Archaeology Wales

Glanfred Enclosure, Llandre, Ceredigion

Geophysical Survey and Archaeological Excavation

By
Iestyn Jones
Daryl Williams
Sam Williams

Report No. 1579

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

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Prepared For: Trisgell Ltd

Edited by: Mark Houliston
Signed: Mark Houliston
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Archaeology Wales Ltd,
The Reading Room, Town Hall,
Great Oak Street, Llanidloes, Powys SY18 6BN
Telephone: 01686 440371
E-mail: admin@arch-wales.co.uk

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Summary

In 2013 Archaeology Wales were commissioned by Trisgell Ltd to monitor the geophysical survey and limited excavation of Glanfred enclosure, Llandre, Ceredigion (NGR: SN 63384 87870)*, as part of a Welsh language archaeology focused television series 'Olion' for S4C (broadcast 2014).*

The geophysical survey revealed sections of the enclosure ditch that had not been previously visible in a 1995 aerial photograph, a number of possible entrances and two concentrations of internal anomalies. The excavation targeted a section of the inner of two ditches on the eastern side of the enclosure and an anomaly within the enclosure. An in situ *iron slag deposit was discovered with an associated context dated between the late seventh and ninth century AD, whilst charred oats discovered in one of the lower deposits within the ditch was dated between the mid-fifth to sixth centuries AD. The results provide a rare insight into early medieval use of enclosures during the post-Roman and early medieval period, not only in north-west Ceredigion but more generally in Wales.*

Crynodeb

Fe gomisiynwyd Archaeology Wales gan gwmni teledu Trisgell i oruchwylio gwaith cloddio cyfyngedig ac arolwg geoffisegol ar dir fferm Glanfred, Llandre, Ceredigion, ym mis Awst 2013. Ffilmiwyd y gwaith ar gyfer cyfres deledu S4C, 'Olion, palu am hanes' (2014).

Fe ddangosodd yr arolwg geoffisegol patrwm y ffosydd dwyreiniol, oedd yn aneglur ar y lluniau awyr, yn ogystal â sawl mynedfa posib a nodweddion eraill o fewn yr amgaead. Fe ddarganfuwyd sorod haearn o'r canol oesoedd cynnar o fewn yr amgaead a gwastraff domestig o'r cyfnod ôl Rhufeinig cynnar wedi ei losgi yn agos i waelod y ffos fewnol. Mae'r gwaith, hyd yn hyn, wedi ychwanegu at y wybodaeth brin sydd am y cyfnod yma yng Ngheredigion.

1. Introduction

In 2013 Trisgell Ltd were commissioned by S4C to produce a six-part television series with an archaeological excavation being the main focus for each programme. Following discussions with the Royal Commission on the Ancient and Historical Monuments of Wales (RCAHMW) it was thought that Glanfred Promontory Enclosure, Llandre, Ceredigion (AW site code GFL/13/EX), would be a suitable site for such work. Enclosing ditches forming part of the enclosure could be seen on aerial photographs during periods of parching although no raised earthworks are visible within the field. The enclosure is univallate at the western, northern and southern edge end but bivallate at the south-eastern end, where the enclosure is more easily accessible due to the more level ground. A Written Scheme of Investigation (WSI) for a Geophysical Survey was completed (AW Project No. 2156 – 07/08/13) and approved by Louise Austin of Dyfed Archaeological Trust. Following this a gradiometer survey was carried out on the 12th and 13th of August 2013 and revealed the presence of ditches where the cropmarks were less clear (see Section 4 below). Following the approval of an excavation WSI (AW Project No. 2156 – 23/08/13) the excavation took place from 10th-13th September 2013. The finds and archive associated with the excavation will be deposited with Ceredigion Museum, Aberystwyth.

2. Site Description

Location, Topography, Geology

The site is located on a natural promontory (48 m OD) 3 km east of Borth and Cardigan Bay and 160m to the north-east of Glanfred Farm which is located 1.1km to the north-east of Llandre, Ceredigion (NGR: SN 63384 87870; Fig. 1). The enclosure as seen on the RCAHMW aerial photographs, is univallate at the western, northern and southern edge end but bivallate at the south-eastern end, where the enclosure is accessible to more level ground. The promontory has a near precipitous slope to the west, and sloping land to the north and east. The river Leri is located 170m north of the enclosure's northern limit and a caravan park is located in the river's bend at the base of the slope. The bedrock geology comprises Silurian Borth mudstone underlying glaciofluvial sand and gravel deposits of which the upper deposits can be described as freely draining and slightly acidic (NSRI 2013). The field is currently used as pasture for sheep and other livestock.

3. Historical Background and previous archaeological work

During 1999 clear cropmarks associated with a possible promontory fort were revealed on a spur near Glanfred farm, Llandre, Ceredigion (centred on NGR: SN 63384 87870). It was the third time that such parching had been recorded, revealing a pattern of possible rock cut ditches with other observed examples recorded in 1975 and 1995 (Driver 2013, 24). Dr Toby Driver took advantage of the 1999 drought to record the dimensions of observed cropmarks and he concluded that due to 'the unresponsive alluvium on the southeast side which has never parched sufficiently to reveal buried features' and that the site 'would benefit from ground-based remote sensing' (Driver 2003).

The field containing the enclosure is named Caer Odyn (639) on the Llanfihangel Genau'r Glyn parish tithe map: Cynull Mawr township (1847). It is possible that this Odyn (kiln) field name refs to the nearby Forge Mill, a cloth-making establishment converted from an older Iron forge. Glanfraed farm was the ancestral home of Bridget Pryce, mother of Edward Lluyd, and the farm's name is probably derived from Glan (on the bank of) and Ffraid (Welsh for Brigid), possibly the name of the brook that runs to the river Leri from the spring near the farm (Baring-Gould and Fisher 1907, 286-n.3). There is a local tradition that an early wooden church dedicated to St Ffraid at Glanfred was abandoned, mid-construction, in favour of another, dedicated to St Michael, at Llandre nearby (Randall Evans 2002, 172).

There is considerable evidence for presumed late prehistoric settlement in the area. A bivallate enclosure, the most northerly within Ceredigion, Caer Allt-Goch (PRN 2009) is located at 120m OD approximately 1.25km to the north-east of Glanfred. Caer Llety Llwyd (PRN 2013) is approximately 1.6km east-northeast of Glanfred and Caer Pwll Glas (PRN 2008) is situated approximately 1.1km to the south-southeast. These enclosures have been described as belonging to the 'Leri Basin small enclosure group' (Driver 2013, 52).

4. Geophysical survey

Daryl Williams
Sam Williams

The aim of the survey was to confirm the cropmarks seen from the air and their interpretation as a possible promontory hillfort. This being the case its primary objective was to elucidate the area to the south-east where the cropmarks are least clear. Any possible identifiable entrance and ditch terminals in this area would be particularly significant ahead of small-scale excavation. The secondary objective was a survey of the interior in an attempt to identify any internal features such as drip gullies, pits or demarcation ditches.

4.1. Methodology

Responses to geoarchaeological surveys over mudstones and drift glaciofluvial sand and gravel deposits are known to be variable between sites and dependent on many local factors but Historic England (2008, 15&16) recommend magnetometer survey as the most suitable technique in the first instance. A Geoscan FM36 Fluxgate Gradiometer was used to carry out this geophysical survey with the aim of identifying any anomalies of potential archaeological significance. This method was particularly suitable in this case due to the limited time scale in which to conduct the survey, of approximately two days, and the fact that the grids could be walked at rapid pace.

Whereas variations in magnetic susceptibility of soils occur naturally, this equipment attempts to detect those resulting from human activity. It is particularly useful in detecting ditches and other silted up features as topsoil is generally more magnetic than bedrock. Conversely masonry is less magnetic than topsoil. It is also sensitive to the presence of hearths and areas that have been in contact with heat due to the process of thermoremanence (Clark 1996, 64-70).

A TBM (Temporary Bench Mark) was first created and recorded in relation to fixed points to enable it to be re-located. A Topcon GTS 212 EDM () was then used to divide the survey area into 20m square grids within a tolerance of +/- 5cms, along a common alignment. Whereas an alignment of the grids along magnetic north is preferable, in this case, a site north was chosen and recorded so as to enable the cropmarks, identified from aerial photographs, to each be crossed at an oblique angle. This is desirable as features running parallel to the direction of traverse can be difficult to detect in the results or even be rendered invisible.

Each grid in turn was sub-divided to give a traverse interval of 1m and sample interval of 0.5m giving 800 readings per grid. Where survey lines could not be completed due to the field boundary cutting across the grid the 'dummy log' key was used to complete the line.

The data obtained was downloaded to a laptop computer in the field and a composite of the survey area created and processed using the Geoplot 3 software package. Normal protocol would be to mark identifiable anomalies, on the plot of the geophysical results. To aid clarity the geophysical background would then be removed from any illustrative figures before inclusion in the final report. In this instance, however, it was deemed that there was little advantage gained in removing the geophysical background and that it was more informative to allow it to remain than to show the anomalies stand alone. The red markings used to illuminate particular anomalies are indicative only and not drawn to scale. The approximate dimensions of features are given, where appropriate, however in the accompanying text.

The survey area was surrounded by a barbed wire fence which affected the survey towards its very south eastern and south western extremities. The tip of the southern corner of the survey area was also crossed by overhead power cables. The remainder of the survey area was under pasture and largely free of obstructions. It is recognised that on such geology signals from smaller features greater than 1m deep are likely to be too weak to be detected (English Heritage (2008, 16). This and the fact that the banks and ditches had been ploughed out or deliberately removed/in-filled suggests that only macro archaeological features are likely to be detectable and even if sub-surface micro archaeological features remain they may have been invisible to the survey.

4.2 Results

Processing parameters:

Despiked usingX=1,Y=3,threshold=3 SD,Replacement=mean Zero MeanTraverse,Grid=All, LMS=On.Pos.Threshold=+5, Neg. Threshold=E5 High pass filter with X=10, Y=10, Gaussian

Low pass filter with X=1,Y=1, Gaussian

Interpolate Y, Expand–Sin X/X(x3)

The most obvious anomaly, on the plot of the geophysical survey results is a 'pear' shaped linear anomaly (fig. 2 and 3). This has a relatively straight western side, orientated approximately north-west / south east, which is approximately 70m in length and 2-4m in width. At its south-eastern end the anomaly diverges as it curves in an arc to the north. The innermost anomaly here is approximately 90m in length, before the two once again merge, with the outer approximately 105m. Both measure approximately 3-6m in width. The area enclosed between the anomalies is approximately 8m at it its widest point and tapers to a point at either end. The anomaly progresses to the north northwest, as a single entity once more, for approximately 40m before turning to the west for a further approximate 30m at approximately 3-5m in width to complete the circuit.

The location, shape and dimensions of this anomaly strongly suggest that it represents the former position of the perimeter bank and ditch of a promontory hillfort of the type commonly found during the Iron Age within the region and indeed throughout Britain. The addition of a further bank and ditch to face the level approach, in this case, from the south east is also common for example Llanmelin Hillfort ST46109257. What is less common is the fact that these appear to run up to approximately 10m down the very steep slope to the south west before running up the slope and forming the bi-vallate south eastern side (figs. 3 and 4). To the north-eastern side they appear to run along the interface between an inner shallow slope and a much steeper slope to the valley below.

A much weaker linear anomaly, approximately 2m in width, runs parallel and approximately 6-8m distant from the first from for approximately 50m along its western side. This continues around the apex and for approximately 20m parallel to the north-eastern side. It may continue for a approximately 10-12m, after a gap of approximately 15m, but the signature to this side is very weak and so this cannot be stated with any certainty (fig. 4). Due to the weak nature of the anomaly it is also not possible to state unequivocally if it terminates at the points indicated or becomes too weak to be detected.

This anomaly can be seen, when compared to fig. 6, to run along the top of the level area of the promontory before it slopes away sharply to the south west and more gradually to the north before becoming a steeper slope. This may therefore indicate the position of a further inner bank and ditch, running along the top of the slope, which has also been ploughed out or deliberately removed / in-filled. Whether these were contemporary with the larger outer defences or possibly represent a different phase can only be ascertained through excavation.

Three possible entrances through the outer defences present themselves. The first is a gap in the northern side, just west of the merger of the ramparts (figs. 4, 5). This appears to have clearly defined terminuses and to be approximately 2-3m in width. Further credence to the hypothesis that this is an entrance is given by the existence of an area approximately $5m^2$ directly to the interior which shows very little 'noise' compared to the area immediately surrounding it suggesting an area clear of obstructions. In addition a weak linear anomaly leads away from the possible eastern terminus at right angles (A, fig. 5). This is therefore possibly a rear entrance for easy access to the river below and if so is similarly positioned to numerous other hillfort sites.

The second is a possible gap of approximately 2m in the outer defences at the approximate mid-point of the south eastern side (fig. 4). This is the least convincing of the three possible entrances and has no corresponding gap in the inner defences. Never the less it is possible that an entrance existed here forcing attackers to travel between the inner and outer defences, below defenders on the bank above, to an entrance in the inner defences further to the west.

The third is found approximately 6m from the top of the western slope in the south western corner of the hillfort (fig. 4). Unfortunately the geophysical anomalies are weakest in this area but a possible gap approximately 4-5m in the inner line of the defences and a gap of indeterminate size in the outer suggest this may have once been the main entrance. If so, it was possibly protected by a feature found immediately to the west (B, fig. 5). This rectilinear feature abuts the defences around the south-western top of the hill. It is formed of a linear anomaly that runs at right angles to the possible entrance, across the level ground, for approximately 10m. It then turns to the west for approximately 15m down a short slope and along the line of the bottom of the hill. It then turns at right angles for approximately 10m up the slope to the outer defences. At the opposing south-eastern corner two linear anomalies, measuring approximately 30 and 45m in length respectively and 2m in width, extend south easterly from the perimeter defences (C & D, fig. 5). These possibly represent the former presence of further banks and ditches whose purpose may have been to protect the entrance from the level ground to the east.

Further supporting evidence for an entrance to this side comes from the surrounding topography. A very deep and relatively wide depression cuts across the south western corner of the field below the hillfort before turning as it enters the next field and emerging onto the level ground broadly opposite the proposed main entrance. It is not known if this feature is natural although visual inspection suggests some form of human agency and this may possibly have been a formal approach way to the entrance. Unfortunately it was not possible to gain access to the next field to investigate this further.

A further, curving, linear anomaly can be identified to the south east of the survey area (E, fig. 5). This may have a corresponding anomaly approximately 22m distant (E1 fig. 5). The curving nature of the anomalies suggests that this may be a circular enclosure but unfortunately anomaly E1 is very weak and therefore it is not possible to state unequivocally that this anomaly is an archaeological feature. In addition both continue outside of the survey area to the north and are cut by a linear anomaly to the south (F fig. 5). This anomaly runs parallel to the field boundary for approximately 120m before being lost in what is most likely interference from the metal gate into the next field. As the anomaly turns towards this gate, albeit at an oblique angle, it cannot be ruled out that this anomaly is caused from modern traffic through the gate and along the field boundary. This also aligns however with the cutting/depression alluded to earlier and therefore an ancient origin, possibly as a trackway, cannot be ruled out. The possibility that this is the return side of the circular platform witnessed in the next field also cannot be ruled out without further investigation.

A second linear anomaly (F1 fig. 5) possibly branches out from the first in an easterly direction for approximately 40m although it is not possible to be certain that this does not continue to the other side of feature F as this is outside of the survey area. This anomaly is either cut by or abuts the outer perimeter defences at its eastern end and also possibly by feature D.

Only one possible internal structure was detected and consisted of a circular anomaly approximately 10m in diameter found at the edge of the level ground to the north-west overlooking the river valley below (G, fig. 5). If this is indicative of a possible roundhouse this would represent the drip gulley around the structure whose dimensions would have been slightly smaller. The dimensions would sit well within the size range of drip gullies found on other Iron Age hillforts.

Two other areas of note from within the interior are indicated on fig. 6 below. These areas are significantly noisier than the remainder of the interior and are interpreted as possibly being concentrations of pits.

4.3 Conclusion

Given the geology, the survey produced good results with clear unequivocal anomalies over much of the site. The cropmarks seen from the air have not only been confirmed but greater detail has been added and missing sections shown as well as further possible buried archaeology detected. The weakest anomalies are found to the south-west area of the possible main entrance but the results strongly suggest its location even if the detail is not as clear here. The site would greatly benefit from a detailed topographical survey and plan to aid its interpretation. Also investigation of possible related archaeology in the field directly to the south-east would assist the full understanding of the site.

5. Excavation

5.1 Excavation objectives and methodology

Following the necessary permissions from the landowner it was planned that two trenches would be excavated to target anomalies highlighted by the geophysical survey. All work conformed to the standards and guidelines of the IFA* (*now CIFA)(2011).

It was initially planned that Trench 1 would be excavated near the possible south-eastern entrance and that Trench 2 would target a possible pit anomaly on the western side of the inner ditch (fig. 7). Due to time constraints it was decided to locate Trench 1 across the inner ditch on the eastern side of the enclosure. Initial excavation to the uppermost archaeological horizon would be by machine and the remainder of the deposits would be hand excavated.

5.2 Results

Trench 1 *(figs. 8, 10, 11, 12)*
Trench 1 was 10.5m long (west-northwest to east-southeast) and 2m wide and was located over a section of inner ditch on the eastern edge of the enclosure.

The topsoil (1000) was a dark brown clayey sand that was 0.40m to 0.50m deep along the length of the trench. Underlying this on the western and eastern end of the trench was a brown clayey sand and gravel with frequent pea grits and poorly sorted stones (1001) up to 0.2m deep where observed. Approximately 3m from the western end of Trench 1 a 4m wide dark-greyish brown sandy clayey silt deposit (1003) appeared to mark the upper fill of a 3.5m wide ditch [1020] aligned north to south. The section of the ditch later revealed another similar deposit (1006) at the western end, probably representing the remains of slumped bank deposit. The ditch was revealed to be 1.3m deep from the base of the natural (1.8m from topsoil surface) and have steep cut sides [1002]. The ditch contained six fills (1003, 1006, 1011, 1012, 1013, and 1014). These deposits appear to represent eroded bank and edge slip of the cut ditch. The base deposit (1014) was a 0.43m (max) deep loose reddish-brown sandy gravel, interpreted as redeposited natural that had slumped down the eastern edge of the ditch and to reach as far as 1.1m above the base of the ditch cut. Deposit (1013), a 0.6m (maximum depth) loose very stoney strong brown sandy silt was found on the western side of the ditch base and partly overlaying (1014) in the centre. This was also interpreted as bank slump of redeposited material from the bank. Both these deposits contained fragments of cattle teeth, most of which were burnt (see Madgwick below). Overlying both these deposits a 1.4m wide and 0.4m deep V shaped dark greyish brown clay silt (1012) represents deposited ditch fill. This fill was sampled (35 litres) and produced evidence (2.6 fragments per litre) representing charred domestic food waste from a hearth or oven containing barley, oats and hazelnut fragments (see Carruthers Appendix I). An oat grain was sent for C14 dating and produced a date of 1563+/-32 BP (UBA-30455), cal AD 418-554 (at 2 sigma). Deposit (1012) was sealed by a 0.4m deep (max) soft friable brown silty-clay with poorly sorted stones (1011) and on its western side by a 0.3m (max) deep dark greyish-brown friable and soft silty clay (1006). The latter deposit was traced to the uppermost edge of ditch [1002] on the western edge, whereas the majority upper fill of the ditch and overlying (1011) was 0.4m deep deposit (1003) described above. A fragment of a corroded iron blade was discovered within this fill (see Bevan below).

Two adjacent post holes [104] and [109] were discovered on the eastern side of the ditch and several more were located but not excavated towards the end of the excavation within 1m of these. Oval post-hole [1004] was located 0.4m east of the inner ditch and was 0.26m diameter and 0.13m deep. This post-hole contained a single fill of compact dark grey-brown clay with occasional small stones and moderate flecks of charcoal. The contents was sampled and found to contain charred animal feed or bedding material (see Carruthers Appendix I)

Approximately 0.2m to the north-west, a second shallower post-hole [1009] was located. This was 0.25m in diameter and 0.08m deep and filled with a light brown clayey silt with small rounded stones and occasional charcoal flecks. The similarity and proximity of these features make it likely that they served the same purpose or were associated with the same structure. Superficial examination of the upper deposits located on the western side of ditch [1002] suggested to the excavators that a bank, now destroyed, had possibly been located in this area, although time constraints prevented further work in this area.

Trench 2 (*figs. 9, 13, 14)*
Trench 2 was located 8 m to the west-south-west of Trench 1 and was located within the southern concentration of anomalies within the enclosure and specifically located over a clear anomaly near the south-eastern inner enclosure ditch. Initially the trench was 4m by 4m but was later extended by 1m on its western edge. The upper turf and topsoil horizon comprising approximately 0.5m of mid brown silt with occasional small stones (2000) gave way to a moderately compact mid orange-brown silty clay subsoil (2001) with linear patches of pea grit and amorphous dark-brown and mid-brown soil patches. A 1m long plough scar was observed running north to south on the eastern side of the trench. An irregular inverted 'L' shaped spread of dark brown soil with charcoal inclusions was located in the centre of the northern end of the trench. When excavated this was found to be a 2m (north to south) by 1.6m (east to west) shallow feature [2002] with rounded sides and a (0.13m to 0.2m deep) U shaped base. The fill of this feature (2003) was a dark brown/black sandy-silt with charcoal inclusions, stones, furnace lining fragments and iron slag (see Young Appendix 1). A radiocarbon date obtained from charcoal associated with this deposit was dated to 1221+/-37 BP (UBA-24080), AD 688 to 889 (at 2 sigma). A further elongated amorphous 1.65m long (north to south) and 0.8m wide feature [2012] was located at the eastern end of the trench. A 0.5m wide slot through the fill of this feature revealed that it was also shallow at 0.25m deep. The feature had a flat base and contained similar fill (2005) to 2003 including furnace lining and slag. Young's analysis of the residues suggests that the features within Trench 2 may represent mixed iron smelting and iron working waste possibly associate with a highly degraded furnace and a dump or workshop floor (see Young, Appendix II)

6. Discussion and Conclusions

The geophysical survey confirmed the location and dimensions of the outer eastern enclosing ditch that was not as clearly defined in the 1995 aerial photograph. Three possible breaks in the ditch also hint at possible entrances with two located on the bivallate south-eastern side and another through the northern univallate edge of the enclosure. Two concentrations of anomalies appear to be located on the northern edge and south-eastern side of the enclosure. Some of these anomalies may have been amongst the parch marks that appear on the 1995 aerial photograph (RCAHMW D12005_0263).

The excavation targeted a section of the inner ditch and an anomaly located on the south-eastern side of the interior of the main enclosure. The interior ditch was found to be 1.5m deep and 4m wide although the inner western bank, now ploughed out, would have made its overall height deeper. Fifth to six century AD deposits located towards the base of the ditch included charred domestic food waste, comprising charred oats, barley and hazelnuts. It was noted that the deposit did not contain hulled wheat, common in IA and Roman Britain, but did contain one grain of free-threshing wheat, more common in the early medieval period. Burnt teeth fragments of cattle were discovered in the edge slump deposits on both sides of the ditch. The teeth fragments are from the extremities rather than the prime meat bones of the cattle and probably represent burnt waste material thrown in the ditch or on the bank. The presence of cattle conforms to the type of livestock known to have been present during this period in such sites as Dinas Powys, although neither sheep nor pig remains were present in the very small ditch sample at Glanfred. A number of post-holes were located on the eastern side of the ditch although the trench was not large enough to discern a structural pattern. The fill of one of these post-holes contained a mixed fill of burnt straw, oats, hazel nut shells and weed seeds, which could be interpreted as burnt animal fodder.

The anomaly located eight metres to the west of the inner ditch was not a pit, as anticipated, but mixed iron smelting waste with some hammerscale, possibly indicating a workshop floor. Adjacent to this (context 2005) may have been the highly degraded remains of a furnace. Charcoal sampled from deposit (2003) containing the slag was dated between the late seventh and ninth century AD. Young's chemical analysis of the iron slag from Glanfred suggests that a local upland bog was the source of the smelting ore (see Young Appendix II). Evidence of iron smelting from enclosures in this area is rare and consists of finds of undated slag from Pen Dinas, Odyn Fach, Pen Dinas Elerch and Hen Gaer (Driver 2013, 156). The discovery of early medieval iron slag from this area is currently unique. North Ceredigion does, however, have a long history of lead exploitation, beginning sometime during the Early Bronze Age (Timberlake 2003). A prehistoric and Roman lead smelting site and 11th to 12th century timber trackway at Llangynfelyn is 5.6km to the north-north-east of Glanfred, whilst the Roman fortlet at Erglodd is 3.3km to the north-east (Page, Hughes et al 2012; Poucher 2009). Similar dating evidence from the Glanfred ditch (median probability – 484) also comes from a single C14 date from the burials at nearby Gogerddan where a burial was dated to 1580+/- 60 (CAR 1045) (Median probability of 480) (Murphy 1992).

The unexpected discovery of a post-Roman date for this site is in tune with Dark's (1994, 5) statement about the 'impossibility of pre-excavation site-recognition'. It is quite possible, as the current draft Research Framework for the Archaeology of Wales (early medieval Wales) suggests, that enclosed sites, previously identified as Iron Age, are either early medieval in origin or have phases of early medieval reoccupation (Edwards, Davies and Hemer 2016). With the exception of imported 5th to 7th century wares, the aceramic nature of the early medieval period presents difficulties in site identification even during the excavation process, and it is only often following post-excavation C14 dating that activity of this period can be suggested. It is also quite possible that Glanfred is a reoccupied Iron Age enclosure and further dating evidence from other ditch sections would be needed to confirm this claim.

It is unlikely that site morphological indicators can be to be used to suggest other local enclosures with the potential for similar dating evidence. Even within the Leri Basin two other similar looking enclosures (Caer Llety Llwyd and Caer Allt Goch) appear triangular in plan but possibly for entirely different topographic reasons (Driver 2013, 52). Small scale targeted excavations with C14 sampling would aid in confirming this.

Prior to excavating this enclosure the author was inclined to dismiss any serious connections with Ffraid (Bridget) and Glanfraed as the location of an early medieval church. Following the dating of occupation deposits at this site these associations cannot be discharged out of hand. Further speculation, however, is fruitless without further evidence.

Place name evidence around this section of the Leri valley contains numerous references to Llys (Welsh for court), with 'Henllys' located 0.6km to the north-west. It would seem that the Leri valley, may have been a strategic east to west route connecting the coast and the lowland north to south (modern A487) route way over the *longue durée* (fig. 18). The Dyfi Estuary and Cors Fochno (crossed by the Llangynfelyn track-way), provided a natural barrier to the north, and the north Ceredigion uplands a barrier to the east.

The evidence at present suggests an enclosure used for domestic and agricultural activity during the 5th to 6th centuries and industrial activity during the 7th to 9th centuries. Whether this occupation is continuous or punctuated cannot with the current body of evidence be stated with any degree of certainty. Although the banks of the enclosure are no longer visible there is considerable scope for further work in the ditches, putative entrance-ways and further anomalies as identified by the geophysical survey (see above). Surviving post-hole patterns have the potential to yield rare evidence of possible early medieval buildings, domestic or otherwise. Further work at this enigmatic site has the potential to provide an insight into this little understood period in Wales.

7. Finds

Finds List*

Pottery, *Dr Peter Webster (fig. 16)*

GFL/13/EX
SF 2. Trench 1 (1006). 11/09/13
Small sherd (16mm x 15mm x 5mm) in off-white with a thick grey core. The filler includes small flecks of mica and mixed grey and black grits. A black streak on the inside face is probably iron corrosion. The quantity and size of the filler makes it unlikely that this is a Roman or a post-medieval sherd. A medieval source seems most likely by a process of elimination.

Small Find, *Dr Lynne Bevan*

GFL/13/EX
SF3. Trench 1 (1003). 11/09/13
A much corroded iron knife blade (SF 3, 1003) from the site was examined. The blade was small in size and broken at the tang. Very little impression of the original size or style of the blade could be determined due to the presence of extensive corrosion products covering the entire surface of the artefact which had started to crumble into fragments. Therefore while the object is certainly part of a knife it's dating cannot be determined.

1. Small tapering iron blade, broken at the tang, now very corroded. Surviving length: 75 mm, maximum width: 14 mm, thickness: 3-5mm. SF 3, 1003. Not illustrated.

(* All finds were retained and all, including ferrous slag samples, will be offered to Ceredigion Museum, Aberystwyth)

Comment on the faunal remains from Glanfred, Ceredigion

Dr Richard Madgwick, Cardiff University

Introduction
A small quantity of extremely friable enamel fragments were assessed at the Osteoarchaeology laboratory of Cardiff Osteoarchaeology Research Group. This brief statement summarises the nature of the remains and their condition (fig. 17).

Trench 1 (1013)
A total 38 enamel fragments were recovered from this context. All are likely to be cattle, although for some small fragments red deer cannot be entirely excluded. The vast majority of specimens were very small (<20mm) and were too friable to assess the number of whole teeth present with confidence, but it is clear that at least two molars and one premolar is present. The enamel fragments are also too small to assign side and therefore it is unclear how many jaws are represented. All specimens are consistent with being from the mandible than the maxilla. The few samples with observable occlusal surfaces show almost no wear. Therefore the remains are likely to be from a young individual (juvenile or sub-adult). The majority of the fragments (33) were burnt, being either charred or calcined and this process has certainly contributed to the poor preservation of the assemblage. Only five fragments were unburnt.

Trench 1 (1014)
Remains from context 1014 were very similar to those recovered from context 1013. Thirty three fragments of enamel were recovered but only three were greater than 20mm in length. One specimen is identifiable – a lower cattle molar. The precise position in the jaw and the side cannot be determined. None of the specimens can be assessed for dental attrition and all are consistent with being from cattle. As the majority are very small fragments it is possible that they all derive from the same tooth. All enamel fragments show evidence of burning (either charring or calcination).

Charred plant remains: Wendy J. Carruthers (see *Appendix 1*)
Archaeometallurgical residues analysis: T.P. Young (see *Appendix 2*)

8. Acknowledgements

Archaeology Wales and Trisgell would like to thank Morgan Hopkins, Tom Guy, S4C, Dr Toby Driver (RCAHMW), Ken Murphy, Louise Austin, Marion Shiner (DAT), Darryl and Sam Williams, Jerry Bond, Dr Erika Guttmann-Bond, Glanfred Farm, Geraint Owen, Dr Jeff Davies, Dr Rhodri Llwyd Morgan, Professor Ray Howell, Chris Smith, Dr Amelia Pannett, Dr Keith Haylock (Aberystwyth University), Dr Peter Webster, Wendy Carruthers, Dr Richard Madgwick (Cardiff University), Felicity Taylor, Dr Lynne Bevan and the Trisgell TV crew for their support and cooperation during this work.

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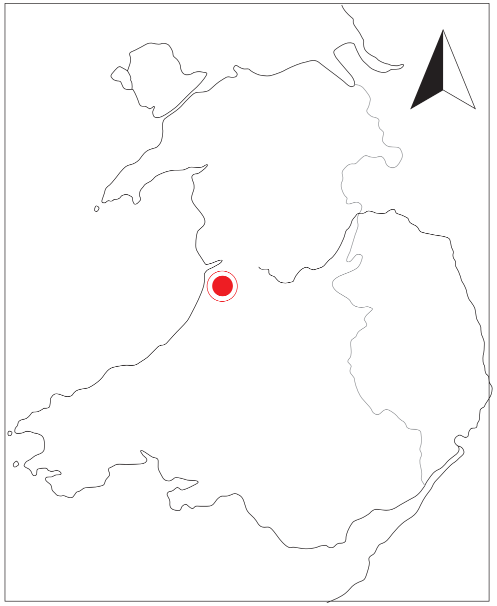

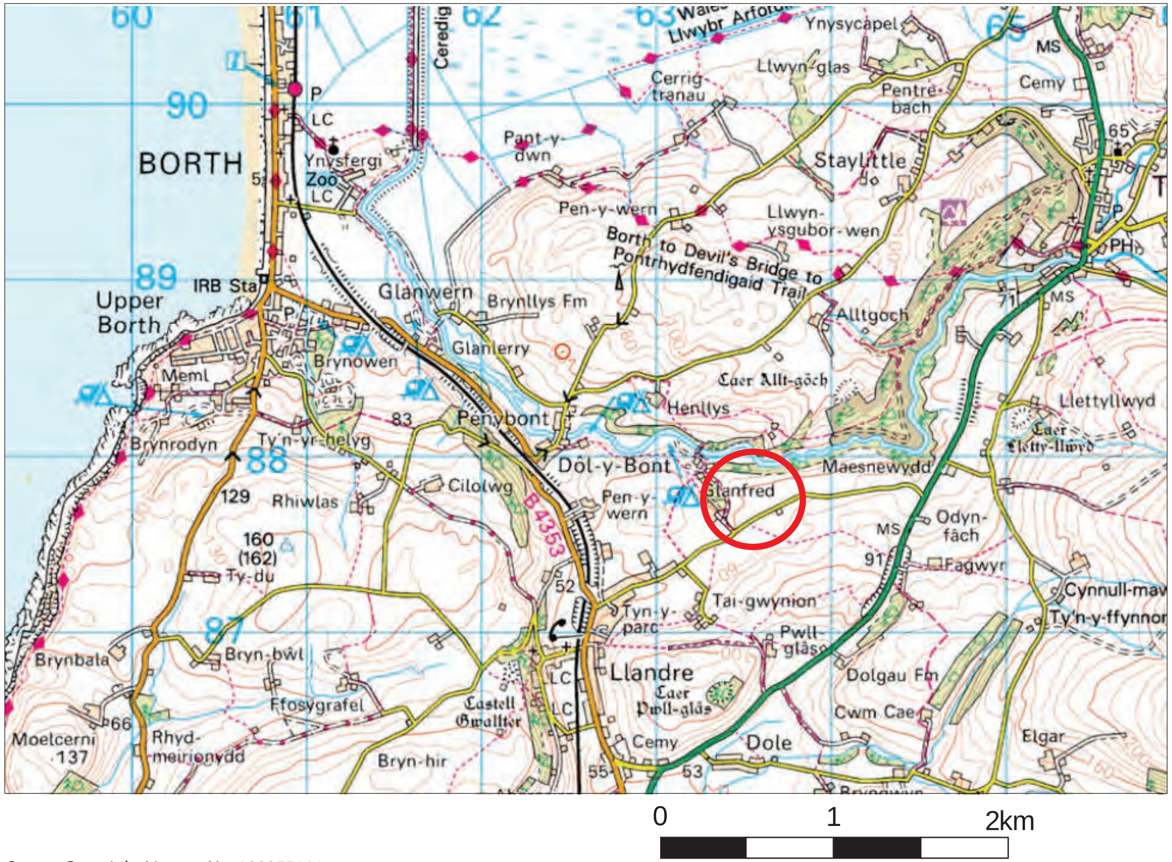

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Fig. 1
Site Location

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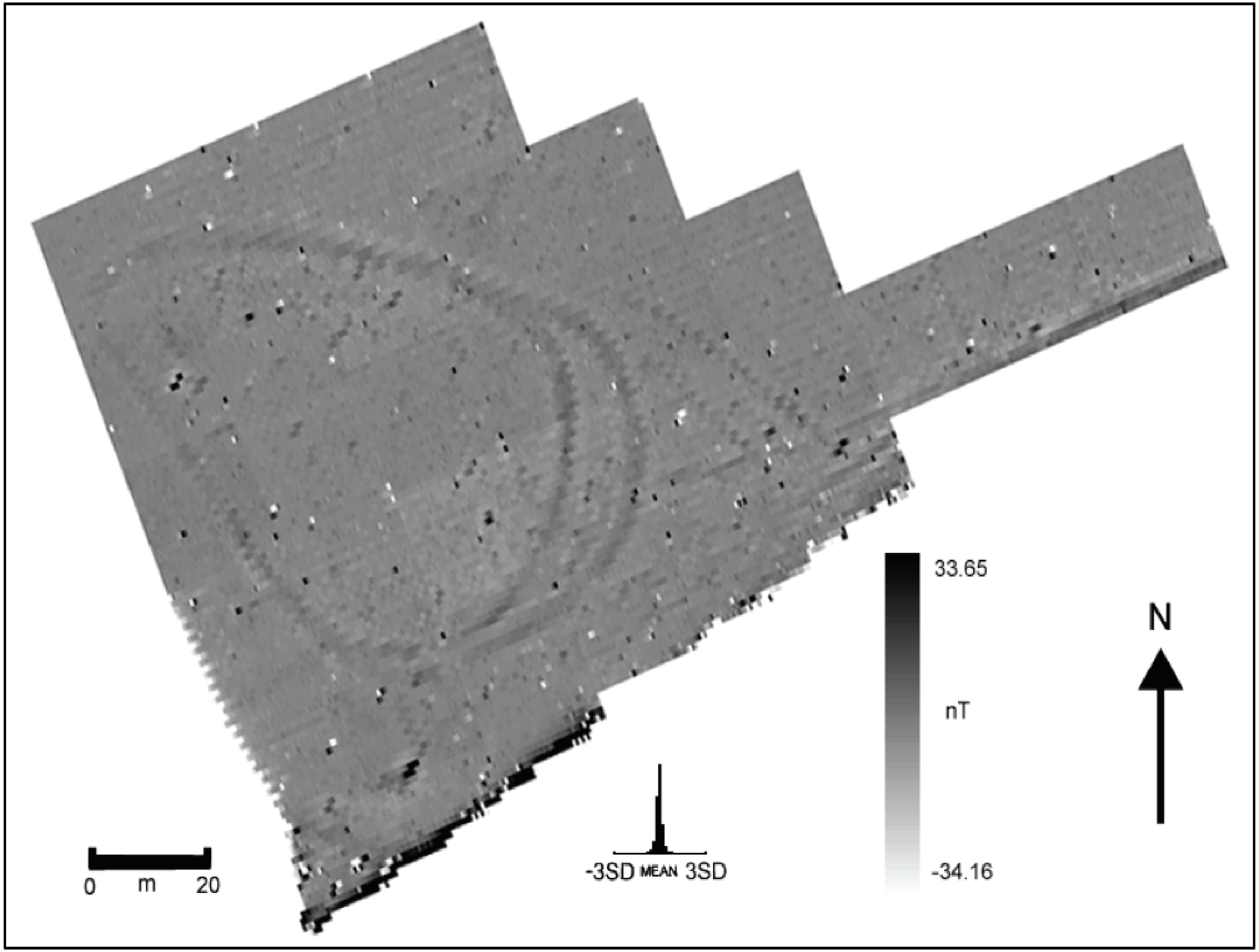

Fig. 2
Unprocessed
Fluxgate gradiometer
survey results

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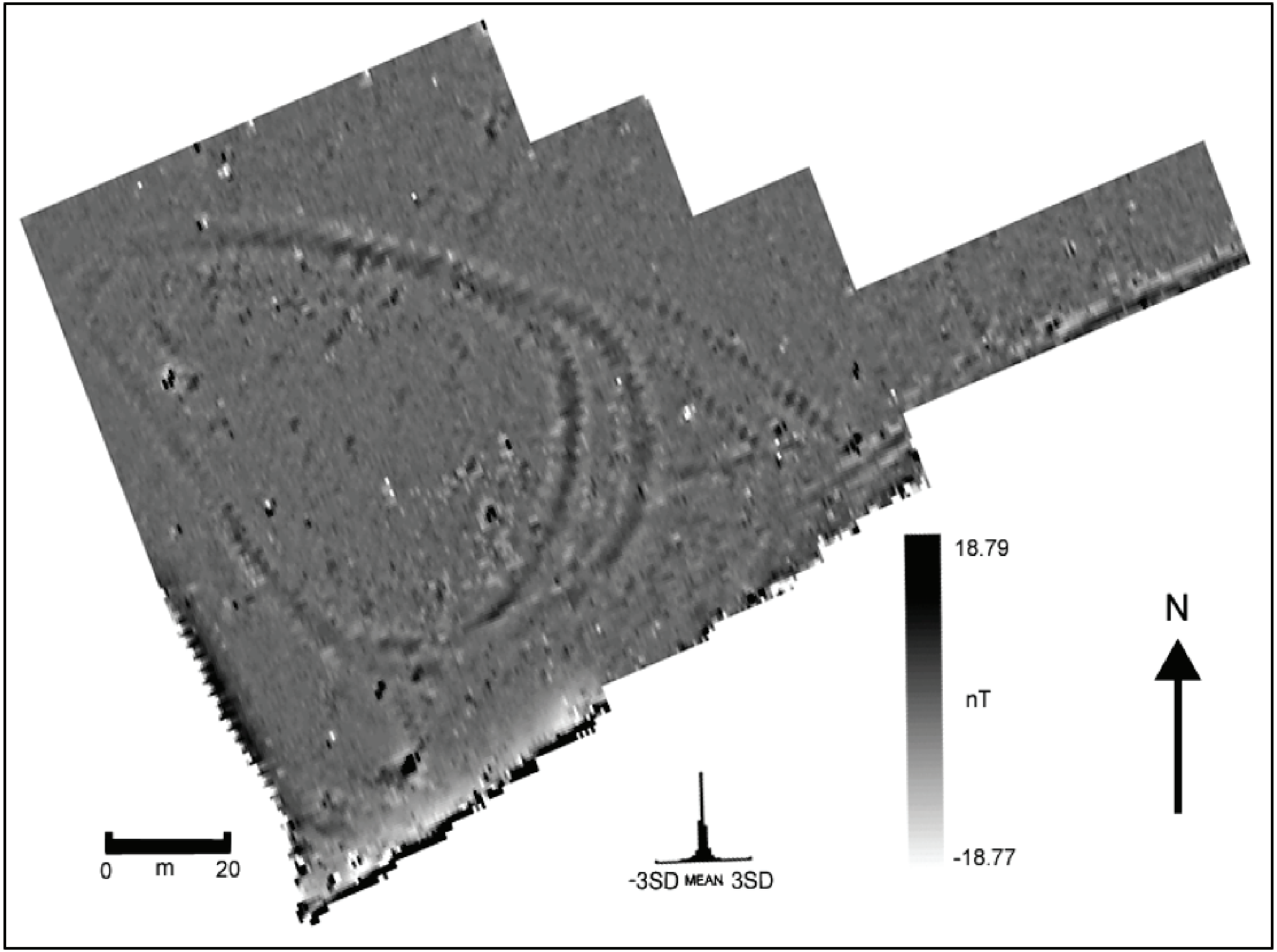

Fig. 3
Processed Fluxgate gradiometer survey results

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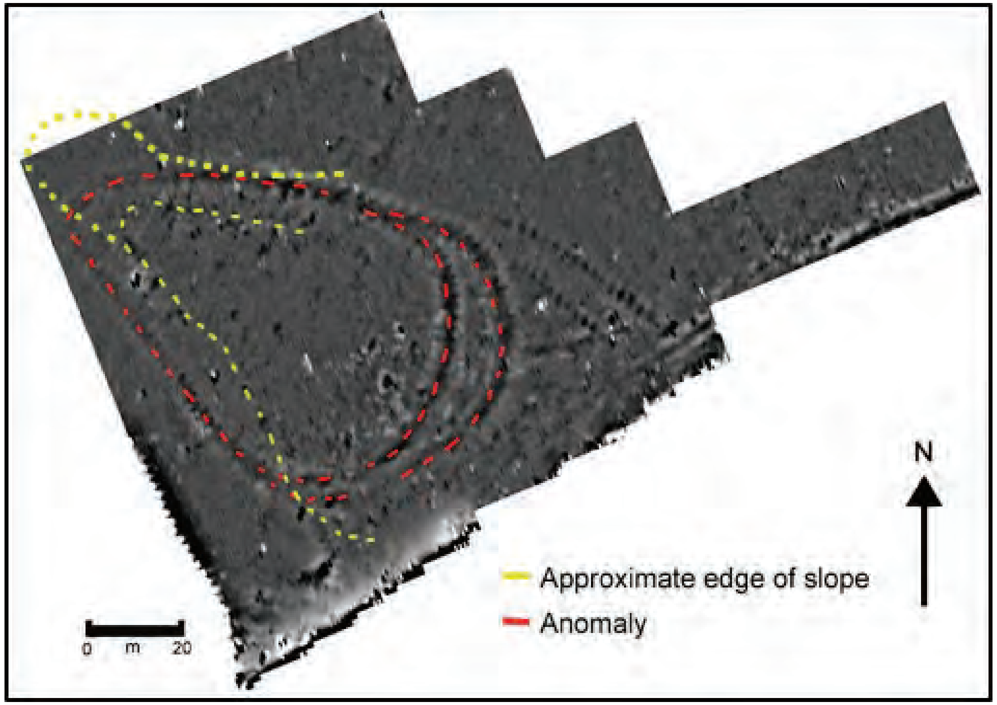
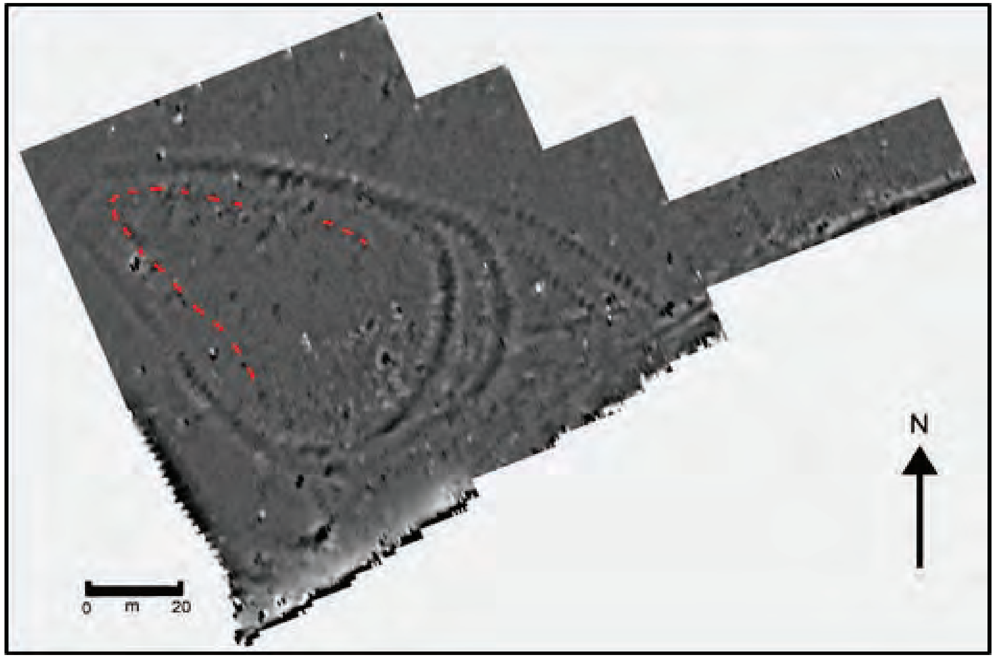


A: Plot of processed survey results with pear shaped anomaly highlighted and approximate edge of slope superimposed



B: Plot of processed survey results with weak anomaly highlighted

Fig. 4
Gradiometer survey results with highlighted anomalies

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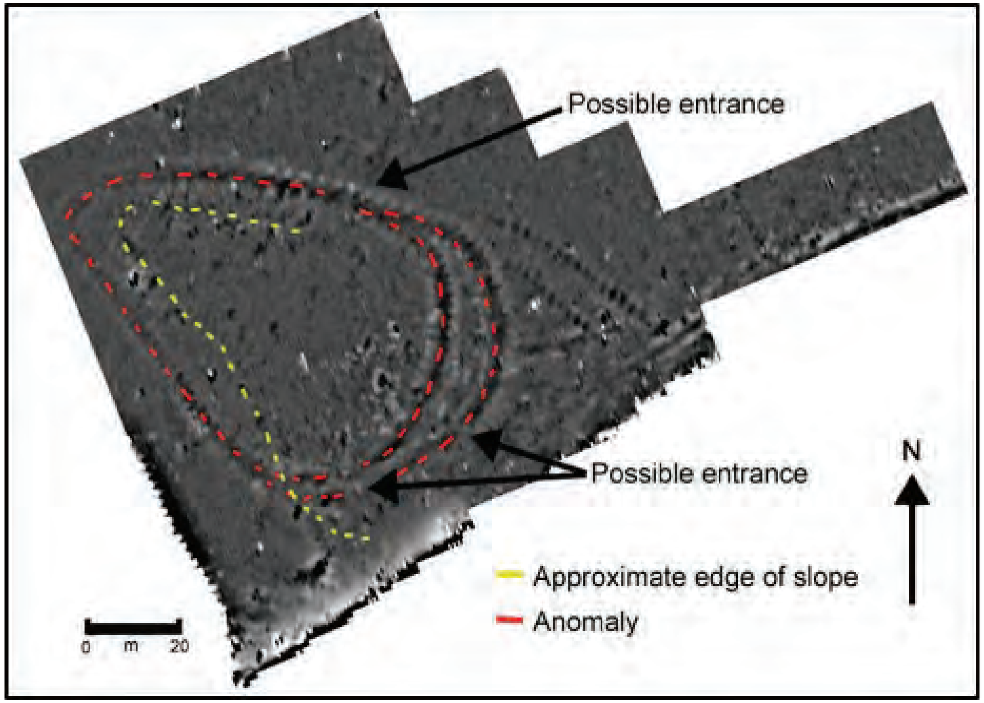
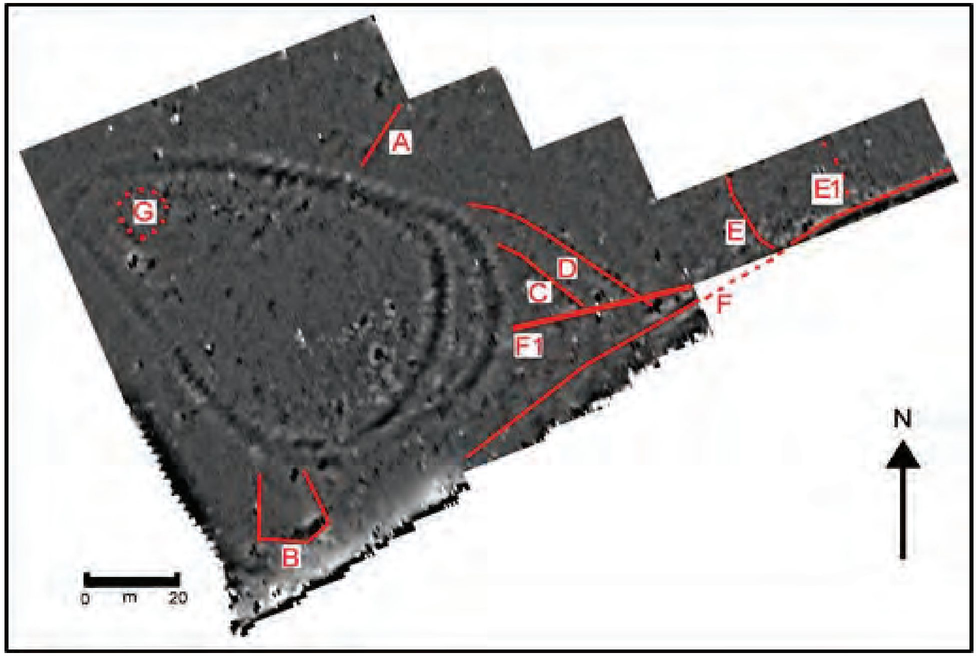


A: Plot of processed survey results with weak anomaly highlighted and possible entrancres indicated



B: Plot of processed survey results with features highlighted

Fig. 5
Gradiometer survey results with highlighted anomalies

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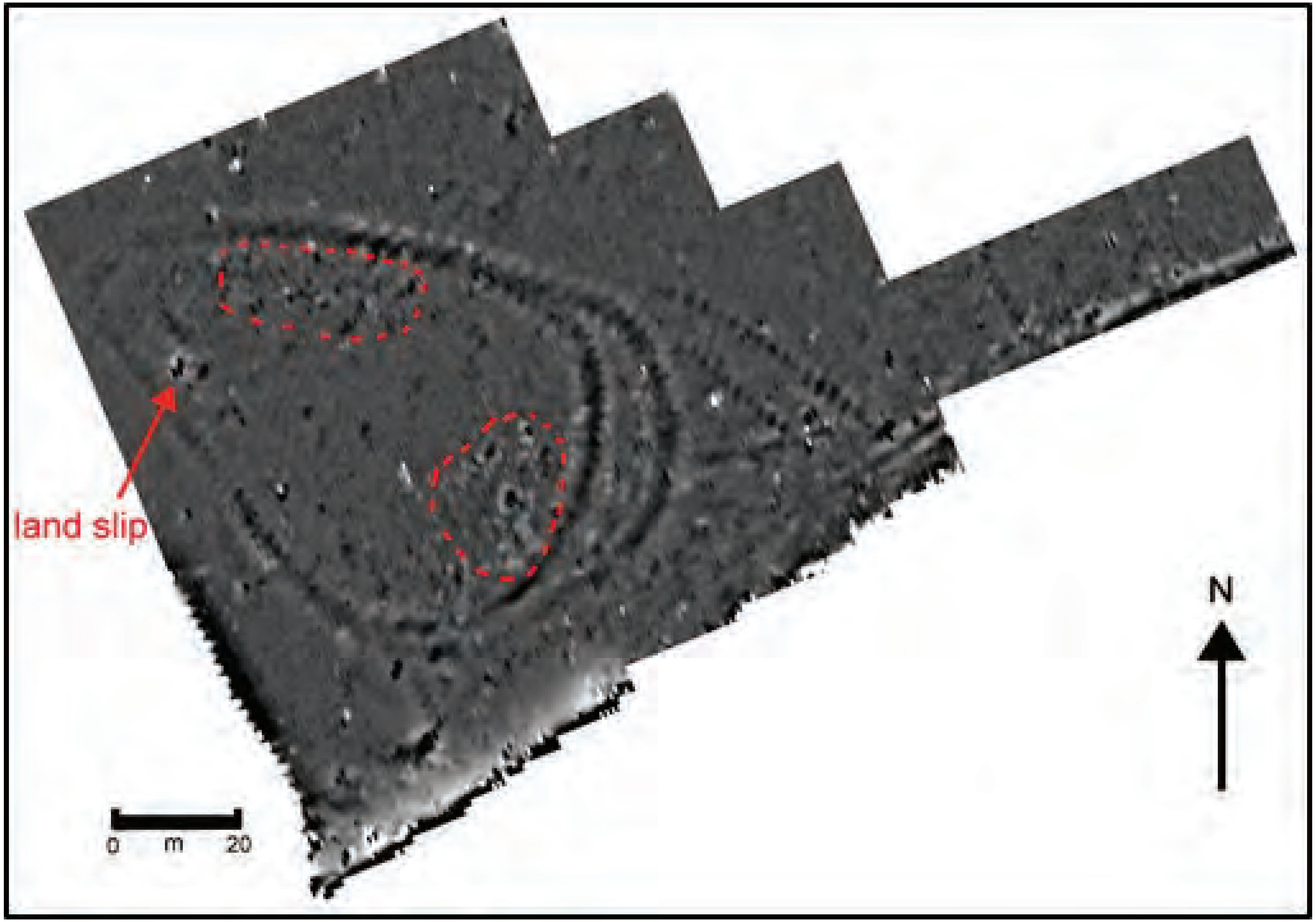

Fig. 6
Plot of processed results with concentrated areas of anomalies highlighted

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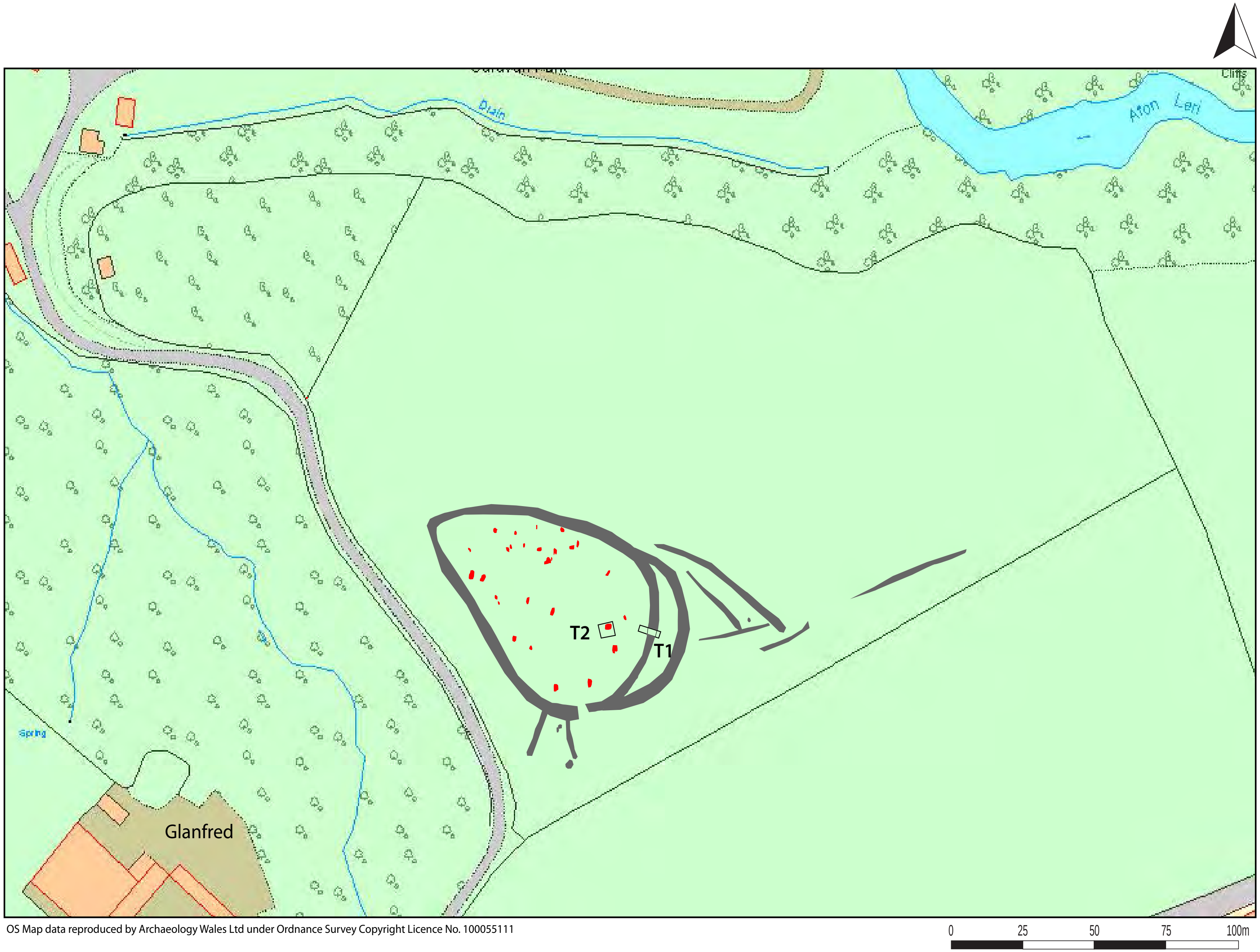

Fig. 7
Map of enclosure showing trench locations

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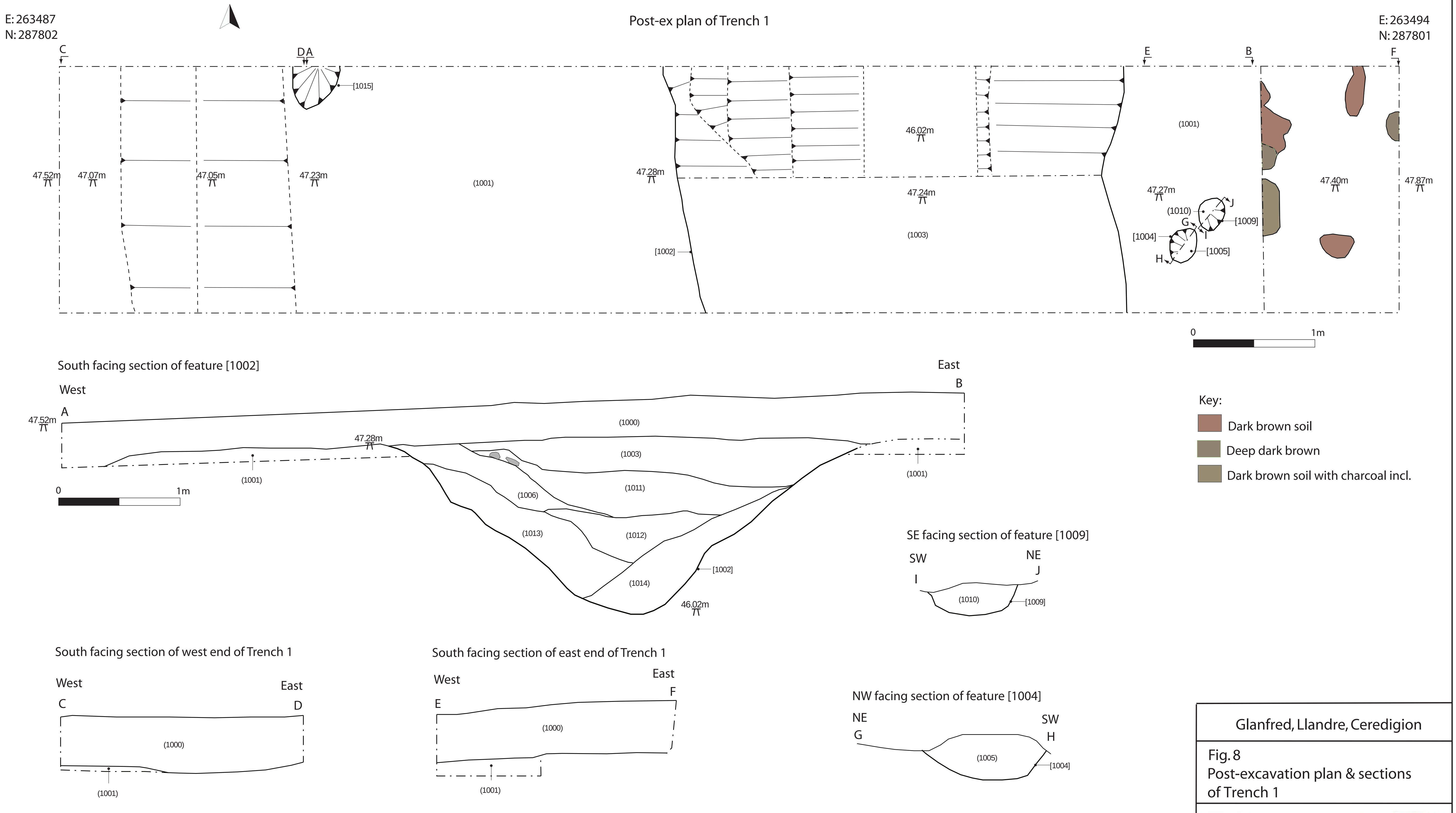

Glanfred, Llandre, Ceredigion

Fig. 8
Post-excavation plan & sections of Trench 1

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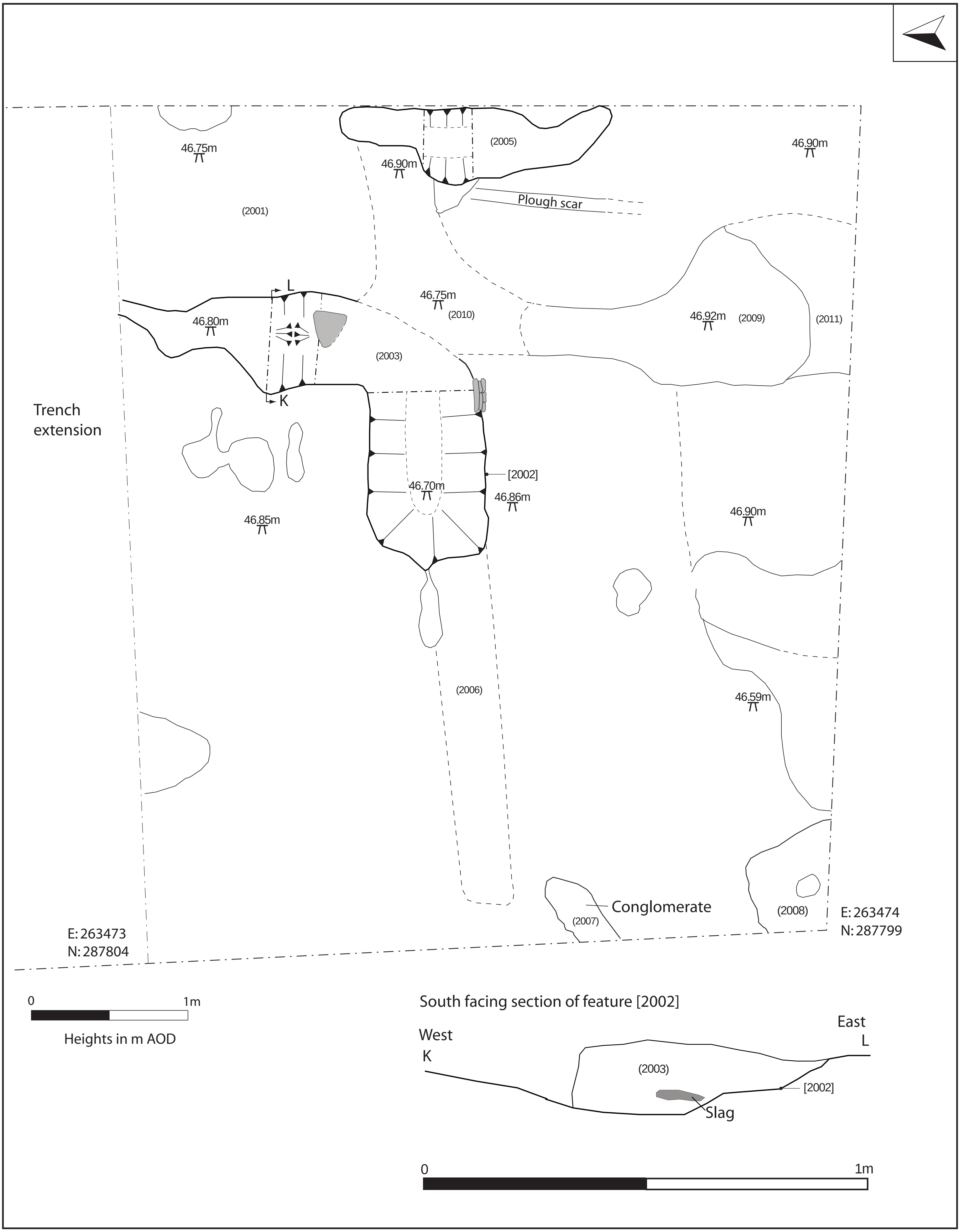

Fig. 9
Plan and section of Trench 2

Fig. 10
Trench 1 following
initial cleaning
(looking west)

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Fig. 11
Trench 1: Section through ditch [1002] (looking north)

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Post-hole [1004] (top) on
eastern side of ditch [1002]

Post-hole [1009] (bottom) on
eastern side of ditch [1002]

Fig. 12
Trench 1: Post-holes
[1004] and [1009]
(looking south)

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Fig. 13
Trench 2 mid-excavation (looking east)

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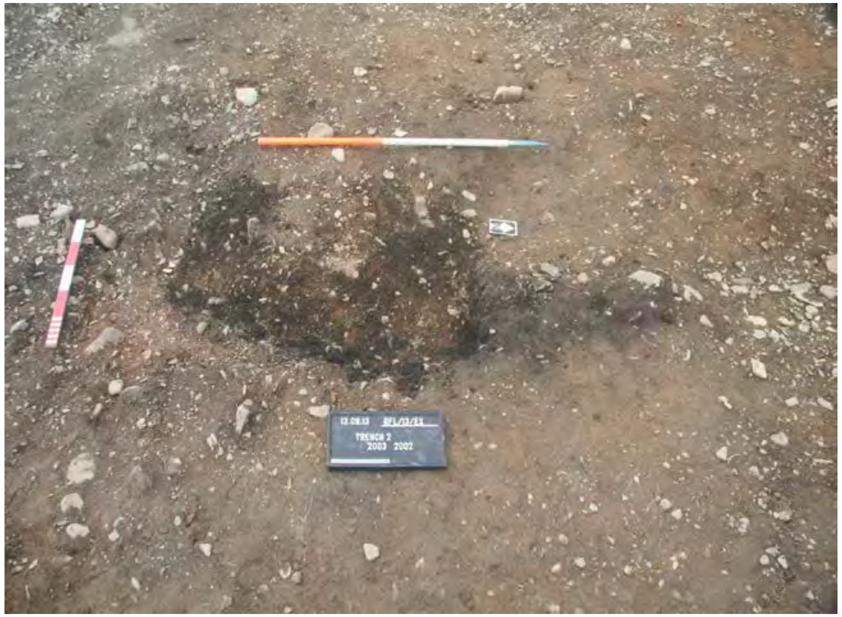
Eastern end of Trench 2 feature [2012] with fill (2005) (looking south)



Central Trench 2 feature [2002] with fill (2003) (looking west)

Fig. 14
Trench 2: Iron smelting/working features

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Burnt Cattle teeth fragments from (1013) at base of ditch [1002]

Fig.15

Cattle teeth fragments

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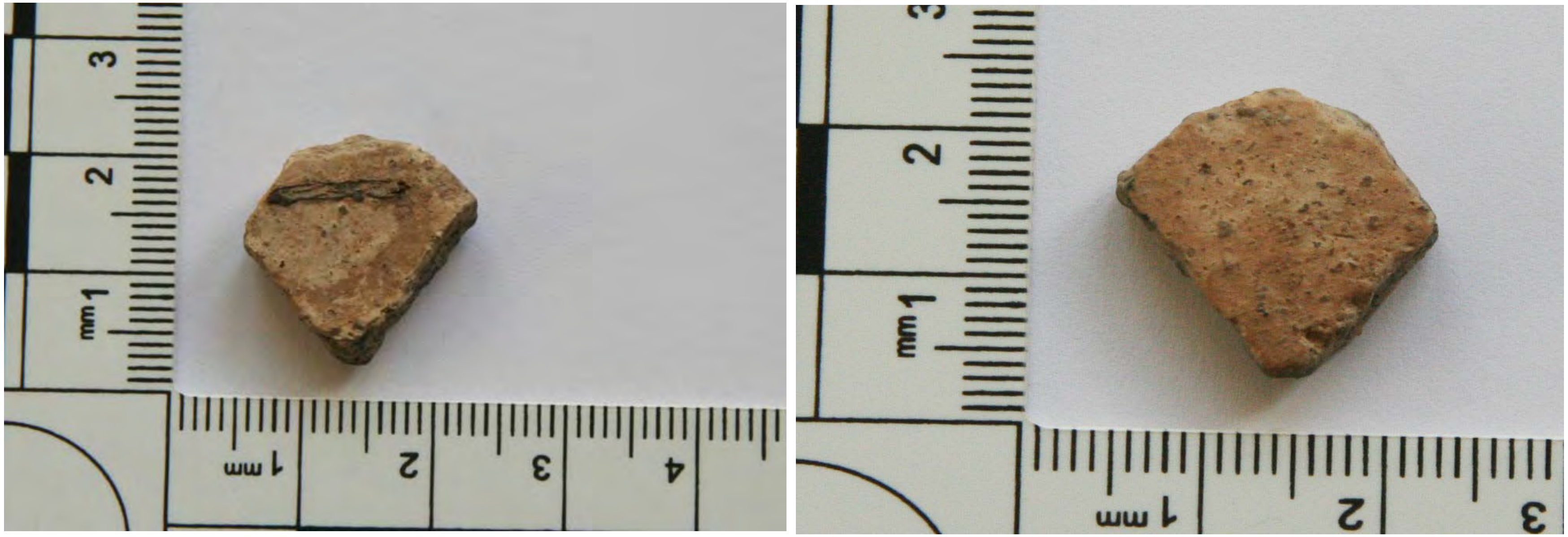

Pot sherd from (1003) within ditch [1002]

Fig.16
Pot sherd

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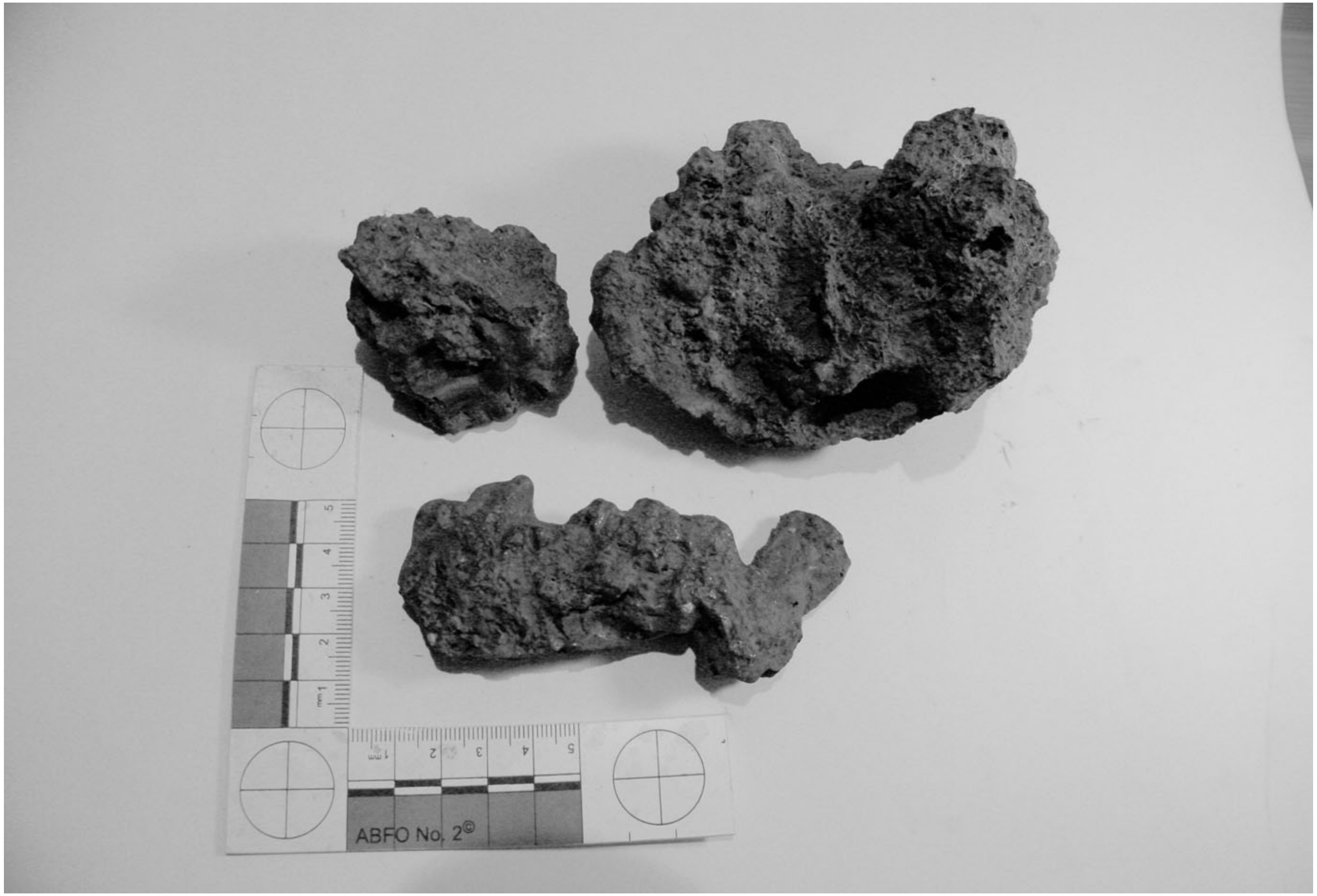

Small selection of Iron smelting residues from (2003), Trench 2

Fig. 17
Iron Slag

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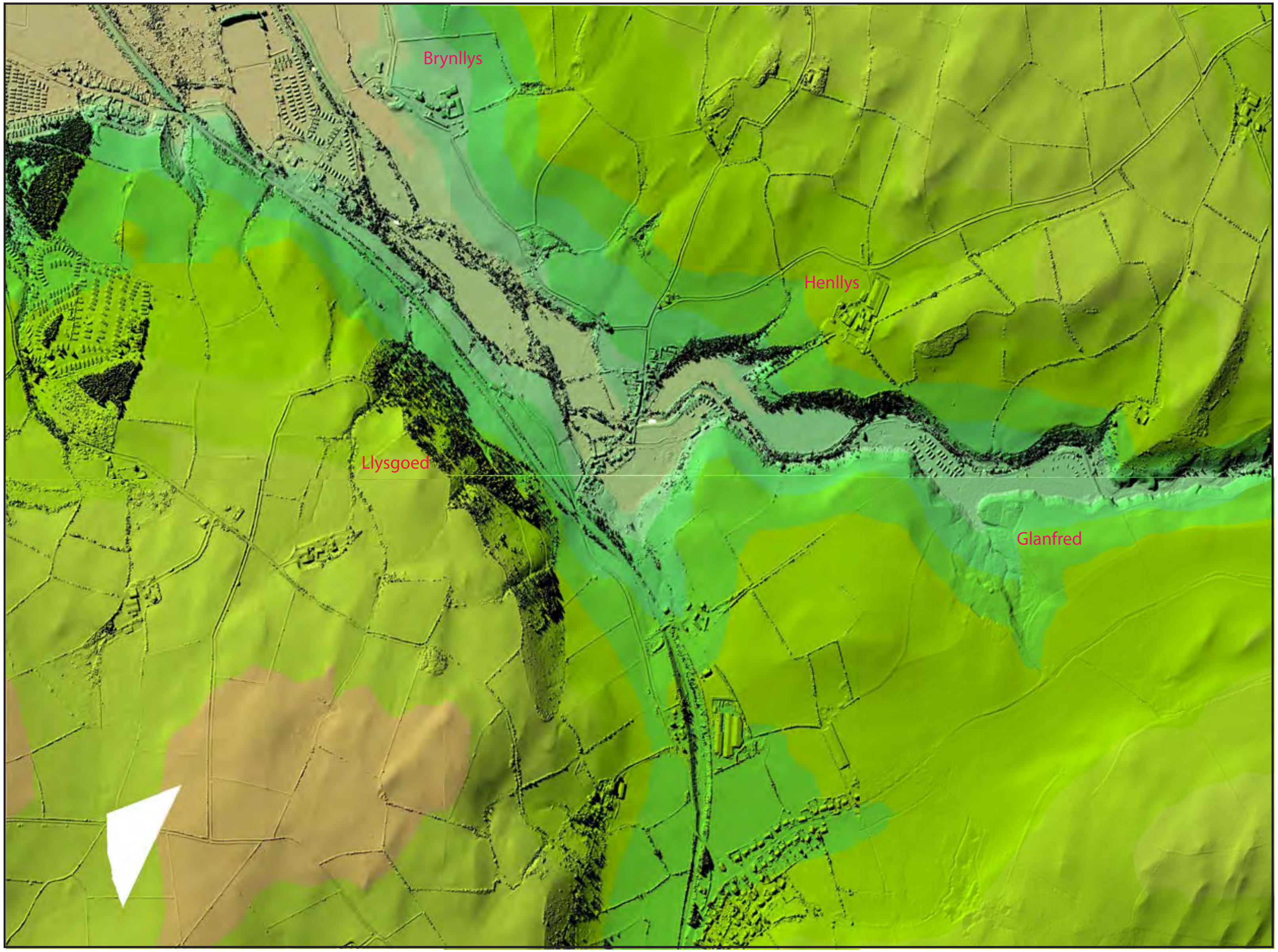

Fig. 18

LiDAR plot of western end of Leri valley

APPENDIX I:
Charred Plant Remains

GLANFRED FARM, LLANDRE, CEREDIGION

The Charred Plant Remains

Wendy J. Carruthers

Introduction

During dry weather in 1999 clear cropmarks were revealed associated with a possible promontory fort on a spur near Glanfred Farm, Llandre, Ceredigion (centered on NGR: SN 63384 87870). In 2013 a Welsh language television series requested permission to excavate at the site for one of the episodes. The Royal Commission on the Ancient and Historic Monuments of Wales (RCAHMW) considered that this would be worthwhile in order to help to clarify the morphology of the earthworks (Iestyn Jones pers. comm.).

The spur on which the fort is sited has a near precipitous slope to the west and sloping land to the north and east. The river Leri is located 170m north of the enclosure's northern limit The bedrock geology comprises Silurian Borth mudstone underlying glaciofluvial sand and gravel of which the upper deposits can be described as freely draining and slightly acidic loamy soils. The field is currently used as pasture for sheep and other livestock (Iestyn Jones pers. comm.).

Two soil samples from Trench 1 (section through the eastern part of the enclosure ditch) were sent to the author for environmental processing and analysis for plant macrofossils;

- Sample 8, context (1012) – a lower fill of enclosure ditch [1002]. 35 litres of very stony pale brown silty soil with frequent charcoal flecks.

- Sample 14, context (1005) – a single fill of small feature [1004] located on the outer side of ditch [1002]. 3 litres of very stony pale brown silty soil with charcoal flecks.

Methods

Each soil sample was processed using standard methods of bucket floatation. Flots were poured off through a 250 micron mesh with floatation for each sample being repeated until no more charred material was seen to float. Once this point had been reached the residue in the bottom of the bucket was washed through a 1mm sieve until all of the silt had been removed. Flots and residues were slowly air-dried and the volumes were measured. The flots were sorted under an Olympus SZX7 stereoscopic microscope. Large charcoal fragments and plant macrofossils were extracted. The residues were coarse sieved to remove large stones (>10mm). It was clear that quite a large number of charcoal fragments had failed to float, as is commonly found in the silty, acidic soils in Wales. This is due to silt and mineral impregnation of the charred material. In some cases a second floatation of the dry residues is effective, but delicate charred remains can be damaged by re-wetting. Because only two relatively small samples were involved, it was considered cost effective to sort the >3mm fraction of residue by eye and then rapidly scan the remaining fine residue under the microscope. This process brought about the recovery of frequent large charcoal fragments as well as a few fragments of hazelnut shell (HNS) from each of the two samples, so it was considered to be worthwhile. No other environmental remains or artefacts were recovered from the flots or residues. It is likely that the soils were too acidic for bone or mollusc preservation.

Results

The results of the analysis are presented in Table 1. Nomenclature follows Stace (2010) with the cereal taxonomy following Zohary and Hopf (2000). Habitat information in the table and text is taken from Stace (2010) and a range of other plant ecology publications including Hill *et al* (1999).

Discussion

a) Provenance, preservation and frequency of the charred plant remains

Both of the flots contained some modern fine rootlets and several uncharred, modern seeds (mostly Chenopodiaceae). Because Chenopodiaceae seeds are black and hard-coated and so are difficult to tell apart from charred seeds, each seed was broken open to determine whether it was charred. Fresh embryos were seen in some seeds and in no cases were charred embryos found. Contamination by these types of seeds is common and this is not problematic unless different phases of occupation overlie each other, making it possible that charred archaeological material could be moved through the soil profile by soil flora and fauna. This was not thought to be the case at Llandre.

Silt and possibly mineral impregnation had clearly affected the efficiency of floatation on this site, as seen from the frequent charcoal fragments found in the residues following the first floatation. However, no charred seeds/fruits were recovered from the residues following microscopic sorting apart from hazelnut shell fragments (HNS). The failure of HNS to float using standard methods of processing is known to be a problem as it is a much denser type of material. For this reason it is always necessary to sort residues for the recovery of nutshell.

Charred plant remains were surprisingly frequent in both samples, particularly in the case of sample 14 (from the small pit/scoop [1004]) where only 3 litres of soil were processed. The concentrations were 2.6 charred fragments per litre (fpl) for ditch fill (1012) and 23 fpl for [1004]. This is relatively high for rural samples, although of course occasionally rich samples are found in rural features such as corndriers.

b) Character of the assemblages

Sample 8, fill (context 1012) of enclosure ditch [1002] - This sample came from a secondary fill towards the bottom of the ditch from the eastern side of the enclosure. The principal cereals represented were oats (*Avena* sp.) and hulled six-row barley (*Hordeum vulgare*), though a single grain of free-threshing wheat (*Triticum aestivum/turgidum*) was also present. Apart from oat awn fragments no oat chaff was recovered to determine whether cultivated oats (*Avena sativa* or *strigosa*), or wild oat (*A. fatua*) were present, but since oats were the dominant cereal in the ditch fill (at least 24 oats compared with 19 barley grains) cultivation of this cereal as a crop is most likely. Other possible gathered foods represented were possible sloe (cf. *Prunus spinosa*), bramble (*Rubus* sect. *Glandulosus*) and hazelnuts (*Corylus avellana*). A few common weeds of cultivation (dock (*Rumex* sp.), common chickweed (*Stellaria media*) and small-seeded grasses (Poaceae)) were the only other charred plant remains present. The overall character of the assemblage is a deposit of charred domestic waste containing food debris, perhaps having been cleared out from a hearth or oven. The presence of a few barley rachis fragments and hazelnut shell fragments suggests that in addition to food remains accidentally dropped into a fire during food preparation, some waste products had probably been deliberately thrown into the fire or used as tinder. The ratio of cereal grains to chaff fragments to weed seeds was 18 : 1 : 1, demonstrating that most of the remains were food items. Fruit and nut remains are not included in this ratio, so the ten fragments of sloe, bramble and HNS increase the bias towards burnt food remains.

The combination of primarily oats and barley (possibly the mixed crop, 'dredge') with a single grain of free-threshing wheat is characteristic of early and later medieval deposits rather than prehistoric ones, particularly as no evidence of hulled wheats was recovered. For this reason three oat grains of the form typically found in cultivated oat, *Avena sativa* (long, plump grains, with visible hairs and slightly wider towards the base) were submitted for radiocarbon dating. The date returned was (at 2 sigma) cal AD 418-564 (UBA-30455; 1563±32 BP), demonstrating that the assemblage was deposited in the early post-Roman period.

<u>Sample 14, fill (context 1005) of pit [1004]</u> – This sample from small pit [1004] produced an assemblage that was richer in waste materials and so may represent charred animal fodder or bedding rather than human food waste. The only cereal represented was oat (*Avena* sp.; two grains), although some of the poorer, eroded grains could only be identified to oat/brome/large-seeded grass (*Avena/Bromus/*Poaceae sp.). Because the oat species could not be confirmed due to the absence of chaff it is possible that the grains represent wild oats, but perhaps less likely due to the fact that they were concentrated in this feature. The other components of the assemblage consisted of relatively frequent straw-sized nodes and straw-sized culm bases, in addition to frequent weed seeds. The ratio of grain to chaff to weed seeds was 1 : 1 : 2, demonstrating that the material represented a different type of waste to that in sample 8, predominantly straw (or hay) and weed seeds. Straw is rarely preserved in large quantities by charring, as it is very combustible and usually burns away to fine ash in the presence of oxygen. The sixteen fragments of straw or a robust grass therefore are probably all that survived from a much larger quantity that was burnt. The weed seeds consisted mainly of dock (*Rumex* sp.; 25 achenes), some of which still retained fragments of the fruit (valves and pedicel). This, and the survival of straw fragments, suggest that delicate material preserved under reducing conditions in a fire had been rapidly buried in the feature or possibly burnt *in situ*. Other, less frequent taxa were knotgrass (*Polygonum aviculare*), grasses (Poaceae), corn spurrey (*Spergula arvensis*) and a small-seeded indeterminate member of the Asteraceae family such as stinking chamomile or yarrow (embryo only preserved). As a whole, the remains may have been derived from burnt hay and oats being used for animal fodder, or the waste from processing oats. Corn spurrey grows as an arable weed on acidic soils and docks are commonly found growing as crop weeds or on waste ground, grasslands and meadows. The presence of 7 fragments of HNS and an elder seed indicate that small amounts of other types of burnt domestic waste were also present.

c) General discussion and comparisons with other sites

The dating of the deposit of oats and barley in the enclosure ditch to the early post-Roman period is of particular interest as the fill was fairly low within the ditch rather than being a later scoop in the top of what was thought to be an Iron Age enclosure ditch. It fits in with the archaeobotanical information in several ways; firstly the earliest confirmed cultivated oats (identifiable to species level due to the presence of floret bases) known to the author came from an E/MIA context at Asheldam Camp (Murphy 1991), though no direct dating was carried out on this material. Oats are sparse and never dominant in the IA so it is generally considered that they were primarily present as crop weeds at this time. Secondly, dredge is typical of the medieval period, particularly in Wales where it is well-suited to the infertile soils. Hulled wheats were dominant in the Iron Age across the British Isles but none were present in this deposit. In Wales, where oats and barley have been found on Iron Age sites, hulled wheats have also been recorded, for example at the Iron Age/Romano-British farmstead at Bryn Eryr, Anglesey (Caseldine 1990, 75). At this site emmer and spelt were dominant but one late context contained hulled barley and oats with a small amount of free-threshing wheat. This type of assemblage is fairly frequently found in Iron Age and Romano-British deposits in Wales with the occurrence of hulled wheats decreasing through time (Astrid Caseldine pers. comm.). However, the complete absence of hulled wheat remains is not common. It would be interesting to radiocarbon date the late deposit of barley and oats from Bryn Eryr. Thirdly, free-threshing wheat has not been confirmed to have been a crop plant in the British Isles until the Roman period so even a single grain within the assemblage indicated that the deposit was unlikely to be IA in date.

Along the Milford Haven pipeline comparable assemblages were recovered from a LIA/ERB site (Site 508). Samples from a ditch produced frequent oats (with cultivated oat confirmed; *Avena sativa*) with barley and just a trace of hulled wheat. A feature cut into the top of the ditch also produced this type of assemblage and was radiocarbon dated to 690-900 cal AD. None of the barley or oat grains radiocarbon dated returned a LIA/ERB date from other parts of the site, though an oat (presumably wild oat) was dated to the Bronze Age (Carruthers & Giorgi, in preparation).

A second trench located 8m to the west-south-west of Trench 1 contained an irregular inverted L shaped spread of dark brown soil with charcoal inclusions. A radiocarbon date obtained from charcoal associated with this deposit was dated to 1221+/-37 BP (UBA-24080), AD 688 to 889 (at 2 sigma) (Iestyn Jones, pers.com.). The date from sample 8 is much earlier than this activity, demonstrating that there was settlement in the area over a number of different periods. Unfortunately there is no archaeobotanical information to help answer the question as to when the enclosure was constructed. It would be useful to excavate a further section through the enclosure ditch in future and take large soil samples from the primary fill (at least 40 litres each) in order to recover charred plant material suitable for radiocarbon dating.

The small pit [1004] located on the outer side of enclosure ditch [1002] produced only a small amount of crop information to assist in dating the feature. Only two oat grains (*Avena* sp.) were confirmed but it is likely at least some of the thirteen indeterminate elongated grains were also oats. The likelihood, therefore, is that this feature was also post-Roman in date, but this remains uncertain. It is interesting that relatively delicate charred plant material survived in this feature, perhaps indicating *in situ* burning, or the careful deposition of deliberately burnt plant material.

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Table 1: Charred plant remains from Glanfred Farm, Llandre (GLF/13/EX)

sample	8	14
context	1012	1005
feature	enclosure ditch 1002	pit 1004
CEREAL GRAINS		
Triticum aestivum/turgidum (free-threshing wheat grain)	1	
Hordeum vulgare L. (hulled six-row barley, twisted lateral grain)	4	
Hordeum sp. (hulled barley, straight grain)	4	
Hordeum sp. (poorly preserved barley grain)	10	
Avena sp. (cultivated/wild oat grain)	24*	2
Avena sp./Bromus sp./Poaceae (oat/brome/large grass caryopsis)	7	13
Indeterminate cereal grain	22	
CEREAL CHAFF		
Hordeum vulgare L. (hulled six-row barley rachis fragment)	4	
Avena sp. (cultivated/wild oat awn fragment))	+++	+
cereal-sized culm nodes		10
cereal-sized culm bases		6
WEEDS & WILD PLANTS		
Prunus spinosa L. (sloe stone fragment) HSW	cf.1	
Rubus sect. *Glandulosus* (bramble seed) DHSW	1	
Corylus avellana L. (hazelnut shell fragments) HSW	8	7
Polygonum aviculare L. (knotgrass achene) CD		2
Rumex sp. (dock achene) CDG	1	20
Rumex sp. (dock achene with remnants of fruit) CDG		5
Rumex acetosella L. (sheep's sorrel achene) EoGCas		cf.1
Stellaria media(L.) Vill. (common chickweed seed) Cno	1	
Spergula arvensis L. (corn spurrey seed) Cas		1
Anthemis/Achillea/Matricaria sp. (chamomile/yarrow/mayweed achene embryo) CDG		1
Sambucus nigra L. (elder seed) DHSW		1
Poaceae (small seeded grass caryopsis) CDG	2	
TOTAL	90	69
soil sample volume (litres)	35	3
frags per litre of soil processed	2.6	23
ratio of grain : chaff : weed seeds	18:01:01	01:01:02
total flot volume (ml)	320	120
charcoal (>3mm) volume (ml)	100	50

KEY: *=radiocarbon dated; +=occasional; +++=frequent: HABITATS: C=cultivated; D=disturbed; E=heath; G=grassland; H=hedgerow; S=scrub; W=woods: SOILS a=acidic soils; o=open; n=nutrient-rich; s=sandy

APPENDIX II:
Archaeometallurgical Residue Analysis

GeoArch

Report 2016/36

Archaeometallurgical residues from Llandre, Ceredigion

Dr Tim Young

26th October 2016

Archaeometallurgical residues from Llandre, Ceredigion

Dr T.P. Young

Abstract

Iron production residues were recovered from two of the cut features excavated within the interior of the enclosure at Glanfred, Llandre. The assemblage include approximately 4.6kg of macro-residues derived mainly or entirely from iron smelting; small quantities of microresidues collected during the washing of the macroscopic specimens also included some hammerscale from ironworking (smithing).

The assemblage is dominated by flow slags with various surface textures and morphologies. The majority of the flow slags are simple elongate flows with free upper surfaces, but amalgamated blocks of flow slag and flows with contact with gravelly material on all surfaces also occur. The material is ambiguous as to the technology it represents: there are no moulds of wood or cereal pit-packing such as normally occur in non-tapping furnaces, how there is no surface – reddening of the flows, or amalgamation into large blocks of flowed slag as is normally seen in tapped furnaces. The assemblage most closely resembles unpublished material of similar age from Cefn Graianog, Gwynedd.

Two pieces of flow slag were selected for further detailed laboratory analysis. Bulk chemical analysis showed the slags were rich in manganese, but otherwise dominantly within the SiO_2-Al_2O_3-FeO system. Phosphorus was slightly elevated. Calcium, sodium and magnesium were all very low. Broadly similar elemental composition has been observed in slags from the smelting of bog iron ore in Gwynedd (Llwyn Du), Powys (Llandefaelog) and Pembrokeshire (Johnston, South Hook). The upper crust-normalised rare earth element profile was flat, probably indicating that the host sediment to the ore was fine-grained, or contained fine-grained bedrock.

In summary, the evidence suggests that the furnace was either non-tapping, or capable of tapping a low-volume of slag. It was smelting what was probably a local upland bog iron ore. Context (2003) probably presents mixed waste (either a primary dump) or as part of the workshop floor, whereas it is possible (but far from certain) that context (2005) might represent the highly degraded remains of furnace.

Contents

Methods

The assemblage was visually inspected as part of an informal assessment. The catalogue is included as Table 1. Following the assessment, two samples were selected for further laboratory analysis.

The selected samples were slabbed on a diamond saw and subsamples were crushed for preparation of a whole-sample chemical analysis.

Bulk chemical analysis was undertaken using two techniques. The major elements (Si, Al, Fe, Mn, Mg, Ca, Na, K, Ti, and P) were determined by X-Ray Fluorescence using a fused bead on the Wavelength-Dispersive X-Ray Fluorescence (WD-XRF) system in the Department of Geology, Leicester University (this also generated analyses for S, V, Cr, Sr, Zr, Ba, Ni, Cu, Zn, Pb and Hf). Whole-specimen chemical analysis for thirty six minor and trace elements (Sc, V, Cr, Co, Ni, Cu, Zn, Ga, Rb, Sr, Y, Zr, Nb, Mo, Sn, Cs, Ba, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, Pb, Th, U) were undertaken using a sample in solution on the ThermoScientific ICAP-Qc quadrupole ICP mass spectrometer (ICP-MS) in the Department of Geology, Leicester University (this also generates lower quality results for Fe, Mn, Ti, P that are used mainly for QA purposes). The raw results of the chemical analyses are presented in full in the archive appendix (Appendix), with the key adjusted data presented as Tables 2 and 3. Adjustment has assumed all iron was originally present as FeO and all manganese as MnO. The assistance of Dr Tom Knott (XRF) and Dr Tiffany Barry (ICP-MS) is gratefully acknowledged.

This project was commissioned by Iestyn Jones.

The residues

Distribution of the residues

Residues were .recovered from the fills ((2003), (2005)) of two cut features of rather irregular plan. Context (2003) produced 4.54kg and context (2005) 105g of residues.

Context (2003) is described as the fill of irregular ‘L’-shaped cut feature [2002], 2m (north to south) by 1.6m (east to west), shallow (0.13 to 0.2m deep), with rounded rides and a ‘U’ shaped base. The fill was a dark brown/black sandy-silt with charcoal inclusions, stones, furnace lining fragments and iron slag. A radiocarbon date obtained from charcoal associated with this deposit was dated to 1221+/-37 BP (UBA-24080), AD 688 to 889 (at 2 sigma).

Context (2005) was the fill of elongated (1.65m long, north to south amorphous; 0.8m wide) feature [2012]. A 0.5m wide slot through the fill of this feature revealed that it was also shallow (0.25m deep), with a flat base. The fill was similar in properties to fill (2003).

Neither feature was noted as containing evidence for in-situ heating, although photographs of [2002] do show possible reddening of the substrate close to the external side of its angle.

The features had been cut into a subsoil of shaley gravel, reflecting the underlying Silurian mudstones of the Borth Formation.

Description: iron smelting macro-residues

The macroscopic smelting residues were divided (Table 1) into several classes:

Flow slags with smooth surfaces: these flow slags show upper surfaces with smooth, dark surfaces and a shiny lustre. In this, they resemble tapped slags (i.e. slags which had been tapped so that they had flowed out of the furnace before cooling). Flow slags in non-tapping furnaces (i.e. those furnaces in which all the slags cooled within the furnace) may also show free surfaces, so this is not a firm discriminating factor. The smooth flow slags did not show any superficial reddening (which forms in tapped slags because of the superficial oxidation of the slag producing a thin layer of haematite), but this is not always a clear discriminant, because some high-manganese tapped slags also may not show much reddening.

These flow slags were mainly either in individual elongate flow lobes/tubes, or in small amalgamations. There were only a few pieces in which the individual prills were more numerous. None of these amounted to a substantial block and they were mostly just a single layer of flow lobes in thickness.

Flow slags with smooth surfaces comprised 1950g (124 pieces) of the assemblage (

Flow slags with gravelly surfaces: some of the flow slags showed dull surfaces with abundant fine gravel inclusions (12 pieces; 330g). Some of these were in well-formed flow lobes, but others were in the form of elongate, rod-like, bodies.

Slag rods are probably most commonly formed by slag entering holes pushed below the furnace charge by a tool (typically an iron rod). Such rods would be more likely to be formed in a slag-tapping furnace, during management of the tapping process. They could theoretically be generated during use of a rod to clear the hot slag from a non-tapping furnace too, but this is much less likely.

Hearth/furnace lining: the assemblage included 19 fragments (weighing 254g of furnace/hearth lining from (2003) and 3 pieces (weighing 10g) from (2005). The fragments were generally small and undiagnostic. No pieces showed evidence for the air supply.

Smithing hearth cake/furnace bottom: the assemblage contained a single large block (380g) containing what appears to be part of the margin of a plano-convex slag cake. The piece shows signs of having been deformed when hot and is difficult to orientate with certainty. It shows a small area of what is probably a smooth top, adjacent to an inclined, gravelly side.

Two other dense slag fragments (54g and 100g) were probably burr fragments (the zone of interaction between the hot slag and hearth/furnace wall just below the air inlet). One of these (a 100g fragment) might alternatively be a fragment of a smithing hearth cake.

Indeterminate slag: in addition to the above pieces (all from (2003) except where indicated), there were (from (2003)) 20 pieces (664g) of slag fragments showing some signs of flow. These were all indeterminate in origin, but might potentially include fragments of flow slag accumulations (but lacking characteristic surfaces) and fragments of furnace bottoms. There were also 6 pieces or lumps of slag that were particularly ‘rusty’, suggesting that they might have contained metallic iron. Again, an origin as furnace slags (or furnace bottom) might be likely, but not evidenced by the morphology of the pieces. There were three fragments (18g) of tis rusty sheet-like material, possibly fragments of ferruginous weathering crusts, but an origin in the weathering of a thin iron sheet is also possible. Finally there were 40 pieces (468g) of iron slag fragments there were entirely indeterminate.

Context (2005) produced 6 pieces of indeterminate slag, all, low density, some in moderately large flow lobes and some possibly brecciated and perhaps related to the ‘sinter’ facies reported from the base of some non-tapping furnaces (e.g. Young 2008). These slags were mostly highly vesicular, pale below the dark surface, and coated in ashy deposits.

Description: iron smithing micro-residues

As no samples were available for the investigation of microresidues, all sediment removed during the washing of the macroscopic samples was collected and wet-sieved at 63µm, before magnetic separation.

For the material from context (2003), the washings were rich, not only in slag debris, but in flake hammerscale (Young 2011). This hammerscale was in small fragments of thin flakes.

The washings from context (2005) did not produce any hammerscale, despite being rich in slag debris and charcoal. These washings were extremely rich in very fine grained black material, probably secondary manganese oxides.

Chemical composition of residues

Bulk major element composition

The adjusted major elemental compositions of the analysed residues are provided in Tables 2 and 3.

The major element composition of these two samples may conveniently be considered within the system SiO_2-Al_2O_3-FeO (Figure 1; after Schairer and Yagi 1952, fig 6) because these three oxides together comprise a very high proportion of the total. The low concentrations of all the other ‘major’ elements is noteworthy. The analyses plot close to the fayalite-hercynite divide

When these analyses are recast on an iron-free basis the compositions of the analysed samples are remarkably similar (Table 4).

Trace elements

The trace elemental compositions of the residues are provided in Table 3. The contents of most trace elements in the slags are relatively low.

The rare earth elements (REE) show almost flat upper crust-normalised profiles (normalisation after Taylor & McLennan 1981; Figure 2).

Interpretation

The morphology of the slags suggests either that they formed in the basal pit/chamber of a non-tapping furnace, or that some of the slags were tapped in low volumes. The presence of gravel within some of the slags is in accordance with the very loose substrate into which the features were dug (as presumably were the features in which the slags originated).

Context (2003) contained both iron smelting macro-residues and smithing microresidues (hammerscale). Such deposits may develop on workshop floors, as well as accumulate in adjacent negative features. Many of the contexts at Cefn Graianog (Young 2015) contained mixed assemblages of this type. Context (2005), although only having a tiny amount of matrix available for examination, did not contain hammerscale. The slags from this context were indeterminate, but with a higher probability of presenting material in-situ in metallurgical feature because of the ashy nature of both matrix and slag; the lack of hammerscale would argue for any such primary feature being from smelting (as would, circumstantially, the elongate nature of the feature, which is of an appropriate size for the highly truncated remans of an early slag tapping furance).

The limited amount of data available for the assemblage means that a full interpretation of the chemical composition in terms of furnace mass balance is not possible. Nonetheless, the data may be compared with analyses of flow slags/tapped slags from other sites.

Chemical analytical data are available for several sites in Wales that have produced analyses interpreted as indicating the smelting of bog iron ores. These sites include Brownslade, South Hook, Steynton (ore only) and Johnston in Pembrokeshire, Llandefaeolog in Powys and Llwyn Du in Gwynedd. As well as being from geographically distinct areas, these sites also lie on differing bedrock geology (although it must be borne in mind that the ore did not necessarily derive from a locality with the same geology): Precambrian: Johnston, Cambrian-Ordovician: Llwyn Du, Silurian: Llandre, Silurian-Devonian (‘Old Red Sandstone’): South Hook, Steynton, Landefalelog, Carboniferous: Brownslade.

The major element analysis of the Llandre slags is compared with those of the comparative sites in Figure 3.

The data indicate that the medieval smelting of bog iron ores developed on Cambrian-Ordovician bedrock in Gwynedd was markedly different from that of the earlier smelting of ores from areas of Precambrian and Old Red Sandstone geology in Central and West Wales. The major change in technology over this period complicates the interpretation (as does the different analytical technique that was applied to the Llwyn Du material, potentially providing less accurate values). However, the geological setting is interpreted as being one of the major controls in the differences. The geological setting would influence both the furnace construction materials and the nature of the ore. Of the major elements, only manganese and phosphorus are likely to be dominantly influenced by the ore, where the other major elements are likely to be most influenced by the composition of the furnace.

The Llandre slags plot as marginal to the Llwyn Du slags on all the diagrams, including those featuring manganese and phosphorus. They are of higher phosphorus content than the majority of the Llwyn Du ores, but contain significantly less phosphorus, than any of the more southern examples. The manganese content of the Llandre slags is somewhat low compared with the typical content observed in the examples, but within their range of compositions. The Llandre slags are also intermediate between the Llwyn Du and South Hook slags in terms of the Mn:Ba ratio, but on this metric the Llandefaelog samples are differentiated from the Pembrokeshire samples, with much lower MnO/Ba driven by elevated levels of barium.

Comparison of the REE profiles is complicated by the poorly understood relative influence of the host sediment and the iron mineralisation on the REE. It currently seems likely that the REE profile is more strongly influenced by the host sediment. The profile for the Llandre slags is very flat and low (with just a very slight downwards inclination of the LREE), probably reflecting the influence of a fine-grained (mudrock; shale/slate) host sediment on the ore (and probably also on the furnace ceramic). A similar flat, low profile, was observed for samples from the Llandefaelog slags (they also show an apparent positive europium anomaly, but this may be a poorly-corrected spectral overlap with [BaO]+). In contrast the data from Pembrokeshire area show profiles with variable elevation of the MREE, reduced LREE and a negative cerium anomaly, reflecting a more complex host sediment, probably with a strong influence from the volcanic rocks of the Skomer Volcanic Group., and possibly also the influence of a coarser-grained host sediment

Summary

The analysis presented above suggests that the samples are bloomery smelting slags from the smelting of a bog iron ore, with a chemical composition quite similar to that of smelting slags (from Llwyn Du) from the smelting of the bog iron ores developed over mudrock bedrock on the eastern side of the Harlech Dome. There are, however, far too few examples of comparative material to produce any real predictive modelling of the characteristics of the source.

The presumed source for the Llwyn Du smelting operation are the upland blanket bogs of the Crawcwellt area (Crew 2009). It is likely that the ores smelted at Llandre were also from an upland bog. One surviving area of peat lies approximately 1km west of Llandre and there were probably other areas of impeded drainage before farmland improvement. It is also possible that there were iron ores associated with the margins of Cors Fochno - although there are no descriptions of iron enrichment in the lowland raised bogs of Wales known to the author (raised bogs, however, do appear to have provided a major resource of iron ore in early times in Ireland). The resource need not have even been in a true bog; deposits that may be termed bog iron ores also form where groundwater leaks (and oxidises) from an area with impeded drainage, in which reducing conditions have allowed the accumulation of iron in the groundwater from weathering of the bedrock.

The technology of the iron smelting is still uncertain. Clarification of this would be highly desirable as the early medieval period shows a complex variation of approaches to iron smelting with both time and geographical location.

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Figure Captions

Figure 1: major element composition of bulk analyses of residues plotted within the ternary system SiO_2-Al_2O_3-FeO (fields after Schairer and Yagi 1952, fig 6). Red circles: analyses of flow slags from Llandre. Black crosses: analyses of tapped slags from Llwyn Du (data from Charlton *et al*. 2010)

Figure 2: upper crust-normalised rare earth element (REE) profiles (normalisation after Taylor & McLennan 1981) for analyses of flow slags from Llandre.

Figure 3: Binary plots of oxide concentrations (in wt%) from bulk chemical analyses (by XRF and ICP-MS) Analyses of slags from Llwyn Du from Charlton *et al*. 2010; from Brownslade after Young 2010a; from South Hook after Young 2010b; from Johnstone and Llandefaelog after Young 2014; and those of the ore from Steynton after Young 2014.

Table 1: summary catalogue. SHC = smithing hearth cake, All weights in gram.

context	*Wt.*	*No.*	*notes*
2003	*1950*	*124*	*Flow slag with smooth surfaces with bright lustre; mostly fragments of isolated prills, but also includes amalgamated flows with multiple narrow prills, some forming in a 'V'-shaped trough – and this resembling tap slags, except having dark surfaces and only one prill layer in thickness. Some pieces show some gravel embedded in base.*
	330	*12*	*Flow slags with much embedded gravel and dull, rough, surfaces; many of these prills are rod-like.*
	254	*19*	*Vitrified hearth/furnace lining*
	380	*1*	*Fragment containing curved side of a slag bowl; difficult to orientate, probably hot-deformed; shows irregular gravelly basal contact and a small area of probable upper surface that is smooth; might be either a basal smelting slag or a deformed SHC*
	54	*1*	*Small fragment of burr*
	70	*1*	*Dimpled tool mould, fractured from a larger slag cake*
	100	*1*	*Dense fragment of either burr or SHC*
	664	*20*	*Broken slag fragments with some indications of flow, but not apparently flow slags*
	252	*6*	*Amorphous fragments/lumps of slag with rusty surfaces, probably contained metallic iron*
	18	*3*	*Very thin rusty sheets of iron oxide; probably contractionary, but just possibly after iron metal*
	468	*40*	*Indeterminate small slag fragments*
	84	*7*	*Natural stone fragments*
2005	*95*	*6*	*Blebby porous and slightly lobate iron slag; some almost of sufficiently low-density to be termed fuel ash slag*
	10	*3*	*Vitrified hearth/furnace lining*

Table 2: Major elements by XRF. < = below detection. All elements presented as wt% oxide. Adjusted to Mn^{2+} and Fe^{2+} and adjusted to exclude volatiles (LOI).

	SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5
LLE1	24.52	8.35	55.53	6.87	0.37	0.77	0.40	1.23	0.38	0.33
LLE2	24.72	8.51	55.12	6.98	0.45	0.87	0.55	1.50	0.36	0.34

Table 3: trace elements by ICP-MS. < = below detection. All elements presented as ppm. Adjusted to Mn^{2+} and Fe^{2+} and adjusted to exclude volatiles (LOI).

	Co	Cu	Ga	Ge	Rb	Sr	Y	Zr	Nb	Mo	Ru	Sn	Cs	Ba	La	Ce	Pr
LLE1	21.65	3.01	10.02	17.32	27.95	85.27	11.64	84.96	10.56	3.68	0.01	0.19	1.50	518.14	9.89	27.04	2.80
LLE2	21.62	2.66	9.85	17.21	21.55	88.10	8.79	86.33	10.48	3.71	0.01	0.22	1.67	558.63	11.19	25.12	3.06

Table 3 (continued): Minor and trace elements by ICP-MS. < = below detection. All elements presented as ppm. Adjusted to Mn^{2+} and Fe^{2+} and adjusted to exclude volatiles (LOI).

	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	W	Pb	Th	U
LLE1	12.49	2.79	0.63	2.56	0.36	2.16	0.45	1.31	0.19	1.44	0.18	2.14	0.42	0.59	1.65	3.23	1.08
LLE2	13.67	2.66	0.54	2.37	0.33	1.99	0.40	1.15	0.16	1.15	0.15	2.16	0.38	0.50	1.41	2.97	1.10

Table 4: Major elements by XRF as Table 2, normalised to exclude iron.

	SiO_2	Al_2O_3	MnO	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5
LLE1	56.43	0.87	19.21	15.80	0.84	1.78	0.93	2.83	0.76
LLE2	55.53	0.82	19.11	15.68	1.01	1.96	1.25	3.37	0.76

Figure 1

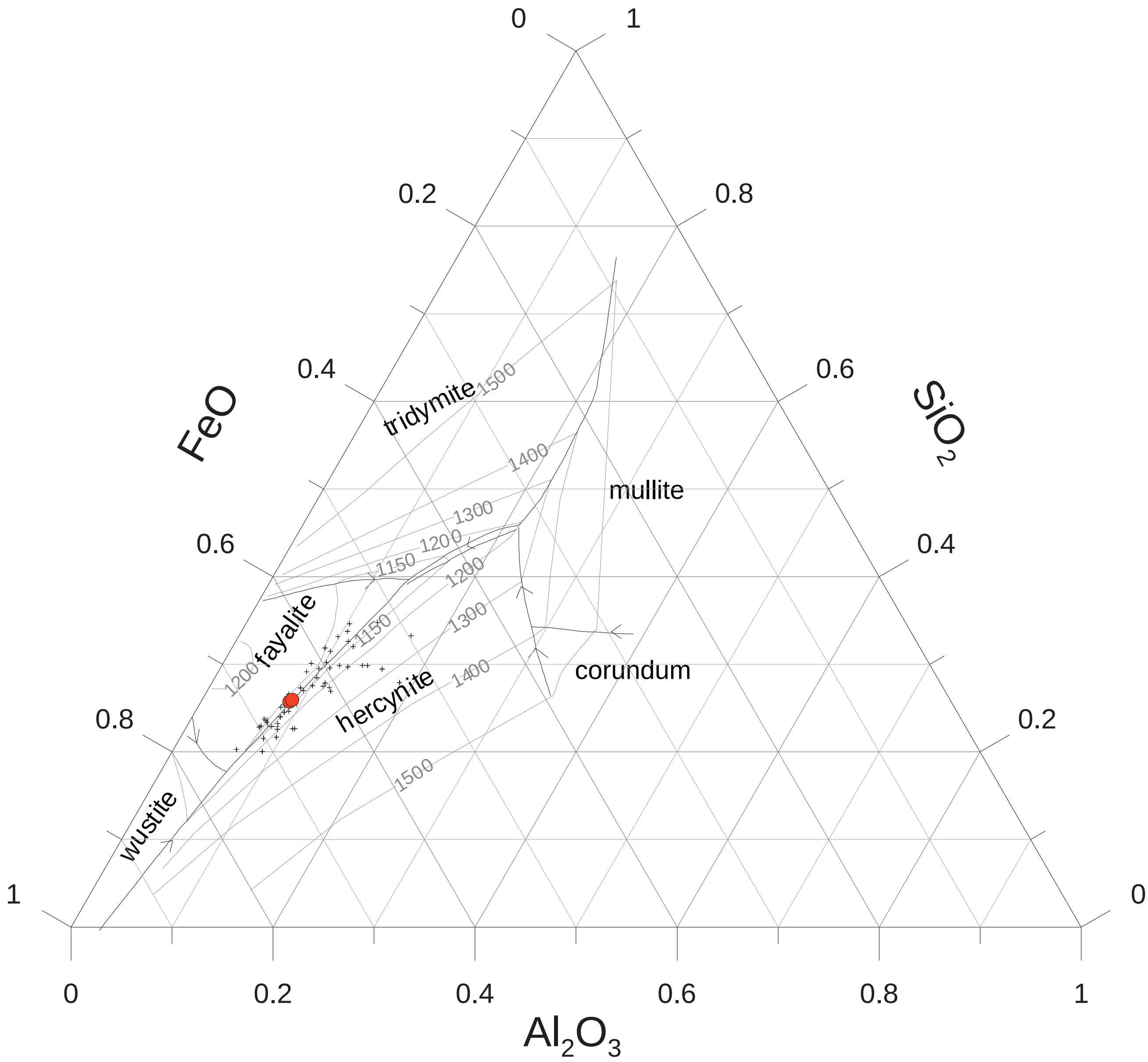

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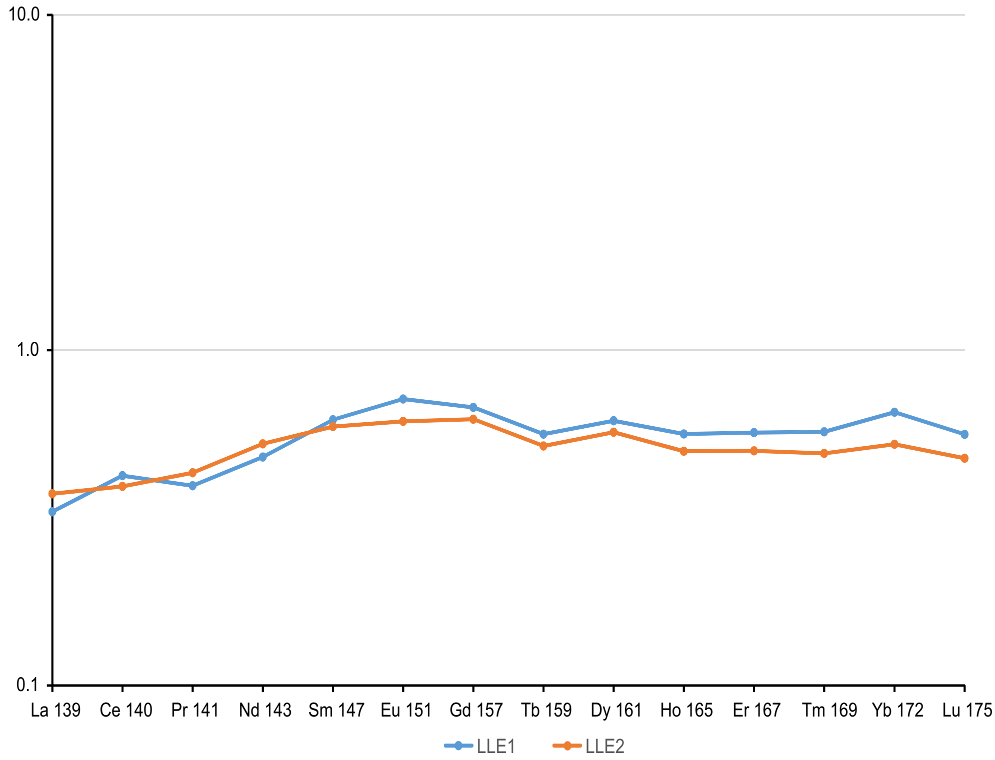
Figure 2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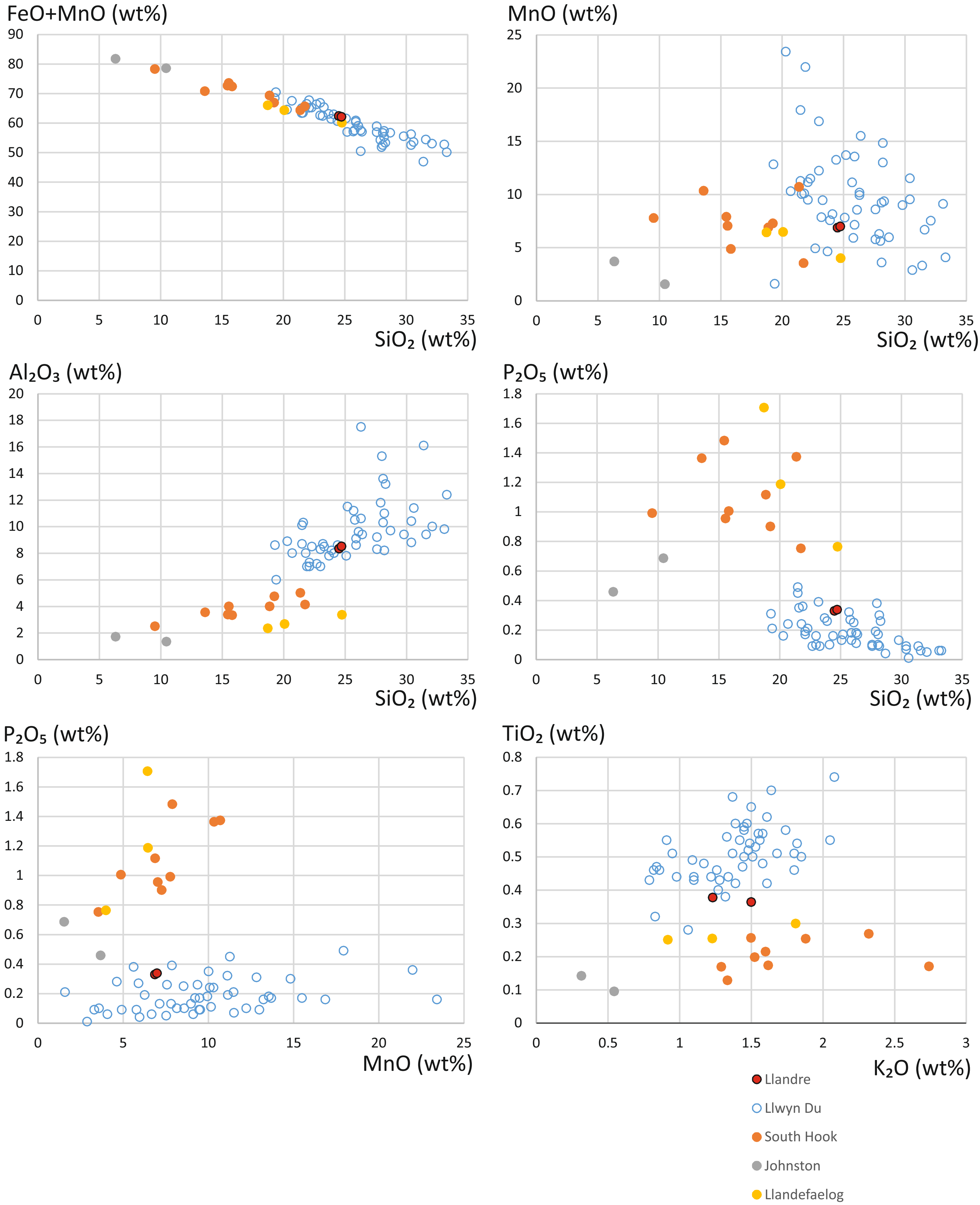
LLE1
LLE2

Figure 3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SiO₂ (wt%)
MnO (wt%)
SiO₂ (wt%)
Al₂O₃ (wt%)
SiO₂ (wt%)
P₂O₅ (wt%)
SiO₂ (wt%)
P₂O₅ (wt%)
MnO (wt%)
TiO₂ (wt%)
K₂O (wt%)
Llandre
Llwyn Du
South Hook
Johnston
Llandefaelog

Appendix:

Raw bulk chemical analyses

Table A1: Major elements by XRF. < = below detection. All elements presented as wt% oxide. Raw data, Fe expressed as Fe_2O_3 and Mn as Mn_3O_4

	Bead	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Mn_3O_4	MgO	CaO	Na_2O	K_2O	P_2O_5	LOI	total
LLE1	LF41664	24.01	0.37	8.17	60.44	7.23	0.36	0.76	0.39	1.21	0.32	-4.57	98.99
LLE2	LF41665	24.52	0.36	8.44	60.74	7.44	0.45	0.87	0.55	1.49	0.33	-5.80	99.62

Table A2: Minor elements by XRF. < = below detection. All elements presented as wt% oxide. Raw data, Fe expressed as Fe_2O_3 and Mn as Mn_3O_4

	Bead	SO_3	V_2O_5	Cr_2O_3	SrO	ZrO_2	BaO	NiO	CuO	ZnO	PbO	HfO_2
LLE1	LF41664	0.15	0.01	<0.005	0.01	<0.003	0.13	<0.004	<0.003	0.000	0.003	<0.005
LLE2	LF41665	0.05	0.01	<0.005	0.01	<0.003	0.15	<0.004	<0.003	0.003	0.003	<0.005

Table A3 (part 1): bulk chemical analyses by ICP-MS. All elements in ppm. bdl = below detection limit

		P	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Cu	Ga	Ge
LLE1	ICP045_21	1517.67	7523.09	7.35	2514.22	44.69	30.72	63318.95	610068.92	21.20	2.94	9.81	16.96
LLE2	ICP045_22	1473.08	8204.86	5.27	2539.50	45.75	30.83	65666.46	624058.45	21.44	2.64	9.77	17.06
BCR-1	ICP045_39	1222.93	65025.72	34.17	11304.58	407.60	bdl	1590.38	126456.13	36.40	13.85	23.77	3.73
BCR-1	recommended	3646.00	-	32.41	22420.00	410.00	13.50	1838.00	-	37.55	19.60	22.19	1.40

Table A3 (part 2): bulk chemical analyses by ICP-MS. All elements in ppm. bdl = below detection limit

		Rb	Sr	Y	Zr	Nb	Mo	Ru	Sn	Cs	Ba	La	Ce	Pr	Nd	Sm
LLE1	ICP045_21	27.37	83.50	11.40	83.20	10.34	3.61	0.01	0.18	1.47	507.39	9.69	26.48	2.74	12.23	2.73
LLE2	ICP045_22	21.37	87.36	8.72	85.61	10.39	3.68	0.01	0.22	1.65	553.95	11.10	24.91	3.03	13.56	2.64
BCR-1	ICP045_39	47.44	309.93	36.82	191.34	12.33	1.82	0.00	0.70	0.98	672.40	24.00	49.70	6.40	29.40	6.91
BCR-1	recommended	46.61	334.90	-	190.30	-	1.52	0.00	-	0.96	683.30	25.46	53.94	6.77	28.68	6.60

Table A3 (part 3): bulk chemical analyses by ICP-MS. All elements in ppm. bdl = below detection limit

		Eu	Gd	Tb	Gd	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	W	Pb	Th	U
LLE1	ICP045_21	0.62	2.51	0.35	2.11	0.44	1.28	0.18	1.41	0.18	2.09	0.41	0.58	1.62	3.16	1.06	0.62
LLE2	ICP045_22	0.54	2.35	0.33	1.98	0.40	1.14	0.16	1.14	0.15	2.14	0.38	0.50	1.40	2.94	1.09	0.54
BCR-1	ICP045_39	1.87	6.68	0.92	6.50	5.97	1.20	3.60	0.47	3.46	0.49	4.37	0.57	0.48	12.77	5.33	1.61
BCR-1	recommended	1.96	6.73	1.06	6.73	6.39	1.27	3.66	0.54	3.38	0.50	4.92	0.79	0.43	13.44	5.79	1.68

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geoarchaeological, archaeometallurgical & geophysical investigations

Unit 6,
Western Industrial Estate,
Caerphilly,
CF83 1BQ

Office: 029 20881431
Mobile: 07802 413704

E-Mail: Tim.Young@GeoArch.co.uk
Web: www.GeoArch.co.uk

Archaeology Wales

APPENDIX III:
C14 dating

UBANo	Sample ID	Material Type	^{14}C Age	±	F14C	±	uAC
UBA-24080	GFL/13/Ex (Sample 7- 2003)	Charcoal	1221	37	0.8589	0.0040	41.9

Iestyn ab Owen Jones
Trisgell Ltd
Unit 15, Douglas Buildings
Royal Stuart Lane
Cardiff, Cardiff CF10 5EL
Wales/UK
VAT No. 165 3776 80

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

Radiocarbon Date Certificate

Laboratory Identification:	UBA-24080
Date of Measurement:	2013-10-24
Site:	GlanFred, Llandre
Sample ID:	GFL/13/Ex (Sample 7- 2003)
Material Dated:	charcoal
Pretreatment:	AAA
Submitted by:	Iestyn ab Owen Jones

Conventional ^{14}C Age:	1221±37 BP
Fraction corrected	using AMS δ^{13}C

Information about radiocarbon calibration

RADIOCARBON CALIBRATION PROGRAM*
CALIB REV7.0.0

*To be used in conjunction with:
Stuiver, M., and Reimer, P.J., 1993, Radiocarbon, 35, 215-230.
Annotated results (text) - -
Export file - c14res.csv

GFL13Ex /
UBA-24080
Radiocarbon Age BP 1221 +/- 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 723- 739	0.144
	767- 780	0.114
	788- 874	0.742
95.4 (2 sigma)	cal AD 688- 889	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.

<>

UBANo	Sample ID	Material Type	^{14}C Age	±	F14C	±
UBA-30455	Sample 8, Context 1012	3 oat grains	1563	32	0.8231	0.0033

Iestyn ab Owen Jones
Trisgell Ltd
32 Boverton St
Roath
Cardiff CF23 5ES
Wales/UK
VAT No. 165 3776 80

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

Radiocarbon Date Certificate

Laboratory Identification:	UBA-30455
Date of Measurement:	2015-11-06
Site:	Glanfred, Llandre (GFL/13/EX)
Sample ID:	Sample 8, Context 1012
Material Dated:	charred seed or nutshell
Pretreatment:	Acid Only
Submitted by:	Iestyn ab Owen Jones

Conventional ^{14}C Age:	1563±32 BP
Fraction corrected	using AMS δ^{13}C

Information about radiocarbon calibration

```
                    RADIOCARBON CALIBRATION PROGRAM*
                              CALIB REV7.0.0
               Copyright 1986-2013 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) - -
                  Export file - c14res.csv

Sample 8 C
UBA-30455
Radiocarbon Age BP   1563 +/-   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 429- 494                   0.743
                            509- 519                   0.113
                            527- 540                   0.143
  95.4 (2 sigma)     cal AD 418- 564                   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.
```

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APPENDIX IV:
Finds List

APPENDIX IV

Find no:	Area	Context	Description	Period	Date
1	T1	(1005)	Very small bone fragment – no ID	Med?	11/09/13
2	T1	(1006)	Small pot body sherd (see Section 7)	Med.	11/09/13
3	T1	(1003)	Corroded Iron blade (see Section 7)	Post med?	11/09/13
4	T1	(1013)	38 fragments of cattle teeth- mainly burnt (5 unburnt) (see Section 7)	Post-Roman?	12/09/13
5	T1	(1014)	33 fragments of burnt cattle teeth (see Section 7)	Post-Roman?	12/09/13

Archaeology Wales

APPENDIX V:
Samples List

APPENDIX V

Sample	Area	Context	Description	initial	Date
01	T1	(1006)	Charcoal fragment (C14 sample)	IJ	11/09/13
02	T1	(1008)	Charcoal fragment (C14 sample)	IJ	11/09/13
03	T1	(1010)	Charcoal fragment (C14 sample)	IJ	11/09/13
04	T1	(1011)	Charcoal fragment (C14 sample)	IJ	11/09/13
05	T2	(2003)	Fill of [2002] – high ferrous slag content (see Appendix II)	IJ	12/09/13
06	T2	(2003)	Charcoal fragment (C14 sample)	IJ	12/09/13
07	T2	(2003)	Charcoal fragment (C14 sample) (See Appendix III)	IJ	12/09/13
08	T2	(1012)	Bulk sample of (1012) from ditch [1002] (35 litres) (See Appendix I & III)	EGB	12/09/13
09	T1	(1014)	Fragment of burnt bone for C14 – not viable	EGB	12/09/13
10	T1	(1013)	Fragment of burnt bone for C14 – not viable	EGB	12/09/13
11	T1	(1013)	Fragment of burnt bone for C14 – not viable	EGB	12/09/13
12	T1	(1013)	Fragment of burnt bone for C14 – not viable	EGB	12/09/13
13	T2	(2005)	Bulk sample of (2005) deposit at E end of T2 (10 litres)- High slag content (see Appendix II)	IJ	13/09/13
14	T1	(1005)	Bulk sample of post-hole [1004] fill (See Appendix I)	CS	13/09/13
15	T2	(2005)	Charcoal fragment (C14 sample)	CS	13/09/13

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APPENDIX V:
Geophysical Survey WSI

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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

Written Scheme of Investigation

for a Geophysical Survey

on land adjacent to Glanfred, Llandre, Ceredigion

Prepared for:
Trisgell Ltd
Unit 15
Douglas Buildings
Royal Stuart Lane
Cardiff, CF10 5EL

Project No: 2156

07th August 2013

Archaeology Wales Limited
Rhos Helyg, CwmBelan, Llanidloes, Powys, SY18 6QF
Tel: +44 (0) 1686 440371
Email: admin@arch-wales.co.uk

NON TECHNICAL SUMMARY

This Written Scheme of Investigation (WSI) details the proposal for a geophysical survey of the site of a probable inland promontory fort or defended enclosure at Glanfred, Llandre, Ceredigion. It has been prepared by Archaeology Wales Ltd. for Trisgell Ltd.

It is hoped that the survey will inform a future limited excavation of the site and the associated separate WSI. The excavation will form the central focus of one programme of a forthcoming six part Welsh language archaeology series (title TBC) to be shown on S4C in 2014.

1. Introduction

Parch marks as revealed in aerial photographs taken in 1975, 1999 and 2006 appear to show a pear shaped inland promontory fort or defended enclosure (NPRN 309953; PRN 241) near Glanfred (Glan Ffrwd) Farm, Llandre, Ceredigion (centred on NGR: SN 63384 87870; Fig. 1).

Trisgell Ltd have been commissioned by S4C to produce a six part Welsh language television series with a small scale archaeological excavation as the main focus for the episodes. Each excavation will take between three and five days and each episode will seek to place each site within their landscape and historical context. It is proposed that a geophysical survey is carried out prior to a possible small-scale excavation at Glanfred (separate WSI). The purpose of the survey is in order to clarify the probable location of the entrance and ditch terminals where the parch marking is less clear due to unresponsive alluvium.

This specification has been prepared by Mark Houliston (MIfA), Managing Director, Archaeology Wales, from information provided by Dr Iestyn Jones (AIFA in application) of Trisgell. Archaeology Wales, a Registered Organisation with the Institute for Archaeologists (IfA), will monitor the project and ensure that all works associated with it are undertaken in accordance with the standards and guidelines of the IfA (revised 2011).

2. Site Description and Historic Background

The observed cropmarks were located on a natural promontory (48 m OD) with a near precipitous slope to the west, and sloping land to the north and east. The bedrock geology comprises Silurian Borth mudstone underlying glaciofluvial sand and gravel deposits.
The river Leri is located 170m north of the enclosure's northern limit and a caravan park is located in the river's bend at the base of the slope. There is considerable evidence for late prehistoric (probably Iron Age) settlement in the area. A bivallate enclosure, Caer Allt-Goch (PRN 2009) is located at 120m OD, approximately 1.25km to the north-east, Caer Llety Llwyd (PRN 2013) is approximately 1.6km east-northeast of Glanfred and Caer Pwll Glas (PRN 2008) is situated approximately 1.1km to the south-southeast.

Glanfred enclosure is currently used as pasture and owned by Glanfred Farm (approximately 160m to the south-west). The farmhouse, listed as a post-medieval 'mansion' (PRN 22386), has been described as the supposed birthplace of Edward Lhuyd (b. 1660), author of Archaeologia Britannica (1707) (Meyrick 1907, 323).

The pear shaped or triangular enclosure as it appeared in parch marks is 99.6m x 65.7m with a possible entrance on level land to the southeast (Murphy, Ramsey and Page 2006). This level area is not as clearly defined in the cropmarks and it is hoped that a geophysical survey will elucidate the rock cut entrance here. A site visit confirmed that no surviving earthworks are visible and it is certain that any banks would have been plough levelled although Driver's observations regarding a series of possible rock cut pits that are located adjacent to the north-west ditches suggest that any inner earthen ramparts would have been between 3.3 and 5m wide (Driver, 2005 & 2013).

3 Method statement for a Geophysical Survey

It is the intention of the project to carry out limited, geophysical, work in the area of other, less well-defined, cropmarks within the field (Fig. 2). The primary intention of the survey will be to attempt to clarify the ditch pattern in the south-eastern entrance area. If time allows the survey will also include the internal area of the enclosure including the possible pits, encountered as parch marks, and any drip gullies of round-houses.

The survey work will be conducted using a Geoscan FM36 Fluxgate Gradiometer. This method was chosen as it will detect enhanced magnetic susceptibility as the result of human activity. It is particularly useful in detecting ditches and masonry and is sensitive to the presence of hearths and areas that have been in contact with heat.

The on-site survey will be undertaken in a single phase lasting approximately 2 days. The survey area will be divided into 20m square grids along a common alignment. Within each grid, parallel traverses 1m apart will be walked at rapid pace along the same orientation. Incomplete survey lines resulting from irregular area boundaries or obstacles will be completed using the "dummy log" key.

All data will be downloaded in the field into a laptop computer. The location of the grid corners will be recorded using a total station so that results can be accurately placed onto an OS map.

A composite of each detailed survey area will be created and processed using the software package *Geoplot V.3*. The final results will be presented at an appropriate scale tied to the Ordnance Survey National Grid.

5 Resources and timetable

<u>Standards</u>
The excavation will be undertaken by AW staff using current best practice.

All work will be undertaken to the standards and guidelines of the IFA.

Staff
The project will be managed by Mark Houliston (MIfA) and directed by Dr Iestyn Jones. The survey will be conducted by Daryl and Sam Williams.

Equipment
The project will use existing AW equipment.

Timetable of archaeological works
Work will commence on site on 12th of August and end on 13th of August 2013

Health and safety
All members of staff will adhere to the requirements of the *Health & Safety at Work Act*, 1974, and the Health and Safety Policy Statement of AW.

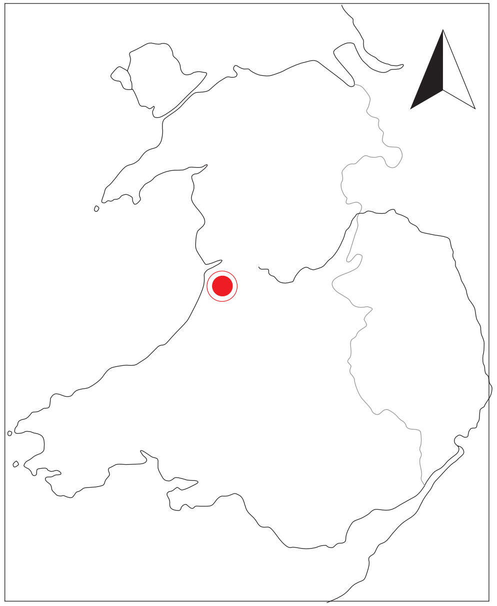
Bibliography

Driver, T. 2005. The Hillforts of North Ceredigion: Architecture, Landscape Approaches and Cultural Contexts. Upublished PhD thesis, University of Wales Lampeter.

Driver, T. 2013. *Architecture, Regional Identity and Power in the Iron Age Landscapes of Mid Wales: The Hillforts of North Ceredigion*. BAR British Series 583, Archaeopress: Oxford.

Meyrick, S.R.M. 1907, *The History of Cardiganshire* (3rd edition: 2000), Collards Antiquities of Wales Series. Rhayader: Stephen Collard.

Murphy, K. Ramsey, R. Page, M. 2006. A survey of defended enclosures in Ceredigion, 2006: Gazetteer of Ordnance Survey Grid squares SN68 and SN69. Cambria Archaeology Report No. 2006/20.



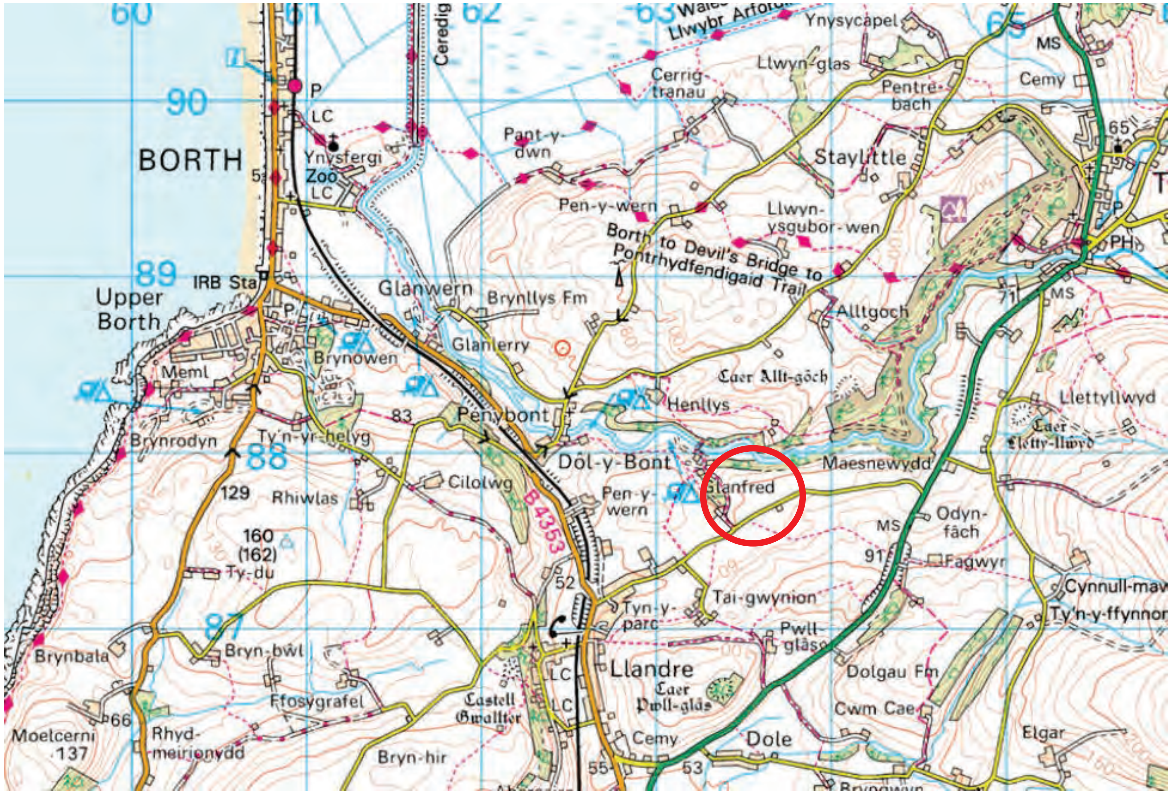


Fig. 1

Location of survey site

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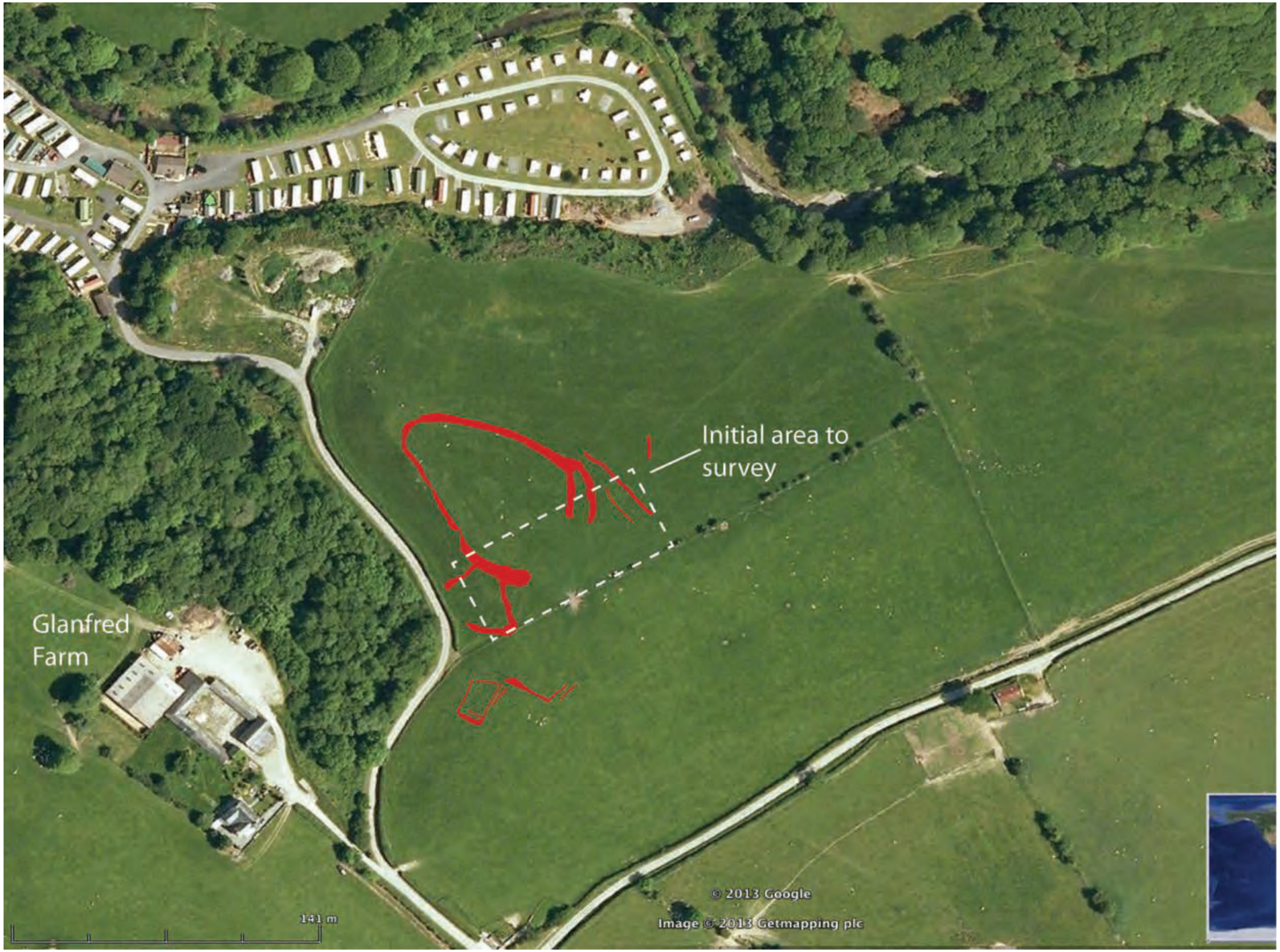

Fig. 2.

Glanfred defended enclosure and proposed initial survey area

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APPENDIX V:
Excavation WSI

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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

Written Scheme of Investigation

for an Archaeological Excavation at

Glanfred, Llandre, Ceredigion

Prepared for:
Trisgell Ltd
Unit 15
Douglas Buildings
Royal Stuart Lane
Cardiff, CF10 5EL

Project No: 2156

23rd August 2013

Archaeology Wales Limited
Rhos Helyg, CwmBelan, Llanidloes, Powys, SY18 6QF
Tel: +44 (0) 1686 440371
Email: admin@arch-wales.co.uk

NON TECHNICAL SUMMARY

This Written Scheme of Investigation (WSI) details the proposal for an archaeological excavation of the site of a crop mark at Glanfred, LLandre, Ceredigion. It has been prepared by Archaeology Wales Ltd. for Trisgell Ltd.

The excavation will form the central focus of one programme of a forthcoming Welsh language archaeology series (title TBC) to be shown on S4C in 2014. The project involves limited excavation of a possible Iron Age defended promontory enclosure.

Dr Iestyn Jones of Trisgell will supervise the excavation and undertake the bulk of the post-excavation analysis and publication. Mr Mark Houliston, Managing Director of Archaeology Wales, will monitor the project and ensure that all works associated with it are undertaken in accordance with the standards and guidelines of the Institute for Archaeologists.

1. Introduction

Trisgell Ltd have been commissioned by S4C to produce a six part Welsh language television series with an archaeological excavation as the main focus for the each episode. Each excavation will take between three and five days and each episode will seek to place each site within their landscape and historical context. Following discussions with the Royal Commission on the Ancient and Historic Monuments of Wales (RCAHMW) it was felt that filming a small-scale excavation of the Glanfred cropmark could elucidate the archaeological interpretation of the site as well as providing a suitable topic for an informative television programme.

This specification has been prepared by Mark Houliston (MIfA), Managing Director, Archaeology Wales from information provided by Dr Iestyn Jones (AIFA in application) of Trisgell. Iestyn is also a Site Supervisor with Archaeology Wales. The excavation will be directed by Iestyn and assisted by Jerry Bond (AIfA) and local volunteers. Archaeology Wales, a Registered Organisation with the Institute for Archaeologists (IfA), will monitor the project and ensure that all works associated with it are undertaken in accordance with the standards and guidelines of the IfA (revised 2011).

During 1999 clear cropmarks associated with a possible promontory fort were revealed on a spur near Glanfred farm, Llandre, Ceredigion (centred on NGR: SN 63384 87870; Fig. 1). It was the third time that such parching had revealed a pattern of possible rock cut ditches with other observed examples recorded in 1975 and 1995 (Driver 2013a). Although Driver took advantage of the 1999 drought to record the dimensions of observed cropmarks he concluded that due to 'the unresponsive alluvium on the southeast side which has never parched sufficiently to reveal buried features' and that the site 'would benefit from ground-based remote sensing' (Driver 2003a). The cropmark patterns were reproduced in plan by Murphy et al (2006), (see Fig. 2).

Following the preparation and submission to Dyfed Archaeological Trust of an approved Written Scheme of Investigation (WSI) (Jones 2013), the permission of the landowner was sought and a three day geophysical survey was conducted between the 12^{th} and 14^{th} of August, 2013, within the confines of the single field where the majority of the observed cropmarks are located (Williams & Williams 2013).

2 Site Description and Historic Background

The cropmarks were located on a natural promontory (48 m OD) with a near precipitous slope to the west, and sloping land to the north and east. The pear shaped or triangular enclosure as it appeared in parch marks is 99.6m x 65.7m with a possible entrance on level land to the southeast (Murphy, Ramsey and Page 2006).

The bedrock geology comprises Silurian Borth mudstone underlying glaciofluvial sand and gravel deposits of which the upper deposits can be described as freely draining and slightly acidic (NSRI 2013).

Glanfred enclosure is currently used as pasture and owned by Glanfred Farm (approximately 160m to the south-west). The farmhouse, listed as a post-medieval 'mansion' (PRN 22386), has been described as the supposed birthplace of Edward Lhuyd (b. 1660), author of Archaeologia Britannica (1707) (Meyrick 1907, 323).

The river Leri is located 170m north of the enclosure's northern limit and a caravan park is located in the river's bend at the base of the slope. There is considerable evidence for late prehistoric (probably Iron Age) settlement in the area. A bivallate enclosure, the most northerly within Ceredigion, Caer Allt-Goch (PRN 2009) is located at 120m OD approximately 1.25km to the north-east of Glanfred. Caer Llety Llwyd (PRN 2013) is approximately 1.6km east-northeast of Glanfred and Caer Pwll Glas (PRN 2008) is situated approximately 1.1km to the south-southeast. These enclosures have been described by Driver as belonging to the 'Leri Basin small enclosure group' (Driver 2013b, 52). Two of these enclosures (Caer Llety LLwyd and Caer Allt Goch) share morphological characteristics with Glanfred in that they are triangular in plan with the main entrance located at the broad end (Driver 2013b, 52).

Williams and Williams's (2013) fluxgate gradiometer survey commissioned by Trisgell has added considerable detail to the cropmark evidence (Fig. 3). Although the survey aimed to elucidate the less clear cropmark evidence in the south-eastern corner of the site it was possible to survey the entire enclosure and some associated external related features within the single field. Given the geology the survey produced outstanding results with clear anomalies over much of the site. The cropmarks seen from the air have not only been confirmed but greater detail has been added as further archaeological features have been detected.

The main discoveries include three possible entrances located on the north, south-east and south-western side of the ditches, a possible trackway, a curvilinear anomaly possibly representing a round-house drip gully and concentrations of pits within the northern and south-eastern area of the enclosure (Fig. 4 a and b).

The aim of this excavation will be a limited examination of some of Williams's key observations regarding this site, namely the south-eastern entrance and one of the putative pits located (see below).

3 Site Specific Objectives

The key objective of the excavation is:

- To establish, examine and record the area of the putative 'main' south-eastern entrance.

This will be accomplished by the excavation of an approximately 10m x 6m trench (T1: Fig. 5) at the south-eastern end of the enclosure. Although the termini of both sides of the entrance ditches will be located, due to the limited time available, only a section of one ditch terminus will be fully excavated. For safety reasons if T1 is deeper than 1.2m the section will be stepped. Dating and environmental evidence will be collected, where possible, through sampling of contexts within the ditch fill.

Secondary objectives of the excavation include:

- To examine at least one of the anomalies identified in the geophysical survey as possible pits.

This will include machine stripping a trench approximately 6m x 4m rectangular trench (T2) and locating the position of the possible pits. Depending on the dimensions of the pits they will be half-sectioned or excavated in opposing quadrants (see 'manual excavation' below). Dating and environmental evidence will be collected, where possible, through sampling of contexts within the pit fills.

4 Methodology

Preliminary

The archaeological project manager in charge of the work will satisfy him/herself that all constraints to ground works have been identified, including the siting of live services, Tree Preservation Orders and public footpaths.

The project manager will ensure that adequate fencing and signage is in place, and that suitable welfare facilities have been provided for site staff. A Risk Assessment will be prepared by a CIEH qualified risk assessor before work starts and its contents agreed with the client and any other contractors or sub-contractors that may be present on the site at the same time.

All areas of trenching left open overnight will be fenced off.

Topsoil Strip/Mechanical Excavation

Trench 1 and 2 will be stripped of topsoil by mechanical excavator under close archaeological supervision (see Fig. 5).

Mechanical excavation will cease at the first significant archaeological horizon, at which point all excavation will be carried out by hand, unless otherwise agreed with DAT in advance. The entire area will be hand-cleaned using hoes and/or pointing trowels to prove the presence, or absence, of archaeological features and to determine their location and significance.

Topsoil will be kept separately from subsoil and will be stored a minimum of 3m from the trench edge.

Manual Excavation
All archaeological features revealed will be hand excavated and accurately mapped onto appropriately scaled plans. Thereafter all identified archaeological contexts will be excavated and recorded. As a minimum this will include:

- 50% excavation, through half sectioning, of pit/posthole features less than 1m in diameter
- 50% excavation, by opposing quadrants, of pit features greater than 1m in diameter
- 35% of linear features (in multiple sections if length greater than 3m)

Excavation will not be undertaken below a depth of 1.2m without adequate shoring.

If possible, natural deposits will be located in at least one location within the excavation area.

Recording
Written, drawn and photographic records of an appropriate level of detail will be maintained throughout the course of the project. Recording will be carried out using AW recording systems (pro-forma context sheets etc), using a continuous number sequence for all contexts. All archaeological features and deposits will be recorded on context sheets and a stratigraphic site matrix will be compiled.

Drawing and recording of all features and finds will be completed in plan and section. Plans and sections will be drawn to a scale of 1:50, 1:20 and 1:10 as required, and these will be related to Ordnance Survey datum and published boundaries.

Digital photographs will be taken using cameras with resolutions of 14 mega pixels or above.

Monitoring
DAT will be contacted at least one week before to the commencement of ground works, and subsequently once the work is underway.

Representatives of DAT will be given access to the site so that they may monitor the progress of the excavation.

DAT will be given the opportunity to inspect all excavated areas.

The AW Project Manager in charge will also monitor proceedings on site.

DAT will be kept regularly informed about developments, both during the site works and subsequently during post-excavation.

Any changes to the specification that the contractor/client may wish to make after approval will be communicated to DAT for prior approval.

Artefacts
Archaeological artefacts recovered during the course of the excavation will be cleaned, and labelled using an accession number obtained from a local museum. A single

number sequence will be allocated to all finds. The artefacts will be handled and stored appropriately, in accordance with IfA Standard and Guidance (2011) until they are deposited with the museum.

All artefacts recovered during the project will be retained and be related to the contexts from which they were derived.

If finds are made of gold or silver these will be excavated and removed to a safe and secure location. These finds will also be reported immediately to the local Coroner (within 14 days, in accordance with the 1997 Treasure Act).

All finds that are considered to be in need of immediate conservation will be referred to a UKIC qualified conservator (Phil Parkes of Cardiff Conservation Services).

Environmental, technological and radiocarbon samples

Sampling of significant features for palaeoenvironmental data will take place where appropriate. Bulk sampling of ditch and pit fills (not less than a 10 litre sample from each context) and any buried soil horizon is expected. All samples will be appropriately stored at the AW main office.

All environmental work will be undertaken in accordance with English Heritage guidelines (EH 2002).

Any organic material identified within sealed contexts and associated with the structure’s construction, use or destruction, will be collected, its precise location recorded, and submitted for radiocarbon dating.

Human remains

Human remains will be left in situ, covered and protected when discovered. No further investigation will be permitted until DAT and the local Coroner have been informed. After discussion, it may be appropriate to take samples for chemical or C14 dating. Removal will only take place under the appropriate Ministry of Justice and Environmental Health regulations.

Specialists

In the event of certain finds/features etc. being discovered, the site archaeologist may have to seek specialist opinion for assistance. Such specialists will be accessed either internally within AW itself or from an external source. A list of external specialists is given in the table below.

Type	Name	Tel No.
Flint	Dr Amelia Pannett	02920 899509
Animal bone	Jen Kitch	07739 093712
CBM, heat affected clay, Daub etc.	Rachael Hall	01305 259751
Clay pipe	Chris Smith	01547 528047
Glass	Andy Richmond	01234 888800
Cremated and non-cremated human bone	Malin Holst	01759 368483
Metalwork	Kevin Leahy	01652 658261

Neo/BA pottery	Dr Alex Gibson	Bradford University
IA/Roman pottery	Jane Timby	01453 882851
Post Roman pottery	Mr Stephen Clarke	
Charcoal (wood ID)	John Carrot	01388 772167
Waterlogged wood	Nigel Nayling	University of Wales (Lampeter)
Molluscs and pollen	Dr James Rackham	01992 552256
Charred and waterlogged plant remains	Wendy Carruthers	01443 233466

5 Post-Fieldwork Program

Conservation
After agreement with the landowner, arrangements will be made for the long term conservation and storage of all artefacts in an appropriate local or county museum.

Archive
The site archive will be prepared in accordance with MORPHE (English Heritage 2006). It will comprise all the data recovered during the fieldwork and shall be quantified, ordered and indexed and will be internally consistent. The archive will be deposited with the finds in a suitable local museum.

Reporting
The results of the excavation will be submitted to the client, DAT and the regional HER (Llandeilo) in an illustrated and bound report, which will include the following material:

- Non-technical summary
- Location plan showing the area/s covered by the excavation, all artefacts, structures and features found
- Plan and section drawings with ground level, ordnance datum and vertical and horizontal scales.
- Written description and interpretation of all deposits identified, including their character, function, potential dating and relationship to adjacent features. Specialist descriptions and illustrations of all artefacts and soil samples will be included as appropriate.
- An indication of the potential of archaeological deposits which have not been disturbed by the excavation.
- Statement of local, regional and national context of the remains
- A detailed archive list at the rear listing all contexts recorded, all samples finds and find types, drawings and photographs taken. This will include a statement of the intent to deposit, and location of deposition, of the archive.

Archive Format & Deposition
The full site archive will be deposited within six months of the completion of the client report.

The archive will include all site notes, finds, documents, drawings, photographs, project correspondence, digital data and a copy of the final report and any prior draft versions. All of these items will be clearly quantified in tabular from in an ‘archive deposition statement’ located at the rear of the client report, and their ultimate location and proposed date of deposition stated.

5 Resources and timetable

Standards
The excavation will be undertaken by AW staff and volunteers using current best practice.

All work will be undertaken to the standards and guidelines of the IFA.

Staff
The project will be managed by Mark Houliston (MIfA) and directed by Dr Iestyn Jones.

Equipment
The project will use existing AW equipment.

Timetable of archaeological works
Work will commence on site on 11th of September 2013 and end on the 13th of September 2013.

Insurance
Trisgell Ltd and Archaeology Wales have Public Liability insurance and all excavation and media staff and volunteers are covered under these policies.

Health and safety
All members of staff and volunteers will adhere to the requirements of the *Health & Safety at Work Act*, 1974, and the Health and Safety Policy Statement of AW. A qualified First Aider will always be on site during the excavation period.

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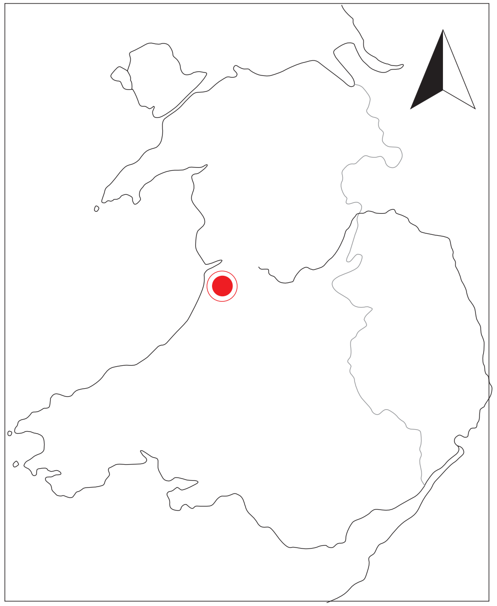
Iestyn Jones BA (Hons), PhD (AIFA in application)
Chris E Smith BA (Hons) MA MIfA



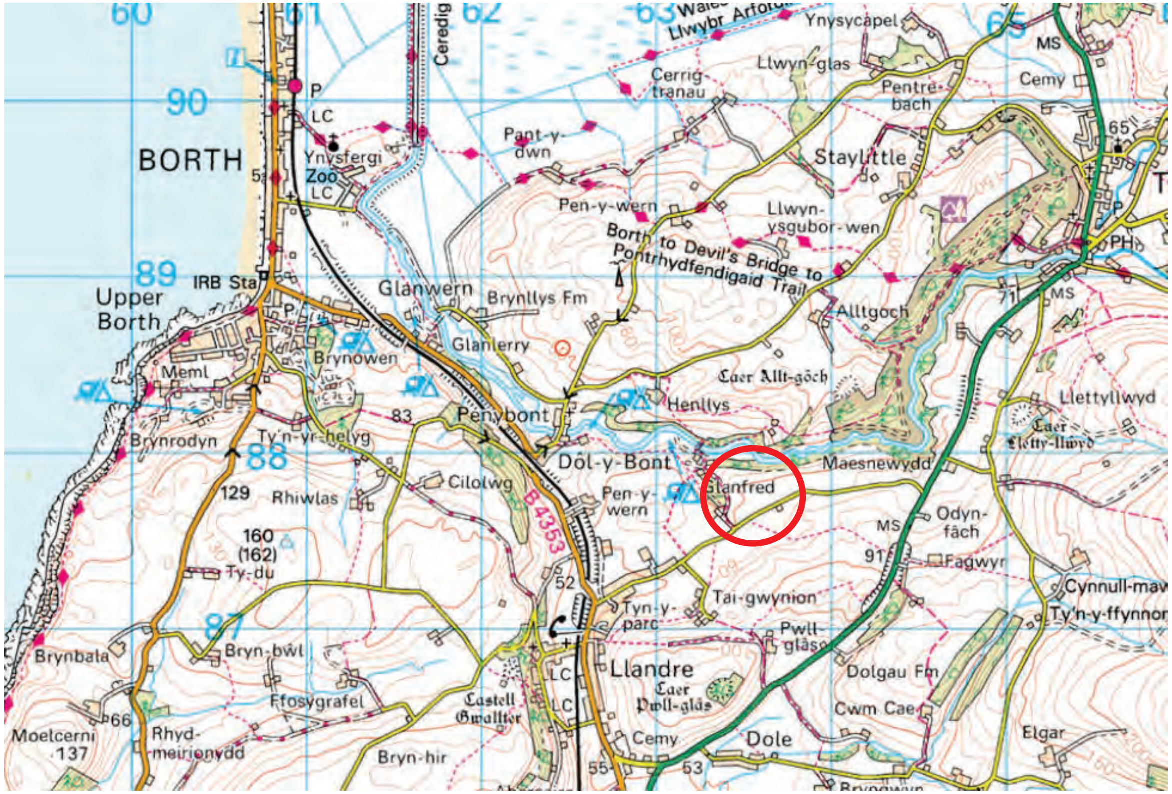


Fig. 1

Location of survey site

ARCHAEOLOGY WALES
Revealing the past, informing the future

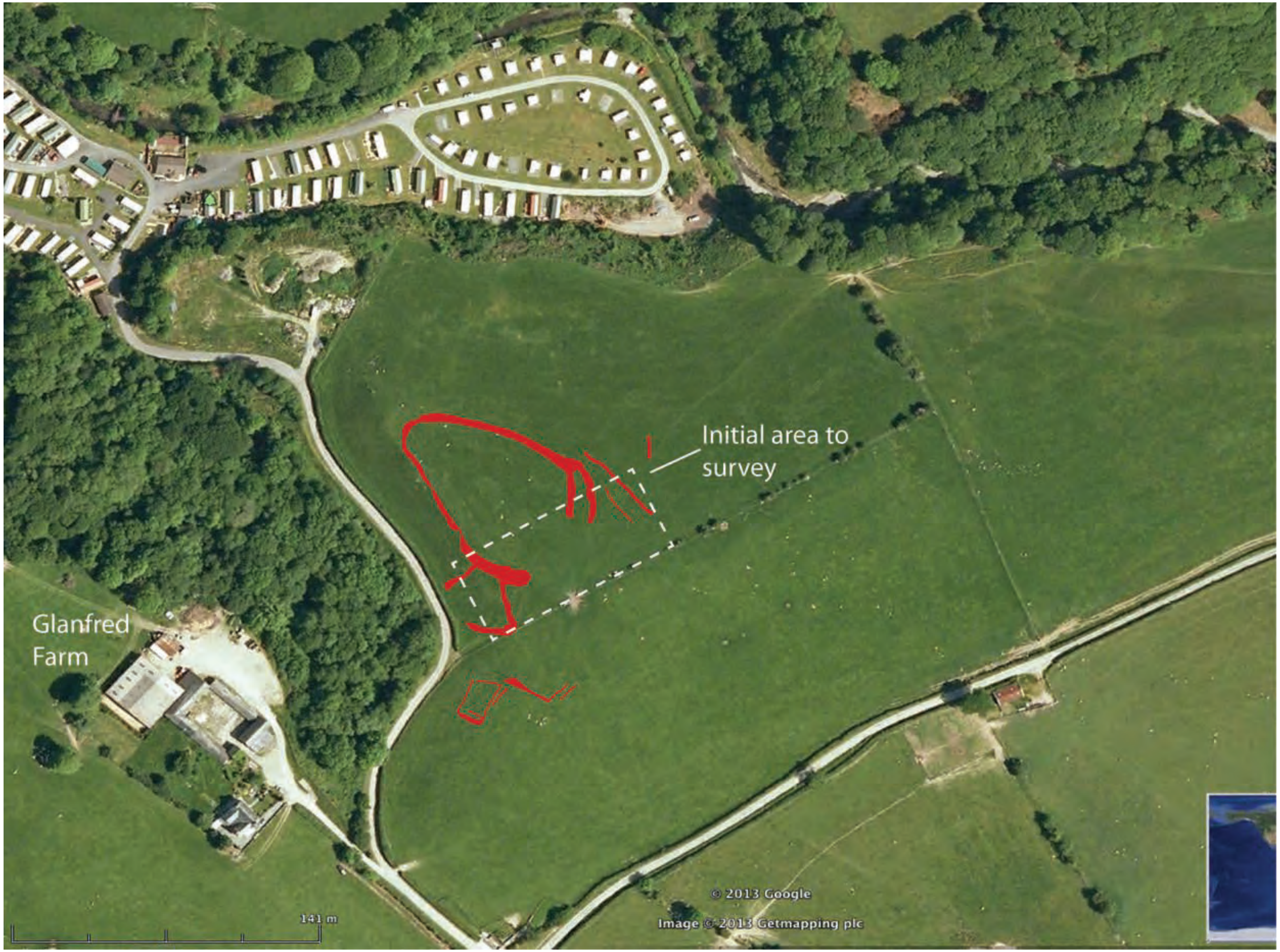


Fig. 2.

Glanfred defended enclosure and proposed initial survey area

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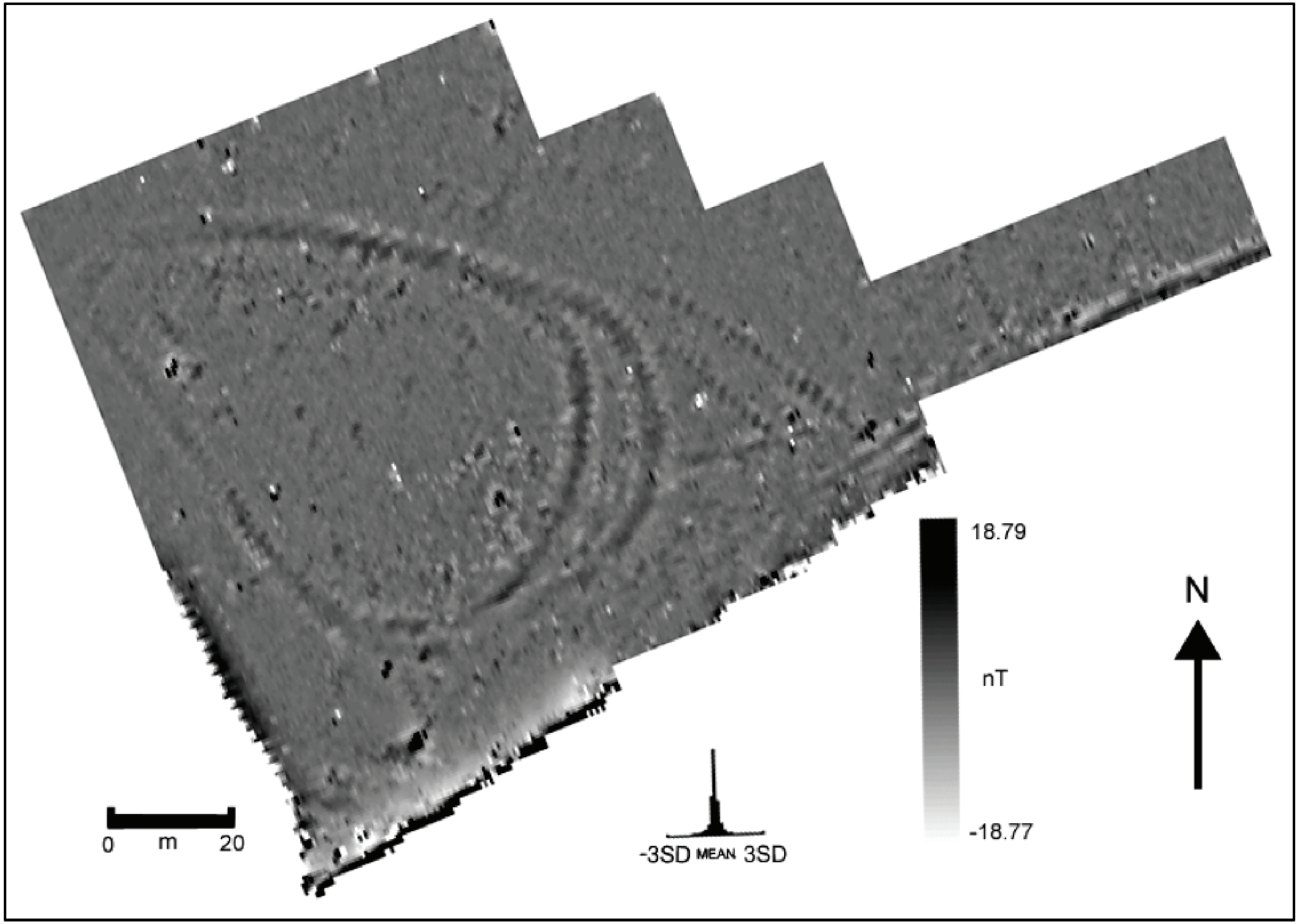

Fig. 3

Glanfred Enclosure: Processed fluxgate gradiometer shade plot (Williams 2013, fig.4)

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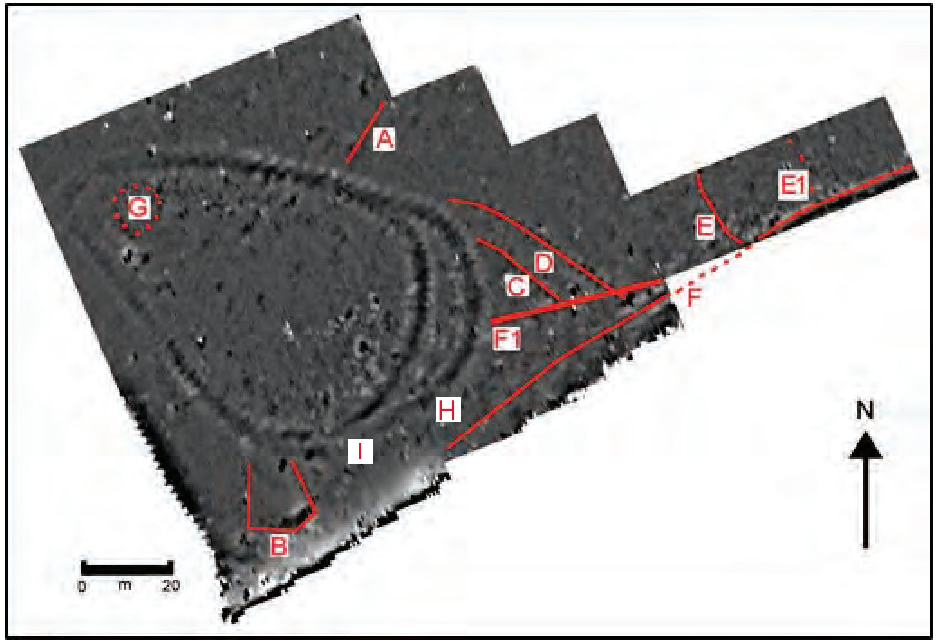
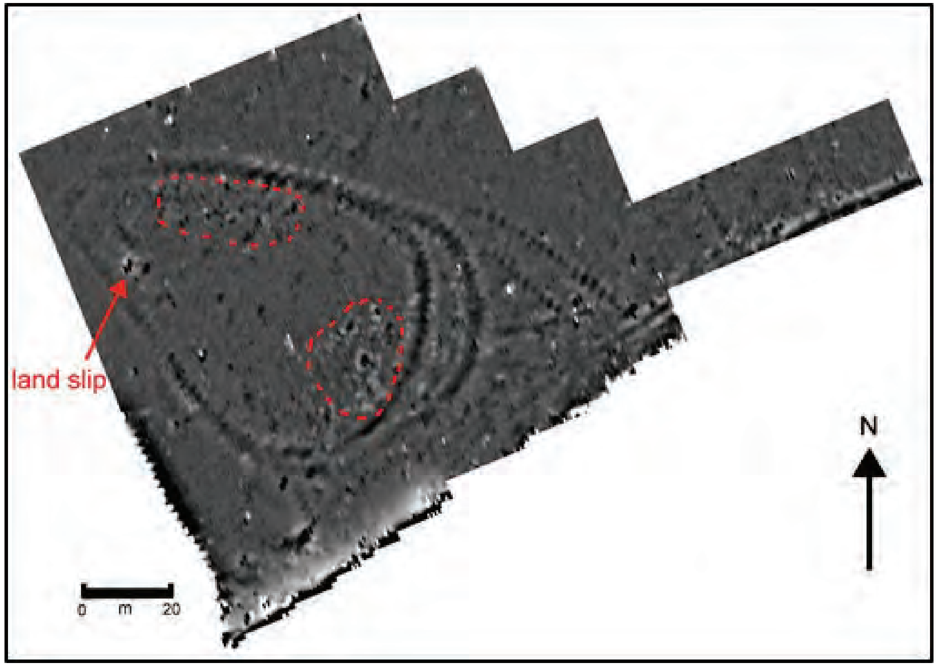


Key

A: Possible entrance?
B: Abutting ditches
C and D: External banks and ditches?
E and E1: Edge of possible circular enclosure?
F and F1: Trackways?
G: Possible roundhouse
H: Possible entrance
I: Possible main entrance

4a.

4b.



Concentration of possible pits

Fig. 4
Processed survey and provisional interpretation

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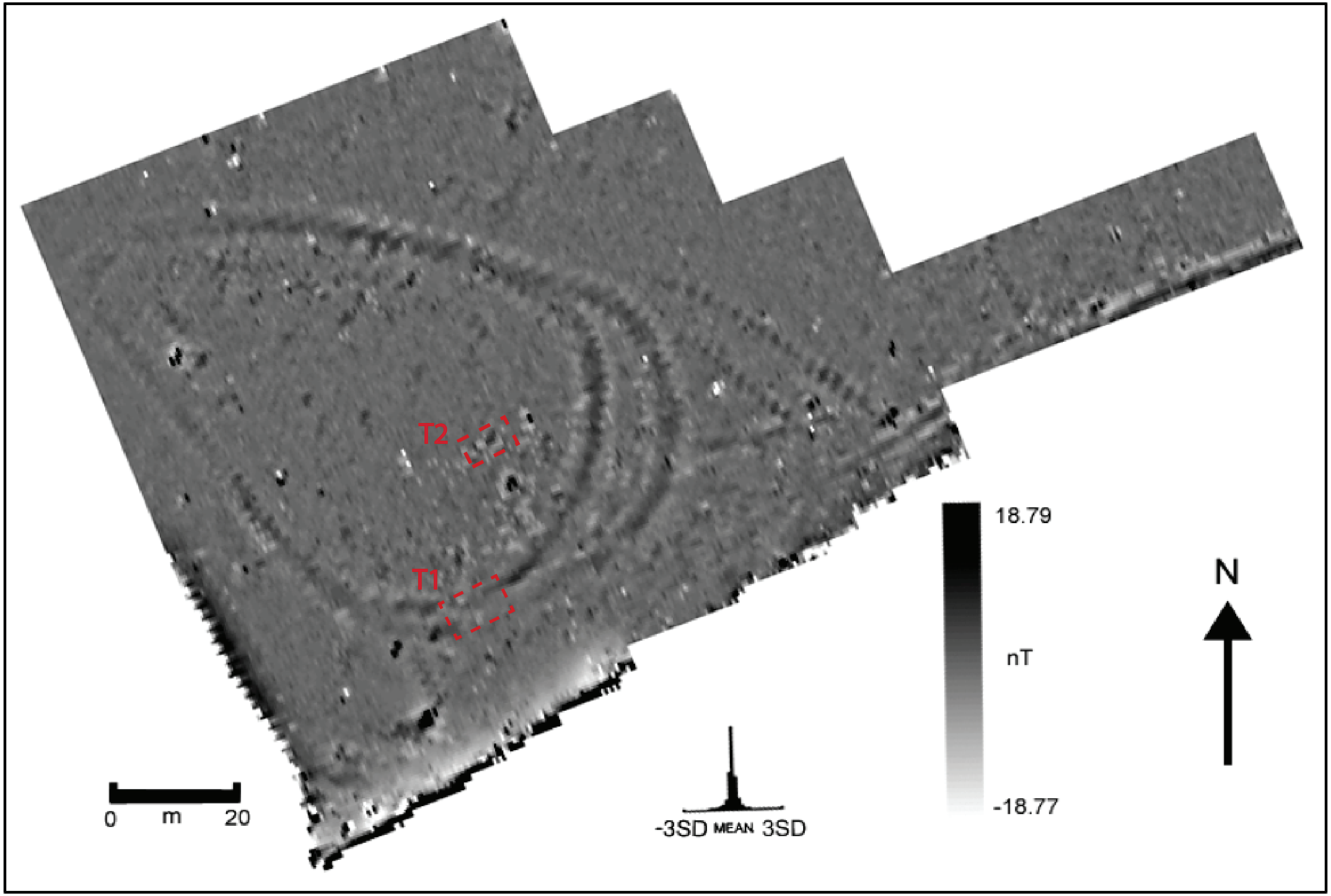

Fig. 5
Proposed trench locations

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 Houiston MCIfA & Jill Houliston
Company Registered No. 7440770 (England & Wales)
Registered Office: Morgan Griffiths LLP, Cross Chambers
9 High Street, Newtown, Powys, SY16 2NY

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