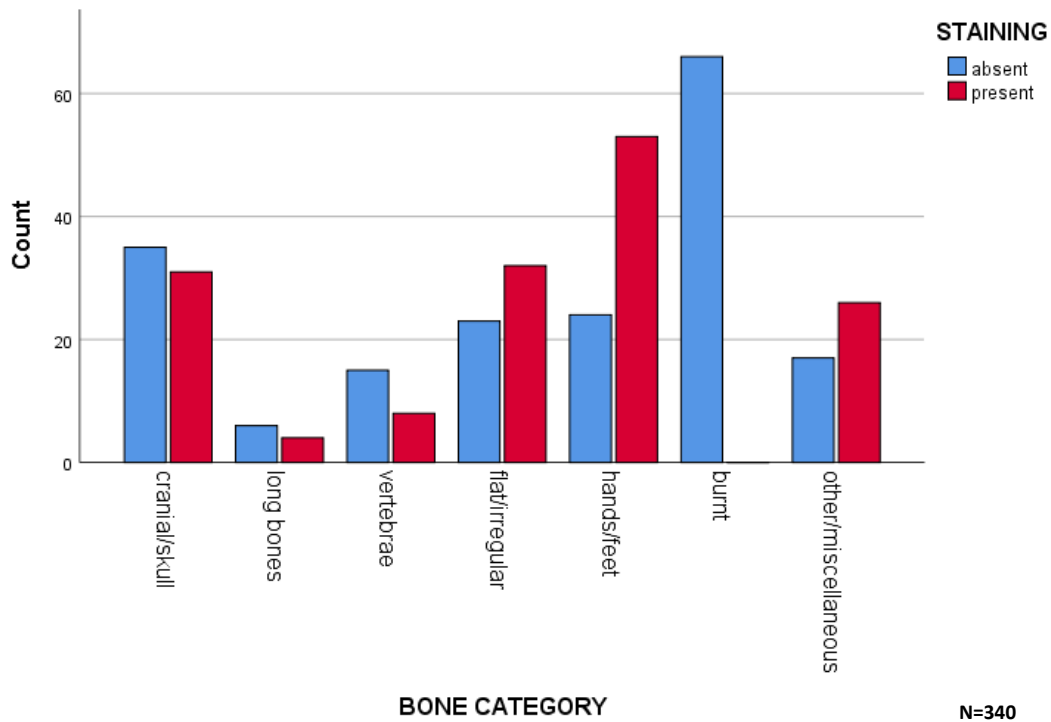


Figure 199. Staining presence/absence based on bone category in George Rock Shelter.

#### 7.3.1.6. Trauma (sharp/blunt force)

Signs of trauma, including sharp and/or blunt force were not recorded on any elements from George Rock Shelter. Erosive processes could have masked previous modifications and might be responsible for the fragile and fragmented state of the remains.

#### 7.3.1.7. Burning

Evidence of cremation was present on 67 (19.7%) small fragments from George Rock Shelter with only three more elements from Ogof Colomendy demonstrating signs of burning across sites examined from Wales. The vast majority of burnt remains were unidentifiable to element (N=61) with five cranial fragments and one triquetral recorded.

Evidence of erosion was identified on five burnt fragments with most fragments demonstrating different burning stages (Table 116/Appendix 6)<sup>258</sup> as examined and

<sup>258</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy – Macroscopic results/Burning.



analysed in section 7.3.1.2. Burnt fragments from George Rock Shelter were recovered from different contexts (1000-1004/1007-9) with most however recovered from 1002 and 1004. Further disturbances could have been responsible for moving of remaining burnt fragments.

#### *7.3.1.8. Fractures (fresh vs dry)*

Fractures were not recorded amongst recovered long bone fragments.

#### *7.3.1.9. Surface preservation*

The majority of elements demonstrated very poor surface preservation (score 0/N=119, 35%; score 2/N=84, 24.7%; score 1/N=78, 22.9%). Scores amongst hands/feet and flat/irregular bones followed a similar pattern with most being one/two and cranial/skull remains showing slightly better surface preservation (most ranging two/three) (Figure 201/Appendix 6)<sup>259</sup>. Elements demonstrating very good surface preservation (score 5) were recovered from a later fill/context 1009 apart from a single proximal foot phalanx recovered from Neolithic horizon 1004. Overall surface preservation was dictated by erosion severity and high fragmentation resulting in low scores.

#### *7.3.1.10. Trampling*

No evidence of trampling was recorded on any elements from George Rock Shelter. Extensive erosion may have been responsible for taphonomic overprinting however, trampling is not a modification often encountered in subterranean environments.

### **7.3.2. Microscopic results**

#### **OHI scores and MFD<sup>260</sup>**

Seven cranial fragments were sampled. Histological destruction of all samples resulted from bioerosion and non-Wedl attack. OHI scores range from zero (N=5, 71%) to one (N=2, 28%) (Figure 202/Appendix 6<sup>261</sup> and 203 below). Collagen preservation

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<sup>259</sup> See Appendix 6/7.3. George Rock Shelter/Taphonomy – Macroscopic results/Surface preservation.

<sup>260</sup> See Appendix 6/7.3. George Rock Shelter/Microscopic results for specification of one sampled element from the post-Medieval layer not included in the analysis.

<sup>261</sup> See Appendix 6/7.3. George Rock Shelter/Microscopic results.

correlated with OHI scores with most demonstrating absence to low birefringence. Types of bacterial attack identified in the microstructure of the samples included budded and linear longitudinal (N=6/all samples) and lamellae MFD (N=5, 71%). Wedl tunneling was not identified in any samples.

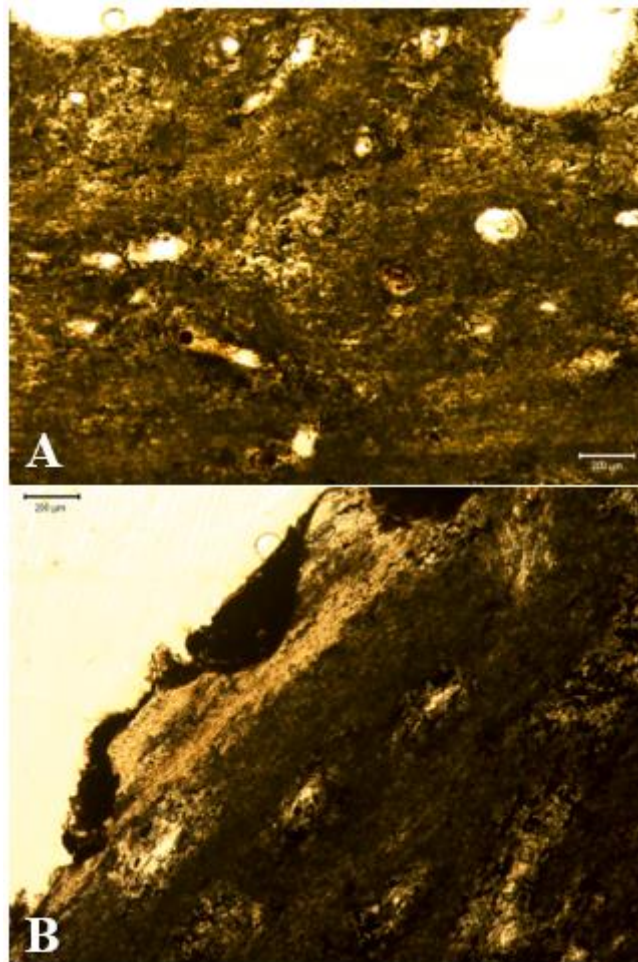


Figure 203. A: cranial fragment – non-Wedl MFD (OHI 0) and B: cranial fragment – non-Wedl MFD (OHI 1). Magnification x5. Source: author

### **Taphonomy**

Signs of surface taphonomy included erosion (N=5, 71.4%), staining (N=6, 85.7%) and abrasion (N=1, 14.3%). Surface preservation scores varied from zero to three amongst samples however, elements that demonstrated medium surface preservation similarly scored low on the OHI scale and therefore no correlations between surface (external) and microstructure (internal) of an element can be made. Elements sampled were

recovered from Neolithic horizons 1002/1004 and 1003 (upper fill of possible Neolithic feature).

### **Birefringence**

Collagen loss was apparent amongst samples with four (57%) demonstrating low birefringence scores and remaining three (42%) indicating absence of collagen survival in their microstructure (Figure 204 and Table 117/Appendix 6)<sup>262</sup>.

### **Other microscopic observations**

Inclusions and infiltrations were observed in four samples (57% for each) and microcracking/microfissures were apparent in a single sample (Table 118/Appendix 6)<sup>263</sup>. Microstructural staining on the other hand was identified in all samples (Tables 119-120/Appendix 6)<sup>264</sup>.

Taphonomic correlation between microcracking and surface erosion or weathering was not observed in any samples. Microcracking in sample 46 was noted under polarised light in very small areas (Figure 205) however no associations can be made as opposed to section elements from Spurge Hole where intense cracking was associated with presence of erosion and/or advanced weathering (high demineralisation).

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<sup>262</sup> See Appendix 6/7.3. George Rock Shelter/Microscopic results for Figure 204 and Table 117.

<sup>263</sup> See Appendix 6/7.3. George Rock Shelter/Microscopic results.

<sup>264</sup> See Appendix 6/7.3. George Rock Shelter/ Microscopic results/ Table 119 for inclusion/infiltration/microstructural staining colour, Table 120 for OHI correlations and Table 121 for intensity patterns.

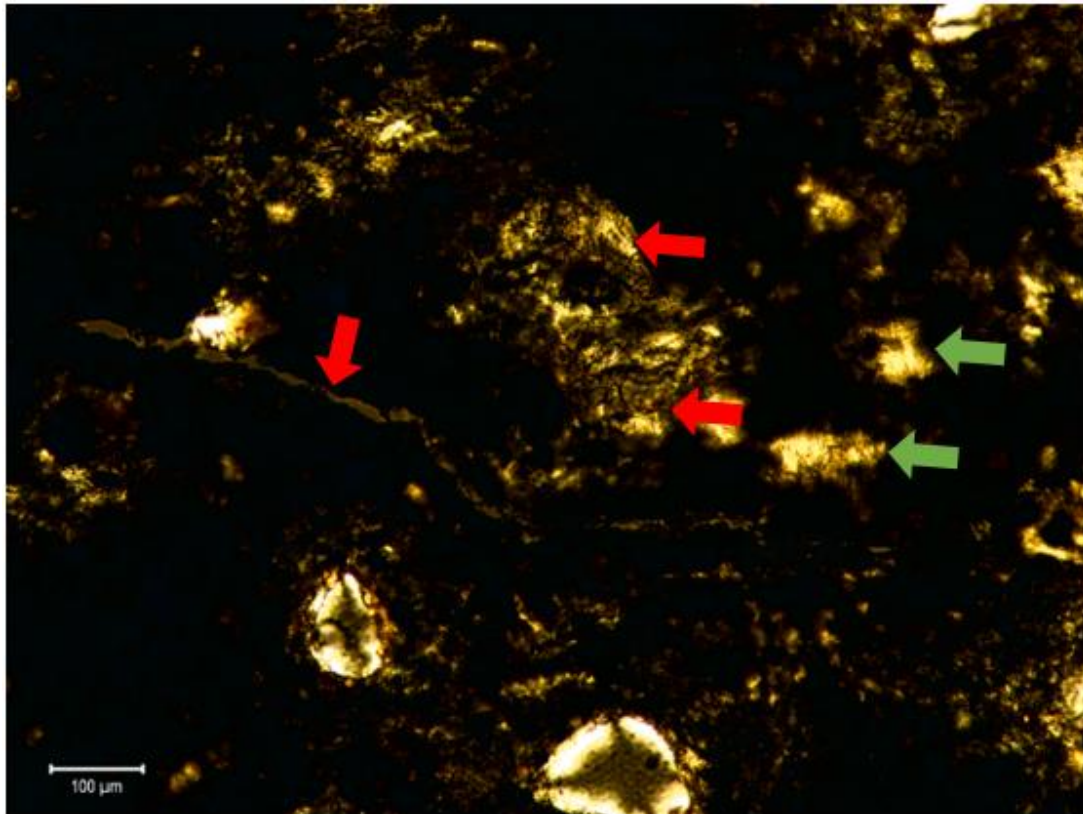


Figure 205. Cranial fragment under polar light. Signs of cracking around Haversian canals and in the middle of the microstructure (red arrows). Collagen retained (green arrows/birefringence score: low/medium) despite extensive non-Wedl MFD (OHI 0). Source: author

### 7.3.3. Short summary of burial depositions in George Rock Shelter

Primary depositions must have taken place in the site with subsequent disturbances and erosion leading to further fragmentation and disintegration of surviving elements. Evidence of gnawing was very low; however, presence of digestion suggests that visits in the cave by scavengers further affected their preservation and might have caused disturbances.

Stratigraphic information (see Appendix 5) and new radiocarbon dating verify that multiple successive depositions occurred in the site in the Early Neolithic and post-Medieval periods whilst the elements' fragmentary state was primarily the result of erosion/root etching.

Based on the frequencies of human remains, long bones surviving from the Neolithic horizons (1002/1004) were severely fragmented and eroded with most not securely identifiable. Results therefore suggest that the low prevalence of Neolithic long bone

fragments, in particular, resulted from selective removal of larger elements for secondary deposition and smaller elements left in the cave. Burnt fragments and a cremation pyre further support the practice of cremation on-site. These small fragments could have easily been discarded, not collected. Bone processing was executed through the scattering of remains, selective retrieval and separation of body parts (see Chapter 8).

#### **7.4. Little Hoyle Cave**

##### **Frequency of skeletal elements**

Results demonstrated a predominance of cranial/skull remains (N=41, 47%) with the remaining assemblage comprising of postcranial remains (N=30, 34%), loose teeth (N=14, 16%) and two miscellaneous fragments (2%) (Figure 206).

Cranial/skull fragments (N=41, 56%) were most prevalent amongst the assemblage followed by hands/feet (N=16, 21%). The remaining assemblage included seven long bone fragments (9%), five flat/irregular bones (6%), two vertebrae and two possible clavicle and scapular fragments (other/miscellaneous remains: 2%) (Figure 207, Table 121). Loose teeth distributions primarily comprised of adult molars. Juvenile teeth [one deciduous canine (7%) and one deciduous molar (7%)] were further recorded amongst the assemblage (Figure 208/Appendix 6)<sup>265</sup>.

Zone representation on long bones using the proximal and/or the distal epiphysis demonstrated higher survival of epiphyses (N=6, 85%) than shafts (N=3, 42%). Surviving long bones comprised of femora (N=4, 57%), ulnae (N=2, 28%) and one humerus (14%) (Table 122/Appendix 6<sup>266</sup>)<sup>267</sup>. Overall long bone representation was low, which further reflects possible selection of body parts (mandibulae) for deposition with surviving long bones scattered in the site.

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<sup>265</sup> See Appendix 6/7.4. Little Hoyle Cave/Frequency of skeletal elements/Figure 208 – details on adult teeth.

<sup>266</sup> See Appendix 6/7.4. Little Hoyle Cave/Frequency of skeletal elements Table 122 – details on taphonomy.

<sup>267</sup> <sup>267</sup> See Appendix 6/7.4. Little Hoyle Cave/Frequency of skeletal elements.

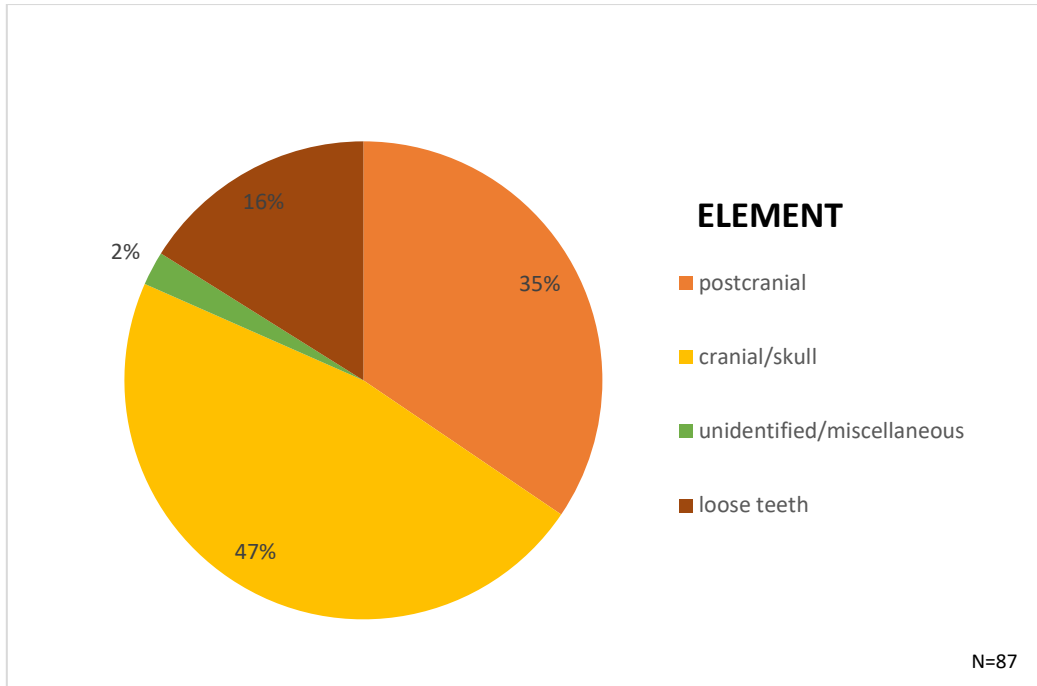


Figure 206. Element frequency amongst the assemblage from Little Hoyle Cave. N=including loose teeth.

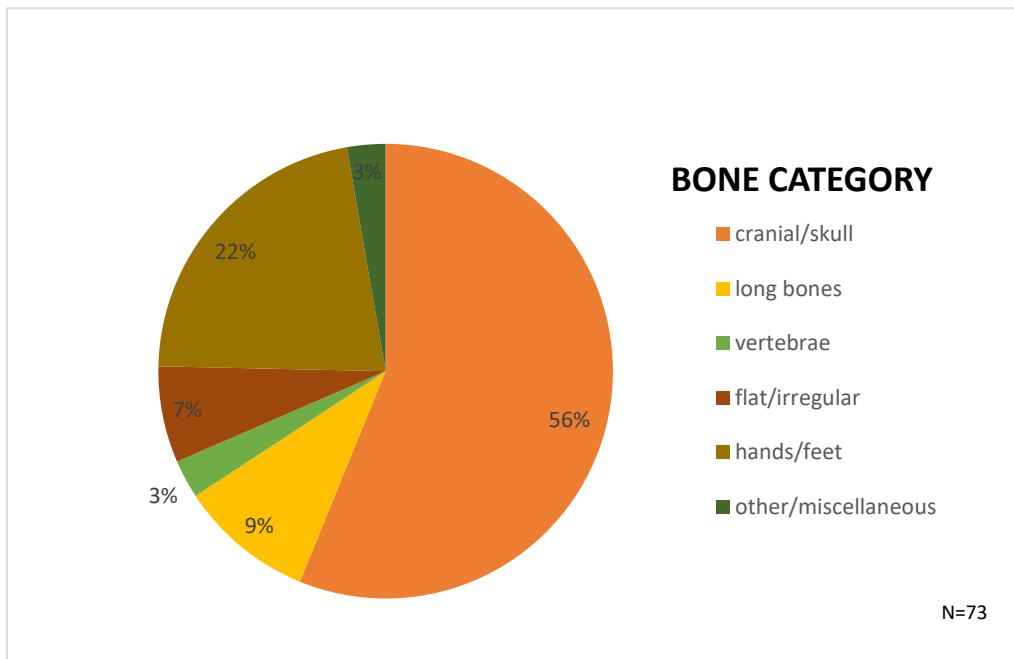


Figure 207. Element frequencies in Little Hoyle Cave based on bone category (excluding loose teeth).

<b>ELEMENT</b>	<b>COUNT</b>
ATLAS (C-1)	1
CLAVICLE	1
CRANIAL FRAGMENT (FRONTAL)	3
CRANIAL FRAGMENT (PARIETAL)	2
CRANIAL FRAGMENT (PERIETAL)	1
CRANIAL FRAGMENT (TEMPORAL)	2
CRANIAL FRAGMENT (TEMPORAL/PETRUS BONE)	1
CRANIAL FRAGMENTS	13
CRANIUM	1
DISTAL HAND PHALANX (2)	1
FEMUR	4
HUMERUS	1
INTERMEDIATE HAND PHALANX (2 OR 3)	1
LOOSE TEETH	14
MANDIBLE	15
MANDIBLE FRAGMENT	3
METACAPRAL (MC 2)	1
METACARPAL (MC 1)	1
METACARPAL (MC 2)	2
METACARPAL (MC 3)	1
METATARSAL	1
MISCELLANEOUS/?CLAVICLE	1
MISCELLANEOUS/?SCAPULA	1
PATELLA	1
PROXIMAL FOOT PHALANX (5)	1
PROXIMAL HAND PHALANX	1
PROXIMAL HAND PHALANX (1)	1
PROXIMAL HAND PHALANX (2)	1
PROXIMAL HAND PHALANX (5)	1
SCAPULA	3
SCAPULA FRAGMENT	1
TALUS	2
ULNA	2
VERTEBRA FRAGMENT	1
(N) TOTAL	87

Table 121. Element representation in Little Hoyle Cave (south-west Wales). N=including loose teeth.

## Element completeness

The vast majority of disarticulated remains from Little Hoyle Cave were not complete (N=64, 87%) with only nine elements demonstrating full zone completeness. Complete elements included two metacarpals, four proximal hands/foot phalanges, one intermediate hand phalanx and two tali (SNOs: 67-8, 72, 87, 90, 92-3, 104 and 109). Different treatment between the individuals, exposure in distinct environments or deposition in different parts of the cave (e.g. sub-aerial exposure or deposition in the opening/chimney filling above the main cave) could have been responsible for separate surface preservation scores (Figure 209/Appendix 6)<sup>268</sup> (Figures 210-211 below and see Appendix 5)

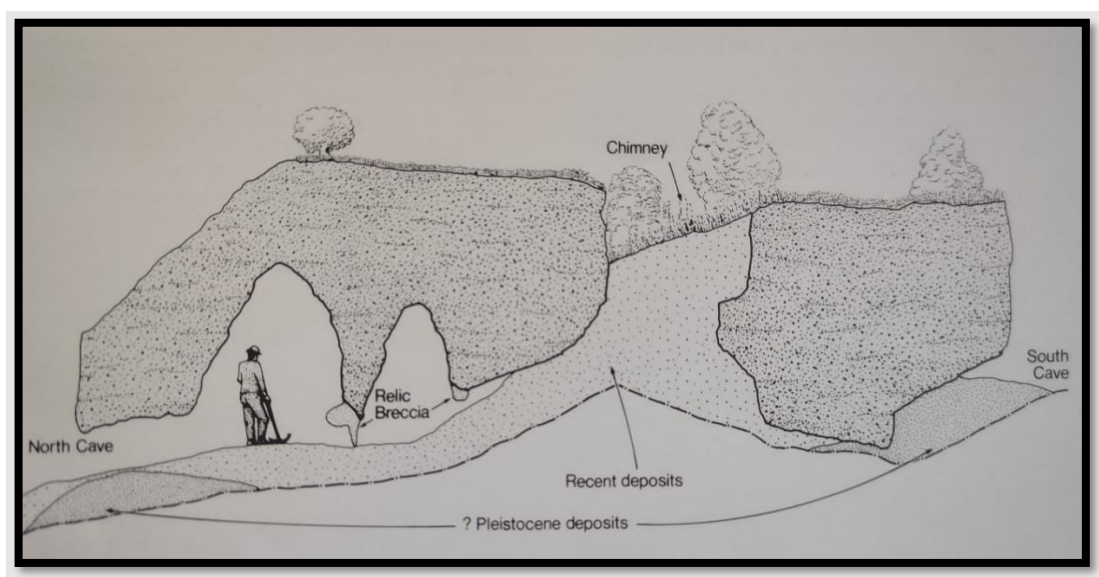


Figure 210. Section of Little Hoyle Cave. The cave connected with the surface through an opening ('chimney' in drawing). From a 19<sup>th</sup> century large watercolour painting with a cross-section drawing of the cave on a hill by Professor Rolleston and E.Laws (Green and Walker 1991: 62)

<sup>268</sup> See Appendix 6/7.4. Little Hoyle Cave/Element completeness/Figure 209 for more details on surface preservation.



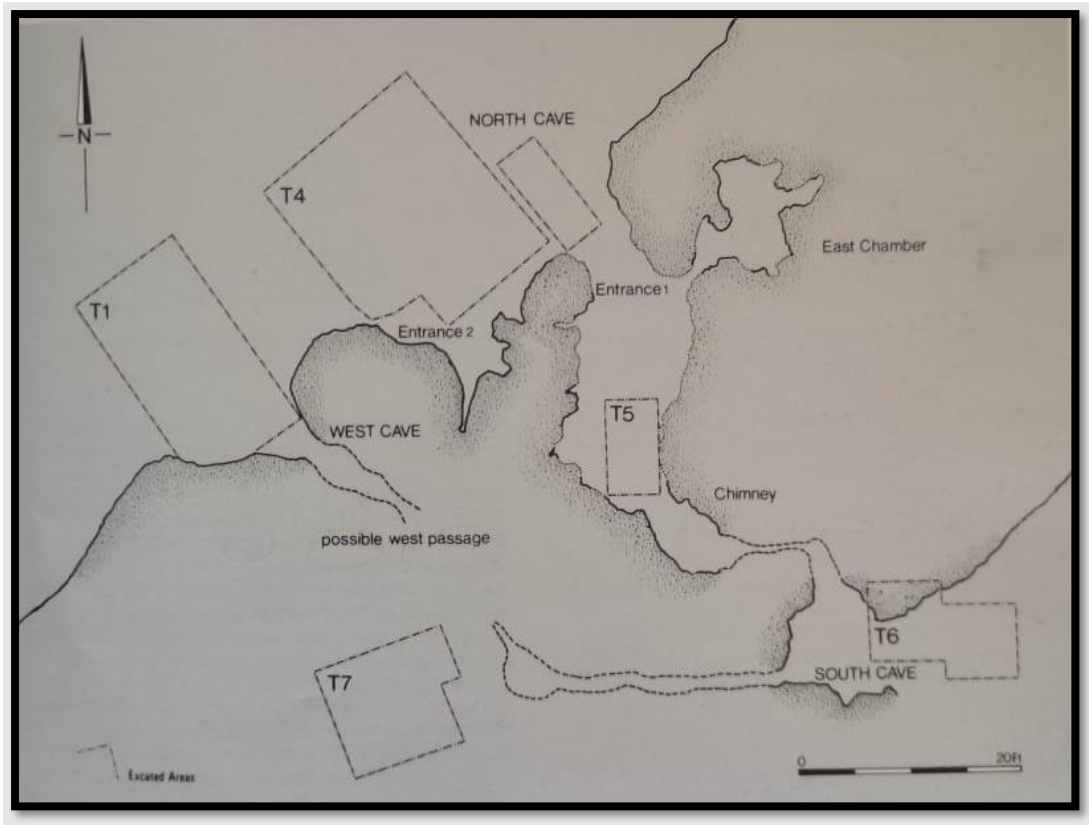


Figure 211. Plan of Little Hoyle Cave indicating excavated areas (discontinuous squares/T1, T4-7) (Green and Walker 1991: 61).

### **MNI, demography and pathology<sup>269</sup>**

Seven adults, three younger adults and one juvenile were identified. Dental attrition based on surviving molars (either still attached on mandibulae or from loose teeth) determined five age groups of c. nine to ten years (M2 deciduous attached and deciduous loose canine and M1), c.17-25 years, c.25-35 years, c.35-45 years and c.45+ years. Three probable males and three probable females, one male and a single female were further identified (mandibulae).

### **Pathology**

Pathology included both dental (N=6), from teeth still attached in the mandibular alveoli, and degenerative (N=4)<sup>270</sup>.

<sup>269</sup> See Chapter 5 for MNI and age/sex estimations.

<sup>270</sup> See Appendix 6/7.4. Little Hoyle Cave/MNI, demography and pathology for more details.

## **7.4.1. Taphonomy – Macroscopic results**

### *7.4.1.1. Weathering*

Weathering was identified on 26 elements (35%) (Figure 212/Appendix 6)<sup>271</sup>. Weathered elements included cranial/skull remains (N=20), one long bone, one vertebra (atlas) fragment, three flat/irregular bones and one proximal hand phalanx. Weathering stage one was noted on most elements (N=23) with more advanced stages identified on three elements (stage 2/N=2; stage 3/N=1). Advanced stages of weathering were solely recorded on two cranial/skull elements with remaining N=17) demonstrating lower stages of sub-aerial exposure (stage one). Abrasion was solely recorded on several weathered elements (stage 1) (N=10) which could be justified by water filtering through the cave roof after remains have undergone short-sub-aerial exposure from deposition in the cave depression. (Table 123/Appendix 6)<sup>272</sup>.

### *7.4.1.2. Gnawing*

Gnawing was recorded on three elements (4%) including one metatarsal, one femur and one metacarpal (SNOs: 73, 82 and 106). Absence of gnawing amongst elements suggests that elements must have been deposited in separate parts of the cave and not in the inner part of the cave (Trench five) where animal remains were unearthed (see Appendix 5)<sup>273</sup>.

### *7.4.1.3. Erosion*

Evidence of erosion was apparent on 44 elements (60%) primarily on cranial/skull remains (N=29) with remaining elements demonstrating approximately equal frequencies amongst eroded and non-eroded human remains (Figures 213-214/Appendix 6)<sup>274</sup>.

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<sup>271</sup> See Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Weathering.

<sup>272</sup> See Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Weathering for more details on taphonomy and Table 123.

<sup>273</sup> And Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Gnawing for more details.

<sup>274</sup> See Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Erosion for more details and Figure 214 on surface preservation amongst eroded remains.

#### 7.4.1.4. Abrasion

Abrasion was noted on 28 elements (38%) including cranial/skull remains (N=18), hands/feet (N=8), one long bone (SNO: 108) and one clavicle (SNO: 123). The majority of both abraded and non-abraded human remains showed similar patterns amongst cranial/skull remains and hands/feet (Figure 215) and most human remains scoring similarly (score 2) (Figure 216/Appendix 6)<sup>275</sup>. Surface-water was noted during the 1877 excavation filtering through the roof which suggests that polishing on the bones is related to water wear. Abrasion was often accompanied by staining (N=21), erosion (N=17) and occasional weathering (stage 1) (Table 124/Appendix 6)<sup>276</sup> whilst gnawing was present on a single abraded metacarpal (SNO: 106) suggesting that carnivore licking could have also been responsible for polishing on the bone.

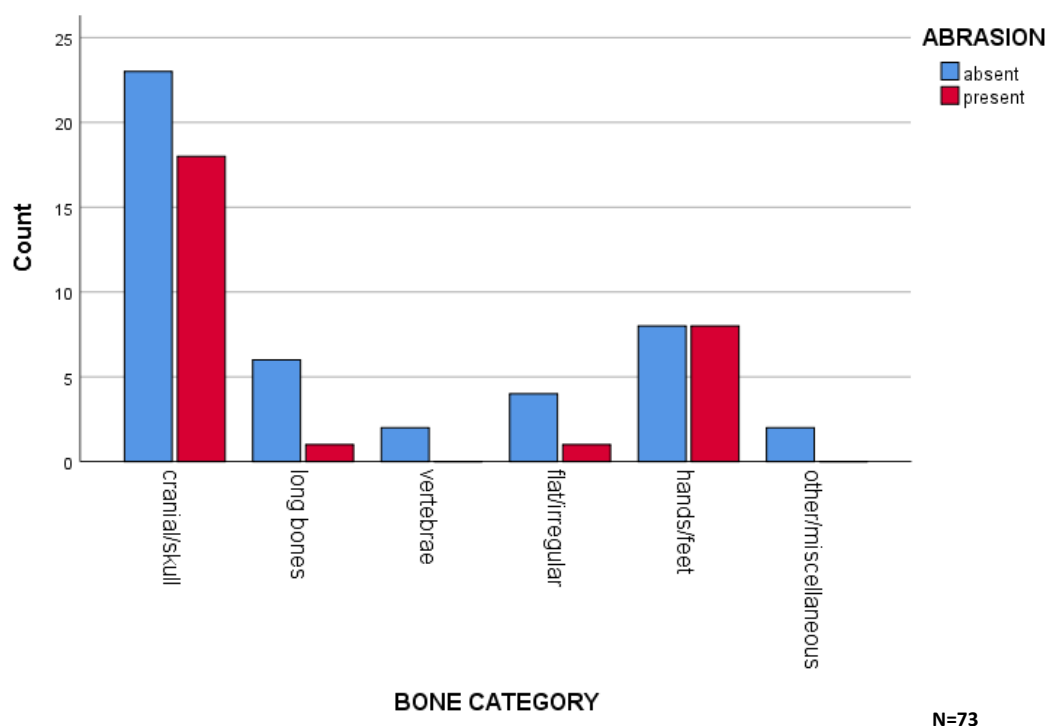


Figure 215. Presence/absence of abrasion based on bone category in Little Hoyle Cave.

<sup>275</sup> See Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Abrasion for more details.

<sup>276</sup> See Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Abrasion.

#### 7.4.1.5. Staining

Staining was recorded on 57 elements (78%) and included black manganese/mould marks that covered most if not all of the surface (Figure 217). Slight cave concretion and/or brown/grey residues often accompanied stained elements (Figure 218 and Table 125/Appendix 6)<sup>277</sup>. The extensive evidence of staining suggests that humid conditions and possible infiltrating air pockets were responsible for this staining pattern on the bones, most of which derived from the cave infilling/roof depression (Figure 219). Similar marks were identified on surviving elements from Ifton Quarry, an old rock shelter where human remains might have been half buried/half exposed with both humid subterranean and sub-aerial conditions resulting in this staining pattern.

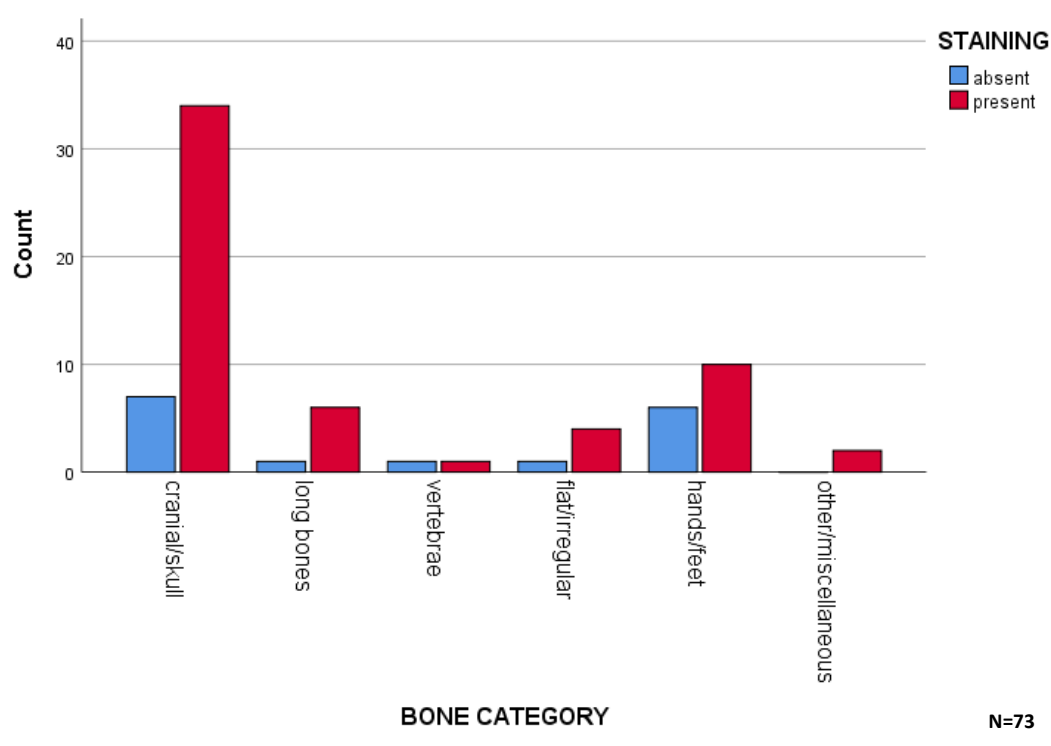


Figure 217. Staining presence/absence based on bone category in Little Hoyle Cave.

<sup>277</sup> See Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Staining/ Figure 218 for surface preservation details and Table 125 for correlations with other taphonomic modifications.



Figure 219. Cranial (right) and mandibulae (centre, left) fragments with different degrees of staining, Source: author

#### *7.4.1.6. Trauma (sharp/blunt force)*

Signs of trauma, including sharp and/or blunt force were not recorded on any elements from Little Hoyle Cave.

#### *7.4.1.7. Burning*

No signs of burning were recorded.

#### *7.4.1.8. Fractures (fresh vs dry)*

Fractures amongst surviving long bones (two femora and one humerus /SNOs: 83, 95 and 107) included two fresh and one dry. Femur shaft 95 exhibited a dry fracture (FFI score: 6) and staining. Humerus SNO 107 exhibited a fresh fracture (FFI score: 2) on its proximal end, with the trochlea of the bone surviving, and signs of staining and erosion. Femur 83 similarly exhibited a fresh break (FFI score: 2) on the distal diaphysis (fused proximal end) and staining marks on its surface. The low number of long bones (N=10) in the assemblage suggests that either remains were deposited in different parts of the cave and subsequently lost or deposition of body parts did not primarily involve circulation of long bones (see Chapter 8 for discussion). Evidence of trauma was not present on long bones exhibiting fresh fractures suggesting that these were not the result of defleshing but occurred during excarnation. Long bones however did not exhibit signs of weathering therefore sub-aerial exposure might not have been part of the practice (excluding ulna SNO 108/weathering stage 1).

#### *7.4.1.9. Surface preservation*

Human remains overall demonstrated poor surface preservation with the majority scoring low (score 2/N=20, 27%; score 1/N=13, 17%) to medium (score 3/N=13, 17%). Remaining elements demonstrated fluctuation in preservation between high (score 4/N=10, 13% and score 5/N=9, 12%) and very low scores (score 0/N=8, 11%), which suggests deposition in separate parts of the cave or exposure to distinct environments prior to deposition in the cave.

Cranial/skull remains were overall more severely affected by taphonomic modifications with most showing poor surface preservation (scores 2-1) (Figure 220/Appendix 6)<sup>278</sup>. Bones of the hands and feet on the other hand demonstrated equal distributions between scores two, four and five (low and high) which suggests exposure in different environments either at the site or before deposition in the cave.

#### *7.4.1.10. Trampling*

Trampling was identified on a single cranial fragment (SNO: 128) with evidence of abrasion (rounding-polishing), erosion and a probable endocranial lesion. Its surface preservation was very good (score 5) suggesting that disturbances could have caused slight kicking of this element that was dragged across sediment resulting in trampling.

### **7.4.2. Microscopic results**

#### **OHI scores and MFD**

Histological destruction of 16 samples resulted from bioerosion and non-Wedl attack. OHI scores ranged from zero to five with most samples demonstrating extensive bacterial attack (OHI score: 1/N=7, 43%) (Figure 221/Appendix 6)<sup>279</sup>. Remaining samples showed better histological preservation (OHI score 2/N=4, 25% and score 3/N=3, 18%) and two demonstrated opposing patterns (OHI score 0/6% and score 5/6% respectively). Variation in OHI scores suggests different treatment between individuals (Figures 222-224). Types of bacterial attack identified in the microstructure of the samples included linear longitudinal (all samples), budded (N=15, 93%) and lamellate MFD (N=10, 62%).

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<sup>278</sup> See Appendix 6/7.4. Little Hoyle Cave/Taphonomy – Macroscopic results/Fractures (fresh vs dry)

<sup>279</sup> See Appendix 6/7.4. Little Hoyle Cave/Microscopic results.

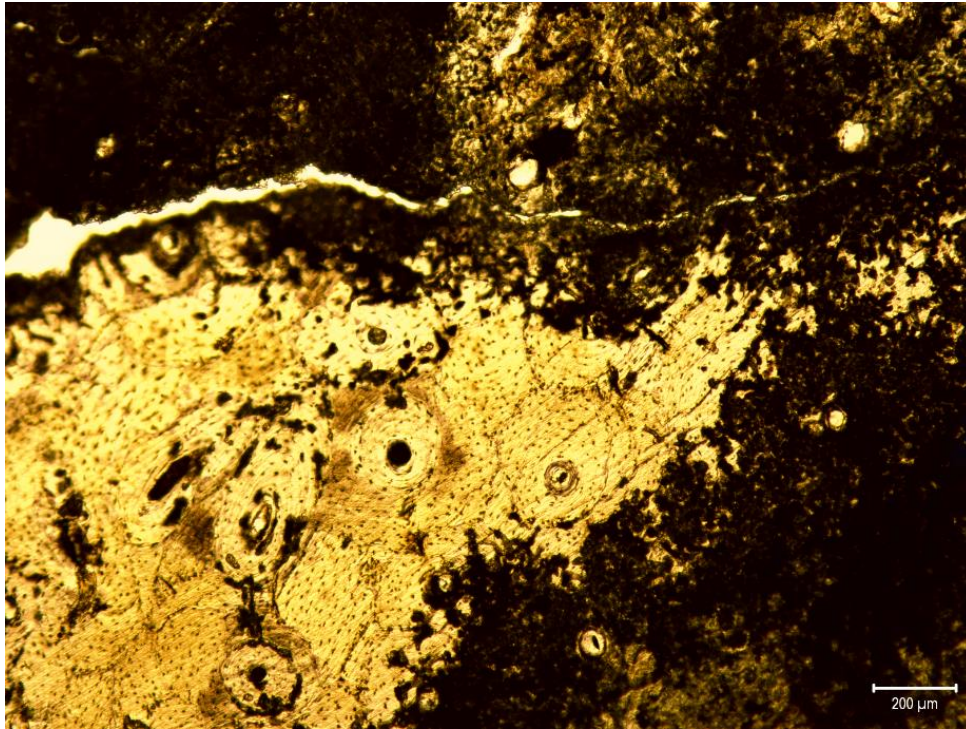


Figure 222. Non-Wedl MFD in mandible with large preserved area (OHI 3). Magnification x5. Source: author

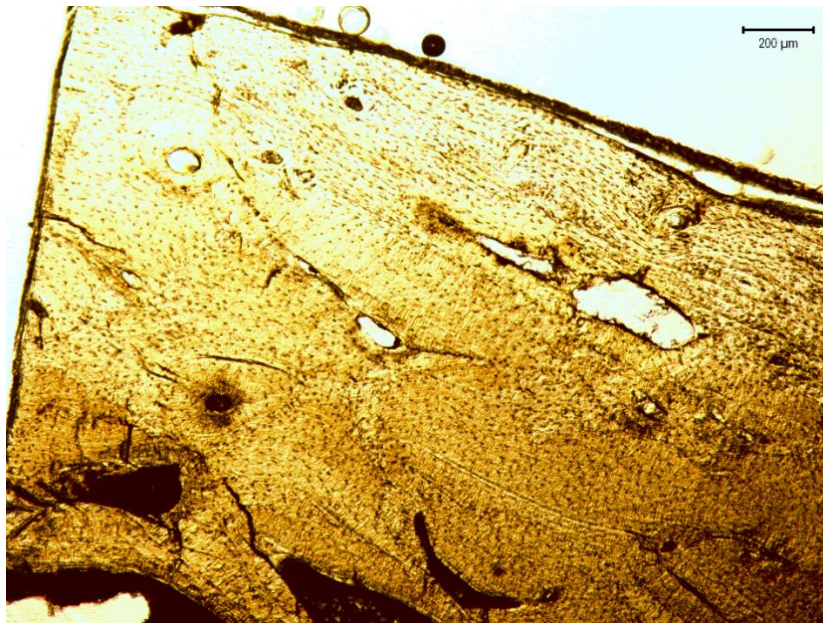


Figure 223. High histological preservation (OHI 5) in mandible. Magnification x5. Source: author



OHI scores amongst long bones reflect possible different treatment as each element (N=4) demonstrated distinct OHI scores (Table 126). Most cranial fragments and mandibulae indicated similar histological preservation (N=3/OHI score: 1). A single mandible (SNO: 2/Appendix 1/Sheet 3/Histology) with perfect histological preservation exhibited minor bacterial attack in places (non-Wedl MFD) that did not affect overall histological preservation (Figure 224) (Table 126).

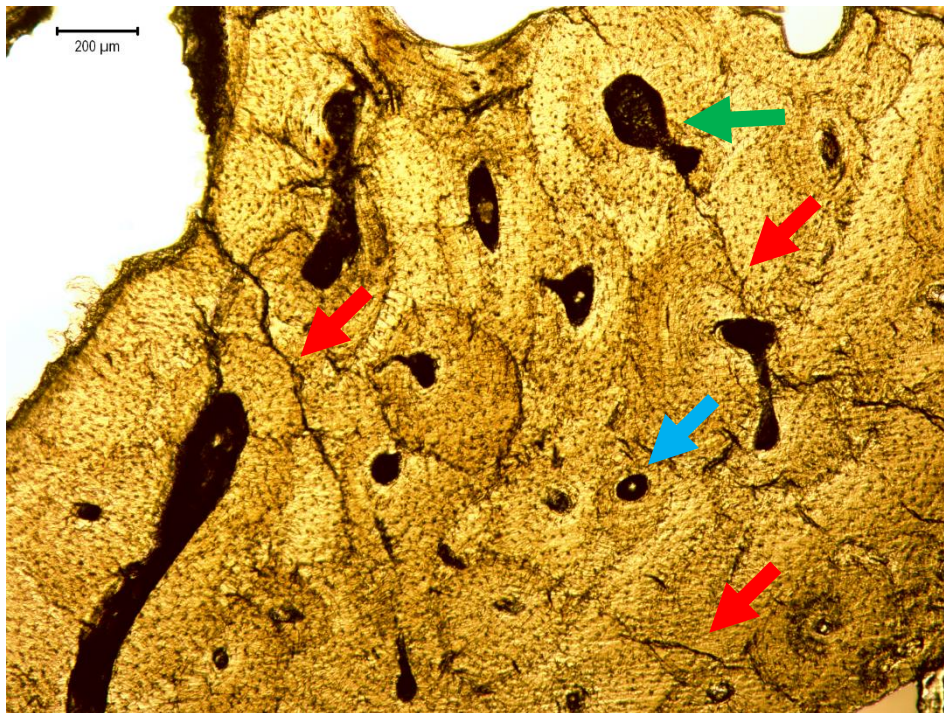


Figure 224. High histological preservation (OHI 5) in mandible. Cracking (red arrows), inclusions (blue arrow) and infiltrations (green arrow) present. Magnification x5. Source: author

Variation in histological preservation (OHI scores 1-5) was also noted amongst samples from Spurge Hole (south-central Wales) and non-parametric tests demonstrated that human remains from Little Hoyle Cave were not significantly better preserved than those from Spurge Hole ( $P=0.226$ ,  $MWU=50.5$ ). Higher OHI scores (both sites) suggest selection and different treatment from elements with minor to no bacterial attack that must have been rapidly skeletonised before MFD destroyed the microstructure.

ELEMENT	OHI SCORE				
	0	1	2	3	5
CF/SKULL	0	3	1	1	0
MAND	0	3	2	1	1
LB	1	1	1	1	0

Table 126. Table demonstrating OHI score distribution amongst cranial fragments (CF), mandibulae (MAND) and long bones (LB) sampled from Little Hoyle Cave. N=16.

## Taphonomy

OHI scores did not demonstrate associations with presence of erosion, staining (N=11, 68% and N=13, 81% respectively) and/or abrasion (N=9, 56%). Weathering (N=8, 50%) was associated with separate OHI scores amongst samples with no pattern identified<sup>280</sup>.

Two fractures (dry/SNO: 14; fresh/SNO: 15) were identified on two long bones. Femur shaft 54 exhibited a dry fracture, staining and medium histological preservation (OHI score 3). Humerus SNO 15 on the other hand, exhibited a fresh fracture, erosion/root etching, staining and abrasion whilst bacterial MFD had severely affected the preservation of the microstructure (OHI score: 0). Sample SNO 15 demonstrated the lowest score amongst samples with a fresh fracture possibly resulting during primary burial either at the site or elsewhere before deposition in the cave. A dry fracture (femur 54) could have resulted from later disturbances and given the very low number of surviving long bones, these could have been exhumed and circulated/brought to the site.

Different OHI scores (1-3, 5) and surface preservation (0-2, 4-5) scores amongst mandibulae further supports different treatment, with collection of body parts, possible circulation and deposition in the chimney where several human remains were exposed sub-aerially.

<sup>280</sup> See Appendix 6/7.4. Little Hoyle Cave/Microscopic results for details on recorded macro- and micro taphonomy.

## **Birefringence**

Birefringence scores demonstrated low (1) (N=6, 37%) to medium (2) (N=8, 50%) collagen preservation with two samples (SNOs: 4 and 13) showing no collagen preservation (12%) and low OHI scores (1) (Figure 225, Table 127/Appendix 6)<sup>281</sup>. Overall collagen preservation amongst samples and given OHI scores showed correlations, particularly amongst samples scoring two to three<sup>282</sup>.

## **Other microscopic observations**

Infiltrations, inclusions, and microstructural staining were present in all samples whilst microcracking were recorded in most samples (N=11, 68.8%) (Table 128/Appendix 6)<sup>283</sup>. Infiltrations in the microstructure by extraneous material in distinct rates might have occurred due to different deposition in the depression of infilling with some elements being deposited deeper than others or in separate parts of the cave as noted in the site report (see Appendix 5 and Appendix 6/Tables 129- 131)<sup>284</sup>.

Demineralisation of the bones (due to weathering) was not associated with cracking in the microstructure of these elements. Evidence of microcracking was further associated with weathering presence amongst low/medium OHI scores (1-3) however, this included both low and high microcracking intensities (1-3) with one cranial fragment (SNO: 12/Appendix 1/Sheet 3/Histology) demonstrating absence of microcracking (Table 131/Appendix 6)<sup>285</sup>.

### **7.4.3. Short summary of burial depositions in Little Hoyle Cave**

Based on available radiocarbon dates, ranging from the Early/Middle Neolithic and available taphonomic data, surviving long bones in Little Hoyle Cave suggest different depositional methods. These involved selective deposition (preference in skull remains

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<sup>281</sup> See Appendix 6/7.4. Little Hoyle Cave/Microscopic results.

<sup>282</sup> See Appendix 6/7.4. Little Hoyle Cave/Microscopic results for details on a single mandible SNO: 2

<sup>283</sup> See Appendix 6/7.4. Little Hoyle Cave/Microscopic results and Table 128 for details on intensity patterns and Table 130 for discussion on discolorations (inclusions, infiltrations, microstructural staining).

<sup>284</sup> See Appendix 6/7.4. Little Hoyle Cave/Microscopic results.

<sup>285</sup> See Appendix 6/7.4. Little Hoyle Cave/Microscopic results/ Table 131 for more details and associations amongst surface and micro-taphonomy.

and use of separate burial areas), exhumation (separate OHI scores which suggest different taphonomic trajectories), collection of body parts and deposition in the site as a single event.

Most human remains were discovered in the 'chimney' infilling which was possibly connected with the cave however unreachable to scavenger activity (lack of gnawing on elements). A roof collapse must have been responsible for the unstratified position in which human remains were discovered with gradual water/rainwater filtering through the roof and resulting in polishing on several elements (presence of abrasion). Furthermore, a notable number of bones must have been exposed (weathering stage one) either when remains were deposited in the chimney, located at the top of the hill that encapsulated the cave or prior to deposition. Variation in OHI scores suggests separate taphonomic trajectories with sampled elements demonstrating very poor (0-1) to middle and high histological preservation (2/3 and 5). Practices involving exhumation, selection of body parts and possible scattering of remains (separation of elements in different parts of the cave) could have resembled variation in practices similar to Neolithic chambered tombs (e.g. clearances, sorting of bone in separate areas) (see Chapter 8).

## **7.5. Priory Farm Cave**

### **Frequency of skeletal elements**

Results demonstrated a predominance of post-cranial remains (N=42, 57%) with a lower number of cranial/skull remains (including a reconstructed cranium) (N=12, 22%) and loose teeth (N=19, 26%) identified (Figure 226). Postcranial fragments included hands/feet (N=16, 29%), long bones and vertebrae (N=10, 18%) and flat irregular bones (N=6, 11%) (Figure 227, Table 132).

Distributions amongst loose teeth demonstrated equal numbers of surviving incisors (N=6, 31%), upper and lower premolars (N=6, 31%), three canines (15%) and four molars (21%) (Figure 228/Appendix 6)<sup>286</sup>. Remaining loose teeth comprised of two

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<sup>286</sup> See Appendix 6/7.5. Priory Farm Cave/Frequency of skeletal elements.

upper 1<sup>st</sup> premolars (10%), one 1<sup>st</sup> molar (5%), three 3<sup>rd</sup> molars (15%) and one unidentified premolar (5%).

Zone representation on long bones (N=10) using the proximal and/or the distal epiphysis demonstrated higher survival of shafts (N=9, 90%) than epiphyses (N=5, 50%). Surviving long bones comprised of radii (N=3, 30%), a single tibia (10%), humeri (N=2, 20%), ulnae and fibulae (N=2, 20% for each). All limbs were fragmented with only one fused distal epiphysis surviving. Proximal epiphyses included one unfused radius (radial head) from an early adolescent and/or juvenile. Human remains derived from individuals from different periods and therefore any associations must be made with caution (Figure 229)<sup>287</sup>.

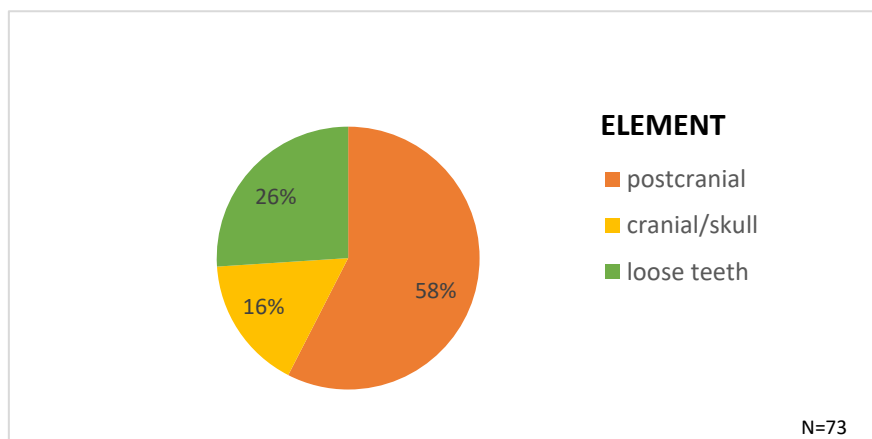


Figure 226. Element frequency amongst the assemblage from Priory Farm Cave. N=including loose teeth.

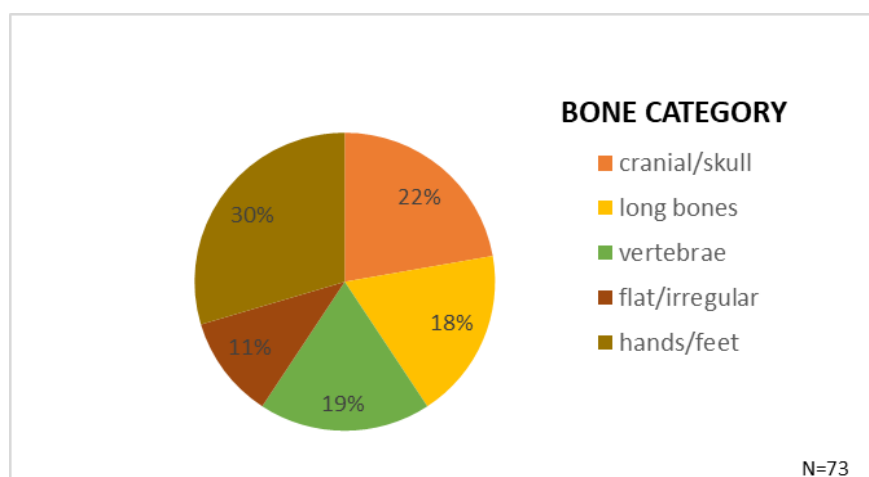


Figure 227. Element frequencies in Priory Farm Cave based on bone category (excluding loose teeth).

<sup>287</sup> See Appendix 6/7.5. Priory Farm Cave/Frequency of skeletal elements for details.

<b>ELEMENT</b>	<b>COUNT</b>
CERVICAL VERTEBRA (C-4)	1
CLAVICLE	2
CRANIUM	1
FIBULA	2
FIRST RIB	1
FIRST SACRAL VERTEBRA	1
FRONTAL	1
HUMERUS	2
INTERMEDIATE HAND PHALANX (3)	1
LOOSE TEETH	19
LUMBAR VERTEBRA (L-1)	1
LUMBAR VERTEBRA (L-2)	1
LUMBAR VERTEBRA (L-3)	1
LUMBAR VERTEBRA (L-4)	1
LUMBAR VERTEBRA (L-5)	1
MANDIBLE	4
MAXILLA	2
METACARPAL (MC1)	2
METACARPAL (MC3)	2
METACARPAL (MC4)	2
METATARSAL (MT1)	1
METATARSAL (MT2)	1
METATARSAL (MT3)	1
METATARSAL (MT5)	1
OCCIPITAL	1
PARIETAL	1
PARIETAL FRAGMENT	1
PATELLA	1
PROXIMAL FOOT PHALANX (2)	1
PROXIMAL HAND PHALANX (2)	1
PROXIMAL HAND PHALANX (5)	2
RADIUS	3
SCAPULA	1
STERNUM	1
TEMPORAL FRAGMENT	1
THORACIC VERTEBRA (T-11)	1

THORACIC VERTEBRA (T-2)	1
THORACIC VERTEBRA (T-7)	1
THORACIC VERTEBRA (T-9)	1
TIBIA	1
ULNA	2
(N) TOTAL	73

Table 132. Element representation in Priory Farm Cave. N=including loose teeth.

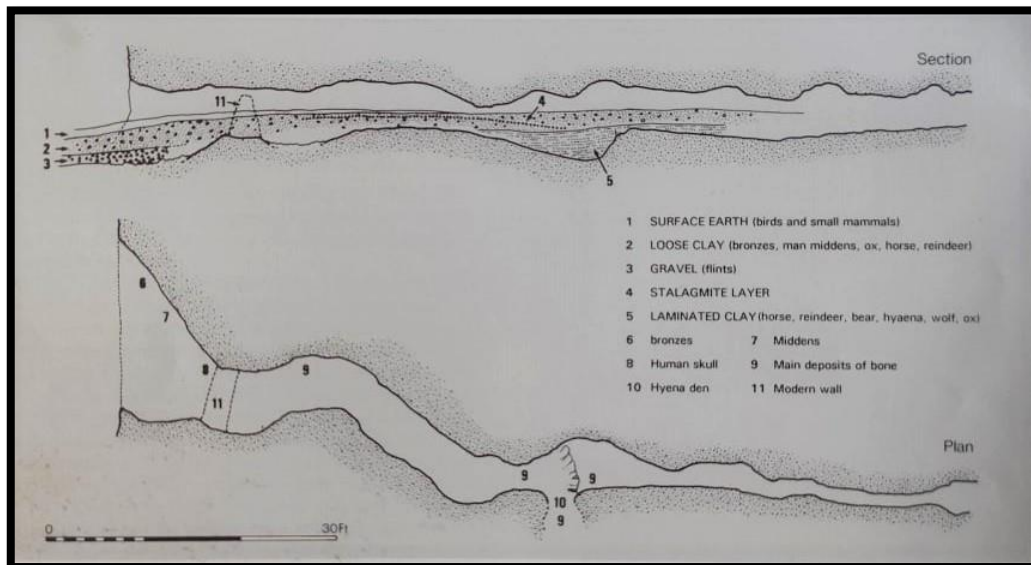


Figure 229. Plan and section of Priory Farm Cave. Five layers identified with human remains - nos. 7 (under a shell midden – cave entrance), 8 and possibly 9); no. 8 – close to cave entrance; no. 9 – inner cave, close to passage. A large quantity of animal bones were also unearthed. (Green and Walker 1991: 64).

### Element completeness

The majority of disarticulated remains from Priory Farm Cave were not complete (N=36, 66%). Complete elements (N=18, 33%) included flat/irregular bones and bones of the hands/feet (Figure 239 and Table 133/Appendix 6)<sup>288</sup>. All bones of the hands/feet showed full zone completeness with fluctuating surface preservation scores, however taphonomic modifications identified on the extremities did not impact all elements in the same degree (Table 133/Appendix 6). Complete hands/feet may reflect natural disarticulation during primary burials that took place on site or selection and removal of these elements for deposition in the cave.

<sup>288</sup> See Appendix 6/7.5. Priory Farm Cave/Element completeness for details and Figure 239 and Table 133.

## **MNI, demography and pathology<sup>289</sup>**

One older adult, three younger adults and one juvenile were identified amongst the assemblage. Dental attrition/teeth eruption based on surviving molars (either still attached on mandibulae/maxillae or from loose teeth) determined three age groups of c. nine to ten years (deciduous M1 and M2, permanent M1, unerupted M2/visible from broken maxilla), c.17-25 years and c.45+ years. Two loose right upper 3<sup>rd</sup> molars and one right upper 3<sup>rd</sup> molar (attached on maxilla/from cranium 66) determined an age period of c.17-25 years. Sex estimations included one probable female (mandible) and one male (cranium)<sup>290</sup>.

## **Pathology**

Signs of dental pathologies were present including caries (N=2), calculus (N=1) and periapical cavities (N=1)<sup>291</sup>. The majority of teeth had been fractured/broken similar to surviving teeth from Ogof Colomendy.

### **7.5.1. Taphonomy – Macroscopic results**

#### *7.5.1.1 Weathering*

Weathering was identified on ten elements (18%) reaching stages one (N=5, 9%), two (N=4, 7%) and three (N=1, 1%) (Figure 231/Appendix 6)<sup>292</sup>. Weathered elements included long bones (N=5), cranial/skull remains (N=2), flat irregular bones (N=2) and one metacarpal. Weathering was not extensively identified amongst human remains and surface preservation scores create a peculiar taphonomic trajectory. Surface preservation scores on weathered elements demonstrated contrasting patterns based on bone category (cranial/skull scores 1 and 4; long bones scores 0, 2, 4; flat/irregular scores 2 and 5) (Figure 232 and Table 134/Appendix 6)<sup>293</sup>.

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<sup>289</sup> See Chapter 4 for MNI and age/sex estimations.

<sup>290</sup> See Appendix 6/7.5. Priory Farm Cave/MNI, demography and pathology for more details.

<sup>291</sup> See Appendix 6/7.5. Priory Farm Cave/MNI, demography and pathology for more details.

<sup>292</sup> See Appendix 6/7.5. Priory Farm Cave Taphonomy – Macroscopic results/Weathering.

<sup>293</sup> See Appendix 6/7.5. Priory Farm Cave Taphonomy – Macroscopic results/Weathering for details and Table 134 for associations with other taphonomic modifications.



### 7.5.1.2. Gnawing

Signs of gnawing were recorded on three elements (5%) including one humerus, one ulna and one proximal hand phalanx (SNOs: 20, 23 and 51). All three elements were very well preserved (scores 4 and 5). Humerus shaft 20 exhibited a fresh fracture (FFI: 3), whilst ulna 23 demonstrated signs of weathering (stage 2). All three elements were abraded which suggests burial in similar parts of the cave (see Appendix 5). Overall absence of gnawing despite the large quantities of animal bones discovered in the site suggests disturbances caused by human activity involving removal of body parts or re-arrangement of remains in separate areas of the cave during re-use of the site.

### 7.5.1.3. Erosion

Erosion was recorded on half of the assemblage and was present on almost all cranial/skull fragments (N=11), flat/irregular bones (N=3), long bones (N=4), vertebrae (N=4) and hands/feet (N=5) (Figure 233)<sup>294</sup>.

Taphonomic modifications correlating with erosion included weathering (stages 1 and 2), staining and abrasion, however these were identified on a low proportion of eroded remains (Table 135/Appendix 6)<sup>295</sup>. This pattern suggests that erosion either impacted some elements more severely (potentially masking other taphonomic modifications) resulting in low surface preservation scores (see Figure 234/Appendix 6)<sup>296</sup> or deposition in different contexts and/or parts of the cave was responsible for these separate patterns<sup>297</sup>.

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<sup>294</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results/Erosion.

<sup>295</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results/Erosion.

<sup>296</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results/Erosion/Figure 234 for details on surface preservation.

<sup>297</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results/Erosion for details.

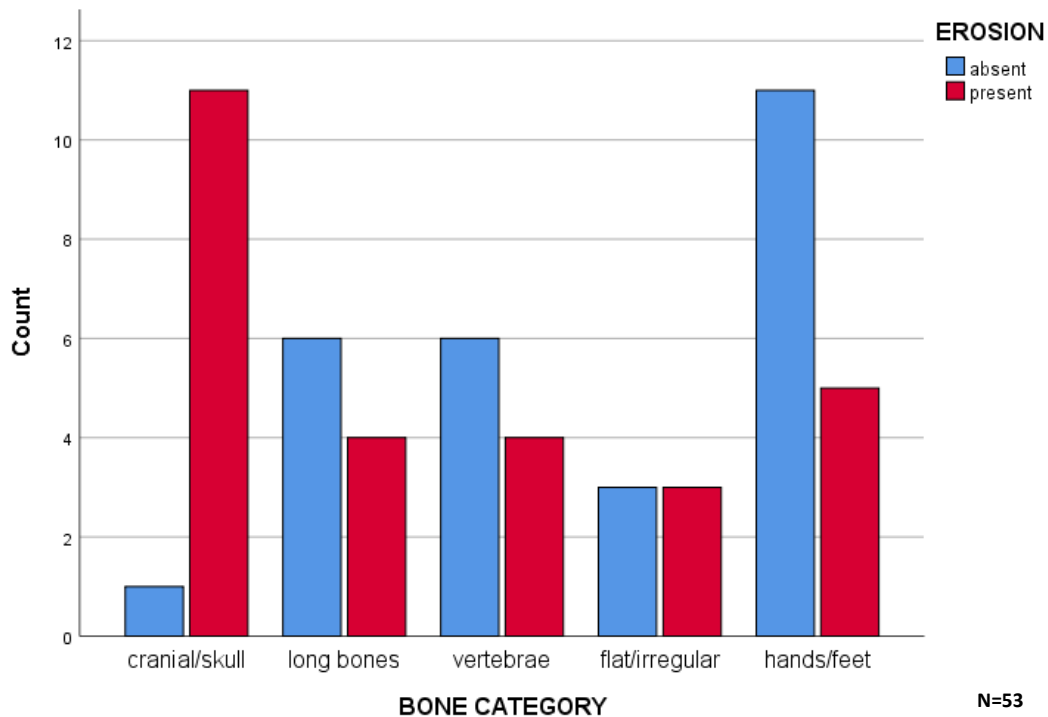


Figure 233. Presence/absence of abrasion based on bone category in Priory Farm Cave

#### 7.5.1.4. Abrasion

Abrasion was noted on 25 elements (46%) including hands/feet (N=9), cranial/skull remains (N=5), long bones (N=6), flat/irregular bones (N=3) and vertebrae (N=2), (Figure 235). Greater impact on hands/feet and long bones could indicate deposition in similar contexts where polishing and slight rounding occurred (Figure 236/Appendix 6)<sup>298</sup>.

Other taphonomic modifications included erosion and staining, however, these were identified on a low proportion of the assemblage (Table 136/Appendix 6)<sup>299</sup>.

<sup>298</sup> See Appendix 6/7.5. Priory Farm Cave/Taphonomy – Macroscopic results/Abrasion and Figure 236 for details on surface preservation.

<sup>299</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results/Abrasion for details.

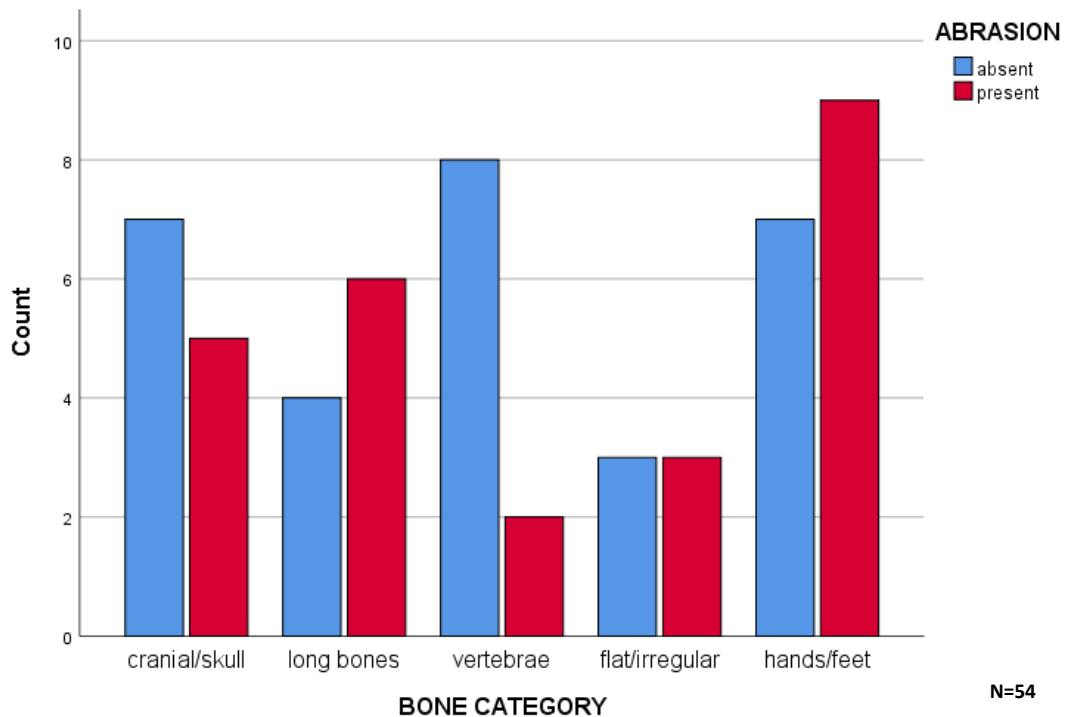


Figure 235. Presence/absence of abrasion based on bone category in Priory Farm Cave.

#### 7.5.1.5. Staining

Staining was recorded on a low proportion of the assemblage (N=10, 18%) including five cranial/skull remains, four long bones and one metacarpal (Figure 236). Staining was often accompanied by concretion residues, whilst surface preservation scores amongst stained remains demonstrated good surface preservation (score 4/N=6) with one radius and metacarpal showing extensive evidence of black staining. Long bones demonstrated good surface preservation (excluding radius 25) similar to cranial fragments (Figure 237 and Table 137/Appendix 6)<sup>300</sup>.

Middle Neolithic mandible SNO 57 showed poor surface preservation (1) and only exhibited staining. Re-use of the site (multi-period) can explain different taphonomic patterns on remains.

<sup>300</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results/Staining /Figure 237 for surface preservation and Table 137 for associations with other taphonomic modifications.

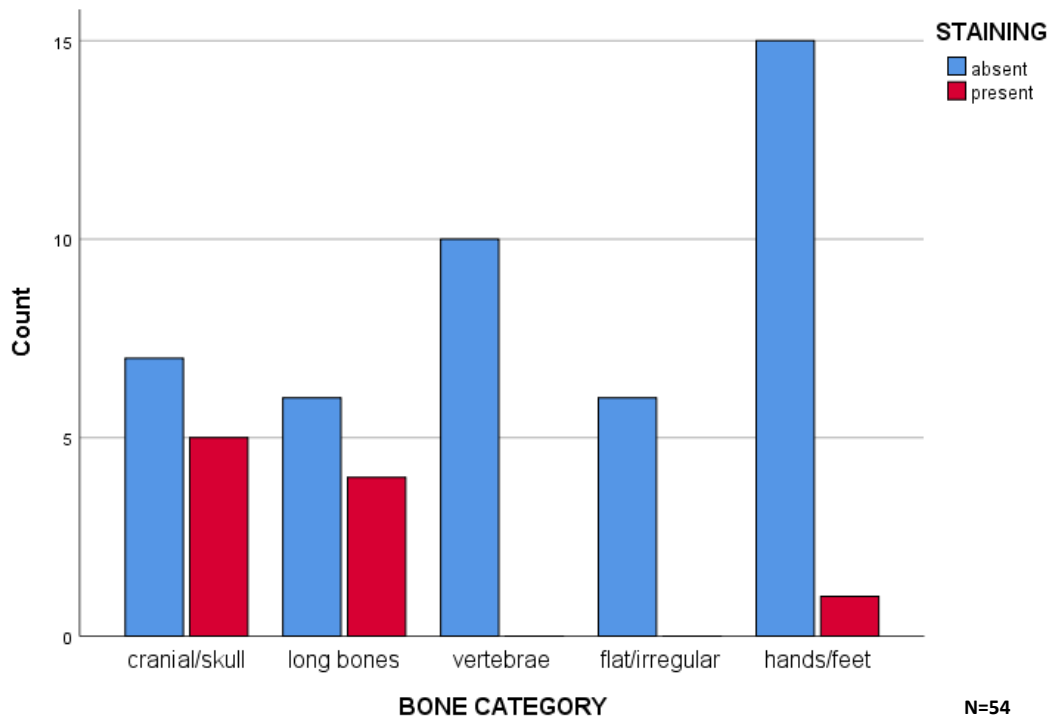


Figure 236. Staining presence/absence based on bone category in Priory Farm Cave.

#### 7.5.1.6. Trauma (*sharp/blunt force*)

Evidence of trauma was not identified on any elements from Priory Farm Cave.

#### 7.5.1.7. Burning

Unidentified burnt cranial fragments, discovered in the shell midden at the entrance of the cave, were reported in the site reports (see Appendix 5); however, these were not recorded amongst the surviving assemblage.

#### 7.5.1.8. Fractures (*fresh vs dry*)

Fractures amongst surviving long bones included five fresh breaks (SNOs: 17, 19-20, 24-25). Scores amongst fractured long bones ranged from zero to three with a similar fluctuation amongst surface preservation scores (0-2, 4)<sup>301</sup>. Different surface preservation might have resulted from deposition in separate parts of the cave (multi-period deposits) where erosion, staining and/or abrasion further impacted the remains.

<sup>301</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results//Fractures for details as remains have not been radiocarbon dated.

#### *7.5.1.9. Surface preservation*

Surface preservation scores amongst human remains demonstrated contrasting patterns between very poor (stage 0/N=12, 22%) and very good surface preservation (stage 5/N=11, 20%). Remaining scores similarly showed variation in preservation with high (score 4/N=9, 16%), low (score 2/N=8, 14%) and low-medium scores (1 and 3/N=7, 13% for each). High surface preservation scores were recorded across all bone categories with equal numbers of cranial/skull remains, flat/irregular and hands/feet (N=3) (Figure 238/Appendix 6)<sup>302</sup>. Results suggest different treatment between individuals whilst deposition in separate areas of the cave and multi-period use must have been responsible for the variation in taphonomy.

#### *7.5.1.10. Trampling*

No evidence of trampling was recorded on any elements from Priory Farm Cave.

### **7.5.2. Microscopic results**

Results from a single Middle Neolithic mandible SNO 45 (57 in Database/Coding) are summarised under one section (see Table 138/Appendix 6). Histological destruction resulted from bioerosion and non-Wedl attack including budded, linear longitudinal and lamellate MFD. Collagen had not survived in all areas of the microstructure. Extraneous material was noted including low intensity inclusions, infiltrations and cracking whilst microstructural staining was associated with surface staining. Inclusion and infiltration colour ranged from brown/dark brown to black whilst microstructural staining was brown/fair, often resembling manganese stains in places, to intense red.

### **7.5.3. Short summary of burial depositions in Priory Farm Cave**

Results from Priory Farm Cave reflect separate depositional episodes in the Middle Neolithic, Late Bronze Age and Middle/Late Iron Age. The scattering of human remains (close to the entrance and inner cave) could suggest a preference in burial areas with disturbances (lack of gnawing) possibly being anthropogenic despite the large

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<sup>302</sup> See Appendix 6/7.5. Priory Farm Cave/ Taphonomy – Macroscopic results/Surface preservation for details.

quantity of faunal remains recovered. Late Bronze Age activity was confirmed by a canine (from a mandible) also discovered at the bottom of the shell midden (cave entrance). Extensive evidence of MFD from the Middle Neolithic mandible, discovered in the inner cave alongside a Middle/Late Iron Age mandible demonstrates a complex depositional scenario. Higher representation and full zone completeness of hands/feet suggest presence of primary burials with various stages of surface preservation resulting from deposition of the individuals in different areas of the cave. Nonetheless, selective deposition (Middle Neolithic mandible) could have taken place (similar to Little Hoyle Cave).

Presence of staining primarily on cranial/skull remains (e.g. Neolithic mandible discovered in the inner cave accompanied by concretion residues) suggests that some remains might have derived from parts of the inner cave close to the stalagmitic layer. Disturbances, clearances and/or movement of interments could have therefore been followed as a custom during re-visits and re-use of the site at later periods which could justify separate areas of deposition and lack of corresponding post-cranial remains. Further radiocarbon dating is required (on post-cranial fragments) to verify Neolithic activity in the site and differentiate treatment between individuals of different ages. Furthermore, histological analysis of more radiocarbon dated remains will clarify whether depositions in Priory Farm Cave showed similarities or distinct manipulation throughout the period of use of this cave. Practices of selection, sub-aerial exposure and separation of body parts in different areas of the cave were mixed with later deposits. Mixing of bone, resembling bone bundles, involved separate stages of bone handling and processing, however, due to the multi-period use of the site, results must be interpreted with caution (see Chapter 8).

## **7.6 Ogot Garreg Hir**

### **Frequency of skeletal elements**

The assemblage comprised of three postcranial remains including one Early Neolithic left ulna (SNO: 1381) on proximal hand phalanx (SNO: 1382) and one left calcaneus (SNO: 1383) with the calcaneal tuberosity still fusing (Table 139).

Zone representation of the ulna included shaft survival and neither proximal nor distal epiphysis present. The element demonstrated signs of weathering (stage 1), erosion and

staining whilst its surface had been poorly preserved (score 0). Fusion on proximal epiphysis was missing however, the ulna appeared unfused, small in size and possibly from an immature individual (MNI: 1).

ELEMENT	COUNT	WTH	EROS	STAIN	SURFACE PRES
ULNA (SNO: 1381)	1	WTH STAGE 1	1	1	0
PROXIMAL HAND PHALANX (SNO: 1382)	1	NO WTH	0	1	0
CALCANEUS (SNO: 1383)	1	NO WTH	0	0	0

Table 139. Element representation in Ogof Garreg Hir. Weathering (WTH) absence (no WTH)/presence (WTH stage 1), erosion (EROS), staining (STAIN), surface preservation (SURFACE PRES).

### Element completeness

Surviving elements were all disarticulated, fragmented and demonstrated very poor surface preservation (score 0). Concretion residues were identified on two elements (proximal hand phalanx and left calcaneus) and affected the surface preservation of the remains<sup>303</sup>.

### MNI, demography and pathology<sup>304</sup>

The elements must have derived from an immature individual (c.10-14 age - juvenile/early adolescent) based on the unfused epiphysis of the calcaneal tuberosity<sup>305</sup>. Elements with sexual dimorphic features were absent and therefore sex assignment could not be determined.

### Pathology

Signs of degenerative pathology were not identified.

<sup>303</sup> See Appendix 6/7.6. Ogof Garreg Hir/Element completeness for more details.

<sup>304</sup> See Chapter 5 for MNI and age/sex estimations.

<sup>305</sup> Proximal hand phalanx and ulna shaft similarly appeared unfused and might have derived from the same individual.

## **7.6.1 Taphonomy – Macroscopic results**

### *7.6.1.1. Weathering*

Signs of stage one weathering were recorded on ulna SNO 1381 with erosion, staining and poor surface preservation (score 0). Histological analysis of the microstructure of the ulna demonstrated low bacterial activity (OHI score: 4) suggesting early disarticulation/exhumation was followed by either sub-aerial exposure and deposition in the cave or deposition close to the entrance leaving the ulna open to the elements.

### *7.6.1.2. Gnawing*

Evidence of gnawing was not identified on any elements.

### *7.6.1.3. Erosion*

Erosions was present on ulna SNO 1381 (weathering stage 1 and staining) possibly resulting from earlier exposure or from deposition in a separate area of the cave as the hand/foot bones did not exhibit signs or erosion. All elements however were very poorly preserved and concretion residues could have masked other modifications.

### *7.6.1.4. Abrasion*

Abrasion was not recorded on any elements from Ogof Garreg Hir. Storm/wave action must have destroyed any stratification (see Appendix 5) and signs of abrasion/polishing on the bone were anticipated.

### *7.6.1.5. Staining*

Evidence of staining was noted on the Neolithic ulna and the proximal hand phalanx. The hand bone further exhibited concretion residues. Staining was brown/black on ulna SNO 1381 but was less intense on proximal hand phalanx SNO 1382 as concretion covered most of its surface. No patterns were identified. Signs of concretion were not present on the ulna; therefore, the element might have been deposited closer to the entrance of the cave with the hand/foot bones left/buried close to a cave wall (concretion/natural limestone affecting their surface).



#### *7.6.1.6. Trauma (sharp/blunt force)*

No evidence of trauma was identified on surviving elements.

#### *7.6.1.7. Burning*

No signs of burning and/or burnt fragments were present.

#### *7.6.1.8. Fractures (fresh vs dry)*

Fractures on ulnae were not recorded due to thin cortical bone surviving (see Chapter 5/5.3.8).

#### *7.6.1.9. Surface preservation*

Surface preservation scores of all elements were very low (0) and were associated with weathering, erosion and staining on ulna 1381 and staining on both hand/foot bones (1382-83) (Table 123/Appendix 6)<sup>306</sup>. Discussion and relation of surface preservation scores and other modifications can be found in aforementioned sections.

#### *7.6.1.10. Trampling*

Evidence of trampling was absent.

### **7.6.2. Microscopic results**

Results from the Early Neolithic ulna SNO 1381 were summarised under one section (Table 140/Appendix 6)<sup>307</sup>. Histological destruction of non-Wedl MFD was low (OHI score: 4) (Figure 239) whilst collagen preservation was high (Birefringence score 3) (Table 140/Appendix 6). Inclusion and infiltration intensities were medium and high respectively; however, no patterns were observed. Microstructural staining was further identified and demonstrated similar colour patterns to inclusions and infiltrations ranging from brown-dark to black/brown. No patterns were observed.

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<sup>306</sup> See Appendix 6/7.6. Ogof Garreg Hir?Taphonomy – Macroscopic results/Surface preservation/Table 123.

<sup>307</sup> See Appendix 6/7.6. Ogof Garreg Hir/Microscopic results/Table 140.

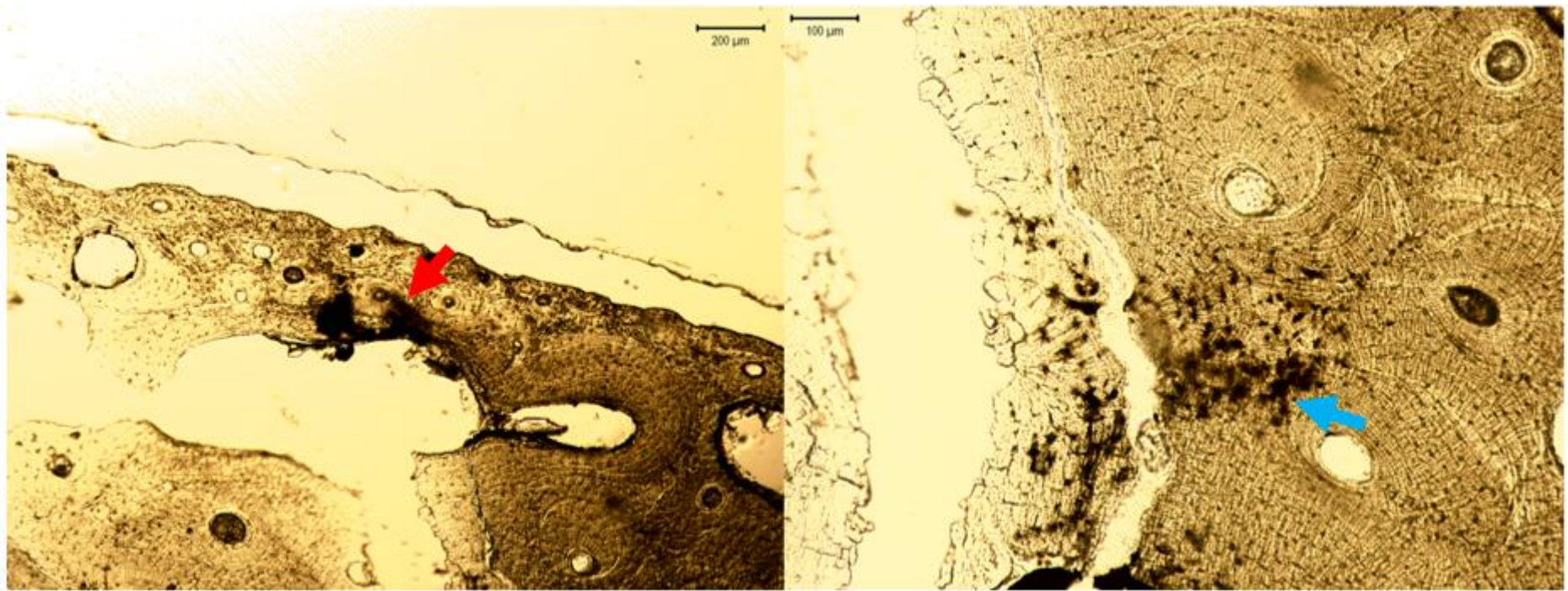


Figure 239. High histological preservation in ulna sample with minor MFD – lamellate coming out of the Haversian canal (red arrow) and budded (blue arrow). Magnification x5 (left) and x10 (right). Source: author

Microcracking (medium intensity) possibly resulted from demineralisation of the bone from weathering and erosion (Figure 240). Despite demineralisation, collagen was still retained in the microstructure, which possibly suggests that collagen loss on denser bones/limbs might either relate to MFD or specific taphonomic modifications causing high demineralisation as in the case of Spurge Hole and Ogof Pant-y-Wennol. Femur SNO 26 and humerus SNO 57 (Appendix 1/Sheet 3//Histology) (OHI score: 5) exhibited advanced stages of weathering (score 3-4) and erosion and scored medium on the birefringence scale (score 2) suggesting that collagen loss probably resulted from the high demineralisation due to sub-aerial exposure.

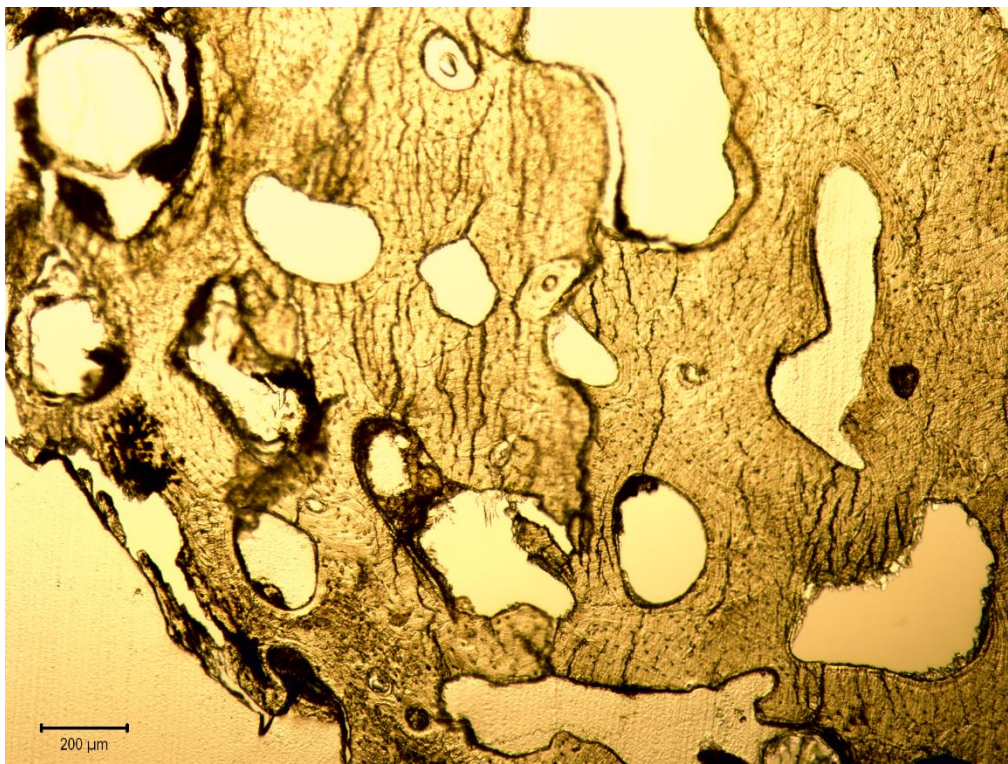


Figure 240. Microcracking in ulna sample (OHI 4). Magnification x5. Source: author

### **7.6.3. Short summary of burial depositions in Ogof Garreg Hir**

The low number of human remains from Ogof Garreg Hir supports that presence of one Early Neolithic sub-adult deposited in the site. The cave forms parts of a series of cave systems along the Castlemartin Cliffs in Pembrokeshire used for burials of one (Ogof Garreg Hir) to two individuals (Ogof Brân Goesgoch) in separate periods throughout the Neolithic (Early and Late Neolithic/Early Bronze Age respectively).

Remains from Ogof Garreg Hir possibly derive from a single sub-adult whilst a high OHI score suggests probable exhumation followed by secondary deposition in cave. Presence of weathering suggests that the element was probably exposed (sub-aerially) whilst hand/foot bones with concretion residues might have been buried/left deeper in the cave, possibly close to a wall. Presence of water abrasion was not apparent amongst surviving elements despite the close (modern) proximity to the sea, therefore, remains must have been deposited further in the cave and not close to the cave entrance. Weathering must have resulted from earlier short sub-exposure of the individual/or parts of the skeleton, followed by collection and deposition in the cave. Similar to other depositions in caves across south-west Wales, multiple stages were involved prior to deposition in the cave. These involved practices of excarnation of certain elements (mainly short sub-aerial exposure), followed by selective retrieval and possible separation of body parts within the cave. This could have resembled a similar separation of how bones in chambered tombs.

## **7.7. Ogof Colomendy**

### **Frequency of skeletal elements**

Results demonstrated a prevalence of postcranial (N=180, 75.3%) than cranial/skull remains (N=12, 5%), followed by unidentified/miscellaneous fragments (N=10, 4.2%), three burnt cranial fragments (N=3, 1.3%) and loose teeth (N=34, 14.2%) (Figure 241). Postcranial fragments comprised of long bones (N=62, 30.2%), flat/irregular bones (N=52, 25.4%), hands/feet (N=37, 18%), vertebrae (N=29, 14.1%) and cranial/skull remains (N=12, 5.9%) (Figure 242, Table 141 below)<sup>308</sup>.

Distributions amongst loose teeth included incisors (N=13, 38%), premolars (N=10, 29%), canines (N=7, 20%) and four molars. Several teeth had been fractured in half with breaks resulting in loss of enamel and/or broken root ends (N=8 unidentified incisors and one molar)<sup>309</sup>.

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<sup>308</sup> See Appendix 6/7.7. Ogof Colomendy/Frequency of skeletal elements for more details.

<sup>309</sup> See Appendix 6/7.7. Ogof Colomendy/Frequency of skeletal elements and Figure 243 for more details.

Zone representation on long bones (N=66)<sup>310</sup> using the proximal and/or the distal epiphysis demonstrated higher survival of shafts (N=38, 59%) than epiphyses (N=29, 43%). Surviving long bones comprised of ulnae (N=19, 28%), femora (N=14, 21%), radii (N=11, 16%), tibiae (N=9, 13%), humeri (N=5, 7%), fibula (N=4, 6%) and unidentified shafts (N=4, 6%). Ulna shafts (N=16) and femur epiphyses (N=12) were more represented compared to other limbs (Table 142/Appendix 6)<sup>311</sup>. Variation in surface preservation amongst long bones was apparent (Figure 244/Appendix 6)<sup>312</sup>. Multi-period use of the site can justify different surface preservation patterns with remains being deposited at separate periods and undergoing several disturbances. No pattern was identified as most taphonomic modifications had impacted a large proportion of the bones (Table 143/Appendix 6)<sup>313</sup>.

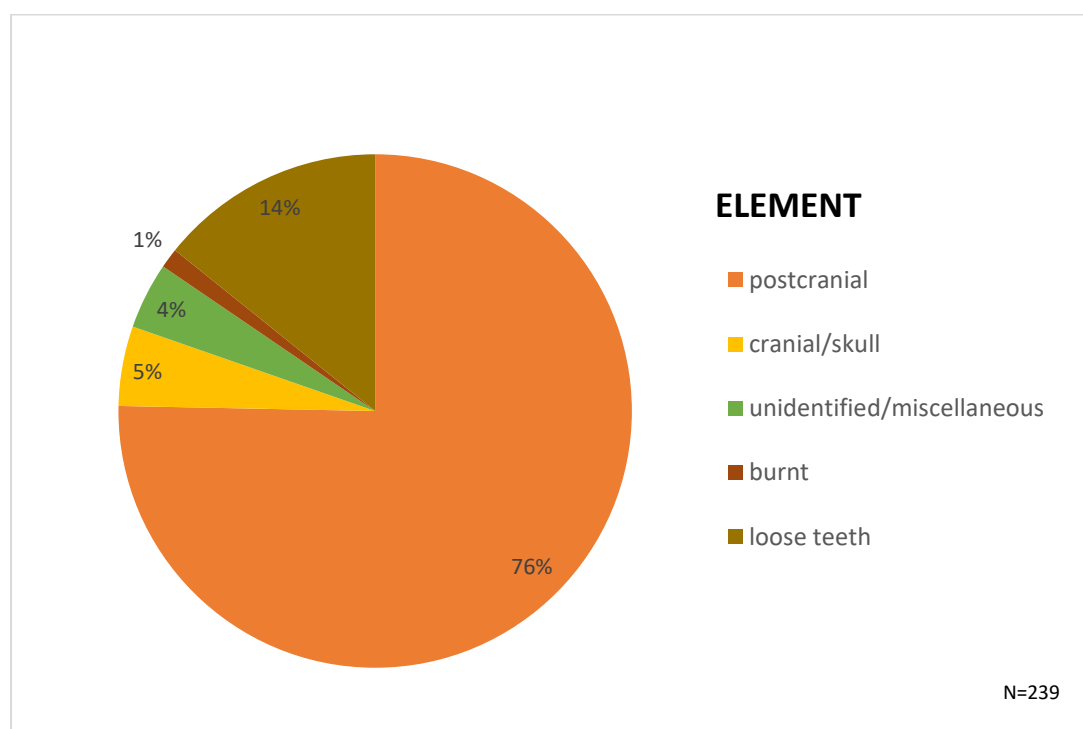


Figure 241. Element frequency amongst the assemblage from Ogof Colomendy. N=including loose teeth. See 6.2 for including burnt fragments in element category.

<sup>310</sup> N= including four unidentified shafts.

<sup>311</sup> See Appendix 6/7.7. Ogof Colomendy/Frequency of skeletal elements for more details.

<sup>312</sup> See Appendix 6/7.7. Ogof Colomendy/Frequency of skeletal elements for more details.

<sup>313</sup> See Appendix 6/7.7. Ogof Colomendy/Frequency of skeletal elements and for more details.

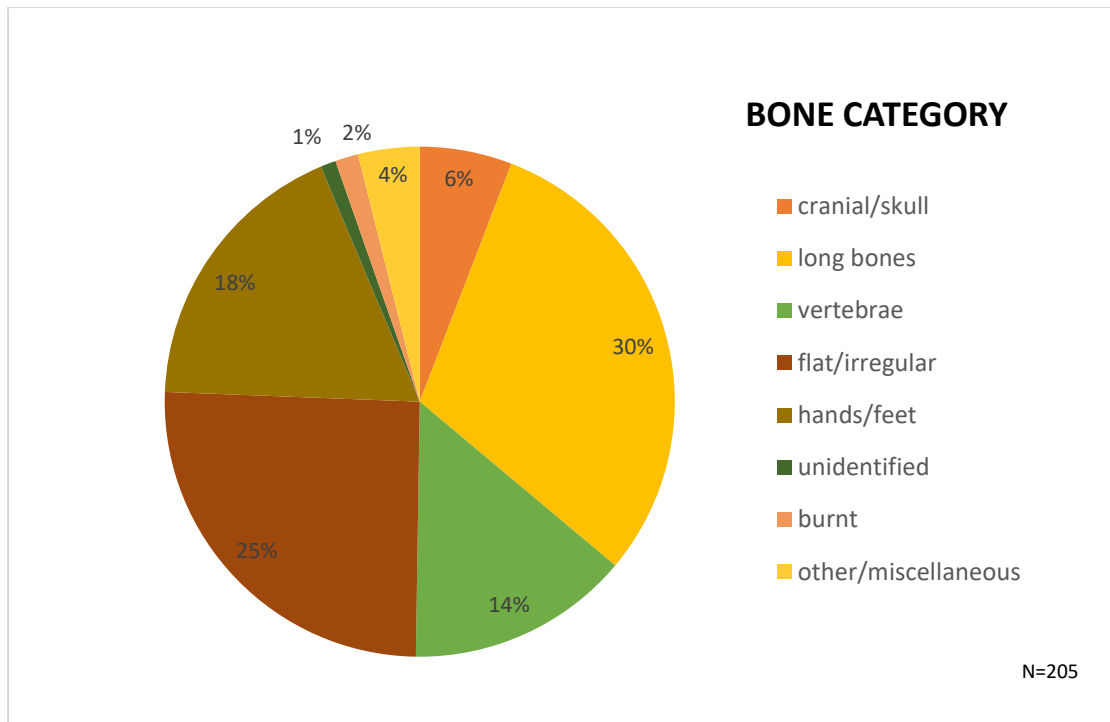


Figure 242. Element frequencies in Ogor Colomendy based on bone category (excluding loose teeth). See 6.2 for including burnt fragments in bone category.

ELEMENT	COUNT
BURNT CRANIAL FRAGMENT	3
CALCANEUS	3
CERVICAL VERTEBRA	2
CERVICAL VERTEBRA (C2)	1
CERVICAL VERTEBRA (C-3)	1
CLAVICLE	8
CRANIAL FRAGMENT	3
CRANIUM	1
CUBOID (CUB)	1
DISTAL HAND PHALANX (1)	1
FEMUR	14
FIBULA	4
FIRST RIB	2
HAMATE	1
HUMERUS	5
INTERMEDIATE FOOT PHALANX	1
INTERMEDIATE HAND PHALANX	2
INTERMEDIATE HAND PHALANX (2)	1
INTERMEDIATE HAND PHALANX (3)	1

LOOSE TEETH	34
MANDIBLE	6
MAXILLA	2
METACARPAL	2
METACARPAL (MC2)	1
METACARPAL (MC3)	1
METACARPAL (MC4)	1
METATARSAL	2
METATARSAL (MT1)	3
METATARSAL (MT2)	1
METATARSAL (MT3)	1
METATARSAL (MT4)	1
METATARSAL (MT5)	5
MISCELLANEOUS FRAGMENTS	7
MISCELLANEOUS/VERTEBRAE FRAGMENTS	1
NAVICULAR (NAV)	1
PATELLA	1
PELVIS	2
PROXIMAL HAND PHALANX	1
PROXIMAL HAND PHALANX (2)	2
PROXIMAL HAND PHALANX (5)	1
RADIUS	11
RIB	21
RIB FRAGMENTS	12
SCAPULA	7
TALUS	2
THORACIC VERTEBRA	16
THORACIC VERTEBRA (T-1)	1
TIBIA	9
ULNA	19
UNIDENTIFIED SHAFT FRAGMENT	2
VERTEBRA FRAGMENTS	8
(N) TOTAL	239

Table 141. Element representation in Ogof Colomendy. Miscellaneous fragments and/or miscellaneous identified remains includes small fragments with no zone representation. N=including loose teeth.

## **Element completeness**

The vast majority of disarticulated remains from Ogof Colomendy were not complete/fragmented (N=193, 94.1%) with only 12 elements (5.9%) showing full zone completeness<sup>314</sup>. Scavenger disturbances and multi-period deposits explain the large fragmentation of human remains and evidence of gnawing.

## **MNI, demography and pathology<sup>315</sup>**

Four adults and a single adolescent were represented. Adults were identified from the fusion of proximal and/or distal epiphysis, duplicate zone presentation of both long bones and other post-cranial remains such as clavicles and dental attrition of teeth on mandibles/maxillae. One adolescent was identified from a proximal fusing humerus epiphysis whilst the iliac crest from a surviving pelvis fragment appeared to be fusing<sup>316</sup>.

Dental attrition based on surviving molars on mandibulae and/or maxillae and two loose molars determined two age groups of c.17-25 years and c.35-45 years. A single mastoid process from a fragmented cranium determining one probable female present which must be considered with caution as no other sexually dimorphic features had survived to verify the sex of the individual.

## **Pathology**

Evidence of caries (N=1) and calculus (N=4) from surviving teeth (all reconstructed/glued to fit alveoli) were identified on four mandibulae and one maxilla. No degenerative pathologies were noted on surviving human remains. Further signs of calculus were recorded on six loose teeth.

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<sup>314</sup> See Appendix 6/7.7. Ogof Colomendy/Element completeness and for more details.

<sup>315</sup> See Chapter 4 for MNI and age/sex estimations.

<sup>316</sup> See Appendix 6/7.7. Ogof Colomendy/MNI, demography and pathology for more details on age representation.



## 7.7.1 Taphonomy – Macroscopic results

### 7.7.1.1. Weathering

Weathering was recorded on ten elements (4.9%) reaching stages one (N=8, 3.9%) and two (N=2, 1%) (Figure 245/Appendix 6)<sup>317</sup>. Weathering stage one was present four long bones (SNOs: 653-4, 679 and 823), three flat/irregular bones (SNOs: 729, 804 and 819) and one mandible (SNO: 721). Stage two was recorded on one clavicle (SNO: 818) and one rib (SNO: 713) (Figure 246). Staining was present on all weathering elements with erosion, gnawing and abrasion recorded on a lower proportion (Table 144/Appendix 6)<sup>318</sup>. Presence/absence of abrasion, erosion and gnawing might relate to deposition in separate areas of the cave, earlier/later depositions and/or exposure prior to deposition<sup>319</sup>.



Figure 246. Weathering stage 2 on rib. Source: author

Both weathering stages (1-2) were associated with poor surface preservation scores (Figure 247/Appendix 6). Weathering might have resulted from exposure close to the

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<sup>317</sup> See Appendix 6/7.7. Ogof Colomendy/Taphonomy – Macroscopic results/Weathering.

<sup>318</sup> See Appendix 6/7.7. Ogof Colomendy/Taphonomy – Macroscopic results/Weathering.

<sup>319</sup> See Appendix 6/7.7. Ogof Colomendy/Taphonomy – Macroscopic results/Weathering for more details.

cave entrance with subsequent disturbances, moving of the bones deeper in the cave during re-visits, resulting in further taphonomic impact (erosion, abrasion).

### 7.7.1.2. Gnawing

Gnawing was present on 42 elements (20.5%) including long bones (N=35), flat/irregular bones (N=3), hands/feet (N=3) and one vertebra (Figure 248). Surface preservation scores amongst gnawed elements demonstrated medium/poor scores (3-0) with a lower number of bones showing better surface preservation (scores 4-5) (Figure 249/Appendix 6)<sup>320</sup>. Scavenger activity was high compared to other cave assemblages recorded (Figure 250).

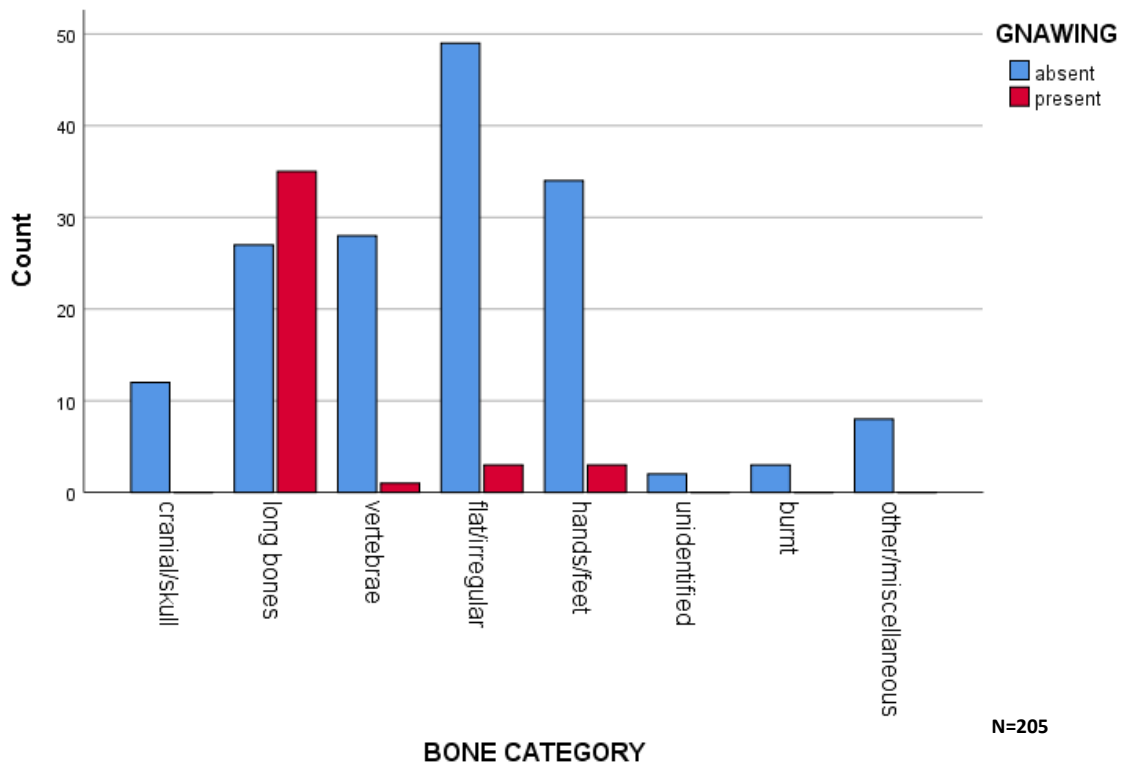


Figure 248. Frequency of gnawing presence/absence based on bone category in Ogof Colomendy.

<sup>320</sup> See Appendix 6/7.7. Ogof Colomendy/Taphonomy – Macroscopic results/Weathering.



Figure 250. Gnawing on femur diaphysis. Source: author

Gnawing was primarily associated with staining (N=35), with several elements further demonstrating erosion (N=19), abrasion (N=10) and weathering stage one (N=4) (Table 145/Appendix 6)<sup>321</sup>. Presence of both fresh and dry fractures on gnawed long bones (N=16) suggested peri- and post-mortem manipulation followed by disturbances due to re-visits (multi-period) and scavenger/human activity resulting in further breakage (dry fractures), moving of the bones in different parts of the cave and gnawing marks (Table 146/Appendix 6)<sup>322</sup>.

#### 7.7.1.3. Erosion

Erosion was present on 81 elements primarily on flat/irregular bones (N=30) and long bones (N=28) (Figure 251). Surface preservation scores amongst eroded remains were primarily medium (score 3) to poor (scores 2-0) with most non-eroded remains showing similar preservation (scores 2-3) and some demonstrating good surface preservation

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<sup>321</sup> See Appendix 6/7.7. Ogof Colomendy/ Taphonomy – Macroscopic results/Gnawing/Table 145 for more details. for more details.

<sup>322</sup> See Appendix 6/7.7. Ogof Colomendy/ Taphonomy – Macroscopic results/Gnawing/Table 146 for more details.

(Figure 252/Appendix 6)<sup>323</sup>. Separate depositions (multi-period) in different areas of the cave could have been responsible for this pattern. Erosion was further correlated with staining (N=61) and a lower number of eroded elements showing presence of abrasion (N=21), gnawing (N=19) and weathering (N=6) (Table 147/Appendix 6)<sup>324</sup>.

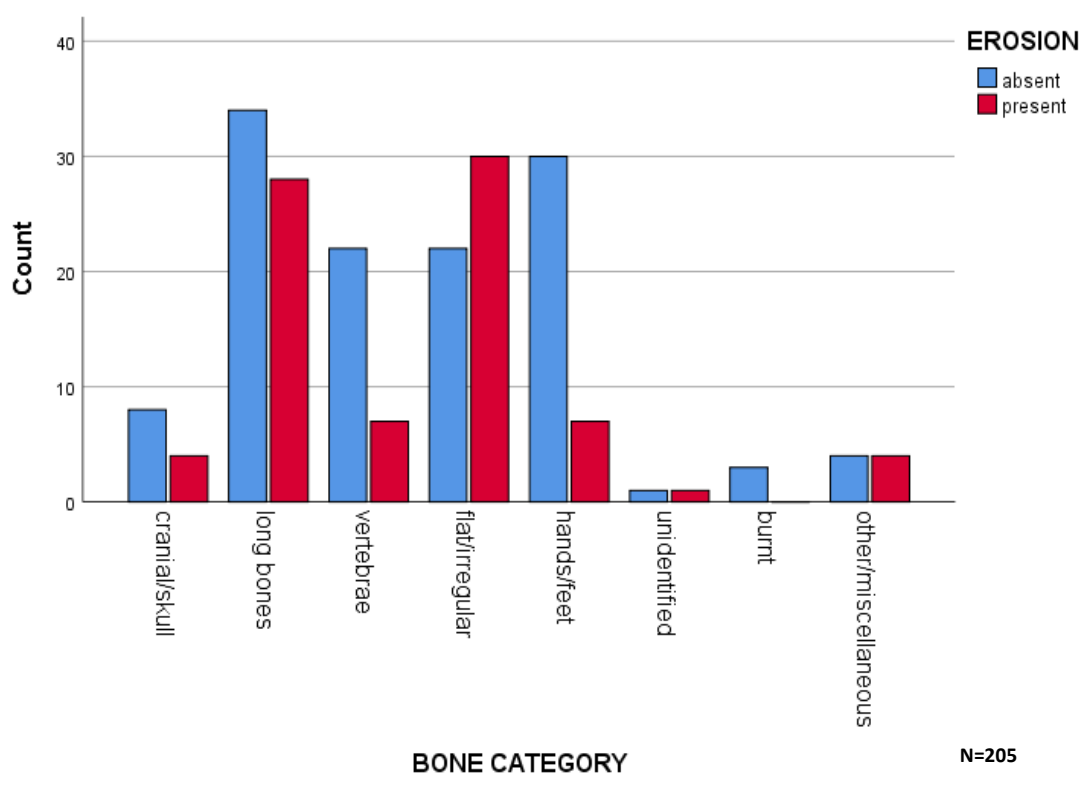


Figure 251. Frequency of erosion absence/presence based on bone category across sites in Ogof Colomendy.

#### 7.7.1.4. Abrasion

Abrasion was recorded on 49 elements (23.9%) primarily on long bones (N=18), flat/irregular bones (N=11) and hands/feet (N=9) (Figure 253). Surface preservation scores amongst abraded and non-abraded remains demonstrated similar patterns with most elements scoring medium (3) to low (2-0) (Figure 254/Appendix 6)<sup>325</sup>. Staining was present on almost all abraded elements (N=43) with about half abraded remains

<sup>323</sup> See Appendix 6/7.7. Ogof Colomendy/ Taphonomy – Macroscopic results/Erosion.

<sup>324</sup> See Appendix 6/7.7. Ogof Colomendy/ Taphonomy – Macroscopic results/Erosion for more details.

<sup>325</sup> See Appendix 6/7.7. Ogof Colomendy/ Taphonomy – Macroscopic results/Abrasion.

demonstrating signs of erosion (N=21) (Table 148/Appendix 6)<sup>326</sup>. Gnawing (N=10) and weathering stage one (N=4) were further noted on some abraded elements. Evidence of abrasion on long bones of different ages (SNOs: 697-99/Early BA humerus, Early/Middle BA humerus and Late Neolithic femur) suggests that water abrasion may have been responsible for polishing on the bones.

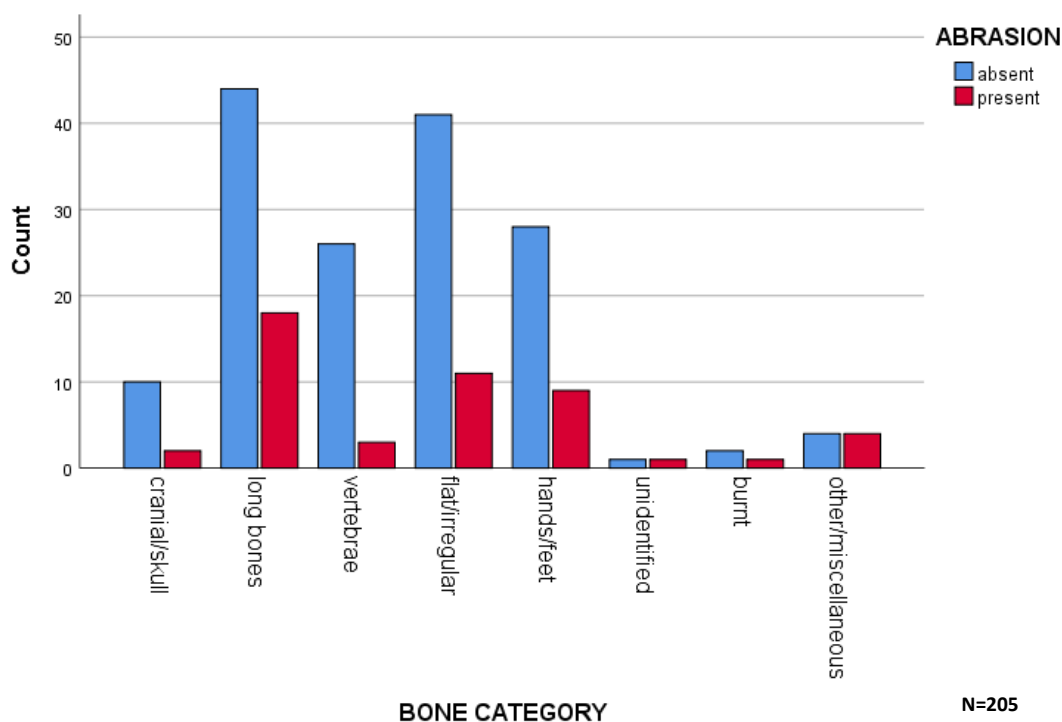


Figure 253. Presence/absence of abrasion based on bone category in Ogof Colomendy.

#### 7.7.1.5. Staining

Evidence of staining was recorded on a large number of human remains (N=138, 67.3%) including long bones (N=50), flat-irregular bones (N=40), hands/feet (N=21) (Figure 255). Staining on a large number of bones of different ages cannot accurately be justified from exposure prior to deposition in the cave as these marks can be attributed to a variety of environmental conditions<sup>327</sup>.

<sup>326</sup> See Appendix 6/7.7. Ogof Colomendy/ Taphonomy – Macroscopic results/Abrasion for more details on insect wear.

<sup>327</sup> See Appendix 6/7.7. Ogof Colomendy/ Taphonomy – Macroscopic results/Staining/Figure 256 for surface preservation scores and Table 149 for other taphonomic modifications.

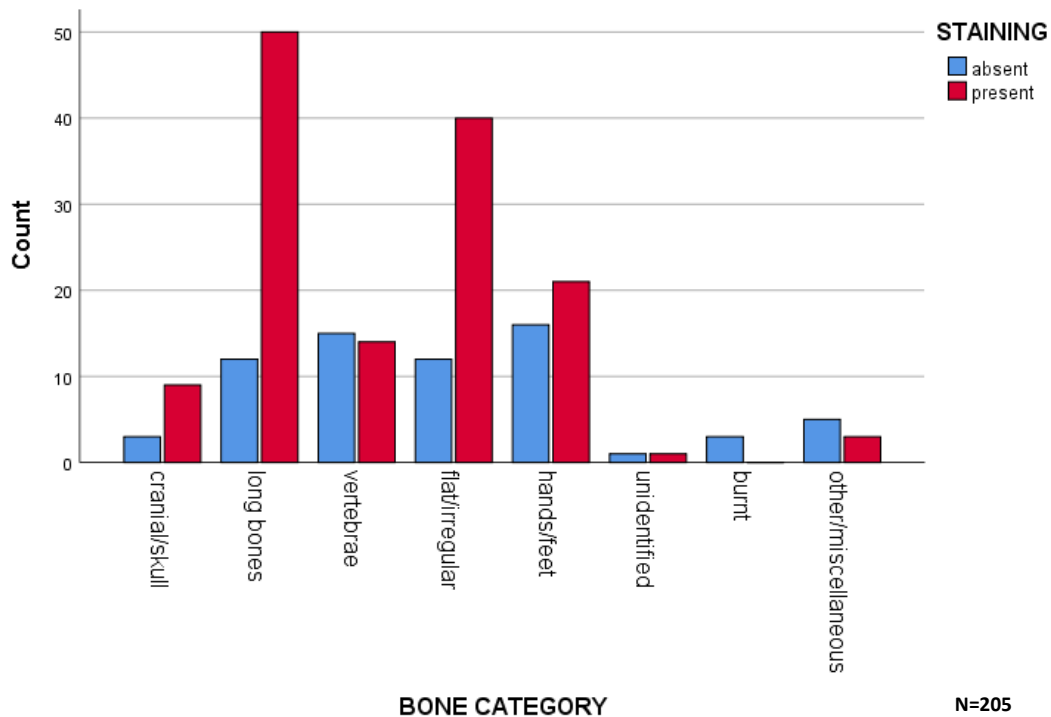


Figure 255. Staining presence/absence based on bone category in Ogot Colomendy.

#### 7.7.1.6. Trauma (sharp/blunt force)

Evidence of sharp force trauma was present on a single fragmented humerus (SNO: 686) on its proximal end under the humeral head (Figure 257). The long bone has been poorly preserved (surface preservation score 1), exhibited staining marks and had been gnawed. The single cutmark indicates peri-mortem activity with the humerus either handled on-site or collected after disarticulation and brought to the cave for deposition. No other signs of trauma were identified, however, the large quantity of processed long bones (both fresh and dry fractures) and several loose teeth (teeth fractured in half, breaks resulting in loss of enamel, broken root ends) (Figure 258) suggests both peri- and post-mortem manipulation of human remains.



Figure 257. Humerus exhibiting a cutmark under surviving humeral head (sharp force trauma). Source: author



Figure 258. Fractured molars. Source: author

#### 7.7.1.7. *Burning*

Burning was noted on three cranial fragments (SNOs; 763-5) from Ogof Colomendy, Different burning stages were recorded on one burnt fragment (SNO: 763) with a burning sequence of zero, four and five (separate temperatures). The two remaining burnt fragments reached burning stage four with 765 showing signs of abrasion/polishing. No signs of a cremation pyre were mentioned in the initial reports (see Appendix 5).

#### 7.7.1.8. *Fractures (fresh vs dry)*

Fractures were identified on 29 long bones including femora (N=10), radii (N=8), tibiae (N=7) and humeri (N=4) exhibiting both fresh and dry breaks (almost equally represented). Fractures on both proximal and distal epiphyses (N=8) were first treated as different entries to identify any separate fracture patterns, bringing the total N to 36. The ratio of fresh and dry fractures was equal (N=18, 50%). FFI scores five (N=10, 27%) and three (N=9, 25%) were the most recurrent amongst long bones (Figure 259) (N=39 breaks in total including double entries for both proximal and distal breaks).

Fractures on either proximal or distal ends were recorded in equal numbers (N=13, 44.8%) whilst breaks on both ends included two dry (6.9%), one dry - fresh (proximal/distal) (3%), solely fresh (N=2, 6.9%) and fresh - dry (proximal/distal) (N=2, 6%). This fracture pattern suggests different treatment between individuals with half breaks resulting at a later stage (dry) and half during peri-mortem interval (fresh).

Surface preservation scores on limbs with fractures in both ends overall demonstrated poor surface preservation (scores 2-0) further suggesting that various levels of manipulations might have been responsible for these preservation patterns (Figure 260/Appendix 6). Taphonomic modifications included erosion, gnawing and staining. These were distributed equally amongst fractures elements (Table 150/Appendix 6)<sup>328</sup> with occasional abrasion present mostly on dry (N=7) than fresh fractures (N=4)<sup>329</sup>.

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<sup>328</sup> See Appendix 6/7.7. Ogof Colomendy/Taphonomy – Macroscopic results/Fractures (fresh vs dry).

<sup>329</sup> See Appendix 6/7.7. Ogof Colomendy/Taphonomy – Macroscopic results/Fractures (fresh vs dry) for more details.



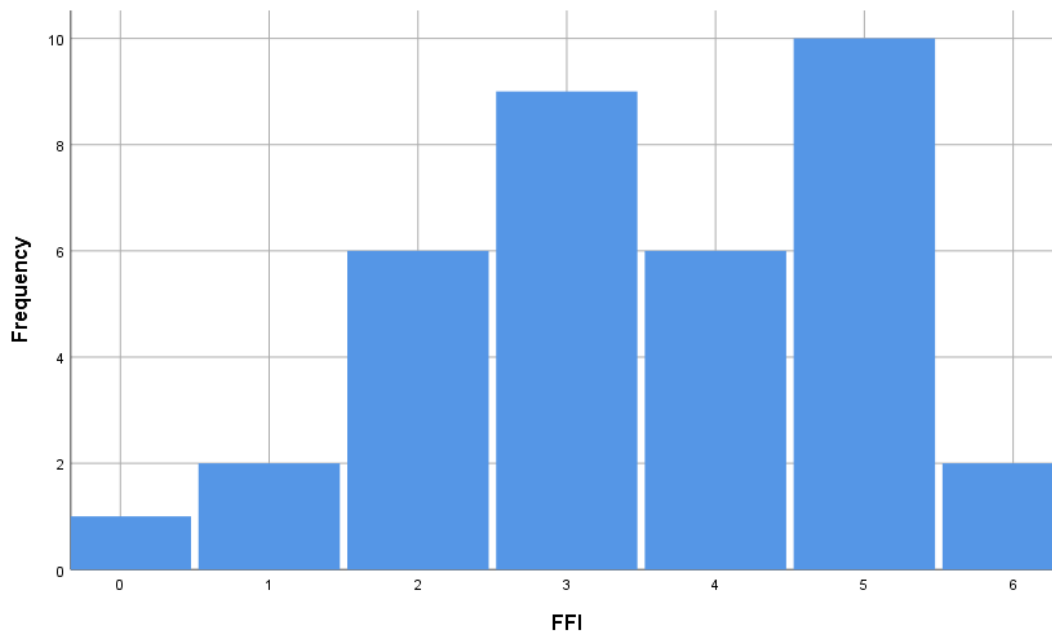


Figure 259. Total FFI scores in Ogof Colomendy. N=double entries for fractures identified in both proximal and distal ends. N=36.

#### 7.7.1.9. Surface preservation

Surface preservation scores amongst human remains primarily showed medium to low preservation (score 3/N=63, 30.7%; score 2/N=45, 22%; score 0/N=17.1% and score 1/N=29, 14.1%). A lower number of bones were better preserved (score 4/N=14, 6.8% and score 5/N=19, 9.3%) (Figure 261/Appendix 6)<sup>330</sup>. Medium surface preservation scores (3) were largely recorded amongst flat/irregular bones, long bones, hands/feet and cranial remains followed by lower scores (2-0). Higher scores (4-5) were apparent in lower numbers primarily amongst long bones and hands/feet. Multi-period depositions and separate manipulation of the individuals, both peri- and post-mortem, explain variation in surface preservation scores.

#### 7.7.1.10. Trampling

Trampling was not present on any elements from Ogof Colomendy. Absence of this modification suggests that trampling can be obscured in subterranean environments, therefore, indication of trampling may reflect exposure prior to deposition in caves.

<sup>330</sup> See Appendix 6/7.7. Ogof Colomendy/Taphonomy – Macroscopic results/Surface preservation.

### 7.7.2. Microscopic results

Results from a single Late Neolithic femur (SNO: 23) are summarised under one section. The femur showed extensive non-Wedl MFD bacterial attack (Figure 262). The sample had been infiltrated by extraneous material including red/brown, red (intense/some under normal light) to brown (dark) inclusions. Infiltrations and microcracking were absent however, the microstructure exhibited brown (dark, fair) microstructural staining and low collagen preservation (score 1 on the Birefringence Index) with slightly better collagen survival around the periosteum (Table 151/Appendix 6)<sup>331</sup>.

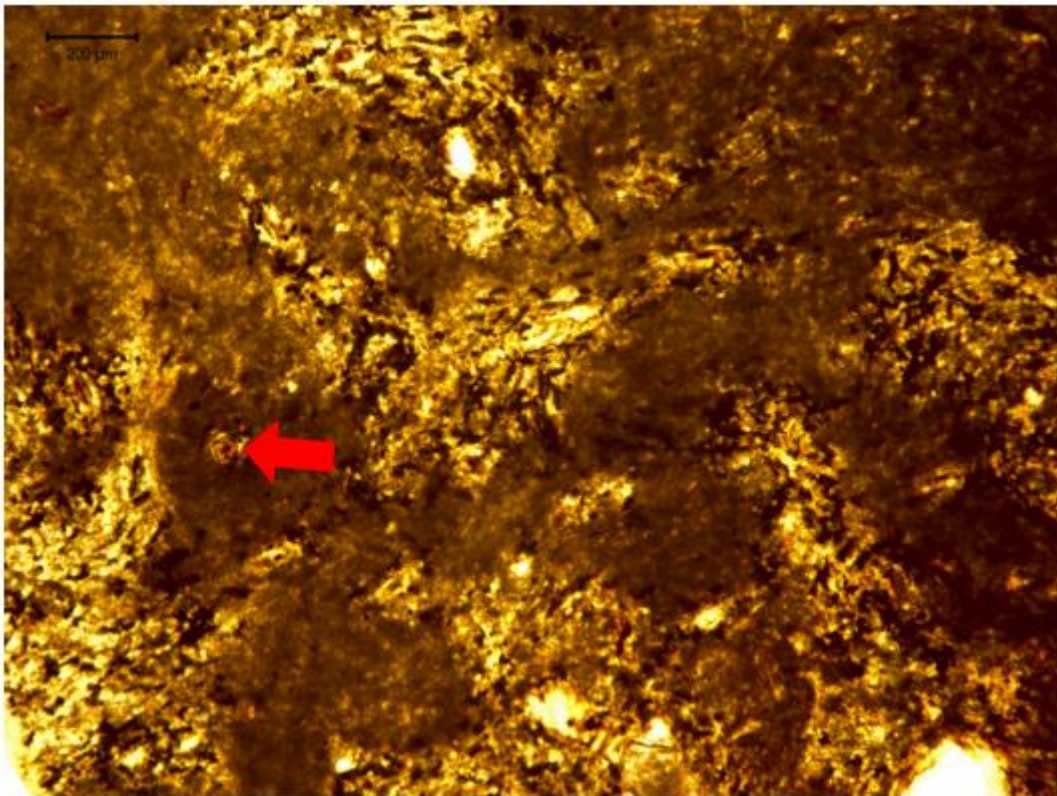


Figure 262. Extensive bacterial attack (OHI 0) in femur sample. Red infiltration (arrow). Magnification x5. Source: author

The femur exhibited a fresh fracture, signs of erosion, abrasion and staining and low surface preservation. Given the low OHI score and a fresh fracture, the individual might have been manipulated shortly after death. Presence of MFD suggests that the

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<sup>331</sup> See Appendix 6/7.7. Ogof Colomendy/Microscopic results.

individual was still buried either in Ogot Colomendy or elsewhere following exhumation and deposition in the site amongst other fractured bones. Bacteria and organic matter might have further infiltrated the microstructure of the bone whilst still fresh<sup>332</sup>.

### **7.7.3. Short summary of burial depositions in Ogot Colomendy**

A large amount of fractured bones, low ratios of skull elements and extremities (hands/feet) suggest that the site was repeatedly used for depositions over a period of time (multi-period). The high presence of both fresh and dry fractures further indicates that different stages of manipulation took place. Separate burials possibly included primary burials, clearances and disturbances, deliberate manipulation and deposition in different areas of the cave. Despite the large quantity of fractured long bones, evidence of trauma was almost entirely absent excluding a single humerus (SNO: 686) that exhibited a cutmark underneath its humeral head suggesting signs of defleshing. Given the multi-period use of this site, depositions in Ogot Colomendy were subject to a complex taphonomic trajectory (both peri- and post-mortem). Human remains were either selected and brought to the cave as a final stage of deposition or were manipulated on-site. This pattern demonstrates how complex multi-stage burials must have been and that caves could have functioned as centres for the circulation of remains. Results verify that peri-mortem manipulation was practiced whilst multi-period deposits possibly reflect a continuation of practices from the Middle/Late Neolithic to the Bronze Age. Commingled assemblages resulted from various stages of processing, separation of body parts inside the cave and later re-use of the site (see Chapter 8).

## **7.8. Gop Cave**

### **Frequency of skeletal elements**

Results demonstrated a prevalence of postcranial (N=77, 67.5%) rather than cranial/skull remains (N=16) followed by loose teeth (N=21, 18.4%) (Figure 263). Postcranial remains comprised of hands/feet (N=46, 49.5%), long bones (N=16, 17.2%), vertebrae remains (N=14, 15.1%) and one possible metacarpal (miscellaneous)

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<sup>332</sup> See Appendix 6/7.7. Ogot Colomendy/Microscopic results for more details on sampled element (including to BA long bones not included in this analysis).

(1.1%) (Figure 264; Table 152). Flat/irregular bones were entirely absent amongst the assemblage. Human remains were unearthed in passages (Figure 265)<sup>333</sup> with some recovered from earlier excavation of the cave in a constructed chamber that connected the cave to a rock-shelter (see Appendix 5).

Distributions amongst surviving loose teeth comprised of a single 1<sup>st</sup> incisor (4%), 2<sup>nd</sup> incisors and canines (N=2, 9% for each), 1<sup>st</sup> and 2<sup>nd</sup> premolars (N=3, 14% for each), 1<sup>st</sup> (N=3, 14%), 2<sup>nd</sup> (N=4, 19%) and 3<sup>rd</sup> (N=2, 9%) upper/lower molars and one deciduous 1<sup>st</sup> molar (4.8%) (Figure 266/Appendix 6)<sup>334</sup>.

Zone representation on long bones (N=16) using the proximal and/or the distal epiphysis demonstrated complete survival of shafts (N=16) and a high survival of epiphyses (N=14, 87%) with only one femur and one fibula demonstrating absence of epiphysis (Table 153 and Figure 267/Appendix 6)<sup>335</sup>.

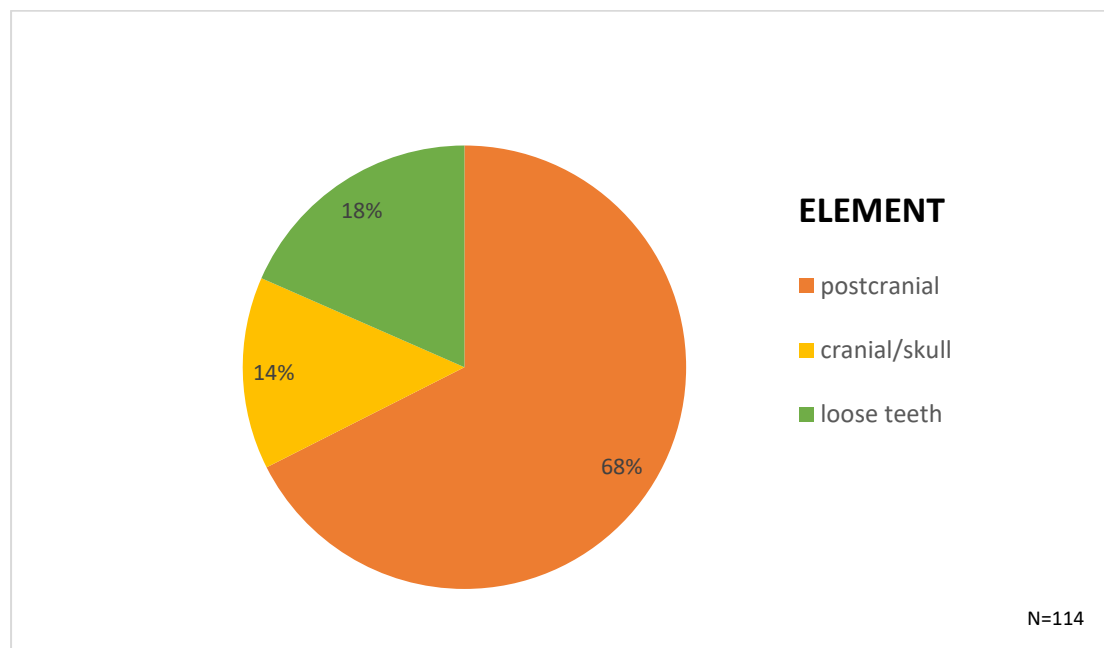


Figure 263. Element frequency amongst the assemblage from Gop Cave. N=including loose teeth.

<sup>333</sup> Elements recorded and examined include X1-X4 in plan with the body of one individual appearing protected, nonetheless disturbed, by a rubble wall across the recess (X2 in plan).

<sup>334</sup> See Appendix 6/7.8. Gop Cave/Frequency of skeletal elements for more details.

<sup>335</sup> See Appendix 6/7.8. Gop Cave/Frequency of skeletal elements/Figure 267 for surface preservation and more details on taphonomy.

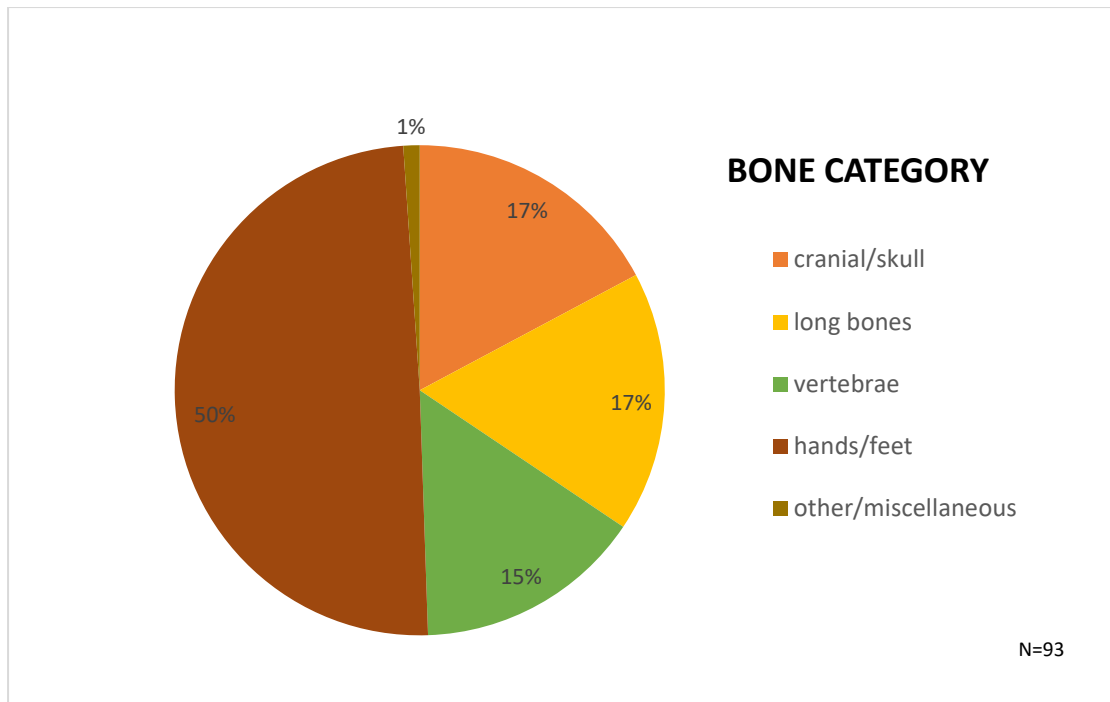


Figure 264. Element frequencies in Gop Cave based on bone category (excluding loose teeth).

ELEMENT	COUNT
ATLAS (C-1)	1
CALCANEUS	2
CERVICAL VERTEBRA (C-2)	1
CERVICAL VERTEBRA (C-3)	1
CRANIAL FRAGMENT (FRONTAL)	4
CRANIAL FRAGMENT (OCCIPITAL)	1
CRANIAL FRAGMENT (PARIETAL)	3
CRANIAL FRAGMENT (TEMPORAL)	1
DISTAL HAND PHALANX	1
FEMUR	2
FIBULA	1
HUMERUS	4
INTERMEDIATE HAND PHALANX	1
INTERMEDIATE HAND PHALANX (2)	2
LOOSE TEETH	21
LUMBAR VERTEBRA	2
LUMBAR VERTEBRA (L-2)	1
MANDIBLE	5
MAXILLA	2
METACARPAL	2

METACARPAL (MC1)	2
METACARPAL (MC2)	3
METACARPAL (MC3)	3
METACARPAL (MC4)	3
METACARPAL (MC5)	1
METATARSAL (MT1)	1
METATARSAL (MT2)	3
METATARSAL (MT3)	2
METATARSAL (MT4)	4
METATARSAL (MT5)	3
NAVICULAR (NAV)	1
PATELLA	1
PROXIMAL FOOT PHALANX (5)	1
PROXIMAL HAND PHALANX	4
PROXIMAL HAND PHALANX (1)	2
PROXIMAL HAND PHALANX (2)	2
RADIUS	4
TALUS	2
THORACIC VERTEBRA	3
THORACIC VERTEBRA (T-1)	1
THORACIC VERTEBRA (T-12)	1
THORACIC VERTEBRA (T-4)	1
THORACIC VERTEBRA (T-7)	1
TIBIA	3
ULNA	2
CERVICAL VERTEBRA	1
OTHER/MISCELLANEOUS (? METACARPAL)	1
(N) TOTAL	114

Table 152. Element representation in Gop Cave (north Wales). Other/miscellaneous/ includes a possible metacarpal. N=including loose teeth

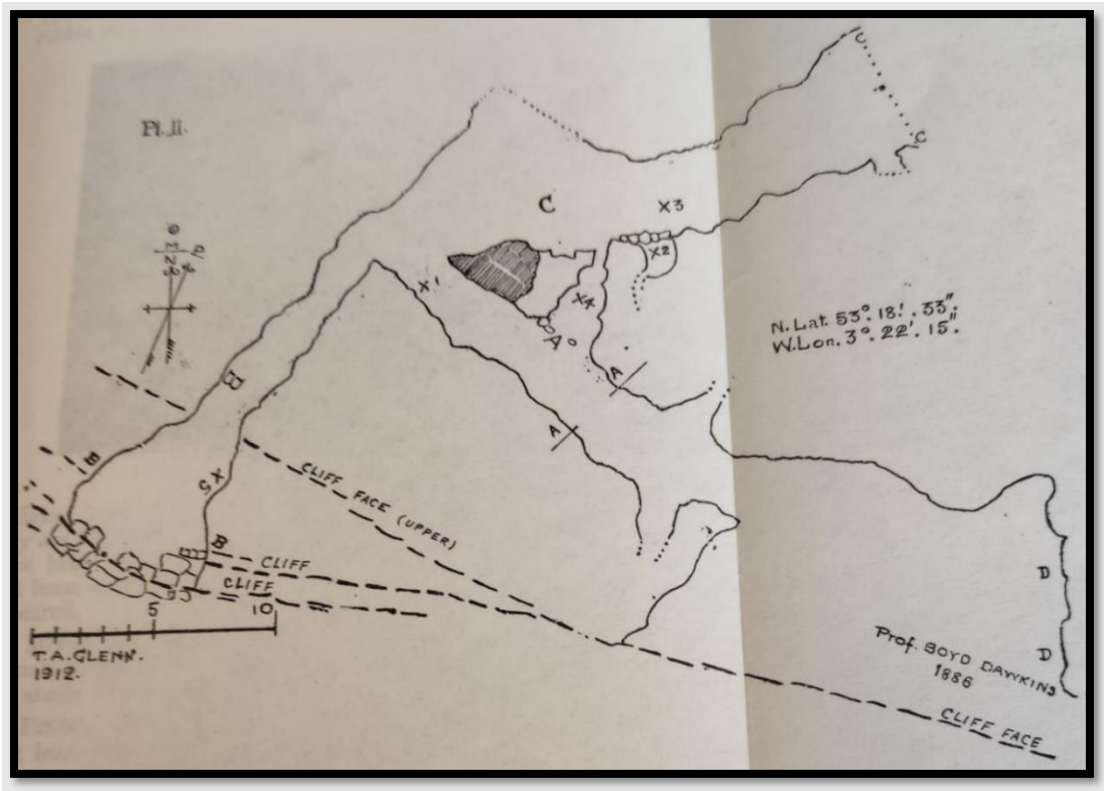


Figure 265. Plan of Gop Cave (from T.A. Glenn in 1911 second exploration 1908-14). Opening of new entrance (AA) beyond the burial chamber; BB= entrance from cliff face, found walled up; CC=terminus of exploration; DD=west side of Dawkins' sepulchral chamber; X1-X4= inhumations; X5= position of axe (See Appendix 5). (Davies 1949: 280).

### Element completeness

Elements demonstrated a higher percentage of completeness (N=52, 55%) compared to other sites and included hands/feet (N=40), eight vertebrae and four long bones. Surface preservation scores of complete human remains showed a prevalence of high scores (5) with a lower number of bones displaying medium to poor surface preservation (3-0) (Figure 268/Appendix 6)<sup>336</sup>. Incomplete/fragmented elements on the other hand (N=41, 44%), demonstrated fluctuations in surface preservation scores. The large number of complete bones of hands/feet suggests that primary burials might have taken place on site.

<sup>336</sup> See Appendix 6/7.8. Gop Cave/Element completeness.

## **MNI, demography and pathology<sup>337</sup>**

Results demonstrated the presence of three adults and a single juvenile. Adults were identified from the fusion of epiphyses, duplicate zone representation of long bones and dental attrition on both loose and attached teeth on mandibular/maxillary alveoli.

Deciduous teeth still attached in the alveoli included a 1<sup>st</sup> and 2<sup>nd</sup> molar, with one permanent 1<sup>st</sup> molar missing and one unerupted permanent 2<sup>nd</sup> molar determining an age of c. seven to ten years. Dental attrition based on surviving molars on mandibulae and/or maxillae and loose teeth determined three age groups amongst adults of c.17-25 years, c.25-35 years and c. 35-45 years whilst one surviving loose (?3<sup>rd</sup>) molar (SNO: 102/Appendix 1/Sheet 4/Dentition) with broken roots appeared recently erupted (wear stage 1 or lower).

Sex estimations based on a reconstructed cranium (frontal/SNO: 617) and two mandibulae (SNOs: 620-1), determined two probable females and one probable male<sup>338</sup>.

## **Pathology**

Degenerative pathologies were not identified on any human remains and dental pathologies were almost entirely absent (caries N=1/abscess N=1)<sup>339</sup>.

### **7.8.1. Taphonomy – Macroscopic results**

#### *7.8.1.1. Weathering*

Signs of weathering were recorded on 13 elements (14%) reaching stages one (N=10, 10%), two (N=2, 2.2%) and three (N=1, 1.1%) (Figure 269/Appendix 6)<sup>340</sup>. Stage one weathering was noted on three long bones, two mandibulae, one thoracic vertebra and four bones of the hands/feet. For example, humerus SNO 543 and radius SNO 546

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<sup>337</sup> See Chapter 4 for MNI and age/sex estimations.

<sup>338</sup> One loose temporal (SNO: 618) with a surviving mastoid process also appeared to have a derived from a probable female, however, this fragment might have derived from frontal SNO 617 (same individual).

<sup>339</sup> See Appendix 6/7.8. Gop Cave/MNI, demography and pathology for details.

<sup>340</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Weathering.



exhibited a dry and a fresh fracture respectively with humerus SNO 543 demonstrating evidence of sharp force trauma (cutmark) that pre-dated weathering (stage one). Results suggest separate episodes of manipulation (Figure 270).



Figure 270. Weathering stage 1 on humerus. Source: author

More advanced stages of weathering were further recorded on a single humerus (SNO: 544), one metacarpal (SNO: 565) reaching stage two and a single tibia (SNO: 534) reaching stage three. Both tibia SNO 534 and humerus SNO 544 exhibited fresh breaks suggesting early manipulation prior to deposition. Further taphonomic modifications identified on weathered elements included abrasion and staining on the majority of elements with erosion further noted on more than half of the bones with stage one weathering. Contrasting patterns amongst humerus SNO 544 and metacarpal SNO 565 with weathering stage two could further suggest separation of body parts in separate burial areas and/or prior exposure in different environmental conditions. (Table 154/Appendix 6)<sup>341</sup>.

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<sup>341</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Weathering.

### 7.8.1.2. Gnawing

Gnawing was present on a low number of bones (N=10, 10%) including six metacarpals, one hand phalanx and three long bones. Most gnawed elements showed full zone completeness and had been impacted by erosion, staining and abrasion with weathering present on three complete elements including two metacarpals (stages 1 and 2) and one radius (stage 2) (SNOs: 553, 565 and 538) (Table 155/Appendix 6)<sup>342</sup>.

Elements exhibiting gnawing marks overall demonstrated slight variation in preservation (Figure 271/Appendix 6)<sup>343</sup>. This pattern suggests that gnawing, along with other taphonomic modifications affected the preservation of the remains compared to the high surface preservation scores of non-gnawed elements (score 5). Variation was particularly apparent amongst surviving gnawed metacarpals (scores 0 and 5) most of which were complete. These were possibly discovered in the cave passages and not at the entrance of the rock-shelter (first excavation/separate assemblage) (Figure 272) where a number of fragmented human remains were recovered.

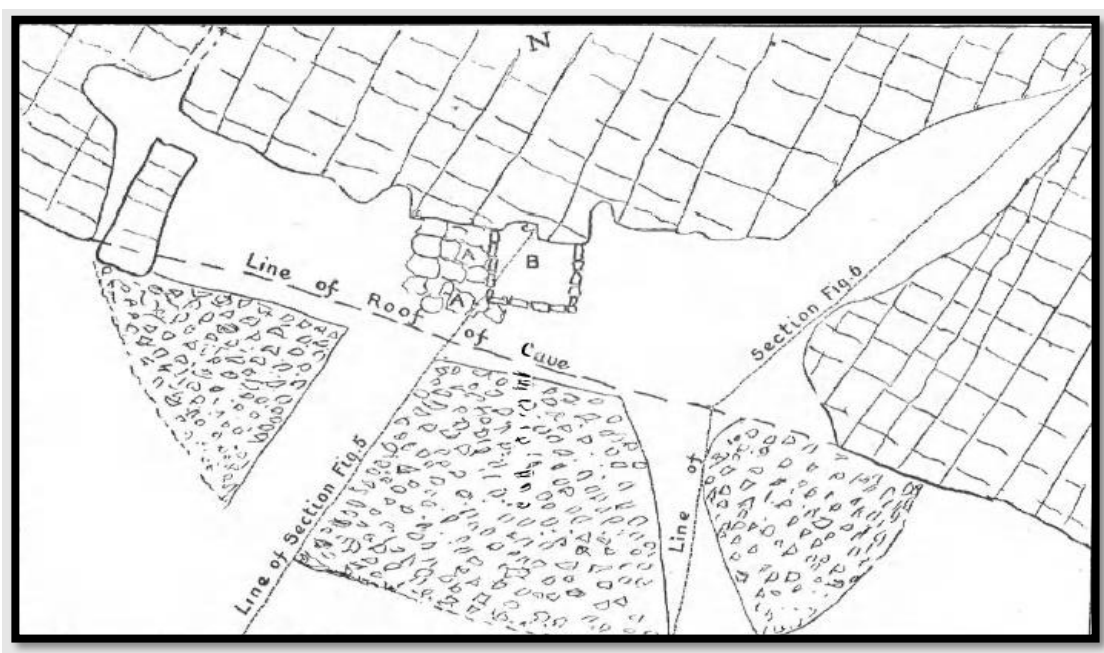


Figure 272. Plan of Gop Cave – during earlier excavation by Boyd Dawkins (first exploration in 1886) indicating two drifts cut down to the bedrock through c.19ft of debris. A=thick layer of charcoal covered with slabs of limestone and B=sepulchral chamber where human were discovered of 14 individuals discovered (lost from records) (Dawkins 1901: 325)

<sup>342</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Gnawing.

<sup>343</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Gnawing.

### 7.8.1.3. Erosion

Erosion was present on 51 elements including a large number of hands/feet (N=27), long bones and cranial/skull remains (N=11 for each) and a single vertebra fragment (Figure 273)<sup>344</sup>. Eroded remains had not been severely impacted by other taphonomic modifications however staining and abrasion were apparent on a high number of both eroded and non-eroded elements (Table 156/Appendix 6)<sup>345</sup>.

Surface preservation scores amongst eroded and non-eroded remains demonstrated very similar patterns (scores 4-5 and 0-3) (Figure 274). Presence/absence of erosion and similar surface preservation patterns suggest that separation of burials in the cave might have been responsible for half of the remains exhibiting signs of erosion. Results amongst surface preservation of eroded and non-eroded remains showed high consistency, a pattern not often encountered amongst other cave assemblages.

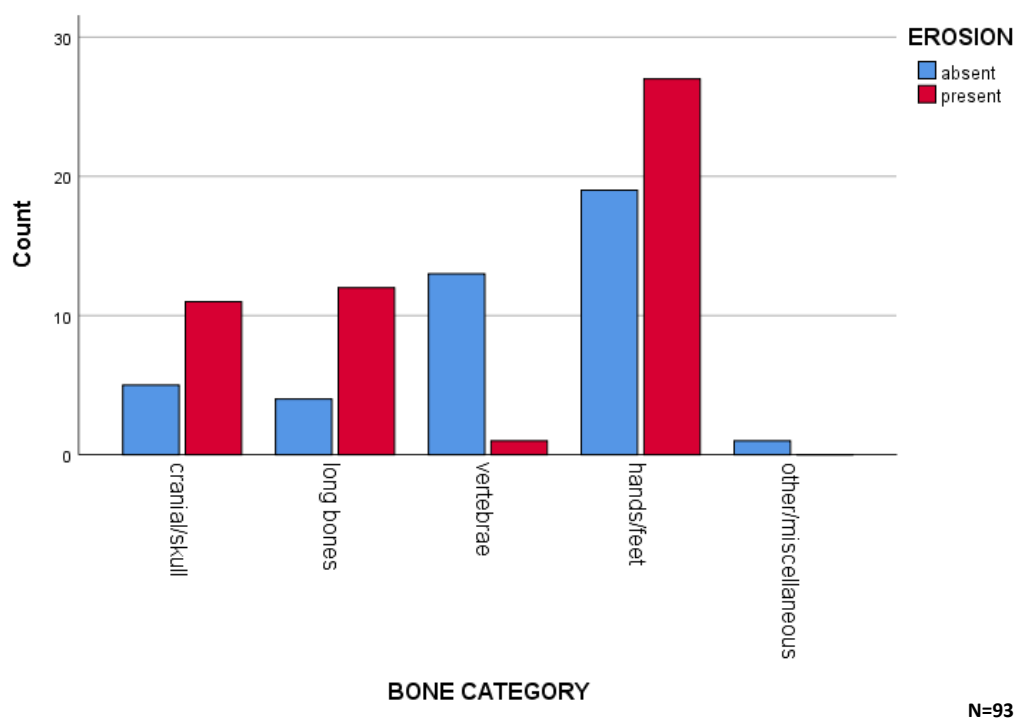
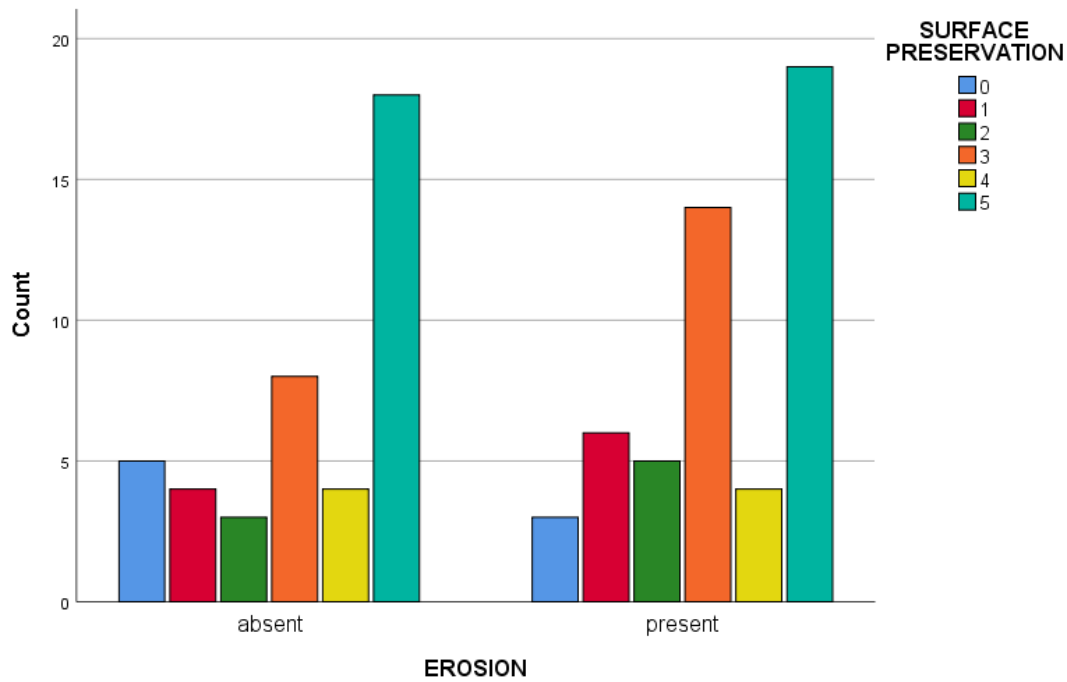


Figure 273. Frequency of erosion absence/presence based on bone category across sites in Gop Cave.

<sup>344</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Erosion for more details on eroded loose teeth, cave concretion and e.g. for humerus 544 (SNO).

<sup>345</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Erosion.



N=93

Figure 274. Surface preservation scores on eroded and non-eroded remains across sites in Gop Cave (0-5/poor-good).

#### 7.8.1.4. Abrasion

Abrasion was present on the vast majority of human remains from Gop Cave (N=84, 90.3%) including bones of the hands/feet (N=45), long bones (N=8), a probable metacarpal fragment and all cranial/skull and vertebrae remains (Figure 275).

Overall, surface preservation amongst abraded human remains was very good (score 5) (Figure 276/Appendix 6)<sup>346</sup>. Abrasion was often accompanied by erosion, staining, gnawing and weathering (Table 157/Appendix 6)<sup>347</sup>. Five abraded long bones exhibited fresh fractures which suggests early manipulation of the bones followed by deposition in the cave.

<sup>346</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Abrasion

<sup>347</sup> See Appendix 6/7.8. Gop Cave/ Taphonomy – Macroscopic results/Abrasion.

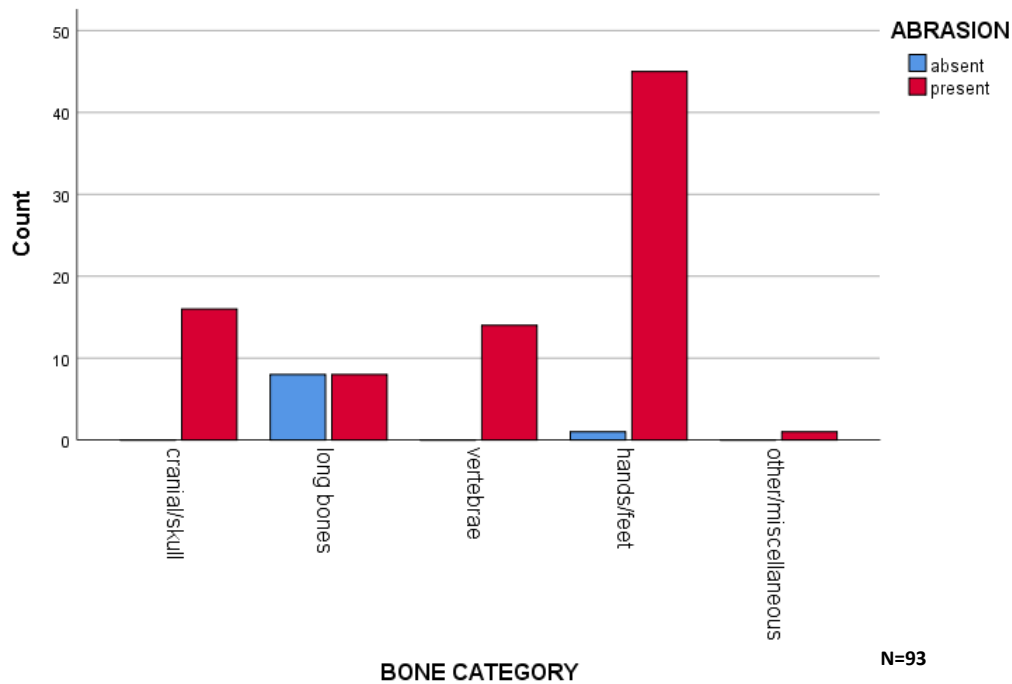


Figure 275. Presence/absence of abrasion based on bone category in Gop Cave.

#### 7.8.1.5. Staining

Staining was recorded on 54 elements (58%) including bones of the hands/feet (N=24), long bones (N=12), cranial fragments (N=10), a single miscellaneous fragment and vertebrae remains (N=7) as well as six loose teeth (Figure 277). Staining comprised of mould/manganese marks similar to other taphonomic assemblages (e.g. Little Hoyle Cave, Ifton Quarry), pink/red marks (N=1) and white/grey concretion residues (N=11)<sup>348</sup>. Staining was more often associated with other taphonomic modifications (erosion, abrasion, gnawing and weathering) compared to unstained human remains (Table 158 and Figure 278/Appendix 6)<sup>349</sup>.

<sup>348</sup> See Appendix 6/7.8. Gop Cave/Taphonomy – Macroscopic results/Staining for more details on pink/red marks (total 591) and concretion (N=11).

<sup>349</sup> See Appendix 6/7.8. Gop Cave/Taphonomy – Macroscopic results/Staining/Figure 278 for surface preservation and table 158.

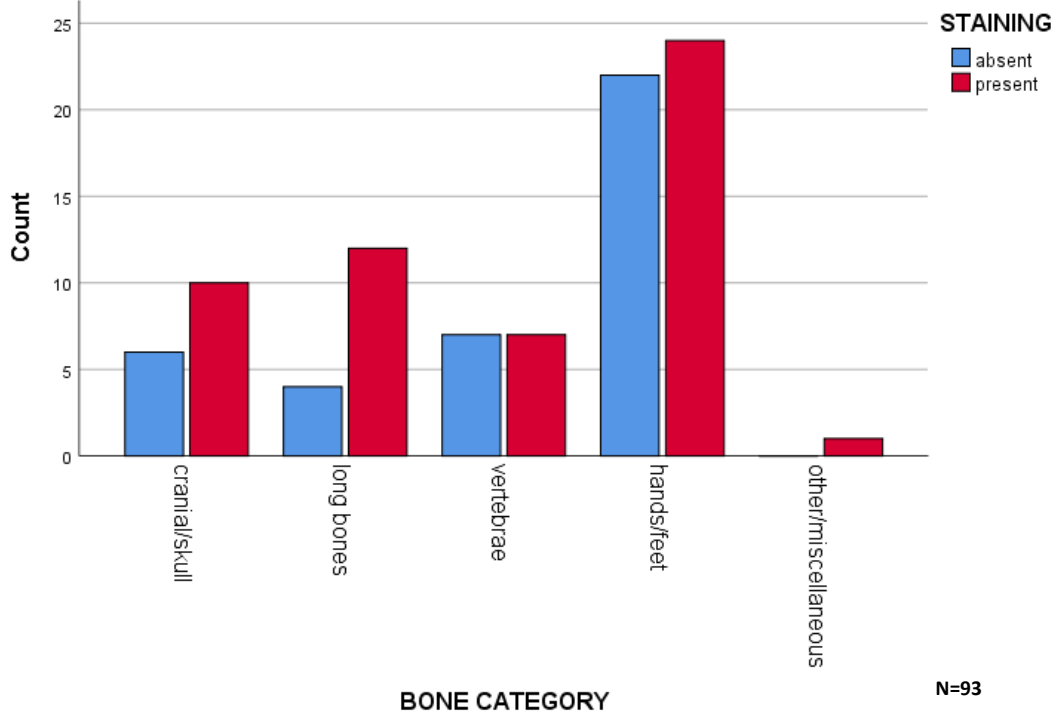


Figure 277. Staining presence/absence based on bone category in Gop Cave.

#### 7.8.1.6. Trauma (sharp/blunt force)

Evidence of sharp force trauma was present on a single fragmented humerus SNO 534 on the anterior view of its diaphysis (Figure 279). The humerus exhibited erosion, staining and medium surface preservation (score 3). The percussion mark on the diaphysis appears to pre-date weathering and suggests peri-mortem manipulation prior to final deposition whilst presence of a dry fracture suggests later disturbances. Similar to the peri-mortem cutmark from humerus 686 (SNO) from Ogof Colomendy, the element was either manipulated on-site or collected after disarticulation and brought to the site for deposition



Figure 279. Sharp force trauma (cutmark) on humeral diaphysis.  
Source: author

#### 7.8.1.7. *Burning*

Evidence of burning was not recorded on any elements from Gop Cave.

#### 7.8.1.8. *Fractures (fresh vs dry)*

Fractures were identified on nine elements including humeri (N=4), radii (N=3), a single femur and a tibia. Fractures were present on either proximal or distal ends with a single femur (SNO: 548) fractured in two (both fused epiphyses present in bag) and therefore two separate fresh fractures were recorded and treated as separate entries, bringing the total N to 10. All but a single break (humerus SNO 543) were fresh (88%). (Figure 280/Appendix 6)<sup>350</sup> (N=10 in total including double entry). FFI scores two and three demonstrated equal and most recurrent distributions (N=4, 40%) amongst long bones followed by scores one and six.

Fractures (N=9) on either proximal or distal ends included fresh (N=7, 77%) and a single dry break (11%) with one long bone exhibiting fresh fractures on both ends (11%). Fresh fractures suggest peri-mortem manipulation whilst the dry break, accompanied by percussion mark on the diaphysis of humerus SNO 543, resulted at a

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<sup>350</sup> See Appendix 6/7.8. Gop Cave/Taphonomy – Macroscopic results/Fractures (fresh vs dry).

later stage (e.g. during disturbances or circulation of bone). Surface preservation scores were primarily medium (score 3) to high (scores 4-5) (Figure 281/Appendix 6)<sup>351</sup>.

Four fractured limbs exhibited different weathering stages (1-3) and variation amongst other taphonomic modifications (Table 159)<sup>352</sup>. Erosion was overall present amongst weathered elements and was further recorded on humerus SNO 543 which exhibited a dry fracture and a peri-mortem percussion mark. Eight more limbs exhibited fresh fractures and three of these demonstrated signs of weathering (stages 1-3) suggesting that whilst depositions must have been a single episode (based on available Middle to Late Neolithic dates and the homogeneity of taphonomic modifications), early manipulation might have been part of the trajectory.

FFI	WEATHERING			EROSION	ABRASION	STAINING
	STAGE 1	STAGE 2	STAGE 3			
DRY	1	0	0	1	0	1
FRESH	1	1	1	4	4	5
FRESH (PROX& DISTAL)	0	0	0	1	1	0

Table 159. FFI correlated with taphonomic modifications in Gop Cave. N=9.

#### 7.8.1.9. Surface preservation

Scores amongst human remains demonstrated high (score 5/N=37, 39%) to medium (score 3/N=22, 23%) surface preservation followed by lower scores (1/N=10, 10.8%) and equal distribution amongst higher and lower surface preservation (scores 4, 2 and 0/N=8, 8% for each) (Figure 282/Appendix 6)<sup>353</sup>.

<sup>351</sup> See Appendix 6/7.8. Gop Cave/Taphonomy – Macroscopic results/Fractures (fresh vs dry).

<sup>352</sup> Abrasion possibly resulted from handling/curation and its presence/absence cannot be considered as an accurate indication of the fractured long bones' taphonomic trajectory.

<sup>353</sup> See Appendix 6/7.8. Gop Cave/Taphonomy – Macroscopic results/Surface preservation.



Overall surface preservation scores showed normal distributions based on the level of processing/handling they underwent. A large number of (complete) hands/feet demonstrated very good surface preservation, weathered elements showed fluctuations in preservation, and long bones demonstrated peri- and post-mortem manipulation.

#### *7.8.1.10. Trampling*

Trampling was present on a single talus (SNO: 591) accompanied by erosion, abrasion and pink/red stains on its plantar view.<sup>354</sup>

### **7.8.2. Microscopic results**

#### **OHI scores and MFD**

Histological destruction of nine samples resulted from bioerosion and non-Wedl attack with one sample (SNO: 35) demonstrating signs of non-Wedl and, possible, Wedl attack (10%). OHI scores ranged from zero to one and three to four with equal distributions of MFD amongst scores zero, one and three (N=3, 30% for each) (Figure 284). A single sample (SNO: 35) showed very good histological preservation (30%) (Figure 283/Appendix 6)<sup>355</sup>. Evidence of MFD amongst samples included budded, linear longitudinal (all samples) and lamellate (N=8, 80%). Fibula 35 demonstrated evidence of budded and linear longitudinal MFD with enlarged canaliculi resembling Wedl-type 2 (Figure 285)<sup>356</sup>.

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<sup>354</sup> See Appendix 6/7.8. Gop Cave/Taphonomy – Macroscopic results/Trampling for more details. Results do not impact the overall taphonomic trajectory of the site.

<sup>355</sup> <sup>355</sup> See Appendix 6/7.8. Gop Cave/Microscopic results.

<sup>356</sup> See Végh *et al.* 2021: 8, Figure 6 for comparison.

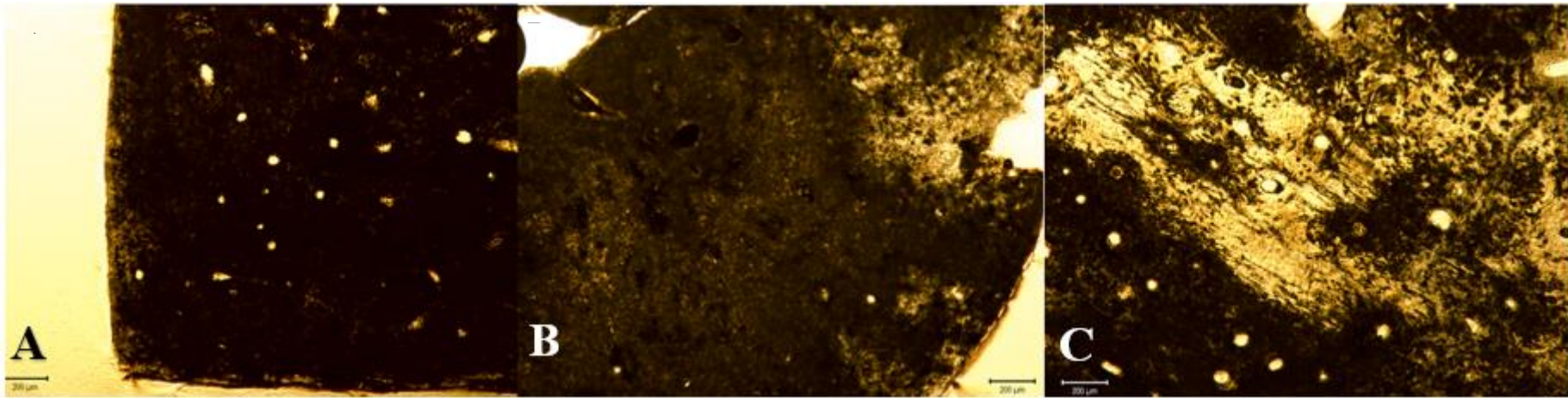


Figure 284. Histological preservation amongst samples – **A**: humerus OHI 0, **B**: mandible OHI 1 and **C**: tibia OHI 3. Magnification x5. Source: author



The fibula demonstrated minor bacterial attack compared to other samples, brown (fair/dark) and black/brown inclusions, infiltrations (some red infiltrations under polar light), microstructural staining, microcracking and high collagen preservation. Similar MFD was identified in a humeral sample from Backwell Cave which might relate to similarities in practices across regions. Overall histological preservation amongst samples did not demonstrate extensive variation, with several OHI scores showing similar distributions between OHI scores<sup>357</sup>. However, variation between bone categories was apparent (Table 160). OHI scores amongst long bones (SNOs: 35-40) varied from zero to one and three to four. Two sampled mandibulae (SNOs: 21-2) further demonstrated different levels of bacterial attack (OHI scores 1 and 3). Different stages of histological preservation could reflect different treatment between individuals also reflected by the presence of peri-mortem manipulation (fresh fractures and sharp force trauma) on several long bones.

The assemblage from Gop Cave (north Wales) showed similar variation in OHI scores to the samples from Little Hoyle Cave (south-west Wales). This suggested differentiation of treatment between the individuals involving selection, sub-aerial exposure and/or collection of remains for deposition in both caves. Non-parametric tests amongst OHI scores demonstrated that human remains from Little Hoyle Cave were not significantly better preserved histologically than those at Gop Cave ( $P=0.608$ ,  $MWU=10.5$ ) suggesting that similar burial patterns might have been adopted across regions.

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<sup>357</sup> See Appendix 6/7.8. Gop Cave/Microscopic results for more details.

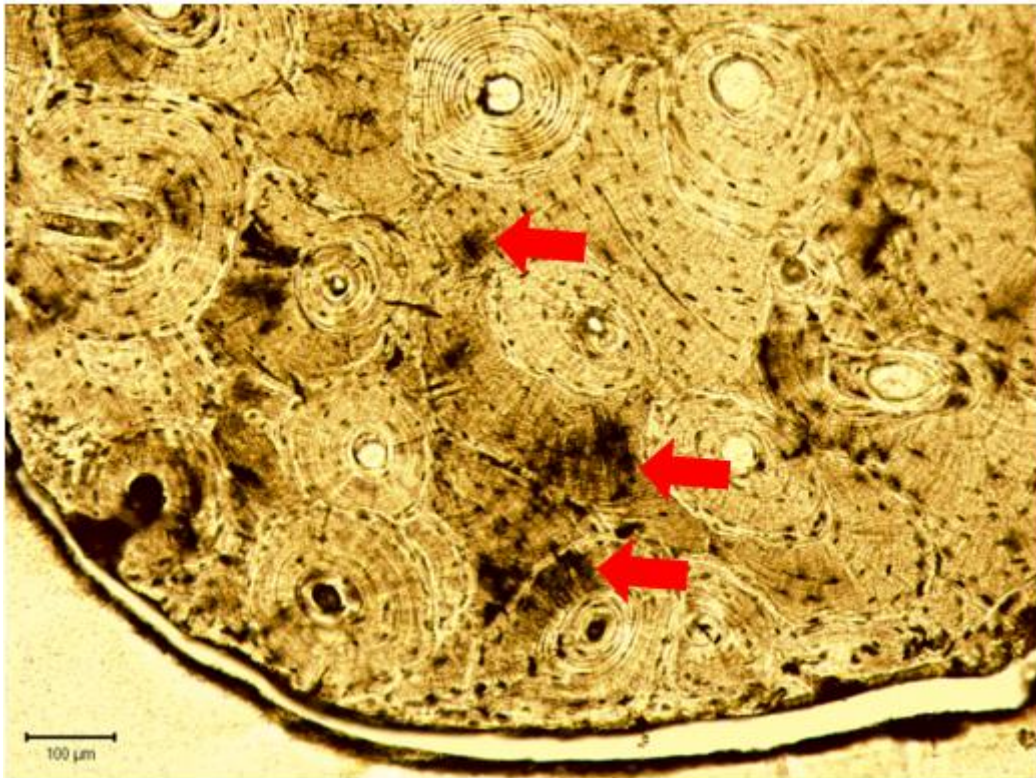


Figure 285. Fibula with canaliculi resembling Wedl-type 2 attack (red arrows) around Haversian canals and close to the periosteal surface (OHI 4). Magnification x5. Source: author

ELEMENT		OHI SCORE			
		0	1	3	4
	CF	1	1	0	0
	LB	2	1	2	1
	M	0	1	1	0

Table 160. Table demonstrating OHI score distribution amongst cranial fragments (CF) and long bones (LB) sampled from Gop Cave. N=10.

### Taphonomy

Weathering presence was followed by different histological patterns. Tibia SNO 40 (weathering stage 3, fresh fracture, slight root etching) and mandible SNO42 (weathering stage 1, abrasion) demonstrated similar histological preservation (OHI

score: 3) whereas humerus SNO 38 (percussion mark, weathering stage 1, dry fracture) showed complete destruction of the microstructure (OHI score: 0).

Surface preservation scores amongst weathered elements similarly varied with humerus SNO 38 demonstrating higher surface preservation (score 3) than tibia SNO 40 and mandible SNO 42 (scores 2 and 0 respectively) despite the severity of bacterial attack.

Long bones exhibiting fractures (four fresh and one dry with evidence of sharp force trauma) suggest different treatment and possible selection of remains after early manipulation. Presence of fresh breaks and low OHI scores (0-1) support disturbances and/or manipulation during the process of decomposition similar to the assemblage from Ogof Colomendy. No associations between erosion, staining, abrasion and OHI scores can be highlighted (similar to the assemblage from Little Hoyle Cave)<sup>358</sup>.

### **Birefringence**

Birefringence scores demonstrated medium (2) (N=3, 30%) to low (1) (N=4, 40%) collagen preservation with one sample (10%) showing high birefringence and two (20%) no collagen survival (Figure 286/Appendix 6)<sup>359</sup>. Overall collagen preservation amongst all samples and given OHI scores showed correlations suggesting that collagen loss relates to bacterial bioerosion (Table 161/ Appendix 6)<sup>360</sup>.

### **Other microscopic observations**

Inclusions were present in all samples whilst infiltrations (N=8, 80%), microstructural staining (N=7, 70%) and microcracking/microfissures (N=4, 40%) were less frequently recorded (Table 162/ Appendix 6). OHI scores and intensity patterns showed associations (Table 163/ Appendix 6) and no pattern was noted<sup>361</sup>. Microstructural staining was associated with surface staining on a low number of samples and different OHI scores (Table 164/ Appendix 6).

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<sup>358</sup> See Appendix 6/7.8. Gop Cave/Microscopic results for more details.

<sup>359</sup> See Appendix 6/7.8. Gop Cave/Microscopic results for more details.

<sup>360</sup> See Appendix 6/7.8. Gop Cave/Microscopic results for more details.

<sup>361</sup> See Appendix 6/7.8. Gop Cave/Microscopic results for more details.

A single fibula (SNO: 44) demonstrated presence of both medium intensity microcracking/microfissures and surface erosion was further accompanied by brown and black/brown inclusions, infiltrations and microstructural staining which suggests that either infiltration from fungal attack (Wedl-type 2) results from demineralisation and cracking in the bone or that microfissures were stained. No other associations between micro- and macroscopic analysis were observed.

Inclusion, infiltration colour and microstructural staining showed variations (Table 170/Appendix 6)<sup>362</sup>. Orange/brown discolouration was present amongst cranial/skull remains (SNOs: 42, 44) (Table 165/ Appendix 6)<sup>363</sup>. Cranial/skull remains and long bones from Little Hoyle Cave, similarly demonstrated orange/brown and red/orange discolouration.

### **7.8.3. Short summary of burial depositions in Gop Cave**

High frequency of hands/feet, accompanied by the possibly circulated, processed (fractures) and/or exposed (weathered) human remains evidence multiple burial patterns. Signs of weathering suggest earlier sub-aerial exposure whilst evidence of sharp force trauma (cutmark) on one of the humerus followed by a dry fracture (percussion mark pre-dated weathering) indicates early manipulation with later disturbances.

Fresh breaks on surviving long bones, three exhibiting signs of weathering (stages 1-3), suggest that whilst depositions must have been the result of a single episode (based on available Middle to Late Neolithic dates and the homogeneity of taphonomic modifications), early manipulation was part of the trajectory. The high prevalence of fresh breaks and presence of sharp force trauma on a single long bone suggest early manipulation which was either followed by sub-aerial or protected exposure (resulting in different weathering stages), collection and final deposition in the cave.

OHI scores (0-1, 3-4) further demonstrated differentiation of MFD which reflects distinct handling of both post-cranial and cranial/skull remains. No particular

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<sup>362</sup> See Appendix 6/7.8. Gop Cave/Microscopic results for more details.

<sup>363</sup> See Appendix 6/7.8. Gop Cave/Microscopic results for more details.

associations between erosion, staining, abrasion and OHI scores were highlighted (similar to the assemblage from Little Hoyle Cave) however, weathering presence was followed by different patterns of histological preservation. Various depositional trajectories were therefore identified. These involved practices of excarnation of certain elements with various stages of weathering and arrangement/separation of individuals within the cave. Larger Middle to Late Neolithic assemblages in north Wales appear processed in various stages and collectively deposited in caves either commingled (Ogof Colomendy) or re-arranged (Gop Cave).

## **7.9. Ogof Pant-y-Wennol**

### **Frequency of skeletal elements**

Results demonstrated a prevalence of postcranial (N=185, 79.7%) than cranial/skull remains (N=13, 5.6%) (Figure 287 below). Post-cranial remains comprised a large number of flat/irregular bones (N=83, 39.7%), hands/feet (N=56, 26.8%) and long bones (N=29, 13.9%). A lower proportion of vertebrae (N=17, 8.1%), other/miscellaneous remains (N=10, 4.8%) and one unidentified element (0.5%) were identified (Figure 288 and Table 166 below).

Distributions amongst loose teeth included incisors and canines (I1/N=2, 8.7%; I2/N=6, 26.1%; C/N=3, 13%), upper and lower premolars (PM1/N=4; 17.4%; PM2/N=3, 13%), three molars (M2/N=2, 8.7%; M3/N=1; 4.3%), one deciduous canine (4.3%) and one unidentified molar (4.3%) (Figure 289/Appendix 6)<sup>364</sup>.

Zone representation on long bones (N=26<sup>365</sup>) using the proximal and/or the distal epiphysis demonstrated a high survival of shafts (N=20, 76.9%) and lower survival of epiphyses (N=14, 53.8%). Long bones included eight tibiae (30%), four fibulae, radii and ulnae (15.4% for each) and three humeri and femora (11.5% for each) (Table 167/Appendix 6)<sup>366</sup>. Taphonomic modifications amongst long bones included erosion (N=12), abrasion (N=8) with absence of gnawing and trauma<sup>367</sup>.

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<sup>364</sup> <sup>364</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Frequency of skeletal elements.

<sup>365</sup> N= excluding three perinate long bones.

<sup>366</sup> <sup>366</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Frequency of skeletal elements.

<sup>367</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Frequency of skeletal elements for more details.



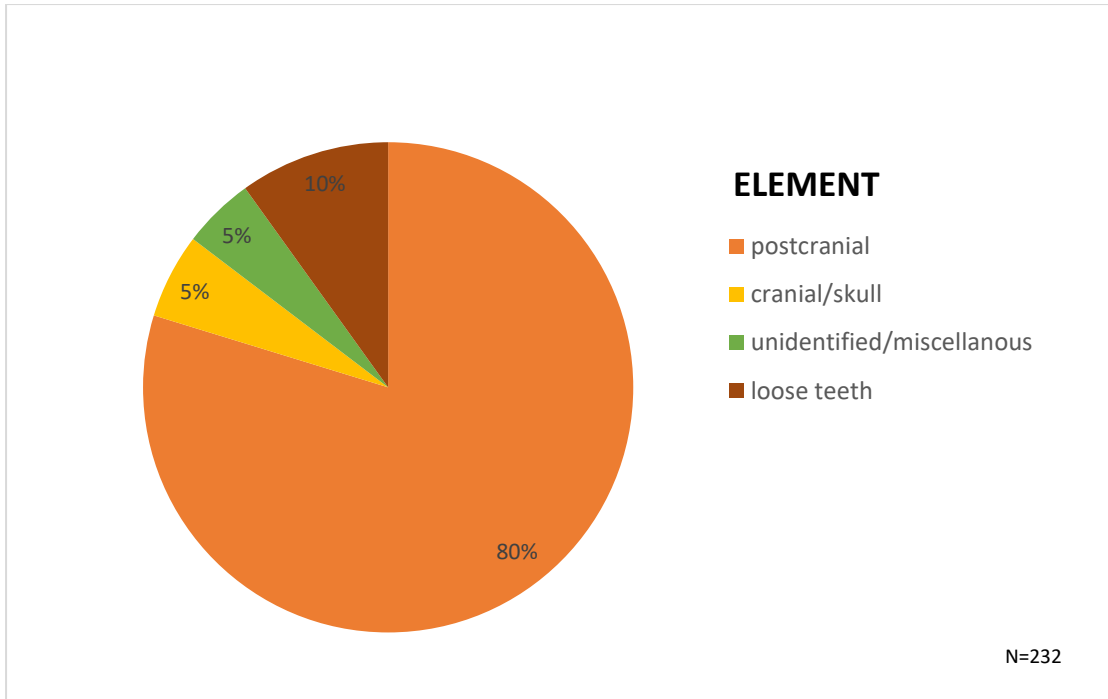


Figure 287. Element frequency amongst the assemblage from Ogof Pant-y-Wennol. N=including loose teeth.

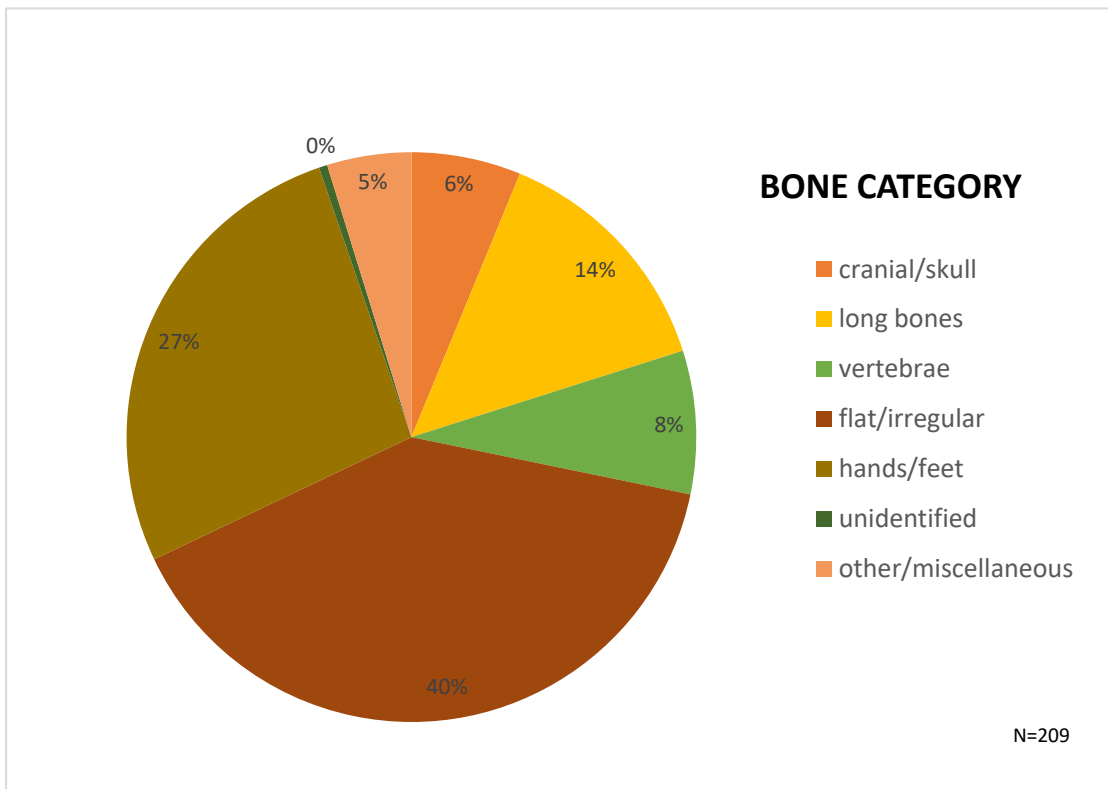


Figure 288. Element frequencies in Ogof Pant-y-Wennol based on bone category (excluding loose teeth).

<b>ELEMENT</b>	<b>COUNT</b>
ATLAS (C-1)	1
AXIS (C-2)	1
CALCANEUS	2
CAPITATE	1
CERVICAL VERTEBRA	2
CLAVICLE	4
CRANIAL FRAGMENTS	3
CRANIUM	1
CUBOID (CUB)	1
DISTAL HAND PHALANX (1)	1
FEMUR	3
FIBULA	4
FIRST RIB	5
HUMERUS	3
INTERMEDIATE FOOT PHALANX	1
INTERMEDIATE HAND PHALANX	2
LOOSE TEETH	23
LUMBAR VERTEBRA	3
MANDIBLE FRAGMENT	1
MAXILLA	1
MEDIAL CUNEIFORM (CU1)	1
METACARPAL	3
METACARPAL (MC 1)	1
METACARPAL (MC 2)	3
METACARPAL (MC 3)	1
METACARPAL (MC 4)	3
METACARPAL (MC 5)	2
METATARSAL	1
METATARSAL (MT 1)	1
METATARSAL (MT 2)	1
METATARSAL (MT 3)	3
METATARSAL (MT 4)	1
METATARSAL (MT 5)	1
MISCELLANEOUS/? MANDIBLE PERINATE FRAGMENT	1
MISCELLANEOUS/? NAVICULAR (NAV)	1
MISCELLANEOUS /ELEMENTS EMBEDDED IN STALAGMITE	1

MISCELLANEOUS FRAGMENTS	5
MISCELLANEOUS/? METATARSAL	1
MISCELLANEOUS/UNIDENTIFIED FRAGMENTS	1
MISCELLANEOUS/VERTEBRAE FRAGMENTS	1
OCCIPITAL	1
PARIETAL FRAGMENT	1
PELVIS	7
PELVIS FRAGMENT	1
PROXIMAL FOOT PHALANX	2
PROXIMAL FOOT PHALANX (5)	2
PROXIMAL HAND PHALANX	9
PROXIMAL HAND PHALANX (1)	3
PROXIMAL HAND PHALANX (2)	4
PROXIMAL HAND PHALANX (3)	1
PROXIMAL HAND PHALANX (5)	1
RADIUS	4
RIB	31
RIB FRAGMENTS	26
SACRUM	1
SCAPULA	6
SCAPULA FRAGMENT	2
TALUS	3
TEMPORAL	3
TEMPORAL FRAGMENT	1
THORACIC VERTEBRA	9
THORACIC VERTEBRA FRAGMENT	1
TIBIA	9
ULNA	6
UNFUSED ? METATARSAL/METACARPAL	1
ZYGOMATIC BONE	1
(N) TOTAL	232

Table 166. Element representation in Ogof Pant-y-Wennol. Miscellaneous included fragmented remains (?=possible identification) other fragments [non-recordable (separate entries) but identifiable], vertebrae remains (all vertebrae fragments) and elements embedded in stalagmite/concretion (one thoracic vertebra; ribs and phalanges). N=including loose teeth.

## Element completeness

Element completeness amongst surviving elements from Ogof Pant-y-Wennol demonstrated higher representation of fragmented/not complete remains (N=176, 84.2%) than complete elements (N=33, 15.8%). Elements showing full zone completeness included approximately half the number of hands/feet (N=27), five long bones (including two perinatal) and a single perinate ilium. High frequencies of hands/feet suggest primary burials with some elements possibly avoiding fragmentation.

Surface preservation scores amongst complete elements demonstrated similar distributions amongst poor and higher preservation (1-5) whereas fragmented/not complete remains indicated much higher distributions amongst low surface preservation scores (0-3) (Figure 290).

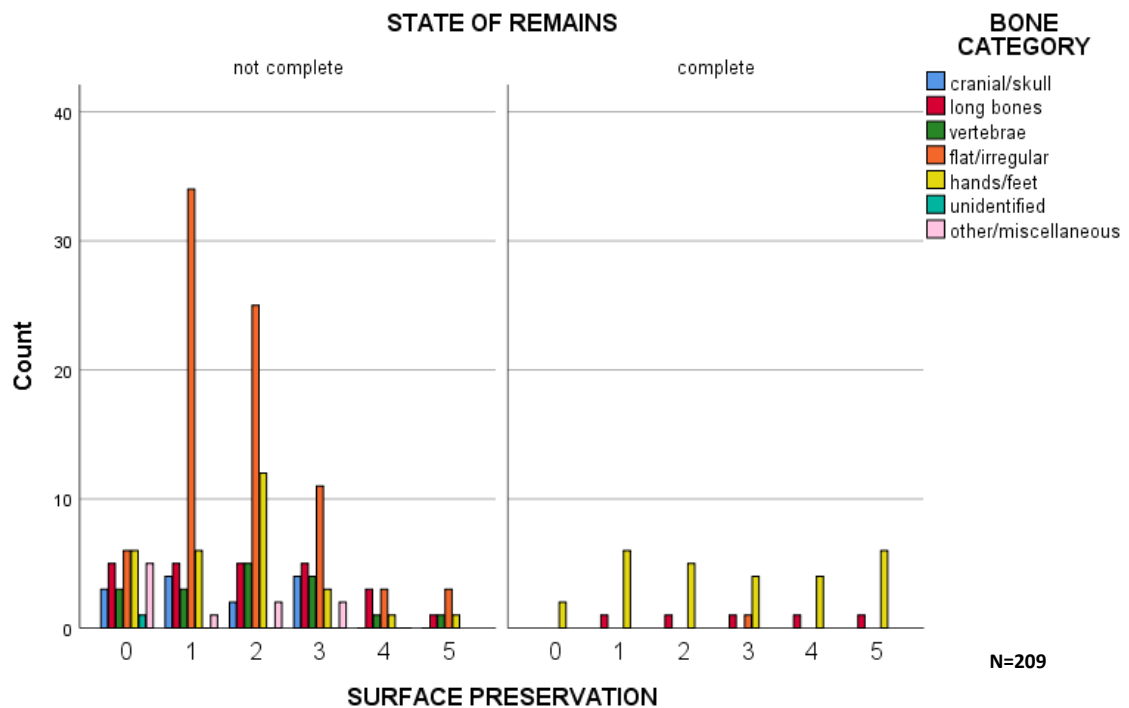


Figure 290. State of remains in Ogof Pant-y-Wennol based on bone category and surface preservation scores (0-5/poor-good). N=excluding loose teeth.

## **MNI, demography and pathology<sup>368</sup>**

Two adults, one younger adult/late adolescent, one juvenile and one perinate were present amongst the assemblage. Adults were identified from the fusion of the proximal and/or distal epiphysis, duplicate zone representation and scapula, clavicle and ossa coxae fusion. Deciduous teeth still attached on a juvenile mandible included deciduous 1<sup>st</sup> and 2<sup>nd</sup> molars and a 1<sup>st</sup> permanent molar determining an age of c.eight years.

Age estimations based on the auricular surface of two surviving ossa coxae fragments determined two age groups of c.55+ years and c.35-38 years. Dental attrition based on surviving molars from a single maxilla fragment and loose teeth determined two age groups of c.17-25 years and 35-45+ years.

Sex estimations based on the nuchal crest of a Neolithic cranium (unstratified), a greater sciatic notch and a preauricular sulcus (square 6), a nuchal crest of a Neolithic occipital (square 14) and a mastoid process of a temporal (square 3) determined two probable females, one probable male and a female<sup>369</sup>.

## **Pathology**

Degenerative or dental pathologies were not identified on any elements<sup>370</sup>.

### **7.9.1. Taphonomy – Macroscopic results**

#### *7.9.1.1. Weathering*

Weathering was noted on 29 elements (13.9%) with the majority of affected bones demonstrating stage one weathering (N=24, 11.5%), followed by stage three (N=3, 1.4%), two and four (N=1, 0.5% for each) (Figures 291 and 292). Stage one weathering was present on flat/irregular bones (N=12), hands/feet (N=7), long bones (N=4) and a single vertebra. More advanced stages of weathering (2-4) were apparent on long bones (stage 2/N=1; stage 3/N=2; stage 4/N=1) and a single rib fragment (stage 3).

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<sup>368</sup> See Chapter 5 for MNI and age/sex estimations.

<sup>369</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/MNI, demography and pathology for more details.

<sup>370</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/MNI, demography and pathology for more details.

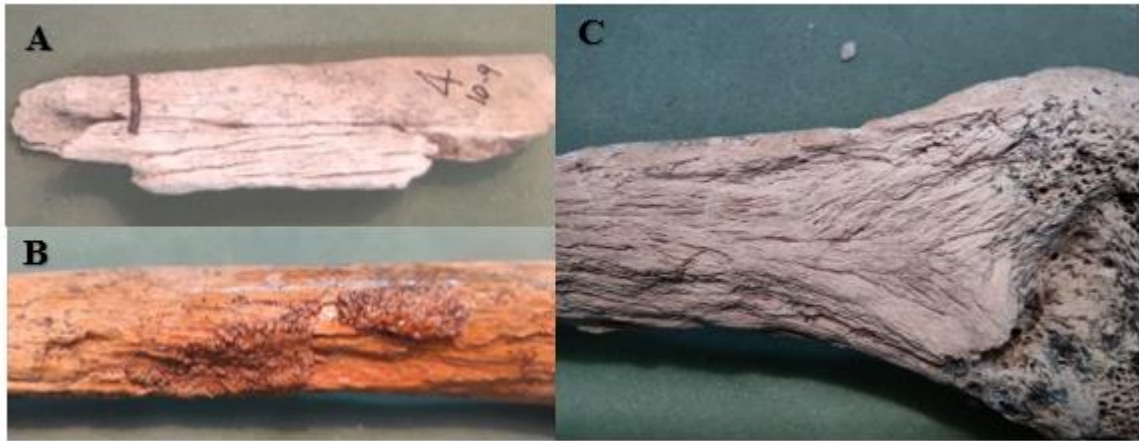


Figure 291. Weathering – A: stage 3 on tibia shaft/fragment, B: stage 3 on femur and C: stage 4 on humerus. Source: author

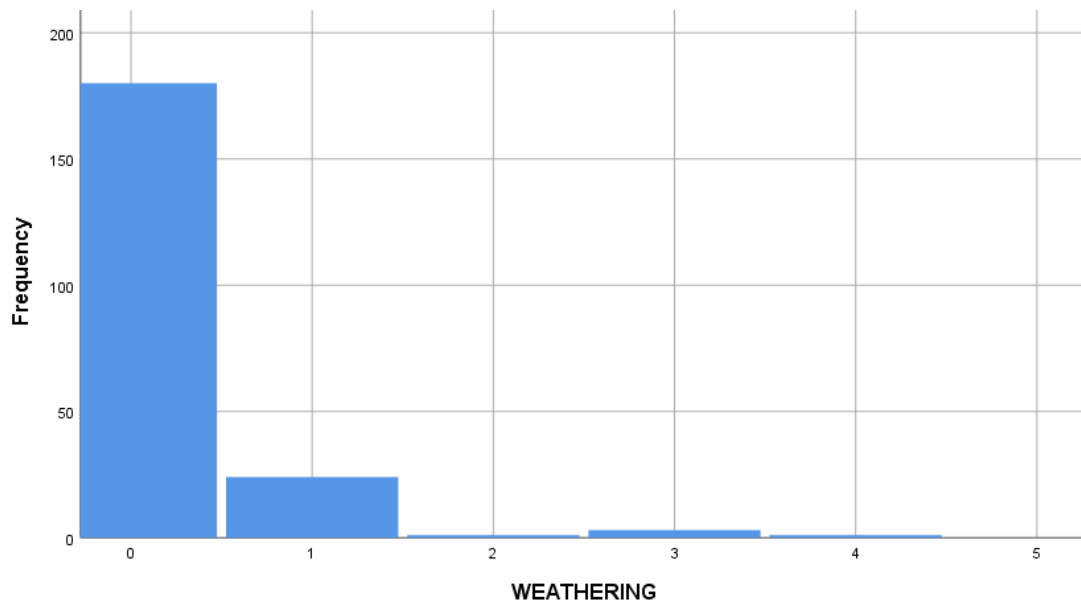


Figure 292. Weathering frequencies (0/no weathering and stages 1-2) from Ogof Pant-y-Wennol. N=209.

Five long bones (SNOs: 1192-93, 1196-97, 1342) exhibited fractures (four dry and one fresh) and showed different weathering stages (1-4). Weathering (stages 1-3) on long bones exhibiting dry fractures suggests early sub-aerial exposure followed by later disturbances. A single humerus (SNO: 1196) with advanced stage of weathering (stage 4), exhibited a fresh fracture and suggests peri-mortem manipulation followed by prolonged sub-aerial exposure prior to deposition in the cave<sup>371</sup>.

<sup>371</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Weathering for more details.

Other taphonomic modifications affecting weathered elements included erosion (stages 1-2), staining (vast majority of weathered elements) and abrasion (stages 1-2) (Table 168/Appendix 6)<sup>372</sup>. Erosion and staining were recorded on the majority of human remains discovered from this site and therefore their appearance on weathered elements does not indicate patterns. Abrasion on the other hand was less recurrent on human remains and was apparent on low weathering stage (1) and one humerus (stage 2) exhibiting a dry fracture.

#### 7.9.1.2. *Gnawing*

Presence of gnawing marks was identified on two elements (1%) including a single perinate ulna (SNO: 1371/unstratified) and a proximal hand phalanx (SNO: 1337/square 6). No taphonomic modification was observed on the perinate ulna however signs of weathering stage one, erosion, abrasion, staining and concretion residues were recorded on the hand bone<sup>373</sup>. Absence of gnawing amongst human remains, despite the large quantity of animal bones discovered, and a large variety of implements suggests continuous use of the cave, possibly for habitation.

#### 7.9.1.3. *Erosion*

Erosion was present on the majority of human remains (N=126, 60.3%) including a large number of flat/irregular bones (N=62), bones of the hands/feet (N=40), long bones (N=12), cranial/skull remains (N=6), miscellaneous (fragmented) remains (N=5) and one vertebra (Figures 293 below and 294/Appendix 6)<sup>374</sup>.

Erosion was associated with staining however abrasion was less recurrent on eroded elements. Advanced stages of weathering were not associated with erosion (Table 169/Appendix 6)<sup>375</sup>. This pattern suggests that prolonged weathering was followed by deposition in separate areas of the cave (absence of both erosion and abrasion), possibly

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<sup>372</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Weathering for more details.

<sup>373</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Gnawing for more details.

<sup>374</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Erosion for more details and Figure 294 for surface preservation patterns amongst eroded and non-eroded remains.

<sup>375</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Erosion.

indicating selection of body parts (long bones) and deposition in separate areas of the cave.

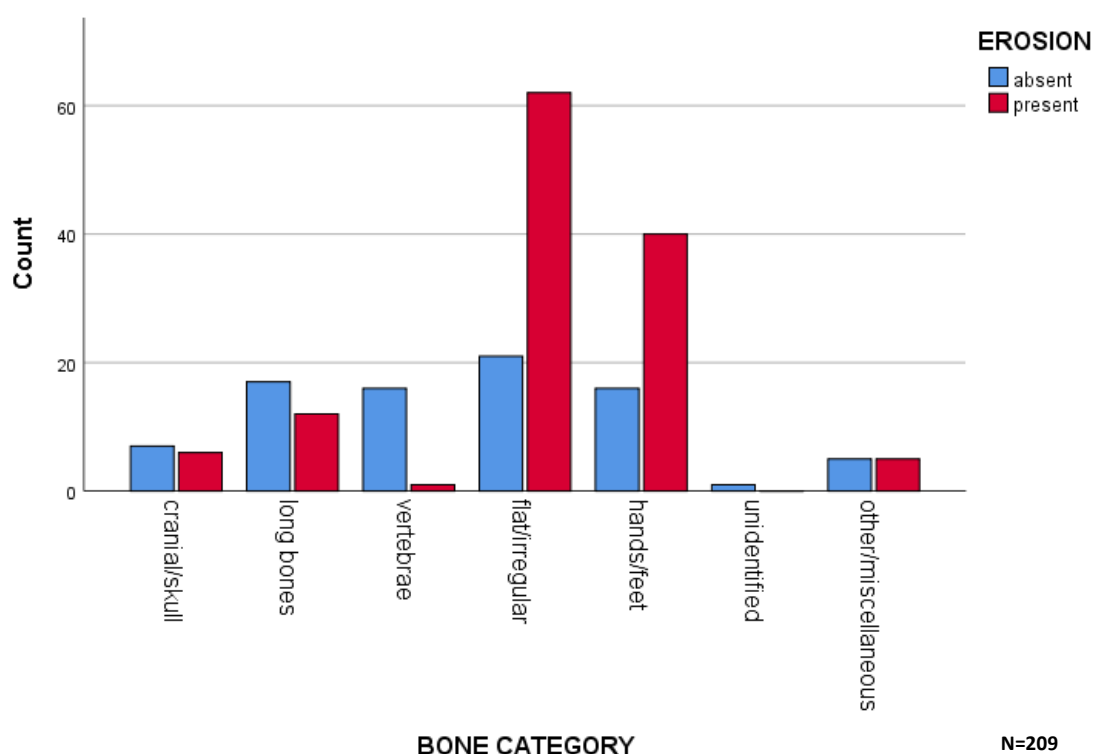


Figure 293. Frequency of erosion absence/presence based on bone category across sites in Ogof Pant-y-Wennol.

#### 7.9.1.4. Abrasion

Abrasion was recorded on 89 elements (42.5%) including hands/feet (N=36), flat/irregular bones (N=35), cranial/skull remains, several long bones (N=8), a single vertebra and three fragmented miscellaneous remains (Figure 295).

Differences in surface preservation scores amongst abraded and non-abraded remains were not significant (Figure 296/Appendix 6)<sup>376</sup>. Abrasion was associated with stage one weathering (and a single element with stage two), staining and erosion (Table 170/Appendix 6)<sup>377</sup>. Lower stages of weathering could suggest water transport of

<sup>376</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Abrasion for more details.

<sup>377</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Abrasion for more details.



smaller elements near the cave entrance whereas lack of abrasion and advanced weathering, suggest sub-aerial exposure prior to weathering and deposition in separate areas of the cave.

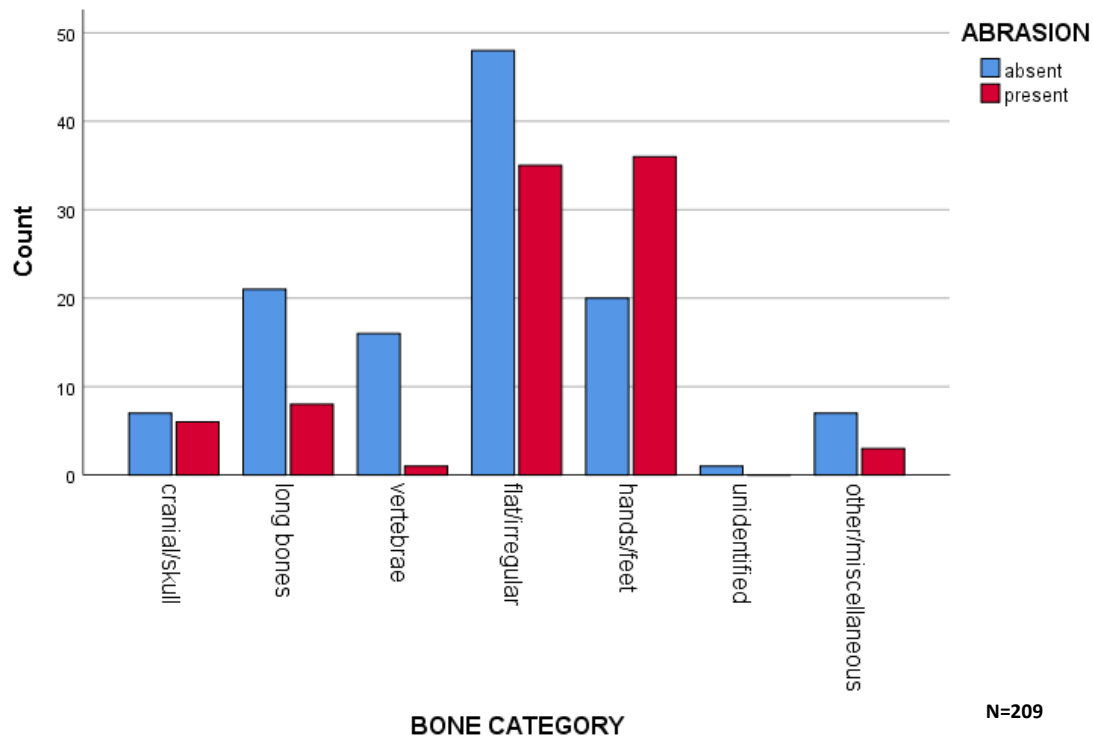


Figure 295. Presence/absence of abrasion based on bone category in Ogof Pant-y-Wennol.

#### 7.9.1.5. Staining

Staining was recorded on the vast majority of human remains (N=172, 82.3%) including flat/irregular bones (N=78), hands/feet (N=43), long bones (N=23), cranial/skull remains (N=10), vertebrae (N=11), a single unidentified fragment and six miscellaneous remains (Figure 297). Staining was associated with all other taphonomic agents, including erosion, abrasion and weathering (all stages) (Table 171/Appendix 6)<sup>378</sup> and included black, brown, red (to light orange) marks and cave concretion<sup>379</sup>.

<sup>378</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Staining for more details.

<sup>379</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Staining for more details on staining..

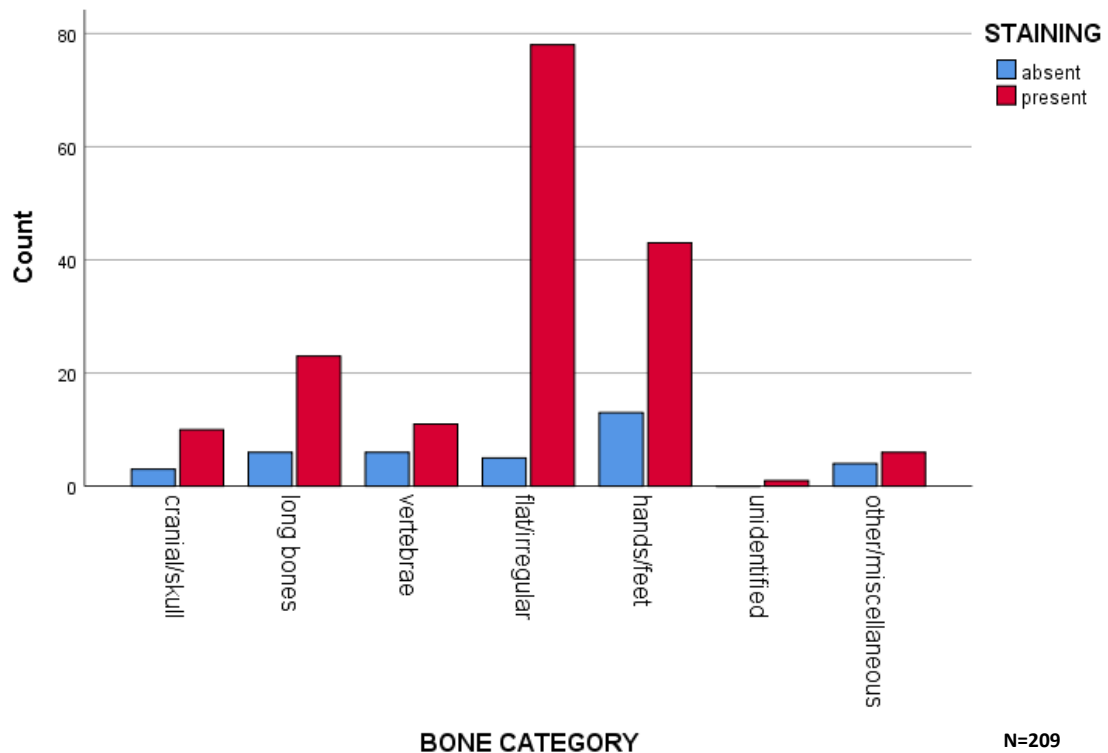


Figure 297. Staining presence/absence based on bone category in Ogof Pant-y-Wennol.

#### 7.9.1.6. Trauma (sharp/blunt force)

No signs of trauma were identified amongst the assemblage in Ogof Pant-y-Wennol.

#### 7.9.1.7. Burning

Burning was not present in Ogof Pant-y-Wennol.

#### 7.9.1.8. Fractures (fresh vs dry)

Fractures were recorded on nine elements including tibiae (N=3), femora (N=2), radii (N=2) and humeri (N=2). Fractures were present on either proximal or distal ends whilst three long bones exhibited dry fractures on both proximal and distal ends and were therefore treated as separate entries bringing the total number to 12. All but a single break (8.3%) were dry (N=11, 91.7%) (Figure 298/Appendix 6)<sup>380</sup>. FFI score four (N=5, 41%) was the most recurrent, followed by scores six (N=4, 33%), five (N=2, 16%) and a single fresh break with a score of two (8.3%).

<sup>380</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Fractures (fresh vs dry).

Surface preservation scores amongst all fractured long bones were low suggesting similar impact from other taphonomic agents. A single radius (SNO: 1202) showed better surface preservation (score 4) which might relate to either different treatment or deposition in separate area of the cave (Figure 299/Appendix 6)<sup>381</sup>.

Five long bones demonstrated signs of advanced weathering with a single humerus (SNO: 1196) exhibiting a fresh fracture and the most advanced weathering (stage 4) across sites in Wales (Table 172/Appendix 6)<sup>382</sup>. Weathering on long bones exhibiting dry breaks (on either proximal/distal ends or shafts with breaks on both ends), showed different weathering stages (1-3), suggesting that sub-aerial exposure was followed by disturbances and moving of interments (resulting in dry fractures).

#### *7.9.1.9. Surface preservation*

Surface preservation amongst human remains demonstrated a prevalence of low (score 0/ N=31, score 1/14.8%; N=60, 28.7%; score 2/N=57, 27.3%) to medium scores (score 3/N=35, 16.7%). A small number of elements were better preserved (scores 4 and 5/N=12, 6.2% for each) (Figure 300/Appendix 6)<sup>383</sup>. Scores amongst flat/irregular bones and hands/feet were primarily lower (scores 1-2) whilst remaining bone categories were approximately equally distributed (scores 0-3).

Human remains were found disturbed in separate areas of the cave therefore disturbances (also supported by the presence of dry fractures on eight long bones) and separate use of areas in the cave for depositions (Figure 301) must have been responsible for the variation in surface preservation scores. The absence of gnawing, however, suggests that scavenger activity was either not extensive, or human remains deposited in passages of the cave were out of reach<sup>384</sup>.

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<sup>381</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Fractures (fresh vs dry).

<sup>382</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Taphonomy – Macroscopic results/Fractures (fresh vs dry) for more details.

<sup>383</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/ Taphonomy – Macroscopic results/Surface preservation.

<sup>384</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/ Taphonomy – Macroscopic results/Surface preservation for more details.

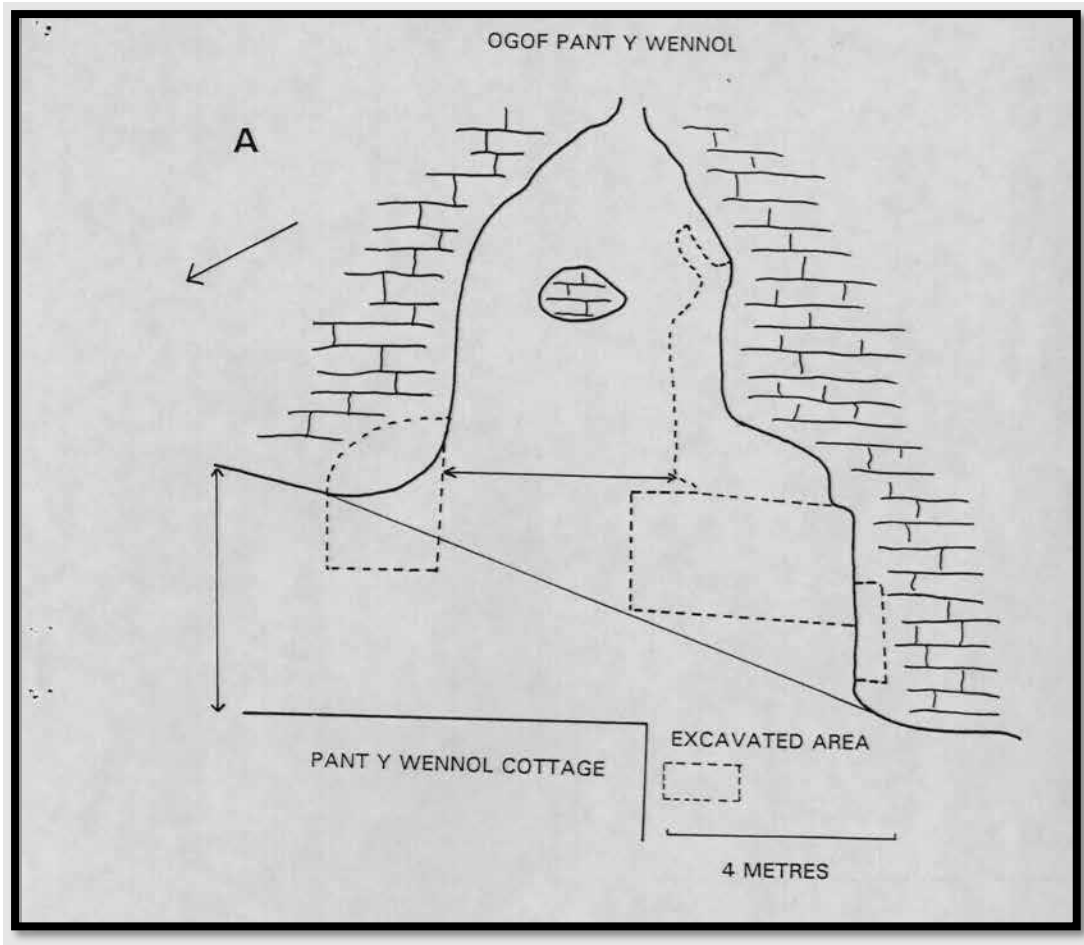


Figure 301. Plan of the cave – from Stone’s excavation (second phase) indicating the excavated areas in discontinued squares (Stones 1994: 5).

*7.9.1.10. Trampling*

Trampling was present on two elements including one cranial fragment (SNO: 1276) and one rib fragment (SNO: 1374). Disturbances must have caused further fragmentation whilst dragging of remains/re-arrangement on the cave floor filled with

hard/solidified stalagmite residues (Figure 302) must have been responsible for the trampling marks<sup>385</sup>.



Figure 302. Thoracic vertebra, rib fragments and phalanges embedded in stalagmite. Source: author

## 7.9.2. Microscopic results

### OHI scores and MFD

OHI scores amongst seven samples showed equal distributions of low (score 1/N=3, 42%) and high (score 5/N=3, 42%) histological preservation with a single femur (SNO: 56) showing medium/to poor preservation (score 2/14%) (Figure 303/Appendix 6)<sup>386</sup>. Evidence of bacterial attack (non-Wedl) amongst samples includes budded (all samples), lamellate and linear longitudinal (N=5, 71% for each). Samples included three Early and Middle Neolithic cranial fragments and four long bones with similar histological patterns (scores 1-2 and 5) (Figures 304-305 below and Table 173/Appendix 6)<sup>387</sup>.

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<sup>385</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/ aphony – Macroscopic results/Trampling for more details.

<sup>386</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results/Figure 303.

<sup>387</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results/Table 173.

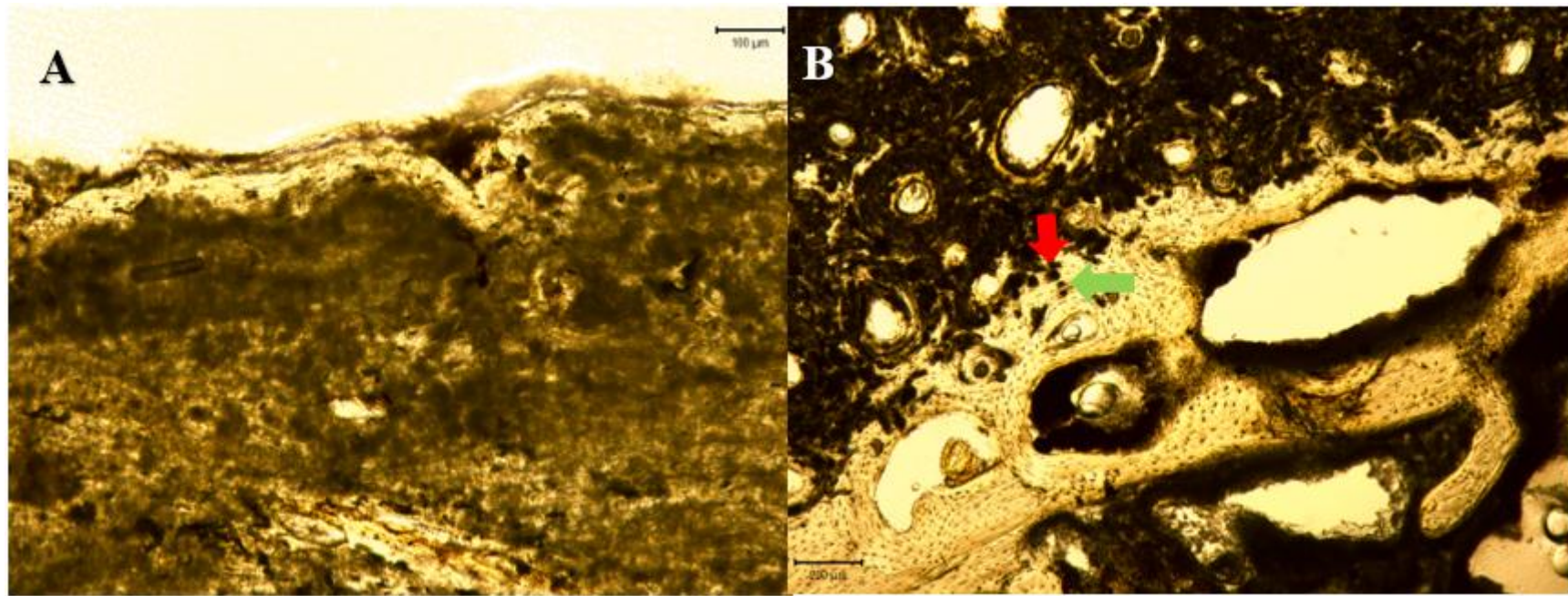


Figure 304. Low histological preservation A: cranial fragment – non-Wedl MFD OHI 1 (magnification x5) and B: femur – non-Wedl MFD (budded/red arrow, linear longitudinal/green arrow) OHI 2. Magnification x5. Source author

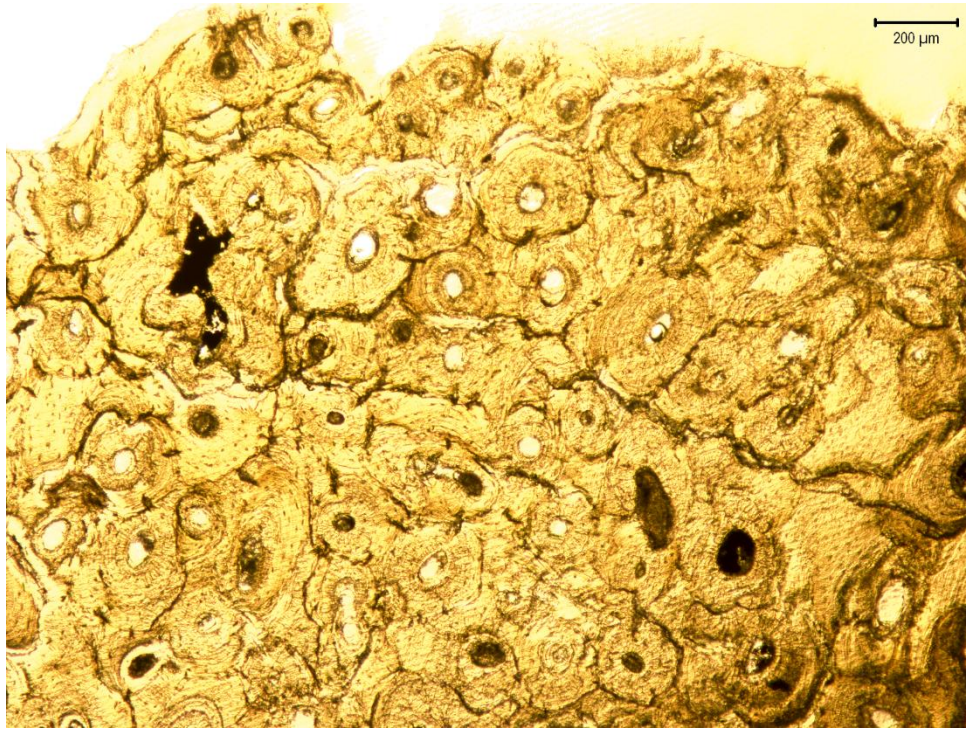


Figure 305. High histological preservation in femur sample – OHI 5. Magnification x5. Source: author

### **Taphonomy**

Surface taphonomy included staining (all samples), erosion and abrasion (N=5, 71% for each). Fractures were apparent on all four long bones including three dry and a single fresh break which had been further impacted by prolonged weathering (stage 4). Surface preservation scores amongst all samples were low to medium (scores 0-3) and overall surface taphonomy amongst samples did not demonstrate any particular associations with OHI scores.

High and lower OHI scores amongst both bone categories (cranial/post-cranial) do not reflect differentiation of cranial versus long bones, but overall different processing between individuals, resulting in this histological profile (e.g. humerus SNO 57 and cranial fragment SNO 60).

### **Birefringence**

Birefringence scores demonstrated variation amongst collagen preservation. Low birefringence (score 1/N=3, 42%) was followed by high collagen preservation (score

3/N=2, 28%) and medium to complete loss of birefringence (score 2/N=1, 14% for each) (Figure 306/Appendix 6)<sup>388</sup>. Overall collagen preservation amongst samples and given OHI scores showed correlations suggesting that collagen loss possibly relates to the rate of MFD (Table 174/Appendix 6)<sup>389</sup>. Humerus SNO 57 (OHI score: 5) demonstrated extensive weathering (stage four) which is likely to have been responsible for the high demineralisation and collagen loss (birefringence score: 2).

### **Other microscopic observations**

Infiltrations, inclusions and microstructural staining were observed in all samples whilst microcracking was present in five samples (71%) (Table 175/Appendix 6)<sup>390</sup>. High MFD (OHI scores: 1-2) was correlated with low (to medium) inclusions, infiltrations and cracking intensities whilst good histological preservation (OHI score: 5) demonstrated high intensity (score 3) cracking and infiltrations (Table 183/Appendix 6)<sup>391</sup>.

Presence of surface erosion on cranial fragment 60 (SNO) and radius 59 (SNO) with high OHI scores, as well as advanced weathering on humerus 57 (SNO) causing demineralisation can justify high microcracking intensities accompanied by extraneous material (high intensities) that infiltrated the microstructure (Tables 176-177/Appendix 6)<sup>392</sup>. Inclusion and infiltration discolourations and microstructural staining was further noted (Tables 178-179/Appendix 6)<sup>393</sup>.

### **7.9.3. Short summary of burial depositions in Ogof Pant-y-Wennol.**

High frequencies of flat/irregular bones and hands/feet (largely fragmented) suggest use of the cave for primary burials that were disturbed. Erosion and staining were recorded on the majority of human remains and weathering amongst remains was not advanced (stage one). Five long bones, however, exhibited fractures (four dry and one

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<sup>388</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results.

<sup>389</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results.

<sup>390</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results.

<sup>391</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results.

<sup>392</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results.

<sup>393</sup> See Appendix 6/7.9. Ogof Pant-y-Wennol/Microscopic results for more details including specifications on orange/brown microstructural staining observed on a number of samples across sites (Table 179).



fresh) and showed separate weathering stages (1-4). Weathering (stages 1-3) on long bones with dry fractures suggests early sub-aerial exposure followed by later disturbances. A single freshly fractured humerus demonstrated advanced weathering stage (4) and very good histological preservation (OHI score: 5) and suggests early manipulation, followed by sub-aerial exposure, collection and deposition in the cave. The taphonomic profiles between individuals indicate separate trajectories.

Presence of abrasion on certain elements could suggest that polishing resulted from water flowing through the cave or flooding (coastal cave) that was confined in certain areas of the cave where a number of humans were deposited. Absence of abrasion on elements exhibiting more advanced stages of weathering (3-4), however, could suggest that these elements were deposited in passages after prolonged sub-aerial exposure (resulting in weathering stages 3 and 4), collection and deposition in the cave passages. Wide fluctuations amongst levels of bacterial bioerosion further reflect different treatment with remains undergoing different stages of processing. Multi-stage depositions, therefore, involved primary burials, various stages of peri- and post-mortem processing, excarnation of selected elements and possible re-arrangement of human remains in the cave. Variation in burial practices follows a similar pattern to other caves in north Wales (Ogof Colomendy, Gop Cave) with larger, disturbed assemblages being processed and accumulated over a period time.

## **7.10. Backwell Cave**

### **7.10.1. Microscopic results**

Targeted histological analysis of a securely dated site with Neolithic activity from north Somerset (Backwell Cave) is used as comparative case-study. Results can lay the groundwork for future research by identifying patterns across regions (widespread funerary processes or variations between Wales and north Somerset).

#### **OHI scores and MFD**

Histological destruction of five right humeri resulted from non-Wedl attack. Elements showed medium (OHI score: 3) to poor (OHI score: 1) histological preservation (N=2, 40% for each score), with a single Early Neolithic long bone (SNO: 65) demonstrating

minor MFD (OHI score: 4) (Figure 307/Appendix 6<sup>394</sup> and Figures 308-310 below). Non-Wedl attack included budded (all samples), lamellate and linear longitudinal (N=4, 80%). Humerus SNO 65 exhibited signs of budded and lamellate MFD without affecting the overall microstructure. Wedl, resembling type 2 tunnelling, was identified in one sample (humerus SNO: 64) with medium OHI score (3) inclusions, infiltrations and brown discoloration and microcracking. No patterns were observed between Wedl and non-Wedl MFD.

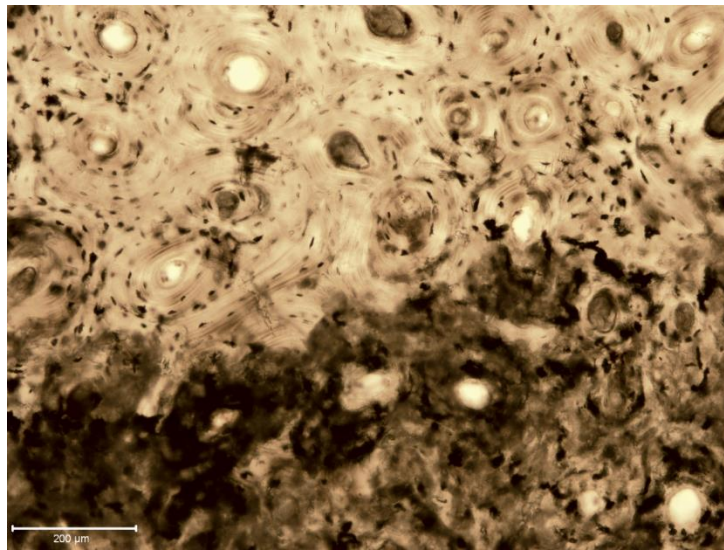


Figure 308. Non-Wedl MFD in humerus. Disturbed burial (OHI 3) as bacterial attack did was not present in the whole sample. Magnification x10. Source: author

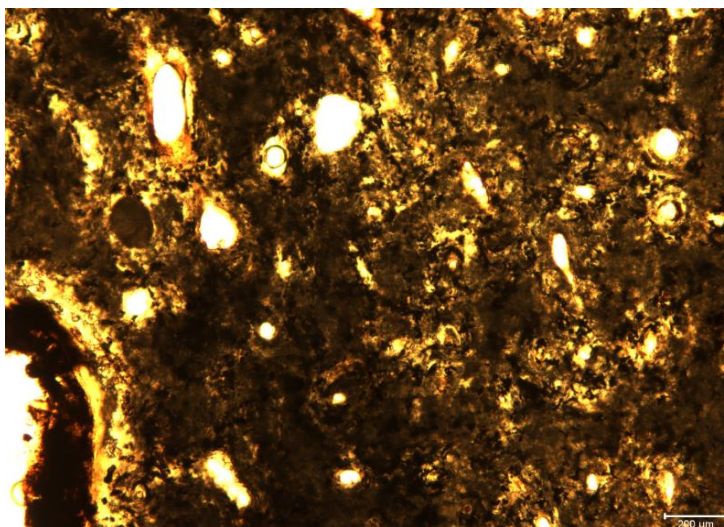


Figure 309. Non-Wedl MFD in humerus (OHI 1) with small preserved area near the periosteal surface. Magnification x5. Source: author

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<sup>394</sup> See Appendix 6/7.10. Backwell Cave for more details.

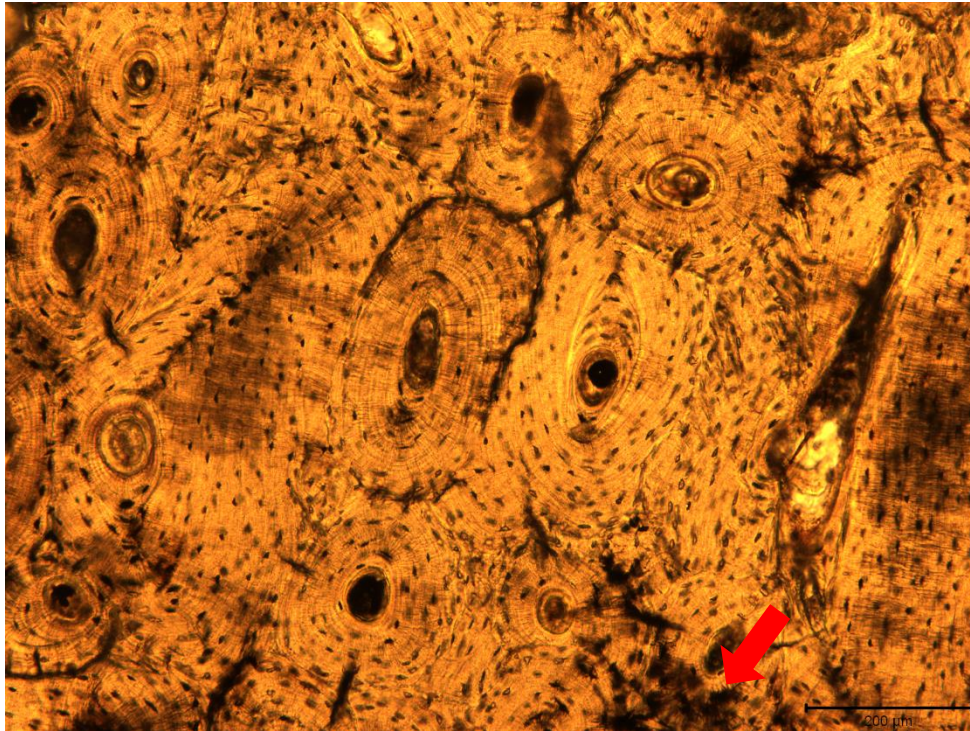


Figure 310. High histological preservation in humerus (OHI 4) with non-Wedl MFD observed in small areas (e.g. arrow). Magnification x10. Source: author

### **Taphonomy**

Associations between surface taphonomy and OHI scores could not be made as primary analysis was not undertaken by the author (only photos were provided). Separate OHI scores reflects different treatment between individuals.

### **Birefringence**

Birefringence scores were high (score 3/N=3, 60%) and low (score 1/N=2, 40%) (Figure 311/Appendix 6)<sup>395</sup>. Birefringence levels were primarily high (score 3/N=3) amongst medium (OHI score: 3) to high histological preservation (OHI score: 5). Based on given OHI scores collagen was retained in the microstructure of samples scoring 3-4 but was almost completely obliterated in lower OHI scores (1) (Table 180/Appendix 6). High birefringence levels in humeri with medium bacterial attack (OHI score: 3), suggests that demineralisation of the bones causing splitting and cracking of the bone

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<sup>395</sup> See Appendix 6/7.10. Backwell Cave for more details.

and exposure to wetting/drying cycles might not have been responsible for collagen loss<sup>396</sup>.

### **Other microscopic observations**

Infiltrations, inclusions and microstructural staining were present in all samples (Table 181/Appendix 6)<sup>397</sup>. Microcracking was present on three humeri (50%) and was observed in medium to high intensities amongst humeri with medium OHI scores (3) and high intensity in the Early Neolithic humeri (SNO: 65/OHI score: 4) (Table 182/Appendix 6)<sup>398</sup>. Samples demonstrated similar histological profiles showing infiltrations by extraneous material (brown to black/brown and red inclusions and infiltrations) and exhibiting microstructural staining (brown fair/dark).

Low OHI scores (1) were accompanied by low (inclusions) to medium (infiltrations) intensities of extraneous material. Microstructural staining intensities showed similar trajectories amongst samples and no patterns were identified (Table 183/Appendix 6)<sup>399</sup>.

Macroscopic examination of the elements was not conducted by the author, therefore no patterns can be explored in relation to this (e.g. erosion or weathering responsible for demineralisation and microcracking).

### **7.10.2. Short summary of burial depositions in Backwell Cave**

Based on the original site report, the high number of individuals discovered and the separate levels of bacterial bioerosion, the site must have functioned as a chambered vault for individuals undergoing different stages of decomposition or further handling (e.g. later disturbances causing a mixture of fracture morphology). Early to Middle Neolithic activity combined with the high number of individuals discovered in the site suggests separate depositional episodes similar to how chambered tombs were used in

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<sup>396</sup> See Appendix 6/7.10. Backwell Cave for more details.

<sup>397</sup> See Appendix 6/7.10. Backwell Cave for more details.

<sup>398</sup> See Appendix 6/7.10. Backwell Cave for more details.

<sup>399</sup> See Appendix 6/7.10. Backwell Cave for more details.

the Neolithic. Different treatment between the individuals can explain distinct OHI scores due to different stages of decomposition.

The stages of processing (based on available OHI scores) from Backwell Cave, indicate similar practices from caves in north Wales where human remains were subjected to various stages of peri- and post-mortem manipulation. Practices include primary burials, separate stages of processing and possible clearances and re-arrangement of skeletal remains. Patterns of multi-stage burials therefore appear to have been adopted or concurrently used across regions from the start of the Neolithic. This association suggests that whilst variations in the stages of processing amongst sites exist, these form part of broader depositional methods that are used concurrently to monumental burials.

### **7.11. Summary – Case studies**

Chapters 6 and 7 presented the results of sites across Wales and north Somerset, subdivided in regional results and case studies.

Separate depositional patterns across sites (see 6.2) persisted in a smaller scale in regional analyses (6.3) and case studies. Multi-stage burials were identified within regional groups including practices of inhumation (primary burials), exhumation, excarnation and secondary burials (Table 184)<sup>400</sup>. These practices were identified in broad regional groups (south-central, south-east, south-west, north Wales and south-west England), however, each case study was part of a multi-stage burial that entailed various processes such as selection, circulation and processing and resulted in sequential depositions and/or residual bone assemblages (Table 184 for definitions). Adults (both males and females) and immature individuals were always part of these practices and were identified in different numbers across caves in Wales and north Somerset. Fluctuations in the numbers of interred individuals might have related to chronological variation (Early to Late Neolithic) and will be discussed in Chapter 8.

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<sup>400</sup> Categorisations provided in Table 184 were based on the results of the macro- and microscopic analyses. Different practices were observed and their definitions are presented in this table before the discussion. Clarity on the definition of primary burial, multi-stage burial, sequential deposition and residual bone assemblage was given based on Knusel 2014, Robb 2016, and Peterson 2019 (referenced in text).

Primary burial: deposited and undisturbed, can entail more than one individual buried. Characteristics: complete preservation, articulation with the survival of labile articulations (Knusel 2014: 46). In caves, possibly includes cases of disturbed bones (either from later deposits in multi-period sites, scavenger activity or moving of interments) and disintegration of elements resulting in loss of complete element representation. Acidic soils can accelerate decomposition and presence of smaller elements (such as hands/feet) that disarticulate from the body rapidly could be considered as evidence of primary burials. Nonetheless, adding of bodies in confined spaces can result in very low representation of fragile or smaller bones (Robb 2016: 690). Therefore, primary burials with in-situ bone less disturbed inhumations or secondary depositions of already disarticulated remains may reflect similar patterns of element representation (ibid.).

Secondary burial: skeletal remains moved for re-burial. This process could entail selective depositions or selective removal of elements, complete disarticulation of bones, absence/underrepresentation of relevant bones (e.g. smaller elements such as hands/feet). Things to consider: taphonomic modifications recorded on elements (e.g. weathering – sub-aerial exposure, gnawing – disturbances causing marks on bones, further fragmentation, fresh/dry fractures: further supporting peri- or post-mortem manipulation) can clarify whether manipulation/handling of remains took place prior to final deposition (in the cave).

Multi-stage burial: period where remains were handled (could have resulted from secondary of primary burials) where there is insufficient evidence to distinguish amongst secondary burials of successive inhumations (Peterson 2019: 59).

Selection: sequential primary or secondary deposition with intentional collection of elements (e.g. cranium) leading to over-representation of certain elements (Robb 2016: 690).

Sequential deposition/successive inhumation: commingled, collective bone assemblages caused by disturbances and re-arrangement of earlier deposits during later placements. Sequential deposition= accumulation over a period of single depositions in the same space disturbing previous deposits (Robb 2016: 690). Entails in situ bone destruction (masking nature of depositions or creating similar profiles to secondary deposits), possible under-representation of small elements and fragile bones due to disturbances of later interments (ibid.). Bone weathering in caves could be an indicator or whether successive inhumation has been practised (Peterson 2019: 58). Certain modifications, therefore (e.g. gnawing marks on elements that could be easily accessed), can be an indication of secondary burial and not successive inhumation.

Residual bone assemblage: bones left in situ with concurrent removal of other elements (e.g. selective removal), by disturbances, often comprising of scattered remains and even left-overs due to selection (e.g. crania), creating an inconsistent representation of zones and possibly, bone frequencies amongst the surviving assemblage (Robb 2016: 690). Over-representation of small or peripheral elements creating contrasted patterns of secondary depositions and selection (ibid.).

Table 184. Definitions of burial methods examined in this research based on results of osteological, macro- and microscopic analyses.

Multi-stage burials in south-central Wales involved selection or removal of body parts that were either part of primary (George Rock Shelter) or secondary burials (Spurge Hole). Under-representation of body parts evidenced residual bone assemblages that had been manipulated either through processes of selective retrieval from primary context of larger elements for secondary burial (George Rock Shelter) or through exhumation, excarnation and circulation for final deposition (Spurge Hole). Lack of gnawing suggested disturbances and moving of interments resulted from human action rather than natural causes whilst chronological variation (Early to Middle/Late Neolithic) was noted between individuals and sites.

Selective deposition following practices of exhumation was further identified in south-east Wales where over-represented crania and presence of ante- peri- and post-mortem trauma were noted on crania and long bones. Sex-related differences might have played a role in the selection of body parts for deposition (discussed in Chapter 8). Chronological variation (Middle to Late Neolithic) between the individuals evidenced different treatment which could have related to chronological changes in practices of selection for secondary deposition in south Wales.

Multi-stage burials were similarly identified in south-west Wales and were characterised by selective depositions and residual bone assemblages leading in over- or under-representation of body parts in caves (e.g. Little Hoyle Cave). Primary deposits were mixed with high or low frequencies of bone (Priory Farm Cave), elements that had undergone sub-aerial exposure (Ogof Garreg Hir) and/or peri- and post-mortem processing and wide variation in chronology. Earlier (Mesolithic) and later (Bronze Age and Iron Age) use of caves in south-west Wales did not relate to chronological changes in practices. Early to Middle Neolithic assemblages were identified in three case studies with methods of deposition overlapping.

Burials in north Wales and north Somerset on the other hand, comprised larger assemblages with early to later Neolithic use and separate stages of manipulation. Sequential depositions were mixed with large assemblages of fractured long bones (Ogof Colomendy) that had been largely disturbed (gnawing) however showed different stages of processing based on both macro- and microscopic observations which related to human agency. A combination of human and animal disturbances was responsible for the levels of fragmentation. Excarnated elements were further identified amongst primary burials (Gop Cave, Ogof Pant-y-Wennol, Backwell Cave), creating complex taphonomic trajectories. Collection for secondary burial and depositions in separate areas of the caves suggested separation based on the level of processing, however, age/sex related differences might have played a role in selection (discussed in Chapter 8).

Intra- and inter-regional variations were apparent and whilst wider burial patterns were identified (Table 185), assemblages in south and north Wales and Somerset were part of two different multi-stage depositional groups (Table 193). The patterning for regions



presented in Table 185 was based on division of regions as presented in Chapter 6. Case studies within these regions were further included. Methods of deposition were based on the results of the taphonomic analysis. Information (justification) can be found within the table. Methods of deposition were further categorised based on two regional groups (south and North Wales) in Table 86 as common burial patterns were preserved within south Wales and north Wales and north Somerset. These were characterised by practices of inhumation, excarnation and exhumation involving body curation, selection or removal resulting in residual bone assemblages across south Wales (A in table 186). Practices of inhumation and excarnation in north Wales and north Somerset (B in Table 186) were further characterised by sequential deposition, residual bone assemblages with different stages of processing and arrangement of body parts. Adoption and re-introduction of methods was identified and was supported by both continuation of practices in the Neolithic and variation in practices across regions. These practices will be discussed based on these key finds presented in Tables 185-6.

The volume of results which have been outlined in Chapters 6 and 7<sup>401</sup> are presented in Tables 185 and 186 to summarize key aspects that will support the discussion (Chapter 8). Methods of deposition (Table 185) are divided based on region and site, justification (frequencies of skeletal remains and taphonomy) and period of use which are then categorised in two broader groups (Table 186) in (A) south Wales and (B) north Wales and north Somerset.

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<sup>401</sup> Appendix 6 presents supporting data that derived from the complex cross-referencing of taphonomic proxies but were not included in the main text as these did not directly contributed to the discussion.

<b>REGION - SITE</b>	<b>DEPOSITION METHOD(S)</b>	<b>JUSTIFICATION</b>	<b>BURIAL ACTIVITY (PERIOD)</b>
South-central	Residual bone assemblages and secondary depositions following selection/removal of body parts	Results mainly dictated by two case studies (below) due to higher element frequencies. Justification below	Early, Middle and Late Neolithic
Case study: Spurge Hole	Exhumation, excarnation collection of different (selective retrieval) body parts for final deposition.	<ul style="list-style-type: none"> <li>• Element representation</li> <li>• Age/sex related differences</li> <li>• Radiocarbon dates ranging from the Early to Middle/Late Neolithic – individuals from separate contexts</li> <li>• Weathered long bones exhibiting dry fractures: high versus low OHI scores, remaining samples – different treatment</li> </ul>	Early to Middle/Late Neolithic
Case study: George Rock Shelter	Primary burial, residual bone assemblage, presence of cremation and selective removal of body parts with later re-use of the cave.	<ul style="list-style-type: none"> <li>• Element frequencies (large under-representation of larger bones)</li> <li>• Gnawing absence – anthropogenic disturbances</li> <li>• Large fragmentation</li> <li>• Low OHI scores</li> </ul>	Early Neolithic and post-Medieval
South-east Case study: Ifton Quarry	Selective deposition/residual bone assemblage /possible selection after exhumation followed by circulation and processing before secondary deposition	<ul style="list-style-type: none"> <li>• Element frequencies (larger representation of crania)</li> <li>• Trauma (ante-, peri- and post-mortem manipulation)</li> <li>• Low OHI scores (exhumed)</li> <li>• Lack of weathering or gnawing negates the possibility of sub-aerial exposure or easy access to the site by scavengers.</li> </ul>	Middle to Late Neolithic

		<ul style="list-style-type: none"> <li>• Different surface preservation scores – possible separate environments</li> <li>• Variation in chronology – Middle and Late Neolithic elements</li> </ul>	
South-west	Excarnation, selection of body parts accompanying earlier burials (multi-period caves with earlier and later deposits). Selection of separate burial areas (could reflect separate stages of decomposition) and residual bone assemblages	Presence of weathering on fresh fractures and different surface preservation supports different modes of deposition taking place prior to burial. High frequencies of hands/feet suggest primary burials.	Mesolithic, Early Neolithic to Late Neolithic/Beaker, Late Bronze age and Middle/Late Iron Age
Case study: Little Hoyle Cave	Selective deposition/ residual bone assemblage with exhumed body parts and scattering of smaller elements in the multiple caves' entrances	<ul style="list-style-type: none"> <li>• Element frequencies (over-representation of mandibles, absence of larger elements, very low number of smaller bones) – selective depositions</li> <li>• Weathering fluctuations (stages 1-3)</li> <li>• Fluctuation in OHI scores 0 different treatment</li> <li>• Depositions in separate areas of the cave (infilled shaft/cave roof – possible protected sub-aerial exposure) and scattering of smaller elements in entrances</li> </ul>	Early (to Middle) Neolithic
Case study: Priory Farm Cave	Residual bone assemblage (probable removal or selection of elements for burial) accompanied by later disturbances/moving of interments in separate areas of the cave and/or possible removal of elements.	<ul style="list-style-type: none"> <li>• Element frequencies and zone completeness of hands/feet – selective deposition of removal of body parts</li> <li>• Good surface preservation – possible primary burials but could be of later date</li> <li>• Low OHI score of Neolithic mandible – result of primary burial</li> </ul>	Middle Neolithic, Late Bronze Age and Middle/Late Iron Age

	Later re-visit (occupation and burials) of site causing disturbances and blockage of inner cave with constructed wall. Further radiocarbon dating needed to verify exact patterns of Neolithic activity	<ul style="list-style-type: none"> <li>• Peri-mortem processing - early manipulation, however, these might solely derive from later deposits (Late BA, Middle/Late IA)</li> <li>• Weathering (different stages) – different processing</li> <li>• Gnawing – almost entirely absent suggesting human disturbances</li> <li>• Combination of staining and cave concretion could support disturbances and moving of interments from inner (stalagmite layer) to cave entrance</li> </ul>	
Case Study: Ogof Garreg Hir	Short sub-aerial exposure prior final deposition (with caution due to absence of supporting elements)	<ul style="list-style-type: none"> <li>• High OHI score (one sampled radius out of three surviving elements)</li> <li>• Weathering on sampled radius - prior (short) sub-aerial exposure</li> </ul>	Early Neolithic
North Wales	Multiple stages of processing - peri- and post-mortem amongst primary burials, possible collection of body parts (due to multi-period sites with earlier and later deposits) involving sub-aerial exposure	Sub-aerial exposure apparent by large presence of weathering (highest presence across Wales). High number of (complete) hands/feet and flat/irregular bones (inhumations), fractured elements (peri and post-mortem). High frequencies of gnawing (highest presence across Wales) primarily in Ogof Colomendy supports high disturbances amongst re-use of site (multi-period).	Mesolithic, Early to Late Neolithic, Early/Middle Bronze Age

<p>Case Study: Ogof Colomendy</p>	<p>Sequential deposition - multiple depositions with separate stages of manipulation (peri- and post-mortem) and phases of decomposition followed by re-use of the cave in later period (multi-period site).</p>	<ul style="list-style-type: none"> <li>• Fractured long bones – different decomposition</li> <li>• Use of the site for repeated depositions with remains undergoing processing</li> <li>• Gnawing - large disturbances by scavengers</li> <li>• Good surface preservation of hands/bones co - possible primary burials with subsequent disturbances/buried deeper in the cave avoiding further fragmentation</li> <li>• Low OHI score (Neolithic femur)</li> </ul>	<p>Middle to Late Neolithic and Early/Middle Bronze Age</p>
<p>Case Study: Gop Cave</p>	<p>Multiple depositions with separate stages of manipulation (peri- and post-mortem) and decomposition. Complex taphonomic trajectory: sequential deposition reflects collection for secondary burial and/or selective manipulation of long bones as part of residual bone assemblage.</p>	<ul style="list-style-type: none"> <li>• Element frequencies – high survival of hands/feet, complete absence of flat/irregular bones</li> <li>• Good surface preservation – hands/feet</li> <li>• Fresh fractures and cutmark on long bone which predates weathering</li> <li>• Weathering (stages 1-3) – different treatment amongst primary burials</li> <li>• Different stages of bacterial bioerosion (0-1, 3-4) amongst long bones and cranial/skull remains</li> </ul>	<p>Middle (to Late) Neolithic</p>

Case study: Ogof Pant-y-Wennol	Multiple depositions with separate stages of manipulation (peri- and post-mortem) and stages of decomposition. Possible primary burials accompanied by selective manipulation of long bones	<ul style="list-style-type: none"> <li>• Element frequencies (high survival of hands/feet, flat/irregular bones)</li> <li>• Fractures and weathering (1-4) - early manipulation (fresh) and early sub-aerial exposure followed by later disturbances (dry fractures)</li> <li>• Separate OHI scores (1 and 5) – different treatment amongst primary burials</li> </ul>	Early and Middle Neolithic
South-west England  Case study: Backwell cave	Multiple depositions with high number of burials (c.18+) possibly successive inhumations/sequential deposition with later disturbances and selection of elements in different stages of decomposition	<ul style="list-style-type: none"> <li>• Different OHI scores (1, 3-4) - variation in treatment and various stages of decomposition</li> <li>• Early to Middle Neolithic activity – variation</li> <li>• Element frequencies - left sides mostly surviving (based on excavation report) suggests clearances in the cave for later interments and disturbances by human action</li> </ul>	Early and Middle Neolithic

Table 185. Summary results on mortuary practice and deposition based on results (Chapters 6-7 and Appendix 6) summarising key finds. Regions divided by sites in Wales (south-central, south-east, south-west, north Wales) and north Somerset.

METHOD OF DEPOSITION	SITE AND PERIOD	STAGES
<p>A. Body curation, selection or removal (residual bone assemblages involving selection or removal)</p> <p>South Wales (all regions)</p>	Spurge Hole - Early to Middle/Late Neolithic	Exhumation of body parts, excarnation or sub-aerial exposure (weathered elements) – collection (selective retrieval – secondary deposition (reconstituted individual).
	George Rock Shelter - Early Neolithic and post-Medieval	Primary burials – selective removal of larger elements – cremation (Neolithic horizon) – re-use of site (multi-period site)
	Ifton Quarry - Middle to Late Neolithic	Exhumation/Selection of crania (peri-mortem manipulation/evidence of sharp and blunt force trauma) - circulation of long bones (dry fractures/post-mortem) – secondary deposition in fissure
	Little Hoyle Cave - Early (to Middle) Neolithic	Exhumation - selection of body parts (largely mandibles and cranial fragments) - deposition in sub-aerial (possible protected) shaft (connecting to the cave via the roof) - possible scattering of small number of hands/feet in separate areas/entrances of the cave.
	Priory Farm Cave - Middle Neolithic, Late Bronze Age and Middle/Late Iron Age	Primary burials (could be of later age/multi-period site) or possible selective deposition of Neolithic mandible (similar to Little Hoyle Cave) and later re-use of site - sub-aerial weathering prior deposition (more advanced stages on long bones) - disturbances/re-arrangement of skeletal remains (involving possible removal of elements and deposition in separate areas of the cave) - later re-use of site (interpreted with caution).
	Ogof Garreg Hir - Early Neolithic	Excarnation (short sub-aerial exposure) – collection – deposition in small cave.
<p>B. Sequential deposition/Residual bone assemblages - entails</p>	Ogof Colomendy - Middle to Late Neolithic and Early/Middle Bronze Age	Possible primary depositions – selection/collection of body parts in separate stages of manipulation (peri- and post-mortem) – disturbances and later re-use of site.

<p>primary and/or processing with different levels of manipulation which results in peculiar element frequencies) – multi-stage commingled and collective bone assemblages caused by disturbances and re-arrangement.</p> <p>North Wales and north Somerset</p>	<p>Gop Cave - Middle (to Late) Neolithic</p>	<p>Possible primary burials, collection of body parts – different stages of decomposition (weathering, peri-post-mortem manipulation) – arrangement of human remains in separate areas of the cave.</p>
	<p>Ogof Pant-y-Wennol - Early and Middle Neolithic</p>	<p>Possible primary burials – peri- and post-mortem manipulation (fresh and dry breaks) – separate stages of processing (selected elements weathered) – possible re-arrangement – depositions in separate areas of the cave.</p>
	<p>Backwell Cave - Early and Middle Neolithic</p>	<p>Primary burials – separate stages of processing (based on OHI scores), clearances of the cave for more interments or re-arrangement of body parts (left sides surviving).</p>

Table 186. Summary interpretation of methods of deposition divided into two groups (A and B) including site and region, stages of burial and further categorisation of methods discussed in Chapter 8.



## **Chapter 8: Discussion**

### **8.1. Introduction**

This chapter discusses the results presented in Chapters 6 and 7 and places them in their wider context. Analysis has revealed a variety of practices and provided a comparison of Neolithic burial practices between individuals, sites, regions and contexts.

The aim is to address the key objectives of this PhD thesis:

- Examine mortuary practices (i.e. practices of inhumation, excarnation and exhumation) in caves through the analysis of pre-, peri and post-depositional processes
- Explore the impact of cave taphonomy and how human-mediated practices can be identified in bone evidence
- Investigate demographic patterns in mortuary treatment
- Explore intra- and inter-regional variation in practices and compare patterns between caves and monuments
- Examine chronological variation between sites and individuals
- Explore regional variations in mortuary treatment

To summarize previous chapters, from the start of the Neolithic period, caves were used for burials and possibly represented a stage in a series of depositional events. Events could have involved distinct practices including primary burials/inhumations, selective depositions or removal of elements for secondary deposits, secondary burials of already disarticulated human remains and multi-stage burials. This major corpus of material has long been neglected, in relative terms, in the narrative of Neolithic funerary practice. However, as proven by this PhD research, the material is now substantial enough to have a transformative impact and examine Neolithic deposition in caves.

The combination of macro- and microscopic analyses with new radiocarbon dating evidence has revealed differences in treatment between individuals, regions and sites across Wales and north Somerset (for a single case study), elucidated the means by which bones became disarticulated and clarified the period of use for seven sites from Wales.

The multi-scalar taphonomic approach provided details on mortuary practices and differentiated natural causes from human agency. Cave taphonomy was seen to reflect both natural/geomorphological impacts and human agency with numerous variables affecting the rate and impact of different processes and bone preservation (Chapter 4/4.3-4). Taphonomic overprinting has been identified and this limits our understanding of the processes that affect human remains in caves and our ability to reconstruct mortuary practices.

Throughout the Neolithic, human agency was identified in practices of curation and in the selection of body parts for removal after excarnation or exhumation. Residual bone assemblages indicative of multiple stages of bone processing were identified. Histological variation revealed details of peri-mortem treatment and variation in taphonomic trajectories between individuals and sites.

There is a diversity in depositional methods across the study sites, with inhumation, excarnation and exhumation based on macro- and microscopic analysis identified. These methods of deposition overlap across south, north Wales and north Somerset but do demonstrate a degree of regional variation. The adoption of burial methods across regions suggests the continuity of multi-stage practices in the Neolithic. Chronological variation in practices is often addressed in the discussion and refers to a practice (i.e. inhumation, exhumation or excarnation) that is either continuously used from the Early to the Middle Neolithic or shows changes and is executed irregularly (e.g. in the Early Neolithic and re-introduced in the Late Neolithic).

Primary inhumations were recognised using a combination of element frequencies and histological preservation across Early, Middle/Late Neolithic assemblages in south-central Wales and possibly in north Wales (accompanied by various stages of processing and commingling). Excarnation was identified in material from the presence of weathering and histological preservation. This combination was often noted in Early to Late Neolithic residual bone assemblages in both south and north Wales, suggesting prior exhumation or rapid skeletonization in Early to Late Neolithic assemblages. Exhumation was primarily identified from element completeness, histological preservation and evidence of processing. The latter often involved sub-aerial weathering, preferential selection of body parts, under-representation of others and

presence of peri-, post- and ante-mortem trauma. Exhumation practices were recognized in south Wales in Early to Late Neolithic assemblages.

Demographic analysis demonstrated that individuals of different ages and sexes are deposited within caves across Wales and north Somerset (single case-study). The number of interred individuals varied from smaller curated burials (composite individual with both adult and immature elements represented) in south-central Wales, to larger more processed deposits of c.5-10 or more individuals in south-west, north Wales and north Somerset. Adults were primarily represented, however, immature individuals (adolescents, juveniles and a smaller number of perinates) were also occasionally present. Females/probable females were more abundant compared to males/probable males, but the demographic dataset is too small to draw definitive conclusions.

Chronological variation was further expressed within assemblages of Early to Middle or Late Neolithic activity, supporting a range of burial methods and processing taking place. Results show similarities in depositional methods across regions involving multi-stage burials with selected or removed body parts (residual bone assemblages) in south Wales (Group A) and sequential deposits with larger, commingled and processed assemblages in north Wales and north Somerset (Group B) (Table 186/Chapter 7). These sections are broken down to discuss variation in pre- and post-depositional treatment amongst the assemblages and across regions and sites based on taphonomic data.

The following discussion places the results within the context of other Neolithic burials to create a narrative for mortuary treatment in caves compared to other forms of burial. Chronological patterns (established and new radiocarbon dates) and demographic information are incorporated where possible.

Methods of deposition summarised in Tables 184, 186 (Chapter 7) are cross-referenced with key taphonomic modifications to clarify how results of both macro- and microscopic analyses relate to these practices. Presence or absence of a taphonomic modification created separate taphonomic narratives amongst surviving assemblages and diversity in burial practices between sites and regions.

## 8.2. Methods of deposition

To summarise the results of this analysis, it has been demonstrated that mortuary practices in caves involved complex activities with the reduction, transformation and the fragmentation of the corpse being a main priority. Selection of skeletal elements, deposited singularly or in groups, reflected multiple processes from the Early Neolithic onwards. Multi-stage burials included re-arrangements, re-use of tombs, communal burials or mixed/bundled assemblages discovered in both caves and monuments. The disparity of skeletal remains across the landscape was notable with parts of the dead involved in deliberate re-arrangement, circulation after removal from primary burial locations and re-depositions. These patterns have been recognised across Britain in a variety of contexts (monumental and non-monumental) (see Chapter 2) and have underlined the complexity with which Neolithic communities dealt with their deceased.

Early Neolithic practices of excarnation, exhumation and collection and/or removal of parts for secondary depositions with the mixing of skeletal remains have been recognised in collective tombs as shown by previous work (e.g. Parc le Breos, Ty Isaf, Pipton, Penywyrllod) and at other locations (e.g. Hazleton North) and in caves and rock shelters based on the results of this research (e.g. Spurge Hole, George Rock Shelter, Ifton Quarry).

Analysis has clearly identified multi-stage burials, ranging from body curation and the selection/removal of body parts (Group A/ Table 186) to sequential depositions and multiple processing of larger assemblages (Group B/ Table 186). This involved a range of practices and re-arrangement of skeletal elements (see Table 185 for definitions). Both Group A and Group B burials were a multi-stage process, with the latter mainly characterised by primary burials and processing of larger assemblages. Practices of exhumation were noted across south Wales with both inhumation and excarnation more common in north Wales/north Somerset.

The following section discusses the predominant burial rite that is primary burials with selective removal (prevalent in south Wales), excarnation and/or processing of bone (prevalent in north Wales).

### 8.2.1. Primary inhumations

This section presents evidence for primary burials accompanied by selective removal (south Wales), excarnation and/or processing of bone (north Wales). These processes have been identified across sites in Wales and throughout the Neolithic which suggests that practices were adopted across regions (south Wales, north Wales and north Somerset) from the Early to the Late Neolithic. Primary inhumations were part of smaller (e.g. George Rock Shelter) and larger, more processed, commingled assemblages (e.g. Ogof Pant-y-Wennol, Backwell Cave) whilst comparable evidence in monumental burials is discussed.

#### 8.2.1.1. *Selective retrieval*

Selective retrieval was identified in assemblages with evidence of primary inhumations in caves possibly relating to elements being removed for deposition in nearby contexts (e.g. monuments). This practice was identified in south-central and south-west Wales from primary contexts of Early to Middle Neolithic with deliberate removal relating to under- and over-representation of elements. Evidence of cremated bone was further associated with selective retrieval and found amongst primary burials (George Rock Shelter/south Wales) or residual bone assemblages with possible primary depositions (Ogof Colomendy/north Wales).

Over or under-representation of certain bone categories did not often correspond to the minimum number of individuals. Whilst loss of material from disturbances, moving of internments or post-excavation could have been responsible for these wide imbalances, taphonomic data from surviving elements supported a different trajectory. High survival of hands/feet (extremities) that disarticulated from the body rapidly and can be missed, filtered down, deeper in caves and avoid fragmentation compared to larger elements, often suggested primary burials (Osterholtz *et al.* 2014b: 14). Practices of selective retrieval from primary to secondary deposits could have been responsible for the unequal ratio of corresponding elements (within post-cranial categories or cranial vs post-cranial). Natural causes such as seismic activity, scavenger activity, water displacements could have distorted the taphonomic trajectories of the individuals buried in caves however, human agency was clearly identified between assemblages with over- or under-representation of body parts. Ogof Colomendy demonstrated the highest

rates of disturbances by scavengers but was accompanied by separate stages of processing (peri- and post-mortem fractures) on long bones and signs of sharp force trauma (cutmark). Evidence supported that the cave was not only re-used in the Bronze Age, but its use involved a range of processing stages and different treatments between individuals of different ages. Absence of gnawing, on the other hand, in assemblages involved in possible deliberate removal of body parts (e.g. George Rock Shelter and possibly Priory Farm Cave) suggested that under-representation of elements resulted from human action and not by scavenger disturbances.

Over-representation of hands/feet (compared to other bone categories) (George Rock Shelter, Gop Cave) and/or zone completeness (compared to overall fragmented assemblages) and good surface preservation (Ifton Quarry, Priory farm Cave Ogof Colomendy, Gop Cave, Ogof Pan-y-Wennol) therefore indicated residual bone assemblages (e.g. George Rock Shelter, Priory Farm Cave, Gop Cave) and/or different phases of processing (e.g. Ogof Colomendy, Gop Cave, Ogof Pant-y-Wennol). This pattern supported multiple-stage depositions throughout the Neolithic involved in selection, processing and recognition of the caves' and rock shelters' functionality. Cave access and use of the caves' morphological properties must have played a key role for practices of selection and deposition or removal.

Practices of selective removal/deposition of body parts in south Wales (e.g. George Rock Shelter and Priory Farm Cave) demonstrated almost entire absence of gnawing marks (<5 elements) suggesting human action was responsible for deliberate removal or re-arrangement of remains. Under-representation of long bones in George Rock Shelter (Early Neolithic) further suggested deliberate removal for deposition in a secondary context. Results from Priory Farm Cave (Middle Neolithic) indicated that elements, even within the same bone categories, were impacted in different ratios and evidenced distinct treatment and separate depositional episodes. Retrieval from primary contexts in the Early and Middle Neolithic in south Wales was therefore associated with selected individuals. Possible primary inhumations in north Wales and north Somerset were part of processing and different levels of manipulation from the Early to the Late Neolithic and were involved in practices of sub-aerial exposure, peri- and post-mortem manipulation (see 8.2.1.2).

Continuum of this practice in south Wales was associated with sporadic demographic evidence from sites in both south and north Wales. Results indicated that individuals of all ages were involved in stages of processing and co-mingling and suggested that selection in cave burial was not based on age-related differences. Immature individuals, in particular, retained a stable character in numbers throughout the Neolithic and were noted between contexts where primary burials occurred. Comparisons between Neolithic/Early Bronze Age cave burials and Neolithic long barrows in Britain demonstrated a significantly lower proportion of individuals deposited in caves (per-site), with nonetheless, a higher ratio of immature individuals, including infants and juveniles compared to monumental burials (Chamberlain 2012: 84). Age-related differences might have been more complex in burial and reflected cultural differences between the individuals. For example, immature individuals might not have been regarded as functioning adults with some juveniles or adolescents representing an intermediate age that was not represented in above-ground monuments (Smith and Brickley 2009: 90).

Practices of selection and retrieval were further associated with presence of cremated bones, possibly from other contexts that were deposited deliberately or symbolically with cave burials. Burnt bone was found in south-central Wales in the Early Neolithic (George Rock Shelter) and in north Wales in the Middle/Late Neolithic (Ogof Colomendy). Its sparse but consistent presence across regions suggested continuation of practice and probable adoption of methods from Earlier Neolithic traditions. A cremation pyre was found in the Neolithic horizons at the George Rock Shelter with burnt bone discovered amongst primary burials and subsequent selective retrieval of larger elements (e.g. long bones). Early Neolithic communal burials included cremated bone and human remains in fragmentary and disarticulated condition after excarnation, practices which could relate to those identified in George Rock Shelter and Ogof Colomendy.

Cremated deposits have generally been discovered from the Early Neolithic in long barrows/chambered tombs (similar to Hazleton North, Gloucestershire; West Kennet, Wiltshire and Ascott-under-Wychwood, Oxfordshire) and comprised of multiple inhumations or individual bodies that have been excarnated and deposited in tombs (Darvill 2010: 113). Some bones also appeared to have been removed from smaller

chambers in long barrows/chambered tombs or elements might have never arrived at the tomb (*ibid.* 114). Similar practices could have been used in George Rock Shelter, with the scattering of cremated remains replacing elements that had previously been removed as part of the funerary process. Scattering of cremated bone was further identified in Neolithic monuments such as Parc le Breos Cwm (Whittle and Wysocki 1998), Dyn Dryfol (Smith and Lynch 1986), Ty Isaf (Wysocki and Whittle 2000), Ffostyll North (Vulliamy 1922), Dyffryn Ardudwy and Penywyrlod (Britnell and Savory 1984: 37-8). Small and often scattered concentrations of cremated bone were discovered amongst assemblages from chambered tombs however, these fragments might have been similarly under-represented. Fragments could have easily been discarded, not collected or might have been invisible to the naked eye. Therefore, cremation might have been a more common practice during the Early Neolithic (Parker Pearson 1999: 6-7) or could have accompanied primary and/or secondary burials (e.g. as a form of sealing of burial).

Cremation could have subsequently been adopted later in the Neolithic in North Wales within commingled and processed bone in the form of scattering. Communal, fragmented and disarticulated burials of the Early Neolithic in monuments in Wales were gradually replaced (from the Middle Neolithic onwards) by cremation deposits in pits and/or at henges. The Later Neolithic Barclodiad Y Gawres in Anglesey, North Wales consisted of a stone-built cruciform chamber and passage set within a round cairn (Powell and Daniel 1956) with a long passage beneath the cairn leading to a corbelled chamber, and three side-chambers where cremated bone was similarly discovered (Lynch 2001: 73). Scattered cremated bones, possibly retrieved from a previous context, were identified amongst the commingled assemblage in Ogof Colomendy (3 elements). Their trajectory was not clear due to the extremely fragmentary state, the various disturbances in the site from quarrying, scavenger activity and long period of use (based on radiocarbon dating evidence). Scattered, cremated bone might have been brought to the site during circulation of other skeletal remains, such as limbs exhibiting dry and fresh fractures. Circulation and use of burnt bone as part of mortuary practices might have therefore been integral in Neolithic assemblages. Scattered cremated bone could have resembled the mixed deposits of both cremated and human bone that characterized Middle/Late Neolithic commingled and



processed assemblages in north Wales and suggested a re-introduction of methods from the Early to the Late Neolithic.

#### *8.2.1.2. Sub-aerial exposure and/or processing*

Practices of excarnation, collection and/or processing often characterised multi-stage burials in caves (south and north Wales and north Somerset). Human remains were part of possible primary burials (e.g. Gop Cave, Ogof Colomendy, Ogof Pant-y-Wennol, Backwell Cave), exhumed or sub-aerially exposed (e.g. Little Hoyle Cave, Ogof Garreg Hir) and rapidly skeletonized after excarnation (e.g. Spurge Hole). Processing involved peri- and post-mortem manipulation and accompanied primary or secondary burials more often than excarnation.

Possible primary burials accompanied by sub-aerial exposure and/or processing were identified in North Wales, possibly south-west Wales and North Somerset in residual bone assemblages. Chronological variation relating to changes in practice was not apparent between regions as this process was identified in Early (north Somerset, north Wales), Middle and Late Neolithic contexts (north Wales). Re-working and processing of human remains was more frequent in north Wales (both Early and Middle/Late Neolithic contexts). Within these deposits, distinct treatment between individuals was noted on a macro- and microscopic level. Overall low weathering presence across Wales involved prior excarnation or manipulation of certain elements (early disarticulation when accompanied by fresh breaks on long bones), circulation (resulting in dry fractures) and irregularities in element representation. Caves in North Wales and North Somerset and one cave in south-west Wales (Priory Farm Cave), entailed excarnated remains (possibly selected and others retrieved) that were often processed within primary deposits. Priory Farm Cave (Middle Neolithic) and Ogof Colomendy (Middle-Late Neolithic) were multi-period and cannot be used to draw definitive parallels on primary burial. Primary burials in Priory Farm Cave for example could be of later age (Late Bronze or Middle/Late Iron Age) and not from the Middle Neolithic.

A combination of primary and secondary practices including retrieval after excarnation or from other contexts could have been adopted in North Wales imitating curated practices from the Early Neolithic in south-central Wales (Spurge Hole, George Rock Shelter). Early disarticulation followed by early or later manipulation was a practice

often encountered in taphonomic re-elaborations and Neolithic assemblages. Caves could have therefore functioned as centres for the circulation of remains from the Early to the Late Neolithic. Processing and deposition in caves was characterised by intentional arrangement of body parts in primary deposits, either as a form of distinguishing the individuals based on age/sex-related differences (sporadic information and therefore, no definitive parallels) or based on different stages of processing. Insufficient data meant that it was impossible to establish whether these patterns related to age or sex-related differences as large assemblages were subjected to multiple processing and fragmentation activities.

Limited demographic evidence, however, suggested that immature individuals retained a stable character in numbers from the Early to the Middle and Late Neolithic and were always involved in multiple burial stages. This was noted across sites in Wales and North Somerset and coincided with demographic data from early agricultural populations in Britain which displayed high mortality rates (c.40%) before adulthood (Chamberlain 1997: 6) with a consistently higher number of immature individuals interred in caves (Kinnes 1992; Chamberlain 2012: 84). Children and infants have been reported amongst prominent chambered tombs including Adlestrop, Ascott-under-Wychwood, Boles Barrow, Burn Ground, Fussell's Lodge, Haddenham, Hazleton North, Lanhill, Notgrove, Parc le Breos Cwm, Rodmarton, Wayland's Smithy, West Kennet and West Tump (Smith and Brickley 2009: 88, Table 7). Ratios amongst adults and immature individuals in the aforementioned chambered tombs demonstrated a great degree of variation which could have resulted from various taphonomic modifications impacting the remains such as susceptibility of elements to destruction (e.g. immature and elderly individuals) based on bone density (Walker 1995) and breakage due to trampling, animal scavenging or re-arrangement of remains (Smith and Brickley 2009: 89). Immature individuals always survived in primary burials amongst adult processed or excarnated human remains. This representation suggested that cultural differences based on age were either not significant or that immature individuals were regarded as functioning adults (Smith and Brickley 2009) and received similar treatment that involved processing and separation of body parts in caves.

From the Early Neolithic, commingled assemblages discovered in deposits of primary burials involved different stages of manipulation and individuals of all ages. These

could have related to deliberate re-arrangement, peri- and post-mortem processing in north Wales (e.g. selected body parts after excarnation or manipulation) or moving of interments for successive depositions (Backwell Cave, north Somerset). Caves with Early to Middle Neolithic use in south Wales similarly demonstrated signs of processing with various stages of sub-aerial exposure (e.g. Spurge Hole, Hoyle's Mouth Cave) however, these were not always part of primary burials. Processing and circulation therefore indicated inter-regional variations between south and north Wales. As opposed to caves in south Wales, primary burials in north Wales were often accompanied by peri- and post-mortem processing which evidenced different stages of manipulation between the individuals. Five long bones demonstrated signs of advanced weathering with a single humerus exhibiting a fresh fracture and weathering stage four in Ogof Pant-y-Wennol. The freshly fractured long bones showed very high histological preservation (OHI score: 5) resulting from peri-mortem manipulation and early disarticulation due to prolonged sub-aerial exposure before final deposition in the cave. Microscopic analysis of four more long bones with dry fractures demonstrated variation in histological preservation (OHI scores: 1-2 and 5) indicating different treatment with remains involved in both peri- and post-mortem processing. Human remains showed chronological variation from the Early to the Middle Neolithic which suggested that processing was continuously part of the taphonomic trajectories of the individuals.

Processing was further identified in Early to Middle Neolithic primary burials in Backwell, north Somerset (Figure 312) and showed different levels of manipulation based on OHI scores. Preference in burial contexts across south-west England was overall more restricted to above-ground monuments and causewayed enclosures during the Early Neolithic compared to the variety of sites apparent in Wales. Burials in solidified monumental environments lacked the transformative nature of caves. Underground locations were susceptible to various external forces (seismic activity, water transport, scavenger activity) which, combined with human activity (i.e. moving of interments, clearances), changed the burial trajectory of human remains. Various stages of decomposition could have been adopted to re-create or imitate the interchangeable subterranean environment.

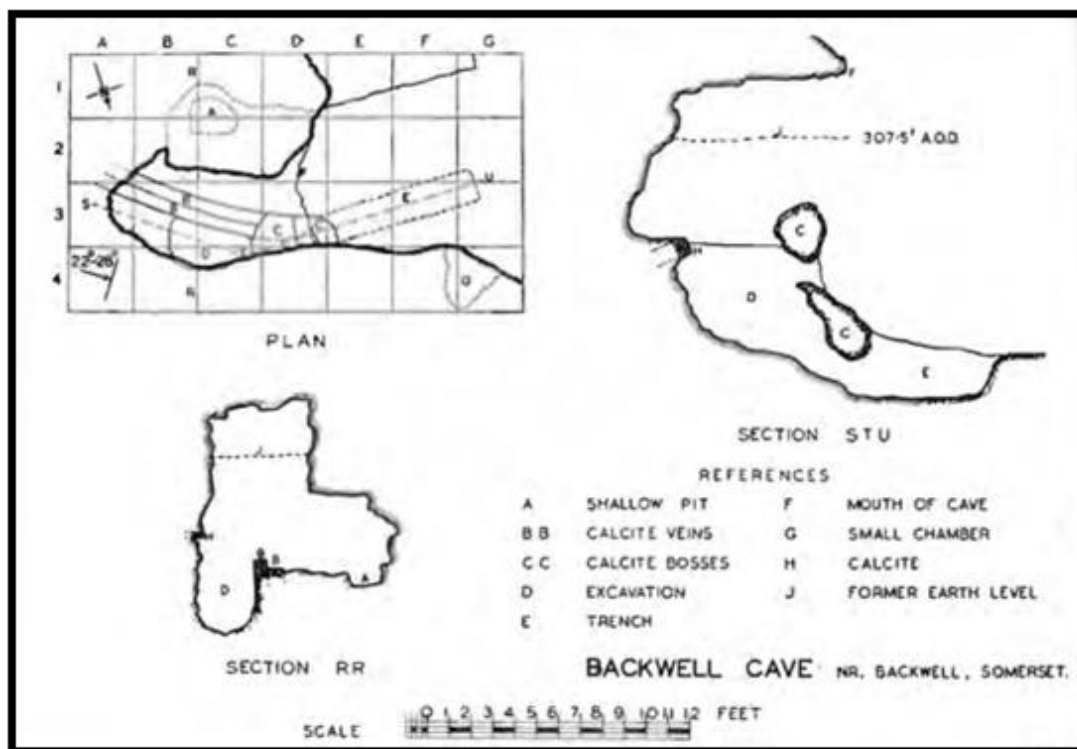


Figure 312. Plan and section of Backwell Cave. Indications of excavated areas/pits with finds/human remains (A, C, D) (Tratman and Jackson 1938: 58).

The number of human remains found in mortuary contexts from south-west England was generally not large, with the exception of the number individuals discovered in Hambleton Hill, Dorset (c. 225) discovered in fragmentary and scattered state (Schulting 2007: 582). 51 individuals from three distinct piles of disarticulated remains were discovered in the timber mortuary house of Fussell's Lodge, Wiltshire (Malone 2001: 121) whilst an inner box contained selected remains of thirteen individuals and four children with an underrepresentation of skulls and long bones (Schulting 1998: 252). Smaller bones were missing from the assemblage and evidence of erosion on a small number of bones suggests that the bodies must have first been exposed and subsequently brought and arranged in piles within the barrow (Wysocki *et al.* 2007: 68-69). West Kennet further contained a very large number of under-represented crania and long bones (apart from five individuals in the innermost chamber which were primarily found in an articulated/complete state) (Schulting 1998: 256). Overall, skeletal deposits were mixed with a portion of the individuals interred either as primary or secondary burials (*ibid.*).

Variation in treatment in these contexts reflected the interchangeable nature of primary and secondary burials, similarly to how practices took place in caves in south-west England. The Mendip uplands became a monumental and ceremonial landscape (Simmonds 2014: 23) with a range of caves/rock shelters used for burials (Lewis 2011). Evidence of Early/Middle Neolithic activity from North Somerset in particular (Figure 313 below), based on 17 radiocarbon dates, was confirmed amongst human remains from Hay Wood Cave (Schulting *et al.* 2013) with a large number of fragmented elements (MNI: 10+) considered the result of later disturbances (Iron Age activity), and a large number of small bones (hands/feet) showing evidence of completeness and articulation (suggesting possible inhumations). More sites in Somerset provided direct evidence of Neolithic activity including Hay Wood Cave, Chelm's Combe, Flint Jack's Cave, Picken's Hole, Skeleton Cave and Aveline's Hole (Schulting *et al.* 2019). Backwell Cave was part of a large cave group in the Mendip Hills with a large number of individuals processed similarly to other Neolithic contexts in north Somerset.

Separate OHI scores (1, 3-4) were noted amongst five fragmented long bones from Backwell Cave with breaks appearing both fresh and dry on the proximal ends of the diaphysis. Different OHI scores reflected separate treatment between the individuals that were however deposited along with primary burials. The large number of individuals discovered in the small cave reflected multiple depositions including primary burial, exhumations, collection of body parts and processing of bone resulting in a combination of both primary and secondary depositions. Hay Wood Cave (Schulting *et al.* 2013) further provided great insight of Early (to Middle) Neolithic activity in the Mendips, creating a strong analogy for depositions in Neolithic above-ground monuments. Both caves were used for multiple depositions, composed of fragmented and disarticulated remains and a large number of individuals.

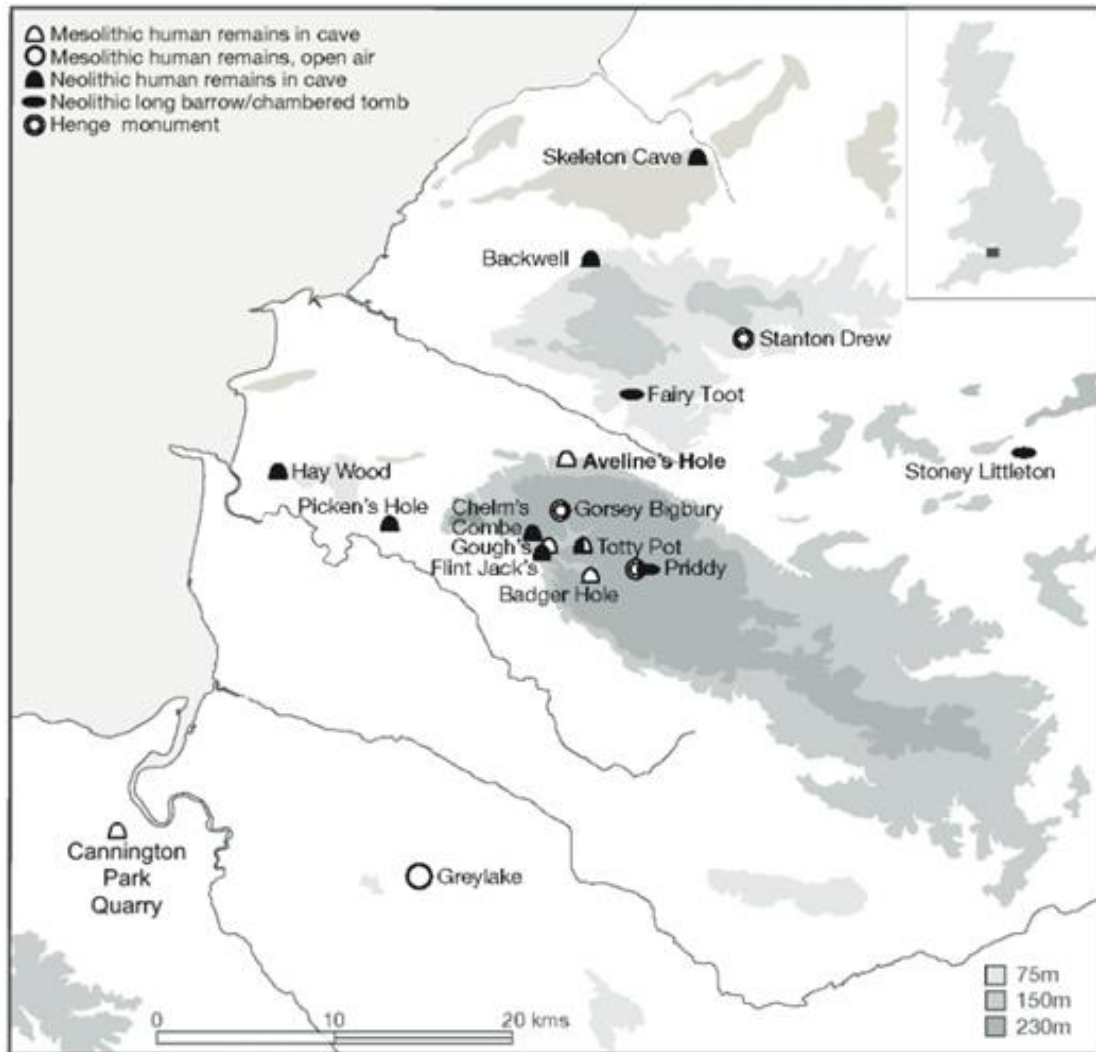


Figure 313. Map of Mendip Hills (Somerset) with indication of Backwell Cave and other Neolithic caves (Skeleton Cave, Hay Wood Cave, Flint Jack's, Chelm's Combe, Picken's Hole) or sites with mixed deposits (Aveline's Hole, Totty Pot) as well as Neolithic monuments in the area (Stoney Littleton, Priddy Long Barrow, Fairy Toot) (Schulting *et al.* 2019: 10, fig. 1).

The overall larger number of individuals interred in caves in north Somerset, contradicted the lower number of human remains discovered in caves in Wales which might have related to the larger variation of contexts used for burials across Wales. This could have further reflected the complexity in which the dead were treated as processed bone was circulated between different contexts. Variation in the number of manipulated and/or processed individuals between north Somerset and north Wales was therefore noted, however, methods of deposition showed similarities. Exchange of methods between regions was further reflected in larger-scale monuments in the Neolithic. Multiple inhumations from disarticulated remains were discovered in long barrows, whilst articulated skeletal remains and accompanying grave goods were frequent

(Darvill 2010: 113). A similar adoption of practices in cave burials could have therefore been pursued. Depositions in long barrows (c.3800BC to 3500BC), mostly concentrated in eastern and southern Britain and largely distributed across the country, similarly showed wide variation in characteristics and levels of processing and reflected a widespread expansion of Neolithic communities in the British Isles (Darvill 2010: 113). This expansion resulted in broader regional groups of this type of monument including the Cotswold-Severn Group which was also established in Wales (north Wales Group) (ibid.).

Links between southern Britain and north Wales and these monumental groups, could be found in cave burials in north Somerset (Backwell) and north Wales as these were identified amongst the same depositional group (residual bone assemblages involving primary burials, commingled remains and processing – Group B/Table 186). Variation in practice between the individuals in caves was identified and was further reflected in chronological patterns with individuals of either Early to Middle or Middle to Late Neolithic discovered in the same assemblages. Re-working and processing of human remains was adopted throughout the Neolithic in both regions with the remains of individuals of Early to Late Neolithic involved in different processes and often reunited as commingled assemblages. Arrangement of depositions (Backwell Cave) or use of separate burial areas after processing (Gop Cave, Ogof Pant-y-Wennol) could have further embodied means of disintegration of the individuals that were re-combined as mixed deposits. Funerary practices of this nature were practiced throughout the Neolithic. Time during processing of bones was defined by the continuity of practices in cave burials as remains that were manipulated derived from individuals from the Early to Late Neolithic period. Ingold (1993: 158) considered that the conception of time derived from the active participation of the people processing skeletal remains (concept of temporality) which meant that the use of caves involved periods of experimentation aimed at reuniting disintegrated body parts. Experimentation would have entailed long periods of bone processing, fragmentation of skeletal remains (visible from fresh fractures) and sub-aerial exposure prior to final deposition (weathering). Caves were the meeting point of these practices throughout the Neolithic that were expressed and performed at separate tempos (Fowler 2010) from the Early to the Late Neolithic.

Adoption or exchange of ideas and practices between north Somerset and north Wales can therefore be suggested through evidence from cave assemblages from the Early (north Somerset – Backwell Cave; north Wales - Ogof Pant-y-Wennol) to the Middle/Late Neolithic (e.g. north Wales - Gop Cave). Weathering in Middle to Late Neolithic Gop Cave, was noted on three long bones that exhibited both dry and fresh fractures and were discovered within primary deposits. High epiphyses survival (highest across sites in Wales) further suggested intentional extraction of long bones from previous contexts and circulation for secondary burial. Human action was further noted based on lack of extensive gnawing suggesting that disturbances were not the result of natural processes (e.g. scavenger activity).

Similar manipulation in remains of later Neolithic date was noted in Ogof Colomendy. Early disarticulation was followed by early processing (fresh fractures) and later manipulation (dry fractures) was accompanied by disturbances in the cave from scavenger activity and re-use in the Early/Middle Bronze Age. A large number of fractured bones, absence of equal number of cranial/skull elements as well as extremities (hands/feet) suggested that the site was disturbed and repeatedly used for depositions whilst various stages of manipulation were responsible for this fragmentary record. Different stages of processing could have related to different treatment between the individuals that were subsequently deposited in separate areas/fissures of the cave. The high prevalence of fresh breaks and sharp force trauma supported early manipulation which was either followed by sub-aerial exposure (resulting in weathering) or protected exposure, collection and final deposition in the cave.

Middle to Late Neolithic residual bone assemblages in north Wales were manipulated after or before selection and excarnation which suggested a continuum in practices. Weathering, distinct fracture morphology and histological preservation of Early to Middle Neolithic human remains from Ogof Pant-y-Wennol supported different stages of processing with elements deposited in separate areas/fissures of the cave. Human remains were similarly deposited in separate passages in Gop Cave of Middle to Late Neolithic activity, with one constructed and enclosed area possibly imitating a natural passage to separate individuals. Elements showed different taphonomic trajectories and chronological variation in practice. Limited demographic data suggested that processing might could have related to practices of selection, similar to caves in south



Wales (see 8.2.3), with females undergoing more manipulation based on cultural selection. Use of caves in north Somerset and north Wales was therefore characterised by different stages of processing and possible clearances within primary burials. Use of separate areas in caves for depositions could support intentional division to imitate chambers or separate individuals according to the stage of processing.

#### *8.2.1.3. Summary*

Primary burials were identified in south and north Wales and were part of multi-stage practices with depositional patterns that overlapped adopted across regions. Processes of selective retrieval and manipulation after excarnation or circulation of bone characterised these assemblages and were identified in different contexts. Results indicated different treatment between the individuals and caves in south Wales however, caves in north Wales and north Somerset showed common mortuary practices in both cave and monumental burials.

Practices of selective retrieval were part of primary burials in south Wales in the Early to Middle Neolithic but were not frequent. Element representation was integral in understanding this process and taphonomic modifications (such as presence/absence of gnawing) were used to distinguish natural causes from human agency. Limited demographic evidence suggested that individuals of all ages were part of these processes. Cremated bone was further associated with the practice of selective retrieval in Early and Middle/Late Neolithic assemblages in south and north Wales which possibly related to the adoption of practices across sites as a form of 'sealing' of burial or scattering of cremated bone to replace retrieved body parts.

Primary burials in north Wales were associated with larger commingled assemblages of Early to Late Neolithic and showed similarities with practices in caves, and other mortuary contexts, of north Somerset. Inhumations were accompanied by processed bone (excarnated or manipulated). Evidence, therefore, suggested common burial patterns in north Somerset and north Wales and different treatment between the individuals. Gradual adoption of this process was evident in both caves and monuments. Demographic evidence was insufficient to support whether separate stages of processing related to age or sex differences, however, consistency in the number of interred immature individuals (low from the Early to the Late Neolithic) suggested that

all ages were involved in this practice. High mortality rates as seen in monumental burials could have been the cause of consistent representation of immature individuals in early prehistoric populations. This might have further related to the adoption of methods across regions (north Somerset/Early Neolithic – north Wales – Early to Late Neolithic). Adoption and continuum in practices could have involved re-working of bone (bone processing, commingling) from the Early to the Late Neolithic.

Separate burial activities were associated with broader depositional groups in monumental burials and showed inter-regional variations. Division in burial further suggested an attempt to imitate constructed chambers and/or reflected different stages of processing between individuals.

### **8.2.2. Excarnation**

This section discusses evidence of excarnation as part of multi-stage burials across Wales involving selection of body parts for secondary deposition. Variable weathering prevalence between assemblages suggests distinction in burial, especially when advanced weathering stages are present (e.g. Spurge Hole – south-central Wales; Ogof Pant-y-Wennol – north Wales), although these are noted on a lower number of bones across sites. Excarnation is often part of multiple burial stages, involving selection, sub-aerial exposure, processing and secondary deposition from the Early to Late Neolithic. Selection and mixing of bone following excarnation and processing is often part of monumental burials and therefore discussion on concurrent use of caves and monuments is incorporated.

Excarnation was identified in Early to Middle Neolithic assemblages in south Wales and Early (one site) to Middle and Late Neolithic sites in north Wales. This suggested that the practice was repeatedly used throughout the Neolithic and forms an integral part of mortuary practices across regions through processes of circulation, disarticulation and mixing of bone in caves.

#### *8.2.2.1. Selection/curation, processing and secondary deposition*

The disaggregation of the body became a major priority in mortuary practices (Parker Pearson 1999: 50) which was reflected in the variety in which the dead were treated in

both caves and above-ground monuments. A new affiliation of the communities with the world was therefore established from the start of the Neolithic and created new requirements where the body needed to be shaped and formed to respond to action and engage in innovation (Hofmann and Whittle 2008: 290). Secondary burial practices in Neolithic Britain involved processing of bone bundles and separated skeletal remains that were placed in tombs, caves, other mortuary contexts or circulated between sites (Parker Pearson 1999: 50). The scarcity of certain bone categories and mixing of bone, resulting in over or under-representation of elements, suggested multiple burial stages throughout the Neolithic involving selection and processing for secondary depositions. Disturbances in caves, circulation or re-arrangement of human remains resulted in different taphonomic trajectories as remains were moved, re-exposed and/or positioned in separate environments prior to deposition (excarnation or exhumation and secondary burial) or areas within caves.

Practices of excarnation retained a stable character throughout the Neolithic and often formed definitive parts in processes involving selection, retrieval or circulation. Constant re-arrangements (selection), movements (circulation) and depositions could have been part of practices in caves that involved deposition in dynamic micro-environments within commingled and processed human remains. Sub-aerial exposure was identified across a number of caves in both south and north Wales with human remains either curated, selected or involved in sequential depositions with commingled remains, peri- and post-mortem processing. Sites across south-west (e.g. Ogof Garreg Hir and Priory Farm Cave), south-central (Spurge Hole) and North Wales (Ogof Colomendy, Gop Cave and Ogof Panty-y-Wennol) comprised of weathered elements impacted by either short or long-term sub-aerial exposure. Different treatment was noted between assemblages and suggested that methods of deposition were practised irregularly from the Early to the Late Neolithic. Individuals or disarticulated and fragmented body parts from different periods (e.g. Spurge Hole) were manipulated at different ratios (either short or long sub-aerial exposure, distinct processing) within the same cave assemblages. This evidence suggested that practices involving excarnation were performed in diverse manners throughout the Neolithic between individuals and sites.

Selection, separation and segregation of body parts after excarnation were characterized by curation with under-representation of the extremities in south Wales in the Early-Middle Neolithic (e.g. south-central Wales/Spurge Hole, south-west Wales/Ogof Garreg Hir) or as part of commingled assemblages (Gop Cave, Ogof Pant-y-Wennol, Ogof Colomendy) in the Early-Late Neolithic in north Wales. Limited demographic evidence indicated that individuals of all ages were involved in processes of excarnation and circulation of remains in the Early/Middle Neolithic in south and north Wales. Weathered long bones of male and female adults with dry fractures and very good histological preservation (OHI: 5) from Spurge Hole showed that rapid skeletonization resulted from excarnation, selection and circulation for secondary deposition in the cave. Weathered elements and exhumed body parts (morphologically different and selected) were interred in the cave. Weathering stage one on a single ulna from an immature individual from Ogof Garreg Hir with a high OHI score (4) suggested that the element underwent different practices including short sub-aerial exposure before final burial. Excarnated and fractured long bones of Middle to Late Neolithic Gop Cave in North Wales derived from adults (fully fused epiphyses) with a single juvenile mandible showing signs of short sub-aerial exposure (weathering stage one). Under-representation of body parts played a key role in selection after excarnation or circulation. Lower bone frequencies did not necessarily reflect a lack in the number of interred individuals but represented individuals of different ages that underwent multiple processes (e.g. excarnation) before final deposition. Element frequencies showed fluctuations in the numbers of surviving elements, however, immature individuals were always part of these processes and were always represented in these mixed assemblages in both south and north Wales.

Separation after excarnation, processing (or earlier processing resulting in fresh fractures) and circulation indicated pre-established practices that were widely used across Britain in the Neolithic but executed differently between sites and regions in caves. Sporadic demographic evidence demonstrated a slightly higher ratio of females (including probable females) to males in caves in north Wales where excarnated remains had been deposited. Females were overall slightly more presented across caves in Wales with multiple burial practices compared to the higher ratio of males amongst assemblages from prominent Neolithic chambered tombs (Smith and Brickley 2009:

88). As it has been established, burial practices between monuments and caves demonstrated similarities in the Neolithic and concurrent use of both contexts suggested mutual understanding of their use for burial. People built, re-used and transformed monuments (specifically during the Chalcolithic) perhaps as means of ordering the landscape through architecture, ‘design’ and authority (Crozier 2018: 192). Order, however, was not reflected in the way human remains were manipulated, processed and arranged in caves as practices were executed differently. Death might have therefore been perceived as a disruption in the rhythm of life (ibid.) and its unpredictability could have been addressed through different forms of processing disarticulating remains. To achieve or re-adjust order, disarticulation and separation of bodies could have been conceptualized as a ‘progressive loss of self’ (Barber 1988), a depersonalization of the body (Kuijt 2008) or as mean to recombine and reconstitute relations and body parts in death (Fowler 2001). Excarnation could have therefore related to cultural selection of individuals undergoing circulation before final deposition. Remains could have been used symbolically with certain individuals selected (and subsequently over-represented) for burial amongst the community based on social status or lineage and kinship as proven and discussed in recent studies in Neolithic Megalithic burials (Edmonds 1999: 61; Fowler 2001: 87, 2010; Chamberlain 2012: 84; Fowler *et al.* 2021; Elliot *et al.* 2022<sup>402</sup>

Continuation of this practice (excarnation) could have related to wider Neolithic perceptions that were expressed in the handling of the dead. Results from a recent study on ancient genomes (Brace *et al.* 2019: 769) suggested that Neolithic people arrived in Britain with prior knowledge of handling the dead in various ways, including depositions in caves (Peterson 2019: 12). A continuum of bone re-working throughout the Neolithic, after a drop in cave depositions in the Late Mesolithic (Chamberlain 1997: 6; Schulting *et al.* 2013: 22), could have therefore entailed prior knowledge and complex activities that were reflected through the reduction, transformation and the fragmentation of the corpse. Cave burials reflected a basic norm of disposal from the Early Neolithic onwards (Leach 2015: 204) and human remains, deposited singularly

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<sup>402</sup> And Edmonds 1999: 61

or in groups, stood as symbol carriers of older customs passed through seasonal networks (Barclay and Hey 1999: 67) in Britain (Brace *et al.* 2019).

Re-working and processing of human remains was systematically adopted during the Middle and/or Late Neolithic and caves might have been distinguished from controlled, sub-divided and formalized and repetitive behaviours encountered in monumental burials (Whittle 1998: 149). Easier access in open caves, compared to the more enclosed, segregated monumental environments, could have played a key role for the continuous use of caves throughout the Neolithic after collection and excarnation (Bryant 2011: 150). Excarnation in caves could have expressed a recombination of body parts or older (curation) and later (processing and manipulation of larger assemblages) practices in the Middle and Late Neolithic. This evidence suggested that skeletal components might have been recombined into their original 'form' possibly similarly to earlier Neolithic (to Middle) contexts in south Wales (i.e. Spurge Hole). Advanced weathering indicated prior excarnation and was noted in Early-Middle Neolithic Ogof Pant-y-Wennol, north Wales where the remains of primary individuals were discovered. Different weathering stages on long bones with dry fractures further suggested that sub-aerial exposure was followed by disturbances and moving of interments in the cave whilst variation in OHI scores indicated multiple practices. Both Spurge Hole and Ogof Pant-y-Wennol encapsulated remains from separate individuals that were manipulated differently but also showed chronological variation (individuals from different periods being involved in similar practices) within the assemblage. This could have signified a reconstitution of the elements into their original form (i.e. reconstituted individual in south-central Wales) after disarticulation to imitate mixed deposits discovered in above-ground monuments. Older and later practices were used for individuals of different ages to achieve disarticulation, decomposition and final gathering of bones in caves.

Bodies undergoing excarnation/sub-aerial and collection/circulation for secondary burials were similarly identified in assemblages in the later Neolithic (e.g. Gop Cave, Ogof Colomendy) in north Wales. Circulation of body parts as part of excarnation in the Middle and Late Neolithic in North Wales suggested that practices might have been adopted across regions. Selected elements undergoing sub-aerial weathering or processing may have therefore been used for the revival of these practices throughout

the Neolithic. Natural disarticulation, fragmentation, disturbances and taphonomic overprinting could have been responsible for the complex taphonomic narratives, however, methods of deliberate selection after exhumation and/or excarnation were clearly identified.

Signs of peri-mortem manipulation were noted in Middle to Late Neolithic excarnated long bones from Gop Cave with a single long bone exhibiting a percussion mark that pre-dated weathering. Remains of Middle/Late Neolithic and Early/Middle Bronze Age from Ogof Colomendy underwent both peri- and post-mortem disturbances with a large number of long bones exhibiting both fresh and dry fractures and gnawing marks. Elements were highly disturbed which could have occurred from natural causes. However, zone completeness of hands/feet, evidence of sharp-force trauma, short sub-aerial exposure and re-use of the site over a period time suggested a range of mortuary practices involving multiple stages of processing before deposition in the cave.

Circulation after excarnation with early and later manipulation therefore indicated a continuation of practices in the Neolithic. Incorporation of these processes in commingled remains and residual bone assemblages in north Wales could have related to chronological variation in practice across regions. Re-use of mortuary practices in Wales throughout the Neolithic indicated an understanding of how decomposition of the body could have been achieved through different stages. These practices involved multiple interactions with the dead as treatment entailed both primary and secondary burials of already disarticulated and skeletonized body parts that were circulated and interred in caves. Burial practices therefore formed interactions between people, communities, and different contexts for burial and reflected established social relations of prehistoric communities (Shanks and Tilley 1982: 151). These social pillars were either expressed through substantial formations (monumental constructions, tools, artefacts and other finds) or connections of the body with its surroundings (landscape) to substantiate permanency or create ties. Whilst in these process, remains redefined the meaning of the nature-culture dichotomy due to the transitional stages that they underwent (Leach 2015: 264). Human remains could have therefore symbolized the nature and culture dichotomy and created a “non-verbal communication” in terms of action, treatment and use of the body and its social units (Shanks and Tilley 1982: 134)

Caves were possibly segments of more complex processes in the Neolithic and formed inextricable part of human bone handling. Results indicated an adoption of methods across south and north Wales with patterns relating to chronological variation in practices similarly to how different burial contexts were used. Neolithic communities had a strong connection with the concept of collectivism and segregation of the body which might have been symbolized through these processes (Pollard 1997: 50; Parker Pearson 2000: 204) and might have differed compared to those performed in controlled and segregated monuments. Cave burials expressed a renegotiation of roles and identities (Brück 2001; Fowler 2001, 2010), a re-definition of death and experimentation and served as vehicles of collective identities (Thomas 2018: 133). Certain taphonomic modifications emphasized separation in treatment (fracture morphologies, weathering) with multi-stage burials performed across regions (south and north Wales) and reflecting three-fold processes. These could have entailed collection of body parts, different phases of decomposition, selective removal, re-arrangement or scattering of bones. Various stages of manipulation, re-burials and fragmentation were therefore achieved in this process.

#### 8.2.2.2. *Summary*

Excarnation practices were identified across Wales and were part of multi-stage burials involving selection, processing and secondary deposition.

Despite the overall low weathering presence recorded across caves, short or prolonged sub-aerial exposure separated treatment between the individuals and showed continuation of practices between south and north Wales from the Early to the Late Neolithic. Different treatment between individuals was further associated with human agency as selected remains were circulated or processed after excarnation (or during early peri-mortem interval) suggesting that co-mingling in caves was not solely the result of natural causes (e.g. disturbances by scavengers, geomorphology).

Chronological variation in practices was identified in Early to Middle Neolithic contexts in Wales and Early to Late Neolithic contexts in north Wales. Adoption of practices across regions indicated that excarnation and constant re-working of bone played a definitive role in the Neolithic and often made the distinction between natural causes and human action challenging. However, over- or under-representation of body



parts, histological preservation of excarnated remains and fluctuations in element frequencies and zone completeness possibly related to the selection of certain individuals for secondary depositions.

Limited demographic evidence demonstrated that all ages were represented in these multi-stage processes, however, adults were the most impacted age-category. Demographic data was insufficient to establish whether selection after excarnation related to age-related differences, as noted for selective retrieval, however a slight over-representation of females involved in excarnation in north Wales could relate to this practice.

Continuation of excarnation in multiple burials from earlier contexts in south Wales supported pre-established traditions that were adopted across regions, focused on experimentation and demonstrated a strong sense of collectivism. Easier access in caves might have played an important role in experimentation, bone re-working during secondary burials and constant circulation of body parts that were discovered in commingled assemblages in north Wales.

### **8.2.3. Exhumation**

Practices of exhumation were identified within multi-stage burials of Early to Late Neolithic. Selective retrieval /curation and processing of bone formed stages in the processes of exhumation across sites in south-east, south-central and south-west Wales and reflected inter-regional variations. Exhumation was often associated with circulation of bone and processing or curation of body parts similarly to excarnation. Sub-aerial exposure was sometimes part of the trajectory however, low OHI scores and under-representation of body parts mainly characterised elements that had been exhumed rather than excarnated.

Assemblages of Early, Middle or Late Neolithic were collectively gathered and deposited in caves. Exhumation was always associated with selective deposition of possibly curated remains that were transported in caves as part of multi-stage burials (e.g. Ifton Quarry, Spurge Hole, Little Hoyle Cave). Practices of exhumation were solely identified in south Wales. Whilst this method was not adopted across regions, it might have been used in different contexts in north Wales or from north Somerset as

concurrent use of above-ground monuments involved similar stacking of bone bundles and co-mingling.

Direct evidence of exhumation in south Wales suggests continuous use throughout the Neolithic. Analogies between monumental and cave burials are discussed to identify patterns of deposition in south Wales.

#### *8.2.3.1. Selection/curation and processing for secondary deposition*

Diversity in burial practices across south Wales often included exhumation and/or rapid disarticulation from excarnation (sub-aerial exposure), followed by collection and circulation of body parts. Sub-aerial exposure for example was primarily noted in Early to Middle Neolithic exhumed assemblages in south-west (Little Hoyle Cave) and south-central Wales (Spurge Hole), regions that were largely associated with practices of selection or curation and residual bone assemblages. Practices of exhumation in south-east Wales (Ifton Quarry) involved peri- and/or ante-mortem manipulation of crania as well as circulation of limbs with dry fractures that resulted at a later stage (not peri-mortem).

Several scenarios have been discussed in this thesis concerning the circulation and movement of remains resulting in lower element frequencies. These included practices of secondary depositions with missing material never ending up in caves (e.g. under-representation of body parts) and remains in monuments brought from primary contexts (e.g. George Rock Shelter) after the soft tissue has decayed with some elements (e.g. smaller bones) deliberately or accidentally left out (Smith and Brickley 2009: 71). Deliberate removal of body parts from monuments to caves following soft tissue decomposition (e.g. Spurge Hole) could have related to practices of selective retrieval that resembled bone bundles in separate chambers within monuments (e.g. Ifton Quarry/crania and Little Hoyle Cave/mandibles).

Secondary burials involving exhumation were characterised by gathering of bones in different stages of decomposition, selection of elements (curated) resulting in under-representation of body parts or over-representation of retrieved elements (Osterholtz *et al.* 2014b: 14). Whilst disturbances, scavenger activity, human displacements and re-use of multi-period sites could have created mixed patterns and caused taphonomic

overprinting, human agency was clearly identified based on macro- and microscopic analysis.

Over- or under-representation of body parts possibly related to practices of curation and selection of certain individuals throughout the Neolithic in caves. Curation or processing after exhumation involved accumulation of different body parts in south-central, south-east and south-west Wales. Chronological variation between sites and individuals was noted and might have related to selection of certain body parts for deposition from the Early Neolithic. Under-representation of corresponding elements (extremities) in Spurge Hole was accompanied by human remains (e.g. long bones, pelvis) that had been collected from separate contexts and were involved in different processes (exhumation, excarnation). Histological examination of excarnated body parts further confirmed that certain long bones were subject to early skeletonization whilst other elements (long bones and cranial) were exhumed and brought to the site for secondary deposition.

Limited demographic evidence suggested that exhumation involved both adults and immature individuals with both males and females represented amongst exhumed assemblages. Results did not relate to chronological changes in practice across sites however, chronological variation was noted between individuals in caves. Individuals of all ages and sexes were subject to multiple stages of manipulation, circulation after exhumation and processing in south Wales from the Early to the Late Neolithic. Two of the three manipulated adult crania from Ifton Quarry, however, derived from females and could have related to differences in processing between individuals.

Processes of exhumation and circulation of body parts could have related to practices of selection with females undergoing more manipulation based on cultural selection. Recent research on kinship practices in Hazleton North suggests that within 15 intergenerational transmissions, one male progenitor reproduced with four women (lower presence of females amongst the assemblage) supporting patrilineal descent, virilocal burial and female exogamy with maternal sub-lineages deposited in particular areas of the tomb based on separate generations (Fowler *et al.* 2021: 584-5, Figure 1). Based on these results, sex representation amongst skeletal assemblages from Neolithic chambered tombs and cairns indicated higher representation of males than females,

however more comparative analyses amongst tomb assemblages is required to test the validity of this argument. Ratios of males and females amongst assemblages from Neolithic chambered tombs have not demonstrated high variability compared to adult and sub-adult ratio (Smith and Brickley 2009: 88) and therefore, age related differences might have been more complex in burial. Data from caves that encapsulated exhumed body parts was insufficient to establish whether patterns related to sex differences or chronological changes in practice from the Early to the Middle/Late Neolithic.

Under-representation or over-representation of body parts was further observed in (Smith and Brickley 2009: 71) in long barrows and chambered tombs (Cotswold-Severn tombs) of the Glamorgan and Monmouthshire group from the Early Neolithic. Similar to assemblages from south-central Wales, human remains of c.40 individuals (including both sexes, adults and sub-adults) from Parc Le Breos were discovered in separate chambers and passages including fragmentary and disarticulated remains and cremated bone. Taphonomic analysis identified peri-mortem fresh fractures, gnawing and separate degrees of exposure/weathering amongst the chamber and not the passage assemblages (Whittle and Wysocki 1998), suggesting that treatment amongst the individuals varied.

Similarly, piles and clusters of bone were discovered in monuments in the Black Mountains/Breconshire group (Penywyrlod, Pipton and Ty Isaf long cairns) (Figure 314 below). Penywyrlod chambered cairn encapsulated the deposits of human remains of about six adults and older subadult/younger adults concentrated in the northeast, northwest and southwest corners of the chamber. Each deposit was found in separate burial areas containing equal frequencies of skeletal elements (skull, axial skeleton, upper and lower limbs). Osteological examination of the assemblage revealed that each deposition consisted of remains of two/three individuals. Pipton, Powys included seven separate piles of bones recovered from one of the monument's chambers (Burrow 2006: 93). These piles were compiled from partial remains of eleven individuals (Wysocki and Whittle 2000) supporting selection of body parts and re-assembling of remains.

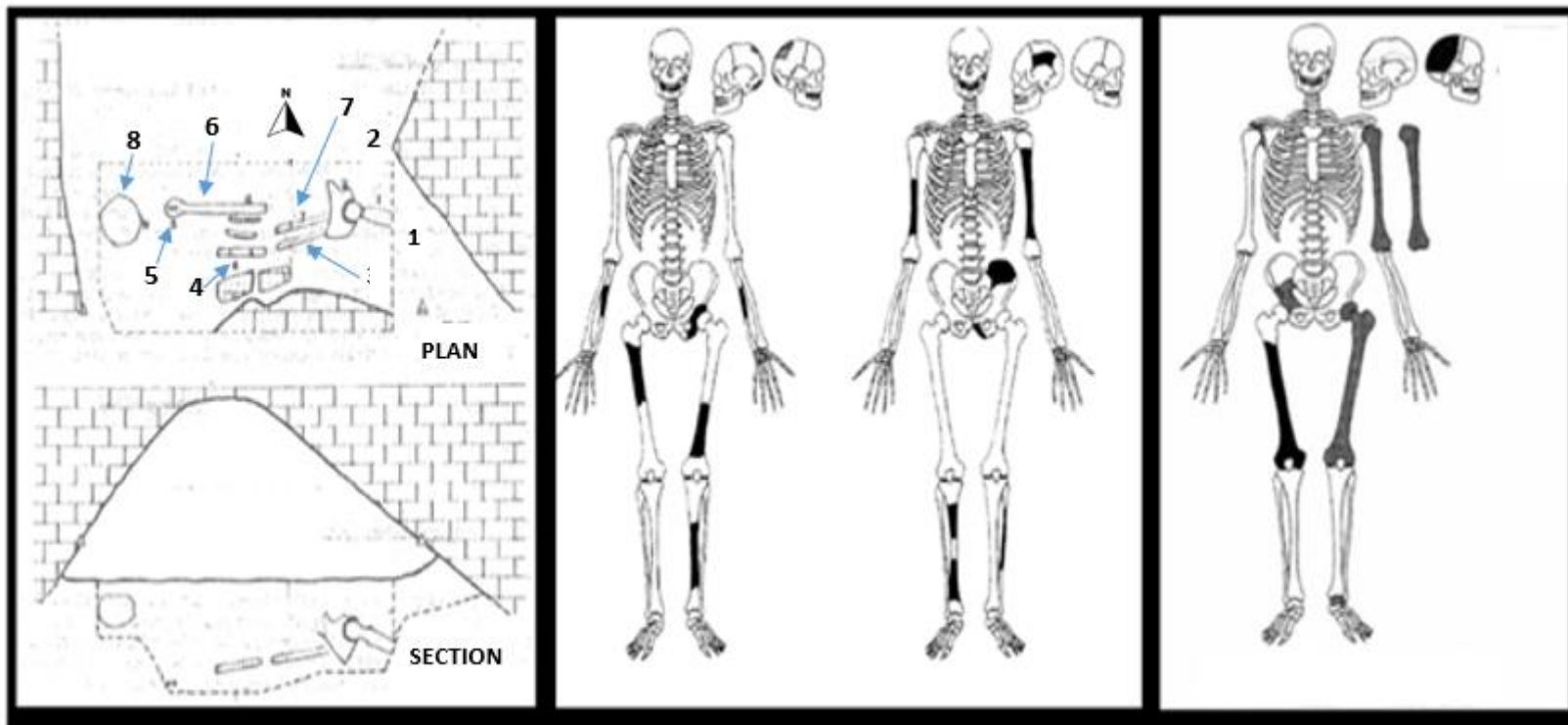


Figure 314. Reconstituted individuals made of different body parts from Spurge Hole (left), Pipton (middle) and Penywyrlod chambered tombs (right). Left: Plan and section of Spurge Hole: 1) left femur articulated with pelvis 2) pelvis 3) right ulna 4) left humerus- shaft fragment 5) two mandibular molars; maxillary molars with loose teeth nearby 6) right humerus – distal end 7) right radius 8) cranium with left mastoid process near the cranium (Davies 1985: 3); Middle: Anatomical locations of female bones (black fill) found in , chamber II, Pipton (groups C/left and F/right) (Wysocki and Whittle 2000: 599); Right: Anatomical and demographic composition of a bone group (A), chamber NE II, Penywyrlod. Top/craniums – Cranium A (no fill), Cranium B (black fill). Post-cranial remains – Male (grey fill), female (black fill), fourth individual (no fill) (Wysocki and Whittle 2000: 598).

Comparable stacking of bones against the side walls was evident in Ty-Isaf cairn where fragmented remains of over thirty individuals were discovered in several of its small chambers (Savory 1980a: 219; RCAHMW 1997: 29). Practices of curation and accumulation of separate body parts in above-ground monuments demonstrated common patterns with caves in south Wales and marked three-fold processes involving selection, re-arrangement and scattering of bones in different contexts. Reconstitution of body parts in mixed assemblages was therefore common in south-central Wales and resembled practices of body curation of individuals of different ages and sex as identified in Spurge Hole. Processes could have reflected decay, transferability and the reconfiguration of the individual's identity in the burial ground with remains involved in separate stages of processing. Three weathered long bones from Spurge Hole exhibited dry fractures that resulted at a later stage during possible circulation whilst high histological preservation indicated that remains were excarnated and moved from their primary location in the Spurge Hole. Human remains were gathered from separate individuals and different contexts with others exhumed and moved for secondary burial. Practices of separation and selection of body parts, resulting in over- or under-representation could have signified an attempt for recombination by interacting with bone bundles in above-ground monuments or disarticulated body parts in caves (Fowler 2001; Whittle 2007; 359; Harris 2018: 11).

Over-representation of crania/skull remains was further noted in south-west Wales (Little Hoyle Cave - Early to Middle Neolithic) and south-east Wales (Ifton Quarry - Middle to Late Neolithic) later in the Neolithic. The assemblages showed intra- and inter-chronological variation and similar selection of body parts. The high number of surviving Early to Middle Neolithic mandibulae from Little Hoyle Cave represented at least 11 individuals (including a juvenile) with a clear under-representation of all other supporting elements. Remains were deposited in an infilled shaft that connected the cave to the roof and resembled a form of 'chimney'. A very low number of hands/feet were discovered scattered in other areas of the cave (multiple entrances) which could support selective deposition of body parts and scattering of smaller elements that were circulated in other areas of or around the cave.

The crania of five adults and two juveniles of Middle and Late Neolithic date from Ifton Quarry were deposited inside a fissure with three adult skulls showing evidence of sharp and/or blunt force trauma. Under-representation of long bones and hands/feet as well as overall corresponding skeletal remains supported intentional deposition of these elements as part of a secondary practice with long bones exhibiting dry fractures that resulted at a later stage. OHI scores further confirmed that remains were once articulated and subsequently exhumed for secondary deposition. Absence of fresh fractures and weathering on the bones possibly suggested that manipulation prior to burial did not take place (i.e. dismemberment and sub-aerial exposure). Remains appeared to have been selectively deposited in the fissure (old rock shelter) whilst dry fractures on surviving long bones must have resulted from circulation of bones.

Representation of cranial, major long bones and smaller elements was not equal between exhumed assemblages across south Wales and therefore selection of distinct body parts for burial could have related to different cultural aspects of Neolithic societies. For example, over-represented adult crania from Ifton Quarry or selected long bones, small cranial remains of separate individuals from Spurge Hole might have been involved in deliberate circulation of separate body parts. Selection of either cranial or post-cranial remains could have reflected variation in the practice of exhumation within the same region (South Wales). This might have related to chronological changes in practices as human remains were transported or interred in separate contexts whilst disarticulated. Whilst in these processes, human remains were part of different social dynamics that either expressed separation of body parts from the original context or inclusion of elements. For example, changes in practices in south-central Wales either involved selective retrieval (George Rock Shelter) or selective deposition (Spurge Hole) from the Early to the Middle/Late Neolithic. Fluctuations in OHI scores and results from the non-parametric tests between the George Rock Shelter and Spurge Hole demonstrated different burial practices between Early to Middle/Late Neolithic elements (secondary burial/Spurge Hole), whereas, normally distributed OHI scores in the George Rock Shelter (layers 1002-1004) suggested primary burials in the Early Neolithic. Patterns of deposition might have therefore related to chronological changes in practice suggesting intra-regional variation. These burial practices were adopted and elements were continuously processed in different manners within the same regions.

Larger assemblages from north Wales, however, involved commingling and deliberate re-arrangement of bodies in separate areas of the cave possibly based on the levels of processing (e.g. Gop Cave, Ogof Pant-y-Wennol). Practices of exhumation were not reflected in the way the dead were treated in north Wales, however, residual bone assemblages similarly indicated three-fold processes. These could have entailed collection of body parts in separate stages of decomposition (e.g. excarnated remains deposited along primary burials), removal or clearing of older interments for further depositions and scattering of bone. Similar patterns were visible in north Somerset (deposition of bodies on left sides, possible clearances and re-arrangement of bodies for more interments) (see Appendices/Site Backgrounds).

Exchange of burial methods and constant re-working of bone through the process of exhumation evidenced wider perception of how people used caves for burials that could have involved re-introduction of depositional methods across regions and contexts. Each cave demonstrated distinct forms of deposition in secondary burial, with intra-chronological variations however, these patterns corresponded to wider perspectives in Neolithic mortuary practices that were executed differently in-between caves and above-ground monuments.

#### *8.2.3.2. Summary*

To summarise, practices of exhumation were part of larger processes in south Wales involving circulation, selection and processing of bone, similar to excarnation. Taphonomic analysis and element frequencies of selected body parts demonstrated that, despite similarities, human remains were exhumed and not excarnated and therefore distinction between the two practices was established.

Chronological variation was apparent between caves in south Wales from the Early to the Late Neolithic. Representation of selected body parts was unequal and practices showed continuation with human remains involved in multiple processing similar to assemblages discovered in above-ground monuments in south-west Britain. Insufficient demographic data did not establish whether selection related to age or sex differences between individuals as all ages and sexes were presented. However, one site in south-east Wales (Ifton Quarry) showed a slight over-representation of manipulated female adult crania (two out of three) and could have related to differences in selection between



males and females. More comparative analysis is required to compare practices of selection/curation, based on sex-related differences, in caves and between above-ground monuments and caves (e.g. Fowler *et al.* 2021; Elliott *et al.* 2022).

Exhumation in south-central Wales (Spurge Hole) from the Early Neolithic was associated with curation, excarnation and re-composition of retrieved body parts that resembled bone bundles and stacking in monuments in the Black Mountains. Practices of re-composition of individuals of different ages/sexes was widely used in south-central Wales with processes of exhumation for secondary burials (Spurge Hole) closely associated with selective retrieval from primary burials (George Rock Shelter). Early, Middle and Late Neolithic practices of exhumation were further identified in south-west and south-east Wales. Clear over-representation of skull elements suggested deliberate curation for secondary deposition, often accompanied by processing of bone and circulation of other body parts in smaller numbers (e.g. hands/feet).

Tailored methods of deposition in south Wales reflected three-fold processes that were similarly recognised in caves of north Wales. Exhumation was not adopted across regions, however, variation in multi-stage burials with exhumed body parts, resembled practices in north Wales and north Somerset that involved processing, circulation and co-mingling, possibly as a form of re-composition of individuals in bone bundles. The re-introduction of practices and concurrent use in above-ground monuments stood as a metaphor for the transitional phases the bodies underwent through different stages of processing. These entailed overlapping practices that showed chronological variation between south and north Wales but also reflected attempts to recombine individuals through different processes.

### **Overall remarks on mortuary practices**

Diversity in mortuary practices was overall reflected across regions and individuals were involved in separate taphonomic trajectories throughout the Neolithic. The complexity in which the dead were treated was visible in the separate stages of manipulation, processing and selection of individuals. Wide burials patterns were identified in south and north Wales which entailed commingled, disarticulated and often poorly preserved remains of individuals of different ages and sexes. Despite this

complexity, careful osteological, macro- and microscopic analyses determined separate methods of processing within Wales and north Somerset.

Absence or presence of certain taphonomic agents (e.g. weathering, gnawing) was combined with element frequencies and radiocarbon dating results and clearly differentiated processes of inhumation, exhumation and excarnation that were practiced in different ways throughout the Neolithic. Concurrent use of caves and monuments demonstrated widespread and common patterns of human manipulation (e.g. bone bundles, selection of body parts) in south-central, north Wales and Somerset between and suggested that cave burial was not dissociated from typical monumental burial. Fluctuations in the numbers of individuals of all ages and sexes throughout the Neolithic supported a continuum in practices. The complexity in which the dead were treated was visible from the various ways caves were used to manipulate disarticulated human remains throughout the Neolithic with practices adopted across regions or re-used later in the Neolithic.

## Chapter 9: Conclusion

### 9.1. Overview

This research demonstrated overlapping depositional methods and regional variation in Neolithic cave practices including practices of inhumation, excarnation and exhumation that did not disassociate caves from Neolithic monumental burials. Practices of exhumation and excarnation were clearly distinguished based on macro- and microscopic data. Various methods were adopted from the Early to the Late Neolithic and Early Bronze Age and these were expressed in various forms (inhumation, exhumation, excarnation) in caves. Intra- and inter-regional variation in practices often related to variation in chronological patterns, based on new radiocarbon dating evidence, which suggested methods were adopted across regions throughout the Neolithic.

Similarities in taphonomic modifications were identified between caves and monuments/other Neolithic mortuary contexts (e.g. causewayed enclosures) in north Somerset. Concurrent use of caves and above-ground monuments, therefore, reflected variation in practices. Various forms of experimentation and handling of bone differentiated treatment between individuals in caves compared to monuments.

Whilst the number of interred individuals in caves was generally not large, all ages and sexes were represented in caves, including a low, but consistent number of immature individuals. Multiple stages of processing might have been responsible for this representation as human remains were constantly moved from one context to another. Pre-established Neolithic practices (Brace *et al.* 2019: 769) might have related to the expression of wider Neolithic perceptions. These were expressed in the handling of the dead.

The presence of immature individuals amongst an overall fluctuating number of interred individuals from the Early to the Late Neolithic possibly related to the high mortality rates of Neolithic populations (Chamberlain 1997). Immature individuals could have been regarded as functioning adults and received similar treatment that involved processing and separation of body parts in caves which could explain their consistent representation within assemblages from the Early to the Late Neolithic.

Sex differentiation did not demonstrate wide fluctuations in caves, however females/probable females were slightly higher in numbers. Further associations between caves and other contexts must be made to confirm biological divisions. Slightly higher representation of females across sites might have related to cultural selection in practices (e.g. excarnation), however limited demographic evidence could not determine whether these patterns related to certain practices.

Results created a robust dataset for further comparative analyses across Britain and proved the validity and importance of using multi-level analyses for deciphering mortuary patterns and distinguishing between natural causes and human agency. This analysis further underlined the need for further radiocarbon dating evidence across sites, as new dates will clarify the period of more caves in Britain.

## **9.2. Methods of deposition and taphonomy**

Taphonomic analysis refined the depositional history between sites, individuals and regions whilst results gave the impetus for a comparative discussion on regional variation and on caves and above-ground monuments.

Arrangement, circulation, excarnation and re-depositions were reflected in both commingled and fragmentary assemblages in caves and between various contexts (e.g. monumental) throughout the Neolithic. Whilst broader categorizations of multi-stage burials were identified, methods of deposition overlapped, were adopted across regions and re-visited later in the Neolithic. Results reflected separate forms of burial from body curation and selection of body parts to selective removal resulting in residual bone assemblages and multi-stage burials with a range of practices and re-arrangement of body parts. Exchange of burial methods and constant re-working of bone could reflect wider perception of how people used caves for burials.

Different practices were identified based on: selection of body parts (element frequencies), processing of bone (peri-mortem trauma and fresh breaks), sub-aerial exposure and later disturbances/re-arrangement (post-mortem breaks and fragmentation). Presence of either single or multiple depositions (multi-period sites) indicated that separate stages of processing were always part of the trajectory. This involved either prior processing with later deposition in the cave (selection of body

parts) as in the case of Spurge Hole, Little Hoyle Cave and Ifton Quarry, selective removal (George Rock Shelter), or various processing creating complex taphonomic trajectories (Ogof Colomendy, Gop Cave, Ogof Pant-y-Wennol, Backwell Cave). Whilst regional variations (south Wales – north Wales and north Somerset) were established, skeletal remains always formed part of multiple burial stages. These involved prior depositions in the cave, repeated processing and re-arrangements or later deposition.

Assemblages from south Wales appeared more curated and selected. The numbers of interred individuals showed fluctuations, but practices were overall more tailored compared to the larger and more chaotic assemblages from north Wales. These involved co-mingling and separate processing between individuals followed by possible deliberate re-arrangement of bodies in separate areas of the cave (e.g. Gop Cave, Ogof Pant-y-Wennol). Similar patterns were visible in north Somerset based on the available excavation report (deposition of bodies on left sides, possible clearances and re-arrangement of bodies for more interments) (see Appendix 5/Site Backgrounds) and new microscopic results (this PhD) which supported different treatment between individuals.

Primary deposits (usually over-representation of hands/feet) were identified on a number of sites across south and north Wales and north Somerset, however these were always accompanied by selective removal, excarnation of certain elements and/or bone processing. Both primary and secondary burials were identified within assemblages from the Early to the Late Neolithic and methods of deposition appeared to have been adopted.

Excarnation/sub-aerial exposure was not always part of multi-stage burials as demonstrated by its low presence amongst the assemblage. However, selected body parts with evidence of advanced weathering supported different treatment between the individuals, selection, circulation and separate stages of processing such as peri- and/or post-mortem manipulation (fresh/dry breaks, sharp force trauma). The practice was identified in caves of both south and north Wales, with a much larger presence in north Wales. Chronological variation between the individuals was apparent and the practice showed continuation from the Early to the Late Neolithic.

Exhumation was always associated with selective deposition of possibly curated remains that were transported to the caves as part of multi-stage burials (e.g. Spurge Hole, Little Hoyle Cave). Inter-regional variations were apparent in the Early-Middle and Middle-Late Neolithic. Exhumation was clearly distinguished from excarnation and evidenced different treatment between the individuals. Practices of exhumation were solely identified in south Wales, however these might have been used in north Wales in different forms (excarnation rather than exhumation). Re-introduction of methods in north Wales for processing of bones could have been achieved through excarnation.

Separate OHI scores (microscopic analysis) with elements demonstrating different ratios of taphonomic modifications further supported a range of methods of bone processing. This was systematically followed throughout the Neolithic and, therefore, re-defined how the body was treated. Cave burials must have formed an integral part of the depositional history in the Neolithic which gave prehistoric communities the opportunity to experiment with bone processing. On the contrary, the rigid and confound spaces in monuments might have encapsulated elements involving division of body parts, selection of skeletal remains for excarnation and re-deposition. Concurrent use of caves (in instances of close proximity e.g. Spurge Hole) might have been involved in these stages.

### **9.3. Theoretical approaches**

Established theory was used to compare whether methods of deposition in caves corresponded to treatment of the individuals in other contexts (monuments). Concurrent use of caves and monuments demonstrated a shared ideology of handling the dead and burials in caves were performed through multiple activities. Human remains from individuals of different ages, sex and often from distinct periods (from the Early to the Late Neolithic and Early Chalcolithic) were part of various stages of processing, circulation and handling to achieve multi-stage practices.

Methods of deposition in caves did not disassociate them from typical monumental or other forms of burial as various ways of burying the dead were adopted from the Early to the Late Neolithic and Early Bronze Age (similar to the practices recognized in monuments/see Chapter 3). Whilst recent studies based on aDNA (Fowler *et al.* 2021)

have argued that separate generations of the same family were distinctively buried in monuments (Hazleton North), no direct evidence of elitism (Childe 1945), lower or higher social rank (Atkinson 1968; Kinnes 1975) and/or egalitarian, autonomous communities (Piggott 1954) can differentiate people that were buried in monuments and caves. This argument can be further supported by comparable stable isotope analysis that concluded that no significant difference in diet was found amongst groups of people buried in caves and cairns of south-west Wales (Schulting *et al.* 2013: 22). New avenues of research (e.g. Elliott *et al.* 2022) can therefore be established using aDNA, isotope studies and taphonomic analysis.

#### **9.4. Chronological variation in practices**

Lack of radiocarbon dates was the biggest obstacle of this project as several sites were either poorly dated or multi-period. To establish the chronology of diverse mortuary treatment in caves, ten new radiocarbon dates from seven sites in Wales were produced to support the research (see 6.2.3). Methods of deposition were not confined within one timeframe but showed variation throughout the Neolithic. For example, practices of inhumation, excarnation and exhumation took place in multiple sites across regions from the Early to the Late Neolithic and Early Bronze Age. Different treatment between individuals (from distinct periods based on radiocarbon dating) across south and north Wales and north Somerset further characterised variation in mortuary practices in the Neolithic.

Accurate recording and use of multiple methods of analysis created a more nuanced narrative of deposition in multi-period sites and underlined the urgent need for more analysis (e.g. further radiocarbon dating to verify depositional patterns in Priory Farm Cave and Ogof Colomendy).

Radiocarbon dating of more elements within assemblages could clarify this issue, as multi-period caves allow us to record possible irregularities amongst the total assemblage and test whether these persist amongst smaller assemblages.

## **9.5. Methodological approach**

By combining macroscopic analysis of bone surface preservation and microscopic analysis of bone microstructure this research examined pre, peri- and post-depositional processes and different mortuary practices (inhumation, excarnation and exhumation). Osteological analysis further revealed demographic patterns across sites in Wales that were, however, insufficient to draw definitive parallels and where incorporated where possible.

Taphonomic analysis was further used to explore the impact of cave taphonomy and distinguish natural causes from human agency. This was reflected in burial trends and the identification of different treatment between individuals and proved the validity of using multi-scalar approaches for the reconstruction of mortuary practices in such challenging contexts. Methods of deposition were cross-referenced with key taphonomic modifications to clarify how results of both micro- and macroscopic analyses related to these practices. Regional patterns were identified, and each case-study demonstrated distinct burial methods that, however, corresponded to wider patterns. Methods of deposition overlapped, were adopted across sites and practices showed a continuum from the Early to the Late Neolithic.

## **9.6. Limitations**

As highlighted throughout this thesis, cave taphonomy creates complex narratives in deciphering mortuary treatment and distinguishing between natural/geomorphological causes and human agency. Human remains deposited caves are subject to various factors that affect the survival rate of the bones. Combined with biological factors, the preservation of the remains is ultimately impacted by various causes that can cause similar patterns (equifinality) and distort our understanding of past activity. Poor preservation, disturbances, lack of stratigraphy and often loss of material were formed some important limitations to this research. This issue was addressed by using a multi-level approach to assess pre- and post-depositional treatment and create a stronger depositional and chronological narrative in caves in south-west Britain.



## **9.7. Future directions and final summary**

### **Future directions**

Multi-level methods using macro- microscopic analyses and radiocarbon dating, however, not only benefited this research and but also wider prehistoric archaeology as results underlined that importance of examining fragmentary records. Combining macroscopic indices with histological analysis can therefore disentangle issues of how bodies decompose and disarticulate under different circumstance in separate contexts, between individuals and animal and human bone. Macroscopic and microscopic taphonomic analyses are great methods in understanding the causes of bone degradation and particularly differentiating between natural causes and human agency. Use of such combined methods can transform understanding of mortuary practices in caves across Britain and more broadly, between caves and other forms of burial. An enhanced approach would include a more robust dataset (e.g. less sites with more human remains for more comparative analysis for both macro- and microscopic analysis, provision of more radiocarbon dates) and more advanced techniques (explained below).

Radiocarbon dating is crucial in establishing a solid chronological foundation for practices between sites and individuals. Caves do not have typical depositional pathways, with material reworked by cave hydrology and consequential movement of interments, disturbances caused by human occupation, scavengers and excavations. As a result, stratigraphy is not a reliable index of chronology and radiocarbon dating is crucial in understanding the history of use of these sites. Accurate dating of human remains supports research into cave archaeology in general, and Neolithic burial practices but can also enhance our understanding of the occupation and uses of caves compared to other contexts.

Use of new techniques can further assist in deciphering taphonomic trajectories in caves. Isotopic, aDNA studies and more advanced techniques (e.g. biomolecular analysis, 3D laser scanning) can exponentially improve our understanding of the people interred in separate contexts (between caves and caves and monuments). Demographic patterns can be established more clearly and variation in practices can relate to differences in age or sex. This could enhance our knowledge of the people that were buried in caves in the Neolithic compared to those buried in above-ground monuments.

A combination of these methods can therefore, help determine criteria for selection of mortuary practices in different contexts which could relate to family ties, age or separate processing.

### **9.8. Final summary**

Results revealed variation in practices of inhumation, excarnation and exhumation between caves and regions. Evidence suggested different stages in the interaction with the dead across sites throughout the Neolithic. Multiple stages were employed during decomposition and disarticulation. These were either practised in the form of body curation, selection or removal of body parts (resulting in unbalanced element frequencies) (south Wales) or in a series of peri- and post-mortem manipulation and processing (North Wales/North Somerset). Results emphasized the complexity and systematic use of various forms of deposition throughout the Neolithic and created robust evidence for comparisons between cave and monumental burials.

### **Research value**

This project demonstrated that a taphonomic approach, fortified by the provision of new radiocarbon dating can decipher complex trajectories in commingled and disarticulated remains and caves and can define taphonomic profiles between sites, regions and individuals. This approach was genuinely unique in a Neolithic context and compared taphonomic data from both caves (primary) and monuments (secondary) to understand mortuary treatment. Results using this multi-level analysis therefore portrayed a clearer image of past activity across Wales, on a regional and individual basis. Adoption of burial methods across regions (south versus north Wales and north Somerset) established a continuum in practices in caves with individuals of different ages and sexes being part of complex trajectories.

Overall, this research provided great insight into multi-level and overlapping mortuary practices in Neolithic caves and created a robust database for future, comparative work in caves across Britain or between monuments and caves.

## 10. Bibliography

References included in Appendix 1 and (primarily) Appendix 5 (Site Backgrounds) are listed in 'Supporting sources' (page, after the Bibliography which includes in-text references). Supporting sources have been used in the gathering of burial data and are listed here separately for assistance in tracking direct bibliography from the Appendices.

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All appendices have been submitted separately due to their size.

1-4 Appendices/Spreadsheets (excel) include **Appendix 1**: gathering data (sites used in the thesis), coding (primary data/macrosopic taphonomic analysis), histology (primary data/microscopic taphonomic analysis), <sup>14</sup>C results (primary results from radiocarbon dating), abbreviations (list of abbreviations used in Chapters 5-7, and in coding and histology (Sheets 2 and 3) and excluded sites (sites not included in the thesis, gathering of secondary data and justification for exclusion). **Appendices 2-4** – Results from statistical analysis (summary statistics) – used in Chapters 6 and 7. Tables and figures presented in Chapters 6-7 and Appendix 6 were based on these results. Sheets include data used for statistical analysis (SPSS) coded –abbreviations for coding included within sheets and clarification included in columns below (list).

**Appendix 1** – Sites, coding, histology, <sup>14</sup>C results, abbreviations, excluded sites

This database is too large to fit into a document, so a digital file is submitted separately

Sheet 1 – Site list

Sheet 2 – Coding

Sheet 3 – Histology

Sheet 4 – Dentition

Sheet 5 – <sup>14</sup>C results

Sheet 6 – Methods and abbreviations

Sheet 7 – Excluded sites

**Appendix 2** – All sites statistical analysis

This database is too large to fit into a document, so a digital file is submitted separately

Sheet number and data used

Clarification

Sheet 1 – Data-stats

All data (taphonomy, demography) across sites coded for SPSS

Sheet 2 – Data-zones	Data on zone survival for long bones
Sheet 3 – Data-FFI	Data on Fracture Freshness Index for fractured long bones
Sheet 4 – FFI-double entries	Data on Fracture Freshness Index for fractured long bones with both ends fractured (given double entries)
Sheet 5 – Data-age	Data used for demography
Sheet 6 – Data-sex	Data used for demography
Sheet 7 – Data-loose teeth	Data used for loose teeth representation
Sheet 8 – Teeth taphonomy	Data used for taphonomy on teeth
Sheet 9 – Histology	Data used for microscopic taphonomy across sites

### **Appendix 3** – Example of regional statistical analysis

This database is too large to fit into a document, so a digital file is submitted separately

<u>Sheet number and data used</u>	<u>Clarification</u>
Sheet 1 – Data-stats south-central Wales	All data (taphonomy, demography) from south-central Wales coded for SPSS
Sheet 2 – Data-zones	Data on zone survival for long bones
Sheet 3 – Data-FFI	Data on Fracture Freshness Index for fractured long bones
Sheet 4 – Data-age	Data used for demography
Sheet 5 – Data-loose teeth	Data used for demography

Sheet 6 – Teeth taphonomy                      Data used for loose teeth representation

Sheet 7 – Histology                                  Data used for microscopic taphonomy  
from south-central Wales

**Appendix 4** – Example of case study - statistical analysis

This database is too large to fit into a document, so a digital file is submitted separately.

<u>Sheet number and data used</u>	<u>Clarification</u>
Sheet 1 – Data-stats Ogof Pant-y-Wennol	All data (taphonomy, demography) from a single case study (example) coded for SPSS
Sheet 2 – Data-zones	Data on zone survival for long bones
Sheet 3 – Data-FFI	Data on Fracture Freshness Index for fractured long bones
Sheet 4 – Data-age	Data used for demography
Sheet 5 – Data-sex	Data used for demography
Sheet 6 – Data-loose teeth	Data used for loose teeth representation
Sheet 7 – Teeth taphonomy	Data used for taphonomy on teeth
Sheet 8 – Histology	Data used for microscopic taphonomy for Ogof Pant-y-Wennol

**Appendix 5** –Site backgrounds (page numbers from separate file)

<u>Site name</u>	<u>Page number</u>
Cathole Cave	1
Spurge Hole	2

Red Fescue Hole	3
George Rock Shelter	3
Pitton Cliff Caves	4
Ifton Quarry	5
Little Hoyle Cave	5
Nanna's Cave	7
Hoyle's Mouth Cave	8
Ogof yr-Benglog/New Cave	9
Priory Farm Cave	9
Ogof Garreg Hir	10
Ogof Brân Goesgoch	11
Cae Gronw Cave	11
Pontnewydd Cave (Bont Newydd Cave)	12
Ogof Colomendy	14
Orchid Cave	15
Gop Cave	16
Ogof Pant-y-Wennol	17
Little Orme's Head Quarry	19
Backwell Cave	20

**Appendix 6** - Tables, figures and data from results. Page numbers from separate file.  
Criteria selection: data that was not considered essential for the presentation and direct interpretation of results (Chapters 6 and 7) and discussion (Chapter 8) has not been included in the main thesis. However, this data (including graphs and tables) was the product of complex analysis and cross-referencing of proxies that could not be discarded and was therefore included as supporting information in the appendix. The structure and presentation of data in Appendix 6 follows the organization of Chapters 6 and 7 for consistency and easier guidance: frequency of skeletal elements, element completeness, MNI/demography/pathology, Taphonomy/Macroscopic results, Microscopic results.

<u>Appendix 6</u>	<u>Tables, figures and data from results</u>	<u>Page number</u>
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	Element completeness	2
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	Taphonomy – Macroscopic results	4
	Microscopic results	21
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	Dental pathologies	25
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	Microscopic results	45
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	Taphonomy – Macroscopic results	53
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	Element completeness	104

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7.3.	George Rock Shelter	113
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7.4.	Little Hoyle Cave	127
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	MNI, demography and pathology	131
	Taphonomy – Macroscopic results	131
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7.5.	Priory Farm Cave	147
	Frequency of skeletal elements	147
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	Taphonomy – Macroscopic results	151
	Microscopic results	162

7.6.	Ogof Garreg Hir	162
	Element completeness	162
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7.7.	Ogof Colomendy	163
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