Archaeology Wales

Llandrillo Campus Extension Llangefni (Anglesey)

Archaeological Excavation Analysis Report

By

Rhiannon Joyce BA (Hons) MSc

Report No. 1806

Archaeology Wales Limited
The Reading Room, Town Hall, Llanidloes, SY18 6BN
Tel: +44 (0) 1686 440371
Email: admin@arch-wales.co.uk
Web: arch-wales.co.uk

Archaeology Wales

Llandrillo Campus Extension, Llangefni (Anglesey)

Archaeological Analysis

Archaeological Watching Brief and Excavation

Prepared For: GLLM

Edited by: Mark Houliston	Authorised by: Irene Garcia
Signed:	Signed:
Position: Managing Director	Position: Project manager
Date: 24.6.19	Date:24.6.19

By
Rhiannon Joyce BA (Hons) MSc

Report No. 1806

June 2019

Archaeology Wales Limited
The Reading Room, Town Hall, Llanidloes, SY18 6BN
Tel: +44 (0) 1686 440371
Email: admin@arch-wales.co.uk
Web: arch-wales.co.uk

Contents

List of Figures

List of Plates

List of Tables

Non-Technical Summary

During August and September 2017, Archaeology Wales Ltd undertook an archaeological excavation of a section of an early medieval cemetery preceding the commencement of ground works connected with a proposed new engineering centre and a car park at Llangefni campus, Penmynnyd Road, Llangefni, Anglesey (OS Grid Reference SH4715875762). The associated Planning Reference Number is 34C304K/1/EIA/ECON. This report presents the final Archaeological Analysis of the results.

Analysis of the results of the archaeological investigations at Llangefni has helped to identify three phases of activity: two associated with the use of the site as a cemetery and one associated with the drying of corn. The earliest phase of activity relates to a late Roman cemetery characterised by extended earth-cut inhumations. The second phase relates to an early medieval cemetery characterised by stone lined cist burials and the final phase relates to a pit used to dry corn.

Macroscopic analysis of the skeletal remains suggests the individuals buried at the development site were generally in good health at their time of death, whereas isotopic analysis of the remains shows that most were not born on Anglesey. The scientific analysis, along with the residual fragments of imported pottery suggests these individuals moved to Anglesey and traded in over-seas material culture.

Although the site is identified as an early medieval, Christian, cemetery it is likely that pagans and Christians were buried together. This is potentially identified through the presence of grave goods and the alignment of the graves, some of which were not on the west-east orientation typical of Christian burials.

The skeletal remains recovered during the excavation have a level of preservation which is very rare for Anglesey. Detailed analysis of these remains, considered in association with the other results of the excavation, has resulted in a much better understanding of the area during the late Roman and early medieval periods, significantly contributing to our knowledge of these important periods.

To further contribute to this knowledge, it is imperative the two assemblages from Archaeology Wales and Archaeolog Brython Archaeology are analysed together. Without the full assemblage, the results are not complete.

All work was conducted in accordance with the standards and guidelines of the Chartered Institute for Archaeologists (2014) and complied with the methodologies set out in the Archaeological Method Statement (WSI).

Crynodeb Annhechnegol

Yn ystod mis Awst a mis Medi 2017, gwnaeth Archaeology Cymru Cyf waith cloddio archeolegol ar ran o fynwent ganoloesol gynnar cyn dechrau gwaith tir a oedd yn gysylltiedig â chanolfan beirianneg newydd a maes parcio ar gampws Llangefni, Ffordd Penmynydd, Llangefni, Ynys Môn (Cyfeiriad Grid OS SH4715875762). Y Cyfeirnod Cynllunio cysylltiedig yw 34C304K/1/EIA/ECON. Mae'r adroddiad hwn yn cynrychioli'r Dadansoddiad Archeolegol terfynol o'r canlyniadau.

Mae'r dadansoddiad o ganlyniadau'r ymchwiliadau archeolegol yn Llangefni wedi cynorthwyo i nodi tri chyfnod o weithgaredd: dau sy'n gysylltiedig â'r defnydd o'r safle fel mynwent ac un sy'n gysylltiedig â sychu grawn. Mae'r cyfnod cynharaf o weithgaredd yn gysylltiedig â mynwent Rufeinig hwyr, sydd wedi'i nodweddu gan gydgladdedigaethau estynedig yn y tir. Mae'r ail gyfnod yn gysylltiedig â mynwent ganoloesol gynnar sydd wedi'i nodweddu gan gladdedigaethau mewn cistiau carreg ac mae'r cyfnod olaf yn gysylltiedig â phwll a ddefnyddiwyd i sychu grawn.

Mae dadansoddiad macrosgobig o'r gweddillion ysgerbydol yn awgrymu bod yr unigolion a gladdwyd ar y safle datblygu yn gyffredinol mewn iechyd da pan fuont farw, tra bo'r dadansoddiad isotopig o'r gweddillion yn dangos nad oedd y rhan fwyaf ohonynt wedi'u geni yn Ynys Môn. Mae'r dadansoddiad gwyddonol, ynghyd â'r darnau gweddilliol o grochenwaith wedi'i fewnforio, yn awgrymu bod yr unigolion hyn wedi symud i Ynys Môn ac yn masnachu mewn diwylliant deunydd tramor.

Er bod y safle wedi'i nodi fel mynwent ganoloesol gynnar Gristnogol, mae'n debygol bod paganiaid a Christnogion wedi'u claddu gyda'i gilydd. Mae'r posibilrwydd hwn wedi'i nodi drwy bresenoldeb nwyddau claddu ac aliniad y beddau - nid oedd rhai ohonynt wedi'u lleoli o'r gorllewin i'r dwyrain fel sy'n nodweddiadol o gladdedigaethau Cristnogol.

Mae lefel gadwraeth y gweddillion ysgerbydol a ganfuwyd yn ystod y gwaith cloddio yn brin iawn ar gyfer Ynys Môn. Mae dadansoddiad manwl o'r gweddillion hyn, a ystyriwyd ar y cyd â chanlyniadau eraill y gwaith, wedi arwain at ddealltwriaeth llawer gwell o'r ardal yn ystod y cyfnodau Rhufeinig hwyr a chanoloesol cynnar, sydd wedi cyfrannu'n sylweddol at ein gwybodaeth am y cyfnodau pwysig hyn.

Er mwyn cyfrannu ymhellach at y wybodaeth hon, mae'n hanfodol bod y ddau gydosodiad gan Archaeology Cymru ac Archaeoleg Brython Archaeology yn cael eu dadansoddi ynghyd. Heb y cydosodiadau llawn, nid yw'r canlyniadau'n gyflawn.

Cynhaliwyd yr holl waith yn unol â safonau a chanllawiau Sefydliad Siartredig yr Archeolegwyr (2014) ac fe'i casglwyd gan ddefnyddio'r dulliau a nodir yn y Datganiad Dulliau Archeolegol.

1. Introduction and planning background

In July 2017, Archaeology Wales was commissioned to conduct an archaeological excavation at Llangefni College Campus, Anglesey (SH 47158 75762) during the construction of a new engineering centre and carpark, Planning Reference Number 34C304K/1/EIA/ECON (Figure 1-2). The excavation was requested by Grŵp Llandrillo Menai after an archaeological evaluation conducted by Archaeoleg Brython Archaeology indicated that the site was of national importance (Parry *et al.,* 2017).

The development site was one of six areas investigated. All six were subject to geophysical survey prior to evaluation trenches being cut (Stratascan 2016; Parry *et al.,* 2017). In total 41 evaluation trenches were excavated to test anomalies present in magnetometer and ground penetrating radar data. Particular attention was paid to the area east of the development site, as it lay adjacent to an area where early medieval burials had been previously excavated during the construction of the Llangefni Link Road (Parry *et al.,* 2017).

The evaluation revealed 15 burials, which included those in both long cists and pit graves. They formed a distinct area located within the development site (the area of the proposed new engineering centre and the car park located to the east). In addition to the burials, the remains of a possible corn dryer and finds dating to prehistoric and Romano-British periods were recovered.

The burials clearly formed part of a larger cemetery area, parts of which were first excavated during the adjacent work on the Llangefni Link Road. Given the national importance of the site as a whole, Gwynedd Archaeological Planning Service recommended the complete excavation of the development site.

The following Analysis Report has been produced in accordance with the Project Design Post-Excavation - Stage 4 - Final Report (Garcia Rovira 2018), which included details of the aims and methodology of the required specialist analysis. The report detailed the analysis of the human remains and the artefactual and ecofactual assemblages recovered during excavation, and a discussion of the local, regional and national context of the site. The aim of the report is to provide archaeological analysis for full understanding of the excavation results.

The location of the site and the geology of the area is described in Section 2, while the archaeological and historical background are summarised in Section 3. Following this, the methodology employed during the excavation is detailed, including how the human remains were excavated and the sampling strategy employed. The stratigraphic account is detailed in Section 6, which is followed in Section 7 and 8 by the specialist summaries of the human remains, the artefactual and the ecofactual evidence. Finally, in Section 9, all of the evidence is considered in terms of its intrinsic value and its contribution to our understanding of the site as a whole, although with the proviso that the full results of the Llangefni Link Road have not yet been published.

Provisional results from the Link Road excavation have already demonstrated that both phases of the cemetery site are likely to be of national importance. This view is supported by the evidence discussed in Section 9. The impact of the site on local, regional and national research frameworks is considered.

2. Location and Geology

The cemetery area is located on the eastern edge of development site, which itself is at the eastern edge of the Coleg Menai campus. The campus is located on the eastern edge of Llangefni, approximately 6 miles to the north-west of Menai Bridge. The site measures approximately 39,250m^2 and is bounded to the east by the Llangefni Link road and to the west, south and north by open grassland that lies within the bounds of the college. The site also contains an area of heavily disturbed land, due to heavy plant training at the college. The site lies on land that slopes gently from north-west to the south-east, with the site itself at approximately 40m AOD. To the south-east the land drops off more steeply towards a spring and watercourse approximately 600m away. The surrounding landscape is gently undulating, although low lying, with a number of springs and drains across the immediate area.

The underlying geology is comprised of the Clwyd Limestone Group. This bedrock formation consists of limestone with interbedded sandstone and conglomerate rock. This is a sedimentary rock formed during the Carboniferous period and it dominates most of the surrounding landscape. The town of Llangefni and the area to the west overlies the Gwna Group, which is a Schist bedrock formed during the Cambrian and Ediacaran periods. The Gwna Group also includes small areas of quartzite bedrock, a small pocket of which is located just to the west of the Coleg Menai campus. The superficial deposits within the area of the site are comprised of Devensian Till, formed during the Quaternary period due to the action of the ice sheets and the melt water (BGS, 2017).

3. Historical and Archaeological Background

The wider landscape surrounding the development site is archaeologically rich, with a number of prehistoric monuments recorded close by. These include the standing stone at Hirdre-Faig (AN155) to the south-east and the burial mound of Mynwent y Llwyn (AN065) to the south. The burial chamber of Bryn Celli Ddu (AN002) is located approximately 3km to the south-east. Sites of medieval through to modern date are also well represented with the medieval moated site of Tre-Garnedd (AN047) and Brew Colliery (AN152) located to the south of the site. The site of Capel Eithin (AN120) lies 2km to the south-east of the site. Excavations revealed this to be a multiperiod site with occupation dating from the Neolithic through to the medieval periods. The activity on the site includes a Neolithic horse-shoe shaped enclosure, a Bronze Age cremation cemetery and a Roman stone structure, although the exact nature of this is unknown. The excavations have though focused on the early medieval cemetery, which is thought to be evidence of early Christianity on Anglesey. Of the 99 graves excavated, 40 were long cist types with the remaining being simple pit type graves. A number of special graves were identified by the excavators, which had square ditched enclosures around them, thought to possibly have supported timber superstructures although this has not been proven (Longley and Richards, 2000). Other such mortuary enclosures have been excavated at sites such as Ysgol Hendre, Caernarvon and Llandygai (Kenney and Parry, 2012; Longley and Richards, 2000).

The first comprehensive archaeological study of the site and its immediate landscape was undertaken during works related to the construction of sections 1 and 2 of Llangefni Link Road. A Desk Based Assessment (AMEC, 2014) and a subsequent archaeological investigation, which included a geophysical survey and an archaeological evaluation revealed little potential for archaeology in the area (ASDU, 2014; WA, 2014). However, during an archaeological watching brief an early medieval cemetery, with exceptional bone preservation, was found centred at SH 4723 7579. Osteological examination of the remains found indicate that at a minimum of 54 individuals are represented in that assemblage (Parry *et al.,* 2017).

The results of archaeological investigation during the work relating to the construction of the Llangefni Link Road led to the recommendation of archaeological mitigation in advance of the expansion of Llangefni Campus. The development plan was sub-divided into six separate areas and an initial stage of non-intrusive investigations was carried out in Areas 4, 5 and 6 (Parry *et al*., 2017; Stratascan 2016). A ground penetrating radar survey was conducted in the eastern extreme of Area 6 in order to try and locate the extent of the early medieval cemetery found in previous work on the link road, although this proved inconclusive (Parry *et al.,* 2017). This was followed by an archaeological evaluation, with 38 trenches being excavated in total across all six areas. Within Area 6 at least a further 15 graves were revealed, and it was estimated that the cemetery contained a further 20 to 50 graves, with the limits of the cemetery falling within Area 6. In addition to the cemetery, the remains of a possible Bronze Age burnt mound, a potential corn dryer and of finds of prehistoric, Romano-British and medieval date were also recorded. The finds assemblage included two copper alloy brooches, the foot of one bow brooch of early Romano-British date and a penannular brooch, which is likely to be post-Roman in date.

Roman Anglesey

The Roman military arrived in Britain in AD 43, bringing large parts of lowland England under their control by the summer of AD 47. Attentions then turned to the conquest of Wales, which ancient sources tell us was split into four separate territories at this time. These were the territories of the Silures in south and east Wales, the Demetae in southwest Wales, the Ordovices in central Wales and the Deceangli in north Wales (Jones and Mattingly, 2007; Guest, 2008). The peoples of these territories resisted the Roman army for over 30 years, finally being brought under Roman control in AD 76/77. During the campaigns across Wales a large number of forts, fortlets and temporary camps were constructed (Jones and Mattingly 2007). One prominent fort, Segontium, was located at Caernarfon, across the menai strait from Anglesey, and a smaller fortlet was located at Holyhead. These were constructed after Agricola defeated Anglesey in AD 77 (Davies 2003).

It was not until the Hadrianic period that the numbers of forts began to be reduced. This was not the case with Segontium however as it was the most important and long-lived military installation in north Wales. There is evidence of the courtyard still being in use in the 3rd Century (Burnham, Davies 2010; Casey, Davies, and Evans 1993). It is suggested that Segontium was eventually evacuated in AD 280-290 (Wheeler 1924), but there is no documentary evidence to support this.

With the reduction of the military presence the number of native farmsteads increased in north Wales. These farmsteads were largely constructed in a similar fashion to Iron Age examples, small enclosed settlements with a number of round houses within. On Anglesey, these round house settlements also included rectangular structures. Some of the sites where these structures have been excavated include Din Llingwy (Baynes 1930), Melin y Pas (Kenney, Smith 2001), Llansadwrn (Waddington 2013), and Llanddyfnan (Waddington 2013), surviving with varying levels of preservation. Most of these sites are not wealthy settlements but working areas with evidence of industrial activity. One clear example of this is Din Llingwy located on the north coast of Anglesey. This site consisted of two round, and five rectangular 'workshop' buildings. These had evidence of smelting hearths and iron slag, suggesting they were areas of metalworking (Baynes 1930). Other finds were also retrieved such as faunal remains, coarse ware pottery and shells. All retrieved finds suggest the site was a rural working area due to the lack of fine ware retrieved from the site.

Wealthier sites, with more stereotypical, Roman style, buildings are also known from the Welsh landscape, with a small number of villas having been excavated. This is nevertheless not the case on Anglesey as no Roman, villa type building, has ever been excavated in the region and there is no documentary evidence to suggest they ever existed. There are however some high-status settlements on Anglesey that lack the villa type buildings but have high status finds. Cefn Cwmwd, located three kilometres southwest of Llangefni, had no obvious villa like structure but had a strong material culture including finds such as: imported samian ware, glass beads, a shale bracelet and coin hoard (Roberts, Cuttler, Hughes 2013). The finds retrieved from Cefn Cwmwd suggests a high-status site without stereotypical Roman style structures.

Early Medieval Anglesey

Early medieval Anglesey spans the period of AD 400-1075, the time between the end of Roman rule and the first Norman intervention. Archaeological evidence for this time period is sparse, contributing to a poorly understood time period in Wales. It is likely that settlements were similar to those from the Roman period but consisted largely of wooden structures, such as the hut settlements as Rhos Gogh (Waddington 2013). Due to the highly acidic soil on Anglesey, most of the material culture from the early medieval period does not survive in the archaeological record.

Christianity became the official religion of the Roman empire in the fourth century and was popular with Roman soldiers (Kenney, Parry 2012). With the Roman fort of Segontium located in Caernarfon, early evidence of Christianity on Anglesey is unsurprising. There is very little evidence of ecclesiastical sites on Anglesey during the early medieval period and it is not until the 12th century the first stone church is recorded (Cuttler, Davidson, Hughes 2013). Therefore, much of our understanding of early Christianity in Anglesey relies on assessing the change burial practices. The most obvious change being the transition of cremation to inhumation as the dominant burial rite. Although the poor burial environment means skeletal remains rarely survive, grave location and alignment, suggests Christianity was practiced in Anglesey centuries before the first stone church was recorded.

The typical Christian burial is an extended, supine, inhumation orientated west-east, with the cranium located to the west. Although there is no document stipulating Christians must be buried with their heads to the west, it is a long-standing tradition. Christians believe that Christ will appear from the west on the day of reckoning and by being buried with their head located to the west, they will be rise to see him (Cuttler, Davidson, Hughes 2012). During the early medieval period, although the style of inhumation had regional differences, it was very rare for Christians to be buried with grave goods. On Anglesey, early Christian inhumations consisted of stone lined cists (Cuttler, Davidson, Hughes 2012), earth cut (Kenney, Parry 2012), and enclosed within a structure (Longley, Richards 2000) or ditch (Brassil, Owen, Britnell 1991). Often these early medieval burial grounds were settlement cemeteries instead of religious ones, meaning that Christians and pagans were often buried together. It wasn't until the 7th century that cemeteries became more structured with burial location being determined by religion instead of settlement (Kenney, Parry 2012).

It was common for old burial sites to be reused in the early medieval period and this is evident on Anglesey, with over 40% of burial sites having connections to previous use (Webster, Brunning 2014). In addition to this, most cemeteries had a focal point where some clusters of graves would be orientated towards. This was commonly a grave (Longley, Richards 2000) or a standing stone (Cuttler, Davidson, Hughes 2012).

4. Methodology

The impact of the development on the archaeological resource was mitigated by a set piece excavation. The program was designed to meet the standards required by *The Chartered Institute for Archaeologist's Standard and Guidance for Archaeological Excavation* (2014). The location of the excavation area (Figure 2) was agreed to with GAPS prior to the commencement of works. The excavation area was stripped to the top of the archaeological horizon, in spits, using a tracked 360º mechanical excavator that was fitted with a toothless grading bucket. All soil stripping was supervised by a competent archaeologist. The excavation area measured 158 metres in length by 35 metres in width and was stripped from the south-west corner moving to the north-east (Plate 1-2). This allowed for the limits of the cemetery to be observed during the stripping and to ensure that any archaeological features outside the cemetery boundary were also observed and recorded.

Following the initial machine excavation, the area was hand cleaned and all archaeological features located and recorded. All features recorded across the site were excavated and all significant archaeological deposits were 100% hand excavated. Such excavation proceeded to the top of the natural subsoil in this area. All archaeological features excavated were recorded with a GPS as well as being hand drawn through the use of sections (where appropriate) and plans. All of the features were photographed using a 12MP digital camera. All the deposits encountered were recorded by means of a continuous context numbering system and recorded on proforma context sheets. All features and deposits are described in accordance with CIfA conventions. A register of all contexts and photographs was also made.

The majority of the features encountered during the excavation were long cists or pit graves containing well preserved human remains. The strategy used for the excavation of human remains was periodically reviewed and informed by osteoarchaeologists who formed part of the excavation team; Caroline Sims and Rhiannon Joyce. Furthermore, the osteoarchaeologists supervised and offered advice to the excavation team.

The excavation of human remains included as a minimum:

- The initial exposure of the cemetery was carried out by a mechanical excavator monitored by a qualified archaeologist. In order to avoid damaging the remains, mechanical excavation ceased before reaching 0.40m below ground level. This measure represents the minimum depth at which the graves have been revealed in previous stages of investigation (see Parry *et al*., 2017).
- The graves were defined through manual excavation using appropriate tools to avoid the disturbance of burial contents. Once the grave cut was revealed, an initial record was produced using a GPS.
- Graves were 100% excavated in plan.
- The first exposure and cleaning of the skeletons was carried out using suitable tools to avoid any further damage of the remains (Wooden hand tools, brushes etc).
- Recording was carried out using suitable skeleton proforma sheets.
- Plans of the skeletons were produced using rectified photography.
- Soil samples of the abdominal and chest areas of the body were taken to retrieve evidence of gallstones and worm infestations. Forty litre samples were taken from juvenile and adult burials, including samples from the areas of the head, feet, hands, chest and stomach.
- Soil samples were also taken from the fills within the cists to maximise the potential for environmental studies and to obtain material suitable for dating.
- Lifting of human remains was carried out taking into consideration anatomical areas of the body (head, torso, limbs – recording which site). This remains were stored in bags perforated to prevent deterioration. Storage of individual bones were considered if the bones are particularly fragile.
- Great care was given to the retrieval of teeth as these are a fundamental source of information for estimating age, sex, provenance and DNA studies.
- Particular attention was given to the definition of intercutting graves. To avoid difficulties during the post-excavation stage, the fieldwork team took extra care in differentiating between the bones of an articulated individual and those disarticulated remains that may be residual of earlier truncated graves.

- Once the excavation of the burial has been completed, the cist stones were removed to investigate the possibility of earlier phases.

Research objectives

During the assessment report several research questions were developed. This final report aims to answer the following:

- Understand the hiatus and timespan between the first and second cemetery phase
- Understand the hiatus and timespan between the sub-phases during the second cemetery phase
- Obtain absolute dates from the non-cemetery pits and understand the relationship between them and the cemetery
- Understand why the Roman finds assemblage is found in a predominantly early medieval site
- Understand the function of the non-cemetery pits
- View Llangefni in the landscape of the Roman period
- Understand Llangefni in relation to its wider context including early medieval burial practices, population make up, and diet

5. Cemetery and Non-Cemetery Features (Figure 3-4)

Whilst developing the project design, several questions were identified to help interpret the site. During post excavation, scientific analysis was conducted on the remains to answer these questions. As a result, the stratigraphic account was modified, and the updated version is included in section six. The following will answer all questions regarding the cemetery and non-cemetery features outlined in the project design (see Appendix 2).

Cemetery

Whilst the site was in use as a cemetery, there is clear evidence of site phases. The first phase of the cemetery is characterised by extended, earth cut inhumations and the second by stone lined cist graves. These phases are separated by a colluvium layer (1139) visible throughout site, measured a maximum depth of 0.30m, and demarcates the transition from earth cut graves to stone line cist burials. To determine the hiatus between the first and second cemetery phase, radiocarbon dates were obtained from skeletal remains from both phases. The skeletal remains used to determine the hiatus were SK1033 (396-539calAD) and SK1072 (536-650calAD). A maximum hiatus can be determined using the earliest date from the first phase and the latest date from the second phase. This gives a maximum hiatus date of 396-650calAD, although the actual hiatus range is likely to be much less than 354 years.

Due to the site being located on a slope, it is likely the amount of colluvium visible on site would have built up much more rapidly than 354 years. Anglesey is a small island and due to this, the weather can often be poor with large amounts of rainfall occurring in a short amount of time. This would contribute to the colluvial build up and have an increase on the amount of colluvium visible on site. Therefore, it is very unlikely the colluvial build up would take 354 years. The radiocarbon dates do however provide a maximum date range which is beneficial for the study of the development site.

Even if this hiatus was brief, there is a clear difference in burial practices between the first and second phase of the cemetery. The transition from earth cut graves to stone lined cist burials could be evidence of migrants moving into the area and burying their dead in a different way. The isotope analysis outlined in section seven helps to validate this statement as most skeletal remains from the development site have isotopic values suggestive of being born away from Anglesey. If this is the case, the evidence of migrant arrival, along with the change of burial practices, could be evidence of the Llangefni founding community.

An alternative interpretation for the transition of earth cut burials to stone lined cists could show the transitionary period between paganism and Christianity. Although the earth cut graves are also on a roughly west-east orientation, there is evidence of pagan burials also being on this alignment if they were orientated towards a feature such as a status burial (Cuttler, Davidson, Hughes 2012). No feature was excavated during the 2017 excavation, but this doesn't mean it was not there. A feature burial may have been located beneath the new road adjacent to the site, or within the area excavated by Archaeolog Brython Archaeology. A better understanding of this suggestion will be possible when both sites are analysed together. A further indication this could be a transitionary period between paganism and Christianity is possibly seen in the use of stone lined cists. It has been suggested that stoned lined cists could be representative of the tomb of Jesus Christ and by being buried in this manner makes you closer to God (Webster, Brunning 2014). If this hypothesis is true, as all burials from the second phase are stone lined cist burials, the second cemetery phase is indicative of a Christian cemetery.

It is uncommon for grave goods to be located within Christian burials, however there is evidence of a brooch (SF 089) and coin (SF 131) being buried as grave goods on this site. It is known that pagans and Christians were often initially buried together in settlement, rather than religious cemeteries (GAT report unpublished). This could show a uniformed burial practice within the cemetery, with pagans being differentiated by grave goods. Additionally, the transition from settlement to religious burial sites could determine why the cemetery at Llangefni went out of use. A full discussion on finds from this site is in section eight.

One grave [1084] truncated a pit [1115]. Before radiocarbon dating, it was assumed [1115] predated the cemetery but the dates obtained from grain, determined [1115] was contemporary with the early medieval cemetery and the grain suggests the pit was used for the drying of crops on site. Please see section five for further information on the non-cemetery features. An alternative suggestion however could be that it was a pagan offering pit. The pit is on the site of a cemetery and contemporary with it, therefore the seed residues could represent the residue left over from the offerings left in the pit. If this suggestion is correct, it could help confirming the development site was a cemetery for both pagans and Christians.

In addition to clear phases on the cemetery site, sub-phases are also evident. For the sub-phases to develop there must have been some hiatus, otherwise, earlier graves are unlikely to be truncated. It is assumed that for a grave to be truncated, its location should be out of living memory. The radiocarbon dates however do not support this. This is likely because the radiocarbon date ranges fall on a flat part of the calibration curve, resulting in broad date ranges. It is not possible to determine a more accurate date range from each skeleton; therefore, a hiatus is not visible using radiocarbon dating. Consequently, the sub-phases must be determined by analysing the truncations of earlier graves.

The lack of hiatus visible using radiocarbon dating suggests that any hiatus at the cemetery would have been minimal. The truncation of earlier graves however implies there must have been some form of hiatus as the location of earlier graves were forgotten and resulted in being truncated when digging new graves. This suggests the burials were not grave markers, or they had disappeared by the time of the second sub-phase. A further suggestion for the truncation of the graves could be due to familial relationships. This however cannot be confirmed unless DNA testing was done on the skeletal remains from the truncated graves.

Non-cemetery features

There were three, non-cemetery related, pits located within site which were all initially thought to predate the cemetery as [1042] and [1003] were cut into the natural horizon. On later observation, pit [1115] cut (1139) meaning it must post-date the earlier Roman cemetery. Additionally, it was possible for radiocarbon dates to be obtained from two pits [1003] and [1115] but no dateable material was retrieved from pit [1042].

After radiocarbon dates had been obtained, it was noted that none of the pits were contemporary. Pit [1042] was a sub oval pit, filled by a single deposit (1043) which had 66 fragments of animal bone and one fragment of Romano-British pottery. The quantity of animal bone retrieved from (1043) means it was unlikely used a primary food waste pit but more likely for secondary food waste. It is not possible however to determine what the secondary use was. Pit [1042] cut the natural and had no other relationship on site, so was therefore stratigraphically placed in phase 1. It is possible that [1042] and [1115] are contemporary, but the lack of material suitable for radiocarbon dating retrieved from [1042], means it had to be stratigraphically placed in the first phase.

It was possible to radiocarbon date the two other non-cemetery features as they both had charred material within the deposits. Sub oval pit [1115] contained one deliberate backfill (1116) and cut into a colluvial layer (1139). The heating in the base of fill (1116) suggests some form of industrial activity but the lack of material makes if difficult to determine what the activity was. The lack of burning on the bed rock the pit cuts into suggests the deposit was not burnt in situ but burnt elsewhere before being put in [1115]. Charred plant remains retrieved from (1116) dates the pit to 600-665calAD which suggests the pit was contemporary with the early medieval cemetery. The fact the pit was contemporary with the early medieval cemetery suggests it was unlikely used for industrial activity as previously thought. The burnt grain retrieved from the samples associated with (1116) suggests the pit was used to dry grain at the same time as the cemetery was in use.

A final sub oval pit [1003] was cut into the natural horizon and contained three fills (1004), (1005), (1006). The middle deposit (1006) had evidence of burning but not in situ, and the uppermost fill (1005) had an abundance of charred grain. This led to the conclusion that pit [1003] was probably related to drying crops. The charred plant remains obtained from (1006) dated the pit to 669-770calAD. This means that the pit relating to the drying of grain post-dates both cemeteries. On the eastern side of the cemetery, there is evidence of a possible corn dryer. This shows the drying of crops was taking place within the site. As there was no dateable material from the corn dryer and radiocarbon dates have not yet been obtained, it is not currently possible to determine if these features are contemporary. This is information which can be analysed when this assemblage is joined together with the finds from Archaeolog Brython Archaeology.

6. Stratigraphic Report (Figure 3-4)

In total 36 cut features and a stone surface were encountered during excavation of the site. These features represent at least three clear phases of activity, with the second phase having five sub-phases. The stratigraphic account has been developed using traditional archaeological techniques and radiocarbon dates. Unfortunately, many of the radiocarbon dates fall on a relatively flat part of the curve, meaning that the date ranges are fairly broad. Where possible, the stratigraphic account and radiocarbon dates and been used together to make the date ranges more accurate. For the full list of radiocarbon dates please see Appendix 1. The stratigraphic discussion that follows is split into phases, beginning with the earliest identified phase.

Phase 1

Two main groups of features can be attributed to Phase 1 activity on the site, which relate to possible industrial use of the site and a small cemetery consisting of seven earth-cut graves. The industrial activity appears to have two distinct sub-phases, with the first comprising of a pit and the second a stone surface. It was not possible to assign the cemetery to either of the sub-phases as there is no relationship between the industrial activity and the graves, however there is a clear distinction between these earth-cut graves and the later, Phase 2 cemetery, which is the reason for the inclusion of these graves within the Phase 1 discussion.

The pit and the graves dating to Phase 1 were all cut through the natural horizon, (1002). This was encountered across the site at a maximum depth of 0.40m and was comprised of a hard, mid-yellow orange clay. In places, particularly at the southern end of the site the limestone bedrock was visible.

Phase 1i: Industrial activity

The earliest feature recorded on site was a pit, cut into the natural. The large sub-oval pit was located on the south-western end of the cemetery, [1042], which measured 2m in length and 1.1m in width with a maximum depth of 0.20m (Figure 9; Plate 8). Singular fill (1043) was a mid-grey brown clay silt. A small fragment of potential Romano-British pottery was recovered from this fill. An assemblage of 66 fragments of animal bone was also recovered from this fill, with identified species being sheep, pig and cow. The elements present, which include ribs, pelvis, vertebrae and lower and upper arm bones, coupled with the presence of chop marks on one element, may indicate that they are food waste. One of the elements also has gnaw marks from a dog present on the surface, which may have occurred after the element had been discarded into the pit. Although the faunal assemblage from this fill is moderate in size for the site, it is unlikely that the pit was primarily used for depositing rubbish as there is just not enough material in the fill. Rather this is more likely a secondary use.

Phase 1ii: Industrial activity

This sub-phase of activity related to stone surface (1041), which covered an area of 4m by 2m and sealed pit [1042] beneath it. The surface was comprised of several unworked and roughly worked limestone blocks, unworked quartz and six quern stones. Four appear to be base stones from rotary querns while the remaining two are the upper stones with central holes. The surviving area of the surface measured 4m in length and 2m at its widest point (Figure 9; Plate 7).

It is likely that this formed part of a larger surface that was in use for an extended period. The much smaller, rounded stones evident around the larger limestone blocks may represent an earlier phase, with the larger blocks being a second phase of surface. The quartz stones appear to have been used to repair the surface and are unworn suggesting the surface went out of use shortly after these were added. No dateable material was recovered. The surface is located in close proximity to one of the evaluation trenches excavated by Archaeoleg Brython Archaeology, which produced evidence of a possible corn drier. It is unlikely the surface represents the remains of a road; more likely it was part of a courtyard or similar that was connected to the industrial activity taking place within this area of the site.

An additional pit [1004] also used for industrial activity is located 21m SSE of the cemetery. Seeds from the upper fill of this pit has placed [1003] into the third phase of activity. It is possible that [1042] also relates to the third phase of activity but without absolute dating, it is impossible to say this for certain. Therefore, without absolute dating, pit [1042] must be included in the first phase of activity because it is cut into the natural with no relation to any other features on site.

Phase 1: Cemetery (Figure 5)

To the east and north-east of (1041) seven earth-cut graves were excavated. It is unsure how these relate to pit [1042] or surface (1041). It is likely that the graves relate to another phase of activity on the site that post-dates the occupation indicated by the pits. However, there is no stratigraphic relationship between the pit and graves, other than they all cut the natural (1002) and so this is not possible to determine.

All the graves, [1031] (396-539calAD), [1051] (397-541calAD), [1074], [1091], [1133], [1170] and [1184], are aligned east to west, with the craniums of each skeleton at the west end of the grave. Two of the graves, [1074] and [1133], did not contain any articulated skeletal material. Each grave however contained some disarticulated skeletal remains. It is not possible to discern whether the skeletal remains belonged to a singular individual, therefore they have been catalogued as 'disarticulated'.

Artefacts were recovered from three of the graves, fill (1052) contained two sherds of pottery, possibly Romano-British in date. The size and abrasion evident suggests these are residual. Grave fill (1032) produced several fragments of iron, SFs 002, 006-009 and 013. These were concentrated around the distal ends of both the tibiae and fibulae of skeleton (1033). One of the fragments is clearly riveted but the levels of corrosion are too great to be certain on their function without further work. Grave fill (1075) produced a partial bow brooch, likely to be a T-shape of first or second century AD date, SF 089. It is possible the brooch is residual but the practice of burying early Roman brooches in graves of late Roman and post Roman date is well documented elsewhere in Britain (Thomas, 2015: 212) and so it may have been deliberately placed within the grave with the deceased at time of burial.

All the graves were sealed by a deposit (1139), which covered the entire site and had a maximum depth of 0.30m. This is a light brown orange deposit whose composition varies from silt to sandy silt. This had inclusions of frequent sub-angular stones varying in size from large to small and charcoal flecks. This deposit seals all the features associated with Phase 1 activity on the site and suggests that the site had been abandoned by this point. The time it took for this deposit to form is unclear and so it is not possible to indicate how long this hiatus may have lasted. It is possible it lasted only a very short period.

Phase 2 (Figure 2)

The bulk of the features excavated on the site are associated with a second phase of activity on the site, with five sub-phases evident. Sub-phases 2ii to 2v all relate to the reuse of the site as a cemetery, with all bar one of the burials being within cist graves. All the cist graves were lined around the sides, and all but nine had limestone capping.

Phase 2i: Industrial Activity

This sub-phase is represented by sub-oval pit [1115], which measured 1.6m in length and 1.20m wide, with a maximum depth of 0.20m. This had been deliberately backfilled with a dark grey black silty clay, which had frequent charcoal inclusions (1116). Mixed charred plant remains from this fill have been radiocarbon dated to 600-665calAD. The base of the cut showed evidence of heating, and suggests the fill was formed through an industrial process taking place near the pit (Figure 10).

The function of the pit is unclear and only one sherd of pottery was recovered from its fill. This is a small body sherd from a Samian ware vessel, the thickness of the sherd suggests it may come from a large bowl form. The sherd appears to be residual though as it is small and very abraded, with the outer slip being heavily pitted (see Section 8).

Phase 2ii: First phase of later cemetery (Figure 6)

This sub-phase of activity is represented by 18 cist graves, [1124], [1164], [1084], [1007], [1030], [1016], [1034], [1058] (561-655calAD), [1011], [1061], [1073], [1101], [1140], [1147], [1153], [1159], [1179] and [1189]. Most of the graves are aligned east to west, although [1023] (614-710calAD), [1073] (536-650calAD) and [1084] (533-648calAD) are on a north-east to south-west alignment. All the graves contained well preserved human skeletal remains.

The edges of each grave were lined by large, roughly worked limestone blocks. There was no evidence of the bases of the graves having been lined. Of the 19 cist graves, only 10 had stone lids and it is unclear if stones were ever placed on top of the remaining 9 or if these graves only ever had stones around the edges of the cut.

All these graves cut through deposit (1139) except grave [1084] which cut through pit [1115]. The fill (1087) contained a Roman coin, SF 131 (Figure 11), which is a cooper alloy coin, either a sestertius or a dupondius, of Antoninus Pius. The coin is very worn with little surviving of the legend (see Section 8 and Appendix I). The positioning of the coin suggests it was deliberately placed in the grave however, it could be residual. This was the only dateable material recovered for this phase of activity.

Phase 2iii: Second phase of later cemetery

This sub-phase is represented by three cist graves, which cut through graves of phase 2ii. These graves are [1023], [1174] (535-649calAD) and [1110] that cut through graves [1034], [1164] and [1124] respectively. These are again lined with large limestone blocks, although only [1110] had evidence of a stone lid. No dateable evidence was recovered from the fills of either grave.

Phase 2iv: Third phase of later cemetery

This sub-phase is again represented by two graves, cist grave [1128], which cuts earlier grave [1110] and pit burial [1195] (534-645calAD), which cuts burial [1174]. Grave [1128] only showed evidence of stone lining, with no lid present. No dateable material was recovered from either of these graves.

Phase 2v: Final phase of later cemetery

The final phase of the cemetery is represented by two further cist graves, [1080] and [1119]. These both cut earlier grave [1128] and are both aligned north-east to south-west. Neither grave appears to have had a stone lid, although the stone lining around the edges of both cuts was well preserved. Again, no dating evidence was recovered from either grave.

The cemetery, in this part of the site, appears to have been abandoned after these graves were dug. As the rest of the cemetery was excavated during different stages of the development process, it is unclear if any later graves exist elsewhere within the cemetery.

Over these graves a thin sub-soil was recorded of mid-orange brown silty clay, (1001). This was overlain by modern topsoil (1000).

Phase 3

The final phase of activity is related to industrial use of the site and is represented by a large sub-oval pit [1003] (Figure 8) cut through the natural horizon. Charred cereal grain from the upper fill of the pit have been radiocarbon dated to 669-770calAD.

Phase 3i: Industrial activity

A large sub-oval pit, [1003], was located 21m SSE from the cemetery area and measured 2.40m in length by 1.35m in width, with a total depth of 0.43m (Figure 7; Plate 3). The pit had three fills, with basal fill (1004) being a dark red-brown silty clay. The fill appears to be a burnt clay that has been deliberately dumped in the base of the pit. There is very limited heat treatment evident in the bedrock the pit has been cut through, which indicates the deposit was not burnt in situ and dumped in the pit sometime after firing. Above this was (1006), a thin dark black brown clay, which had frequent small charcoal inclusions. The presence of charcoal within this fill suggests it linked to the same process that formed the basal fill. The presence of a large amount of charred seeds in the final fill, (1005), indicates that this process was likely related to the drying of crops grown in the surrounding landscape.

7. Skeletal Remains

Skeletal remains form most of the total assemblage recovered from the development site. The preservation and completeness of many skeletons is of a quality rarely found on Anglesey. The following account gives a brief overview of the macroscopic and isotope analysis on the skeletal remains excavated from Llangefni in 2017.

Skeletal remains

Due to poor burial environments in north Wales, skeletal remains are rarely retrieved from archaeological sites. The good level of preservation meant that a full macroscopic analysis could be conducted on the skeletal remains. The assemblage consisted of skeletal remains representing 31 individuals. The macroscopic and isotopic analysis follows. For the full skeletal report, see Appendix 1.

Of the 31, articulated, individuals excavated at Llangefni, 25 were adults, four were subadults, and it was not possible to determine an age range for two individuals. It was noted that most of the adult assemblage was either young (seven individuals) or older (seven individuals) adults. The assemblage size is too small however for meaningful statistical analysis.

Biological sex determination was only undertaken on articulated adult individuals as there is not currently an accurate methodology to determine biological sex on subadult skeletal remains. Therefore, it was not possible to determine sex due to either age or lack of sexually dimorphic characteristics on 12 individuals. Of the remaining 19 individuals, 13 were female, four were male, and two were indeterminate. The bias of females to males suggests the possibility males had different mortuary rights to females. As Archaeology Wales only excavated a small proportion of the cemetery, there is a possibility that the male population were buried elsewhere in the site. This will have to be confirmed when this assemblage is joined with the one excavated by Archaeoleg Brython Archaeology. If the highest concentration of females is focal to this small part of the cemetery, it indicates females were being treated differently as they are buried on the cemetery periphery.

Pathology

The archaeological framework for Wales outlines that attention should be paid to pathological lesions on skeletal remains from the early medieval period. As this is a time period in Wales which has limited osteological data, pathological lesions are important for understanding population health in early medieval Anglesey.

Of the 25 individuals which had dentition, 15 had evidence of dental pathology. This included antemortem tooth loss, carious lesions, periapical cavities and enamel defects. Of the 25 individuals with dentition, seven had evidence of carious lesions, four has periapical cavities possibly representing abscesses, and five with enamel hypoplasia. This shows that, on a whole, the dental health of those buried at the Llangefni cemetery site was good.

Evidence of joint disease was present in nine of the twenty-five adult individuals and unsurprisingly, there was no evidence of joint disease on any of the sub-adult individuals. The vertebral column was most commonly affected, with seven individuals showing evidence for pathological lesions indicative of joint disease. Shoulder and hip joints were also affected, and one individual had osteophytosis on the radius and a metatarsal. Of the nine individuals with evidence of pathology, seven were categorised and older adult, two were middle adults, and on one individual, it was not possible to get a more precise age rang than adult. This suggests the joint disease within this community could be age related instead of activity related.

Healed trauma was evident on four of the individuals. Possible lower limb trauma was evident on two individuals. SK1145 shows bilateral asymmetry of the femoral curve with the left particularly exaggerated, and SK1162 has an atypical angle in the curve of the anterior border of the left tibia, which have the possibility of being well-healed earlier trauma. Upper limb trauma was evident on two individuals. SK1053, exhibiting angling of the left radius most likely the result of a well-healed antemortem fracture. The second upper limb trauma was on SK1064 which had a probable dislocation or other injury to the acromion of the left scapula. Healed trauma suggests there was some level of care in the community as all trauma had time to heal antemortem. It is unlikely that any of this trauma had a direct affect on causing the death of the individuals.

Out of the 35 individuals excavated during 2017, only one had evidence on perimortem trauma. SK1059 had evidence of a perimortem break in the left parietal bone which was most likely caused by a blunt force trauma. The location of the trauma taken into consideration with the trauma being inflicted perimortem, suggests this was the cause of death.

The lack of any severe pathological lesions on the skeletal remains suggests the individuals buried at Llangefni were, generally, in good health when buried. It was assumed the rural living of those buried at Llangefni would cause skeletal indicators typical of heavy, manual work. The typical indicator of this type of work is most visible as joint disease, however only nine of the twenty-five adult individuals had these indicators. Additionally, of these nine, six were categorised as older adults, two were middle adults and it was not possible to estimate an age for one. The bias of joint disease towards older adults suggests the joint manifestations were age instead of activity related. A higher proportion of joint disease may be visible on the male population as typically they would be responsible for the heavier, manual, work but as previously discussed, the bias towards women on this site prevents that analysis.

This is something that should be undertaken when the two assemblages are joined together.

Isotope analysis

The excellent level of preservation at the Llangefni site meant that as well as macroscopic analysis, scientific analysis could also be conducted on the skeletal remains which is very rare for north Wales. Along with radiocarbon dating, to accurately work out the chronology of the site, the skeletal remains were also subject to multi-isotope analysis. Bone collagen and dental enamel was extracted from a selection of the excavated remains to examine diet and geographic origin through multi-isotope ($\delta 13C$, $\delta 15N$, $\delta 34S$, $\delta 18O$, 87Sr/86Sr) analysis. Please see Appendix 1 for the full multi-isotope report.

Carbon ($\delta 13C$) and nitrogen ($\delta 15N$) isotope analysis was undertaken on bone collagen to reconstruct diets of the sampled individuals. A sample was also taken from faunal remains retrieved from site to act as a control measure. It was determined that all faunal remains were from animals raised on Anglesey, except one which was likely raised away from Anglesey. The results of the human skeletal remains were mostly as expected, with all individuals having carbon and nitrogen isotopes consistent with a terrestrial omnivorous diet. It was noted however that there was no evidence of substantial marine protein in any of the diets. This is surprising as Anglesey is a small island surrounded by water and marine life would have been abundant.

Strontium (87Sr/86Sr) and oxygen ($\delta 18O$) and sulphur ($\delta 34S$) isotopic analysis was undertaken on dental enamel and bone collagen to determine the geographic origin of the sampled individuals. Sulphur analysis was undiagnostic for potential origin, but it did confirm the sampled individuals were not consuming marine food. Therefore, it is only possible to use strontium and oxygen isotopes to determine the geographic location of the sampled individuals.

It was possible to conduct strontium and oxygen isotope analysis on 20 of the excavated individuals. The results from this sample were unusually wide for one site, with the combined strontium and oxygen values suggesting only one (SK1059) of the 20 were born in Anglesey. The geographic origins of the remaining individuals are as follows: four (SK1029, SK1103, SK1126, SK1182) had levels expected for western Britain, six (SK1040, SK1162, SK1155, SK1177, SK1015, SK1145) had levels indicative they were from the area located around todays border of England and Wales, five from east Britain (SK1014, SK1033, SK1053, SK1064, SK1186) and four from outside of Britain. Two were indicative to be from a warmer climate such as Iberia (SK1024, SK1167) and two from a cooler climate, possibly Scandinavia (SK1010, SK1091). The sulphur levels of all individuals however were all broadly consistent with Anglesey. We therefore must assume none of the individuals buried at the cemetery were recent migrants to the area.

It is interesting that the majority of individuals buried at this site were not born on Anglesey. Due to the generally poor survivability of skeletal remains in Anglesey, it is unknown whether migrants settled on other parts of the island, during the early medieval period, or if migration was focal to the Llangefni area. The lack of skeletal remains from this time period deems it impossible for regional comparison. There is however evidence of early medieval migration, primarily due to trade, in other parts of Wales such as Llandough (Glamorgan) and Pembrokeshire (Hemer et al. 2013). Hemer (2013) determined this was evidence for the movement of people alongside the trade of material culture with Mediterranean societies and the Byzantine Empire. Therefore, we could assume this form of migration is happening throughout Wales during the early medieval period.

The arrival of migrants to Anglesey during the early medieval period could explain the change of burial practices from earth cut graves to stone lined cists. Migrants from Britain and beyond would have likely brought with them their own funerary beliefs. If this was a community consisting widely of migrants, a change in burial practices is not entirely surprising.

On Anglesey, a Roman naval base was situated at Holyhead and one of its aims was to control trade in the Irish sea (Jones 2010). The location of the port at Holyhead, along with evidence of imported material culture at Llangefni, and high status settlements near by (Edwards et al. 2017, Roberts et al. 2012) determines Anglesey had trade routes throughout Britain and beyond. It is not surprising that, after travelling to Britain to sell their trade, traders and their families settled alongside native people. Additionally, if Anglesey was a hub of trade, it is likely mobile traders, travelled throughout Britain and eventually settled in Anglesey where trade was good. The suggestion that those buried in the Llangefni cemetery site were mobile traders which settled in Anglesey from Britain and beyond, opposes the stereotypical view that they were rural farmers. This new suggestion does however take into consideration the material culture and the scientific data from the skeletal remains to draw this conclusion.

8. Finds and Environmental Results

The site of Llangefni has very well preserved skeletal remains for the area but the archaeological finds were minimal in comparison. This is not entirely surprising as the site is interpreted to be a predominately Christian burial site, where grave goods would not be expected. Two high value objects, a Hod hill type brooch and a dupondius of Antoninus Pius retrieved from graves [1074] and [1084] respectively, were the only two retrieved objects intentionally placed in any of the graves excavated in 2017. All other finds associated with the cemetery appear to be residual. In addition to the finds associated with the cemetery, there was also stone surface covering pit [1042] which included a high quantity of quern stones.

Environmental processing was necessary to retrieve any environmental or material objects which may have been missed during the excavation. After all environmental samples were fully processed, it was determined that any environmental or material objects would be sent to the associated specialist for further analysis. The following section addresses any questions regarding the finds and environmental assemblage addressed in the project design.

High value finds

During the 2017 excavation, two high value finds of Romano-British date were retrieved from two different contexts. These are a brooch (SF 089) and coin (SF 131) from contexts (1075) and (1087) respectively. The following will be a discussion on the high value finds and the contexts they were retrieved from.

The Roman brooch (SF 089) excavated from (1075) is made of copper alloy and identified as a Hod Hill type, similar to Mackreth's types 10d and 10e. These types have a broad date range from mid first to third centuries A.D (2011, 141) and are rarely recovered from mortuary contexts.

The brooch is fairly good condition, with only part of the foot and the head missing. At the top of the bow there are two parallel groves, with no other decorative element's observable. The bow profile at the head is right angled, with the head being flat. The head of the brooch would have rolled under around an axial bar, which is unusual for a Hod Hill brooch as the head usually rolls forward. Part of the notch where the pin would have attached to the axial bar is still evident.

The brooch was retrieved from burial [1074] which only had disarticulated skeletal remains as opposed to an articulated skeleton. This is likely due to the truncation by two later cist burials [1058] and [1062]. As the skeletal remains from this context were disarticulated, and minimal, it was not possible to obtain radiocarbon dates for this grave. It is however possible to obtain an estimated date range for [1074]. The earliest dated grave is earth cut and dated to 396-539calAD (SK1033) and grave [1058] which truncates [1074] is dated to 561-655calAD. Therefore grave [1074] is likely to be dated to AD396-561.

The earliest date for grave [1074] is the late fourth century AD with post-dates the date ranges of the Hod hill type brooch by approximately one hundred years. It is possible the brooch is residual, but this seems unlikely as it is in a good condition and was therefore probably placed in the grave intentionally. The practice of burying early Roman brooches in graves of late Roman and post Roman date is well documented elsewhere in Britain (Thomas, 2015: 212) and could indicate status or wealth.

The most common brooches associated with early medieval mortuary contexts are penannular brooches. The excavated brooch from the cemetery phase at Llangefni is, however, a Hod hill type, which is rarely excavated from this context. One of the few examples of a Hod hill type brooch excavated from a mortuary context comes from

Stanway, Essex (Paynter unpublished). Although lack of skeletal remains excavated from [1074] means isotope analysis is not possible, the high proportion of individuals from this site with an isotopic signature indicative of eastern Britain (see Appendix 1), along with one of the few burials containing a Hod hill type brooch being located in Essex, could suggest this individual originated from eastern Britain. This is however only speculative as the lack of skeletal remains from [1074] means this cannot be scientifically proven.

The coin is a dupondius of Antoninus Pius. The obverse shows Antoninus facing right, but as the coin is worn little other detail is discernible, with most of the legend no longer being present. The reverse shows a standing, draped figure most likely Libertas holding a pileus in her right hand. The only legend that survives on the reverse is SC, 'Senatus Consulto', showing that the value of the coin was supported by decree of the Senate. The coin was possibly minted in the mid AD 150s, however, without the legend it is difficult to be precise.

The coin was located next to the left hip joint of SK1086, dated to 619-647calAD. As with the brooch, this also means the deposition of the coin in the mortuary context occurred much later that its manufacture. On this occasion, the deposition of the coin occurred potentially almost 400 years after it was minted. The location of the coin, close to the left hip, suggests it could have been placed within a small bag attached to the hip at the time of burial. This means it is unlikely that the coin is residual but intentionally placed with the individual when they were buried. As with the brooch, this implies the coin was of importance to the individual it was buried with.

Both high value finds were intentionally placed within a burial with an individual when interred. Although the common association with grave goods is status or wealth, this is not usually the case in Christian burial grounds. As discussed in previous sections, this cemetery was likely the resting place for both pagans and Christians. Therefore, those buried with grave goods could be assumed pagans.

An alternative suggestion for the brooch and coin being buried with an individual is that they were heirlooms. Lillios (1991) states that to identify an object from an archaeological context as an heirloom it is usually, amongst others, has the following traits: portable, have an earlier date range to everything else in the context, contributed to economic or social success, or be an item of adornment. Both the brooch and coin adhere to the traits outlined by Lillios and therefore could be heirlooms. Both objects would have been in circulation for generations before its final deposition. The good condition both finds were in, along with the location of the coin to SK1086 suggests they were objects of value and significance to their owner. Therefore, the suggestion these items were heirlooms cannot be dismissed.

Pottery

Only five sherds of Roman pottery were recovered during the 2017 excavation, with three being fragments from one or more local redware vessels. One sherd of Central Gaulish Samian ware was identified, although the vessel form was not identifiable. In addition to the five sherds of Roman pottery retrieved from site. No pottery was retrieved from any samples. All pottery excavated from site is residual, suggesting a settlement of Romano-British date exists within the immediate landscape, with the site being on the periphery. Additionally, the presence of some Samian ware fragments shows the inhabitants had connections to long distance trade routes.

Quern stones

In total six quern stones were recorded; all had been re-used as part of a stone surface that lay to the south-west of the cemetery. The surface had sealed an earlier pit [1003] with a high quantity of charred seeds in the upper fill (1005). It was determined this pit was used to dry crops from the immediate landscape. The uppermost fill of the pit dated to 669-770calAD which post-dates the cemetery features.

All quern stones have been identified as being of Anglesey Grit and so were produced from stone quarried on the island. A number of other quern stones were found by Archaeoleg Brython Archaeology during the earlier evaluation of the site (Haycock, 2018). These are also likely to be of Anglesey Grit, although the results are yet to be fully published. The high quantity of quern stones made of Anglesey Grit indicates there was possibly a production centre somewhere on the island. There was no evidence from the excavations in 2017 to suggest that the stones were being manufactured on site and so were likely brought in.

Animal bone

The faunal assemblage from Llangefni is moderate in size, with 270 specimens being recorded. Taxon or taxon size could only be identified for a quarter of the assemblage though, with 31 cattle, 23 caprine, 6 pig and 1 dog specimens within the assemblage. Over half of the assemblage was recovered from Phase 1 pit [1042] and Phase 2ii grave fills. The surface preservation of many of the bone fragments indicates that the specimens were lying on the ground surface, or at least open to the elements, for some time prior to final burial. Evidence of canine and rodent gnawing on some of the elements supports this. It is then possible that the faunal remains, particularly those in grave fills, are residual. Incorporated into the graves at the time they were cut rather than being remains of feasting at the grave side. The majority of the elements recovered are tooth and cranial fragments, which would further support this. The lack of animal bone within the fills of the Phase 1 graves in comparison to those of Phase 2, only one fragment of pig bone was recovered, may suggest that the Phase 1 cemetery pre-dates the use of the area for industrial purposes

The only evidence to suggest the deposition of food waste is the faunal assemblage from pit [1042], which belongs to Phase 1i. The pit contained the remains of limb bones, vertebrae and ribs, all more associated with meat cuts than the cranial and teeth fragments common in other phases of activity. One element did have a chop mark on it suggesting butchery, although nothing was evident on the other remains. The size of the assemblage and the poor preservation will not allow much more analysis and the assessment report makes it clear that reconstruction of the husbandry and diet practices of the population is not possible. However, the fact that this pit contains what is likely food waste shows that cattle, sheep and pigs were being raised and eaten in the area surrounding the site. It is possible that these animals were not reared primarily for meat, but it is not possible to make definitive statements here.

Isotope analysis was undertaken on 12 faunal samples consisting of seven cattle (Bos taurus), three sheep (Ovis aries) and two pig (Sus scrofa). For the full isotope report, see Appendix 1. Isotope analysis was initially undertaken on the faunal remains to act as a control measure for the skeletal remains. Carbon (δ13C) and nitrogen (δ15N) isotopic results however were interesting. Similar to the human skeletal remains, many of the faunal remains had nitrogen values are higher than expected for most terrestrial herbivores. They are however within the range expected for coastal herbivores, whereby the nitrogen is enriched through the marine-affected soils (Britton et al. 2008; Jay and Richards 2007). This is similar to the nitrogen values viewed in the human skeletal remains.

There is one anomaly in the isotope analysis for the faunal remains whereby one sheep has much lower than expected carbon values. It is therefore likely that this animal was raised away from Anglesey in an area with less carbon. This shows that although grazing animals, and those used as a food source, were mostly raised on Anglesey, some were raised elsewhere. This could be an example of trade or migrants relocating and travelling with livestock. Although this is a small sample size which makes statistical analysis difficult, there is a clear example of one sheep being raised elsewhere.

Environmental

A total of 133 soil samples were taken during the excavation, with 131 relating to grave fills and two from pit features. All finds from the skeletal remains were as expected with no signs of intestinal parasites. This concurs with the macroscopic pathological analysis which concluded those buried in the Llangefni cemetery were in generally good health.

During stage four, all finds from the samples were quantified. As many of the finds retrieved from the samples are very small, these have been quantified by weight and are as follows:

Faunal remains	36.99g
Fe	10.74g
Magnetic residue	173.88g

Slag	21.32g

Although 173.88g of magnetic residue was retrieved from the samples, it was later determined that only a fraction was related to industrial activity and the rest was natural. Of the 79 bulk environmental samples which had evidence of magnetic residue, only 16 produced evidence for hammerscale, the waste product of metalworking. In all cases the evidence for hammerscale was minimal. It was generally present in flake form, with only one sample producing evidence in spheroid form. Although there was no obvious indication of industrial activity on site, fragments of slag and low levels of hammerscale retrieved from samples suggests there was some level of metallurgical or industrial activity within the landscape of, if not directly at, Llangefni.

The two samples which were unrelated to graves were taken from pits [1003] and [1115]. It was determined that on a whole, the plant remains from these samples are in a relatively poor state of preservation. The fill from [1003] has a high concentration of grain and charcoal. Before radiocarbon dating, it was assumed that [1003] predated the cemetery phase. After the dates were returned it was determined this was not the case. The pit post-dates the cemetery phase and is dated to 669-770calAD.

The grain rich deposit (1005), from pit [1003], had evidence that barley (Hordeum sp.) is the dominant species with wheat (Triticum sp.) and a small oat /brome type (Avena/Bromus sp.) also present. The presence of both large straight and smaller twisted grains suggests the presence of a multi row variety. In addition to grain, the seed capsules of wild radish (Raphanus raphanistrum) was also identified. It is suggested that as the seed capsules are a similar size to the cereal grains, they may have been gathered with the crop an retains during the processing stages. The presence of Stinking chamomile (Anthemis cotula), sedge (Carex sp.), heather/heath (Erica/Calluna sp.) and possible cotton grass (cf. Eriophorum sp.) and knotgrass (cf. Persicaria sp.) suggests some plant material was gathered from a wet, acidic environment. This is highly consistent with the Anglesey burial environment.

It was initially assumed pit [1115] predated the cemetery but as with [1003] this was not the case. Pit [1115] however was dated to 578-646calAD which dates the pit to being in use during the cemetery phase. The fill (1116) of pit [1115] contained 28 degraded fragments of cereal grain which were too poorly preserved to allow further identification. In addition to this, there were two examples of barley grains, two hazelnut shell fragments (Corylus avellana) and a single grass type seed (Poaceae).

Although limited identification can be made regarding the cereal grain from (1116), the radiocarbon dates and the grain suggests pit [1115] was unlikely used for industrial activity as previously thought. Instead, it appears to have a similar function to [1003] and relate to a low-level grain drying process. An alternative view of [1003] is that along with the drying of grain, other processes were happening. The presence of hedge, grass, chamomile and heather could suggest these species were being gathered to be used as bedding and thatch. The waste from these activities may have been deposited in this pit and used as fuel to dry the grain.

9. Discussion and Conclusions

The archaeological investigations at Llangefni revealed three phases of activity. Two of these were associated with the use of the area as a cemetery and the third to activity associated with the drying of corn. The earliest phase of activity relates to a late Roman cemetery and was characterised by extended earth-cut inhumations. The second phase relates to an early medieval cemetery characterised by stone lined cist burials and the final phase relates to a pit used to dry corn.

Macroscopic analysis of the skeletal remains suggests the individuals buried at the development site were generally in good health at their time of death. The bias of females over males suggests biological sex played a role in determining how or where an individual was buried. Until the two assemblages from the cemetery have been joined together however, it is not possible to determine how biological sex played a role in determining burial location.

Isotopic analysis on the skeletal remains determined most of the individuals buried at the development site were not born on Anglesey. The scientific analysis, along with the residual fragments of imported pottery suggests these individuals moved to Anglesey at the same time as trading in material culture.

Although the site is identified as an early medieval, Christian cemetery, it is likely that pagans and Christians were buried together. This is potentially identified through the presence of grave goods, and the alignment of some graves not definitively being on the west-east alignment typical of Christian burials. The gradual transition of settlement to religious cemeteries in the 7th century could help to explain why the cemetery fell into disuse.

The skeletal remains have a level of preservation which is extremely rare for Anglesey. As a result of the excavation, it has been possible to form a better understanding of the late Roman and early medieval inhabitants of the area, and of Anglesey as a whole. To further contribute to this knowledge, it is imperative the two assemblages from Archaeology Wales and Archaeolog Brython Archaeology are analysed together. Without the full assemblage, the results are not complete.

10. Bibliography

Baynes, E.N. 1930. Further excavations at Din Lligwy, Archaeologia Cambrensis 85, 375-393

Brassil, K.S., Owen, W.G., Britnell, W.J. 1991. Prehistoric and Early Medieval Cemeteries at Tandderwen, near Denbigh, Clwyd. The Archaeological Journal 148, 46-97

Burnhuam, B.C., Davies, J.L. 2010. Roman Frontiers in Wales and the Marches. Royal Commission on the Ancient & Historical Monuments of Wales

Casey, P., Davies, J. and Evans, J. 1993. Excavations at Segontium (Caernarfon) Roman fort, 1975-1979. York, UK: Archaeology Data Service.

Cuttler, R., Davidson, A., and Hughes, G. 2012. A corridor through time: the archaeology of the A55 Anglesey Road Scheme. Oxbow Books

Davies, J. L. 2003. A Research Framework for the Archaeology of Wales. Northwest Wales – Roman.

Edwards, N., Davies, T., and Hemer, K.A. 2017. Research framework for the archaeology of early medieval Wales c. AD 400 – 1070. IFA Wales/Cymru.

Hemer, K.A., Evans, J.A., Chenery, C.A., Lamb, A.J. 2013. Evidence of Early Medieval Trade and Miration between Wales and the Mediterranean Sea Region. Journal of Archaeological Science (40) 2352-2359

Jones, R.S. 2010. Holyhead Waterfront, Holyhead, Anglesey. Archaeological and Cultural Heritagge Desk Based Assessment. Cambrian Archaeological Projects. Report 645

Kenney, J. and Parry, L.W. 2012. Cae Ty Gwyn Playing Fields and Environs Development of a New Primary School, Ysgol Hendre at Llanbelig, Caernarfon. Archaeological Assessment of potential for Analysis report and Updated Project Design. Gwynedd Archaeological Trust. Unpublished report

Kenney, J. and Smith, G. 2001. A55 Anglesey DBFO Scheme: Excavation reports for Ty Mawr Melin y Pas and Penmynydd. Unpublished

Lillios, K.T. 1999. Objects of Memory: The Ethnography and Archaeology of Heirlooms. Journal of Archaeological Method and Theory 6 (3): 235-262

Longley, D and Richards, A. 2000. Early Medieval Burial in Gwynedd. Unpublished Report: Gwynedd Archaeological Trust, Report 350.

Millet, M. 1986. Early Roman Cemetery at Alton, Hampshire. Hants Field Club Society 42: 43-87

Parry, I.G., Parry, L.W., Owen, K. and Lynes, M. 2017. Fieldwork report: Archaeological Evaluation Trenching. Coleg Menai Llangefni. Unpublished Report: Archaeoleg Brython Archaeology

Roberts, H., Cuttler, R., Hughes, G. 2012. 'Cefn Cwmwd, Rhostrehwfa pit circle, early Bronze age cemetery, Iron age/ Romano-British farmstead and early Medieval occupation.' In A Corridoor through time: The Archaeology of the A55 Anglesey Road Scheme. Oxford and Oakville: 30-65

Stratascan, 2016. Llangefni, Anglesey (Coleg Menai) Geophysical Survey. Unpublished Report.

Waddington, K. 2013, The Settlement of Northwest Wales: From the Late Bronze Age to the Early Medieval Period. University of Wales Press

Webster, C.J., Brunning R.A., 2014. A Seventh-Centurd AD Cemetery at Stonage Barton Farm, Bishop's Lydeard, Somerset and Square-Ditched Burials is Post-Roman Britain. The Archaeological Journal 161: 54-81

Wheeler, R. E. M. 1924. Segontium and the Roman Occupation of Wales. The Honourable Society of Cymmrodorion. London.

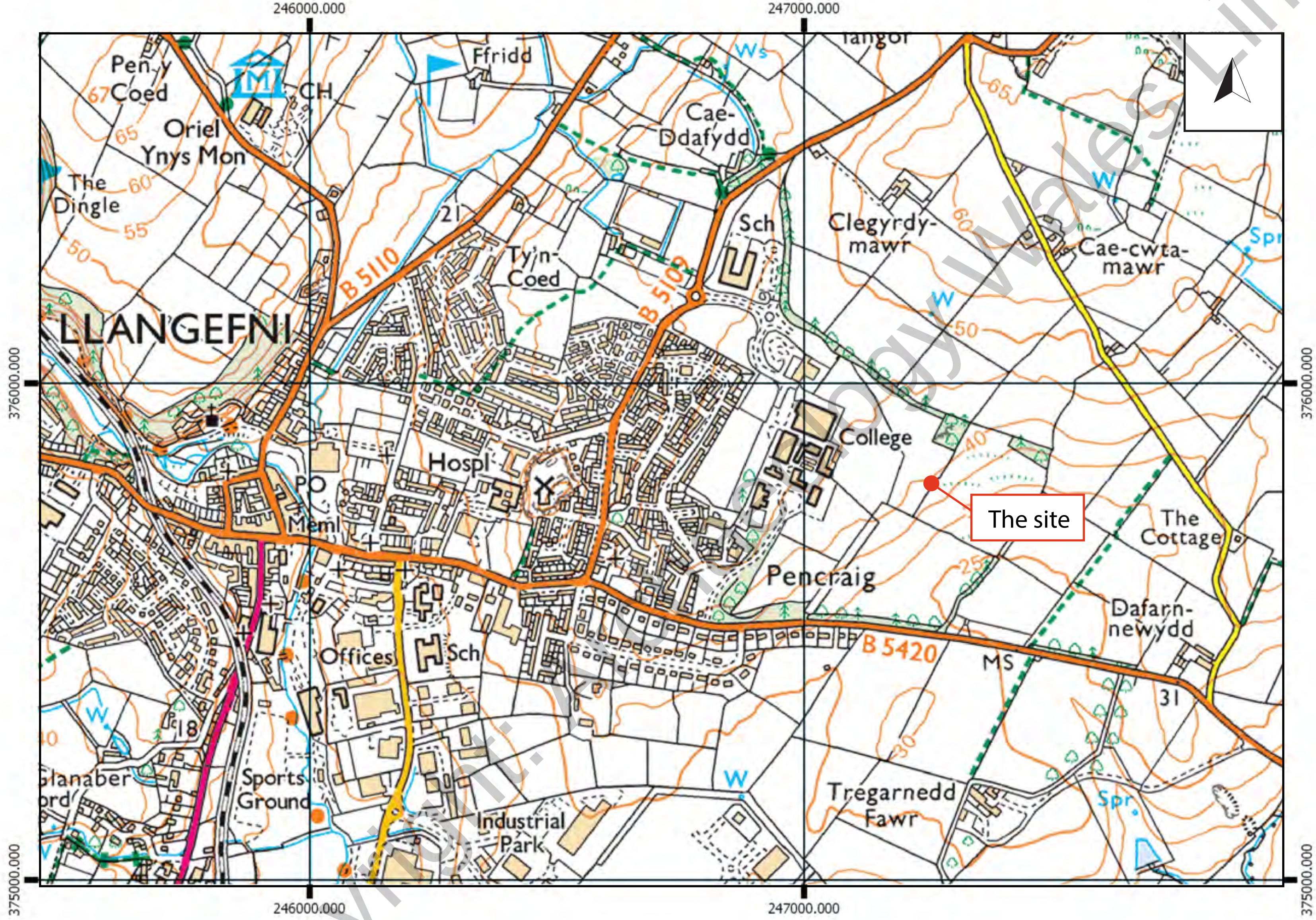


Figure 1. Site location

ARCHAEOLOGY WALES
Revealing the past, informing the future

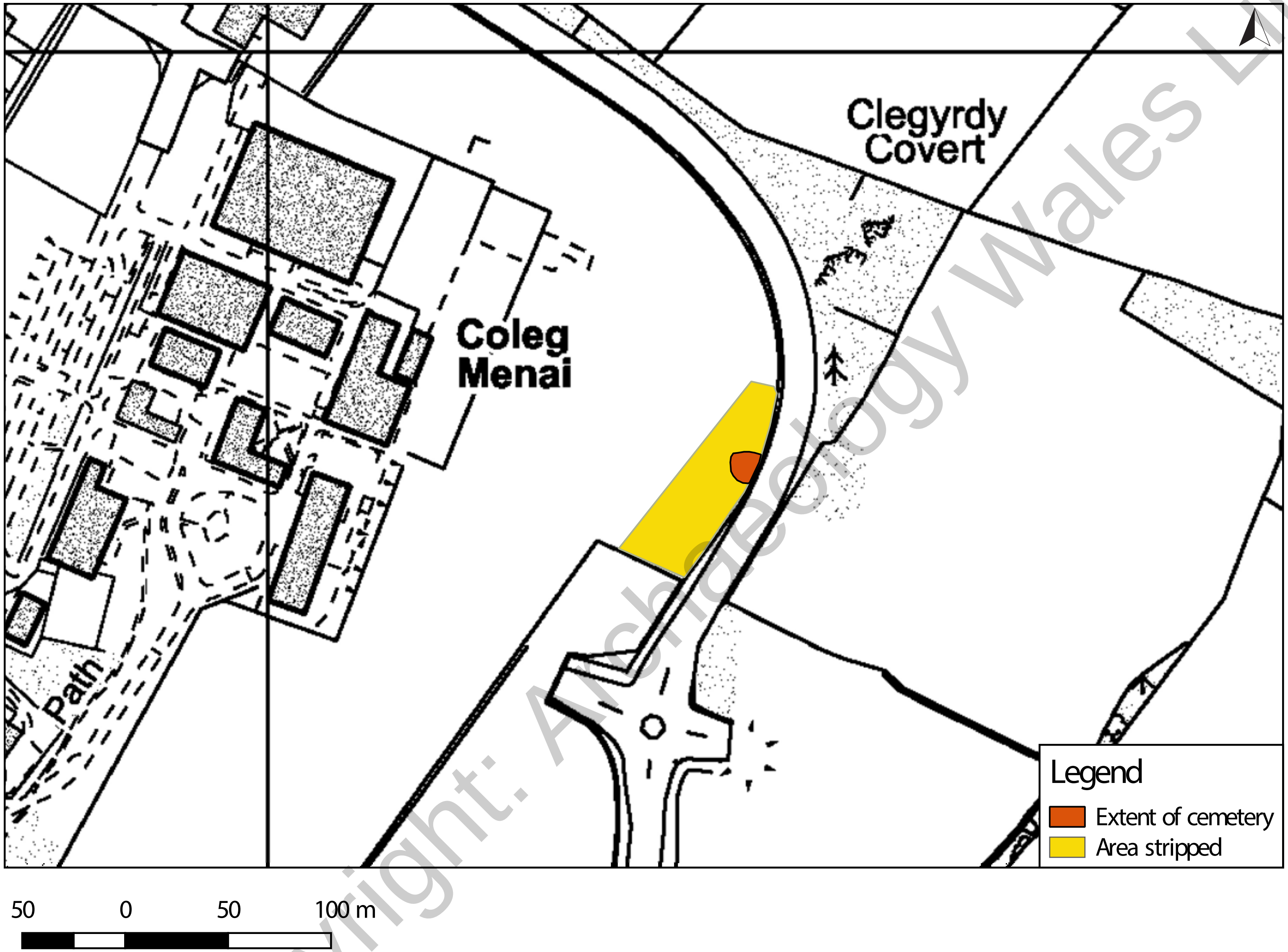
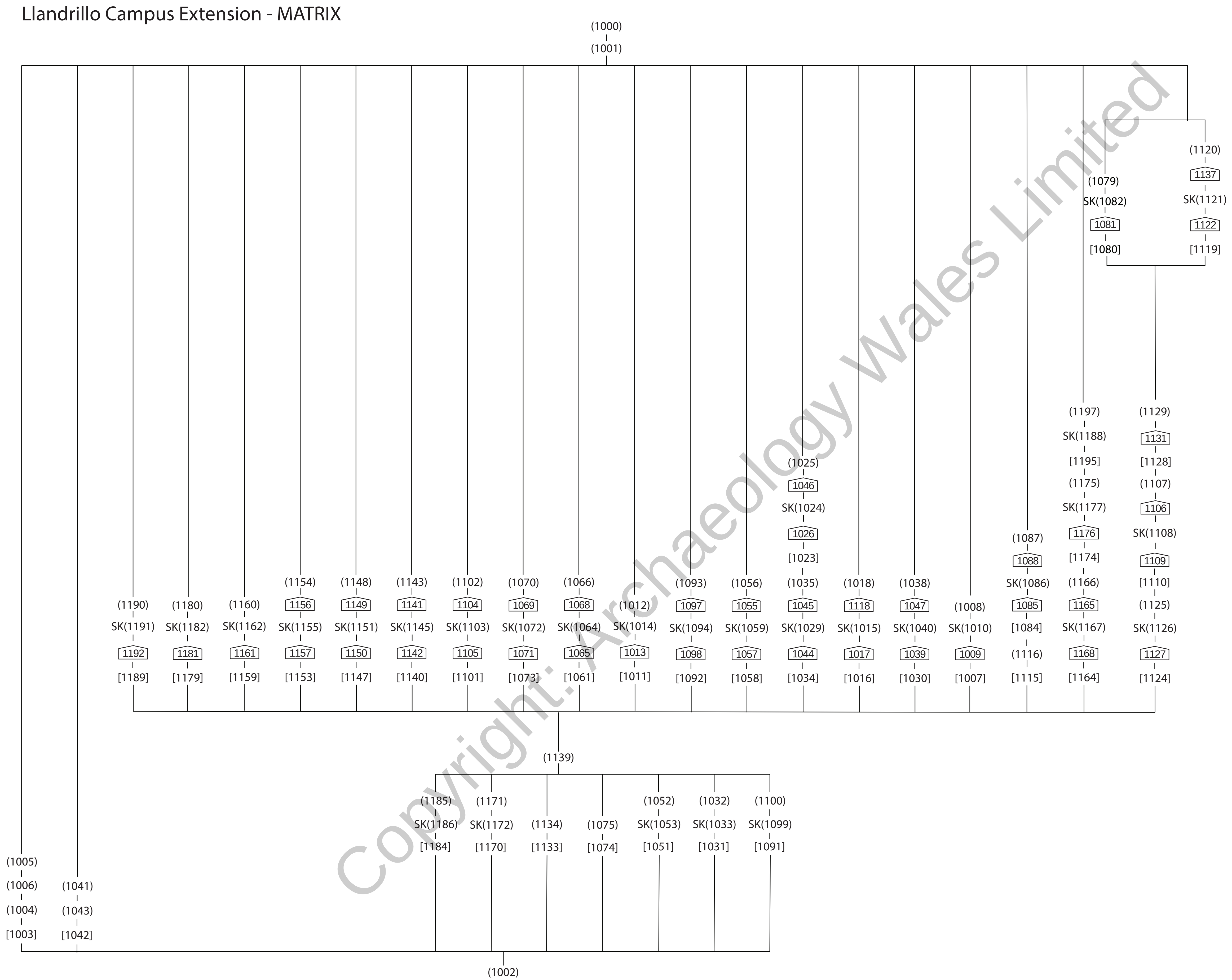


Figure 2. Location of cemetery.



Job Title: Llandrillo Campus Extension

Drawing Title: Site Matrix

Date: April 2018

Figure 3

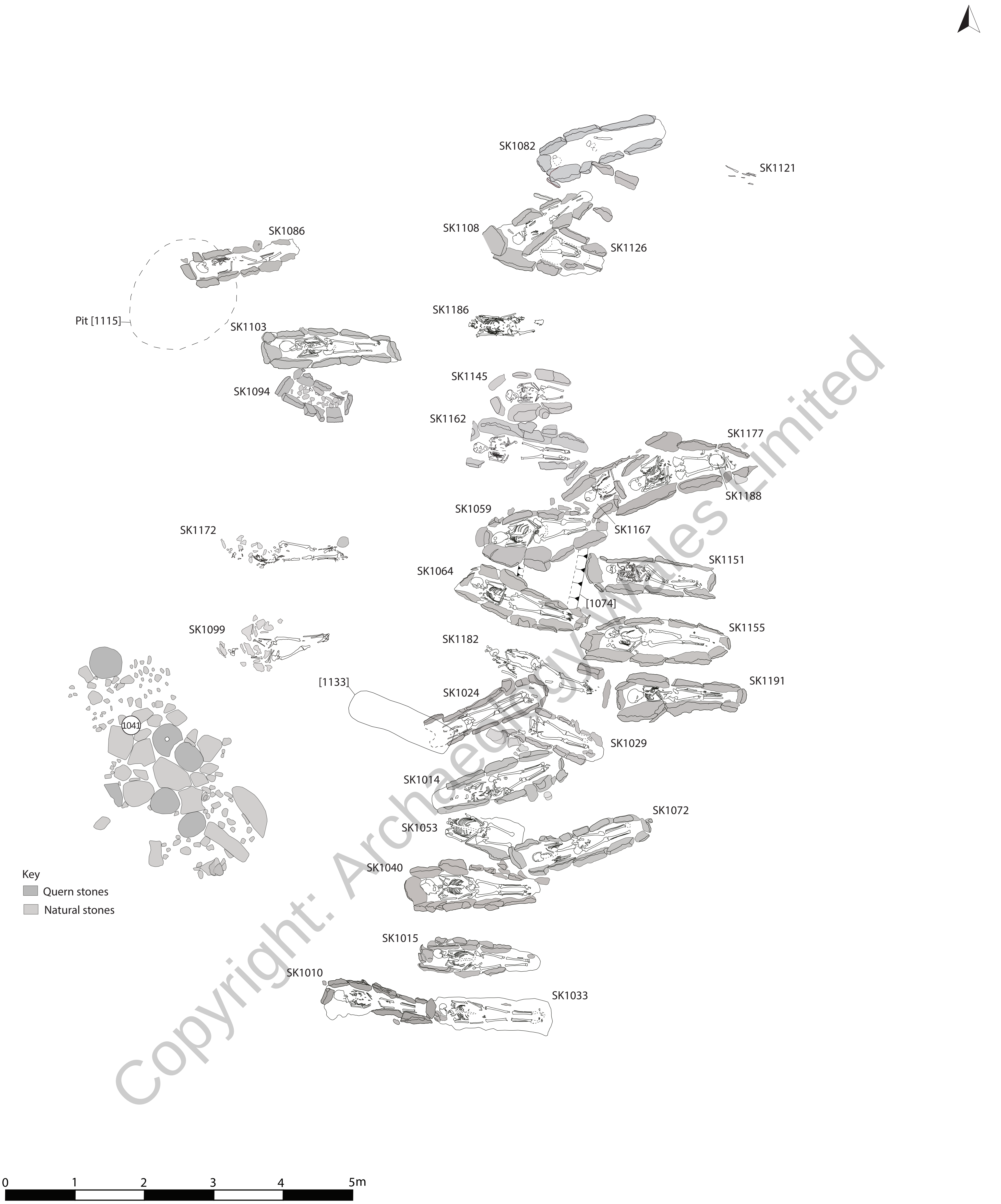


Figure 4. Overall plan of the cemetry

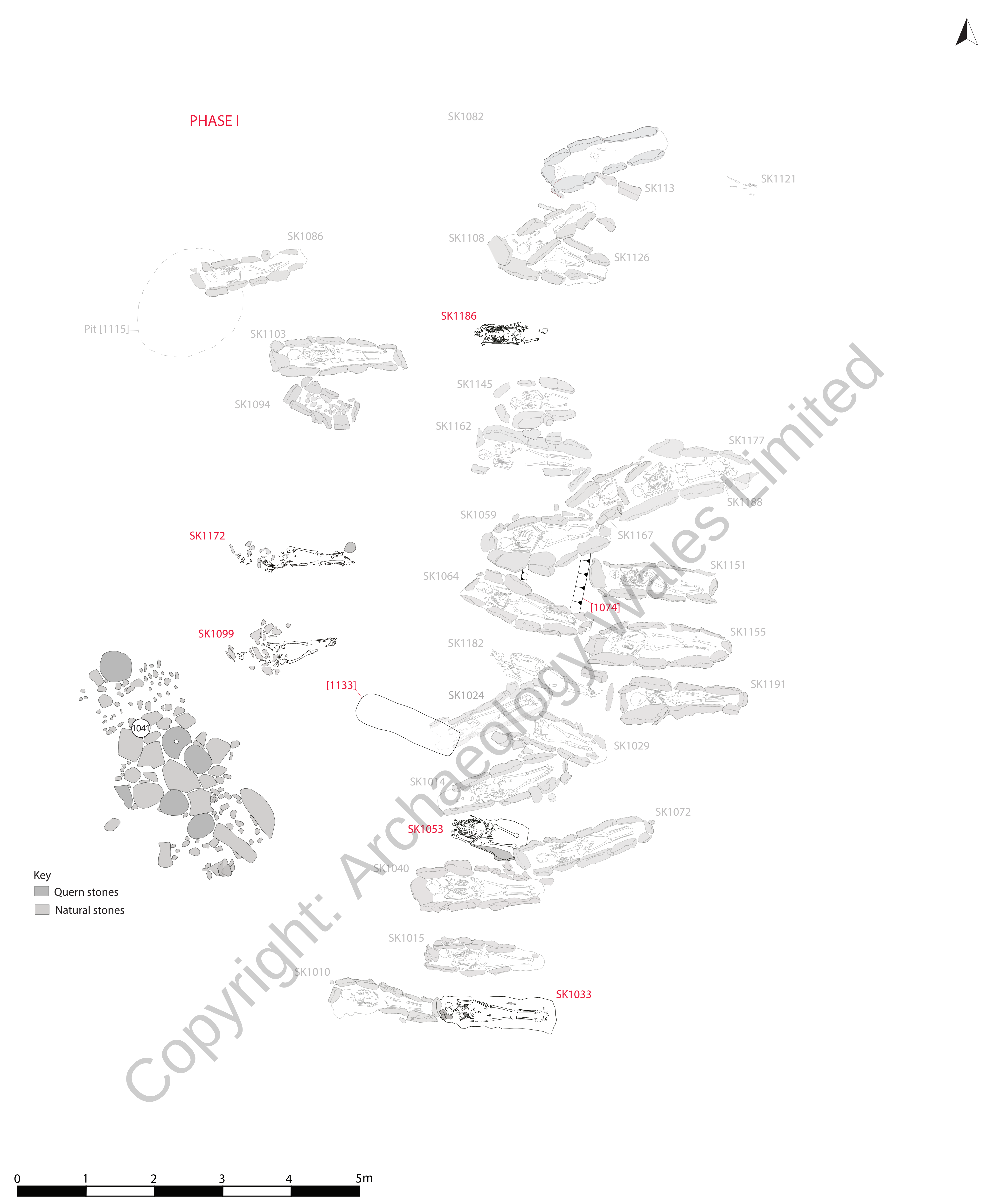


Figure 5. Plan showing phase I of the cemetery

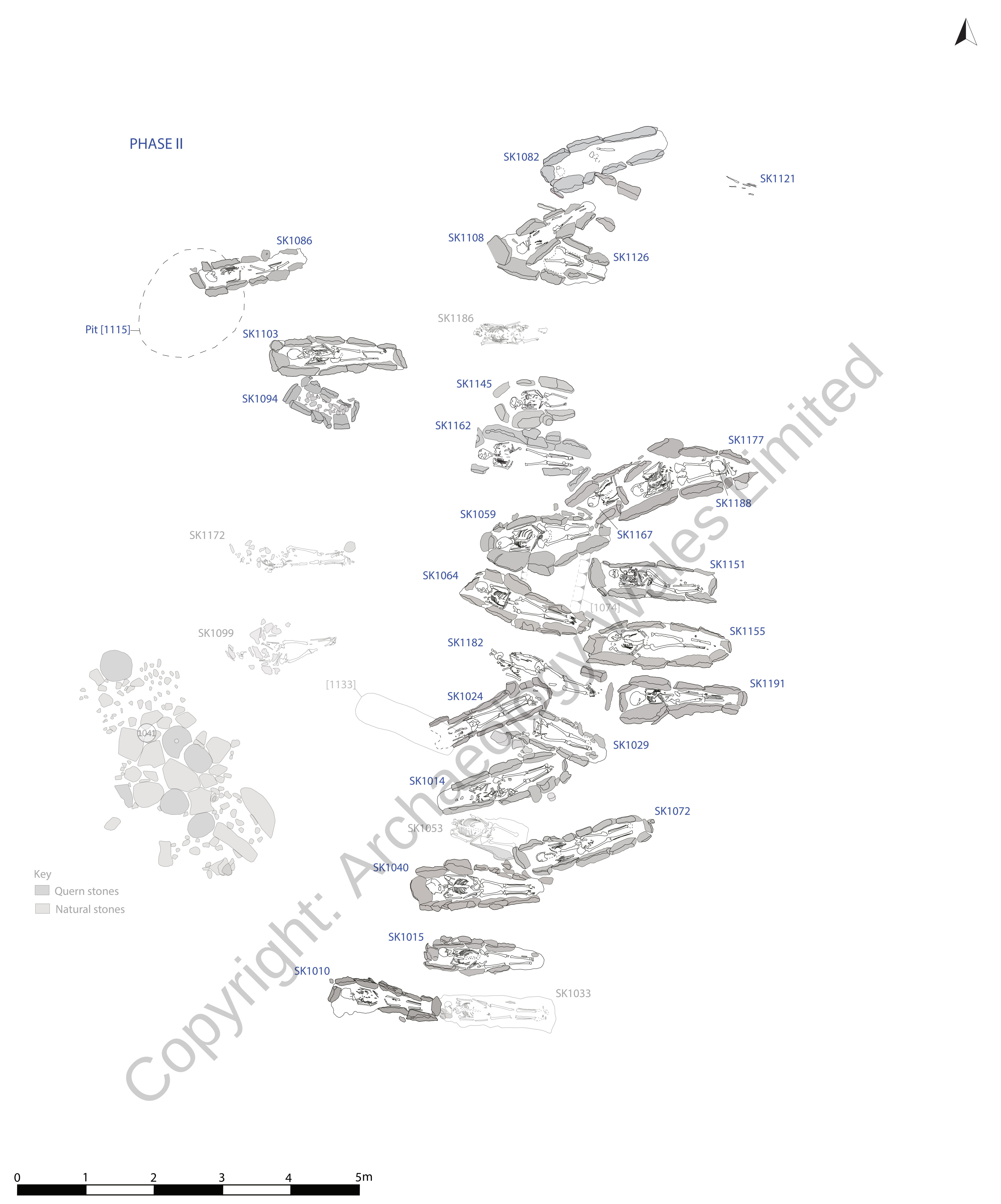


Figure 6. Plan showing phase II of the cemetery

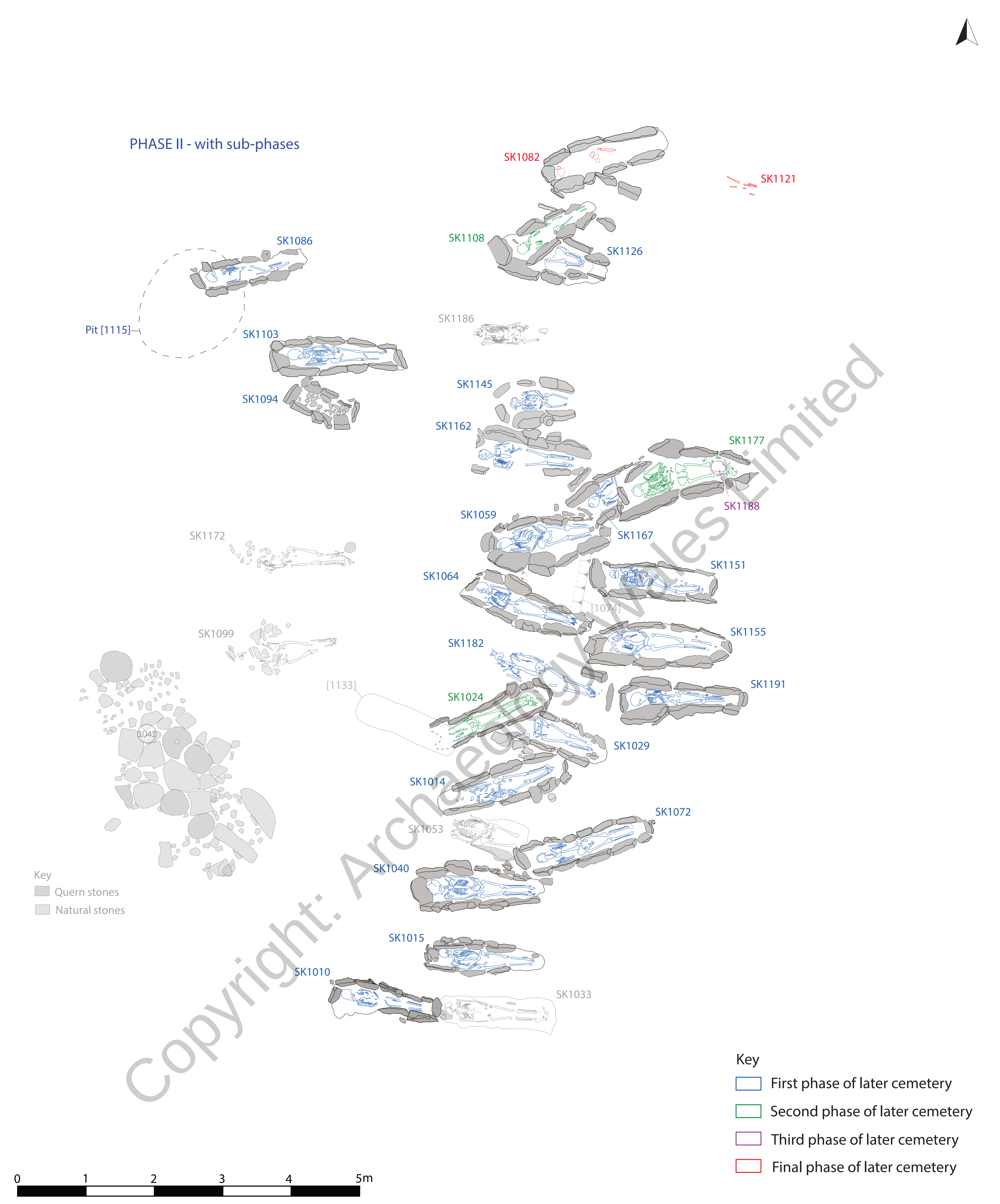
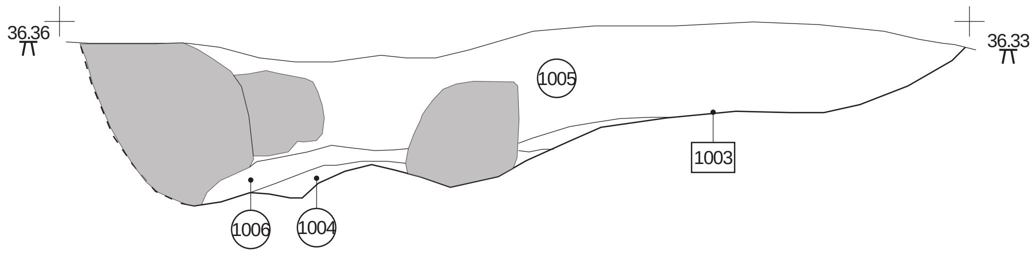
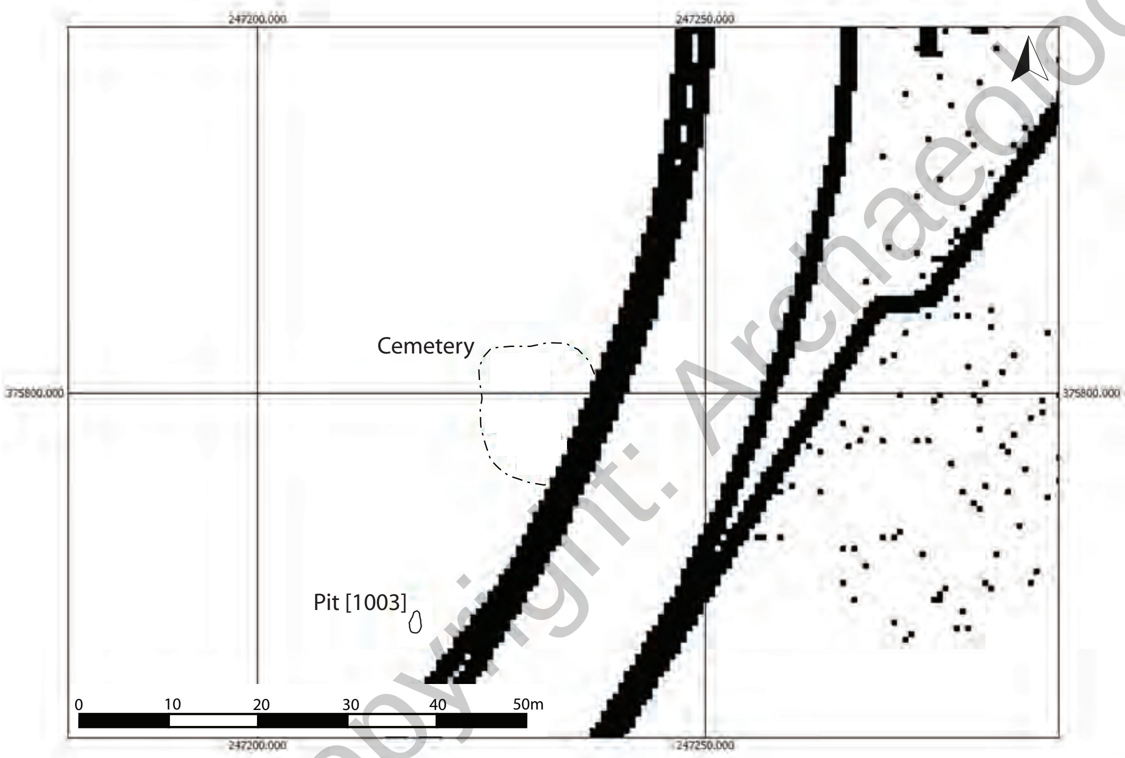


Figure 7. Plan showing phase II with sub-phases of the later cemetery

Section of Pit [1003]



Plan showing location of Pit [1003]



Plan of Pit [1003]

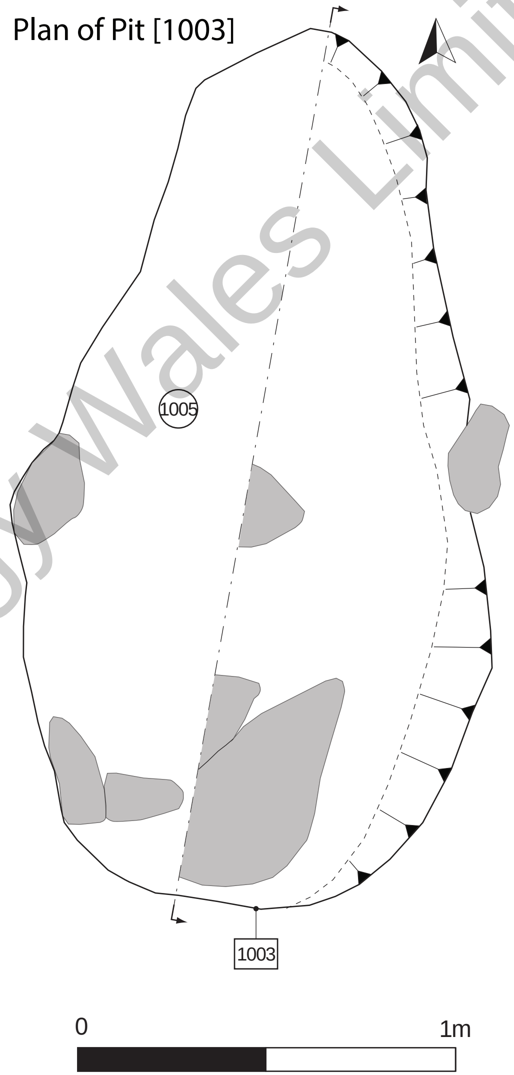


Figure 8
Plan, section and location plan of Pit [1003]

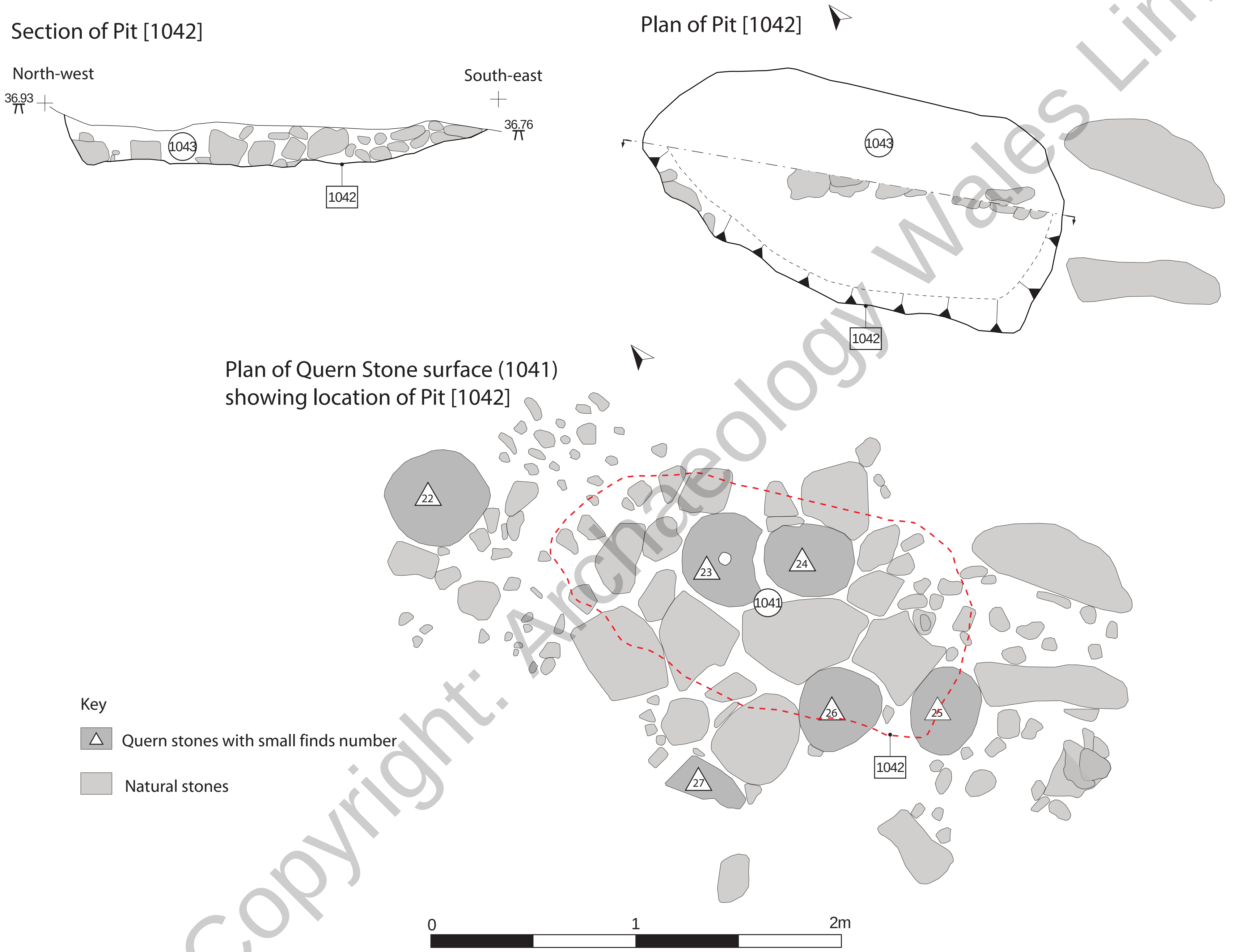
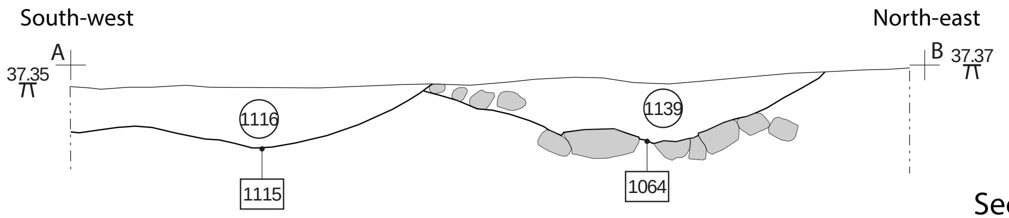


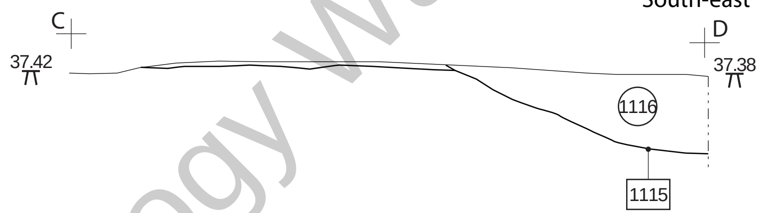
Figure 9
Plan & section of
Pit [1042] and plan
of quern stone surface
(1041) showing location
of Pit [1042]

ARCHAEOLOGY WALES
Revealing the past, informing the future

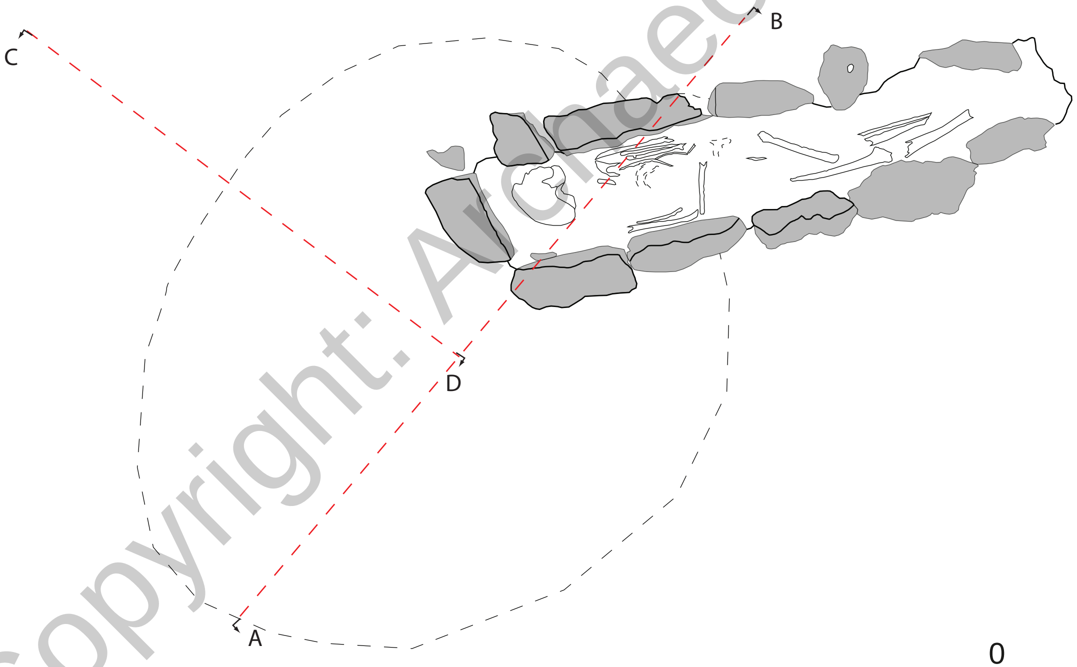
Section of Pit [1115] truncated by Grave cut [1064] of SK1086



Section of Pit [1115]



Plan of Pit [1115] truncated by Grave cut [1064] of SK1086



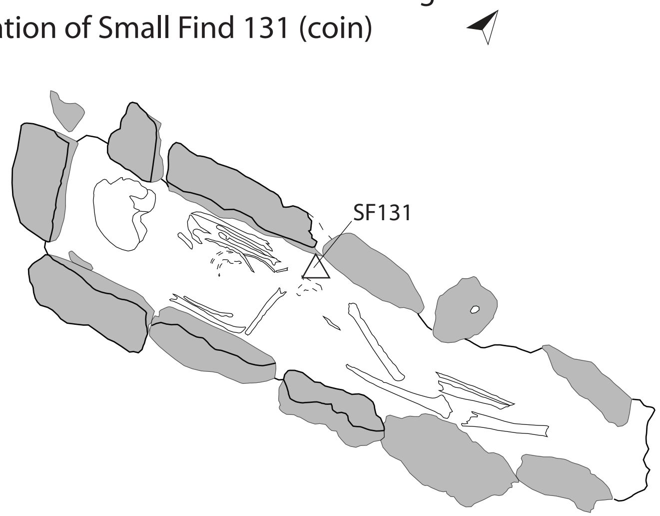
0 1m

Note: all heights are metres above Ordnance Datum

Figure 10
Sections and plan showing Pit [1115] truncated by Grave cut [1064]

ARCHAEOLOGY WALES
Revealing the past, informing the future

Plan of cist burial of SK1086 showing location of Small Find 131 (coin)



Plan of grave cuts [1061] of SK1064 and [1058] of SK1059 (both phase 2) showing location of Small Find 89 (brooch) within grave cut [1074] of SK1076 (phase 1)

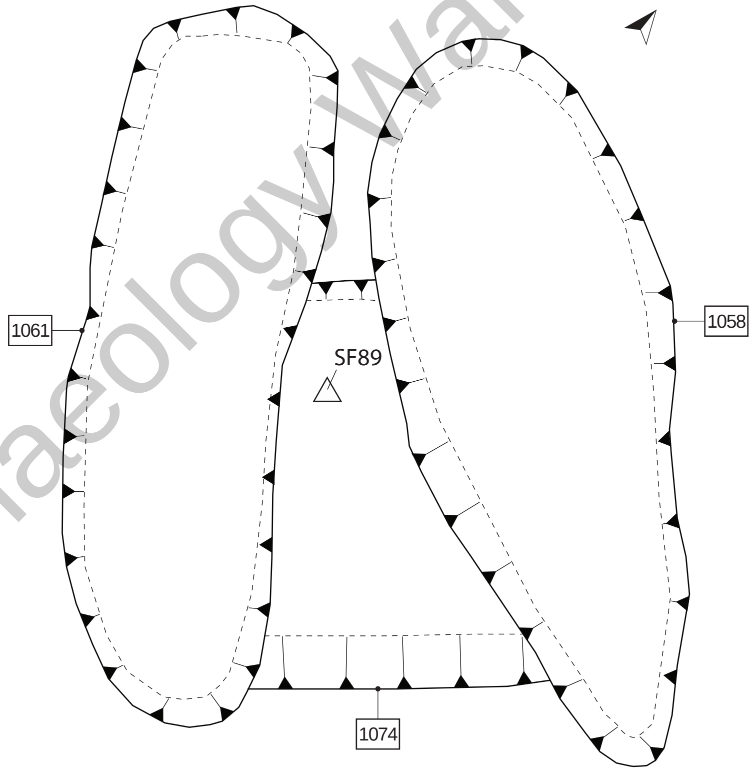


Figure 11
Plans of graves showing location of Small Finds SF131 and SF89

ARCHAEOLOGY WALES
Revealing the past, informing the future

Plate 1. Working shot of topsoil stripping. Looking NE

Plate 2. Stripping of site completed. Looking SW

Plate 3. View of Pit [1003], looking ENE. Scale 2m

Plate 4. Earth cut grave of SK1186, looking W. Scale 1m

Plate 5. Earth cut grave of SK1053, looking W. Scale 1m

Plate 6. Earth cut grave of SK1033, looking W. Scale 1m

Plate 7. View of cut [1042] after excavation, looking SW. Scale 1m

Plate 8. View of Quernstone surface (1041) after excavation, looking NE. Scale 1m

Plate 9. View of SK1015 exposed.

Plate 10. View of SK1040 with capstones *insitu,* looking SW. Scale 2m

Plate 11. View of SK1029 exposed, looking SW. Scale 1m

Plate 12. Cut of grave corresponding to SK1040, looking W. Scale 2m

Plate 13. View of SK1064 and SK1066, looking W. Scale 1m

Plate 14. View of SK1059, looking W.

Plate 15. View of SK1094, looking SW. Scale 1m

Plate 16. Pre-excavation shot of SK1103. Looking N. Scale 1m

Plate 17. Post-excavation view of SK1103, looking S. Scale 1m

Plate 18. View of SK1151, looking N.

Plate 19. View of SK1191, looking W.
Scale 1m

Plate 20. View of SK1086, looking W.
Scale 1m

Plate 21. View of SK1108, looking NW. Scale 1m

Plate 22. View of SK1177 and SK1188 (on the right), looking N.

Archaeology Wales

APPENDIX I:
Specialist Reports

The Human Bone from Llangefni College Campus Site Extension – Llangefni, Anglesey

KATIE FAILLACE AND RICHARD MADGWICK
CARDIFF UNIVERSITY
WITH CONTRIBUTIONS FROM RHIANNON JOYCE

Prepared for Archaeology Wales Ltd

1. Introduction

Human remains from Llangefni College Campus Site Extension, Anglesey, excavated by Archaeology Wales in 2017 were subject to analysis at Cardiff University (Garcia-Rovira n.d.). All analysis adhered to the Cardiff University School of History, Archaeology, and Religion (SHARE) Code of Ethics. Thirty-two graves were identified, each containing human remains. Only 31 discrete individuals are reported here because one (Sk1121) was too poorly preserved to analyse. Another 11 disarticulated contexts containing human bone were recovered and analysed, representing at least two individuals. The remains represent a mixed population, containing males and females ranging in age from perinate to older adult. This report is submitted to Archaeology Wales with a Microsoft Excel file summarizing the recorded data.

2. Skeletal Biology

2.1. Osteological Methodology

Standard osteological analysis of all human remains was undertaken, following recommendations of Buikstra and Ubelaker (1994), Brickley and McKinley (2004), and Mitchell and Brickley (2017). Human bone and teeth were identified with reference to White *et al.* (2012), Scheuer and Black (2004), and Schaefer *et al.* (2009). Pathology was recorded with in accordance with Ortner (2003). All data was recorded on Cardiff University Bioarchaeology skeletal recording sheets following established laboratory protocol.

2.1.1. Inventory, condition, and completeness

Condition was recorded during the assessment phase following the system of McKinley (Brickley and McKinley 2004), and reconsidered against the taphonomic analysis undertaken during this phase of analysis. Human bone inventory and completeness were recorded in tandem, with each element being identified as absent, complete/nearly complete, 75-95%, 50-75%, 25-50%, or <25% complete. They were also illustrated on diagrams adapted from Buikstra and Ubelaker (1994). Dental inventory was adapted from Buikstra and Ubelaker (1994).

2.1.2. Estimation of biological age and sex

Non-adult age estimation was achieved through dental eruption and development (Ubelaker 1989; AlQahtani *et al.* 2010), epiphyseal fusion (Suchey 2006; Scheuer and Black 2004), and for the perinate (Sk1094), element morphology (Schaefer *et al.* 2009). Adult age estimation was difficult due to the degradation of preferred aging features, namely the pubic symphysis (Brooks and Suchey 1990) and sternal rib ends (İşcan *et al.* 1984; İşcan *et al.* 1985; Hartnett 2010). Therefore, for this population, age estimates were based upon degradation of the auricular surface (Lovejoy *et al.* 1985; Buckberry and Chamberlain 2002) and dental wear (Brothwell 1981; Lovejoy 1985). Age categories were adopted from Marquez-Grant and Loe (2008) and are reproduced in Table 2.1.

Age Category	Chronological Years
Foetus	2nd Trimester – Birth
Perinate	~Birth
Neonate	Birth – 1 month
Infant	1 month – 2 years
Young Child	2 – 5 years
Older Child	5 – 12 years
Adolescent	13 – 17 years
Young Adult	18 – 25 years
Middle Adult	26 – 35 years
Mature Adult	36 – 45 years
Older Adult	45+ years
Non-Adult	<18 years
Adult	>18 years

Table 2.1 Age categories and corresponding chronological age estimates.

Sex estimation was not attempted in non-adults as there is currently no reliable macroscopic method for doing so. Adult sex was estimated from traits of the pelvis (Buikstra and Ubelaker 1994; Phenice 1969) and cranium (Buikstra and Ubelaker 1994). Due to poor preservation of these preferred elements, distal humerus morphology was also considered for sex estimation (Vance *et al.* 2011). Where metrics were taken, FORDISC 3.1 was used as a tertiary estimate of sex using "white," "black," and "Hispanic" populations (Jantz and Ousley 2005). For each individual, sex was estimated as female, probable female, male, probable male, indeterminate, and unknown.

2.1.3. Metric and non-metric analysis

Cranial and post-cranial measurements following Buikstra and Ubelaker (1994) were taken where possible; however, fragmentation precluded the possibility of metrics for most of the individuals. Stature was estimated where possible using FORDISC 3.1, with a 90% confidence interval with the most accurate formula possible without known sex (Jantz and Ousley 2005). Unusually, stature was estimated from metrics taken from the right side, as the right side allowed calculation based on a greater number of elements, with the exception of Sk1040. Fragmentation also precluded recording most non-metric features, though when observable presence/absence was recorded. Where possible, dental non-metric traits following the Arizona State University Dental Anthropology System were noted (Scott and Irish 2017).

2.1.4. Taphonomy

Brief notes were made regarding the taphonomy of the bones, relating to their appearance, surface preservation, and completeness. No pre-depositional modifications such as gnawing, trampling or weathering were recorded.

3. Results

3.1. Condition and completeness

All remains reached a minimum of Grade 3 surface preservation (19/31, 61% of individuals), defined as "Most of the bone surface affected by some degree of erosion…; general morphology maintained but detail of parts of surface masked by erosive action" (McKinley 2004:16). Eleven individuals were classified as Grade 4 (11/31, 35% of individuals), and one individual was classified as Grade 5 (1/31, 3% of individuals), although this individual was represented by a single element. Although disarticulated remains were not scored during the assessment, they have been included in this analysis (Table 3.1).

Preservation Score	Number of Contexts (*n*=42)	% of Contexts
Grade 1	0	0%
Grade 2	0	0%
Grade 3	21	40%
Grade 4	18	43%
Grade 5	2	5%
Grade 5+	0	0%

Table 3.1 Preservation of bone recovered from all contexts, following the guidance of McKinley (2004).

Completeness of the discrete burials ranged from poor (<25%) to excellent (76-95%), however, no skeleton was complete or nearly complete (>95%) (Table 3.2). Six had poor preservation (6/31, 19%), 10 had fair preservation (10/31, 32%), 13 had good preservation (13/31, 42%), and two had excellent preservation (2/31, 6%).

Completeness Classification	% Complete	Number of Individuals	% of Individuals
Poor	<25%	6	19%
Fair	26-50%	10	32%
Good	51-75%	13	42%
Excellent	76-95%	2	6%
Complete	>95%	0	0%

Table 3.2 Skeletal completeness of individuals.

The Minimum Number of Individuals for this site is 33; the disarticulated material had an MNI of 2 and there were 31 discrete individuals.

3.2. Biological age and sex

This assemblage is comprised of 25 adults (24/31, 77%) and 4 non-adults (4/31, 13%), with 2 individuals and the disarticulated remains having unknown age (3/31, 10%). Adult deaths peaked in the Young Adult age category and the Older Adult age category (Table 3.3, Figure 3.1), though the sample size is too small for meaningful statistical analysis.

Age Category	Approximate Chronological Age	Number of Individuals

Foetus	2nd Trimester – Birth	0
Perinate	~Birth	1
Neonate	Birth – 1 month	0
Infant	1 month – 2 years	0
Young Child	2 – 5 years	0
Older Child	5 – 12 years	1
Adolescent	13 – 17 years	1
Young Adult	18 – 25 years	7
Middle Adult	26 – 35 years	5
Mature Adult	36 – 45 years	3
Older Adult	45+ years	7
Non-Adult	<18 years	1
Adult	>18 years	3

Table 3.3 Age-at-death distribution of individuals.

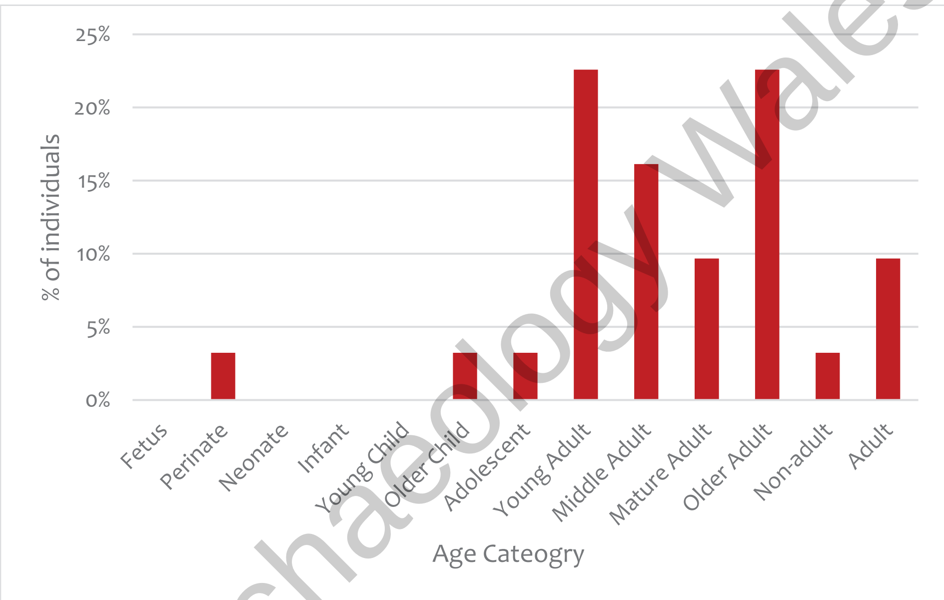


Figure 3.1 Mortality profile of individuals.

There are more females than males in this assemblage (Figure 3.4). If probable estimates are combined with their assigned sex, there are 13 females (13/31, 42%) and 4 males (4/31, 13%), 2 individuals of indeterminate sex (2/31, 6%), and 12 individuals with unknown sex due to lack of preserved sexually dimorphic characteristics and/or age (12/31, 39%).

Age Category	Female	F?	Male	M?	Indeterminate	Unknown	*Totals*
Non-Adult						4	*4*
Unknown Age						2	*2*
Young Adult	1	2	1	1		2	*7*
Middle Adult	3				2		*5*
Mature Adult	1		1			1	*3*
Older Adult	4	1		1		1	*7*
Adult		1				2	*3*
Totals	*9*	*4*	*2*	*2*	*2*	*12*	*31*

Table 3.4 Sex distribution of individuals by age-at-death.

3.3. Metric and non-metric analysis

Limited craniometrics were possible for four individuals (4/31, 13%). Post-cranial metrics were possible for nine individuals (9/31, 29%). Of the nine individuals with post-cranial measurements, eight had metrics that could be used to estimate stature (Table 3.5). Height point estimates ranged from 155cm (5’1”) to 169cm (5’7”). Unfortunately, the 90% confidence intervals are large, up to 20cm (8”), due to poor preservation of most long bone epiphyses. Differences between male mean height (164cm, 5’5”) and female mean height (163cm, 5’4”) are minor, though sample size is small.

Skeleton ID	Height	+/-	Sex	Element Used
Sk1024	168	7.9	M	Calcaneus + Tibia Lengths
Sk1040	169	7.0	M	Femur Maximum Length
Sk1064	155	7.3	M?	Calcaneus and Humerus Lengths
Sk1072	157	9.9	F	Calcaneus Length
Sk1103	164	9.8	F	Calcaneus Length
Sk1177	167	6.8	F	Femur Bicondylar Length
Sk1182	155	8.3	I	Calcaneus and Radius Lengths
Sk1188	155	9.9	U	Calcaneus Length

Table 3.5 Stature estimates from individuals with post-cranial metrics.

Non-metric traits were recorded from 12 individuals (Table 3.6), and include dental variants, congenitally absent teeth, septal aperture of the humeri, Wormian bones, and Pacchionian depressions (non-pathological pitting of the parietals). Due to the small sample size, potential biological relationships cannot be examined; however, comparison with the human remains excavated from this site previously would be of benefit.

Non-Metric Trait	Number of Individuals	Skeleton Numbers
Septal Aperture	2	Sk1014, Sk1177
Bifurcated Spinous Process (Cervical Vertebrae)	2	Sk1151, Sk1186
Bifurcated Radial Tuberosity	1	Sk1186
Orbital Notch	1	Sk1151
Pacchionian Granulations	2	Sk1024, Sk1103
Wormian Bones	1	Sk1103
Inion Hook	1	Sk1103
Congenital Absence (M3)	2	Sk1015, Sk1059
Congenital Absence (P2)	1	Sk1155
Buccal Pits	3	Sk1024, Sk1064, Sk1191
Other dental traits (ASUDAS)	4	Sk1064, Sk1108, Sk1186, Sk1191

Table 3.6 Quantification of present non-metric traits.

3.4. Taphonomy

All remains exhibited soil staining and post-mortem fragmentation. As evidenced by the scores of 3 and above for condition, all remains were affected by surface erosion. These features are consistent with the burial environment. There was limited variation in preservation of the stone lined cists and earth cut graves. The acidic soil of Anglesey causes accelerated degradation of skeletal remains and a lack of basal stones in the stone lined cists means there was no barrier between the skeletal remains and the acidic soil. Additionally, degradation of the remains has likely been accelerated by cycles of wetting and drying, evidenced by the waterlines (Image 3.2) on skull fragments of five individuals and drying cracks from 11 individuals. Crania were also often affected by localised erosion, probably as a result of the changing water table within each grave (Image 3.3).

Figure 3.2 Right parietal of Sk1010 exhibiting a waterline, the white shadow indicated by the arrows.

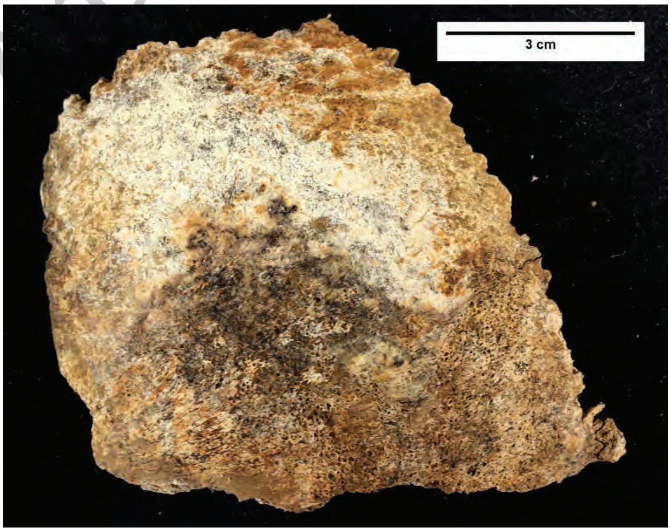


Figure 3.3 Localised erosion of the parietal of Sk1015, with large areas of macroporosity adjacent to better-preserved cortex.

Where femora were preserved, they were often broken at midshaft, where the curvature is greatest. This particular fracture is likely a result of the pressure from the grave collapsing on top of the remains. Iron staining is present on six individuals, and most frequently appears on the ribs and cranium, though is also present on one femur and one ulna. Given the patterning of iron staining, it is probable that the stain results from a grave inclusion (Schultz *et al.* 2003), such as a shroud pin. One individual (Sk1188) was excavated with additional lower limbs, including fragments of both tibiae and fibulae, and likely represents one of the truncated burials. Although not enough is present to confirm on morphology alone, the extra elements likely belong to Sk1177, who was excavated without elements inferior to the femora.

3.5. Disarticulated Remains

Disarticulated remains from 12 contexts were examined. One context (Sk1076 Disarticulated Remains) contained only animal bone. Considering disarticulated material as a whole, there are at least two individuals represented (MNI=2), based on differential wear of permanent teeth, the presence of deciduous teeth, and multiple portions of the frontal bone. Also represented among the disarticulated remains are other cranial fragments, ribs, a right humerus, a radius, and an ischium. No metrics or non-metrics were noted within the disarticulated material, nor were any features related to sex or stature. Taphonomy of the disarticulated material was consistent with the burials, including soil staining, cortical erosion, and post-mortem fragmentation.

4. Pathology

All remains were examined for pathological lesions and described using standard terminology (Ortner 2003; Buikstra and Ubelaker 1994; Brickley and McKinley 2004). Poor surface preservation and cortical erosion made observation of pathological and traumatic conditions difficult, therefore the results presented here are limited and likely do not reflect true prevalence of conditions that may appear in skeletal remains. This is particularly true of superficial lesions such as periostitis and myostitis ossificans, which appear as new bone growth on the surface and will therefore be disproportionately affected by surface erosion. Spinal pathology is also likely under-reported here, as erosion and fragmentation will have obscured conditions like spondylolysis, Schmorl's nodes, and patterns of compression.

4.1. Dental Health

Tooth quantities based on *n*=30 individuals*	***Tooth numbers (%)***
Total teeth expected for 100% preservation/recovery	958 (100)
Teeth present	401 (41.9)
Teeth lost antemortem	58 (6.1)
Teeth lost post-mortem	116 (12.1)
Congenitally absent teeth	5 (0.5)
Tooth status unknown	380 (39.7)

Table 4.1 Dental presence and absence based on discrete individuals.
*30 individuals present with permanent or mixed dentition, 1 neonate individual excluded. Expected number has been adjusted to account for the older child's mixed dentition.

Teeth were present in 25 individuals. Dental pathology was recorded in 15 individuals, including antemortem tooth loss, carious lesions, periapical cavities, and enamel defects. Out of 410 present teeth, 15 teeth from seven individuals had evidence of carious lesions (15/410, 3.7%; 7/24, 30%) (Image 4.1). Removing teeth from disarticulated contexts or deciduous teeth does not significantly affect the prevalence of caries (15/401, 3.7% and 15/400, 3.8%, respectively).

Figure 4.1 Carious lesions, from left. First row: right mandibular canine and left maxillary third molar of Sk1015. Second row: left mandibular first molar of Sk1072; right mandibular first molar of Sk1086. Third row: (probable) maxillary first premolar, right mandibular second premolar, and left mandibular second molar of Sk1103.

Agriculturalists with high carbohydrate intake are expected to have caries prevalence rates over 7% (Davidson 2009), indicating a lower carbohydrate diet than expected (this will be further investigated through the programme of isotope analysis). A minimum of nine individuals exhibited antemortem tooth loss (9/30, 30%). One individual (Sk1151) was entirely edentulous. This prevalence rate is almost certainly an underestimate, as antemortem tooth loss was only recorded where the mandible or maxilla retained the surface of the alveolus. Periapical cavities represent localized inflammation at tooth roots, and are often referred to by osteologists as "abscesses" (including in the associated Excel file for this assemblage), however, the cavities recorded in skeletal populations can have multiple aetiologies beyond the medical definition of an abscess. In this sample, four individuals had evidence for periapical cavities (4/30, 13%). Enamel formation can be disrupted as a result of illness or stress events, such as acute or chronic infection or weaning periods. Linear enamel hypoplasia was recorded from three individuals (Sk1014, Sk1024, Sk1177), both from the maxillary central incisors, and enamel pit defects were recorded in two individuals (Sk1126 and Sk1145) for a prevalence rate of 20% (5/25 individuals with teeth) (Table 4.2) (Image 4.2). Periodontal recession is common among older individuals, as teeth erupt as they wear to remain in occlusion; it differs from pathological periodontal disease which occurs due to irritation of the periodontal tissue (Ortner 2003). Although periodontal recession was common, periodontal disease was not recorded in this assemblage.

Individual	Type of Defect	Tooth Affected	Age at Crown Formation
Sk1014	LEH	Maxillary I1s	6 months – 4 years
Sk1024	LEH	Maxillary M3s	9 – 14 years
Sk1177	LEH	Maxillary I1s	6 months – 4 years
Sk1126	Single Enamel Pit	Mandibular P1s	2 – 7 years
Sk1145	Multiple Enamel Pits	Left Mandibular I2	1 – 4 years

Table 4.2 Enamel defects and their location by individual.

Figure 4.2 Linear enamel hypoplasia of Sk1024 (right maxillary third molar) and Sk1177 (maxillary central incisors), indicated by arrows.

4.2. Joint Disease

Evidence for joint disease in the form of osteophytosis and porosity was recorded in nine adults (9/24, 37.5%), indicating possible osteoarthritis. The vertebral column was most commonly affected, with seven individuals exhibiting pathologies (Table 4.3). Shoulder and hip joints were also affected, and one individual had osteophytosis on the radius and a metatarsal (Sk1014). Two individuals with osteophytosis certainly had osteoarthritis, as evidenced by the presence of pathognomonic eburnation on the affected joints (Ortner 2003). Sk1029 had indicators of osteoarthritis bilaterally on the humeri, femur, and acetabulum (Image 4.3), and Sk1188 had indicators of osteoarthritis bilaterally on the femora and acetabulum, and on a lumbar vertebra. Schmorl's nodes, another indicator of degenerative joint disease in the vertebral column, were present in two other individuals in this group (Sk1151, Sk1182) (Image 4.4). Unsurprisingly, non-adults showed no signs of joint disease, and six of the nine individuals affected are classified as "Older Adults." Two affected individuals were "Middle Adults" and one could not be aged further than "Adult." Remains from two disarticulated contexts (unspecified Disarticulated/Unstratified and Sk1019) did have elements with signs of joint disease, with osteophytosis of a hand phalanx and porosity and osteophytosis of the C1 and C2 vertebra respectively.

Individual	Age Category	Sex	Location
Sk1014	Older Adult	I	Right radial tuberosity, left 1st metatarsal, foot phalanx
Sk1029	Older Adult	I	Humeral heads, left femoral head, both acetabula
Sk1053	Older Adult	I	5th lumbar vertebra, 2 vertebral facets (unidentified to number)
Sk1072	Older Adult	F	Throughout vertebrae, including lower thoracic, 5th lumbar, and 2nd cervical
Sk1103	Older Adult	F	Lumbar vertebrae
Sk1151	Older Adult	F	Scapulae, 2nd cervical vertebra, left humerus, thoracic vertebrae
Sk1177	Middle Adult	F	Thoracic vertebrae
Sk1182	Middle Adult	I	Throughout vertebrae
Sk1188	Adult	U	Both femora, right acetabulum, lumbar vertebrae

Table 4.3 Location of degenerative joint changes by individual.

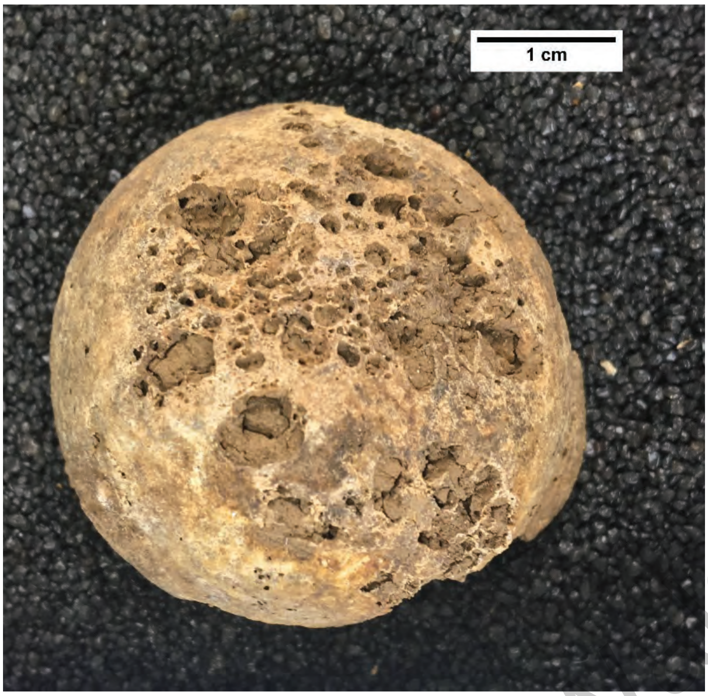


Figure 4.3 Example of osteoarthritis of the right humeral head from Sk1029. Note the macroporosity and shiny eburnation.

Figure 4.4 Schmorl's Node on lumbar vertebra from Sk1182, indicated by arrow.

4.3. Non-Specific conditions

Non-specific variations were recorded in two adults and one non-adult. One individual (Sk1015) had signs of healed cribra orbitalia in the right orbit (Image 4.5). Though previously attributed to iron-deficiency anaemia, cribra orbitalia is now considered to have multiple aetiologies, including nutritional deficiency, chronic inflammation, and haemorrhagic processes (Ortner 2003). The variations of the other two individuals are likely age-related, but may have pathological aetiologies. The cranial vault of Sk1151 was abnormally thickened, and adolescent Sk1191 had sections of immature, woven bone on the femur and their parietals were lacking meningeal grooves.

Figure 4.5 Probable healed cribra orbitalia on the right orbit of Sk1015, indicated by arrows.

4.4. Trauma

Confident differential diagnosis of trauma was made difficult due to post-mortem fragmentation, which meant that none of the elements could be observed in their entirety and bilateral comparisons were hindered by differences in preservation and completeness. No individuals exhibited definitive traumatic lesions; however, five individuals have evidence for possible trauma. Sk1059 has a break in the left parietal bone which is most probably perimortem blunt force trauma, based on the incomplete and radiating fractures (Christensen *et al.* 2014) (Image 4.6). One individual (Sk1064) has a probable dislocation or other injury to the acromion of the left scapula (Image 4.7). Although the right is fully fused, the left is missing its epiphysis, which is most likely from a traumatic injury. Failure to fuse is not impossible but it would be highly unusual, and acromioclavicular injuries today are most often seen as a result of contact sports or falls. Another upper limb trauma is evident on Sk1053, exhibiting angling of the left radius most likely the result of a well-healed antemortem fracture (Image 4.8). Both examples of upper limb trauma are consistent with the rural environment, as upper limb injuries are frequent in agricultural communities (Judd and Roberts 1999). Examples of possible lower limb trauma are found on Sk1145 and Sk1162. Sk1145 shows bilateral asymmetry of the femoral curve with the left particularly exaggerated, and Sk1162 has an atypical angle in the curve of the anterior border of the left tibia, which have the possibility of being well-healed earlier trauma. However, these lower limb abnormalities are more likely to result from manual habits, such as gait and weight distribution.

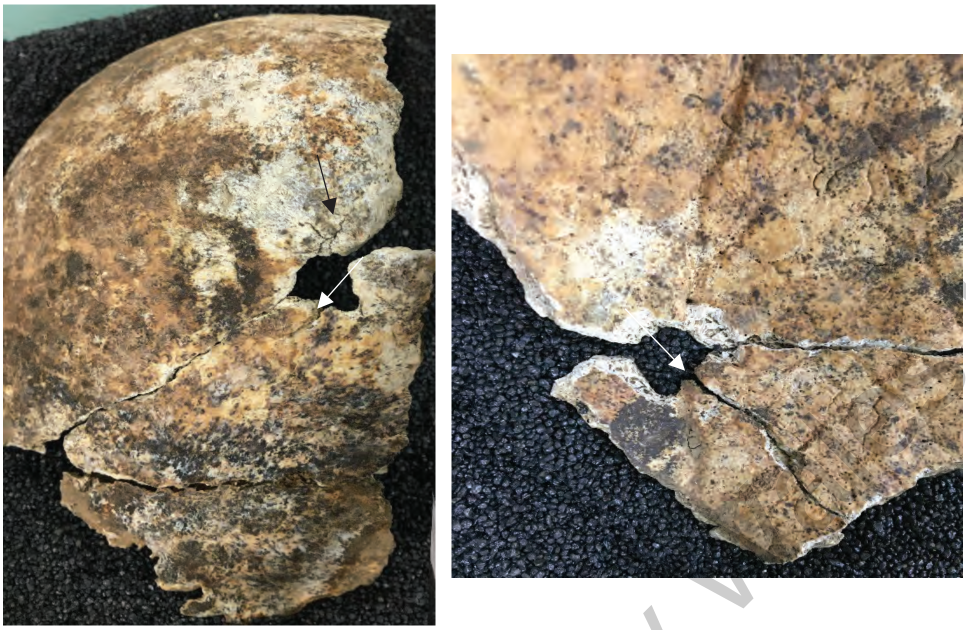


Figure 4.6 Probable perimortem trauma to the left parietal of Sk1059. Note the fracture present on the image on the right which has not reached the ectocranial surface in the left image (white arrows). Another incomplete, radiating fracture is indicated by the black arrow.

Figure 4.7 Left and Right acromion process of Sk1064. Note the difference in length because of the left missing the acromion epiphysis, while the right is fully fused.

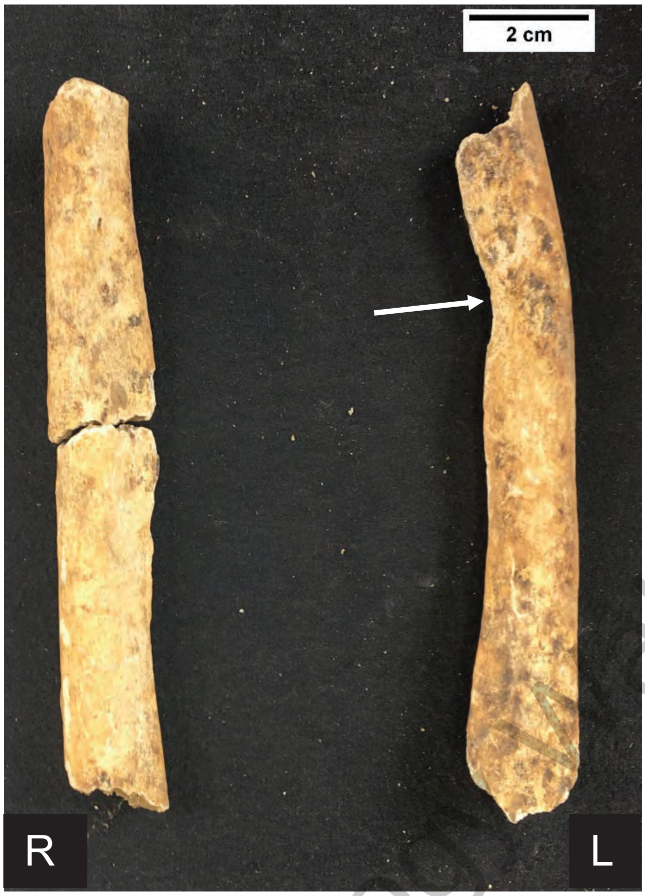


Figure 4.8 Right and left radii of Sk1053. Healed fracture is indicated by the arrow. Though exacerbated by taphonomic damage, the angle is different than that of the right radius, likely because of a fracture.

5. Comparisons

The radiocarbon dates from eight individuals confirmed the dating of the site from the 4th to the 8th centuries AD. In comparison to other published sites from early medieval north Wales, the remains from this cemetery have relatively good preservation and completeness. The sites of Ysgol yr Hendre (Kenney and Parry 2012) and Arfryn (Hedges 2016) did not produce skeletal remains that could be analysed; however, Tywyn y Capel (Davidson 2009) provided useful comparative material. Both cist and non-cist burials were present at Tywyn y Capel, but this comparison will focus on the cists as they are more analogous to the skeletal remains from Llangefni.

Remains from the Tywyn y Capel cist burials included 10 adults and 9 non-adults. Of the adults, seven were identified as female, two were identified as male, and one was unknown. The authors suggested the bias towards females was an artefact of taphonomy, however, considering the bias towards females in this assemblage, the possibility of differential funerary treatment or burial rites for males and females should not be dismissed.

The age distribution of the cist burials at Tywyn y Capel include more non-adults than the current assemblage, however, they are all children under the age of five (Table 5.1). If the age categories are redistributed in the same way as the Tywyn y Capel report, both sites show fairly consistent mortality across adult age groups, as the “Middle Adult” category would combine to reach eight individuals. Tywyn y Capel has the same preservation issue as Llangefni in precluding the observation of many common pathological and traumatic lesions, and therefore the results are almost certainly an underestimate of true prevalence. However, since that is true for both sites, it is easier to compare them. Both samples have low caries prevalence, with 5.9% at Tywyn y Capel compared to 3.7% in Llangefni. No enamel hypoplasia was recorded in the cist burials from Tywyn y Capel. Even if the pit defects from Llangefni are excluded because not all osteologists record them as hypoplasia, there are still two individuals from Llangefni that have linear enamel hypoplasia (2/25, 8%). The prevalence of degenerative joint changes was higher at Tywyn y Capel, with 70% of the adult sample affected; however, this difference could be an artefact of sample size. Two individuals at Tywyn y Capel had evidence for healed antemortem fractures, both to the upper limb, similarly to the Llangefni fractures. No perimortem trauma or features of metabolic illness were observed on the remains from Tywyn y Capel; although rare at Llangefni, perimortem trauma and cribra orbitalia were observed.

The non-cist burials from Tywyn y Capel had a very different mortality profile, with 42% of the sample being non-adult. As a result, there are fewer degenerative changes and more metabolic and developmental pathological conditions, although caries prevalence is still low (3.4%). Enamel hypoplasia prevalence is also low, at 2.3%. Sex distribution of the non-cist burials is equal, with 21 males/probable males and 21 females/probable females. Comparison of the Llangefni cists, Tywyn y Capel cists, and Tywyn y Capel non-cists further questions the assumption that the uneven sex distribution of the cists is a result of differential preservation and not differential mortuary treatment.

Although comparative material from north Wales is limited, there are a few contemporary sites further south. Once published, the 5th to 10th century site of St. Patrick's Chapel, Whitesands Beach, Pembrokeshire will be a useful comparison, and certain associations are possible the Llangefni isotope report. The published cemetery site of Brownslade, Pembrokeshire contained 12 cists and 14 earth cut graves dated to the 8th century AD, and the churchyard excavation of Llandough, Cardiff revealed 16 cists and 1010 earth cut graves dated to the 4th to 12th centuries AD. Both of these sites had closer male to female ratio than Llangefni, with 16 males and 17 females at Brownslade, and 233 males and 194 females at Llandough. Brownslade has a greater proportion of non-adults represented than Llangefni and Llandough, but is similar to Tywyn y Capel (Table 5.1). When comparing childhood stress indicators, Llangefni has values slightly more consistent with Brownslade. Cribra orbitalia was identified on two individuals from Brownslade (2/52, 3.8%) and 138 at Llandough (138/385, 35.8%). Linear enamel hypoplasia was present on three individuals from Brownslade (3/52, 5.8%) and 57 individuals from Llandough (57/551, 10.3%). The greater percentage of linear enamel hypoplasia at Llandough and Llangefni could be a result of the lower non-adult mortality, indicating that the individuals who underwent childhood stress were able to survive the illness, however, variable sample sizes means that statistical significance is likely to be invalid. Adult stature at Llangefni was more aligned with the ranges at Llandough than Brownslade, but this is likely an artefact of sample size rather than a similarity in lifestyle. Although the publications of Brownslade and Tywyn y Capel are not suitable for comparison of osteoarthritis, Llandough had an adult prevalence of 32.8% for osteoarthritis.

Age Category	Llangefni *n* (%)	Tywyn y Capel *n* (%)	Brownslade *n* (%)	Llandough *n* (%)
Foetus	-	-	-	6 (1%)

<table>
<tr><td>Perinate</td><td>1 (3%)</td><td>1 (5%)</td><td>-</td><td rowspan="2">13 (2%)</td></tr>
<tr><td>Neonate</td><td>-</td><td rowspan="3">8 (42%)</td><td>2 (4%)</td></tr>
<tr><td>Infant</td><td>-</td><td>4 (9%)</td><td>46 (6%)</td></tr>
<tr><td>Young Child</td><td>-</td><td rowspan="2">12 (26%)</td><td>48 (6%)</td></tr>
<tr><td>Older Child</td><td>1 (3%)</td><td>-</td><td>55 (7%)</td></tr>
<tr><td>Adolescent</td><td>1 (3%)</td><td>-</td><td>2 (4%)</td><td>30 (4%)</td></tr>
<tr><td>Young Adult</td><td>7 (23%)</td><td>4 (21%)</td><td>7 (15%)</td><td>87 (11%)</td></tr>
<tr><td>Middle Adult</td><td>5 (16%)</td><td rowspan="2">3 (16%)</td><td>4 (9%)</td><td>127 (16%)</td></tr>
<tr><td>Mature Adult</td><td>3 (10%)</td><td>8 (17%)</td><td>102 (13%)</td></tr>
<tr><td>Older Adult</td><td>7 (23%)</td><td>3 (16%)</td><td>7 (15%)</td><td>109 (14%)</td></tr>
<tr><td>Non-Adult</td><td>1 (3%)</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Adult</td><td>3 (10%)</td><td>-</td><td>-</td><td>150 (19%)</td></tr>
</table>

Table 5.1 Age-at-death distribution of Llangefni, Tywyn y Capel cists, Brownslade, and Llandough cemeteries.

Although the difficulties of comparing osteological data from published reports are well-documented due to the variability with which people categorise and analyse the data, comparing Llangefni to other published cemetery sites identifies has revealed some anomalies. For instance, the low non-adult representation at Llangefni, undoubtedly exaggerated by poor preservation, may be evidence of differential treatment of non-adults at this site. Similarly, the greater prevalence of females at Llangefni and Tywyn y Capel deserves further investigation, with a greater number of females having cist burials than males. Although possibly a result of excavation bias, it could be evidence for differential mortuary treatment by sex. The two examples of linear enamel hypoplasia from Llangefni both occur on the maxillary central incisors, and may correspond to the period of weaning, but the pitted defects occur at later ages. As a small, rural cemetery, it is expected that the individuals of Llangefni were agriculturalists, which is supported by the high prevalence of osteoarthritis and upper limb trauma (Judd and Roberts 1999). The osteoarthritis also indicates that the people buried in Llangefni were elders in the community, as it is also age related. Because of the limited number of metrics taken from this assemblage, stature comparisons have not been attempted; however, the range of stature estimates from Llangefni individuals fits within the ranges from Llandough and could therefore be considered “normal” for this period. A greater understanding of lifeways at Llangefni will be achieved once the results of the isotopic investigation are available. Further comparisons should also be drawn from the previous, Brython Archaeology excavation, particularly for non-metric traits and mortality profile, to investigate potential familial connections and differential mortuary treatment based on sex and age.

6. Conclusion

The site of Llangefni College Campus Extension expands the osteological understanding of early medieval Anglesey considerably. Although these results are preliminary until they are compared with the osteological data from the earlier excavation, the human remains reveal a sample of the population that was relatively healthy. The osteological examination also opens up new lines of inquiry for burial rites in early medieval Wales, particularly the question of cist burial status.

7. References

AlQahtani, S. J., Hector, M. P., and Liversidge, H. M. (2010) Brief communication: the London Atlas of Human Tooth Development and Eruption. *American Journal of Physical Anthropology* 142: 481 – 490

Brickley, M. and McKinley, J. (2004) *Guidelines to the Standards for Recording Human Remains*. Institute of Field Archaeologists.

Brooks, S. and J. M. Suchey (1990) Skeletal age determination based on the os pubis: A comparison of the Acsádi-Nemeskéri and Suchey-Brooks methods. *Human Evolution* 5:227-238.

Brothwell, D. R. (1982) *Digging Up Bones*. Oxford: Oxford University Press.

Buckberry, J. L. and Chamberlain, A. T. (2002) Age estimation from the auricular surface of the ilium: a revised method. *American Journal of Physical Anthropology* 119: 231 – 239

Buikstra, J. E. and D. H. Ubelaker (eds.) (1994) *Standards for Data Collection from Human Skeletal Remains*. Arkansas Archeological Survey Research Series No. 44, Fayetteville, AR.

Christensen, A. M., Passalacqua, N. V., and Bartelink, E. J. (2014) *Forensic Anthropology Current Methods and Practice.* Oxford: Elsevier Academic Press.

Davidson, A. (2009) Excavations at Tywyn y Capel, Treaddur Bay, Anglesey, 1997 and 2002-3. *Archaeologia Cambrensis* 158, 167-224.

Edwards, N., Lane, A., Bapty, I., and Redknap, M. (2005) Early Medieval Wales: A framework for archaeological research. *Archaeology in Wales* 55, 33-46.

Edwards, N., Davies, T., and Hemer, K.A. (2017) Research framework for the archaeology of early medieval Wales c. AD 400-1070. *A Research Framework for the Archaeology of Wales 3*.

English Heritage (2004) *Centre for Archaeology Guidelines: Human Bones from Archaeological Sites*. Historic England Publications.

Garcia Rovira, I. (n.d.) Written scheme of investigation for archaeological excavation at Llangefni College campus site. Unpublished Report (Archaeology Wales)

Hartnett, K. M. (2010) Analysis of age-at-death estimation using data from a new, modern autopsy sample—Part II: Sternal end of the fourth rib. *Journal of Forensic Sciences* 55:1152-1156.

Hedges, J. (2016) Bronze Age settlement and early medieval cemetery at Arfryn, Bodedern, Anglesey. *Archaeologica Cambrensis* 165, 113-185.

Hemer, K.A. (2011) Stable isotope analysis of human remains: Brownslade and West Angle Bay. In Groom, P., Schlee, D., Hughes, G., Crane, P., Ludlow, N., and Murphy, K. (eds.). Two Early Medieval Cemeteries in Pembrokeshire: Brownslade Barrow and West Angle Bay. *Archaeologia Cambrensis* 160: 133-203.

Hemer, K.A., Lamb, A.L., Chenery, C.A., and Evans, J.A. (2016) A multi-isotope investigation of diet and subsistence amongst island and mainland populations from early medieval western Britain. *American Journal of Physical Anthropology* 162: 423 – 440.

Ìşcan, M. Y., Loth, S. R., and Wright, R. K. (1984) Age estimation from the rib by phase analysis: white males. *Journal of Forensic Sciences* 29: 1094 – 1104

Ìşcan, M. Y., Loth, S. R., and Wright, R. K. (1985) Age estimation from the rib by phase analysis: white females. *Journal of Forensic Sciences* 30: 853 – 863

Jantz, R. and S. Ousley (2005) *FORDISC 3.1*. University of Tennessee Press, Knoxville, TN

Judd, M. A. and Roberts, C. A. (1999) Fracture trauma in a medieval British farming village. *American Journal of Physical Anthropology* 109: 229 – 243

Kenney, J., Parry, L. (2012) Ysgol yr Hendre, Llanbeblig, Caernarfon: a possible construction camp for Segontium fort and early medieval cemetery. *Archaeologia Cambrensis* 161, 249-284.

Lovejoy, C. O. (1985) Dental wear in the Libben population: its functional pattern and role in the determination of adult skeletal age at death. *American Journal of Physical Anthropology* 68: 47 – 56

Lovejoy, C. O., Meindl, R. S., Pryzbeck, T. R., and Mensforth, R. P. (1985) Chronological metamorphosis of the auricular surface of the ilium: a new method for the determination of adult skeletal age at death. *American Journal of Physical Anthropology* 68: 15 – 28

Márquez-Grant, N. and Loe, L. (2008) Chapter 3: The Human Remains. In: Simmonds *et al.* (*eds*) *Life and Death in a Roman City: Excavation of a Roman Cemetery with a Mass Grave at 120-122 London Road, Gloucester.* Oxford: Oxford Archaeology pp.29 – 79

Mitchell, P., and Brickley, M. (eds.) (2017) *Updated Guidelines to the Standards for Recording Human Remains*. CIfA and BABAO.

Ortner, D. J. (2003) *Identification of Pathological Conditions in Human Skeletal Remains*. 2nd ed. Amsterdam: Academic Pres.

Phenice, T. W. (1969) A newly developed visual method of sexing the os pubis. *American Journal of Physical Anthropology* 30:297-301.

Schaefer, M., Black, S., and Scheuer, L. (2008) *Juvenile Osteology: a laboratory and field manual*. Burlington, MA: Elsevier Academic Press.

Scheuer, L. and Black, S. (2004) *The Juvenile Skeleton*. Burlington, MA: Elsevier Academic Press

Schultz, J. J., Williamson, M. A., Nawrocki, S. P., Falsetti, A. B., and Warren, M. W. (2003) A taphonomic profile to aid in the recognition of human remains from historic and/or cemetery contexts. *The Florida Anthropologist* 56: 141 – 147

Scott, G. R. and Irish, J. D. (2017) *Human Tooth Crown and Root Morphology*. Cambridge: Cambridge University Press.

Suchey, J. (2006) Workshop materials for determination of skeletal age, presented at the JPAC-CIL on 18 January 2006.

Vance, V. L., M. Steyn, and E. N. L'Abbé (2011) Nonmetric sex determination from the distal and posterior humerus in Black and White South Africans. *Journal of Forensic Sciences* 56:710-714.

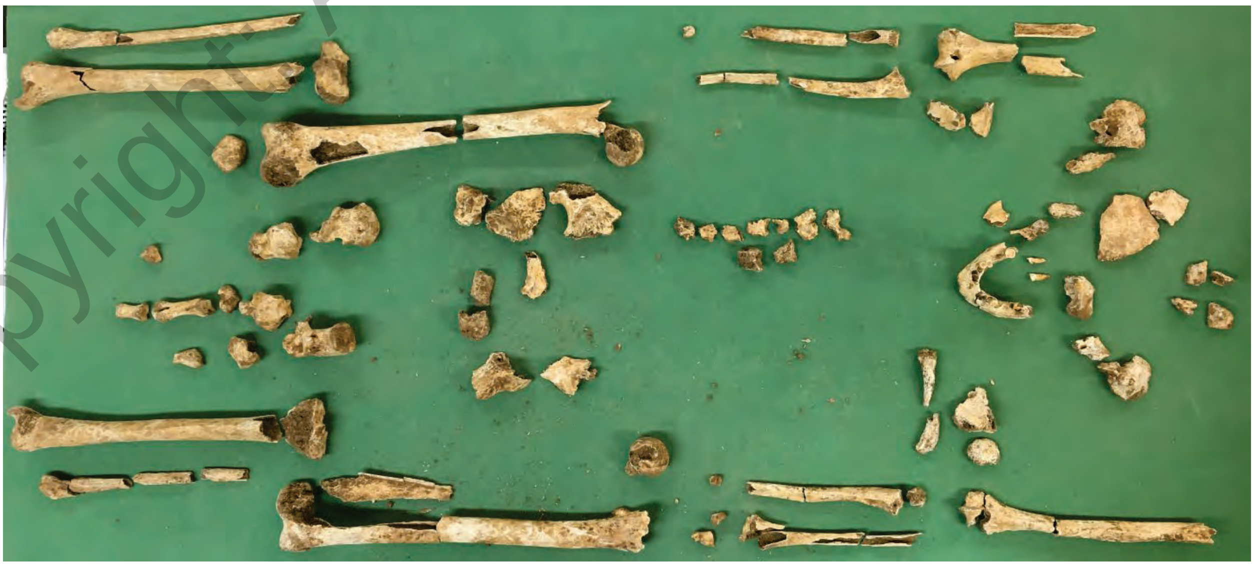
White, T. D., Black, M. T., and Folkens, P. A. (2012) *Human Osteology (3rd Edition)*. Burlington, MA: Elsevier Academic Press.

8. Appendix 1: Individual Summaries

8.1. Sk1010

Sk1010	
Preservation	3
Completeness	26 – 50% (~40%)
Sex	N/A
Age	9 years +/- 2
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, water line
Non-Metric Traits	N/A
Pathology/Trauma	None visible

8.2. Sk1014



Sk1014	
Preservation	4
Completeness	51 – 75% (~70%)
Sex	F?
Age	>40
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, iron staining, drying crack(s), possible tool mark
Non-Metric Traits	Septal Aperture
Pathology/Trauma	Antemortem tooth loss, dental caries, dental abscess, linear enamel hypoplasia. Osteophytosis on radial tuberosity, MT1, foot phalanx.

8.3. Sk1015

Sk1015	
Preservation	3
Completeness	51 – 75% (~70%)
Sex	F
Age	25 – 40
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, iron staining
Non-Metric Traits	Congenital absence of M3
Pathology/Trauma	Dental caries, healed cribra orbitalia.

8.4. Sk1024

Sk1024	
Preservation	3
Completeness	51 – 75% (~70%)
Sex	M
Age	16 – 25
Stature	168.4 +/- 7.9cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion, water line, drying crack(s)
Non-Metric Traits	Pacchionian granulation, buccal pit LM2
Pathology/Trauma	Enamel defects (pitted)

8.5. Sk1029

Sk1029	
Preservation	3
Completeness	26 – 50% (~35%)
Sex	F
Age	>45
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	Osteoarthritis (shoulder, hip)

8.6. Sk1033

Sk1033	
Preservation	4
Completeness	26 – 50% (~40%)
Sex	N/A
Age	33 – 50
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	None visible

8.7. Sk1040

Sk1040	
Preservation	3
Completeness	51 – 75% (~60%)
Sex	M
Age	>35
Stature	169.4 +/- 7.0cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	None visible

8.8. Sk1053

Sk1053	
Preservation	3
Completeness	26 – 50% (~40%)
Sex	M?
Age	33 – 55
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, drying crack(s), yellow staining
Non-Metric Traits	N/A
Pathology/Trauma	Osteophytosis on vertebrae, probable healed fracture of L radius

8.9. Sk1059

Sk1059	
Preservation	3
Completeness	75 – 95% (~85%)
Sex	F
Age	18 – 35
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, water line, yellow staining
Non-Metric Traits	Congenitally absent M3s
Pathology/Trauma	Probable perimortem blunt force trauma to L parietal,

port

8.10. Sk1064

Sk1064	
Preservation	4
Completeness	51 – 75% (~60%)
Sex	M?
Age	16 – 25
Stature	155.2 +/- 7.3cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion, drying cracks
Non-Metric Traits	Dental: Interruption groove and tuberculum dentale (RI2), large hypocones (M1s), buccal pits
Pathology/Trauma	Lack of L acromion with probable traumatic origin

8.11. Sk1072

Sk1072	
Preservation	3
Completeness	76 – 95% (~80%)
Sex	F
Age	>45
Stature	157.5 +/- 9.9cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion, water line
Non-Metric Traits	N/A
Pathology/Trauma	Dental caries, antemortem tooth loss. Osteophytosis and compression of vertebrae.

8.12. Sk1082

Sk1082	
Preservation	5
Completeness	<25% (fragments only)
Sex	N/A
Age	N/A
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	None visible

8.13. Sk1086

Sk1086	
Preservation	4
Completeness	26 – 50% (~26%)
Sex	N/A
Age	>33
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, drying crack(s)
Non-Metric Traits	N/A
Pathology/Trauma	Dental caries

8.14. Sk1094

Sk1094	
Preservation	3
Completeness	<25% (fragments only)
Sex	N/A
Age	7 foetal months
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	None visible

8.15. Sk1099

Sk1099	
Preservation	3
Completeness	26 – 50% (~35%)
Sex	F?
Age	>18
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	None visible

8.16. Sk1103

Sk1103	
Preservation	3
Completeness	51 – 75% (~60%)
Sex	F
Age	>45
Stature	164.4 +/- 9.8cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	Wormian bones, presence of inion hook, Pacchionian granulation
Pathology/Trauma	Dental caries, antemortem tooth loss, possible abscess. Porosity and osteophytosis of lumbar vertebrae.

8.17. Sk1108

Sk1108	
Preservation	4
Completeness	<25% (~10%)
Sex	N/A
Age	17 – 25
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	Dental traits: anterior fovea, distal accessory tubercle (M2)
Pathology/Trauma	Impacted mandibular M3

8.18. Sk1126

Sk1126	
Preservation	4
Completeness	51 – 75% (~55%)
Sex	F?
Age	17 – 25
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, iron staining
Non-Metric Traits	N/A
Pathology/Trauma	Enamel defects (pitted)

8.19. Sk1145

Sk1145	
Preservation	4
Completeness	26 – 50% (~35%)
Sex	N/A
Age	17 – 25
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, drying crack(s), black dot staining (fungal/mould?)
Non-Metric Traits	N/A
Pathology/Trauma	Enamel defects (pitted)

8.20. Sk1151

Sk1151	
Preservation	4
Completeness	51 – 75% (~65%)
Sex	F
Age	>50
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, iron staining, drying crack(s)
Non-Metric Traits	Bifurcated spinous process (cervical vertebrae), orbital notch
Pathology/Trauma	Edentulous, possible abscess. Osteophytosis of scapulae, C2, porosity of L humerus, Schmorl's nodes on thoracic vertebrae. Thickened cranial vault.

8.21. Sk1155

Sk1155	
Preservation	4
Completeness	51 – 75% (~51%)
Sex	F?
Age	17 – 26
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, drying crack(s)
Non-Metric Traits	Congenital absence of P2
Pathology/Trauma	None visible.

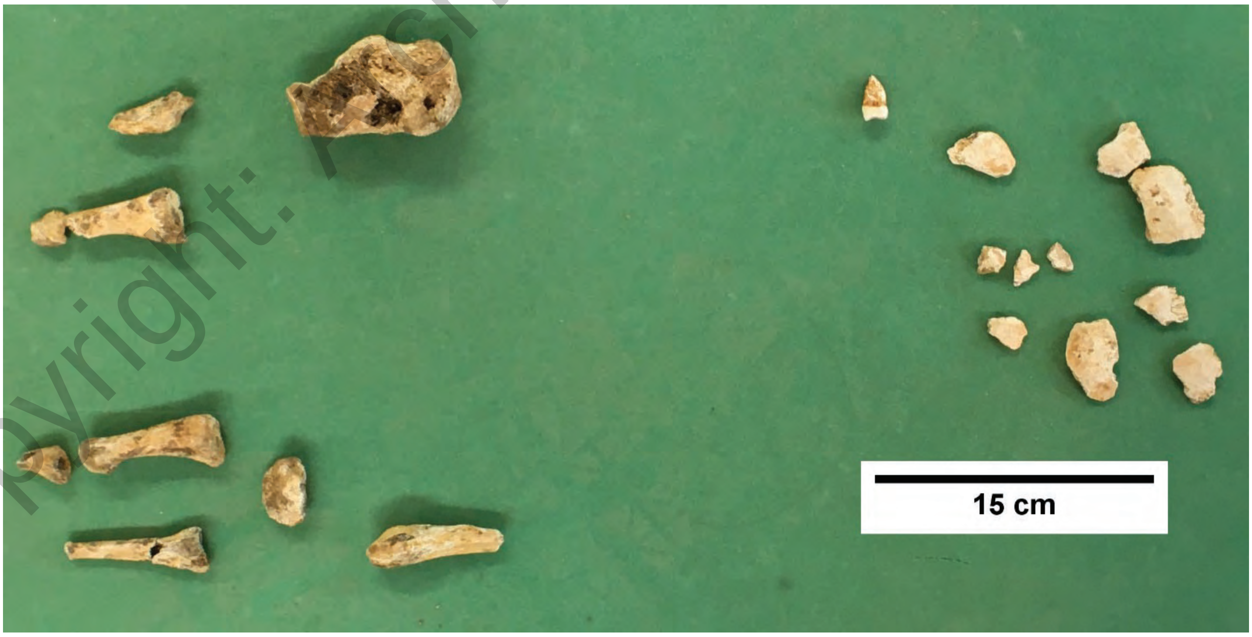
8.22. Sk1162

Sk1162	
Preservation	3
Completeness	26 – 50% (~35%)
Sex	I
Age	33 – 55
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, iron staining
Non-Metric Traits	N/A
Pathology/Trauma	Antemortem tooth loss. Possible healed fracture of L tibia but probably related to lifestyle not trauma.

8.23. Sk1167

Sk1167	
Preservation	3
Completeness	51 – 75% (~55%)
Sex	F
Age	>35
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	Dental abscess, dental caries.

8.24. Sk1172



Sk1172	
Preservation	4
Completeness	<25% (~5%)
Sex	N/A
Age	N/A
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	None visible.

8.25. Sk1177

Sk1177	
Preservation	3
Completeness	51 – 75% (~70%)
Sex	F
Age	20 – 38
Stature	167.6 +/- 6.8cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion, water line, drying crack(s)
Non-Metric Traits	Septal aperture (bilateral)
Pathology/Trauma	Linear enamel hypoplasia, osteophytosis of thoracic vertebra

8.26. Sk1182

Sk1182	
Preservation	3
Completeness	51 – 75% (~51%)
Sex	I
Age	25 – 40
Stature	155.4 +/- 8.3cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	Schmorl's nodes, degenerative disk disease

8.27. Sk1186

Sk1186	
Preservation	3
Completeness	26 – 50% (~35%)
Sex	F
Age	17 – 30
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, iron staining
Non-Metric Traits	Dental: Cusp 5. Bifurcated spinous process, bifurcated radial tuberosity
Pathology/Trauma	Dental caries

8.28. Sk1188

Sk1188	
Preservation	4
Completeness	51 – 75% (~70%)
Sex	N/A
Age	>17
Stature	155.2 +/- 9.9cm
Taphonomy	Soil staining, post-mortem breakage, surface erosion, extra lower limbs present as a result of truncation
Non-Metric Traits	N/A
Pathology/Trauma	Osteoarthritis (hips and vertebrae)

8.29. Sk1191

Sk1191	
Preservation	3
Completeness	26 – 50% (~30%)
Sex	N/A
Age	15 years +/- 3
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, drying crack(s)
Non-Metric Traits	Dental: Tuberculum dentale, buccal pits
Pathology/Trauma	None visible

8.30. Sk1194

Sk1194	
Preservation	3
Completeness	<25% (fragments only)
Sex	N/A
Age	<18
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion, drying crack(s)
Non-Metric Traits	N/A
Pathology/Trauma	None visible

8.31. Sk1199

Sk1199	
Preservation	3
Completeness	<25% (fragments only)
Sex	N/A
Age	N/A
Stature	N/A
Taphonomy	Soil staining, post-mortem breakage, surface erosion
Non-Metric Traits	N/A
Pathology/Trauma	None visible

9. Appendix 2: Disarticulated Summaries

9.1. Unspecified Disarticulated/Unstratified

Unspecified Disarticulated/Unstratified	
MNI	1
Human Remains	3 fragments R femur (1 head, 2 proximal shaft), 1 hand phalanx, 1 un-ID (possibly non-adult) fragment
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion
Pathology/Misc.	Osteophytic lipping on phalanx

9.1. (1012) Disarticulated

(1012) Disarticulated	
MNI	1
Human Remains	3 fragments R femur (1 head, 2 proximal shaft), 1 hand phalanx, 1 un-ID (possibly non-adult) fragment
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion
Pathology/Misc.	Osteophytic lipping on phalanx

9.2. Sk1019 Disarticulated

Sk1019 Disarticulated	
MNI	1
Human Remains	1 right frontal fragment, 1 right maxilla fragment with I2, C, P1, P2 teeth in occlusion, 2 occipital condyles (right and left), 5 cervical vertebra fragments representing atlas and axis (C1, C2), 1 right mandibular I2, 1 unsided mandibular premolar, 2 clavicle fragments (1 right, the other unsided), 1 left scapula fragment, 2 left humerus fragments, 1 left radius fragment, 2 rib fragments, 2 metatarsal (?) fragments, 7 un-identified fragments.
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion
Pathology/Misc.	Vertebrae have signs of osteoarthritic changes (porosity, fusion, osteophytosis), possible LEH on mandibular I2, teeth are heavily worn.

9.3. Disarticulated with Sk1040

Disarticulated with Sk1040	
MNI	1
Human Remains	1 right talus, 2 right fibula fragments
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion
Pathology/Misc.	N/A

9.4. Sk1062 misc. disarticulated

Sk1062 misc. disarticulated	
MNI	1
Human Remains	2 cranial fragments (1 temporal/mastoid, 1 frontal), 1 4th metatarsal, 1 un-identified fragment
Faunal Remains	2 sheep fragments
Taphonomy	Post-mortem breakage, soil staining, cortical erosion
Pathology/Misc.	N/a

9.5. Sk1076 Disarticulated Remains

Sk1076 Disarticulated Remains	
MNI	1
Human Remains	N/A
Faunal Remains	9 bone/horn fragments, including cow rib, horn core, and sheep elements
Taphonomy	N/A
Pathology/Misc.	N/A

9.6. Sk1112 Disarticulated

Sk1112 Disarticulated	
MNI	1
Human Remains	7 fragments of 1 right humerus
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion. Drying crack at proximal shaft
Pathology/Misc.	Pronounced deltoid tuberosity

9.7. Sk1113 Disarticulated

Sk1113 Disarticulated	
MNI	1
Human Remains	1 un-identified cranial fragment
Faunal Remains	1 sheep tibia
Taphonomy	Post-mortem breakage, soil staining, cortical erosion. Plastic deformation to cranial fragment
Pathology/Misc.	N/A

9.8. Disarticulated with Sk1155

Disarticulated with Sk1155	
MNI	1
Human Remains	1 fragment of right frontal (orbit), 1 right deciduous maxillary first molar, 1 mandibular molar (probably M3), 1 peg tooth
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion.
Pathology/Misc.	N/A

9.9. 1197 Disarticulated

1197 Disarticulated	
MNI	1
Human Remains	1 fragment of left distal radius, 1 fragment of left ischium
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion.
Pathology/Misc.	Radius is fused so over 16 years

9.10. Sk1198 Disarticulated

Sk1112 Disarticulated	
MNI	1
Human Remains	2 radius fragments (right?), 3 un-identified fragments
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion.
Pathology/Misc.	N/A

9.11. Sk1200 Disarticulated

Sk1112 Disarticulated	
MNI	1
Human Remains	3 frontal fragments
Faunal Remains	N/A
Taphonomy	Post-mortem breakage, soil staining, cortical erosion.
Pathology/Misc.	Possibly non-adult

Multi-Isotope Analysis of Human Remains from Llangefni College Campus Site Extension – Llangefni, Anglesey

KATIE FAILLACE AND RICHARD MADGWICK
CARDIFF UNIVERSITY

Prepared for Archaeology Wales Ltd.

1. Introduction

Human remains from Llangefni College Campus Site Extension, Anglesey were subject to multi-isotope analysis at the Cardiff University BioArchaeology Laboratory. The site was excavated by Archaeology Wales Ltd. in 2017 and is an early medieval cemetery dating from the 4th to 8th centuries AD. Thirty-two graves were identified, and 31 individuals were analysed following standard osteoarchaeology methods at the Cardiff University BioArchaeology Laboratory (Faillace *et al.* n.d.). This site is comparatively well preserved for Wales, and therefore offers unique potential to investigate diet and migration in early medieval Wales using multi-isotope methods. The aim of this study is to examine diet and geographic origin for a sample of the excavated individuals through multi-isotope ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$, $\delta^{18}O$, $^{87}Sr/^{86}Sr$) analysis of bone collagen and dental enamel to expand the previous macroscopic investigation of these individuals and augment archaeological understanding of the immediate Llangefni site, as well as early medieval Wales more broadly.

Bone collagen was examined for indications of dietary protein sources. Collagen reflects average values based on remodelling rates of the sampled elements, for example, human ribs are thought to represent the five-year average before death (Fahy *et al.* 2017). However, a recent study by Matsubayashi and Tayasu (2019) has concluded that, in long bones, cortical bone closest to the periosteum does not remodel significantly from adolescence; samples that are taken from the whole width of the cortex are an average since adolescence. In this study, ribs were targeted for collagen extraction, but long bones were supplemented when collagen yields from ribs were low. Carbon ($\delta^{13}C$) values are influenced by landscape carbon baselines, the consumption of plants with different photosynthetic pathways, and the consumption of marine (e.g. sea-spray) affected plants. Nitrogen ($\delta^{15}N$) values principally indicate the trophic level of the individual, with the lowest values representing terrestrial herbivores, and the highest representing marine carnivores. Individuals with marine diets tend to have higher nitrogen values as a result of elongated food chains in marine ecosystems. Dietary isotope systems also provide a backdrop for the interpretation of provenancing isotope data, as diet can influence all other proxies, especially if there is evidence of the consumption of marine produce or sea spray-affected plants. Human dietary isotope systems should be supplemented by faunal dietary isotope systems from the same environment, to function as a baseline for comparison.

For geographic origin, isotope ratios of oxygen, strontium, and sulphur are used. Variation in oxygen ($\delta^{18}O$) values is dictated by climate with a broad east to west gradient of increasing values in Britain (Darling *et al.* 2003). Strontium ($^{87}Sr/^{86}Sr$) values reflect the underlying bedrock from where the food was sourced, with older lithologies providing more radiogenic (higher) values (Evans *et al.* 2010). As strontium and oxygen provide values from dental enamel, they represent a snapshot of location at the time the enamel was formed. Sulphur ($\delta^{34}S$) values are analysed from bone collagen and generally reflect coastal proximity, with individuals residing near the coast typically having sulphur isotope values of >14‰ (Nehlich 2015).

2. Methods

2.1. Sample Selection

Sample selection (Table 2.1, Appendix 1) was largely dictated by osteological preservation and completeness. Individuals with multiple rib fragments were first targeted for collagen extraction, as these elements are numerous and largely undiagnostic osteologically. Long bones were substituted in individuals with poor or no collagen yield, or no surviving rib fragments. No individual had complete dentition, so those with non-pathological left maxillary second molars were targeted for enamel extraction, though substitutions were made in respect to side and arcade. Three individuals had no remaining molars and in their cases, premolars were substituted.

ID	Rib Sampled?	Long Bone Sampled	Tooth Sampled	Sex	Age
SK1010	Yes	Femur	M2	Non-Adult	7 – 11
SK1014	Yes	Femur	P2	Female?	>40
SK1015	Yes		M2	Female	25 – 40
SK1024	Yes		M2	Male	16 – 25
SK1029	Yes		M2	Female	>45
SK1033	Yes	Femur	M2	Unscorable	33 – 50
SK1040	Yes	Femur	M2	Male	>35
SK1053	Yes		M2	Male?	33 – 55
SK1059	Yes		M2	Female	18 – 35
SK1064	Yes		M2	Male?	16 – 25
SK1072	Yes			Female	>45
SK1086		Femur		Unscorable	>33
SK1099		Femur		Female?	>18
SK1103	Yes		P1	Female	>45
SK1108		Femur		Unscorable	17 – 25
SK1126	Yes	Femur	M2	Female?	17 – 25
SK1145	Yes	Femur	M2	Unscorable	17 – 25
SK1151	Yes			Female	>50
SK1155	Yes		M2	Female?	17 – 26
SK1162	Yes		M2	Indeterminate	33 – 55
SK1167	Yes		M2	Female	>35

SK1172		Fibula		Unscorable	n/a
SK1177	Yes		M2	Female	20 – 38
SK1182	Yes		M2	Indeterminate	25 – 40
SK1186	Yes		P2	Female	17 – 30
SK1188	Yes			Unscorable	>17
SK1191	Yes		M2	Non-Adult	12 – 18

Table 2.1 Summary of samples, including individual sex and age.

2.2. Collagen ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$)

Collagen was extracted from ribs (n=23) initially and supplemented with extraction from femora (n=9) and a fibula (n=1), for carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulphur ($\delta^{34}S$) analysis. Collagen extraction was undertaken following a modified Longin (1971) method (Brown *et al.* 1988). The surface of the bone was gently abraded with a tungsten burr, then samples weighing between 0.5 and 1.0 gram were extracted using a diamond wheel. The samples were demineralised in 0.5M HCl until soft, then washed with deionised water and gelatinised in pH3 H2O on a hot block at 70°C. After 48 hours, the samples were removed from the hot block, filtered using Ezee™ filters, transferred to polypropylene tests tubes and frozen overnight. Samples were then lyophilised, leaving dry gelatinised collagen. Collagen samples were measured for δ13C and δ15N isotope analysis in duplicate to a weight of 0.9+/-0.2 mg. Samples were measured for δ34S analysis in duplicate to a weight of 2.0+/-0.1 mg. Carbon and nitrogen isotope analysis was undertaken using continuous flow mass spectrometry at Cardiff University Stable Isotope Facility using a Flash 1105 elemental analyser coupled to a ThermoFinigan Delta V Advantage. Analytical error (one standard deviation) of the supermarket gelatin standard was 0.07 and 0.13 for δ15N and δ13C, respectively. Extracted collagen had C:N atomic ratios between 3.2 and 3.4, well within the range (2.9 to 3.6) considered indicative of good collagen preservation (DeNiro 1985). Isotope ratios of sulphur were measured by CF-EA-IRMS at the NERC Isotope Geosciences Laboratory, Keyworth, Nottinghamshire. The instrumentation consists of an elemental analyser (Flash/EA) coupled to a ThermoFinnigan Delta Plus XL isotope ratio mass spectrometer via a ConFlo III interface. Analytical error (one standard deviation) of the M1360p gelatin standards was 0.19.

2.3. Enamel ($\delta^{18}O$, $^{87}Sr/^{86}Sr$)

Enamel was extracted from second molars preferentially; however, second and first premolars were substituted where needed. The Cementum Enamel Junction (CEJ) was targeted for each tooth, which develops between 5 and 8.5 years old (AlQahtani *et al.* 2010) for all three tooth types, but the friable state of many teeth meant that some samples had to be extracted from closer to the occlusal surface (see Appendix 1 for precise measurements). Lingual and mesial surfaces were targeted preferentially, but substitutions were made when necessary. The surface of the enamel was first abraded using a tungsten carbide burr. Then, a slice of enamel was extracted using a precision dental drill and all dentine abraded away. A small fragment of enamel was drilled into a fine powder using a 3.0 millimetre round diamond burr and a minimum of 3.0 mg was weighed into a microcentrifuge tube ready for analysis.

Non-powdered enamel was then cleaned in an ultrasonic bath, rinsed, and dried. A clean enamel fragment weighing a minimum of 30.0 mg was stored in a microcentrifuge tube and transferred to a clean working area (class 100, laminar flow) for further sample preparation and $^{87}Sr/^{86}Sr$ isotope analysis at Cardiff Earth Laboratory for Trace Element and Isotope Chemistry (CELTIC). Samples were digested in 8M HNO_3 and heated overnight at 120°C. Strontium extraction from enamel samples used Sr Spec™ resin using a revised version of protocol of Font *et al.* (2007). Samples were loaded into resin columns in 1ml 8M HNO_3. Matrix elements (including Ca and traces of Rb) were then eluted in several washes of 8M HNO_3 and the samples placed on a hotplate (120°C) overnight. This process was then repeated for a second pass in order to remove all Ca remaining in the sample after the first pass. Once purified samples were dry, samples were re-dissolved in 2% HNO_3. Strontium isotope ratios were measured using a Nu Instruments Multi-Collector Inductively Coupled Plasma mass spectrometer (MC-ICP-MS) at Cardiff University. All data was first corrected for on-peak blank intensities, then mass bias corrected using the exponential law and a normalization ratio of 8.375209 for $^{88}Sr/^{86}Sr$ (Nier 1938). Residual krypton (Kr) and rubidium (^{87}Rb) interferences were monitored and corrected for using ^{82}Kr and ^{83}Kr ($^{83}Kr/^{84}Kr$ = 0.20175 and $^{83}Kr/^{86}Kr$ = 0.66474; without normalization) and ^{85}Rb ($^{85}Rb/^{87}Rb$ = 2.5926), respectively. Analysis of NIST SRM 987 during the analytical session gave a $^{87}Sr/^{86}Sr$ value of 0.710292 ± 0.000007 (2σ n=11) and all data is corrected a NIST SRM 987 values of 0.710248 (Avanzinelli *et al.* 2005). Total procedural blanks are typically less than 20pg of Sr, which is negligible relative to the amount of Sr contained in each sample. Accuracy of the method was assessed by measurement of $^{87}Sr/^{86}Sr$ in NIST SRM 1400 (Bone Ash) gave a $^{87}Sr/^{86}Sr$ value of 0.713129±0.000019, which is consistent with 0.713126±0.000017, as published for this material (Romaniello *et al.* 2015).

3. Results

3.1. Carbon and Nitrogen

The mean $\delta^{13}C$ value for the human samples is -20.8‰, with a median of -20.8‰ (Table 3.1). The range is -21.3‰ to -20.3‰ and standard deviation is 0.3. All values are within two standard deviations of the mean, and there are no marked outliers; however, three individuals (Sk1177, Sk1010, and Sk1072) have somewhat lower $\delta^{13}C$ values, all below -21.0‰. The mean $\delta^{15}N$ value for the human samples is 10.6‰, with a median of 10.6‰ (Table 3.1). The range is 9.6‰ to 11.5‰, and standard deviation is 0.5. All values are within two standard deviations of the mean, and there are no marked outliers; however, two individuals (Sk1040 and Sk1064) have noticeably lower $\delta^{15}N$ values, both below 10.0‰.

Sample	Element	$\delta^{13}C$	$\delta^{15}N$	%C	%N	C:N
Sk1010	Rib	-21.1	11.1	32.85	11.59	3.31
	Femur	-21.3	11.1	19.07	6.61	3.37
Sk1014	Rib	-20.6	10.6	39.20	14.06	3.25
	Femur	-21.1	10.1	19.53	6.88	3.31
Sk1015	Rib	-20.3	10.4	36.89	13.32	3.23
Sk1024	Rib	-20.8	10.9	40.19	14.28	3.28
Sk1029	Rib	-20.7	11.1	40.94	14.80	3.23
Sk1033	Rib	-20.7	10.6	26.82	9.37	3.34
Sk1040	Rib	-20.8	9.7	35.68	12.77	3.26
	Femur	-20.8	9.6	36.96	13.12	3.28
Sk1053	Rib	-20.5	10.8	38.57	13.75	3.27
Sk1059	Rib	-20.9	10.9	35.06	12.50	3.27
Sk1064	Rib	-20.9	9.7	36.31	12.96	3.27
Sk1072	Rib	-21.1	11.0	40.19	13.98	3.35
Sk1099	Rib	-21.0	10.6	23.28	8.14	3.34
Sk1103	Rib	-20.9	10.6	36.20	12.80	3.30
Sk1145	Rib	-20.7	10.4	30.66	10.47	3.41
Sk1151	Rib	-20.7	10.2	40.05	14.23	3.28
Sk1155	Rib	-20.5	10.9	38.22	13.75	3.24
Sk1162	Rib	-20.8	10.5	34.09	12.31	3.23
Sk1167	Rib	-20.6	10.8	34.50	12.31	3.27
Sk1177	Rib	-21.2	11.5	34.03	12.05	3.29
Sk1182	Rib	-20.5	10.5	40.59	14.58	3.25
Sk1186	Rib	-20.8	10.9	38.81	13.95	3.24
Sk1188	Rib	-20.9	10.3	32.46	11.69	3.24
Sk1191	Rib	-20.3	10.4	41.40	14.96	3.23

Table 3.1 $\delta^{13}C$ and $\delta^{15}N$ results, each row representing the mean of duplicate analysis.

3.2. Sulphur

The mean $\delta^{34}S$ value is 11.9‰, with a median of 12.1‰ (Table 3.2). The range is 8.1‰ to 14.6‰ and the standard deviation is 1.6‰. All values are within two standard deviations of the mean, and there are no marked outliers.

Sample	$\delta^{34}S$	%S	%C	%N	N:S	C:S	$\delta^{34}S$ 1SD
Sk1010	10.8	0.11	32.9	11.6	241	796	-
Sk1014	11.4	0.22	39.2	14.1	149	486	0.06
Sk1015	11.6	0.18	36.9	13.3	169	547	0.37
Sk1024	13.3	0.23	40.2	14.3	145	476	0.07
Sk1029	12.6	0.21	40.9	14.8	161	520	0.31

Sk1033	12.0	0.15	26.8	9.4	143	477	-
Sk1040	9.4	0.22	35.7	12.8	133	433	0.35
Sk1053	10.1	0.21	38.6	13.8	153	502	0.24
Sk1059	12.3	0.19	35.1	12.5	150	492	0.37
Sk1064	13.4	0.20	36.3	13.0	148	484	0.28
Sk1072	8.1	0.33	40.2	14.0	98	330	0.12
Sk1103	11.0	0.26	36.2	12.8	115	379	0.42
Sk1151	11.0	0.23	40.1	14.2	141	464	0.27
Sk1155	13.1	0.18	38.2	13.8	175	566	0.57
Sk1162	13.2	0.17	34.1	12.3	165	535	0.05
Sk1167	10.5	0.19	34.5	12.3	152	497	0.38
Sk1177	12.1	0.20	34.0	12.1	141	465	0.21
Sk1182	12.8	0.22	40.6	14.6	155	503	0.25
Sk1186	12.7	0.21	38.8	14.0	156	505	0.01
Sk1188	14.6	0.17	32.5	11.7	162	525	0.28
Sk1191	13.4	0.21	41.4	15.0	167	539	0.29

Table 3.2 δ^{34}S results, each row representing the mean of duplicate analysis with standard deviation of that mean given in the final column, except Sk1010 and Sk1033 which could only be analysed once.

3.3. Oxygen and Strontium

The mean phosphate $\delta^{18}O_{VSMOW}$ value is 17.5‰, with a median of 17.5‰ (Table 3.3). The range is 16.1‰ to 19.1‰ and standard deviation is 0.75. All values are within two standard deviations of the mean, and there are four outliers: two that have $\delta^{18}O_{VSMOW}$ values greater than 18.5‰ and two that have $\delta^{18}O_{VSMOW}$ values less than 16.5‰. The mean $^{87}Sr/^{86}Sr$ is 0.7110, with a median of 0.7109 (Table 3.3). The range is 0.7095 to 0.7129, and standard deviation is 0.001. All values are within two standard deviations of the mean, and there are three outliers that have more radiogenic (greater) values than 0.7120.

Sample	$^{87}Sr/^{86}Sr$	2 SE $^{87}Sr/^{86}Sr$	$\delta^{18}O_p$ VMSOW	$\delta^{18}O_p$ VMSOW SD	$\delta^{13}C_{VPDB}$
Sk1010	0.7106	0.000015	16.2	0.03	-15.5
Sk1014	0.7102	0.000015	17.1	0.02	-14.5
Sk1015	0.7097	0.000014	17.5	0.02	-14.2
Sk1024	0.7114	0.000014	18.8	0.02	-14.3
Sk1029	0.7112	0.000012	18.1	0.02	-13.9
Sk1033	0.7103	0.000011	16.7	0.02	-14.8
Sk1040	0.7129	0.000012	17.5	0.03	-15.0
Sk1053	0.7105	0.000010	17.3	0.02	-15.7
Sk1059	0.7104	0.000014	18.0	0.02	-14.5
Sk1064	0.7102	0.000012	17.1	0.04	-14.7
Sk1103	0.7118	0.000011	17.9	0.03	-15.2
Sk1126	0.7112	0.000014	17.9	0.04	-14.3

Sk1145	0.7095	0.000011	17.5	0.03	-14.5
Sk1155	0.7115	0.000014	17.6	0.02	-14.4
Sk1162	0.7126	0.000012	17.5	0.02	-15.0
Sk1167	0.7102	0.000012	19.1	0.02	-14.9
Sk1177	0.7114	0.000012	17.5	0.02	-14.9
Sk1182	0.7126	0.000013	17.9	0.02	-14.8
Sk1186	0.7115	0.000012	16.6	0.03	-14.4
Sk1191	0.7102	0.000011	16.1	0.03	-16.1

Table 3.3 $^{87}Sr/^{86}Sr$ and $\delta^{18}O_{VSMOW}$ results. $^{87}Sr/^{86}Sr$ was analysed singularly, $\delta^{18}O_{VSMOW}$ is represented by the mean of duplicate analyses with the standard deviation indicated by "SD".

4. Discussion

4.1. Diet: Carbon and Nitrogen

Carbon and Nitrogen values are consistent with a terrestrial omnivorous diet. A $\delta^{13}C$ value of -20.0‰ is typically considered the boundary for a completely terrestrial diet in a C3 ecosystem such as Britain (Richards *et al.* 2006), and all values from this sample fall below that boundary (Figure 4.1). There is no evidence for a substantial marine protein component within the diet, which is perhaps surprising given the island location, but not uncommon for the Early Medieval period (Hull and O'Connell 2011). Because $\delta^{13}C$ values can increase with a sea-spray effect due to proximity to the coast, it is possible that the three individuals with the lowest $\delta^{13}C$ values (Sk1177, Sk1010, and Sk1072) were from a more inland location or had a greater proportion of their dietary protein derived from plant sources. The $\delta^{15}N$ values are consistent with an omnivorous diet, with the individuals with the two lowest values (Sk1064 and Sk1040) likely deriving a greater proportion of their protein from plant sources than the other individuals. The sex ratio of the site is imbalanced, with approximately half of the individuals lacking a sex estimate, therefore it is impossible to examine sex differences with any degree of certainty. However, it is worth noting that the individuals with the two lowest nitrogen values are both males (Sk1040, Sk1064). Of the three individuals with the lowest $\delta^{13}C$ values, two are female and one is non-adult (no sex estimate).

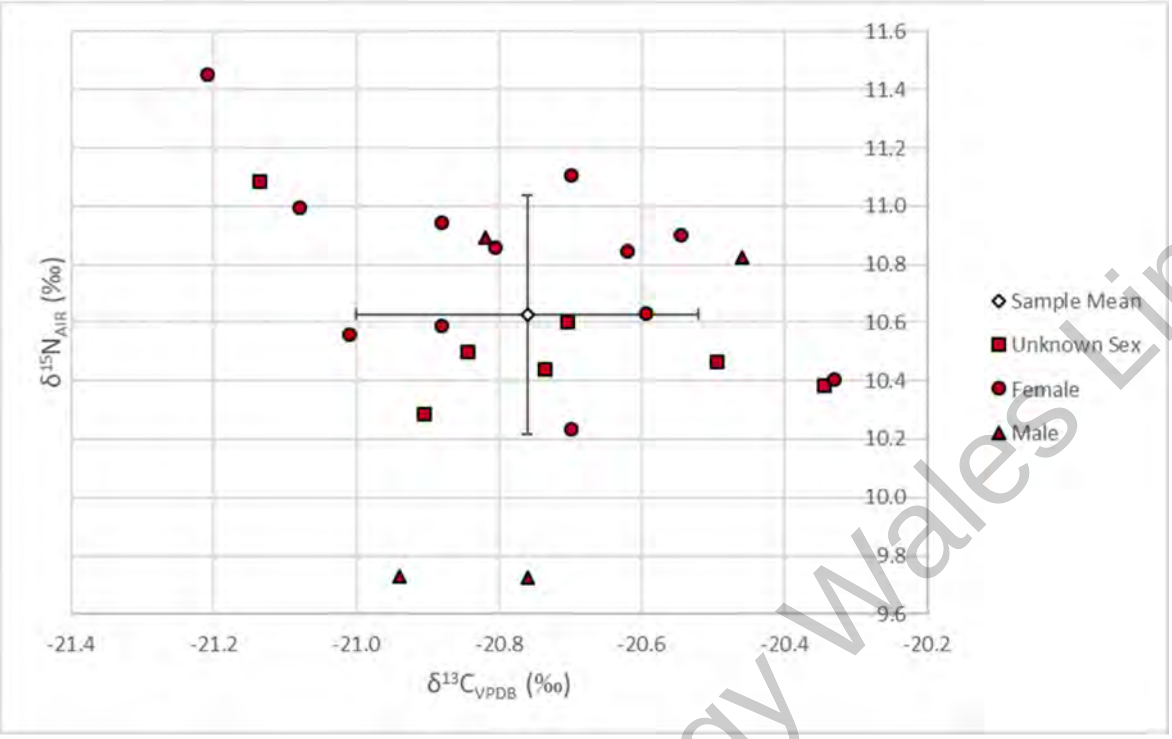


Figure 4.1 $\delta^{13}C$ and $\delta^{15}N$ results for the Llangefni cemetery sample, with the mean value for the sample represented by the hollow diamond with one standard deviation error bars.

$\delta^{13}C$ and $\delta^{15}N$ was also examined for 12 faunal samples comprised of 7 cattle (*Bos taurus*), 3 sheep (*Ovis aries*), and 2 pig (*Sus scrofa*) (Figure 4.2). Many of the cattle and sheep $\delta^{15}N$ values are higher than expected for most terrestrial herbivores; however, they are within the range expected for coastal herbivores, whereby the nitrogen is enriched through the marine-affected soils (Britton *et al.* 2008; Jay and Richards 2007). We can expect the human values to be nitrogen enriched for the same reason. Therefore, the individuals with the lowest nitrogen values may actually be non-local migrants from more inland locations who were previously unaffected by marine environments. One sheep has a much lower $\delta^{13}C$ value of -22.9‰, with a lower value than expected for most southern British sites (e.g. Britton *et al.* 2008). This animal is likely to have been raised away from Anglesey, in a $\delta^{13}C$-depleted landscape.

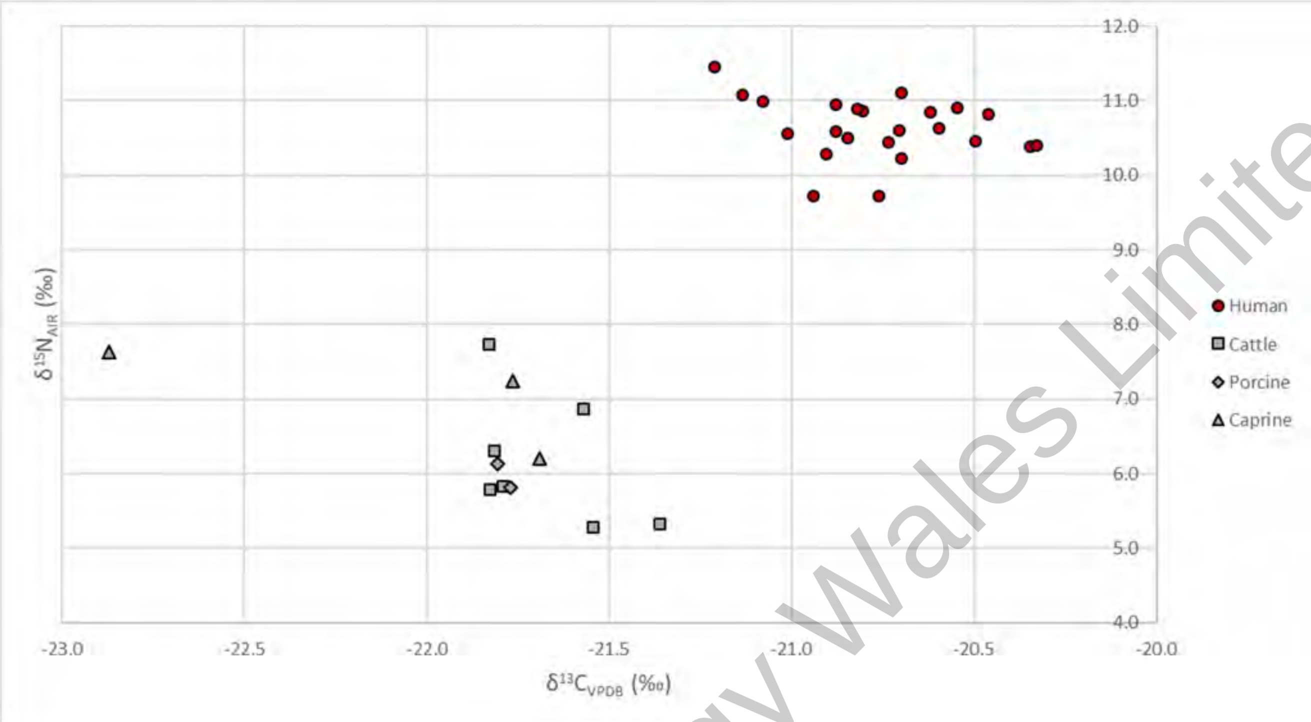


Figure 4.2 δ13C and δ15N results for Llangefni human and faunal samples.

4.2. Origins: Sulphur, Oxygen, and Strontium

Sulphur can be a useful tool for provenancing because it has a low fractionation rate, meaning the $\delta^{34}S$ values derived from bone collagen will be a close reflection of the $\delta^{34}S$ values in the food consumed. In the sample from Llangefni, the range of $\delta^{34}S$ values (8.1‰ to 14.6‰) is consistent with that of a coastal environment, 8‰ to 21‰ (Evans *et al.* 2018) (Figure 4.3). This reflection of the geological sulphur is further evidence that the individuals buried in Llangefni were not eating marine food, as Nehlich (2015) identifies 14‰+ as the expected minimum for a marine diet. Although the sulphur data in this sample is undiagnostic for potential origin, supporting the local environment or any other coastal region, it does support the conclusion of a terrestrial-based diet for these individuals, at least for the last few years of their lives. There are no qualitative sex differences in the sulphur values. Although sulphur mapping in Britain remains relatively low resolution, in an exposed western coastal location with high rainfall such as Anglesey, values higher than 14‰ and certainly higher than 10‰ might be expected. The mid-ranging data for individuals from Llangefni therefore hints that some may not be local.

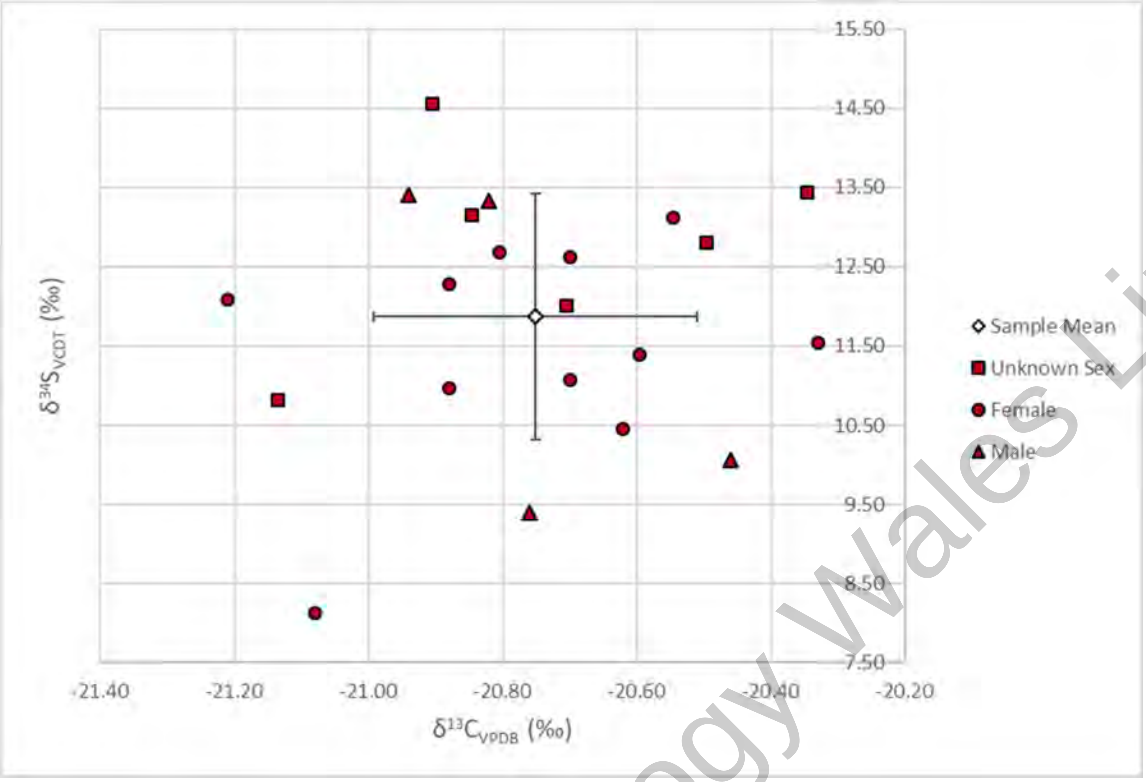


Figure 4.3 $\delta^{34}S$ results for the Llangefni human sample against $\delta^{13}C$, with the mean value for the sample represented by the hollow diamond with one standard deviation error bars.

The $\delta^{18}O$ values from Llangefni have a broad range, from 16.1‰ to 19.1‰, which is beyond the expected range of Britain, 16.6‰ to 18.7‰ (Evans *et al*. 2012, Evans *et al*. 2018), and especially beyond the expected range for western Britain (17.7‰ to 18.7‰). In fact, only five of the twenty examined individuals fall within the expected range for western Britain (Sk1029, Sk1059, Sk1103, Sk1126, and Sk1182). Two individuals have higher $\delta^{18}O$ values, suggestive of a warmer climate than Britain such as Iberia or the Mediterranean region (Sk1024, Sk1167), although these values have been documented elsewhere in the UK (see Evans *et al.* 2018 supplementary data). Oxygen values can be elevated by dietary practice (e.g. large quantities of stewed, brewed or boiled liquids consumed, Brettell *et al*. 2012) or dominant water sources having high evaporation rates (e.g. shallow ponds). However, the highest value sits outside of two standard deviations of the mean for all humans analysed from Britain (Evans *et al.* 2012) and the possibility that this individual derives from a warmer climate must be considered. Six individuals have values that border the West/East distinction in Britain, including the region around the northern Welsh/English border today (Sk1040, Sk1162, Sk1155, Sk1177, Sk1015, Sk1145). Whilst this East-West distinction is diffuse, graduated and cannot be considered a hard border, it would be expected that individuals raised on Anglesey would be at the higher end of the range for Western Britain. Seven individuals appear to have values suggesting a more eastern origin. Four individuals have $\delta^{18}O$ values of 16.7‰ to 17.1‰, consistent with eastern Britain (Sk1014, Sk1033, Sk1053, Sk1064), one individual has the borderline $\delta^{18}O$ value of 16.6‰ (Sk1186) and three have $\delta^{18}O$ values lower than 16.6‰, which are closer to areas of continental Europe (Sk1010 and Sk1191). These are suggestive of origins in an area with a colder climate, such as Scandinavia (e.g. Chenery *et al.* 2014), but values are borderline and depletion could relate to dietary practice or water sourcing. Consequently, the interpretation of oxygen isotope values is complex and these data cannot be taken as incontrovertible evidence of non-British origin. Comparison with existing British datasets suggests an unusually wide-range for a single site, suggesting varied origins with the highest and lowest values potentially being non-British. However, water sources and dietary practice could potentially account for this. For example, it is worth noting, that in their study of human enamel oxygen isotope values from Britain, Evans *et al.* (2012) found a number of individuals from Medieval Rutland with $\delta^{18}O$ values lower than 16.6‰ potentially relating to lifeways, rather than origins.

The site of Llangefni is situated on sandstone of the carboniferous limestone supergroup, with expected $^{87}Sr/^{86}Sr$ values ranging from 0.7088 to 0.7101, with an area of schist less than 10 kilometres from the site with expected values of 0.7090 to 0.7110 (Evans *et al*. 2018). The values expected from the schist were called "the strontium of doom" by Montgomery and colleagues (2014) for being infamously undiagnostic due to their ubiquity in Britain. Restricted pockets of more radiogenic lithology also exist on the north and west coast of Anglesey, which would be expected to produce Sr values between 0.7120 and 0.7136. However, they are so limited in area it is unlikely that communities would acquire there food exclusively from these zones. These biosphere characterisations are from Evans *et al.* (2018) and rely on some lithological extrapolation. It is advisable to undertake primary plant sampling for more accurate characterisation but this was not possible within the scope of this project. The range of $^{87}Sr/^{86}Sr$ values from the sampled human enamel is 0.7095 to 0.7129 (Figure 4.4). Half of the samples have Sr ratios that indicate an older lithology than is consistent with Llangefni, with $^{87}Sr/^{86}Sr$ ratios between 0.7112 and 0.7129. There are consistent with older lithologies from the northern-most coasts of Anglesey, but with consideration of the low sulphur values, it is unlikely that these individuals were consistently sourcing food from along the coast itself. There are larger areas consistent with these values in central and southern Wales, Devon and Cornwall, and northeast Scotland, as well as the region between Derbyshire and Yorkshire (Figure 4.5). Combining isotope proxies makes these regions more likely areas of origin. However, it is possible that the Anglesey biosphere is inadequately mapped, a problem that has complicated the use of biosphere projections elsewhere in Wales (Madgwick *et al*. 2019).

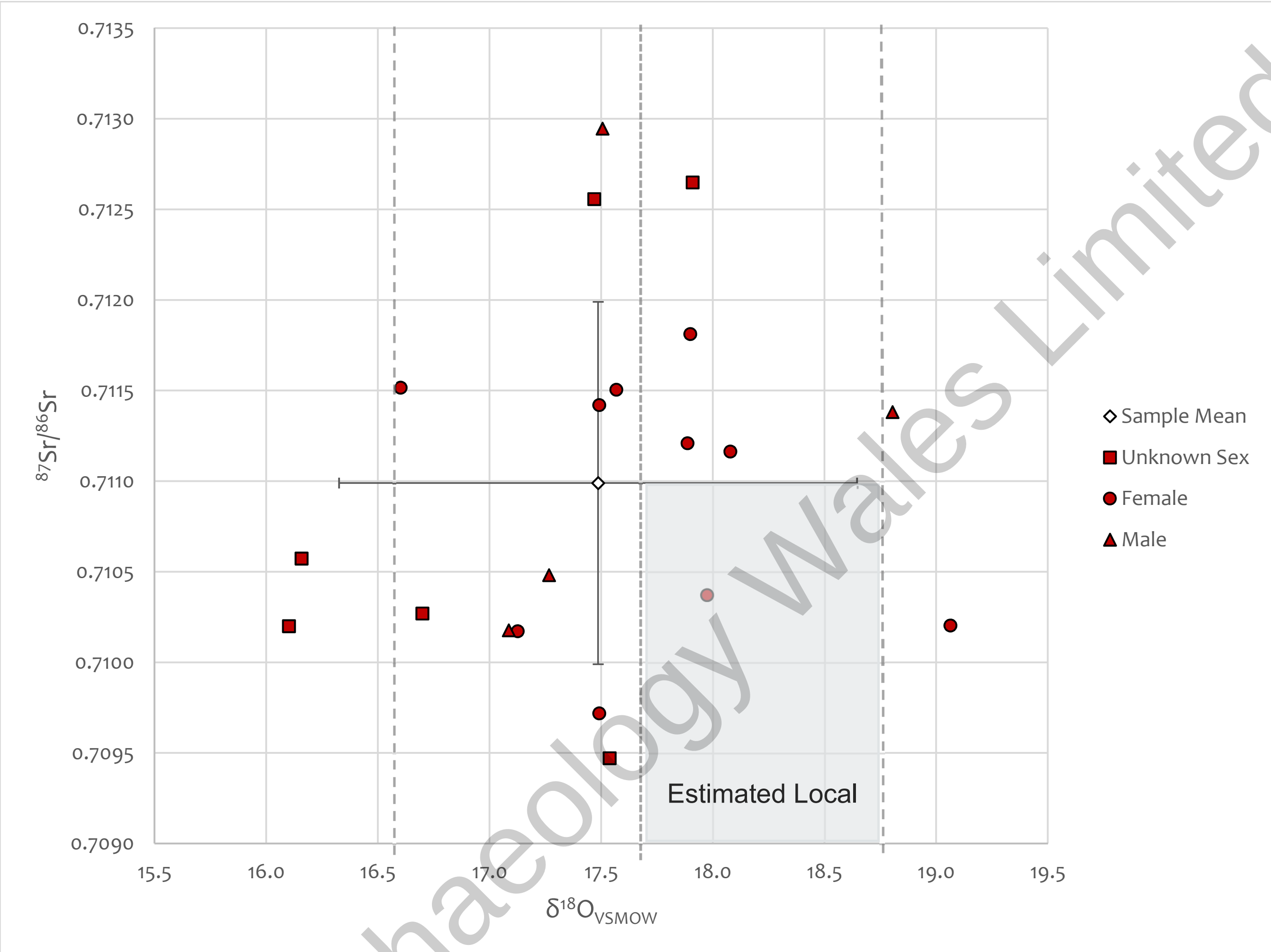


Figure 4.4 $^{87}Sr/^{86}Sr$ and $\delta^{18}O_{VSMOW}$ results for the Llangefni human sample, with the mean of the sample represented by the hollow diamond with one standard deviation error bars. Expected $\delta^{18}O_{VSMOW}$ values for Britain are bound by the dashed lines, and the expected East/West divide is marked by the dotted line. The estimated local range of $^{87}Sr/^{86}Sr$ and $\delta^{18}O_{VSMOW}$ for Llangefni is shaded.

Figure 4.5 Estimated areas of Britain that correspond to the $^{87}Sr/^{86}Sr$ values of 0.7112 to 0.7129 (Evans et al. *2018).*

When examining the isotope systems that can investigate migration holistically, an interesting collection of values emerges. Sulphur is analysed from bone collagen, and in 19 of the 21 individuals analysed, sulphur was extracted from rib samples (Sk1010 and Sk1033 were from femora), representing approximately the last five years of life. All sulphur values are broadly consistent with the island of Anglesey and any other coastal area in Britain; it is reasonable to conclude from this information that the majority of individuals buried at Llangefni were not recent migrants to the area, although higher sulphur values might be expected in the exposed westerly location of Anglesey. When childhood origins are examined, however, greater variation is revealed. Only one individual is within the combined $\delta^{18}O$ and $^{87}Sr/^{86}Sr$ values expected: Sk1059. Eight of the individuals have values consistent with bands of sandstone that can be found in the central Welsh border region north to Yorkshire, areas of Scotland, five have values consistent with west or central Wales, large parts of Devon and Cornwall, and parts of Western Scotland. Two individuals have values that are consistent with virtually all of eastern Britain, but not with Wales, and four are likely not from Britain. Of these four, two are likely from warmer climates (Sk1024, Sk1167) and two are likely from cooler climates (Sk1010, Sk1191). Although there is no pattern of sex difference among geographic isotope systems, there is an age related one. The two individuals likely from a colder climate are the only two non-foetal, non-adults in the excavated sample. Sk1024 is estimated to be 9 years old (+/- 2), and Sk1191 is estimated to be 15 years old (+/- 3).

4.3. Comparisons

Though not every site was analysed for all five isotope systems analysed here, recent studies by Hemer and colleagues (2013 and 2017) provide the nearest comparative isotope data for early medieval Wales. These studies analysed individuals from Atlantic Trading Estate (4th – 6th centuries AD), Llandough (4th – 11th centuries AD), Brownslade (5th – 11th centuries AD), Porthclew (5th – 10th centuries AD), West Angle Bay (7th – 12th centuries AD), and St. Patrick's Chapel (7th – ? centuries AD), as well as three sites from the Isle of Man (Balladoole (4th – 7th centuries AD), Cronk keeillane (6th – 8th centuries AD), and Peel Castle (7th – 10th centuries AD)). Arnold *et al.* (1998) analysed a small sample from Ty Newydd, Anglesey, and even smaller samples from medieval Towyn Y Capel and Bronze Age Great Orme were included in Evans and colleague's (2012) study (Figure 4.6).

Figure 4.6 Map of sites compared in this study.

Comparison of the dietary isotope systems with other Welsh and Isle of Man sites demonstrates a broadly consistent diet across this region at this time, with little evidence for significant marine input in diets at most British sites (Hull and O'Connell 2011) (Figure 4.7). The Llangefni $\delta^{13}C$ mean groups with the lower $\delta^{13}C$ means of Cronk Keeillane and Porthclew, but the $\delta^{15}N$ mean is within the middle of the range of Nitrogen means from other the other sites. It is interesting that the geographically closest site to Llangefni, Ty Newydd, is the only outlier, with a lower $\delta^{15}N$ mean than the other sites, despite Arnold and colleague's (1998) interpretation that the $\delta^{15}N$ values are relatively elevated for omnivores. Given the coastal locations for many of these sites, it is unclear why there is such a range in $\delta^{15}N$ values between them. This likely relates to the influence of marine-affected soils, manuring practices between communities, and variations in the availability of protein sources between communities.

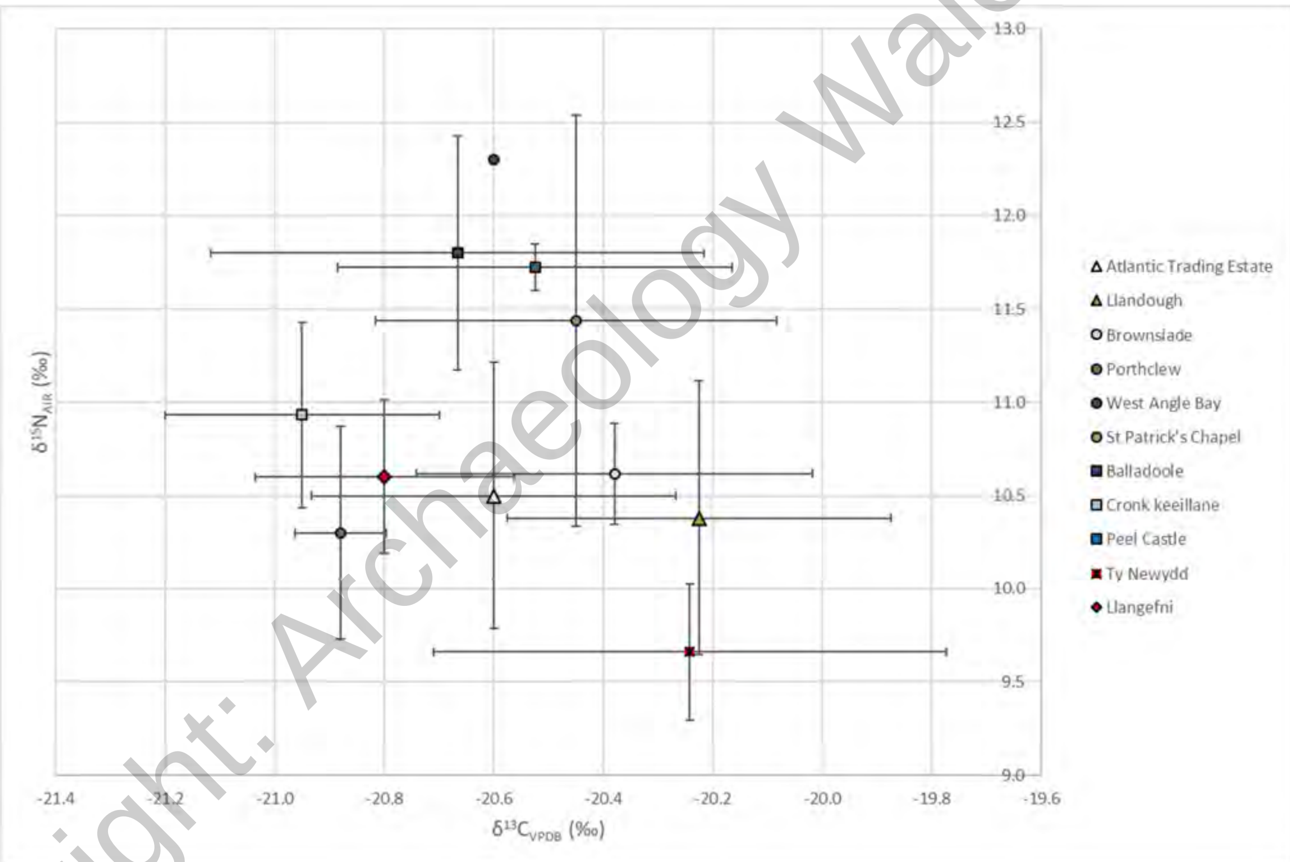


Figure 4.7 Mean $\delta^{13}C$ and $\delta^{15}N$ of Llangefni as compared to the mean values from other Welsh and Isle of Man sites. All error bars represent one standard deviation. The sample of West Angle Bay is represented by 1 individual.

The sulphur results from Llangefni were compared to six other Welsh and Isle of Man sites. Only one site, Llandough, has a mean $\delta^{34}S$ value consistent with an inland location. All other site means are above 8.0‰, consistent with their coastal locations. Of the sites grouped in Figure 4.8, Llangefni has the second lowest mean $\delta^{34}S$ value, likely because it is the most inland site (after Llandough). This suggests that even on a relatively small island such as Anglesey, the sea-spray effect on sulphur isotope values does not permeate the entire island evenly.

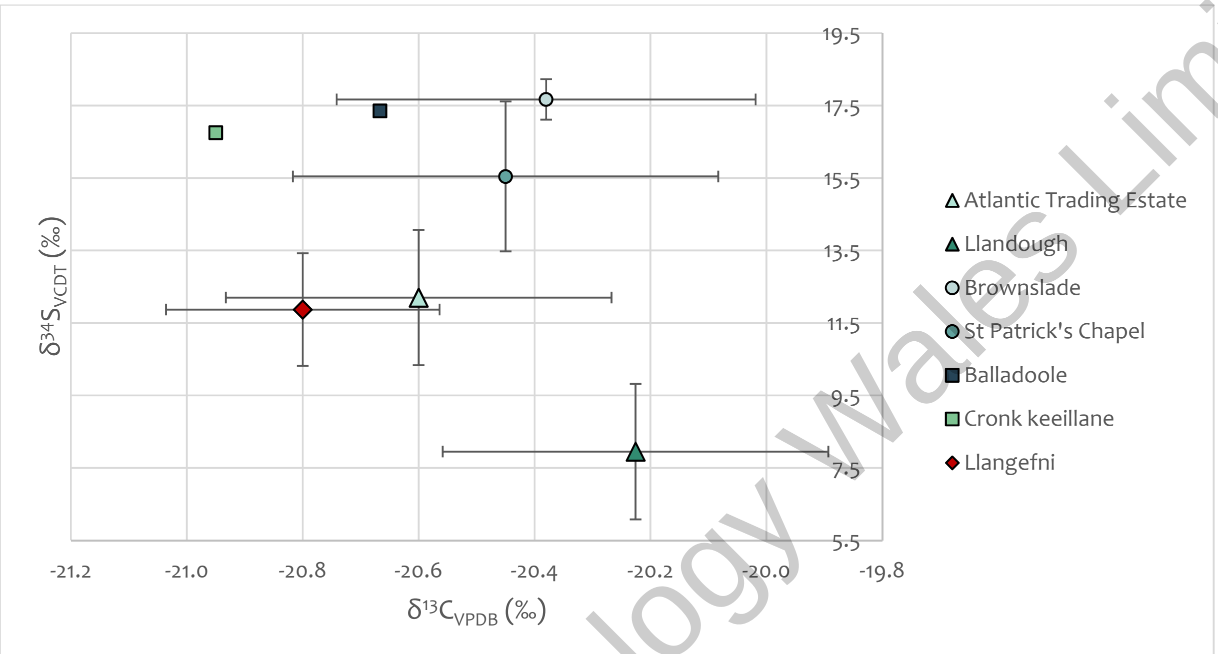


Figure 4.8 Mean $\delta^{34}S$ (against $\delta^{13}C$) of Llangefni as compared to the mean values from other Welsh and Isle of Man sites. All error bars represent one standard deviation. The samples of Balladoole and Cronk keeillane are represented by 2 individuals and therefore do not include error bars.

Comparison of $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ is also made to six sites from Wales and the Isle of Man. Llangefni is an outlier in Figure 4.9, in both $^{87}Sr/^{86}Sr$ and $\delta^{18}O$, as well as standard deviation, exhibiting the widest range of values for both isotope systems. The six other sites fit comfortably within the expected boundaries for Western Britain (17.7‰ to 18.7‰), which is in contrast to the mean for Llangefni at 17.5‰. In this comparison of means alone, the oxygen values would suggest that Llangefni was an eastern site, not a western one.

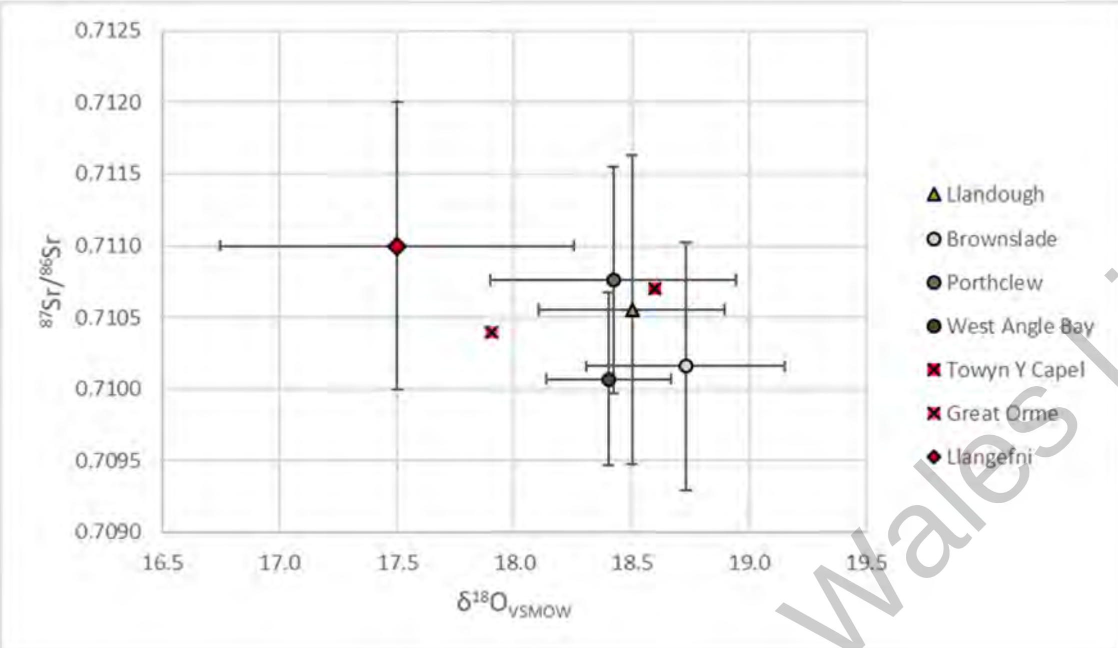


Figure 4.9 Mean $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ of Llangefni as compared to the mean values from other Welsh sites. All error bars represent one standard deviation. The samples of Towyn y Capel and Great Orme are represented by 2 and 1 individuals respectively and therefore do not include error bars.

5. Conclusion

Equifinality remains a hurdle to confident interpretation of isotope data, even when using multiple proxies. Consequently, it is necessary to explore a range of potential interpretations of the data.

The most conservative interpretation is that this region of the UK is poorly understood in regards to archaeological isotope analysis, and that this wide range in values could reflect the amount of variation in the environment of Anglesey. Alternatively, the particularly wide-ranging oxygen values could result from the exploitation of different water sources and/or the varied dietary practice (relating to brewing, stewing and boiling). However, when comparing to human oxygen isotope datasets from across Britain (e.g. Evans *et al.* 2012; Pellegrini *et al*. 2016), the potential of non-British origins must be considered.

Another interpretation is that the individuals in this sample represent a founding population for the site of Llangefni, a population which most probably came from central England or parts of Scotland. However, this interpretation over-simplifies the variation in $^{87}Sr/^{86}Sr$ and $\delta^{18}O$ values and does not account for the extreme, non-British values. It also ignores the range in radiocarbon dates, which suggests the cemetery was in use for up to three centuries.

A third interpretation requires greater reliance on the artefactual and historical record. It is possible that Llangefni is an early medieval centre for trade, attracting merchants and artisans from Britain and beyond. Hemer and colleagues (2013) identified 12 possible non-British migrants in their samples from south Wales, all of whom had childhood origins in warmer climates. This was interpreted as evidence for movement of people alongside the trade of material culture with Mediterranean societies and the Byzantine Empire (Hemer 2013). It is unfortunate that the two individuals who likely derive from a cooler climate were not selected for radiocarbon dating. Although their oxygen values likely represent a cooler climate than Britain, they are not extreme enough to strongly suggest Scandinavian migrants (Montgomery *et al.* 2014). It is therefore more probable that they represent early Anglo-Saxon migrants. There is artefactual evidence supporting high status settlements on Anglesey at this time (Edwards *et al*. 2017, Roberts *et al*. 2012). The breadth of values strongly suggests a community of diverse origin, raised in both eastern and western Britain (and perhaps beyond).

6. References

AlQahtani, S.J., Hector, M.P., and Liversidge, H.M. 2010. Brief communication: the London Atlas of Human Tooth Development and Eruption. *American Journal of Physical Anthropology* 142: 481 – 490

Arnold, C.J., Wysocki, M.P., and Richards, M. 1998. Excavation of ‘Ty Newydd’, Ynys Enlli (Bardsey Island), Gwynedd. *Archaeologia Cambrensis* 147: 96 – 132

Avanzinelli, R., Boari, E., Conticelli, S., Francalanci, L., Guarnieri, L., Perini, G., Petrone, C.M., Tommasini, S., and Ulivi, M. 2005. High precision Sr, Nd, and Pb isotopic analyses using the new generation Thermal Ionisation Mass Spectrometer ThermoFinnigan Triton-Ti®. *Periodico di Mineralogia* 74: 147 – 166

Brettell, R., Montgomery, J., and Evans, J., 2012. Brewing and stewing: the effect of culturally mediated behaviour on the oxygen isotope composition of ingested fluids and the implications for human provenance studies. *Journal of Analytical Atomic Spectrometry* 27: 778-785.

Britton, K., Müldner, G., and Bell, M. 2008. Stable isotope evidence for salt-marsh grazing in the Bronze Age Severn Estuary, UK: Implications for palaeodietary analysis at coastal sites. *Journal of Archaeological Science* 35: 2111 – 2118

Brown, T.A., Nelson, D.E., Vogel, J.S., and Southon, J.R. 1988. Improved collagen extraction by modified Longin method. *Radiocarbon*, 30: 171 – 177

Chenery, C., Lamb, A., Evans, J., Sloane, H., Stewart, C., 2014. Appendix 3. Isotope analysis of individuals from the Ridgeway Hill mass grave. In: Loe, L., *et al.* (Eds.), '*Given to the Ground': a Viking Age Mass Grave on Ridgeway Hill, Weymouth. DNHAS*.

Darling, W.G., Bath, A.H., and Talbot, J.C. 2003. The O & H stable isotopic composition of fresh waters in the British Isles. 2. Surface waters and groundwater. *Hydrology and Earth System Sciences* 7: 183 – 195

DeNiro, M.G. 1985. Postmortem preservation and alteration of in vivo bone collagen isotope ratios in relation to palaeodietary reconstruction. Nature 317: 806 - 809

Edwards, N., Davies, T., and Hemer, K.A. 2017. Research framework for the archaeology of early medieval Wales c. AD 400 – 1070. IFA Wales/Cymru.

Evans, J., Montgomery, J., Wildman, G., and Boulton, N. 2010. Spatial variations in biosphere 87Sr/86Sr in Britain. *Journal of the Geological Society*, 167: 1 - 4

Evans, J.A., Chenery, C.A., and Montgomery, J. 2012. A summary of strontium and oxygen isotope variation in archaeological human tooth enamel excavated from Britain. *Journal of Analytical Atomic Spectrometry*, 27: 754 - 764.

Evans, J.A., Chenery, C.A., Mee, K., Cartwright C.E., Lee, K.A., Marchant, A.P., and Hannaford, L. 2018. Biosphere Isotope Domains GB (V1): Interactive Website. British Geological Survey. (Interactive Resource). https://doi.org/10.5285/3b141dce-76fc-4c54-96fa-c232e98010ea

Fahy, G.E., Deter, C., Pitfield, R., Miszkiewicz, J.J., and Mahoney, P. 2017. Bone deep: variation in stable isotope ratios and histomorphometric measurements of bone remodelling within adult humans. *Journal of Archaeological Sciences* 87: 10 – 16

Faillace, K.E., Madgwick, R.D., and Joyce, R. 2019. The Human Bone from Llangefni College Campus Site Extension – Llangefni, Anglesey. Unpublished osteological report.

Font, L., Nowell, G.M., Pearson, D.G., Ottley, C.J., and Willis, S.G. 2007. Sr isotope analysis of bird feathers by TIMS: a tool to trace bird migration paths and breeding sites. Journal of Analytical Atomic Spectrometry 22: 513 – 522

Hemer, K.A., Evans, J.A., Chenery, C.A., and Lamb, A.L. 2013. Evidence of early medieval trade and migration between Wales and the Mediterranean Sea region. *Journal of Archaeological Science,* 40: 2352 – 2359

Hemer, K.A., Lamb, A.L., Chenery, C.A., and Evans, J.A. 2017. A multi-isotope investigation of diet and subsistence amongst island and mainland populations from early medieval western Britain. *American Journal of Physical Anthropology,* 162: 423 – 440

Horwitz, E., Chiarizia, R., and Dietz, M.L. 1992. A novel strontium-selective extraction chromatographic resin. *Solvent Extraction and Ion Exchange* 10: 313 – 336

Hull, B.D. and O'Connell, T.C. 2011. Diet: recent evidence from analytical chemical techniques. In Hamerow (Ed), *The Oxford Handbook of Anglo-Saxon Archaeology*. Oxford: Oxford University Press, 667 – 687

Jay, M. and Richards, M.P. 2007. British Iron Age diet: stable isotopes and other evidence. *Proceedings of the Prehistoric Society* 73: 169 – 190

Longin, R. 1971. New method of collagen extraction for radiocarbon dating. *Nature*, 230: 241 – 242

Madgwick R, Lewis J, Grimes V, and Guest P. 2019. On the hoof: exploring the supply of animals to the Roman legionary fortress at Caerleon using strontium ($^{87}Sr/^{86}Sr$) isotope analysis. *Archaeological and Anthropological Sciences 11*: 223-235.

Matsubayashi, J. and Tayasu, I. 2019. Collagen turnover and isotopic records in cortical bone. *Journal of Archaeological Science* 106: 37 – 44

Montgomery, J., Grimes, V., Buckberry, J., Evans, J.A., Richards, M.P., Barrett, J.H. 2014. Finding Vikings with isotope analysis: the view from wet and windy islands. *Journal of the North Atlantic* 7: 54 – 70

Nehlich, O. 2015. The application of Sulphur isotope analyses in archaeological research: a review. *Earth-Science Reviews* 142: 1 – 17

Nier, A.O. 1938. The isotopic constitution of strontium, barium, bismuth, thallium, and mercury. *Physical Review* 54: 275

Pellegrini, M., Pouncett, J., Jay, M., Parker Pearson, M., and Richards, M.P. 2016. Tooth enamel oxygen "isoscapes" show a high degree of human mobility in prehistoric Britain. *Scientific Reports* 6: 34986Richards, M.P., Fuller, B.T., and Hedges, R.E.M. 2001. Sulphur isotopic variation in ancient bone collagen from Europe: implications for human palaeodiet, residence mobility, and modern pollutant studies. *Earth and Planetary Science Letters* 191: 185 – 190

Richards, M.P., Fuller, B.T., and Molleson, T.I. 2006. Stable isotope paleodietary study of humans and fauna from the multi-period (Iron Age, Viking, late Medieval) site of Newark Bay. *Journal of Archaeological Science*, 33: 122 – 131.

Roberts, H., Cuttler, R., and Hughes, G. 2012. Cefn Cwmwd, Rhostrehwfa. Pit circle, early Bronze Age cremation cemetery, Iron Age/Romano-British farmstead and early medieval occupation' in Cuttler *et al. A Corridor through Time. The Archaeology of the A55 Road Scheme*. Oxford: Oxbow Books.

Romaniello, S.J., Field, M.P., Smith, H.B., Gordon, G.W., Kim, M.H., Anbar, A.D. 2015. Fully automated chromatographic purification of Sr and Ca for isotopic analysis. Journal of Analytical Atomic Spectrometry 30: 1906 – 1912

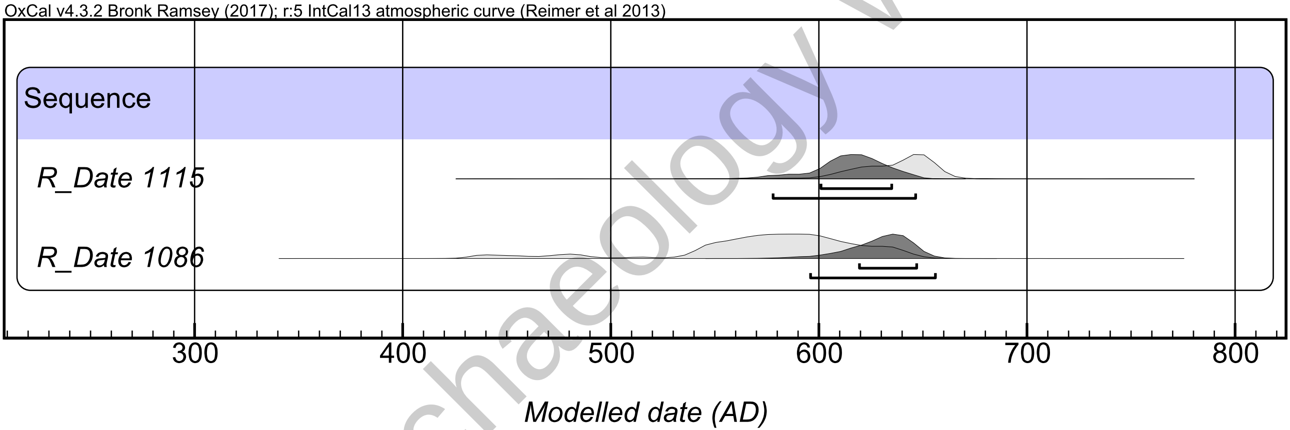
7. Appendix 1: Sample Locations

ID	Rib Sampled?	Long Bone Sampled	Tooth Sampled	Sex	Age
SK1010	Yes	R Femur (shaft)	R Mand M2	Non-Adult	7 – 11
SK1014	Yes	R Femur (shaft)	R Mand P2	Female?	>40
SK1015	Yes		R Max M2	Female	25 – 40
SK1024	Yes		L Max M2	Male	16 – 25
SK1029	Yes		L Max M2	Female	>45
SK1033	Yes	R Femur (shaft)	L Max M2	Unscorable	33 – 50
SK1040	Yes	R Femur (shaft)	R Max M2	Male	>35
SK1053	Yes		R Mand M2	Male?	33 – 55
SK1059	Yes		L Max M2	Female	18 – 35
SK1064	Yes		R Max M2	Male?	16 – 25
SK1072	Yes			Female	>45
SK1086		R Femur (shaft)		Unscorable	>33
SK1099		R Femur (shaft)		Female?	>18
SK1103	Yes		L Mand P1	Female	>45
SK1108		L Femur (neck)		Unscorable	17 – 25
SK1126	Yes	R Femur (shaft)	L Max M2	Female?	17 – 25
SK1145	Yes	R Femur (shaft)	R Max M2	Unscorable	17 – 25
SK1151	Yes			Female	>50
SK1155	Yes		L Max M2	Female?	17 – 26
SK1162	Yes		L Max M2	Indeterminate	33 – 55
SK1167	Yes		L Max M2	Female	>35
SK1172		L Fibula (distal shaft)		Unscorable	n/a
SK1177	Yes		L Max M2	Female	20 – 38
SK1182	Yes		R Mand M2	Indeterminate	25 – 40
SK1186	Yes		R Max P2	Female	17 – 30
SK1188	Yes			Unscorable	>17
SK1191	Yes		R Max M2	Non-Adult	12 – 18

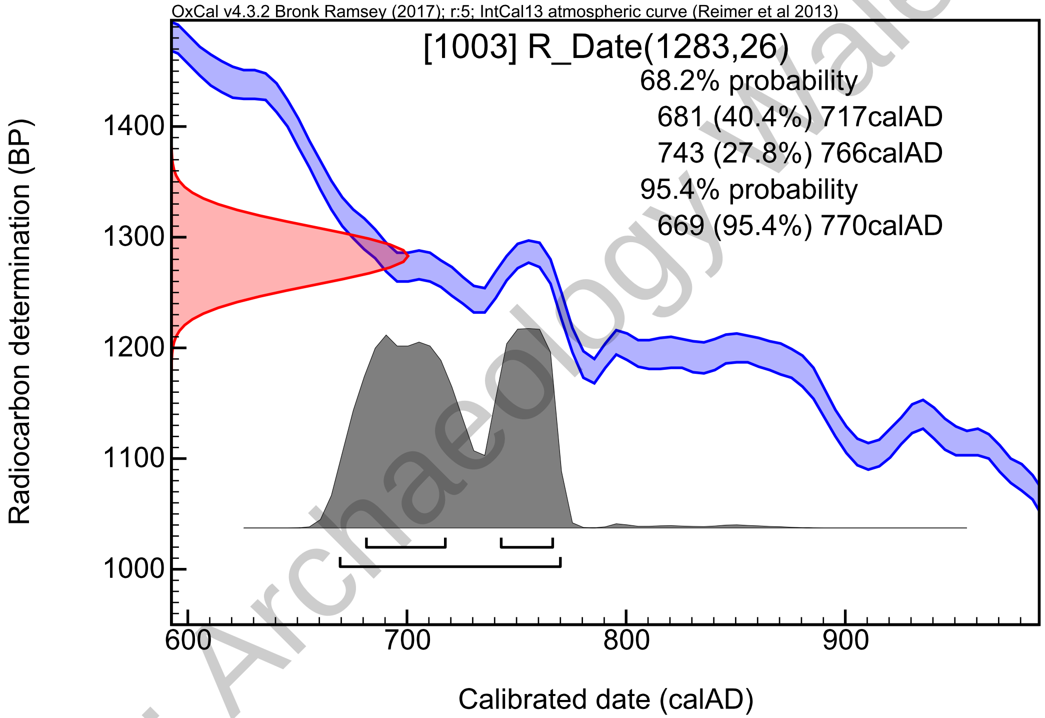
Table 7.1 Element sampled.

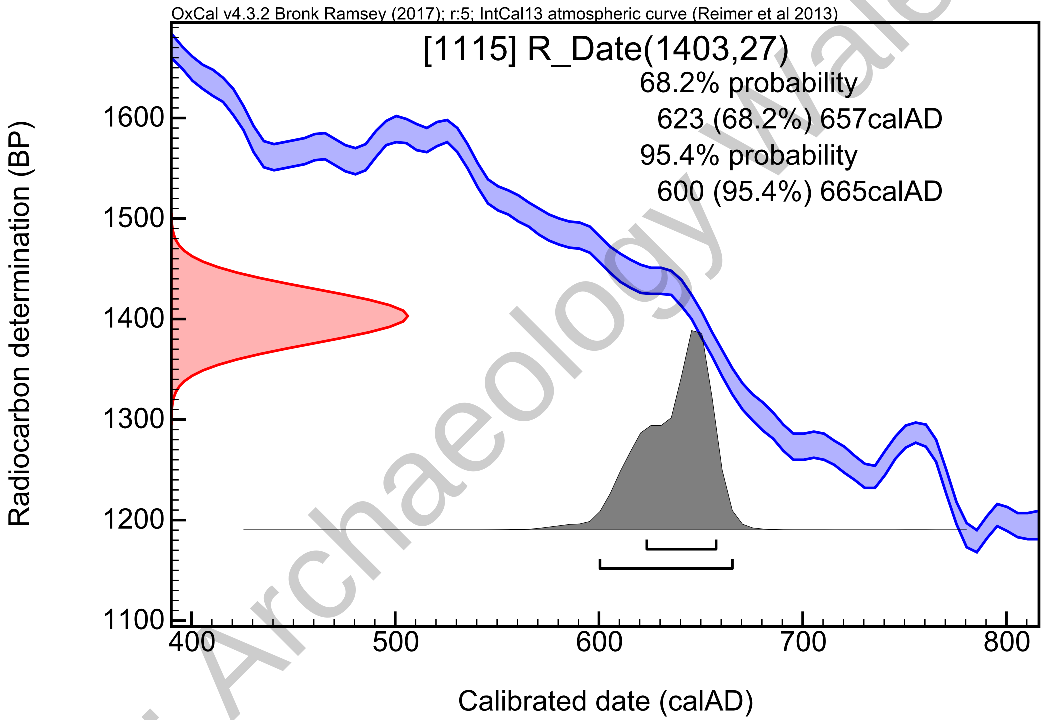
ID	Arcade	Side	Tooth	$\delta^{18}O$ Sample Location	$^{87}Sr/^{86}Sr$ Sample Location
SK1010	Mand	L	M2	Ling. 1.5mm from CEJ, 1.3mm wide	Mes. 0.8mm from CEJ, 3.3mm wide
SK1014	Mand	R	P2	Bucc. 1.5mm from CEJ, 0.8mm wide	Dist. 0.1mm from CEJ, 2.4mm wide (whole surface)
SK1015	Max	R	M2	CEJ	CEJ
SK1024	Max	L	M2	CEJ	CEJ
SK1029	Max	L	M2	CEJ	CEJ
SK1033	Max	L	M2	2.5mm from CEJ	Dist. 3.1mm from CEJ, 3.0mm wide
SK1040	Max	R	M2	Dist. 1.0mm from CEJ, 1.4mm wide	Dist. Whole surface chipped off (CEJ to Occl Surface)
SK1053	Mand	L	M2	Mes. surface (all)	Mes. 4.2mm wide. (whole surface)
SK1059	Max	L	M2	Ling. 2.3mm from CEJ, 0.8mm wide	Mes. 1.1mm from CEJ, 3.3mm wide
SK1064	Max	R	M2	Ling. 2.4mm from CEJ, 1.8mm wide	Mes. 1.1mm from CEJ, 2.3mm wide
SK1103	Mand	L	P1	Ling. 1.0mm from CEJ, 0.7mm wide	Dist. 3.2mm from CEJ (whole surface from there)
SK1126	Max	L	M2	Ling. 1.3mm from CEJ, 1.0mm wide	Mes. 0.4mm from CEJ, 2.8mm wide
SK1145	Max	R	M2	0.8mm from CEJ, 2.5mm wide	Mes. 0.9mm from CEJ, 2.5mm wide
SK1155	Max	L	M2	Ling. 1.8mm from CEJ, 0.8mm wide	Mes. 2.6mm wide. Chipped from CEJ.
SK1162	Max	L	M2	Ling. 0.6mm from CEJ, 1.8mm wide	Dist. 0.8mm from CEJ, 2.1mm wide
SK1167	Max	L	M2	Ling. 0.5mm from CEJ, 2.2mm wide	Mes. 0.5mm from CEJ, 2.4mm wide
SK1177	Max	L	M2	Dist. 0.6mm from CEJ, 1.0mm wide	Distolingual corner of tooth. 2.3mm wide section from CEJ
SK1182	Mand	R	M2	Bucc. 1.2mm from CEJ, 1.8mm wide	Ling. 0.7mm from CEJ, 2.8mm wide
SK1186	Max	R	P2	Ling. 0.3mm from CEJ, 2.0mm wide	Mes. 0.8mm from CEJ, 2.5mm wide
SK1191	Max	R	M2	Ling. 1.8mm from CEJ, 2.0mm wide	Mes. 1.1mm from CEJ, 4.0mm wide

Table 7.2 Sample locations for $\delta^{18}O$ and $^{87}Sr/^{86}Sr$, including tooth surface and measurements.

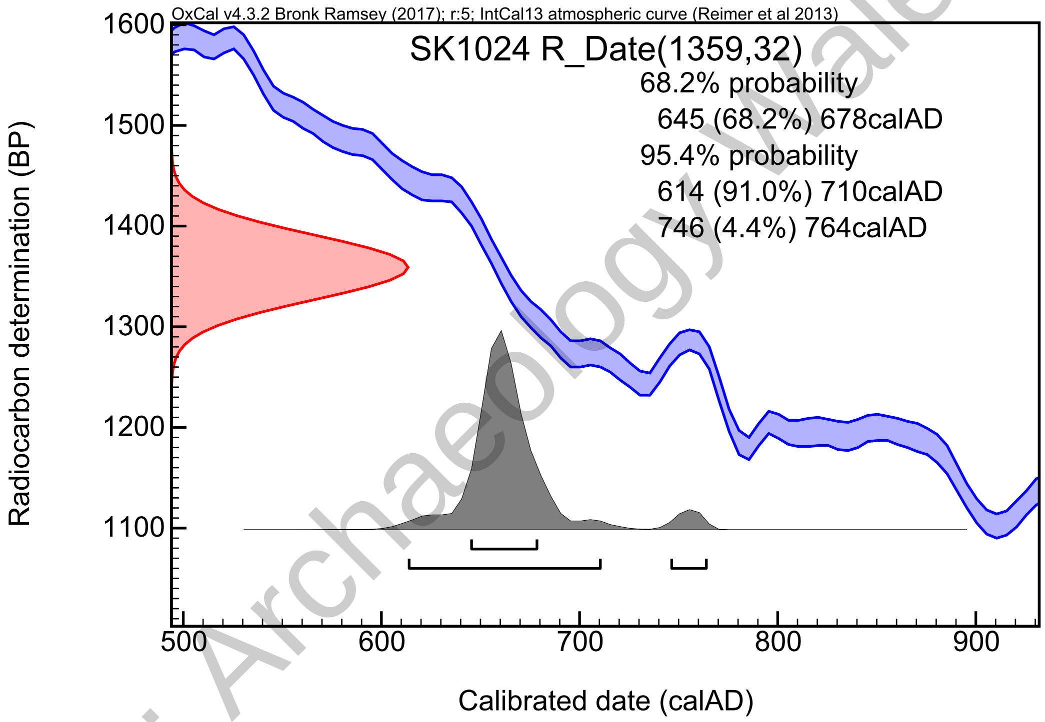

OxCal v4.3.2 Bronk Ramsey (2017); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
Sequence
R_Date 1115
R_Date 1086
300
400
500
600
700
800
Modelled date (AD)

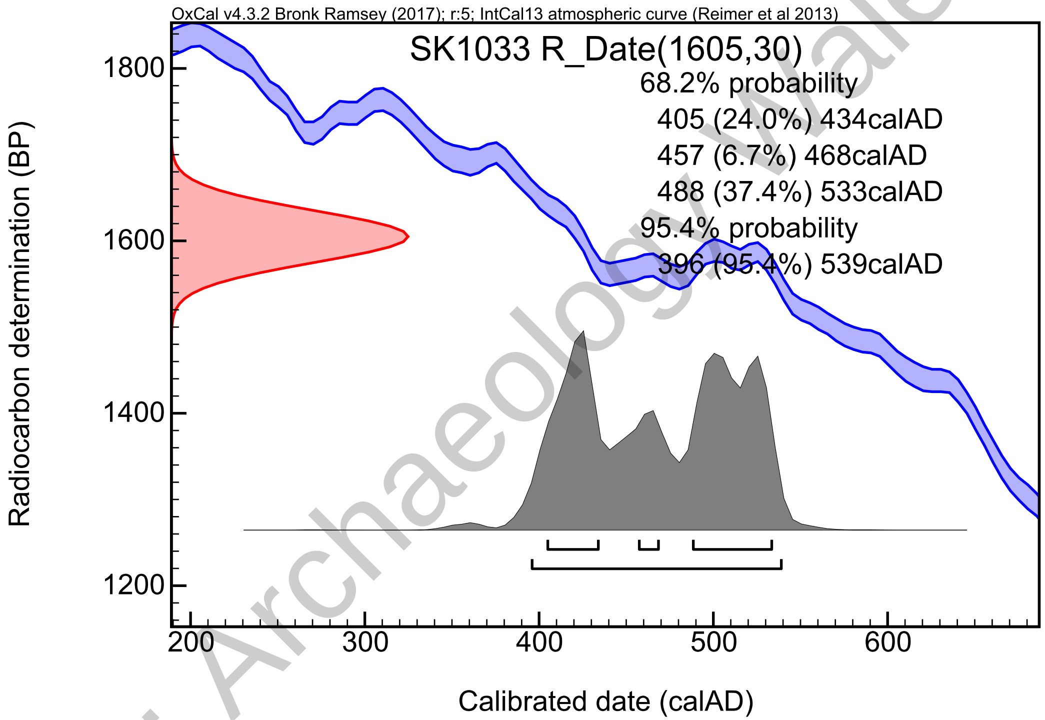
Name	Unmodelled (BC/AD)						Modelled (BC/AD)					
	from	to	%	from	to	%	from	to	%	from	to	%
Sequence												
R_Date 11:	623	657	68.2	600	665	95.4	601	635	68.2	578	646	95.4
R_Date 10!	546	618	68.2	434	648	95.5	619	647	68.2	596	656	95.4

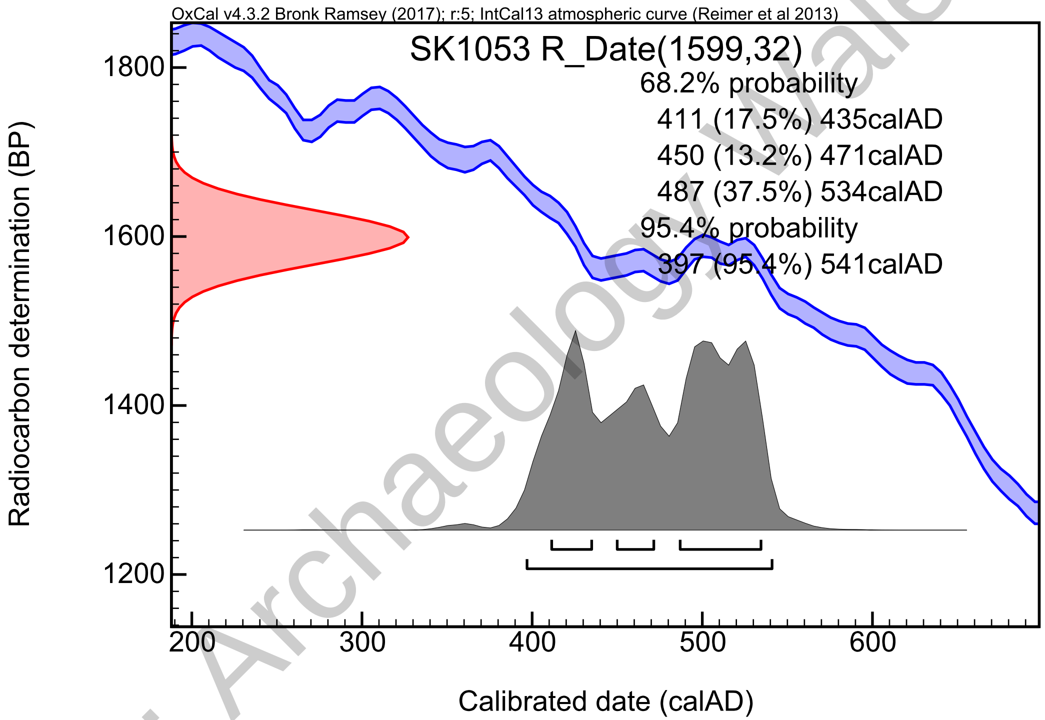

OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
[1003] R_Date(1283,26)
68.2% probability
681 (40.4%) 717calAD
743 (27.8%) 766calAD
95.4% probability
669 (95.4%) 770calAD
Radiocarbon determination (BP)
1400
1300
1200
1100
1000
600
700
800
900
Calibrated date (calAD)



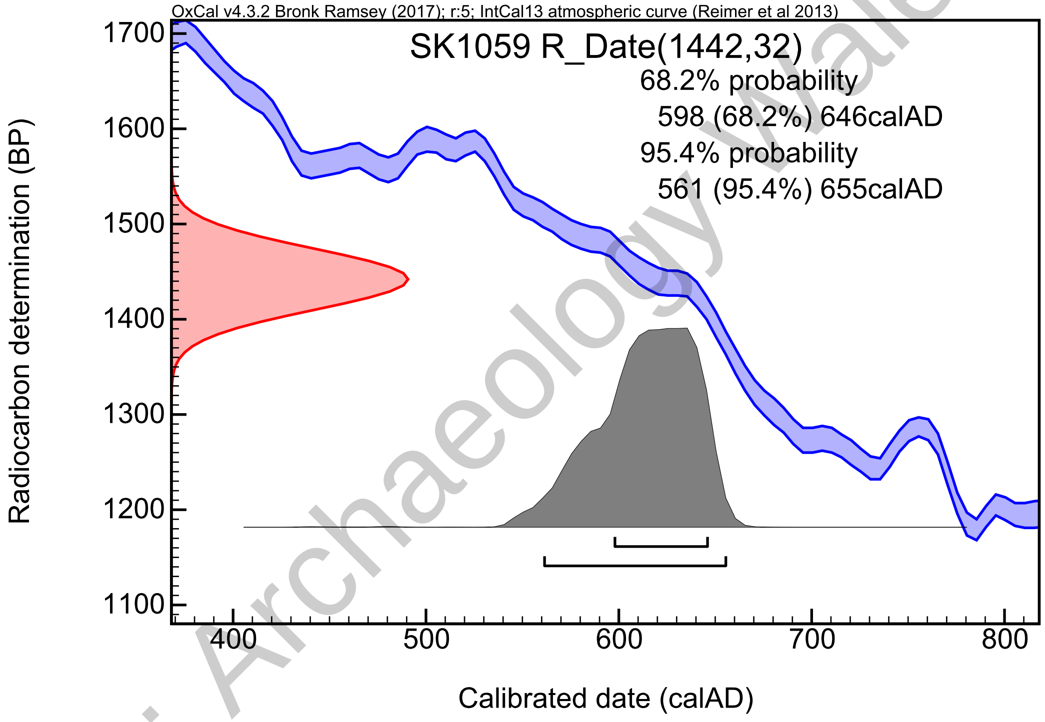
OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
[1115] R_Date(1403,27)
68.2% probability
623 (68.2%) 657calAD
95.4% probability
600 (95.4%) 665calAD
Radiocarbon determination (BP)
1600
1500
1400
1300
1200
1100
400
500
600
700
800
Calibrated date (calAD)

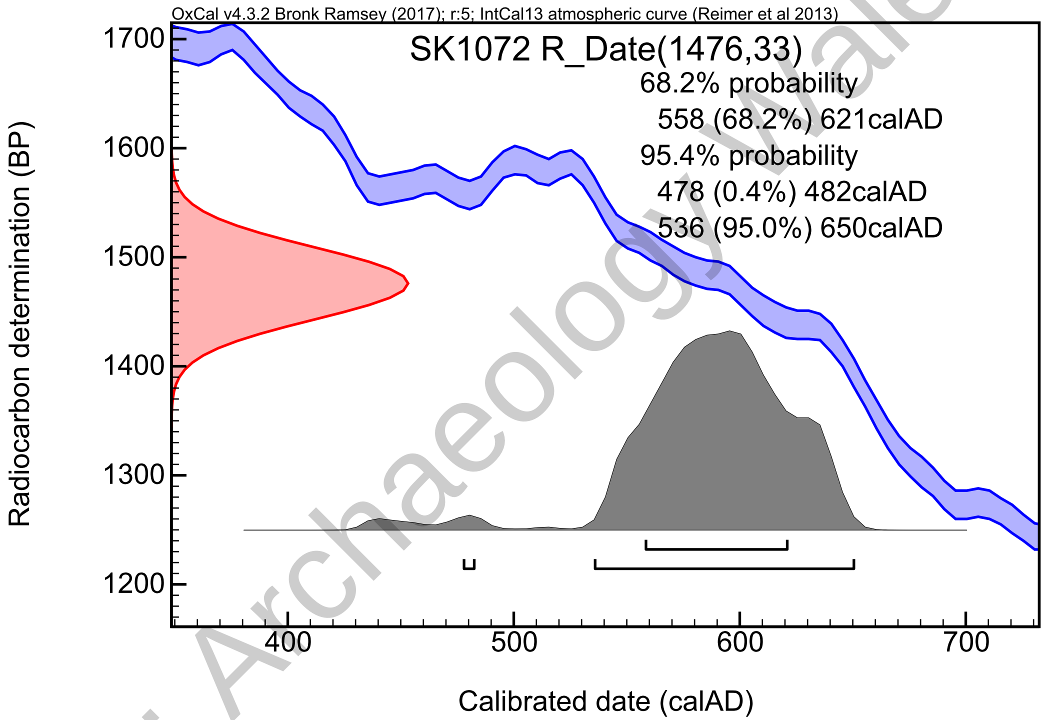

OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1024 R_Date(1359,32)
68.2% probability
645 (68.2%) 678calAD
95.4% probability
614 (91.0%) 710calAD
746 (4.4%) 764calAD
Radiocarbon determination (BP)
1600
1500
1400
1300
1200
1100
500
600
700
800
900
Calibrated date (calAD)

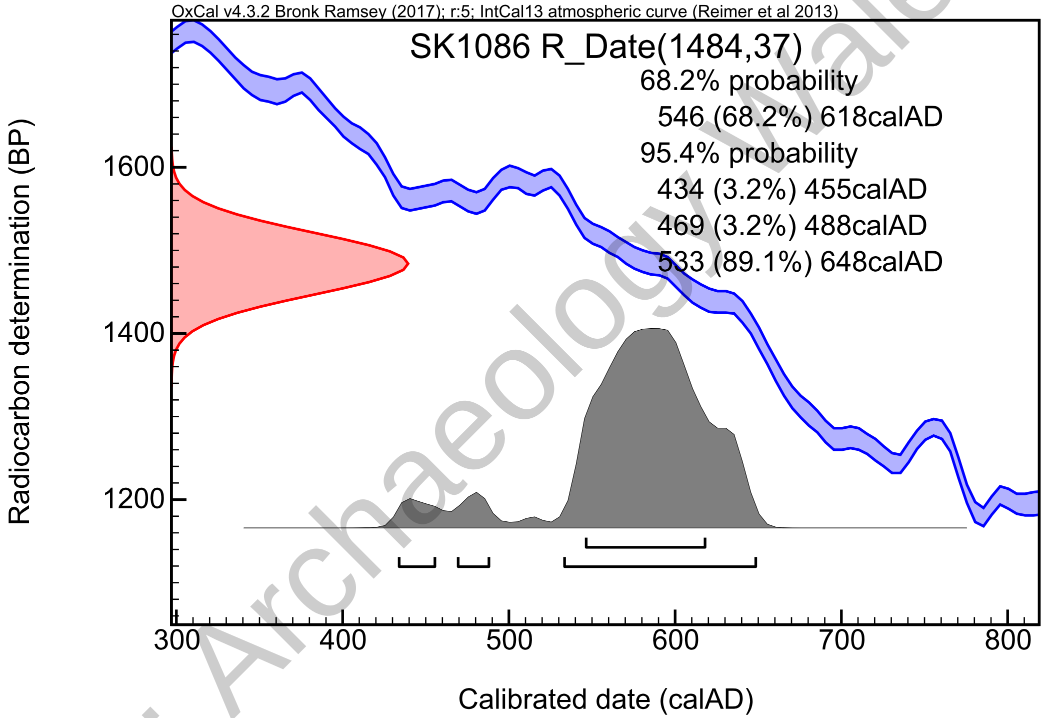

OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1033 R_Date(1605,30)
68.2% probability
405 (24.0%) 434calAD
457 (6.7%) 468calAD
488 (37.4%) 533calAD
95.4% probability
396 (95.4%) 539calAD
Radiocarbon determination (BP)
1800
1600
1400
1200
200
300
400
500
600
Calibrated date (calAD)

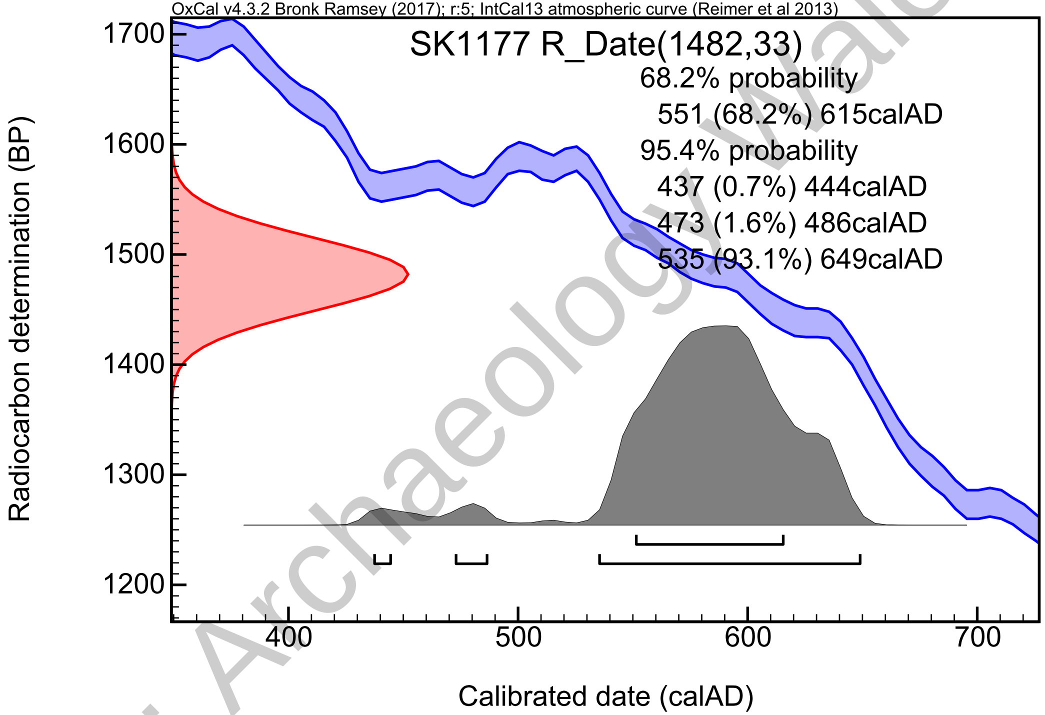


OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1053 R_Date(1599,32)
68.2% probability
411 (17.5%) 435calAD
450 (13.2%) 471calAD
487 (37.5%) 534calAD
95.4% probability
397 (95.4%) 541calAD
Radiocarbon determination (BP)
1800
1600
1400
1200
200
300
400
500
600
Calibrated date (calAD)

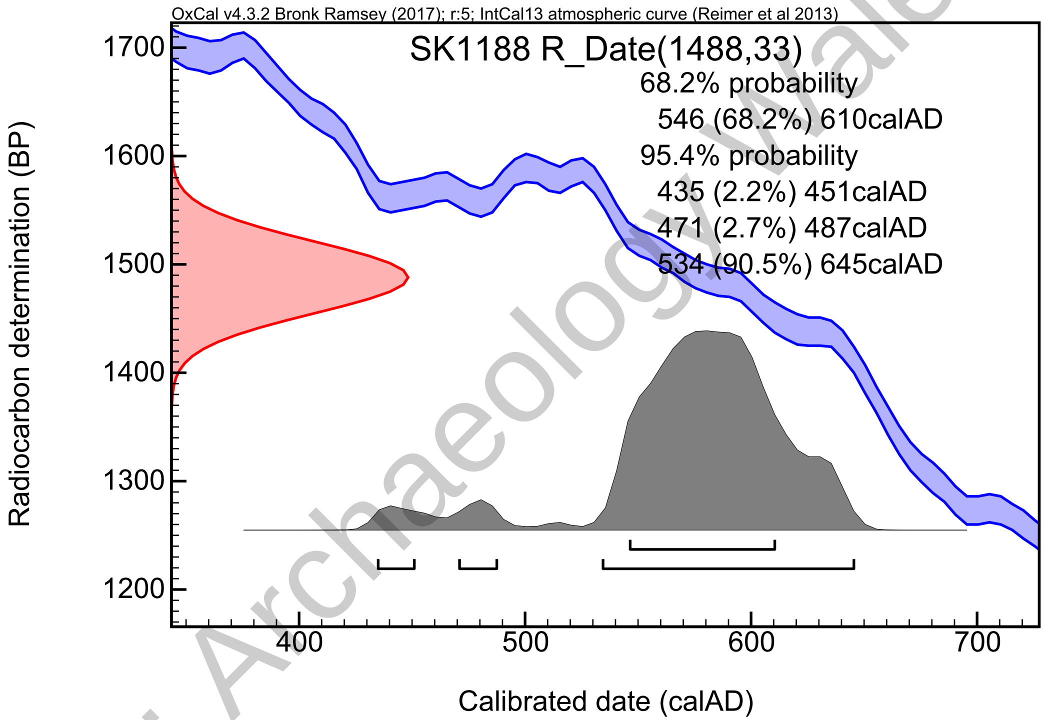

OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1059 R_Date(1442,32)
68.2% probability
598 (68.2%) 646calAD
95.4% probability
561 (95.4%) 655calAD
Radiocarbon determination (BP)
1700
1600
1500
1400
1300
1200
1100
400
500
600
700
800
Calibrated date (calAD)
Archaeology Wales


OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1072 R_Date(1476,33)
68.2% probability
558 (68.2%) 621calAD
95.4% probability
478 (0.4%) 482calAD
536 (95.0%) 650calAD
Radiocarbon determination (BP)
1700
1600
1500
1400
1300
1200
400
500
600
700
Calibrated date (calAD)

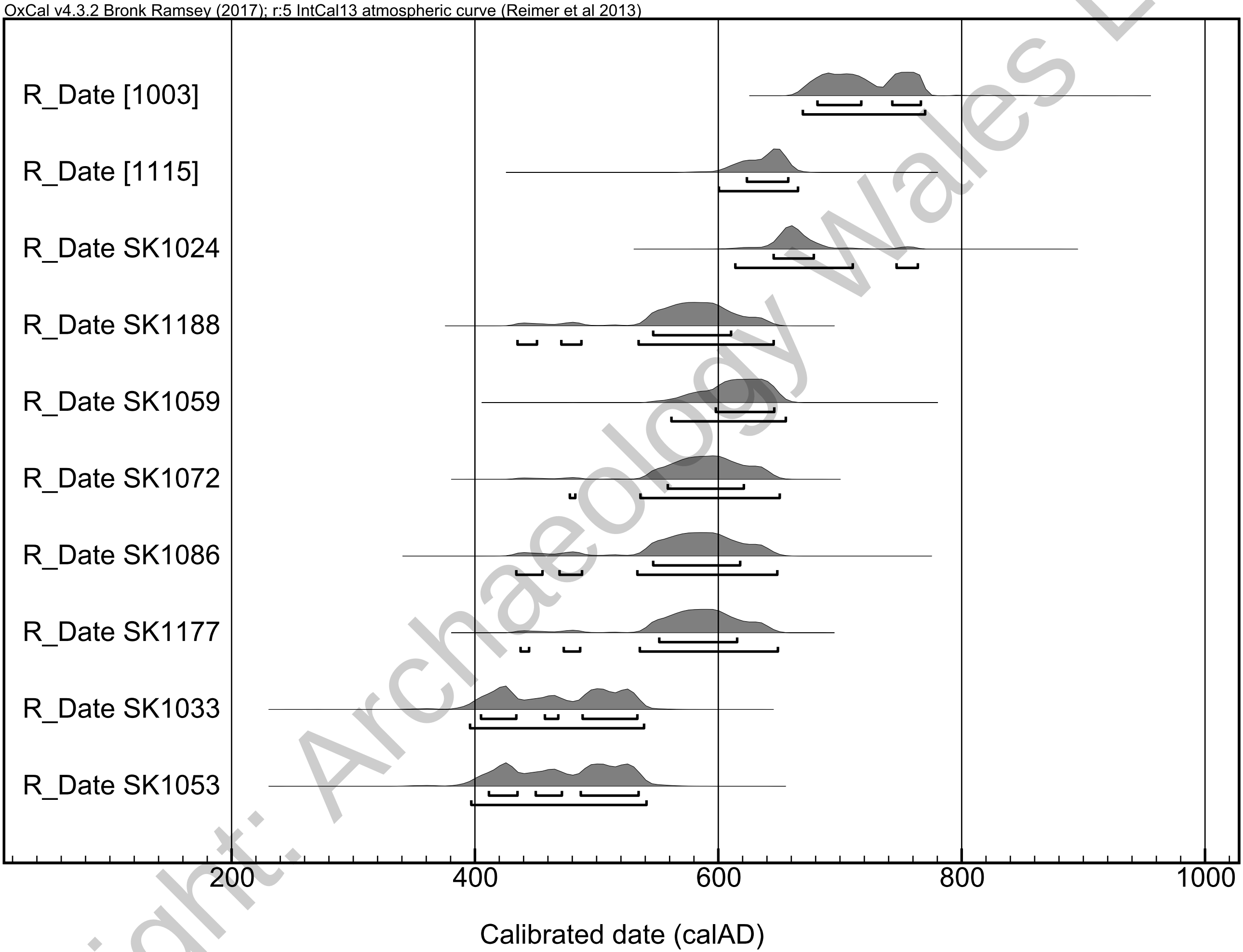

OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1086 R_Date(1484,37)
68.2% probability
546 (68.2%) 618calAD
95.4% probability
434 (3.2%) 455calAD
469 (3.2%) 488calAD
533 (89.1%) 648calAD
Radiocarbon determination (BP)
1600
1400
1200
300
400
500
600
700
800
Calibrated date (calAD)



OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1177 R_Date(1482,33)
68.2% probability
551 (68.2%) 615calAD
95.4% probability
437 (0.7%) 444calAD
473 (1.6%) 486calAD
535 (93.1%) 649calAD
Radiocarbon determination (BP)
1700
1600
1500
1400
1300
1200
400
500
600
700
Calibrated date (calAD)



OxCal v4.3.2 Bronk Ramsey (2017); r:5; IntCal13 atmospheric curve (Reimer et al 2013)
SK1188 R_Date(1488,33)
68.2% probability
546 (68.2%) 610calAD
95.4% probability
435 (2.2%) 451calAD
471 (2.7%) 487calAD
534 (90.5%) 645calAD
Radiocarbon determination (BP)
1700
1600
1500
1400
1300
1200
400
500
600
700
Calibrated date (calAD)


OxCal v4.3.2 Bronk Ramsey (2017); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
R_Date [1003]
R_Date [1115]
R_Date SK1024
R_Date SK1188
R_Date SK1059
R_Date SK1072
R_Date SK1086
R_Date SK1177
R_Date SK1033
R_Date SK1053
200
400
600
800
1000
Calibrated date (calAD)
Copyright: Archaeology Wales Ltd

Oxcal Calibrated Dates

Name	Unmodelled (BC/AD)					
	from	to	%	from	to	%
R_Date [1003]	681	766	68.2	669	770	95.4
R_Date [1115]	623	657	68.2	600	665	95.4
R_Date SK1024	645	678	68.2	614	764	95.4
R_Date SK1188	546	610	68.2	435	645	95.4
R_Date SK1059	598	646	68.2	561	655	95.4
R_Date SK1072	558	621	68.2	478	650	95.4
R_Date SK1086	546	618	68.2	434	648	95.5
R_Date SK1177	551	615	68.2	437	649	95.4
R_Date SK1033	405	533	68.1	396	539	95.4
R_Date SK1053	411	534	68.2	397	541	95.4

UBANo	Sample ID	Material Type	^{14}C Age	±	F14C	±
UBA-39635	SK1177	Human Rib Fragment	1482	33	0.8315	0.0034
UBA-39636	SK1053	Human R. Limb Fragment	1599	32	0.8196	0.0033
UBA-39637	SK1033	R. TIBIA FRAGMENT	1605	30	0.8189	0.0031
UBA-39638	SK1086	Human R. Femur Fragment	1484	37	0.8314	0.0039
UBA-39639	SK1072	Human Rib Fragment	1476	33	0.8321	0.0034
UBA-39640	SK1059	Human Rib Fragment	1442	32	0.8357	0.0033
UBA-39641	SK1188	Human Rib Fragment	1488	33	0.8309	0.0034
UBA-39642	SK1024	Human R. Femur	1359	32	0.8444	0.0034
UBA-39643	[1115]	Mixed charred plant remains	1403	27	0.8397	0.0028
UBA-39644	[1003]	Charred Cereal Grain	1283	26	0.8524	0.0028

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39635
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1177
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1482±33 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39636
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1053
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1599±32 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39637
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1033
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1605±30 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39638
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1086
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1484±37 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39639
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1072
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1476±33 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39640
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1059
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1442±32 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39641
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1188
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1488±33 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39642
Date of Measurement:	2019-02-01
Site:	LMCE/17/EX
Sample ID:	SK1024
Material Dated:	bone, antler or tooth root
Pretreatment:	Collagen
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1359±32 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

Queen's University Belfast
^{14}CHRONO
Centre for Climate, the Environment, and Chronology

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification: UBA-39643
Date of Measurement: 2019-01-17
Site: LMCE/17/EX
Sample ID: [1115]
Material Dated: charred seed or nutshell
Pretreatment: Acid Only
Submitted by: Rhiannon Philp

Conventional ^{14}C Age:	1403±27 BP
Fraction corrected	using AMS δ^{13}C

Jill Houliston
Archaeology Wales
The Reading Room,
Town Hall
Great Oak Street
Llandloes, Powys
SY18 6BN
UK
Customer No.
2310805

^{14}CHRONO
Centre
Queens University
Belfast
42 Fitzwilliam
Street
Belfast BT9 6AX
Northern Ireland

Radiocarbon Date Certificate

Laboratory Identification:	UBA-39644
Date of Measurement:	2019-01-17
Site:	LMCE/17/EX
Sample ID:	[1003]
Material Dated:	charred seed or nutshell
Pretreatment:	Acid Only
Submitted by:	Rhiannon Philp

Conventional ^{14}C Age:	1283±26 BP
Fraction corrected	using AMS δ^{13}C

Information about radiocarbon calibration

```
                    RADIOCARBON CALIBRATION PROGRAM*
                             CALIB REV7.0.1
               Copyright 1986-2019 M Stuiver and PJ Reimer
       *To be used in conjunction with:
       Stuiver, M., and Reimer, P.J., 1993, Radiocarbon, 35, 215-230.
                 Annotated results (text) - -

39635
UBA-39635
Radiocarbon Age BP   1482 +/-   33
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)      cal AD 553- 614                    1.000
  95.4 (2 sigma)      cal AD 438- 443                    0.006
                             473- 486                    0.015
                             535- 648                    0.978

39636
UBA-39636
Radiocarbon Age BP   1599 +/-   32
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)      cal AD 412- 434                    0.258
                             452- 470                    0.172
                             487- 534                    0.570
  95.4 (2 sigma)      cal AD 397- 540                    1.000

39637
UBA-39637
Radiocarbon Age BP   1605 +/-   30
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)      cal AD 405- 433                    0.360
                             457- 468                    0.091
                             488- 533                    0.548
  95.4 (2 sigma)      cal AD 396- 537                    1.000

39638
UBA-39638
Radiocarbon Age BP   1484 +/-   37
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)      cal AD 547- 616                    1.000
  95.4 (2 sigma)      cal AD 434- 456                    0.033
                             469- 488                    0.033
                             533- 648                    0.934

39639
UBA-39639
Radiocarbon Age BP   1476 +/-   33
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)      cal AD 559- 620                    1.000
  95.4 (2 sigma)      cal AD 537- 650                    1.000
```

```
39640
UBA-39640
Radiocarbon Age BP   1442 +/-   32
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)     cal AD 598- 645                     1.000
  95.4 (2 sigma)     cal AD 564- 654                     1.000

39641
UBA-39641
Radiocarbon Age BP   1488 +/-   33
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)     cal AD 548- 609                     1.000
  95.4 (2 sigma)     cal AD 434- 452                     0.024
                            470- 487                     0.027
                            534- 645                     0.950

39642
UBA-39642
Radiocarbon Age BP   1359 +/-   32
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)     cal AD 646- 676                     1.000
  95.4 (2 sigma)     cal AD 615- 695                     0.943
                            701- 709                     0.012
                            746- 763                     0.046

39643
UBA-39643
Radiocarbon Age BP   1403 +/-   27
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)     cal AD 624- 657                     1.000
  95.4 (2 sigma)     cal AD 602- 664                     1.000

39644
UBA-39644
Radiocarbon Age BP   1283 +/-   26
Calibration data set: intcal13.14c               # Reimer et al. 2013
  % area enclosed       cal AD age ranges            relative area under
                                                 probability distribution
  68.3 (1 sigma)     cal AD 681- 717                     0.596
                            742- 766                     0.404
  95.4 (2 sigma)     cal AD 670- 769                     1.000
```

References for calibration datasets:

Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck CE Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Haflidason H, Hajdas I, HattÃ© C, Heaton TJ, Hogg AG, Hughen KA, Kaiser KF, Kromer B, Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Turney CSM, van der Plicht J.
IntCal13 and MARINE13 radiocarbon age calibration curves 0-50000 years calBP
Radiocarbon 55(4). DOI: 10.2458/azu_js_rc.55.16947

Comments:
* This standard deviation (error) includes a lab error multiplier.
** 1 sigma = square root of (sample std. dev.^2 + curve std. dev.^2)

```
** 2 sigma = 2 x square root of (sample std. dev.^2 + curve std. dev.^2)
where ^2 = quantity squared.
[ ] = calibrated range impinges on end of calibration data set
0* represents a "negative" age BP
1955* or 1960* denote influence of nuclear testing C-14

NOTE:  Cal ages and ranges are rounded to the nearest year which
       may be too precise in many instances.  Users are advised to
       round results to the nearest 10 yr for samples with standard
       deviation in the radiocarbon age greater than 50 yr.
```

<>

The Analysis of plant remains (LMCE/17/EX)

Kath Hunter Dowse

9th November 2018

Following a programme of excavation at Llandrillo Campus, Llangefni, Anglesey by Archaeology Wales, two samples were submitted for full analysis of the charred plant remains recovered. They were selected by Archaeology Wales based on the presence of potentially identifiable cereal grains, seeds and other remains. This report details the full analysis of these plant remains, from potentially early mediaeval deposits interpreted as being associated with crop drying. The cereals and associated environmental remains are, in the main, relatively poorly preserved. The assemblage from sample1 context 1005 produced evidence of several types of cereal crops with associated weed seeds. These weeds and others from the sample may suggest that the crops were grown locally. In the case of sample 86 context 1116 only a few of the remains are identifiable to species level. Though this was a relatively small assemblage, it did seem to be consistent with others identified from similar sites of this period on Anglesey and elsewhere in North Wales.

<u>Sample Processing</u>

All of the samples were processed by Archaeology Wales for the recovery of environmental remains. They were processed using a modified siraf style floatation machine and the flots were collected in a 250µm mesh. The residues were retained in a 500µm flexible nylon mesh. The resulting flots and residues were air dried prior to bagging. The residues were sorted by Archaeology Wales.

<u>Analysis methodology</u>

The plant remains extracted from the flots and residues, of the two samples were analysed using low powered microscopes at a magnification of between x10 and x 20(MTL10 stereo microscope) by the author.

The nomenclature for the plant remains follows Stace 2010. The identification of the plant remains was carried out using modern reference material and standard reference texts (Beijerinck 1947, Cappers et al 2006, Jacomet 2010).

Sample 1 context 1005

The assemblage from this sample was relatively small. Where identification was possible it appears that barley (*Hordeum* sp.) is the dominant species with wheat (*Triticum* sp.) and a small oat /brome type (*Avena/Bromus* sp.) also present. All of the barley grains appear to be of a hulled type (*H. vulgare)*. The presence of both large straight and smaller twisted grains suggests the presence of a multi row variety. A single and poorly preserved rachis fragment was present, but not sufficiently well preserved to suggest which species. Therefore, it is not possible to rule out the presence of a two-row type.

It is often not possible to distinguish between species of free threshing wheats and glume wheats using grain morphology alone. The lack of any preserved wheat chaff fragments from this assemblage have meant it is not possible to identify the grains beyond genus level.

A single wild oat (*A. fatua*) floret base with part of the distinctive sucker at the base was present. This suggests the presence of a crop weed common in cereal fields of this period. It is not possible to distinguish cultivated and weed species of oat from the grain morphology alone. So, it is possible that cultivated oat could also be present in the assemblage. Also, the oat like grains present in this assemblage are quite small and have been identified as a possible oat/brome type.

None of the cereal grains preserved showed any obvious evidence of germination but the presence of nine detached cereal embryos may suggest that the process might have started to occur in some cases. Whilst this might be an indication of the early stages of deliberate germination, through a malting process, it could also be an indication of uncontrolled germination due to poor storage conditions.

The seed capsules of wild radish (*Raphanus raphanistrum*) may represent a plant growing amongst the cereal crop. The seed capsules are a similar size to cereal grains so could have been gathered with the crop and been retained during the processing stages. These could then be hand picked from the grain and disposed of in the fire or have remained mixed with the grain. Stinking chamomile (*Anthemis cotula*) is also a common arable weed on base rich heavy soils. The presence of sedge (*Carex* sp.), heather/heath (*Erica*/*Calluna* sp.) and possible cotton grass (cf. *Eriophorum* sp.) and knotgrass (cf. *Persicaria* sp.) suggest that some plant material has been gathered from a wet, possibly acidic, environment. This might have been from wet areas within the arable field but could also suggest the gathering of species for other purposes such as bedding or thatch from elsewhere. Waste from these activities could then have been burnt as fuel.

Sample 86 Context 1116

The charred plant remains from this sample were very poorly preserved. There were two examples each, of barley grains and hazelnut shell fragments (*Corylus avellana)* with a single grass type seed (Poaceae). The 28 degraded fragments of cereal grain were too poorly preserved to allow further identification.

<u>Discussion</u>

The assemblage from sample 1 is a mixture of charred cereal with some weed seeds. The dominant type of identifiable cereal is barley with evidence of at least some of it being from a multi-row variety. Whilst Barley is the most frequent of the identifiable grains a relatively large number of grains have been tentatively attributed to a wheat type. There is evidence of at least some wild oat in the assemblage but it is not possible to rule out a cultivated type. This assemblage appears to be a redeposition of burnt plant remains, possibly the result of accidental charring during drying mixed with elements of fuel. Other grain assemblages of this date on Anglesey have been dominated by oat and hulled multi rowed barley. A corn dryer at Cefn Du (Caraldi 2012) produced oats, barley and wheat along with 3 flax (*Linum usitatissimum*) seeds. The weed assemblage also contained wild radish and heather.

Ciaraldi suggests that oat and barley may have been grown together as a maslin crop. A practice adopted by farmers to insure the survival of at least some of a crop in growing seasons with poor weather. The more rigid barley plants may also have offered physical support to the oat plants preventing them from collapsing or lodging during periods of high winds and or heavy rain. This can help to avoid the spoiling through premature sprouting or rotting of crops in the field. It can be problematic distinquishing whether a mixed archaeological assemblage reflects a maslin crop or is a result of the accumulation of grains from several burning episodes." Identification of mixed assemblages from the medieval period onwards is problematic. Historical texts identify the presence of mixed planting such as Maslin (wheat and rye), Pulse (beans and peas), Molybong (oats, peas and vetches or buckwheat), Dredge (barley and oat) and Berevechicorn (dredge and vetch) but distinguishing the preserved remains of a mixed crop as opposed to a mixed waste deposit from different origins is very difficult" (Carruthers and Hunter forthcoming).

An assemblage of charred grain from Ysgol yr Hendre, Caernarfon from a medieval corn dryer was dominated by oat grains with barley and hazelnut. (McKenna 2012). A Stake-hole dated to the early medieval period excavated at Carrog, Llanbadrigon Anglesey produced a charred grain assemblage dominated by barley. (Caseldine et al 2014).

Acknowledgements.

I would to like to thank Kate Griffiths and Astrid Caseldine for their help in compiling this report.

Bibliography.

Beijerinck, W, 1947 *Zaden Atlas der Nederlandsche Flora.* Wageningen, Biol. Stat Wijster 30

Caseldine, A., Griffiths, C. and Peck, I. 2014b Charred plant remains, in Smith, G., A Late Bronze Age/Early Iron Age Hilltop Enclosure with Evidence of Early and Middle Neolithic and Early Medieval Settlement at Carrog, Llanbadrig, Anglesey. *Studia Celtica* 48, 82-87.

Cappers, R T J, Bekker R M and Jans J E A 2006 *Digitale Zandenatlas Van Nederland* Groningen University

Carruthers W and Hunter K (Forthcoming) *A Review of Archaeological Plant Remains from the Midland Counties* Heritage England Regional Review

Ciaraldi, M. 2012 Charred plant remains. In Cuttler, R., Davidson, A. and Hughes, G., A *Corridor Through Time: The Archaeology of the A55 Anglesey Road Scheme*. Oxford, Oxbow Books, 222-242.

Jacomet S 2006 *Identification of cereal remains from archaeological sites.* 2nd edition 2006Archaeobotany Lab IPAS, Basel University. English translation partly by James Greig.

McKenna, R. 2012b Charcoal and other charred plant remains. In Kenney, J. and Parry, L., Excavations at Ysgol yr Hendre, Llanbeblig, Caernarfon: a possible construction camp for *Segontium* fort and early medieval cemetery. *Archaeologia Cambrensis* 161, 277-280.

Stace C 2010 *New flora of the British Isles* Cambridge University Press

Table 1. plant taxa LMCE/17/EX

				Feature			
				Context	**1005**	**1116**	
				Sample	**1**	**86**	
Taxa	**Common Name**	**Part**	**Habitat**				
Triticum sp.	wheat	grain	cultivated		25		
cf. *Triticum* sp.	possible wheat	grain	cultivated		81		
Hordeum sp.	barley	grain	cultivated		57		
Hordeum vulgare L.	barley, six row	side grain- twisted	cultivated		34		
cf. *Hordeum* sp	possible barley	grain	cultivated		277	2	
Avena /Bromus sp.	oat/brome	grain	cultivated,grassland		44		
Cereal NFI	unidentified cereal	grain fragments	cultivated		200+	28	
Hordeum sp.	barley	rachis fragment	cultivated		1		
Avena sp.	oat	awn fragments	cultivated,arable, rough and waste ground		1		
Avena fatua L.	wild oat	floret base	arable, rough and waste ground		1		
Cereal NFI	unidentified cereal	detached embryo	cultivated		9		
Fabaceae	possible legume	seed fragments			5		
Corylus avellana L.	hazelnut	shell frags	waste,scrub,hedgerow			2	
Raphanum raphanistrum L.	wild radish	mericarp	cultivated and rough ground,waste places and tips		2		
cf. *Persicaria sp.*	possible knotweeds	achene			2		
Amaranthaceae	goosefoot family				3		
cf. *Calluna/Erica sp.*	possible heather/heath	seed capsule			1		
cf. *Calluna/Erica sp.*	possible heather/heath	seed			2		
Anthemis cotula L.	stinking chamomile	achene	arable, heavy soils		4		
cf. *Eriophorum* sp.	possible cotton grass	nut	wet places		1		
Carex sp. (Trigonus)	sedge	nut	marsh,bankside,woods,grassland esp. disturbed arable damp/wet soils.		3		
Carex sp. (bi-convex)	sedge	nut	marsh,bankside,woods,grassland esp. disturbed arable damp/wet soils.				
Poaceae	grass family	caryopsis			4	1	
unident		amorphous charred fragments			5		

Archaeology Wales

APPENDIX II:
Post-Excavation Project Design

Archaeology Wales Ltd
Rhos Helyg, Cwm Belan, Llanidloes, Powys SY18 6QF
T: 01686 440371
E: info@arch-wales.co.uk
www.arch-wales.co.uk

PROJECT DESIGN

POST-EXCAVATION – STAGE 4 – FINAL REPORT

LLANGEFNI COLLEGE CAMPUS SITE

Prepared for:

GLLM

Planning Application Number: 34C304K/1/EIA/ECON

Project No: 2538

July 2018

Archaeology Wales Limited
The Reading Room, Town Hall, Great Oak Street
Llanidloes, Powys SY18 6BN
Tel: +44 (0) 1686 440371
Email: admin@arch-wales.co.uk

Contents **Page**

Summary

This project design outlines the aims, objectives and methodology to be followed during Stage 4 of investigations of the Early Medieval cemetery associated with the development of Llandrillo Campus Extension (Llangefni, Anglesey). Stage 4 will culminate with the production of a final report and will follow recommendations outlined during Stage 3 – assessment report.

All work will be undertaken to the standards and guidance set by the Chartered Institute for Archaeologists (2014), and by the Management of Research Projects. MoRPHE (2015). AW is a Registered Organisation with the CIfA.

1. Introduction

This project design outlines the aims, objectives and methodology to be followed during Stage 4 of investigations of the Early Medieval cemetery associated with the development of Llandrillo Campus Extension (Llangefni, Anglesey). Stage 4 will culminate with the production of a final report and will follow recommendations outlined during Stage 3 – assessment report (Appendix 1). Stage 4 will form the basis from which to assemble the results obtained during the excavation of the eastern and western part of the cemetery in the form of a published monograph (Stage 5).

A Written Scheme of Investigation (Stage 1) was produced in advance of the excavation of the cemetery site located within the bounds of Menai College (Llangefni). During Stage 2, the limits of the cemetery were defined and the cemetery was excavated. This led to the retrieval of 32 articulated burials and three pits associated with industrial activity in the area. Stage 3 included the detailed analysis of each assemblage (human bone, animal bone, metal objects, pottery, environmental) with the aim of producing an assessment report which set recommendations for further work.

This project design has been prepared by Dr Irene Garcia Rovira, Project Manager, Archaeology Wales Ltd (henceforth - AW). All work will be undertaken to the standards and guidance set by the Chartered Institute for Archaeologists (2014). AW is a Registered Organisation with the CIfA.

2. Aims and Objectives

This project design summarises the procedures to be followed during Stage 4 of investigations, which will culminate with the production of a final report. The objectives set for this stage of investigations follow recommendations outlined during a phase of assessment – Stage 3.

Stage 4 will aid better understanding of the site itself, and of the site within its regional and national context. A detailed account of the tasks scheduled for this stage of investigations can be found in section 3. These tasks will contribute to examine the following research questions:

Site specific research questions

- **Chronology and phasing:** during the excavation of the western area[1] of the cemetery, a number of phases where defined. However, further work can contribute to phasing refinement, and therefore, can enhance our understanding of the changing uses of the site through time. It is particularly significant to consider:

  a) A substantial layer of colluvium was identified separating the earth-cut graves (Phase 1) from the cist graves (Phase 2). While the evidence suggests a hiatus of use of the cemetery between Phase 1 and 2, it is necessary to obtain better understandings of the temporal span to assess its implications for the interpretation of the site.

  b) Similarly, it is deemed necessary to assess the hiatus that might exist between Phase 2 sub-phases as some of the graves appear to have been truncated by later graves.

[1] The western part of the cemetery refers to the cemetery area located within the bounds of Menai College.

c) The excavation yielded evidence of three non-burial pits. Although some temporal relationships with the cemetery can be extrapolated through stratigraphic relationships, it is necessary to obtain absolute dates for these pits to be able to establish more refined interpretations of these features and their relationship to the cemetery.

d) Slight differences between the phasing attributed to the western and eastern part of the cemetery exist. It is therefore significant to assemble the data recovered during the excavations of the two sides of the cemetery to obtain a more holistic interpretation of the site. The determination of the samples to be sent for C14 dating will be made following the consideration of the cemetery as a whole.

- **The Roman finds:** While the overall interpretation of the cemetery defines it as belonging to Early Medieval chronologies, the finds assemblage associated to it, is largely of Roman chronologies. This context leads to three distinct possibilities: (1) the earliest phase of the cemetery dates back to Roman times; (2) these finds correspond to curated objects which are only deposited in graves after a number of generations; (3) these finds are residual and have no direct relationship with the burials. In order to shed light into this question, it is significant to consider:

a) A comparative study with the Roman assemblage revealed during the excavation of the eastern[2] part of the cemetery.

b) A study of the contexts in which finds of Roman date were revealed in light of C14 results.

- **The non-burial pits:** features [1003], [1042] and [1115] were characterised as non-burial pits, possibly associated with industrial activity at the site. During the stage of assessment, it has been possible to note that [1003] appears to have functioned as crop drier, [1042] is associated with food

[2] It refers to the cemetery area exposed during the construction of Llangefni New Road by Archaeoleg Brython.

waste and [1115] shows indications of firing. Further understanding of the function of the pits and its association with the cemetery is sought during the final stage of investigations. It is significant to consider:

a) A full examination of the flots produced during the assessment stage.

b) A contextual study of these pits and similar evidence that may be present on the eastern side of the cemetery.

c) A contextual study which consider similar sets of evidence recovered in analogous sites.

<u>The site and its immediate context: research questions</u>

- **The landscape of east Llangefni in Roman times:** the Roman finds assemblage, and potentially the non-burial features may be related to other sets of evidence gathered during intrusive investigations within the surrounding area. It is therefore significant to consider a contextual analysis with other sites to be able to start building up the picture of Roman activity in Llangefni. This can be achieved by:

  a) Pre-cemetery finds are contemporary with those at the nearby hut circle of Peboc. Furthermore, during the construction of the link road, a number of small granaries and a reasonable faunal assemblage were recovered. It is deemed significant to establish a comparative study between this site and the pre-cemetery activity found within the bounds of the college.

<u>The site within the wider context: research questions</u>

- **Early Medieval burial practices, population make up and diet:** the exceptional bone preservation allow a range of investigations to take place, which will be key to new understandings about population make up and diet; topics outlined on the Research Framework for Wales. This can be achieved by:

a) Strontium (87Sr/86Sr) isotope analysis should be undertaken on dental enamel along with oxygen (δ18O) isotope analysis, which will allow the origins of these individuals to be determined.

b) Carbon (δ13C) and nitrogen (δ15N) isotope analysis should also be undertaken on bone collagen, which will allow diet to be reconstructed. The isotopic analysis of sulphur (δ34S) in bone collagen would also provide an indication of coastal proximity and/or the consumption of substantial quantities of marine foods in the years before death.

3. Detailed methodology

This section outlines the work accomplished during Stage 3 of investigations and the work and methodology selected to complete Stage 4, taking into consideration each type of data separately. It also gives an indication of the timeframe required to complete each stage.

3.1. High Value Finds

During the course of the excavation a Roman brooch and coin were recovered. The brooch – SF 089, was found in the fill of the earth-cut grave [1074] from Phase 1 cemetery. The coin – SF 131 – was found in the fill of grave [1084] (see Appendix 1 for details).

- During Stage 3 – assessment report – the finds were;

1) Stabilised and cleaned by the conservation team at Cardiff University.

2) Examined and photographed by Dr Thomas (Archaeology Wales), providing an indication of type and date. The brooch was identified as a Hod Hill type with dates ranges between the mid-first to third centuries AD. The coin was defined as a dupondius of Antonius Pius, dating to approx. mid-150 AD.

3) The finds were assessed and recommendations for further work were outlined in the assessment report.

- During Stage 4 – final report – the finds will be;

1) Contextualised taking into consideration the context and position of similar items revealed during the excavation of the eastern side of the cemetery by Archaeoleg Brython.

2) Contextualised taking into consideration the results obtained through C14, and through the systematic study of the bone assemblage found in earth-cut grave [1074], and grave [1084]. Dating refinement will be key to the definition of phasing and, therefore, will aid to the categorisation of these finds as either residual or structured depositions in the form of grave goods.

The results of the work will be documented in the final report, and this assemblage will subsequently be deposited alongside the finds recovered by Archaeoleg Brython at Oriel Ynys Mon (Llangefni, Anglesey).

It is expected that the tasks outlined for Stage 4 will take two days to be accomplished.

3.2. The pottery assemblage

A total of six small fragments of pottery were recovered from the excavation. All fragments were Roman, encompassing four fragments of red ware, and a fragment of Central Gaulish Samian Ware dating to 120 – late second century AD. Given the size of the fragments recovered, it was not possible to give an indication of vessel type.

- During Stage 3 – assessment report – the pottery assemblage was;

1) Cleaned and stored in optimal conditions.

2) Examined by Rowena Hart (Archaeology Wales) providing an indication of type and date.

3) The finds were assessed and recommendations for further work were outlined in the assessment report.

- During Stage 4 – final report – the finds will be;

1) Contextualised analysis them in relation to the results obtained by Archaeoleg Brython during the excavation and analysis of the eastern area of the cemetery.

2) Contextualised with the results obtained through C14, and through the results obtained during the final analysis of the bone and environmental assemblages.

3) Contextualised taking into account all other ceramic fragments obtained during flotation. The latter will be incorporated into the final catalogue.

SF	DESCRIPTION	CONTEXT	DESCRIPTION OF CONTEXT	CONTEXTUAL STUDY
028	Local redware body fragment	(1043)	Fill of [1042]. Pit underneath quernstone surface	- Environmental Samples - Animal Bone - C14
053	Redware fragment	(1052) (1053)	Fill of earth cut grave [1051]	- Human Bone Analysis - C14 - Any other finds retrieved through sample flotation
205	Central Gaulish samian ware.	(1116)	Fill of pit [1115]	- C14 - Any other finds retrieved through sample flotation

The results of the work will be documented in the final report, and this assemblage will subsequently be deposited alongside the finds recovered by Archaeoleg Brython at Oriel Ynys Mon (Llangefni, Anglesey).

It is expected that the tasks outlined for Stage 4 will take two days to be accomplished.

3.3. Quernstone assemblage

Six archaeological finds were examined to determine their lithology and a potential geological provenance, by matching the observed characteristics to known lithologies. It was determined that all six finds are composed of and worked from sedimentary rocks and it is considered highly likely that they have a local source. These finds have been worked from the 'Anglesey Grits': sandstone and conglomerates of the Clwyd Limestone Group (Loggerhead Limestone Formation / Cefn Mawr Limestone Formation).

- During Stage 3 – assessment report – the quernstone assemblage was;

1) Cleaned and drawn.

2) Examined by Andrew Haycock providing an indication of geological provenance.

3) The finds were assessed and recommendations for further work were outlined in the assessment report.

- During Stage 4 – final report – the finds will be;

1) Contextualised analysing them in relation to the results obtained by Archaeoleg Brython during the excavation and analysis of the eastern area of the cemetery. This will include the creation an overall site plan noting the location of all quernstones.

The results of the work will be documented in the final report, and this assemblage will subsequently be deposited alongside the finds recovered by Archaeoleg Brython at Oriel Ynys Mon (LLangefni, Anglesey).

It is expected that the tasks outlined for Stage 4 will take two days to be accomplished.

3.4. The environmental assemblage

The excavation of the Early Medieval cemetery at Llandrillo Campus (Llangefni, Anglesey) produced 133 samples. 131 belonged to grave contexts and two were from non-grave related features – pit [1003], and [1115]. The grave fills were sampled to ensure all surviving bones were recovered, along with any possible neonate bones, calcified cartilage, gut parasites, worms and gallstones. Of the non-grave features samples were taken to retrieve any ecofacts preserved within the fills, that may aid with reconstructing the surrounding landscape, including plants and crops grown and processed by the inhabitants of the site.

- During Stage 3 – assessment report – the environmental assemblage was;

1) All samples were subjected to flotation.
2) All bones and other finds were retrieved and either rejoiced with the corresponding remains of properly stored.

- During Stage 4 – final report – the samples will be;

1) Sample <001> - context (1005), and Sample <086> - context (1116) will be analysed by Wendy Carruthers to determine what species of plants the seeds belong to and so what species were being grown and processed within the area of the site. The arable regimes of the inhabitants should then be possible to reconstruct. Charcoal samples will be selected for C14.
2) The animal bone assemblage retrieved during flotation will be sent to Dr Richard Madgwick for full analysis.

The results of the work will be documented in the final report, and this assemblage will subsequently be deposited alongside the finds recovered by Archaeoleg Brython at Oriel Ynys Mon (LLangefni, Anglesey).

It is expected that the tasks outlined for Stage 4 will take two weeks to be accomplished.

3.5. The human bone assemblage

- During Stage 3 – assessment report – the human bone assemblage was;

1) Examined by Richard Madgwick et al providing an indication of:
   1.1) The quantity, nature and condition of remains.
   1.2) The importance of materials and whether further study was required.

1.3) Recommendation strategies and requirements relating to time and cost.

- During Stage 4 – final report – the finds will be;

1) Full standard analysis of assemblage considering pathology diet and provenance
2) Multi-isotope analysis of a minimum of 20 individuals, including;

   2.1) Carbon ($\delta 13C$) and nitrogen ($\delta 15N$) isotope analysis on bone collagen for dietary reconstruction

   2.2) Strontium (87Sr/86Sr) isotope analysis on dental enamel (M1 or M2) to provide a geological biosphere signal relating to early life origins

   2.3) Oxygen ($\delta 18O$) isotope analysis on tooth to provide a comparable climatic signal for origins. Both dietary and provenancing analysis will be augmented by sulphur ($\delta 34S$) isotope analysis of bone collagen. This will provide an indication of coastal proximity and/or the consumption of substantial quantities of marine foods in the years before death.

3) The production of a report detailing the results obtained during final analysis. This will consider the results obtained by Archaeoleg Brython during analogous analyses carried out on the eastern area of the cemetery.

The results of the work will be documented in the final report, and this assemblage will subsequently be deposited alongside the finds recovered by Archaeoleg Brython.

It is expected that the tasks outlined for Stage 4 will take ten days to be accomplished.

3.6. Faunal assemblage

- During Stage 3 – assessment report – the animal bone assemblage was;

1) Examined by Poppy Hodkinson and Richard Madgwick providing an indication of:

   1.1) The quantity, nature and condition of remains.

1.2) Indications of age, sex, burning, butchering, gnawing and weathering.

1.3) Recommendation strategies and requirements relating to time and cost.

- During Stage 4 – final report – the finds will be;

  1) 13 individuals will be subjected to carbon and nitrogen isotopic analysis, to provide with a faunal baseline sample that allow comparison with isotopic studies on human bone.

  2) A direct comparison will be established between the faunal assemblage recovered during the archaeological investigations carried out prior to the construction of Llangefni Link road.

The results of the work will be documented in the final report, and this assemblage will subsequently be deposited alongside the finds recovered by Archaeoleg Brython at Oriel Ynys Mon (LLangefni, Anglesey).

It is expected that the tasks outlined for Stage 4 will take three days to be accomplished.

3.7. Absolute dating

The procurement of C14 dates is key to Stage 4. The strategy followed for the selection of samples will undoubtedly require the examination of the cemetery as a whole. In order to accomplish Stage 4, the selection of samples will be informed by the work carried out by Archaeoleg Brython during the final analysis of the eastern part of the cemetery.

In taking into account the data gathered from the western area of the cemetery, it appears significant to obtain samples from:

PHASE	CONTEXT	TYPE	SAMPLE TYPE	REASON SELECTED
1	SK1053	BURIAL	MOLAR	Primary phase burial

				(good bone preservation)
1	SK1033	BURIAL	MOLAR	Primary phase burial (good bone preservation)
1	[1003]	PIT	CHARCOAL	Associated with industrial activity
1	[1042]	PIT	CHARCOAL	Associated with industrial activity
2i	[1115]	PIT	CHARCOAL	Associated with industrial activity
2ii	SK1086	BURIAL	MOLAR	Secondary phase burial associated with coin
2ii	SK1072	BURIAL	MOLAR	Secondary phase burial associated with quern reused as cist stone
2ii	SK1059	BURIAL	MOLAR	Secondary phase burial (Position within this cluster)
2iii	SK1188	BURIAL	PREMOLAR	Secondary phase burials (good bone preservation)
2iii	SK1024	BURIAL	MOLAR	Secondary phase burials (good bone preservation)
2iv	SK1177	BURIAL	PREMOLAR	Secondary

				phase burials (good bone preservation)
2v	SK1130	BURIAL	MOLAR	Secondary phase burials (good bone preservation)

The results of the work will be documented in the final report, and contextualised C14 results obtained by Archaeoleg Brython.

It is expected that the tasks outlined for Stage 4 will take three weeks.

3.8. The archive

- During Stage 3 – assessment report – the records produced onsite were;

1) Cross-checked and amended as necessary
2) Digitised and stored
3) All drawings were digitised
4) GPS data was cross-checked and stored as a project file.

- During Stage 4 – assessment report – the records produced onsite will be;

1) Both the digital and paper archive will be stored in optimal conditions and will be deposited at the RCAHMW, Aberystwyth.

It is expected that the tasks outlined for Stage 4 will take three days to complete.

3.9. The report

Stage 4 of investigations will culminate with the production of a final report. The report will include the following:

- Summary
- Introduction
- Background to investigations

- Research objectives
- Site description – stratigraphic account
- Specialist results
- The site within its local context
- The site within its wider context
- Conclusions
- Appendices

It is expected that the final report will be completed in two weeks following all tasks detailed in section 3.1 to section 3.8.

It is anticipated that Stage 4 of investigations will be completed in three months from the completion of this document.

Archaeology Wales

Archaeology Wales Limited
The Reading Room, Town Hall, Llanidloes, SY18 6BN
Tel: +44 (0) 1686 440371

Email: admin@arch-wales.co.uk
Company Directors: Mark Houliston MCIfA & Jill Houliston
Company Registered No. 7440770 (England & Wales)
Registered Office: Morgan Griffiths LLP, Cross Chambers
9 High Street, Newtown, Powys, SY16 2NY