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Burnt mounds along the Milford Haven to Brecon gas pipeline, 2006–07

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Recording along the length of a pipeline which traversed South Wales identified 39 burnt mounds, along with troughs, hearths and spreads of unburnt stone. A programme of radiocarbon dating revealed that the earliest mound dated to the Late Neolithic period, with most examples being Bronze Age in date and with a single Middle Iron Age example also present. Of note was an example at Upper Neeston which was well preserved and lay adjacent to a water course which had largely silted up. Within the silts of this water course was a large wooden trough which proved to have been associated with the mound and with an adjacent stone-lined hearth. Also of particular interest were a group of eight burnt mounds and a trough with no associated mound found along a stream bank at Glan-rŷd Bridge. Radiocarbon dating of these showed that the site had been used intermittently from the Late Neolithic through to the Middle Bronze Age periods, a remarkable duration of up to 16 centuries.

INTRODUCTION
By Jonathan Hart

Background to the project

Archaeological recording was undertaken between 2005 and 2007 by Cotswold Archaeology and Cambrian Archaeological Projects along the length of the South Wales high pressure gas pipeline scheme, between Milford Haven and Brecon (Fig. 1). This 216 kilometre section forms part of a 316 kilometre pipeline which extends to Tirley in Gloucestershire. The construction work was undertaken on behalf of National Grid who commissioned NACAP Land and Marine Joint Venture (NLMJV) to undertake the groundworks between Milford Haven and Brecon. NLMJV themselves commissioned RSK Environment (part of the RSK Group) to manage the archaeological works. Pre-construction works included archaeology and heritage surveys, geophysical surveys, earthwork surveys and evaluations. Significant sites identified during these initial works were selected for archaeological excavation where the pipeline could not be re-routed. Other sites were identified during a watching brief undertaken during construction and have been reported on individually as grey literature reports (with a global Historic Environment Record (HER) event number of 102846). One notable result of the archaeological investigations was the frequency with which burnt mounds and associated remains were encountered, and these remains are therefore reported on collectively here. Full details of each burnt mound are available within the grey literature report for that site, and within the project archive, which has been deposited with the RCAHMW (a digital copy of the paper records for each site has been deposited with approved local museums, along with the material archive) and summaries will be made available via *Archwilio*, the Welsh Archaeological Trust's online HER system.

Methods

The fieldwork followed the methods set out within a global written scheme of investigation (WSI) for the project and within site-specific WSIs for individual excavation sites. An archaeologist was present

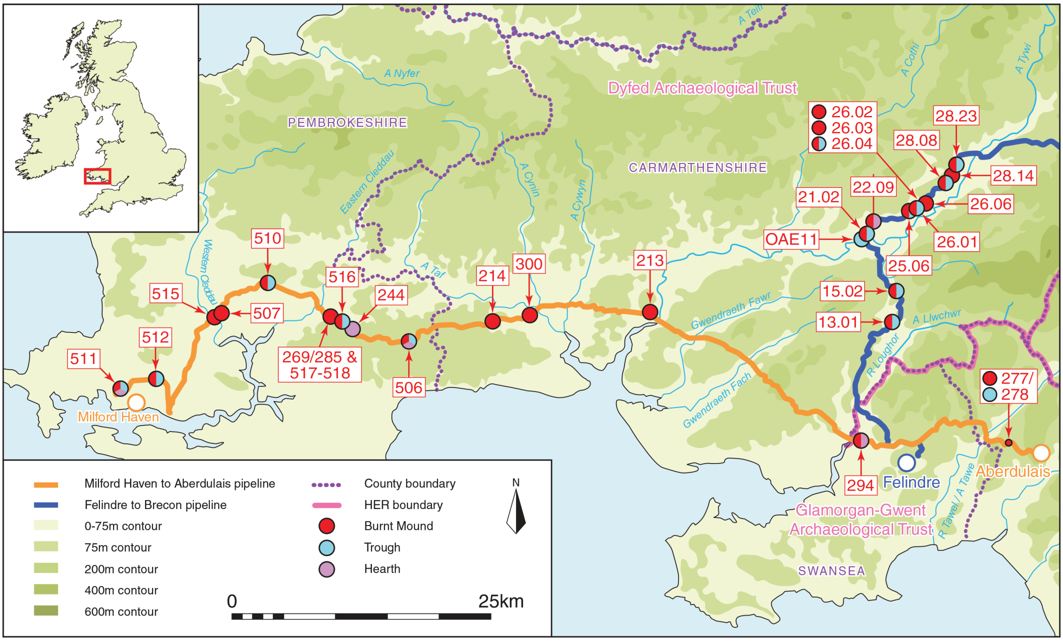

Fig. 1. The pipeline route, showing topography and site locations.

during intrusive groundworks comprising machine stripping of the pipeline easement to the top of the archaeological deposits. Excavation continued by hand thereafter. Where mounds of sufficient size were exposed, these were investigated through the excavation of opposing quadrants, excavated stratigraphically. Smaller mounds were either half sectioned or investigated by the excavation of sondages. Associated features such as troughs, pits and postholes were at least fifty per cent excavated by area and samples were taken from suitable deposits for the recovery of palaeoenvironmental evidence and material suitable for radiocarbon dating. Post-excavation work comprised initial preliminary reports (CA 2007, 2009; CAP 2008a, 2008b) of the archaeological remains along the pipeline, and these formed the basis of assessment reports (NLMJV 2012a, 2012b) which themselves informed the creation of an updated project design (GA 2012) detailing the requirements for further analysis and reporting. The results of the palaeoenvironmental investigations, radiocarbon dating and Bayesian analysis are summarised within this report with full versions of the reports for these works available within the project archive.

Landscape and geology By Jonathan Hart and James Rackham

The 216 kilometre section of the pipeline under discussion traversed the rural landscape of South Wales. Working westwards from Milford Haven, the pipeline first runs through low-lying land associated with the Eastern and Western Cleddau rivers. From the eastern bank of the Eastern Cleddau, the pipeline crosses through Canaston Wood, ascending slightly higher ground before descending again to the valley at the confluence of the Taf, Cynin and Cywyn. East of this, the route bisects the lower valleys of a series of rivers between Laugharne and Aberdulais. The continuation of the route from Felindre initially runs northwards along the valley of the Loughor and Towy before turning eastwards to ascend high ground within the Brecon Beacons National Park.

Most of the geological strata of South Wales traverse the country from west to east, curving to the north above the South Wales Upper Coal Measures Formation above Swansea and Cardiff on the southern flanks of the Brecon Beacons.[5] This means that the pipeline, much of which follows a similar axis, shows relatively little geological variety along its length from Milford Haven to Brecon. Much of the eastern section of the Milford Haven to Aberdulais pipeline lies over Silurian, Devonian and Ordovician sandstones, conglomerates, siltstones and mudstones. At most of the burnt mound sites along this part of the route no superficial deposits are recorded, but glaciofluvial sand and gravels occur at Sites 515, 507 and 294 and glacial till (diamicton) at Site 285, whilst Sites 300 and 213 lie on diamicton of Devensian age. On the Felindre to Brecon section, the first stretch crosses the strata before turning parallel at Llandeilo. On this stretch the bulk of the route overlies mudstones, although at the southern end Sites 13.01 and 15.02 lie on the Coal Measures and Twrch Sandstone Formation respectively, with the latter site close to the Oxwich Head limestone formation. All the other burnt mound sites between 15.02 and 28.23 lie over mudstones. Superficial deposits are more extensive along this part of the route and Devensian diamicton is recorded at Sites 13.01, 15.02, 22.09, 26.02, 26.03, 26.06, 28.08 and 28.08a. Site 26.01 lies on the edge of the floodplain of the river Dulais and its superficial deposits are alluvial sediments of clay/silt, sand and gravels.

Archaeological background

The pipeline provided a transect across South Wales and thus crossed areas with well attested archaeological remains, as well as areas where little archaeological activity has been recorded. The watching brief and excavations revealed sites in both upland and lowland areas and these included Mesolithic, Neolithic, Chalcolithic, Beaker Period, Bronze Age, Iron Age, Roman, medieval, post-medieval and modern remains relating to settlement, production, ritual and burial activities. The burnt mounds and associated remains were largely found within Pembrokeshire and Carmarthenshire, with outliers in Swansea and Neath Port Talbot. None were recorded within Powys. A small number were found in upland areas but the majority were adjacent to lowland water courses or palaeochannels. A recent article on burnt mounds in north-west Wales (Kenney 2012) includes a useful summary of the form of these features and there is little to be gained by duplicating that work here. In summary, a classic burnt mound comprises an oval or crescent-shaped low mound of burnt stone found in association with one or more troughs and hearths. Pits and postholes can also be present, the latter often suggestive of lightweight structures. Most mounds are found near water courses, although some in upland areas are found near springs or by former wells or water holes. It is generally accepted that these remains relate to activities relying on the heating of water by adding stones heated on the hearths to water contained in the troughs. Determining the functions of this 'hot stone technology' is more controversial, in part due to the generally low occurrence of artefactual or ecofactual remains from the mounds and associated features. The mounds have been interpreted variously as saunas, places for boiling meat, brewing areas, tanneries and dyeing areas, but no definitive evidence has been found to support any interpretation.

THEMATIC RESULTS

By Jonathan Hart

Topographical locations

Thirty-nine burnt mounds were found along the pipeline. The majority were located below 80m above Ordnance Datum, within or close to the flood plains of major water courses. Where the pipeline traversed land above 80m fewer mounds were found and all of these were on land below 215m above Ordnance

Datum. With two exceptions, all of the burnt mounds were located adjacent to or very near to existing water courses or palaeochannels. The exceptions were a burnt mound and troughs at Pistyll-bâch (Site 15.02) and a burnt mound at Llechwen-dderi (Site 26.06), both of which were found on hillsides and away from any current or known former springs or water courses.

Feature types and morphologies

Of the 39 identified burnt mounds, 14 were associated with one or more troughs and eight were associated with hearths (Appendix 1, Table 1). It is worth noting that since none of the mounds was fully excavated, and some were not fully exposed, further hearths or troughs may have been present beneath unexcavated areas. In addition to these 39 mounds, further possible areas of burnt mound activity were suggested by the presence of pits containing burnt stone and of small layers of burnt stone. These might represent troughs where any associated mound has been entirely truncated, sites where activity was of insufficient intensity to produce a significant mound or sites where the mound lay beyond the excavated area.

The most extensive mounds found along the pipeline comprised large oval, sub-circular or crescent-shaped accumulations of burnt material. Thirty-five mounds could be considered as large (at least 4m wide) and well-preserved. Of these, the largest examples were those at Upper Neeston (Site 511, Figs 2–4; 17m wide and 0.15m thick), Steynton (Site 512, Figs 5–6, 18m wide and 0.5m thick), Ammanford (Site

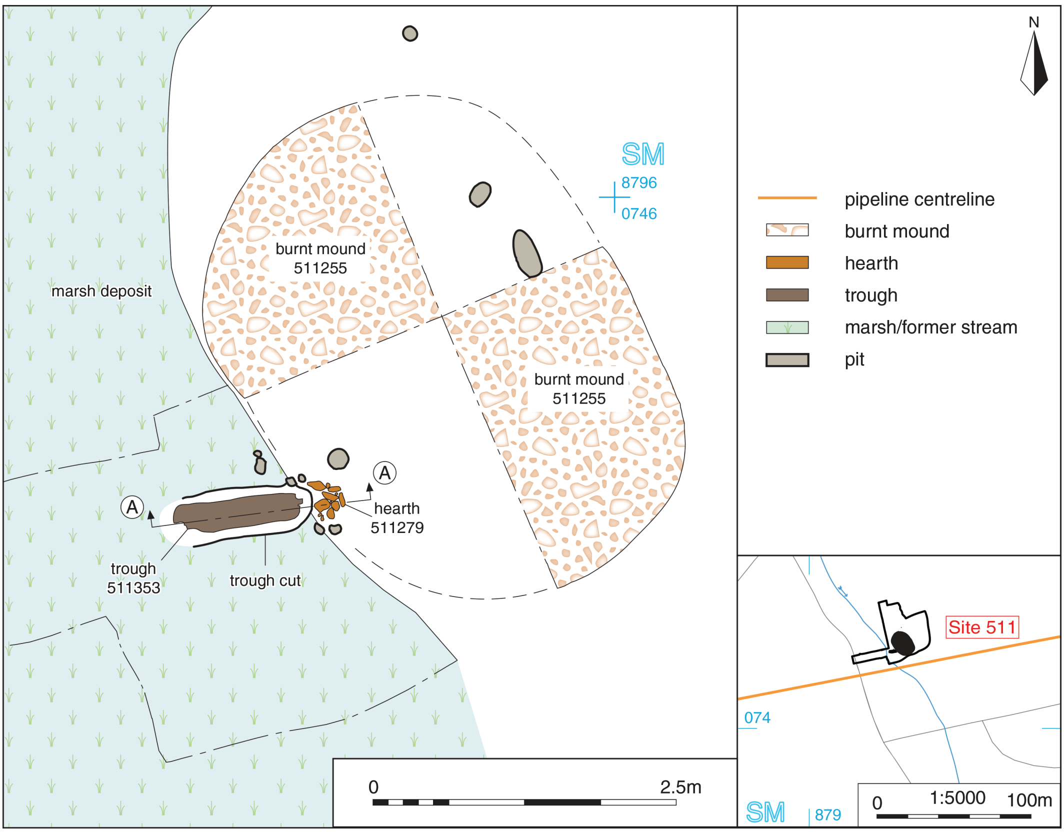

Fig. 2. Upper Neeston (Site 511): plan of the burnt mound, wooden trough and hearth.

13.01; 13m wide and 0.2m thick) and Dolau Farm (Site 26.01; 12m wide and 0.35m thick). Fifteen of these larger mounds were formed from two or more layers of burnt and unburnt material. The maximum number of identified layers within a single mound was seven, from the mound at Steynton (Site 512).

Fig. 3. Upper Neeston (Site 511): view of the burnt mound, wooden trough and hearth, looking north-west.

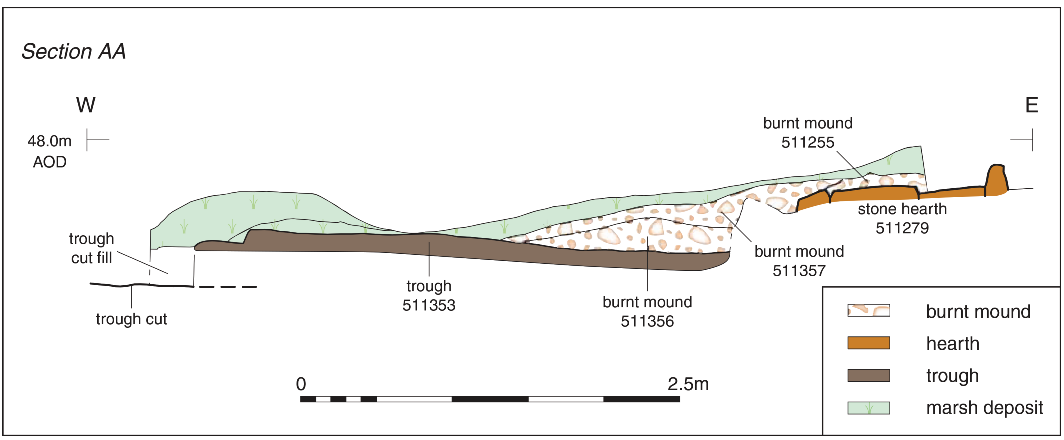

Fig. 4. Upper Neeston (Site 511): profile showing the burnt mound, wooden trough and hearth.

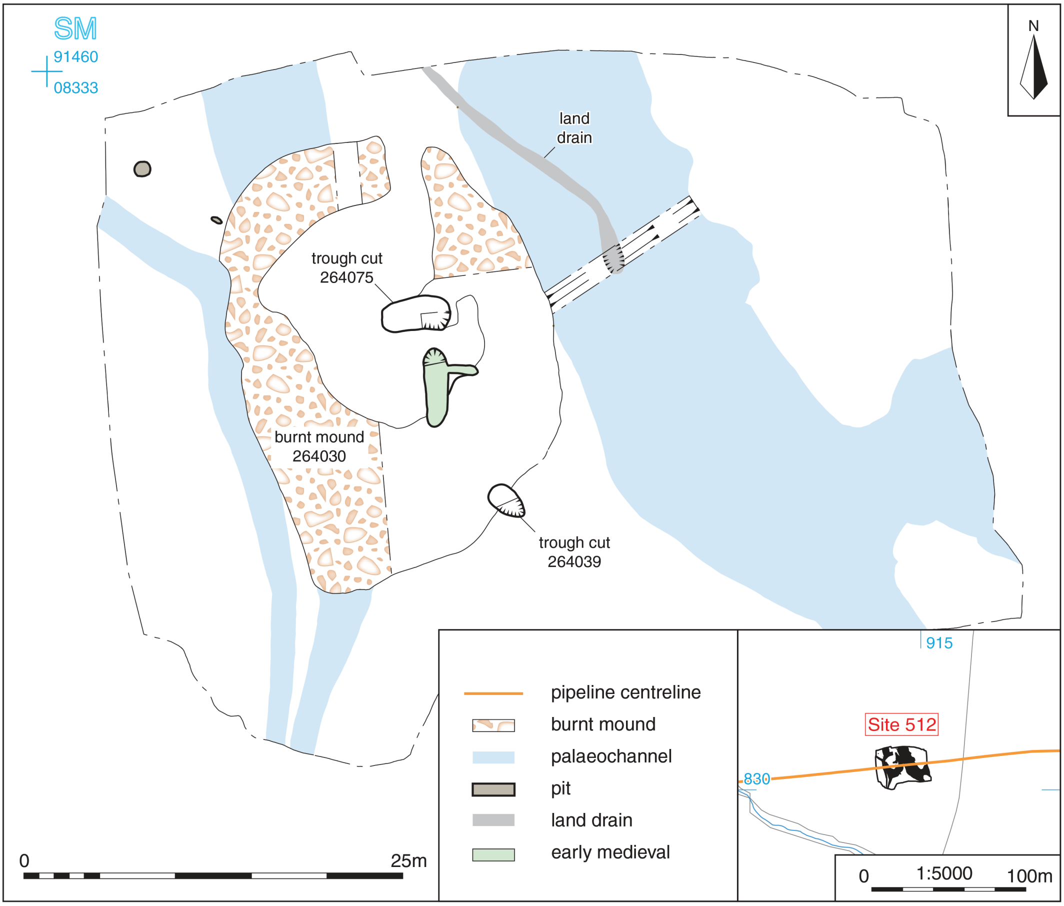

Fig. 5. Steynton (Site 512): plan of the burnt mound and troughs.

Hearths were identified with certainty at only a small number of sites, with a maximum of eight mounds having associated hearths. The best-preserved example was at Upper Neeston (Site 511, Figs 2–4) where the mound occupied a slight rise in ground level and was adjacent to a hearth. The hearth was edged by large scorched stones and was adjacent to a substantial wooden trough which extended into a stream. Other hearths survived as small pits with scorched edges and filled with burnt stones. Five such pits with scorched edges were found near the burnt mound at Dolau Farm (Site 26.03) and a similar small pit with scorched edges and filled with burnt stones was found at Coedbach Park (Site 294), although no accompanying mound was present in that instance. Further possible hearth locations were suggested by patches of scorched substrate beneath mounds 506003/019, 506004 and 506077/081, all at Glan-rŷd Bridge (Site 506, Fig. 7). A patch of scorched clay beneath mound 2823122 at Aber-Marlais Park (Site 28.23, Fig. 8) may have been the location of another hearth.

Troughs were more commonly found than hearths, with 14 mounds having at least one trough, and five mounds having multiple troughs. In addition, a further eight groups of probable troughs that lacked associated burnt mounds were found. The most troughs found in association with a single mound were

Fig. 6. Steynton (Site 512): view of the burnt mound, showing location of Bronze Age ring-ditch at Site 513, looking west.

the eight examples beneath and adjacent to the mound at Pistyll-bâch (Site 15.02, Fig. 9). This was one of the few mounds not to be located by a water source, although whether this was significant in terms of the number of troughs created is not readily apparent. There was no relationship between the shape of the mounds and the presence or absence of troughs. All of the troughs found along the pipeline were based on pits cut into the substrate. Ten of the troughs were sub-rectangular cuts with steep to vertical sides and flat bases; the majority of these fell within the range of 2.7–3.2m long, 0.7–1.3m wide and 0.25–0.4m deep. The remaining 32 troughs were oval to circular in plan with most having rounded profiles, although a few steep-sided, flat-based cuts were also present. These were typically 1–3m wide and 0.1–0.5m deep. Five of the troughs had evidence for clay or wood linings, the most notable of these being the large wooden trough found at Upper Neeston (Site 511). This had been hewn from a single length of mature oak and was a long, shallow, flat-based receptacle 4.26m long and 0.98m wide. Evidence was found within oval trough 506068 at Glan-rŷd Bridge (Site 506) and within sub-rectangular trough 261012 at Dolau Farm (Site 26.01) for stakes that may have retained plank linings. No extant remains of such linings survived on those sites but fragments of wood within the fill of trough 2631010 at Dolau Farm (Site 26.03) were perhaps the remains of such a lining. A clay-lined trough was found at Ammanford (Site 13.01); this sub-rectangular trough had been cut into the burnt mound at that site and the fact that the trough was cut into the porous material of the

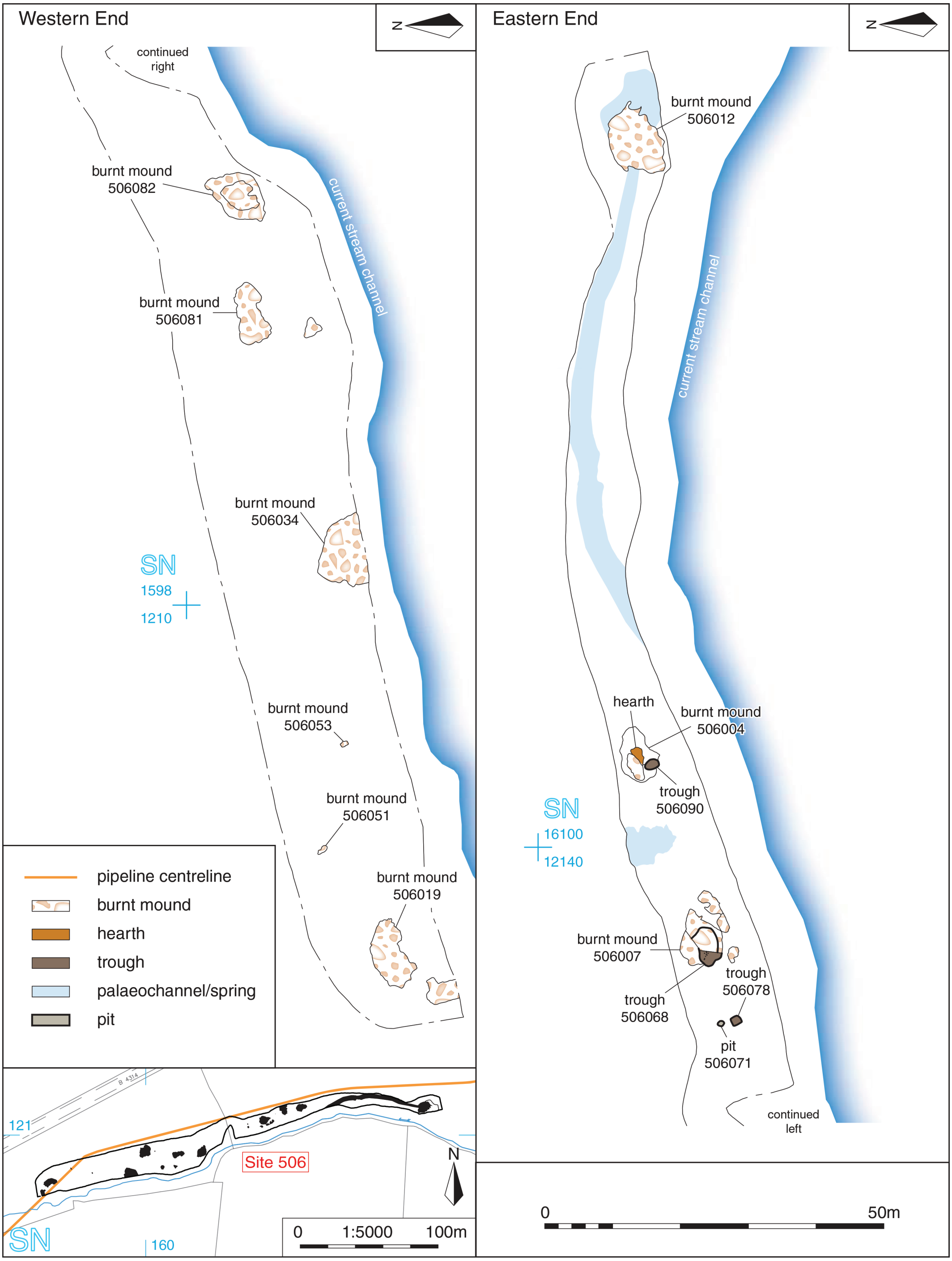

Fig. 7. Glan-rŷd Bridge (Site 506): plan of the burnt mounds and associated features.

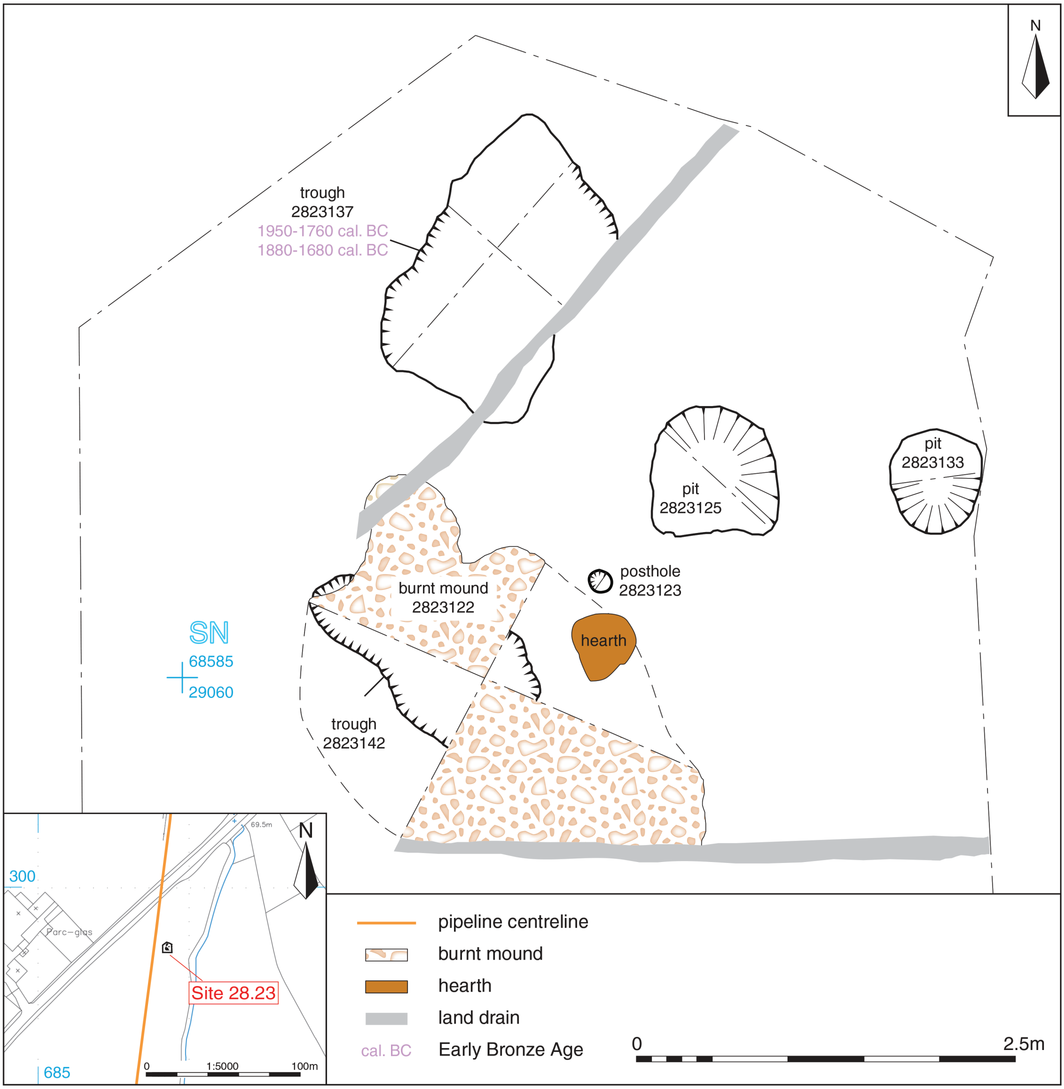

Fig. 8. Aber-Marlais Park (Site 28.23): plan of the burnt mound, troughs and possible hearth location.

mound explains why it was clay-lined and stands in contrast to an earlier trough below the mound which had simply relied on the clay substrate to retain water. The use of the clay substrate into which the majority of the troughs were cut to act as an impermeable edge seems to have made it unnecessary to line the troughs in most cases and unlined examples were by far the most frequently encountered.

Almost all of the troughs contained burnt stones and charcoal. Indeed, for those examples found without an associated burnt mound, it was the presence of burnt stones taken in conjunction with proximity to a water course that was taken to suggest that these might relate to burnt mound-type activity (although it is accepted that features unrelated to burnt mounds can also contain burnt stones). Artefacts were virtually absent from the trough fills and were restricted to a few crumbs of prehistoric pottery from a trough at

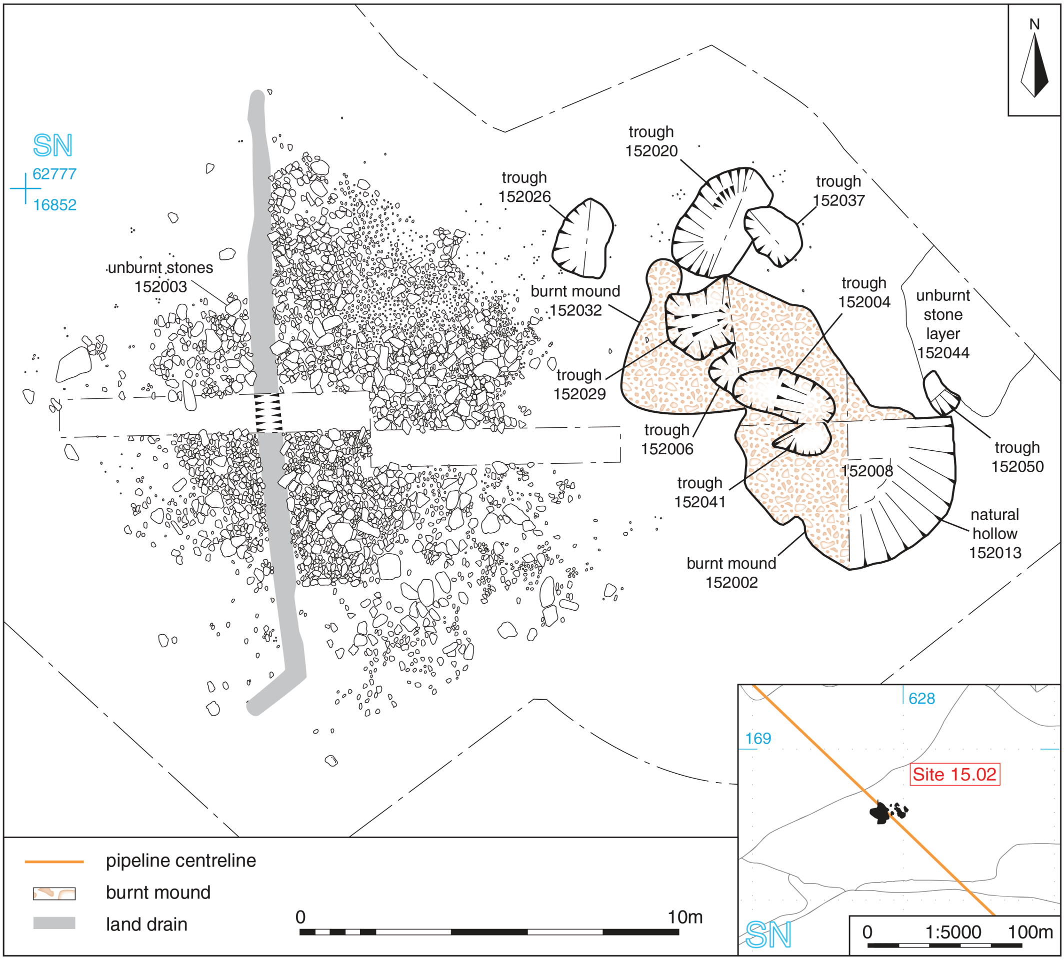

Fig. 9. Pistyll-bâch (Site 15.02): plan of the burnt mound, troughs and unburnt stone layers.

Upper Neeston (Site 512) and a small number of worked flints from a few of the other mound sites. All of these finds were either residual or were not closely dateable. The charcoal was dominated by the remains of fuelwood, with food remains being found rarely and in small quantities.

Postholes were found at a minority of the burnt mound sites. Those found within troughs have been discussed above. Others may have supported small structures. At Upper Neeston (Site 511) postholes found at the eastern end of the wooden trough and hearth could have supported a lightweight structure (Fig. 2). A similar interpretation may pertain for two postholes found at either side of the southern end of sub-rectangular trough 131074 found at Ammanford (Site 13.01), and for the postholes found near the troughs at Dolau Farm (Site 26.03) and Bail y Llwyd (Site 28.08).

Surfaces and clearance

The burnt mound sites were characterised by the presence of burnt stones. However, the upland mound at Pistyll-bâch (Site 15.02, Fig. 9) was found adjacent to a larger oval spread of unburnt stones covering an area 15m by 12m in extent and up to 0.7m thick. A smaller spread of unburnt stones was present on the other side of the burnt mound and the burnt mound itself had accumulated within a hollow, the base of which was covered with cobble-sized unburnt pebbles. A simple explanation for these unburnt stones is that they were stores of unused materials, although, this does not explain the layer of unburnt pebbles found beneath the burnt mound at Pistyll-bâch.

One notable feature of the burnt mounds along the pipeline is the very few visible preserved buried soil horizons. Instead, most directly overlaid the natural substrate and this seems to be true of burnt mounds more generally, with only a minority reported as having overlaid former soil horizons. This was also true of the unburnt stone layers at Pistyll-bâch (Site 15.02), which directly overlaid the natural clay. Along the pipeline route, of all the burnt mounds identified, only that at Bail y Llwyd (Site 28.08) did not directly overly the natural substrate. Here, a small patch of yellow sandy clay 0.6m wide and 0.1m thick was preserved beneath a larger burnt mound which otherwise overlaid the natural substrate. In addition, the lowest layer of the mound at Canaston Wood (Site 516) comprised grey sandy silt with charcoal and burnt stones, which could arguably represent burnt mound material mixed into an underlying soil horizon. It is unclear whether this general absence of visible buried soils represents clearance prior to the activities occurring on site, or is a reflection of post-depositional conditions.

Dating

In common with burnt mounds found elsewhere, material remains were almost entirely absent. The programme of radiocarbon dating concentrated on producing spot dates from the burnt mounds or associated features, rather than creating a dating model for the layers found within each mound. However, in some cases sufficient samples were present to allow Bayesian analysis to generate models showing key events at certain mounds. Full details of the methodologies used and of the models produced are contained within Appendix 2. The outputs of the Bayesian models are quoted in italics in the following text. The available radiocarbon chronology (Appendix 2) shows that activity at the mound sites began in the Late Neolithic in *3200–2850 cal. BC* (95% probability; *FirstBurntMound*, Fig. 12), an estimate derived from the earliest dated activity at Site 506. The latest activity from a mound along the pipeline was at Site 26.06 which yielded Middle Iron Age dates of 400–210 and 370–170 cal. BC (SUERC-55504 and 55505; 95% confidence). The chronology of the mounds along the pipeline is discussed below whilst their duration of use is considered in a following section.

Late Neolithic mound

Site 506 at Glan-rŷd Bridge (Fig. 7) contained the largest number of burnt mounds (eight burnt mounds and a trough with no associated mound), seven of which were radiocarbon dated evidencing activity in the Late Neolithic and Early and Middle Bronze Age periods. The earliest of those mounds, 506007, located towards the centre of the site, was radiocarbon dated to *2820–2630 cal. BC* (93% probability; SUERC-52549; Fig. 16) and *2760–2620 cal. BC* (SUERC-52550; 82% probability; Fig. 16). Comparable dates of *2780–2580 cal. BC* (SUERC-52551; 94% probability; Fig. 16) and *2760–2570 cal. BC* (SUERC-52552; 94% probability; Fig. 16) were returned from the fills of trough 506068. These dates are statistically consistent and indicate that the mound formed during the earlier part of the Late Neolithic period.

Early Bronze Age mounds

Deposits associated with three of the burnt mounds at Glan-rŷd Bridge (mounds 506034, 506082 and 506004), distributed over a distance of 135m, returned Early Bronze Age dates. Burnt mound 506034 was dated to *2470*–2280 and *2470–2290 cal. BC* (SUERC-52544 and -52548; 95% probability; Fig. 16);

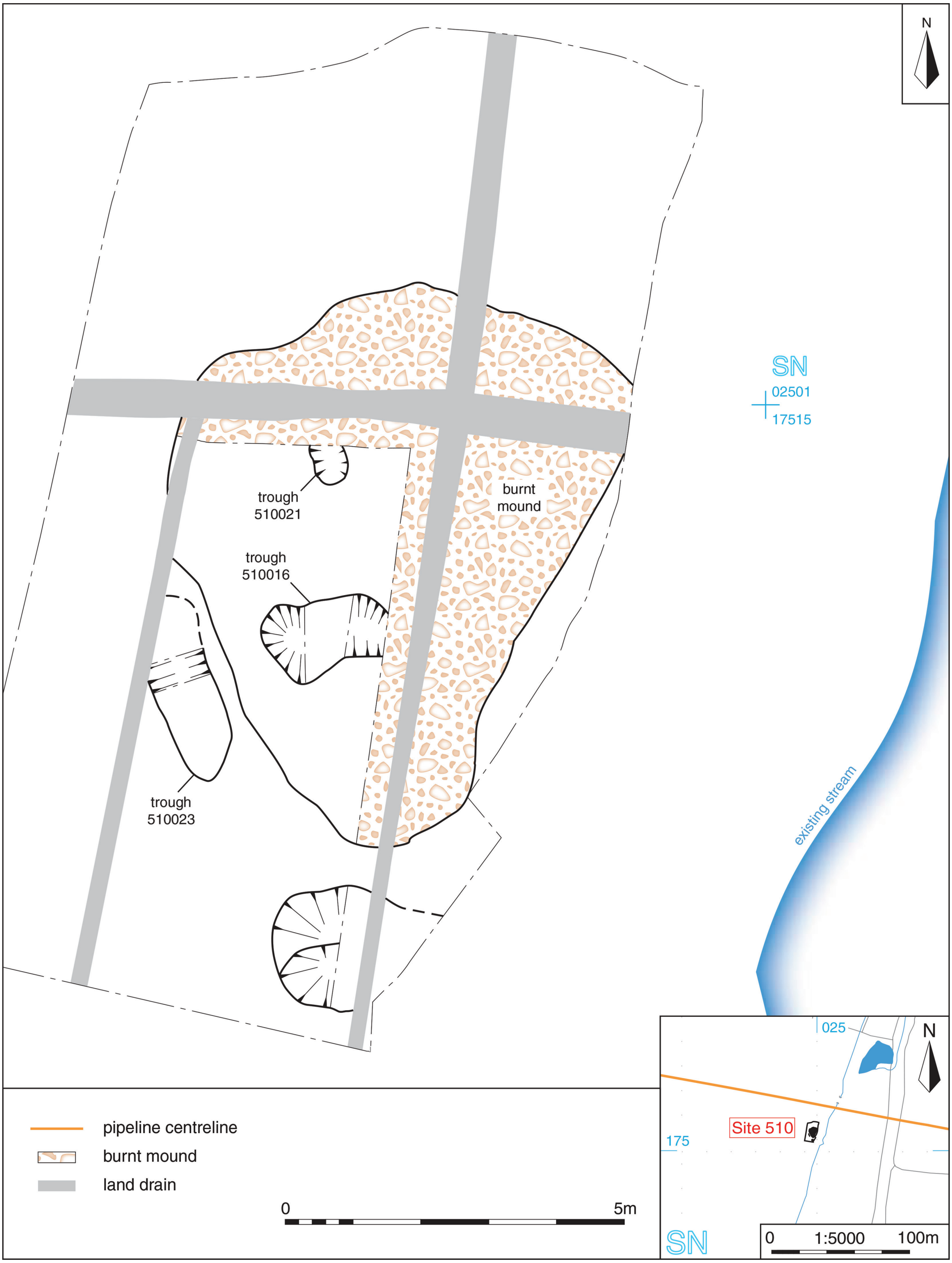

Fig. 10. Scurtle (Site 510): plan of the burnt mound and troughs.

Fig. 11. Scurtle (Site 510): view of the burnt mound and troughs, looking east.

burnt mound 506082 was dated to *2460–2200* and *2470–2280 cal. BC* (SUERC-52562 and -52563; 95% probability; Fig. 16) whilst the fills of trough 506090 associated with mound 506004 returned dates of *2470–2290* and *2470–2280 cal. BC* (SUERC-52564 and -52568; 95% probability; Fig. 16). These ranges are all consistent and fall within the earlier part of the Early Bronze Age. Burnt mound 506019, at the western end of the Glan-rŷd Bridge site, was radiocarbon dated to *1950–1760* and *1880–1690 cal. BC* (SUERC-52541 and -52542; 95% probability; Fig. 16), dates within the later part of the Early Bronze Age. The fills of trough 506078 towards the centre of the same site returned somewhat later dates of *1640–1510* and *1750–1620 cal. BC* (SUERC-52571 and -52572; 95% probability; Fig. 16) and comparable dates came from a pit adjacent to this trough (pit 506071: *1620–1450* and *1750–1610 cal. BC*; SUERC-52569 and -52570; 95% probability; Fig. 16).

Other burnt mounds along the pipeline route produced dates within the middle and later parts of the Early Bronze Age. The burnt mound at Church Hill (Site 507) was dated to 2040–1880 and 2120–1890 cal. BC (SUERC-54701 and -54702; 95% confidence) whilst that at Scurtle (Site 510, Figs 10–11) was dated to 2130–1900, 1950–1760 and 1750–1530 cal. BC (SUERC-54564, 54568 and Beta-249354; 95% confidence) and that at Gilfach (Site 213) to 1870–1630 and 1690–1500 cal. BC (SUERC-55508 and -55512; 95% confidence). Dates of 1880–1660 and 1740–1530 cal. BC (SUERC-55516 and -55515; 95% confidence) came from the fills of a trough at Aber-Marlais Park (Site 28.23) whilst two adjacent mounds at Vaynor Farm (Site 214) were dated to 1610–1430 cal. BC and 1620–1450 cal. BC respectively (SUERC-55513 and -55514; 95% confidence).

Middle Bronze Age mounds

The two latest mounds at Glan-rŷd Bridge (Site 506) were located at opposite ends of the site, 265m apart. The westernmost, mound 506051, which survived only as a small patch of burnt material, was radiocarbon dated to *1460–1370* (SUERC-52553; 78% probability; Fig. 16) and *1420–1270 cal. BC*

(SUERC-52554; 95% probability; Fig. 16). Three statistically inconsistent radiocarbon dates from the same context from burnt mound 506012, were produced (SUERC-52559, -52560 and -52561; T'=8.2; T'5%=6.0; df=2). Two results on charcoal samples of different species from this context (SUERC-52559, -52560) produced the same calibrated ranges at 95% confidence, but a measurement (SUERC-52561) on grain of *Triticum* sp. indicated earlier activity at this mound site in *1630–1500 cal. BC* (95% probability; SUERC-52561; Fig. 16).

Radiocarbon dates from the mound at Upper Neeston (Site 511) indicated that it began to be formed in *1500–1410 cal. BC* (95% probability; *Construct511*, Fig. 15), most probably in the 50 years between *1470–1420 cal. BC* (68% probability; *Construct511*, Fig. 15). The end of activity at this mound is estimated to have occurred in *1490–1350 cal. BC* (95% probability) or *1440–1400 cal. BC* (68% probability; *End511*, Fig. 15).

The well preserved burnt mound at Steynton (Site 512; Figs 5 and 6) was associated with two troughs; radiocarbon dates were obtained from the mound and one of the troughs. The earliest activity thus revealed was from trough 264039, which contained charcoal dated to *1740–1600 cal. BC* (SUERC-55486; 84% probability; Fig. 15), a date within the later part of the Early Bronze Age. Trough 264039 also yielded a later date of *1460–1290 cal. BC* (SUERC-55487; 94% probability; Fig. 15) and this was comparable to the three dates obtained from the mound itself (*1500–1380*, *1510–1390* and *1510–1400 cal. BC*; SUERC-55488, -55494 and -55495; 95% probability; Fig. 15). The earliest dates could represent an otherwise unrecognised early phase of the mound, or might derive from unrelated activity. The main focus of activity at the site this might be estimated to have begun in *1510–1420 cal. BC* (95% probability; or 1500–1440 cal. BC 68% probability; *FirstFill*, Fig. 15), and ended in *1470–1380 cal. BC* (86% probability, or *1350–1310 cal. BC*, 9% probability; or *1450–1400 cal. BC*, 68% probability; *LastFill*, Fig. 15).

Middle to Late Bronze Age mounds

Of the two burnt mounds identified at Ammanford (Site 13.01), one was radiocarbon dated to *1370–1110* and *1000–830 cal. BC* (SUERC-55502 and -55498; 95% probability; Fig. 14). Rectangular trough 131074 had been cut through the mound and was associated with two postholes located either side of one end. The fill of one of these postholes, 131078, was radiocarbon dated to *1280–1050* and *1090–910 cal. BC* (SUERC-55497 and -55496; 95% probability; Fig. 14). The second mound was dated to *1300–1110 cal. BC* (SUERC-55502; 95% probability; Fig. 14). A Bayesian model of these results presents the activity beginning *1290–1120 cal. BC* (95% probability; *First13.01*, Fig. 14) with the last dated event estimated as dating to *990–830 cal. BC* (95% probability; *Last13.01*, Fig. 14). Dates within the later part of the Middle Bronze Age were obtained from charcoal from the burnt mound at Cilsan (Site 21.02), which produced statistically consistent measurements (T'=0.4; T'5%=3.8; df=1) dating to 1220–1010 and 1260–1040 cal. BC (SUERC-55506 and -55507; 95% confidence) whilst the burnt mound at Uzmaston (Site 515) produced radiocarbon dates of *1120–900* and *1210–920 cal. BC* (SUERC-56060 and -56061; 95% probability).

Iron Age mound

The latest radiocarbon results obtained from one of the mounds came from that at Llechwen-dderi (Site 26.06). Here an oval spread of burnt pebbles 5.8m wide and 0.15m thick was located on the slope of a hill. No associated features were present, although this is potentially because the mound was only fifty per cent excavated. Statistically consistent radiocarbon dates of 400–210 and 370–170 cal. BC (SUERC-55504 and 55505; 95% confidence) were obtained from the mound, suggesting activity during the Middle Iron Age.

Longevity of use, seasonality and multiple mounds

The burnt mound sites contained evidence for varying levels of intensity of use, ranging from single possible troughs with no associated burnt mound, to mounds consisting of multiple layers and/or including multiple troughs and sites including multiple mounds.

Short duration burnt mounds and troughs with no burnt mounds

For possible troughs with no associated burnt mound, it is possible that any former mounds have been entirely truncated or were not exposed within the excavated area. However, it is also possible that the activity at these sites was limited to a single event, insufficient to produce a burnt mound. If this interpretation is accepted, a total of 11 such low-intensity sites were found, although this may either be an under-representation of such low-intensity sites, which are clearly less easy to recognise as representing burnt mound activity, or an over-representation if such remains were associated with more extensive deposits located just beyond the excavated area.

Long duration burnt mound activities

In contrast, and more numerous, were mounds which were either extensive or included multiple layers or were associated with multiple troughs. If mounds larger than 4m wide or with two or more layers or two or more troughs are considered, 35 examples were recorded along the pipeline out of a total of 39 mound sites. Such sites must have been the focus of intense or prolonged activity and this is also true of sites which included multiple mounds. The programme of radiocarbon dating for the eight burnt mounds and the isolated trough at Glan-rŷd Bridge (Site 506) revealed that these had formed over a considerable period between the Late Neolithic and Middle Bronze Age periods. Bayesian modelling of these results suggests that activity started in *3030–2640 cal. BC* (95% probability) or *2870–2680 cal. BC* (68% probability; *Start 506*, Fig. 16). The last evidenced activity is estimated to have occurred in *1410–1100 cal. BC* (95% probability) or *1390–1250 cal. BC* (68% probability; *End 506*, Fig. 16). This represents a time span of 1250–1570 years (95% probability) or *1290–1450* years (68% probability; *Duration506*).

Further evidence that some burnt mound sites were in use over considerable lengths of time was found at Ammanford (Site 13.01) where an estimate for the duration of use of the two mounds was *170–420* years (95% probability; or *240–370* years, 68% probability; *Duration13_01*), a duration suggestive of episodic use over centuries. Radiocarbon results associated with the use of the burnt mound at Scurtle (Site 510) indicate activity in 2130–1900, 1950–1760 and 1750–1530 cal. BC (SUERC-54564, 54568 and Beta-249354; 95% confidence). These results are all statistically significantly different and probably indicate activity at the burnt mound site over a considerable period of time. A somewhat shorter, but still potentially significant duration was represented by the burnt mound at Upper Neeston (Site 511) which Bayesian modelling suggests formed over a period of *1–70* years (95% probability; Fig. 15) or *1–30* years (68% probability; Fig. 15).

Seasonality

Whilst it is possible that this intense activity was the result of single events on some sites, it may be more convincing to see it as representing episodic visits to the mound sites. This must certainly be the case where troughs or hearths were sealed below mounds, and may also have been the case where mounds were composed of multiple layers or where multiple mounds were found in close proximity to one another. There was nothing within the palaeoenvironmental assemblages from the mounds to indicate use during particular seasons, although this may simply reflect the limited range of the palaeoenvironmental remains.

THE PALAEOENVIRONMENTAL EVIDENCE

By James Rackham and Dana Challinor

Vegetational history

The vegetational history of the landscape that the pipeline traverses is less well documented than the upland landscape of the Brecon Beacons and mid Wales. Apart from a few kilometres where the route takes it over Mynydd Myddfai, at an altitude of over 400m, the pipeline does not cross any of the mountainous areas. Few pollen studies have been undertaken on lowland sites in South Wales and this discussion relies on the sequences generated by the pipeline project (Rackham *et al.* in prep).

No off-site palaeoenvironmental studies were conducted along the Milford Haven to Aberdulais section and there are little vegetational history data available for this part of the route. A limited evaluation of a core sequence at Martin's Pill, Pwllcrochan, near the western end of the route records alder dominated local woodland on the valley floor, with hazel and oak (Bates *et al.* 2010) on the valley sides and a limited pastoral component in the Early Bronze Age. Thomas (1965) studied a raised bog at Llanllwch, just west of the Carmarthen showground, which includes deposits of Neolithic and Bronze Age date. While only one radiocarbon date exists for this sequence, it conveniently falls in the Early to Middle Bronze Age and shows a landscape dominated by oak and hazel woodland, and alder in the damper areas. There are pastoral elements in the landscape and occasional traces of cereal type pollen.

In contrast, the Felindre to Brecon section was surveyed along its length and a series of organic sediment sequences were sampled, dated and studied (Rackham *et al.* in prep). The Neolithic is represented in several of the pollen diagrams (ibid.). Just north east of Felindre a wooded landscape of oak and hazel was present, with birch on drier soils and encroaching alder in the wetter areas. A similar pattern occurred in the valley of the river Loughor north of Pontarddulais and on the uplands of Mynydd Myddfai where the land above 400m was forested. To the east of the pipeline at 420m above Ordnance Datum on the south-facing slopes of the Brecon Beacons at Rassau, Ebbw Vale, an oak and hazel forest with birch and falling elm pollen dominated the landscape (Rackham and Scaife 2011). One sequence taken along the pipeline route above 350m above Ordnance Datum on Mynydd Myddfai shows that significant forest clearance had already occurred by the Early Bronze Age and included evidence for cereal cultivation at that altitude. On the Graig Fawr uplands just north of Cefn Drum, at 270m above Ordnance Datum, Grant (2011) did an exploratory study of a small mire sequence which by extrapolation from two radiocarbon dates near the top and bottom of the sequence included Neolithic and Bronze Age deposits. She records a decline in tree and shrub pollen during the Neolithic with increasing evidence for pasture and the appearance of cereal-type pollen. In the following zone, which she attributed to the Bronze and Early Iron Age, Grant noted a marked expansion of heath and continued low tree-pollen counts, with continued traces of cereal-type pollen that disappeared towards the top of the zone. This would suggest marked early clearance on this upland plateau and cultivation during the Neolithic and Bronze Age; however, without further radiocarbon dates the extrapolation of the dating is unreliable. The first significant clearances in the lowland zone occurred in the Bronze Age, thus being contemporary with many of the mounds, but this is not uniform across the region. In a diagram from a site just east of Llandybie (ibid.), a phase of clearance is suggested by falling oak and hazel pollen in the Early Bronze Age, accompanied by a short rise in birch suggesting colonisation of the cleared areas. There was a short period of oak woodland regeneration, before falling oak and hazel pollen in the Middle Bronze Age suggests clearance and birch colonisation of the cleared areas. This latter period showed a fall in grasses, perhaps suggesting scrub colonisation of the open areas, and the first appearance of cereals in the Late Bronze Age. At a site just east of Glasallt-fawr Wood north-east of Llangadog, Carmarthenshire (ibid.), the Late Bronze Age was characterised by hazel dominated woodlands, with oak expanding after a period of fall, and associated elm and lime in the woodlands. The site is a small enclosed valley and a peak of alder during this period reflects growth on the peats that were forming on the valley floor. Grasslands were present but a relatively small part of the pollen spectra, and cereal pollen first appeared although a hiatus below the Late Bronze Age deposits precludes comments on the earlier period. At a site (ibid.) near the mound at Site 28.23 and another a few kilometres north of this, the Late Bronze Age to Early Iron Age still shows a wooded landscape dominated by oak and hazel, with a marked episode of clearance in the early to middle Iron Age with an associated expansion of pastoral indicators. Evidence for local cereal cultivation is present throughout the Iron Age sequences. The sequence near Site 28.23 shows continued clearance and expanding grassland pasture in the Roman period.

Overall, these data show a still extensively wooded landscape along most of the Felindre to Brecon route, and probably also the Milford Haven to Aberdulais section, for the whole of the period during which the burnt mounds were being created. There is evidence from Mynydd Myddfai of an opening up of the uplands by the Early Bronze Age but woodland still appeared to cover much of the lowlands and foothills. At the lower sampled locations pasture lands appear a relatively small component of the landscape with cereal cultivation evident from the Middle Bronze Age onwards. This small open landscape component might be partly due to taphonomic factors, the pollen sites being located in contemporary wooded areas where tree pollen swamps the pollen from further afield. In the uplands there is evidence for cereal cultivation from the Late Neolithic within a landscape still extensively wooded, although early clearance is perhaps suggested on the southern uplands of Graig fawr and Cefn Drum, above Pontarddulais. The overall impression is of a patchwork of land on the flatter areas and fairly good soils probably having been cleared for pasture and cereal cultivation, but narrow valleys, steeper hillsides, wetland areas and probably also many streamsides and floodplains are likely to have remained wooded for much of the Bronze Age.

Environmental evidence from the mounds

The density of charcoal was very variable both within the mounds and between them with between <2ml and >400ml of charcoal per 1kg of deposit. At Site 510, where six spits were sampled from the column through the mound, burnt stone comprised more than seventy per cent of the sample by weight in all but the lowest spit, but charcoal concentrations were less than 3ml/kg except for the top spit, with 9.4ml/kg. This contrasts with the three spits through the deposits of mound 2631004 (Site 26.04) where the concentration of charcoal ranged from 111ml/kg in the top spit, 167ml/kg in the second, to 417ml/kg in the basal spit. However, the processes leading to this great variation in densities are not readily apparent and could be post-depositional rather than functional.

Although one theory concerning the origin of burnt mounds suggests they were feasting or cooking sites, excavated examples are generally lacking in surviving food remains (Kenney 2012). While food items were lacking at a number of the sites along the pipeline over sixty-three per cent produced some food remains, although these were often no more than one or two charred cereal grains or hazel nutshell fragments and, even in the richest samples, the density of food waste was low. Animal bone was almost entirely absent from the mounds. For unburnt bone, this potentially reflects post-depositional destruction, given the acidity of some of the local soils. More significant is the almost total absence of calcined or burnt bone, which might be expected to survive the local acidity. Only mound 506102 (Site 506) produced any burnt bone, and this comprised two small fragments weighing less than 0.1g. It is almost inconceivable that no bone would become burnt at a feasting site, and with a total volume of mound deposits processed within this project in the order of 4,000 litres, two tiny fragments of burnt bone are not suggestive of feasting although even burnt bone is subject to dissolution in acid soil. Analysis of the frequency of recovered food remains against sample size showed no correlation, so a conclusion that significant food waste is absent from the mounds seems valid.

The plant remains that have been identified are primarily fragments of charred hazel nutshell (*Corylus avellana*), which are fairly ubiquitous in prehistoric sites, but also charred barley (*Hordeum vulgare*), wheat grains (*Triticum* sp.), a single glume base of emmer (*Triticum dicoccum*), a single oat (*Avena* sp.) grain, indeterminate cereal grain, and a single hawthorn fruit. Rare charred seeds of cleavers (*Galium aparine*), wild raddish (*Raphanus raphanistrum*), herbaceous stem material and small indeterminate tubers were found in some deposits. The frequency of non-food items is extremely low suggesting little evidence for crop processing debris, dried kindling or anything other than wood fuel in the fires.

Fuelling the mounds

Identifiable charcoal assemblages were studied from 70 samples from 28 of the sites, covering all of the chronological phases of the mound activity discovered along the pipeline. Given the size of the assemblage and the relatively limited diversity of the taxonomic record, sub-samples of 30 fragments were identified per sample, using standard methodological practice. In some instances there were several samples per burnt mound, but other sites are represented by only a single sample. At some sites, such as Site 506, preservation of the charcoal was good. Other sites, such as the Dolau Farm sites (26.01, 26.02, 26.03), produced very poorly preserved charcoal, which was heavy with mineral deposits. It is assumed that this occurred as a result of deposition in a waterlain or waterlogged environment or due to a subsequent fluctuating water table.

Analysis of the charcoal demonstrates the dominance of three taxa in the assemblages, with oak, hazel and alder representing almost ninety per cent. These results are replicated by ubiquity analysis, showing the presence of oak in almost all and hazel in seventy-six per cent of analysed samples. The ubiquity of oak and hazel in the burnt mound charcoal and the restricted range of taxa suggests that deliberate selection for fuel was occurring, which in part would reflect the locally available resource, good burning qualities of oak and hazel and the ease with which these species can be managed. Like oak and hazel, alder will coppice and can supply firewood if well-seasoned. There was little chronological variation in the occurrence of the three main taxa; similarly, patterns related to geographical location or proximity to water sources were absent. The number of burnt mound sites discovered suggests a significant investment in the sourcing of firewood. The charcoal does not indicate any pressures on the woodland and derives from both young roundwood (with ring counts from three years' growth), to trunkwood or large branchwood (with some ring counts of more than 30 years growth). Mature oak heartwood was recorded in more than 160 fragments and the presence of bark testifies to the use of branches. Some fragments showing fast growth (>6mm average ring width) and slow growth (where growth in oak was restricted to only the large earlywood pores) were recorded, but the evidence was limited by the variable condition.

DISCUSSION

By Jonathan Hart and James Rackham

One of the most important results of the project is the number and density of burnt mound sites revealed along the route and lying within a modern agricultural landscape. Given that the pipeline generally crossed water courses at right-angles, rather than running alongside them, it is reasonable to suppose that many more mounds were present close to those reported on here, and that in the wider landscape many thousands probably await discovery, particularly below *c*. 250m above Ordnance Datum. An overview of the distribution of the mounds along the pipeline route confirms the view that the majority existed in valleys, a fact which is unsurprising given their association with water. However, the presence of upland burnt mounds, such as that at Pistyll-bâch (Site 15.02) is a reminder that water sources other than streams were sometimes utilised. None of the mounds along the route were found near a recorded contemporary settlement and the mound at Site 512 almost certainly post-dated a nearby cremation cemetery associated with a ring-ditch at Site 513. Although this could reflect the narrow width of the pipeline easement (40m) with undiscovered settlements potentially lying just beyond the excavated area, it does fit the general pattern for burnt mound sites established by open area excavations which suggests that mounds were not located adjacent to settlements (Kenney 2012, 263), although this is something that requires further research and survey.

At Glan-rŷd Bridge (Site 506), where the pipeline ran along rather than directly crossed the river bank, the number of burnt mounds found was significant (eight mounds and an isolated trough over a distance of 300m), and more may well lie beyond the easement. Together, these represent use over a remarkable period of time, perhaps as much as 16 centuries. Longevity of use was observed at other sites along the pipeline and at mound sites excavated elsewhere. Two burnt mounds recorded at Burlescombe, Devon were in use over a period of 10–170 years and 0–60 years (95% probability; Gent 2007, 37) whilst a mound site at Watermead Country Park, Leicestershire was in use over 1–100 years (95% probability; Ripper and Beamish 2011, 181). At Llandygai, North Wales, at least 14 mounds formed as a result of successive visitations over a period lasting from 3490–3120 to 1120–900 cal. BC (Flook and Kenney 2008, 61). Two mounds at Hoppenwood Bank, Northumberland may have dated to the Early Neolithic and Bronze Age, respectively; other mounds are known in the vicinity but it is not known whether collectively these represent continuous activity over some 2000 years, or whether two distinct and unrelated 'technologies' are preserved (Young 2014, 18–19).

The majority of the mounds along the pipeline had formed during the millennium separating the adoption of Beaker pottery and the Middle to Late Bronze Age transition, between approximately 2400 and 1400 BC. Examples pre- and post-dating this time span were few and this is reflected elsewhere but what is less apparent is what activity such sites represent. The limited material remains from the mounds along the pipeline provide further evidence for arguments that significant food consumption did not take place nor was there evidence for any craft or industrial processes. Archaeologists tend to rely on material culture to arrive at conclusions about the nature and functions of the remains encountered but, in the case of burnt mounds, it is this lack of evidence that must be used along with the limited archaeological information that is recovered. It is certainly possible that different mounds had different functions, or even that individual mounds had multiple functions. While the most commonly suggested uses for burnt mounds are that they were cooking places or saunas (Topping 2011), a range of alternative activities has been offered for the Irish examples including bathing, laundries, dyeing, brewing and possible ritual activities.[6] Experimental archaeology has shown that the troughs could be used to cook large joints of meat (O'Kelly 1954; Denvir 2002) and to brew.[7] The rarity of animal bone at mound sites would however necessitate the argument that such meat was consumed elsewhere (though this is in turn countered by an apparent lack of nearby contemporary settlements) and a model that envisages joints of meat being transported to and from a settlement before and after cooking seems unconvincing. It could be argued though that the cooking places were used only on certain occasions, with meat having been prepared at burnt mound sites for feasting events or ceremonies undertaken elsewhere. This is slightly more convincing as it explains the rarity of animal bones at the mounds, but fails to convincingly address the problem of transporting large joints of meat, with the attendant risk of loss and with the cooked joints cooling. It also fails to acknowledge that an important part of any ceremony involving the consumption of meat would be the anticipation of that consumption; the sight, sounds and smells of the cooking meat being prepared would have been important precursors to any consumption and would be lost if the meat was cooked away from the feasting site.

The major competing interpretation, that the burnt mound sites were the locations of saunas, is difficult to sustain from direct evidence as such a usage might be expected to leave little in the way of discarded material, whilst the sauna itself could easily have been constructed as a lightweight superstructure, such as a bender, which would leave little or no archaeological trace. The relative absence of cultural finds and food remains from the pipeline burnt mound sites is consistent with this interpretation, with the majority of environmental remains deriving from fuelwood. Using this interpretation, mound sites could be seen as washing places for everyday ablutions and this with their apparently ubiquitous nature would suggest a fairly well settled agricultural landscape not inconsistent with a patchwork of agricultural settlements within the otherwise wooded landscape suggested by the pollen evidence. However, at least some mounds may have been the sites of something more than simply pragmatic washing locations and it is possible that saunas could have been used during rituals such as rites of passage. Certainly this could explain the suggestion that the mounds were located away from settlements, with rites of passage being undertaken out of sight within wooded stream-side locations. Although there must have been a functional reason for mounds to have been sited next to a water source, water perhaps had a mystical meaning in prehistory (Darvill forthcoming) and siting the saunas near water may have been as much a recognition that these were liminal areas as a functional requirement. It is worth noting that the suggestion that mound sites may have related to brewing is not incompatible with an interpretation that sees them as having a ceremonial function. The extreme use of narcotics and steam bathing as trials by endurance during rites of passage are paralleled in the ethnographic and historical record: see Price (2010, 134) for an example of the former in a Viking funerary context, and Bucko (1998) for the use of sweat lodges during ritual activities amongst the Lakota Sioux. Even if some or all of the mounds were simply washing places, unrelated to formal ritual, it is easy to view such communal washing areas as locations outside the normal rules of the settlement site to which they were attached, where gossip could be exchanged, and the normal rites of life perhaps suspended.

Whether the mounds were used for washing or for laundry, brewing, dyeing, wool cleaning or any other activities that need fairly large quantities of warm water but leave little cultural residue, or they had a more ceremonial function, the longevity of many burnt mound sites, over decades and centuries, is suggestive of a cultural tradition. Given that many sites were revisited over generations, it may be that the mounds themselves were significant, providing visible markers enabling the sites to be rediscovered, and serving as reminders that some of these sites may have been liminal areas. The dark red and black colours of the mounds would have made them stand out and, along with their waterside locations, may have been resonant of concepts such as birth, death, darkness, blood, fire and water.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The pipeline provided a significant transect across South Wales, giving an opportunity to undertake archaeological investigations within areas that have seen little or no previous excavation. For all of the sites revealed, the narrow confines of the pipeline easement mean that it is unlikely that the full extent of the archaeological activity was revealed. The significance of the project therefore lies in the frequency with which remains such as the burnt mounds were discovered, their distributions and the opportunity to radiocarbon date and undertake Bayesian modelling for a relatively large number of these. Following on from the results of these investigations, a number of recommendations can be made for the future excavation of burnt mound sites.

A growing corpus of larger burnt mounds have been radiocarbon dated, but it would be useful to scientifically date sites that might relate to single events, associated mounds that might reflect sequential use, and large mounds that might indicate continual use over long periods.

More attention should be paid to the formation processes associated with the burnt mounds, in particular whether the mounds were formed on ground that had already been stripped to the natural substrate and where the stones, water and fuel were sourced from. Traditionally, mounds have been excavated in quadrants, often leaving fifty per cent of the mound intact. Instead, a single context approach to excavation would enable the formation processes to be better recorded, with the extent of each layer being established, allowing for calculations based on material volumes to be made about the duration and extent of periods of activity represented by each layer. Full excavation of each mound would also allow for all of the features sealed by the mound to be revealed, thus allowing more meaningful analysis of the number of associated features such as hearths and troughs. This approach should be tied to radiocarbon dating where possible, allowing the sequence thus revealed to be tied to a chronological framework. Bayesian analysis of such results has proved enlightening on larger mound sites, and should be applied where possible. Streams should be studied for flow rate, size and as a potential source of stone. Wider stripping beyond the limits of the mound might reveal tree throw pits or quarries as a possible source of stone.

If mounds were the product of a variety of uses then relevant organic remains may survive where waterlogging occurs. So, any waterlogged mounds should be targeted as a priority for environmental sampling employing a variety of lines of evidence.

The visibility of burnt mounds within the wider landscape should be considered, which would require both topographical analysis and a consideration of the contemporary vegetation.

In order to consider the interaction of mound sites with settlements and other monuments and topographical features, an extensive study of these elements within a defined area (such as a parish) could prove enlightening. Such a study would have to consider both the archaeological evidence and evidence such as soundscapes and viewscapes. For example, whilst rites of passage undertaken at a sauna may have been hidden from the rest of the population who stayed behind at the settlement, elements of the ritual may have been more widely tangible, most obviously columns of smoke from the hearths.

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APPENDIX 1: GAZETEER OF BURNT MOUND SITES ALONG THE PIPELINE

Table 1: Summary of burnt mound sites found along the South Wales gas pipeline

Site	Location	Site centred at	Height above OD	Shape and dimensions of mounds	No. layers	No. troughs	No. hearths
511	Upper Neeston, Herbrandston, Pembs.	SM 8796 0746	48m	oval, 17m × 12m; 0.15m thick	3	1, wooden	1
512	Steynton, Milford Haven, Pembs.	SM 9147 0834	40m	crescent, 18m × 12m, 0.5m thick	7	2	0
515	Uzmaston, Uzmaston and Boulston, Pembs.	SM 9699 1422	20m	not fully exposed, >10m wide, 0.25m thick	1	0	0
507	Church Hill, Uzmaston and Boulston, Pembs.	SM 9766 1475	20m	intermittent patches over 6.5m, 0.15m thick	3	0	0
				–	–	1	0
510	Scurtle, Wiston, Pembs.	SN 0250 1751	70m	oval, 7m × 6m, 0.25m thick	4	1	0
269	Canaston Wood, Llawhaden, Pembs.	SN 07 14	45m	7m diameter; unexcavated	–	0	0
285	Canaston Wood, Llawhaden, Pembs.	SN 07 14	45m	irregular, 9m × 6m; 0.3m thick	1	0	0
517	Canaston Wood, Llawhaden, Pembs.	SN 07 14	47m	intermittent patches, oval overall and covering 6.5m	3	0	0
518	Canaston Wood, Llawhaden, Pembs.	SN 07 14	56m	crescent, 6.5m × 3.5m, 0.35m thick	3	0	0
516	Canaston Wood, Llawhaden, Pembs.	SN 09 13	55m	oval? (not fully exposed) >4.5m wide	4	1?	0
244	Captain Style, Templeton, Pembs.	SN 1004 1331	85m	–	–	2?	0
506	Glan-rŷd Bridge, Lampeter Velfrey, Pembs.	SN 1598 1210	160m	mound 506003/019, crescent 10m × 5m, 0.4m thick	2	0	1?[1]
				mound 506051/506053	1	0	0
				mound 506034, partially exposed, >10m wide, 0.4m thick	5	0	0
				mound 506077/081, oval, 9m × 5m, 0.2m thick	2	0	2?[1]
				mound 506082, oval, 11m wide, 0.3m thick	1	0	0
				square trough 506078	–	1	0
				mound 506007, oval, 10m wide	1	1	0
				mound 506004, oval, 4m × 1.8m, 0.2m thick	1	1	1?[1]
				mound 506012, oval, 11m wide 0.5m thick	1	0	0
214	Vaynor Farm, Llanddowror, Carms.	SN 2400 1400	60m	mound 214004, sub-circular, 4.5m wide; 0.15m thick	1	0	0
		SN 2403 1400		mound 214007, partially exposed, > 8m × 7m wide, 0.15m thick	1	0	0

Table 1: Summary of burnt mound sites found along the South Wales gas pipeline *continued*

Site	Location	Site centred at	Altitude	Shape and dimensions of mounds	No. layers	No. troughs	No. hearths
300	Nantyietau, Llanddowror, Carms.	SN 2748 1458	25m	oval?, >4.75m × 3m, 0.2m thick	1	0	0
213	Gilfach, Llangain, Carms.	SN 3864 1470	45m	oval, 5.3m × 3.35m; 0.1m thick	1	0	0
294	Coedbach Park, Pontarddulais, Swansea	SN 5957 0243	30m	–	–	0	1?
		SN 5964 0236		–	–	1?	0
277	Gelli-march Farm, Blaenhonddan, Neath Port Talbot	SN 7601 0143	215m	intermittent, covering 15m area, 0.05m thick	1	0	0
278	Blaenhonddan, Neath Port Talbot	SN 7595 0146	215m	–	–	1?	0
13.01	Ammanford, Llandybie, Carms.	SN 6247 1388	50m	mound 131017, oval, 13m wide, 0.2m thick	1	2[2]	0
		SN 6250 1380		mound 131087, oval, 15m × 12m, 0.4m thick	1	0	0
15.02	Pistyll-bâch, Llandybie, Carms.	SN 6277 1685	120m	oval, 9.5m wide, 0.4m thick; layers of unburnt stones found near the burnt mound	5	8	0
OEA 11	Cilsan, Llangathen, Carms.	SN 5981 2222	35m	–	–	1?	0
21.02	Cilsan, Llangathen, Carms.	SN 6004 2248	35m	–	1	2	0
22.09	Llwyncelyn Farm, Llangathen, Carms.	SN 6055 2360	80m	circular, 4.5m wide, 0.4m thick	1	0	1
25.06	Rhosmaen House, Manordeilo and Salem, Carms.	SN 6400 2456	55m	oval, 10.6m × 9.8m, 0.7m thick	3	0	1
26.01	Dolau Farm, Manordeilo and Salem, Carms.	SN 6472 2496	40m	crescent, 12m × 5m; 0.35m thick	2	1[3]	0
				–	–	5	0
26.02	Dolau Farm, Manordeilo and Salem, Carms.	SN 65 25	40m	partially exposed, >11m wide, 0.2m thick	1	1	0
26.02	Dolau Farm, Manordeilo and Salem, Carms.	SN 65 25	40m	partially exposed, >6m wide 0.25m thick	1	0	0

Table 1: Summary of burnt mound sites found along the South Wales gas pipeline *continued*

Site	Location	Site centred at	Altitude	Shape and dimensions of mounds	No. layers	No. troughs	No. hearths
26.03	Dolau Farm, Manordeilo and Salem, Carms.	SN 65 25	40m	intermittent, over an area 10m × 5m	1	1[4]	5[5]
26.06	Llechwen-dderi, Manordeilo and Salem, Carms	SN 6544 2547	60m	oval, 5.8m wide, 0.15m thick	2	0	0
28.08	Bail y Llwyd, Manordeilo and Salem, Carms	SN 6794 2768	80m	partially exposed, > 7m × 3.5m, 0.4m thick	1	1	0
28.08a	Bail y Llwyd, Manordeilo and Salem, Carms.	SN 6771 2765	80m	oval, 9m × 6.6m	4	1–3	0
28.14	Bail y Llwyd, Manordeilo and Salem, Carms	SN 6812 2806	80m	oval, 6m wide, 0.15m thick	1	0	0
28.23	Aber-Marlais Park, Llansadwrn,	SN 6859 2906	80m	mound 2823122, partially exposed, >2.6m wide, 0.15m thick	1	2	1?[1]
		SN 6857 2892	80m	mound 2823103, intermittent, > 1.4m wide	1	0	0

Notes
1. Scorched substrate below mound.
2. One was clay-lined.
3. Internal postholes, to ?retain lining.
4. Possible wood lining.
5. Five hearths exposed in nearby evaluation trenches, one with an Early Bronze Age radiocarbon date.

APPENDIX 2: RADIOCARBON DATING AND BAYESIAN ANALYSIS
By Seren Griffiths

Introduction

Two phases of work occurred as part of the chronological analysis of burnt mounds from the scheme. From the first phase of work plant macrofossil remains were radiocarbon dated (samples with the laboratory code Beta-, with the exception of Beta-396753 and Beta-396752, which were dated as part of the second phase). Radiocarbon dates from the second phase of work were produced on short-life, single entity (Ashmore 1999) charred plant remains from deposits associated with burnt mounds from across the scheme. Where multiple burnt mounds were excavated on a single site and suitable samples were available, results were produced to investigate the landscape development and activity associated with different burnt mounds over time. Samples with the Beta- laboratory code were pre-treated as detailed here <http://www.radiocarbon.com/>. Samples with the SUERC- laboratory code were pretreated using an acid-base-acid process (cf. Mook and Waterbolk 1985), combusted (Vandeputte *et al.* 1996; Freeman *et al.* 2010), graphitized (Slota *et al.* 1987) and dated by Accelerator Mass Spectrometry (AMS; Xu *et al.* 2004; Freeman *et al.* 2010). The results are conventional radiocarbon ages (Stuiver and Polach 1977), quoted according to the international standard set at the Trondheim Convention (Stuiver and Kra

1986). The results have been calibrated using IntCal13 (Reimer *et al*. 2013), and OxCal v4.2 (Bronk Ramsey 1995; 1998; 2001; 2009). The date ranges given below have been calculated using the maximum intercept method (Stuiver and Reimer 1986) and have the endpoints rounded outward to 10 years. The probability distributions shown in the figures were obtained by the probability method (Stuiver and Reimer 1993).

Bayesian modelling

Bayesian modelling provides a means of revising understandings of scientific dates, using archaeological "prior information", or understandings of the relationships between measurements (Buck *et al.* 1991; 1992; 1994). It has been applied here using OxCal v4.2 (Bronk Ramsey 1995; 1998; 2001; 2009). Different types of archaeological understandings of the relationships between scientific dating measurements can be more or less informative (Bayliss *et al.* 2007); the nature of the models applied here are described in the text; the OxCal Command Query Language keywords and brackets shown in the text define the model applied here. The outputs of the Bayesian models are quoted in italics.

Results and Bayesian modelling

The results from the burnt mounds from the project have been presented in a single figure for most of the sites where there are insufficient results to constrain the data. The results are presented as shown in Figure 12. Results from Sites 512, 13.01, 511 and 506 have been constrained within site-specific models. Results from Site 512 are presented as representing a phase of archaeological activity; this interpretation is discussed in more detail below. Results from Site 13.01 are presented as deriving from phases of archaeological activity at each site. Results from Site 511 are presented as representing a sequence of events, with a result on oak heartwood from the burnt mound trough (Beta-218656) represented as earlier than results on shortlife samples associated with the use of the burnt mound (SUERC-55517, SUERC-55518, Beta-257710, Beta-257711). Results from Site 506 are modelled to represent the stratigraphic relationship between burnt mound features 506074 and 506068, and the interpretation that all burnt mounds on Site 506 represent an archaeological phase of activity; this interpretation is discussed in further detail below. Radiocarbon results from other sites on the project are calibrated to provide estimates for activity associated with individual phases of activity at different sites. Results from individual sites are detailed below and in Table 2.

Site 511 Upper Neeston

Five radiocarbon results on material associated with the mound at Site 511 include four statistically consistent results on shortlife samples (T'=1.9; T'5%=9.5; df=3; Ward and Wilson 1978), which could be of the same actual age. Two results were produced on charred grain from context 511255 (Beta-257710 and Beta-257711), while two were produced on charcoal from the burnt mound (SUERC-55517 and -55518). Another result (Beta-218656) was produced on oak wood from the trough, which may be subject to an inbuilt 'old wood' offset. A radiocarbon model that reflects the interpretation that the burnt mound was constructed *after* the measurement on the mature oak timber from the trough (Beta-218656, which must be older than the date of felling of the timber and the construction of the mound), but before the use of the burnt mound (reflected by Beta-257710, Beta-257711, and SUERC-55517 and -55518) estimates that the mound was constructed in 1500–1410 cal. BC (95% probability), most probably in the 50 years between *1470–1420 cal. BC* (68% probability; *Construct 511*, Fig. 15). This model has good overall agreement (A overall =121%). The end of activity associated with this mound is estimated to have occurred in *1490–1350 cal. BC* (95% probability; or *1440–1400 cal. BC*, 68% probability; *End 511*, Fig. 4). The duration of activity represented by the use of the mound is estimated at between *1–70 years* (95% probability, or *1–30 years* (68% probability; *Duration 511*).

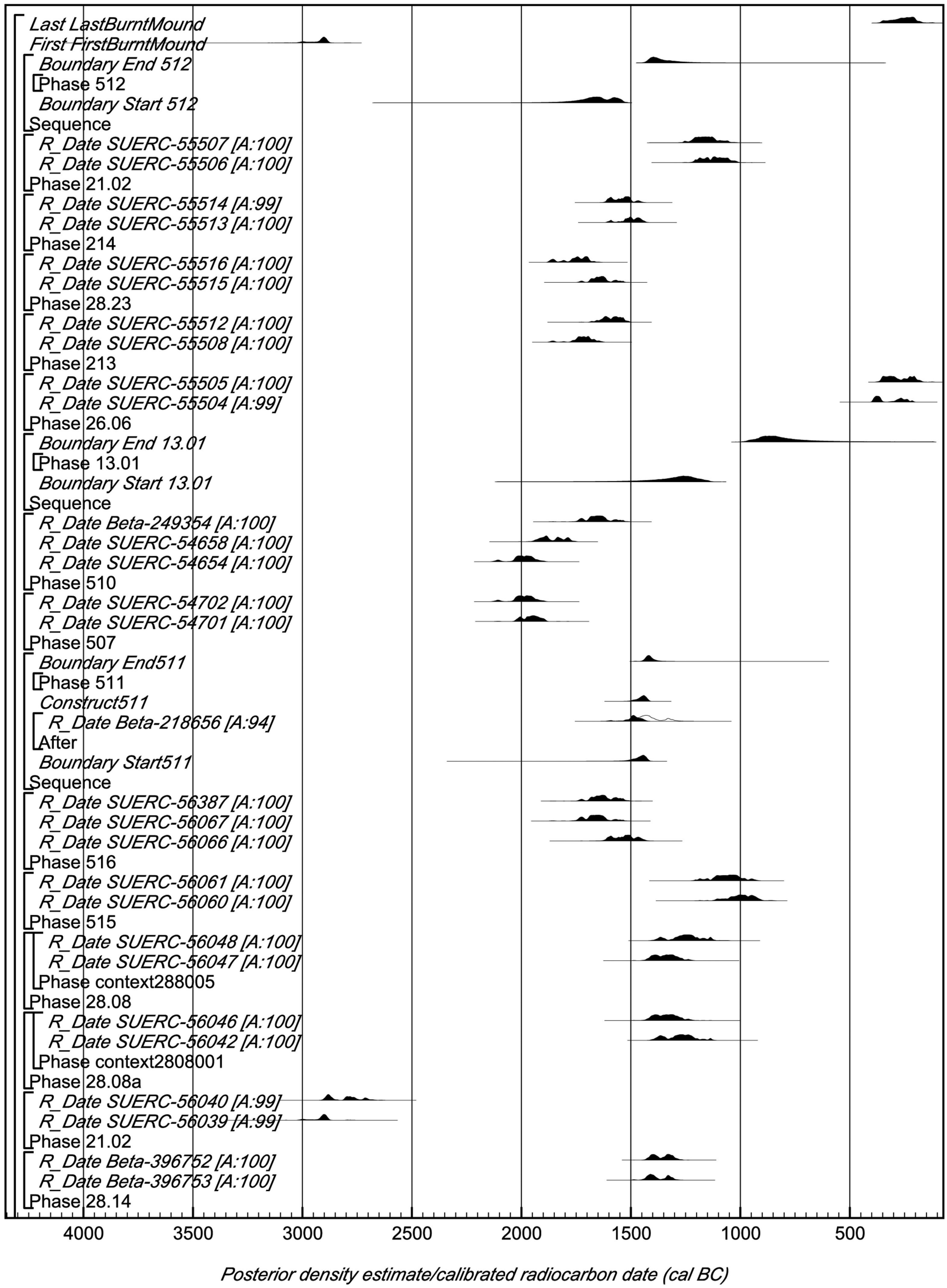

Fig. 12. Calibrated radiocarbon results and posterior density estimates from burnt mounds from sites excavated as part of the scheme. Details of the site Bayesian models for Sites 512, 13.01, 511, and 506 are shown below, parameters of the same name for these sites shown in Fig. 12 are the same as those shown in the following figures.

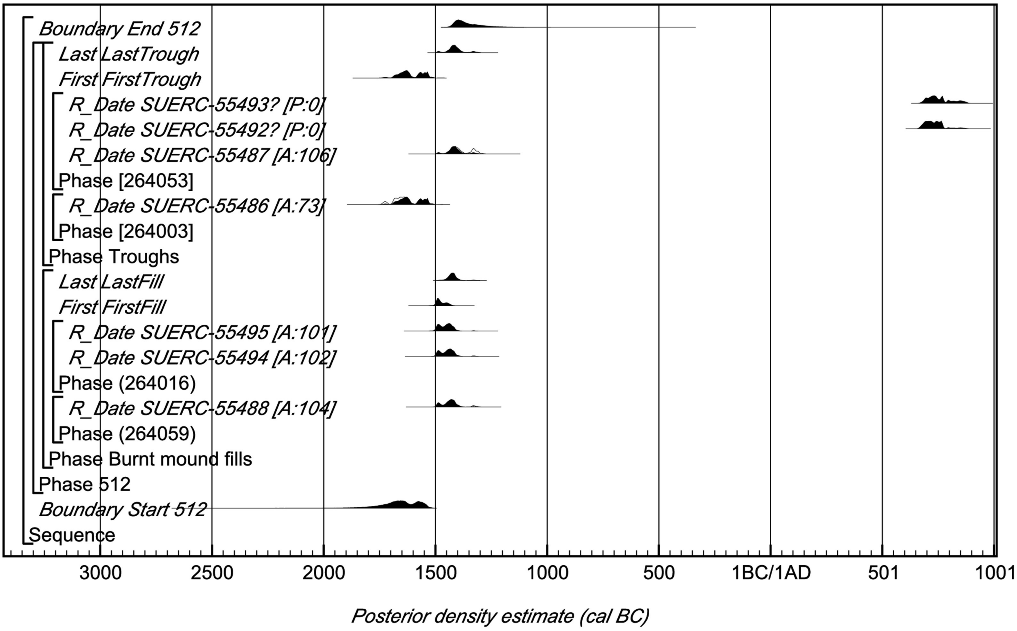

Fig. 13. Chronological model for the results from Site 512. For each radiocarbon result included in the model two ranges have been plotted. The ranges in outline represent the calibrated radiocarbon results, the solid distributions represent the posterior density estimates (the outputs from the Bayesian statistical model illustrated in the figure). The brackets and OxCal keywords define the model, which is described in the text.

Site 512 Steynton

Seven radiocarbon dates were produced on shortlife samples from deposits associated with the burnt mounds and troughs at Site 512 (Fig. 13). Three radiocarbon dates from burnt mound deposits are statistically consistent (SUERC-55488, -55494, -55495; T'=0.2; T'5%=6.0; df=2; Ward and Wilson 1978), and could be of the same actual age. A weighted mean taken prior to calibration suggests that if the activity represented by these results represented a single 'archaeological event', these burnt mounds deposits could have been associated with activity in the 15th century cal. BC.

The model for Site 512 has good overall agreement (A overall =100%). Of the samples from trough fills, SUERC-55487 (trough 264039) reflects the evidence from the burnt mound deposits and suggests activity in the 15th or 14th centuries cal. BC. Also from trough 264039 a single result (SUERC-55486) is much older than the other scientific dates from the site and indicates activity in *1740–1530 cal. BC* (95% probable), most probably in the 17th century cal. BC in *1690–1610 cal. BC* (68% probable; SUERC-55486; Fig. 13). Two other results from a pit on the site (SUERC-55492 and -55493) are statistically consistent (T'=0.2; T'5%=3.8; df=1; Ward and Wilson 1978), and could be of the same actual age, in the later 7th or 8th centuries cal. AD. These later samples were initially thought to derive from a trough, but subsequent stratigraphic analysis indicates that they derive from a later intercutting feature and are most probably unrelated to the burnt mound activity.

The periodicity of Bronze Age activity at the site could include multiphase activity associated with the use of burnt mounds (as represented by SUERC-55486), which is poorly represented within the radiocarbon sample, or that the radiocarbon dates from the site reflect activity of much shorter duration focusing on the 15th century cal. BC with much earlier and poorly understood human presence in the area. *If* the statistically consistent results from the burnt mound fills represent the main focus of activity at the site this might be estimated to have begun in *1510–1420 cal. BC* (95% probable, or *1500–1440 cal. BC*, 68% probable; *FirstFill*, Fig. 13), and ended in *1470–1380 cal.* BC (96% probable, or *1350–1310 cal. BC*, 9% probable, or *1450–1400 cal. BC*, 68% probable; *LastFill*, Fig. 13).

Site 507 Church Hill

Two results were produced on burnt mound layer 507111 from Church Hill (Fig. 12; SUERC-54702 and -54701). These results are statistically consistent (T'=0.4; T'5%=3.8; df=1) and could be of the actual age. If these results represent the same archaeological event, a weighted mean taken prior to calibration would suggest that activity occurred at the very end of the 21st century cal. BC or the 20th century cal. BC.

Site 510 Scurtle

Three results were produced on shortlife charcoal from layers associated with the use of the burnt mound at Scurtle (Fig. 12). These results are all statistically significantly different (T'=28.9; T'5%=6.0; df=2) and probably indicate activity at the burnt mound site over a considerable period of time. The earliest activity is represented by the sample measured by SUERC-54654 to 2130–1900 cal. BC (95% confidence), and the latest activity is represented by the sample measured by Beta-249354 to 1750–1530 cal. BC (95% confidence).

Site 506 Glan-rŷd Bridge

Duplicate results were selected from features and burnt mounds at Site 506. Where possible these were demonstrably independent samples, ie material of different organisms that provide independent measurements for the age of associated activity. In the case of mound 506012, three measurements were commissioned, two on charcoal and one on wheat grains from the same context. In many cases (Table 2), the duplicate results are statistically inconsistent, indicating that activity of several different radiocarbon ages was probably represented at the parent feature. In many cases these results probably indicated that activity went on for a period of time, or features were reused later. Given the spread of the dates (Fig. 16) and number of burnt mounds in this landscape it must be concluded that there was considerable attraction over a period of time at this place. There does not appear to be any particular spatial trend in the use of the burnt mounds at Site 506. The earliest activity for which we have scientific dating evidence is associated with burnt mound 506007. After this, the results from burnt mound 506034, 506082 and 506004 are all statistically consistent and could be of the same actual age (SUERC-52544, -52548, -52562, -52564, -52568; T'=0.9; T'5%=11.1; df=5). The ranges for these results are deleteriously affected by the shape of the calibration curve, but could represent activity in the second half of the 25th century cal. BC to the 24th century cal. BC. The last evidence for activity we have on the site from radiocarbon dates is estimated to have occurred in *1410–1100 cal. BC* (95% probability; *1390–1250 cal. BC*, 68% probability; *End 506*, Fig. 16). This represents a duration of *1250–1570 years* (95% probability; or *1290–1450 years*, 68% probability; *Duration 506*).

Site 213 Glifach

Two radiocarbon results produced on shortlife samples from burnt mound layer 213004 were statistically inconsistent (T'=6.0; T'5%=3.8; df=1; Ward and Wilson 1978) and indicate that activity at the site occurred between 1870–1630 cal. BC (95% confidence; SUERC-55508) and 1690–1500 cal. BC (95% confidence; SUERC-55512; Fig. 12).

Site 214 Vaynor Farm

Two radiocarbon results produced on shortlife samples from two burnt mounds (214004 and 214007) were statistically consistent (T'=0.5; T'5%=3.8; df=1; Ward and Wilson 1978; Fig. 12) and could be of the same actual age. The burnt mounds at this site therefore could have been in use at the same time. If these results represented a single 'archaeological event', a weighted mean taken prior to calibration might suggest activity associated with the burnt mounds in the late 17th to 15th centuries cal. BC.

Site 13.01 Ammanford

Four radiocarbon dates were produced from two burnt mounds at Site 13.01. Two statistically inconsistent measurements (SUERC-55496 and -55497) were produced on charcoal from a posthole associated with burnt mound 131017, and SUERC-55498 from a deposit within this burnt mound. SUERC-55502 was produced on a deposit within burnt mound 131087. The four results could indicate that the site was the focus of at least two phases of activity, with earlier activity represented by SUERC-55497 and -55502, and then later activity by SUERC-55496 and -55498. Currently insufficient results exist to determine whether activity at the site was punctuated or more continuous, but the presence of two burnt mound troughs might be taken as further evidence to indicate two relatively discrete phases. The first dated event associated with the burnt mounds at Site 13.01 is estimated as *1290–1120 cal. BC* (95% probable, or *1270–1160 cal. BC*, 68% probable; *First13.01*, Fig. 14). The last dated event associated with the burnt

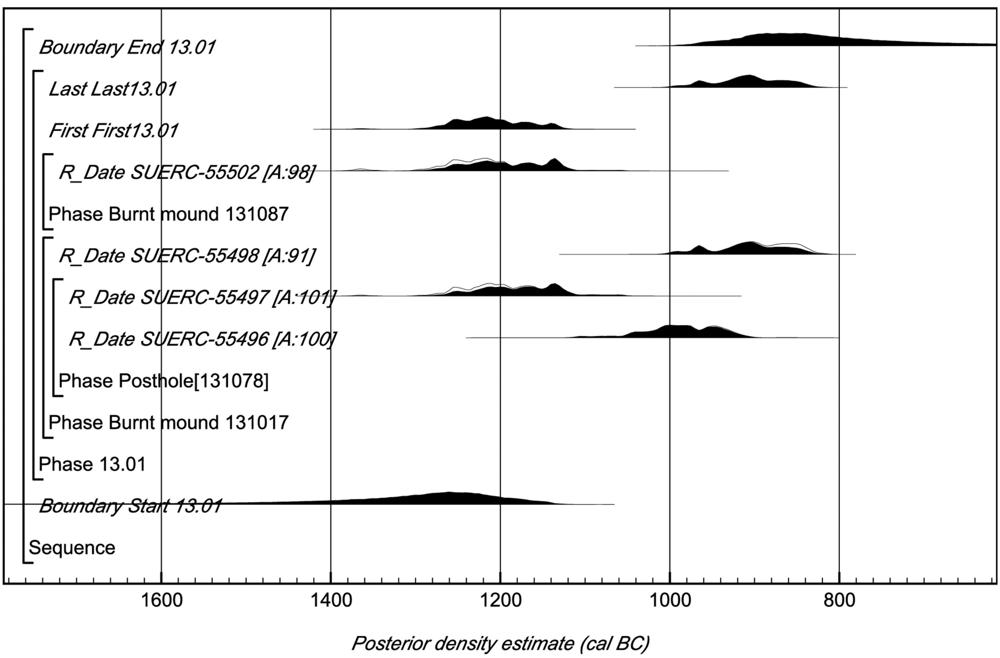

Fig. 14. Chronological model for the results from Site 13.01. For each radiocarbon result included in the model two ranges have been plotted. The ranges in outline represent the calibrated radiocarbon results, the solid distributions represent the posterior density estimates (the outputs from the Bayesian statistical model illustrated in the figure). The brackets and OxCal keywords define the model, which is described in the text.

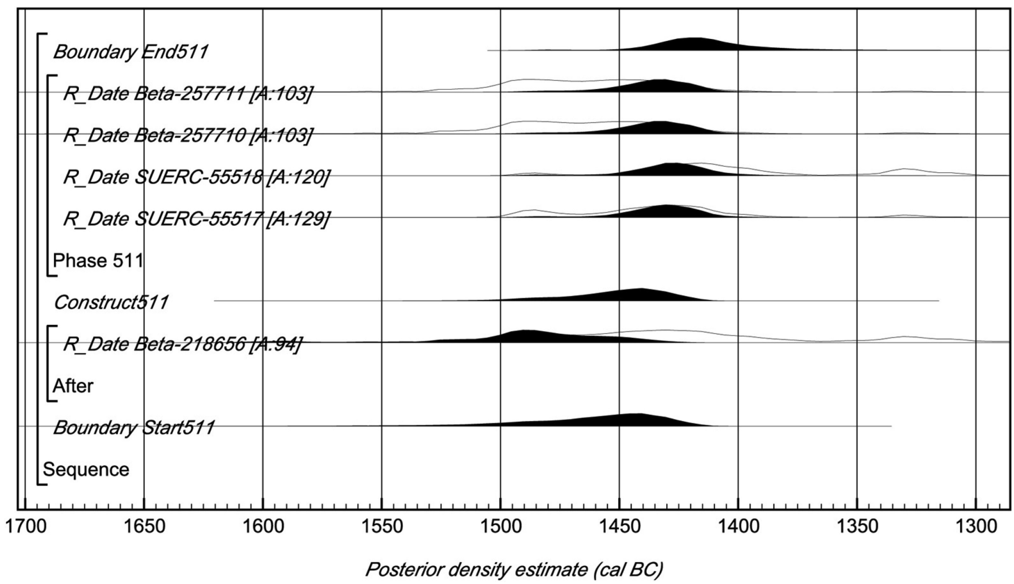

Fig. 15. Chronological model for the results from Site 511. For each radiocarbon result included in the model two ranges have been plotted. The ranges in outline represent the calibrated radiocarbon results, the solid distributions represent the posterior density estimates (the outputs from the Bayesian statistical model illustrated in the figure). The brackets and OxCal keywords define the model, which is described in the text.

mounds at the site is estimated as *990–830 cal. BC* (95% probable; or *970–960 cal. BC*, 5% probable, or *940–850 cal. BC*, 63% probable; *Last13.01*; Fig. 14). The duration of activity represented by these results is estimated as occurring over *170–420 years* (95% probable, or *240–370 years*, 68% probable; *Duration13.01*).

Site 21.02 Cilsan

Two radiocarbon results produced on shortlife samples from burnt mound layer 212055 from were statistically consistent (T'=0.4; T'5%=3.8; df=1; Ward and Wilson 1978; Fig. 12) and could be of the same actual age. If these results represented a single 'archaeological event', a weighted mean taken prior to calibration might suggest activity associated with the burnt mound in the 13th to 11th centuries cal. BC.

26.02 Dolau Farm

A single result (SUERC-56041) was produced from the burnt mound at Dolau Farm. This result probably dates the use of the burnt mound in 1380–1050 cal. BC (95% confidence; SUERC-56041; Fig. 12).

Site 26.06 Llechwen-dderi

Two radiocarbon results produced on shortlife samples from burnt mound layer 2606003 were statistically consistent (T'=3.4; T'5%=3.8; df=1; Ward and Wilson 1978; Fig. 12) and could be of the same actual age. If these results represented a single 'archaeological event', a weighted mean taken prior to calibration might suggest activity associated with the burnt mound in the 4th or 3rd centuries cal. BC.

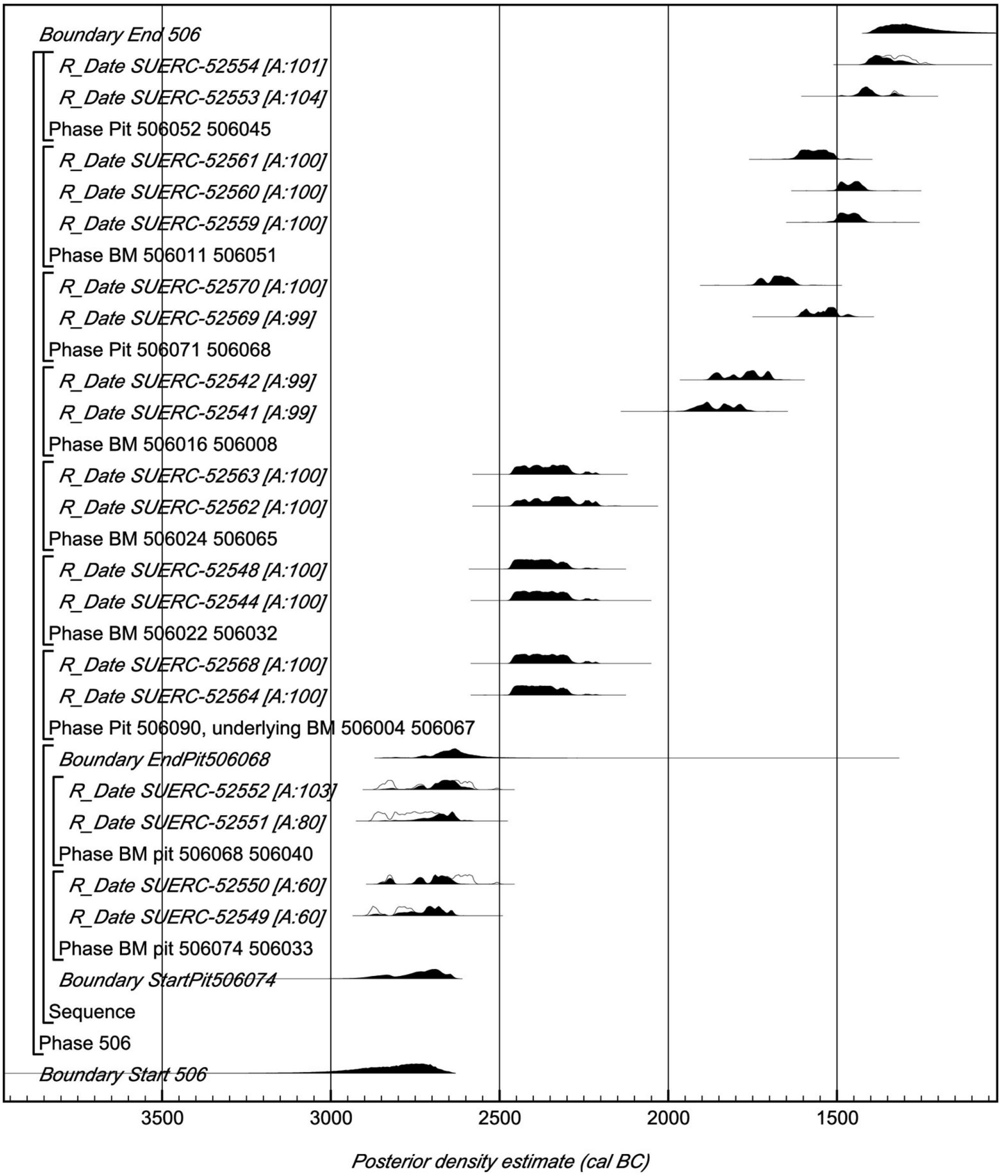

Fig. 16. Chronological model for the results from Site 506. For each radiocarbon result included in the model two ranges have been plotted. The ranges in outline represent the calibrated radiocarbon results, the solid distributions represent the posterior density estimates (the outputs from the Bayesian statistical model illustrated in the figure). The brackets and OxCal keywords define the model, which is described in the text.

28.08 Bail y Llwyd

Two results were produced from trough fill 288005. The results from each deposit are statistically consistent (SUERC-56042 and SUERC-56046; T'=1.0; T'5%=3.8; df=1; Fig. 17) and suggest activity in 1410–1120 cal. BC (95% confidence; SUERC-56042) and 1440–1220 cal. BC (95% confidence; SUERC-56046).

28.08a Bail y Llwyd

Two results were produced from trough fill 2808001. The results are statistically consistent (SUERC-56042 and -56046; 2808001; T'=1.9; T'5%=3.8; df=1; Fig. 12), and suggests activity in 1440–1230 cal. BC (95% confidence; SUERC-56047) and 1400–1120 cal. BC (95% confidence; SUERC-56048).

28.14 Bail y Llwyd

Two statistically consistent results (Beta-396753 and Beta-396752; T'=0.2; T'5%=3.8; df=1; Ward and Wilson 1978) were obtained from the burnt mound and date its use to 1440–1270 cal. BC (95% confidence; Beta-396752) and 1450–1290 cal. BC (95% confidence; Beta-396753; Fig. 12).

Site 28.23 Aber-Marlais Park

Two radiocarbon results produced on shortlife samples from trough fill 2823138 were statistically inconsistent (T'=4.7; T'5%=3.8; df=1; Ward and Wilson 1978; Fig. 12), and indicate that activity occurred between 1740–1530 cal. BC (95% confidence; SUERC-55515) and 1880–1660 cal. BC (95% confidence; SUERC-55516).

SITE 512 STEYNTON

SUERC-55486 (GU35181)
Sample: 264012, *Corylus* sp. charcoal
Context: 264005, fill of trough 264039
Result: 3359±30 BP; δ13C: –27.6
Calibrated date range (95% confidence): 1740–1560 cal. BC
Posterior density estimate: *1740–1600 cal. BC* (84% probability) or *1590–1530 cal. BC* (11% probability).

SUERC-55492 (GU35184)
Sample: 264006, *Cytisus*/*Ulex* charcoal
Context: 264005, fill of trough 264039
Result: 1268±30 BP; δ13C: –25
Calibrated date range (95% confidence): cal. AD 660–780
Posterior density estimate: *cal. AD 660–810* (94% probability)
Note: statistically consistent with SUERC-55493; T'=0.2; T'5%=3.8; df=1

SUERC-55493 (GU35185)
Sample: 264006, *Alnus*/*Corylus* charcoal
Context: 264005, fill of trough 264039
Result: 1247±30 BP; δ13C: –25.3
Calibrated date range (95% confidence): cal. AD 670–880
Posterior density estimate: *cal. AD 670–870* (94% probability)
Note: statistically consistent with SUERC-55492; T'=0.2; T'5%=3.8; df=1

SUERC-55487 (GU35182)
Sample: 264010, *Alnus*/*Corylus* charcoal
Context: 264056, fill of trough 264039
Result: 3126±30 BP; δ13C: –26.4
Calibrated date range (95% confidence): 1450–1300 cal. BC
Posterior density estimate: *1460–1290 cal. BC* (94% probability)

SUERC-55488 (GU35183)
Sample: 264007, *Alnus*/*Corylus* charcoal
Context: 264059, fill of burnt mound 264057, dark grey-brown silty sand
Result: 3155±30 BP; δ13C: –26.3
Calibrated date range (95% confidence): 1500–1320 cal. BC
Posterior density estimate: *1500–1380 cal. BC* (91% probability)

SUERC-55494 (GU35186)
Sample: 264005, *Corylus* sp. charcoal
Context: 264016, fill of burnt mound 264013, dark grey-black silt and burnt stone
Result: 3167±30 BP; δ13C: –25.2
Calibrated date range (95% confidence): 1510–1390 cal. BC
Posterior density estimate: *1510–1390 cal. BC* (95% probability)
Note: statistically consistent with SUERC-55495; T'=0.0; T'5%=3.8; df=1

SUERC-55495 (GU35187)
Sample: 264004, *Alnus* sp. charcoal
Context: 264016, fill of burnt mound 264013, dark grey-black silt and burnt stone
Result: 3175±30 BP; δ13C: –26.8

Calibrated date range (95% confidence): 1510–1400 cal. BC
Posterior density estimate: *1510–1400 cal. BC* (95% probability)
Note: statistically consistent with SUERC-55494; T'=0.0; T'5%=3.8; df=1

SITE 13.01 AMMANFORD

SUERC-55496 (GU35188)
Sample: 1313021, *Alnus glutinosa* charcoal
Context: 131079, posthole fill associated with trough, in burnt mound 131017
Result: 2832±30 BP; δ13C: –27.2
Calibrated date range (95% confidence): 1060–900 cal. BC
Posterior density estimate: *1090–910 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-55497; T'=11.2; T'5%=3.8; df=1.

SUERC-55497 (GU35189)
Sample: 1313021, *Fraxinus* sp. charcoal
Context: 131079, posthole fill associated with trough, in burnt mound 131017
Result: 2974±30 BP; δ13C: –25.5
Calibrated date range (95% confidence): 1280–1110 cal. BC
Posterior density estimate: *1280–1050 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-55496; T'=11.2; T'5%=3.8; df=1

SUERC-55498 (GU35190)
Sample: 1313017, *Alnus glutinosa* charcoal
Context: 131044, angular stone in a loose brown-grey silty clay matrix in burnt mound 131017
Result: 2754±30 BP; δ13C: –26.7
Calibrated date range (95% confidence): 980–820 cal. BC
Posterior density estimate: *1000–830 cal. BC* (95% probability)

SUERC-55502 (GU35191)
Sample: 1313039, *Corylus* sp. charcoal
Context: 131088, burnt mount 131087 upper layer: angular stone in a dark brown silty matrix/firm grey clay with small stone within mound material
Result: 2986±30 BP; δ13C: –26.6
Calibrated date range (95% confidence): 1370–1110 cal. BC
Posterior density estimate: *1300–1110 cal. BC* (95% probability)

SITE 26.06 LLECHWEN-DDERI

SUERC-55504 (GU35193)
Sample: 2606002, *Corylus* sp. charcoal
Context: 2606003, burnt mound deposit of compacted brown-grey clay silt with high quantities of burnt stone and charcoal
Result: 2269±30 BP; δ13C: –26.2
Calibrated date range (95% confidence): 400–210 cal. BC
Note: statistically consistent with SUERC-55505; T'=3.4; T'5%=3.8; df=1)

SUERC-55505 (GU35194)
Sample: 2606003, *Corylus* sp. charcoal
Context: 2606003, burnt mound deposit of compacted brown-grey clay silt with high quantities of burnt stone and charcoal
Result: 2191±30 BP; δ13C: –25.6
Calibrated date range (95% confidence): 370–170 cal. BC
Note: statistically consistent with SUERC-55504; T'=3.4; T'5%=3.8; df=1

SITE 21.02 CILSAN

SUERC-55506 (GU35195)
Sample: 2123021, *Corylus* sp. charcoal
Context: 212055, yellow-grey silty clay burnt mound fill
Result: 2922±30 BP; δ13C: –28.3
Calibrated date range (95% confidence): 1220–1010 cal. BC
Note: statistically consistent with SUERC-55507; T'=0.4; T'5%=3.8; df=1

SUERC-55507 (GU35196)
Sample: 2123021, Maloideae charcoal
Context: 212055, yellow-grey silty clay burnt mound fill
Result: 2950±30 BP; δ13C: –26.8
Calibrated date range (95% confidence): 1260–1040 cal. BC
Note: statistically consistent with SUERC-55506; T'=0.4; T'5%=3.8; df=1

SITE 213 GILFACH

SUERC-55508 (GU35197)
Sample: 213000, *Alnus* sp. charcoal
Context: 213004, burnt mound layer; charcoal, ash and burnt stone burnt mound layer
Result: 3418±30 BP; δ13C: –26.7
Calibrated date range (95% confidence): 1870–1630 cal. BC
Note: statistically inconsistent with SUERC-55512; T'=6.0; T'5%=3.8; df=1

SUERC-55512 (GU35198)
Sample: 213000, *Corylus* sp. charcoal
Context: 213004, burnt mound layer; charcoal, ash and burnt stone burnt mound layer
Result: 3314±30 BP; δ13C: –26
Calibrated date range (95% confidence): 1690–1500 cal. BC
Note: statistically inconsistent with SUERC-55508; T'=6.0; T'5%=3.8; df=1

SITE 214 VAYNOR FARM

SUERC-55513 (GU35199)
Sample: 214002, *Corylus* sp. charcoal
Context: 214004, burnt mound layer; charcoal and burnt stone layer
Result: 3231±30 BP; δ13C: –25.4
Calibrated date range (95% confidence): 1610–1430 cal. BC
Note: statistically consistent with SUERC-55514; T'=0.5; T'5%=3.8; df=1

SUERC-55514 (GU35200)
Sample: 214001, *Corylus* sp. charcoal
Context: 214007, burnt mound layer; charcoal and burnt stone layer
Result: 3260±30 BP; δ13C: –25.5
Calibrated date range (95% confidence): 1620–1450 cal. BC
Note: statistically consistent with SUERC-55513; T'=0.5; T'5%=3.8; df=1

SITE 28.23 ABER-MARLAIS PARK

SUERC-55515 (GU35201)
Sample: 2823013, *Corylus* sp. charcoal
Context: 2823138, fill of trough; pale blue silty clay with burnt stone and charcoal
Result: 3347±30 BP; δ13C: –24.6
Calibrated date range (95% confidence): 1740–1530 cal. BC
Note: statistically consistent with SUERC-55516; T'=4.7; T'5%=3.8; df=1

SUERC-55516 (GU35202)
Sample: 2823013, *Alnus* sp. charcoal
Context: 2823138, fill of trough; pale blue silty clay with burnt stone and charcoal
Result: 3439±30 BP; δ13C: –27.5
Calibrated date range (95% confidence): 1880–1660 cal. BC
Note: statistically consistent with SUERC-55515; T'=4.7; T'5%=3.8; df=1

SITE 511 UPPER NEESTON

SUERC-55517 GU35203)
Sample: 511002, *Alnus* sp. charcoal
Context: 511009, burnt mound fill; dark grey-black heat-affected stone
Result: 3157±30 BP; δ13C: –27.3
Calibrated date range (95% confidence): 1500–1320 cal. BC
Posterior density estimate: *1490–1400 cal. BC* (95% probability)
Note: statistically consistent with SUERC-55518, Beta-257710, Beta-257711; T'=1.9; T'5%=7.8; df=3

SUERC-55518 (GU35204)
Sample: 511002, *Quercus* sp. roundwood charcoal
Context: 511009, burnt mound fill; dark grey-black heat-affected stone
Result: 3134±30 BP; δ13C: –25.7
Calibrated date range (95% confidence): 1500–1320 cal. BC
Posterior density estimate: *1490–1390 cal. BC* (95% probability)
Note: statistically consistent with SUERC-55517, Beta-257710, Beta-257711; T'=1.9; T'5%=7.8; df=3

Beta-257710
Sample: 511024, 'charred grain'
Context: 511255, burnt mound fill; dark grey-black heat-affected stone
Result: 3190±40 BP
Calibrated date range (95% confidence): 1530–1400 cal. BC
Posterior density estimate: *1490–1400 cal. BC* (95% probability)
Note: statistically consistent with SUERC-55517, SUERC-55518, Beta-257711; T'=1.9; T'5%=7.8; df=3

Beta-257711
Sample: 511028, 'charred grain'
Context: 511255, burnt mound fill; dark grey-black heat-affected stone
Result: 3190±40 BP
Calibrated date range (95% confidence): 1530–1400 cal. BC
Posterior density estimate: *1490–1400 cal. BC* (95% probability)
Note: statistically consistent with SUERC-55517, SUERC-55518, Beta-257710; T'=1.9; T'5%=7.8; df=3

Beta-218656
Sample: WOOD001, edge of a mature oak wood timber
Context: trough 511353; 4.2m-long oak trough 511353 had been set within a narrow, east/west-aligned, purpose-dug trench 511358 cut into the clay bed and clay and stone eastern bank of the former stream course. The dated element was material damaged by machining during the initial discovery. 114 rings have been preserved in the sampled core, but this may not represent the full heartwood sequence. No sapwood survived on the timber.
Result: 3160±50 BP
Calibrated date range (95% confidence): 1530–1300 cal. BC
Posterior density estimate: *1560–1420 cal. BC* (91% probability)

SITE 507 CHURCH HILL

SUERC-54701 (GU34696)
Sample: 507001, *Alnus glutinosa* charcoal
Context: 507011, burnt mound layer
Result: 3598±29 BP; δ13C: –25.9
Calibrated date range (95% confidence): 2040–1880 cal. BC

SUERC-54702 (GU34697)
Sample: 507002, *Alnus* sp charcoal
Context: 507111, burnt mound layer
Result: 3624±29 BP; δ13C: –26.4
Calibrated date range (95% confidence): 2120–1890 cal. BC

SITE 510 SCURTLE

SUERC-54654 (GU34664)
Sample: 510006, *Corylus* sp. charcoal
Context: 510019, burnt mound deposit; dark brown silt with burnt pebbles
Result: 3626±29 BP; δ13C: –27
Calibrated date range (95% confidence): 2130–1900 cal. BC

SUERC-54658 (GU34665)
Sample: 510023, *Corylus* sp. charcoal

Context: 510007, fill of oval pit which might have been trough
Result: 3535±29 BP; δ13C: –27.4
Calibrated date range (95% confidence): 1950–1760 cal. BC

Beta-249354
Sample: 510008, one fragment of *Alnus/Corylus avellana* branchwood
Context: 510031, burnt mound deposit; charcoal lens within the main deposit (510029)
Result: 3360±40 BP
Calibrated date range (95% confidence): 1750–1530 cal. BC

SITE 506 GLAN-RŶD BRIDGE

SUERC-52541
Sample: 506039, *Corylus avellana* charcoal >8 rings
Context: burnt mound 506019
Result: 3532±29 BP; δ13C: –25.9
Calibrated date range (95% confidence): 1950–1760 cal. BC
Posterior density estimate: *1950–1760 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52542; T'=4.0; T'5%=3.8; df=1

SUERC-52542
Sample: 506039, *Quercus* sp. roundwood charcoal 13+ rings
Context: burnt mound 506019
Result: 3453±27 BP; δ13C: –25.5
Calibrated date range (95% confidence): 1880–1680 cal. BC
Posterior density estimate: *1880–1690 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52541; T'=4.0; T'5%=3.8; df=1

SUERC-52544
Sample: 506038, *Quercus* sp. sapwood charcoal 25+ rings
Context: burnt mound 506034
Result: 3881±29 BP; δ13C: –24.4
Calibrated date range (95% confidence): 2470–2210 cal. BC
Posterior density estimate: *2470–2280 cal. BC* (95% probability)
Note: statistically consistent with SUERC 52548; T'=0.1; T'5%=3.8; df=1

SUERC-52548
Sample: 506038, *Corylus avellana* charcoal
Context: burnt mound 506034
Result: 3891±29 BP; δ13C: –28.3
Calibrated date range (95% confidence): 2470–2280 cal. BC
Posterior density estimate: *2470–2290 cal. BC* (95% probability)
Note: statistically consistent with SUERC 52544; T'=0.1; T'5%=3.8; df=1

SUERC-52549
Sample: 506073, *Corylus avellana* charcoal
Context: burnt mound pit 506007, stratigraphically earlier than burnt mound pit 506068
Result: 4195±29 BP; δ13C: –25
Calibrated date range (95% confidence): 2900–2670 cal. BC
Posterior density estimate: *2820–2630 cal. BC* (93% probability)
Note: statistically inconsistent with SUERC-52550; T'=7.7; T'5%=3.8; df=1

SUERC-52550
Sample: 506073, *Quercus* sp. sapwood charcoal, 4+ rings
Context: burnt mound pit 506007, stratigraphically earlier than burnt mound pit 506068
Result: 4091±24 BP; δ13C: –26.4
Calibrated date range (95% confidence): 2860–2500 cal. BC
Posterior density estimate: *2760–2620 cal. BC* (82% probability)
Note: statistically inconsistent with SUERC-52549; T'=7.7; T'5%=3.8; df=1

SUERC-52551
Sample: 506065, *Betula* sp. charcoal
Context: burnt mound pit 506068, stratigraphically later than burnt mound pit 506074
Result: 4156±29 BP; δ13C: –26.1
Calibrated date range (95% confidence): 2880–2620 cal. BC
Posterior density estimate: *2780–2580 cal. BC* (94% probability)
Note: statistically consistent with SUERC-52552; T'=1.7; T'5%=3.8; df=1

SUERC-52552
Sample: 506065, *Corylus avellana* roundwood charcoal, 5+ rings
Context: burnt mound pit 506068, stratigraphically later than burnt mound pit 506074
Result: 4103±29 BP; δ13C: –25.4
Calibrated date range (95% confidence): 2870–2500 cal. BC
Posterior density estimate: *2760–2570 cal. BC* (94% probability)
Note: statistically consistent with SUERC-52551; T'=1.7; T'5%=3.8; df=1

SUERC-52559
Sample: 506012, *Corylus avellana* charcoal >3 rings
Context: burnt mound 506012
Result: 3192±29 BP; δ13C: –25.3
Calibrated date range (95% confidence): 1510–1410 cal. BC
Posterior density estimate: *1510–1410 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52560, -52561; T'=8.2; T'5%=6.0; df=2

SUERC-52560
Sample: 506012, Maloideae charcoal
Context: burnt mound 506012
Result: 3180±27 BP; δ13C: –26.5
Calibrated date range (95% confidence): 1510–1410 cal. BC
Posterior density estimate: *1510–1410 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52559, -52561; T'=8.2; T'5%=6.0; df=2

SUERC-52561
Sample: 506012, *Triticum* sp. grain
Context: burnt mound 506012
Result: 3285±29 BP; δ13C: –22.9
Calibrated date range (95% confidence): 1630–1500 cal. BC
Posterior density estimate: *1630–1500 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52559, -52560; T'=8.2; T'5%=6.0; df=2

SUERC-52553
Sample: 506051, *Corylus avellana* roundwood charcoal, 5 yrs
Context: pit 506051
Result: 3129±26 BP; δ13C: –24.8
Calibrated date range (95% confidence): 1450–1300 cal. BC
Posterior density estimate: *1460–1370* (78% probability) or *1350–1300 cal. BC* (15% probability)
Note: statistically consistent with SUERC-52554; T'=2.5; T'5%=3.8; df=1

SUERC-52554
Sample: 506051, *Quercus* sp. roundwood charcoal with pith 6+ rings
Context: pit 506051
Result: 3067± 29 BP; δ13C: –25.2
Calibrated date range (95% confidence): 1420–1230 cal. BC
Posterior density estimate: *1420–1270 cal. BC* (95% probability)
Note: statistically consistent with SUERC-52553; T'=2.5; T'5%=3.8; df=1

SUERC-52562
Sample: 506082, *Hedera helix* charcoal
Context: burnt mound 506082
Result: 3858±29 BP; δ13C: –25.8
Calibrated date range (95% confidence): 2470–2200 cal. BC
Posterior density estimate: *2460–2200 cal. BC* (95% probability)
Note: statistically consistent with SUERC-52563; T'=0.1; T'5%=3.8; df=1

SUERC-52563
Sample: 506082, *Alnus glutinosa* charcoal
Context: burnt mound 506082
Result: 3873±27 BP; δ13C: –26.5
Calibrated date range (95% confidence): 2470–2210 cal. BC
Posterior density estimate: *2470–2280 cal. BC* (93% probability)
Note: statistically consistent with SUERC-52562; T'=0.1; T'5%=3.8; df=1

SUERC-52564
Sample: 506093, *Corylus avellana* charcoal, >10 rings
Context: pit 506090, underlying burnt mound 506004
Result: 3889±27 BP; δ13C: –24.7
Calibrated date range (95% confidence): 2470–2280 cal. BC
Posterior density estimate: *2470–2290 cal. BC* (95% probability)
Note: statistically consistent with SUERC-52568; T'=0.1; T'5%=3.8; df=1

SUERC-52568
Sample: 506093, *Hedera helix* charcoal
Context: pit 506090, underlying burnt mound 506004
Result: 3879±29 BP; δ13C: –27.2
Calibrated date range (95% confidence): 2470–2210 cal. BC
Posterior density estimate: *2470–2280 cal. BC* (95% probability)
Note: statistically consistent with SUERC-52564; T'=0.1; T'5%=3.8; df=1

SUERC-52569
Sample: 506072, *Corylus avellana* roundwood charcoal with bark >10 rings
Context: pit 506071 associated with use of burnt mound
Result: 3258±26 BP; δ13C: –26.2
Calibrated date range (95% confidence): 1620–1450 cal. BC
Posterior density estimate: *1620–1450 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52570; T'=10.0; T'5%=3.8; df=1

SUERC-52570
Sample: 506072, Maloideae charcoal, 30+ rings
Context: pit 506071 associated with use of burnt mound
Result: 3381±29 BP; δ13C: –27.5
Calibrated date range (95% confidence): 1750–1610 cal. BC
Posterior density estimate: *1750–1610 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52569; T'=10.0; T'5%=3.8; df=1

SUERC-52571
Sample: 506080, *Corylus avellana*, incomplete roundwood
Context: pit 506078 associated with use of burnt mound
Result: 3303±25 BP; δ13C: –24.7
Calibrated date range (95% confidence): 1640–1500 cal. BC
Posterior density estimate: *1640–1510 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52572; T'=4.8; T'5%=3.8; df=1

SUERC-52572
Sample: 506080, cf. Maloideae charcoal
Context: pit 506078 associated with use of burnt mound
Result: 3387±29 BP; δ13C: –25
Calibrated date range (95% confidence): 1750–1610 cal. BC
Posterior density estimate: *1750–1620 cal. BC* (95% probability)
Note: statistically inconsistent with SUERC-52571; T'=4.8; T'5%=3.8; df=1

SITE 26.02 DOLAU FARM

SUERC-56041
Sample: 2603005, *Alnus* sp. charcoal
Context: burnt mound 4
Result: 2985±40 BP; δ13C: –25.2
Calibrated date range (95% confidence): 1380–1050 cal. BC

SITE 28.14 BAIL Y LLWYD

Beta-396752
Sample: 28.14.001, *Alnus* sp. charcoal
Context: burnt stones within black silty clay matrix with frequent charcoal flecks
Result: 3100±30 BP; δ13C: –24.6
Calibrated date range (95% confidence): 1440–1270 cal. BC
Note: statistically consistent with Beta-396753; T'=0.2; T'5%=3.8; df=1

Beta-396753
Sample: 28.14.003, *Corylus* sp. charcoal
Context: burnt stones within black silty clay matrix with frequent charcoal flecks
Result: 3120±30 BP; δ13C: –24.5
Calibrated date range (95% confidence): 1450–1290 cal. BC
Note: statistically consistent with Beta-396752; T'=0.2; T'5%=3.8; df=1

SITE 515 UZMASTON

SUERC-56060
Sample: 515002, *Corylus* sp. charcoal
Context: burnt mound deposit; black clay silt with charcoal and burnt stones
Result: 2837±40 BP; δ13C: –26.0
Calibrated date range (95% confidence): 1120–900 cal. BC
Note: statistically consistent with SUERC-56061; T'=0.6; T'5%=3.8; df=1

SUERC-56061
Sample: 515002, *Alnus* sp. charcoal
Context: burnt mound deposit; black clay silt with charcoal and burnt stones
Result: 2881±40 BP; δ13C: –26.4
Calibrated date range (95% confidence): 1210–920 cal. BC
Note: statistically consistent with SUERC-56060; T'=0.6; T'5%=3.8; df=1

SITE 516 CANASTON WOOD

SUERC-56066
Sample: 516003, Maloideae charcoal
Context: 516004, burnt mound deposit; grey-black abundant burnt sandstones and charcoal flecks
Result: 3250±40 BP; δ13C: –29.0
Calibrated date range (95% confidence): 1630–1430 cal. BC
Note: statistically consistent with SUERC-56067, -56387; T'=4.8; T'5%=6.0; df=2

SUERC-56067
Sample: 516001, *Corylus* sp. charcoal
Context: 516004, burnt mound deposit; grey-black abundant burnt sandstones and charcoal flecks
Result: 3368±40 BP; δ13C: –24.6
Calibrated date range (95% confidence): 1750–1530 cal. BC
Note: statistically consistent with SUERC-56066, -56387; T'=4.8; T'5%=6.0; df=2

SUERC-56387
Sample: 516005, *Corylus* sp. charcoal
Context: 516005, burnt mound deposit; grey-black abundant burnt sandstones and charcoal flecks
Result: 3342±38 BP; δ13C: –26.1
Calibrated date range (95% confidence): 1740–1520 cal. BC
Note: statistically consistent with SUERC-56066, -56067; T'=4.8; T'5%=6.0; df=2

SITE 28.08 BAIL Y LLWYD

SUERC-56042
Sample: 2882006, *Alnus* sp. charcoal
Context: upper fill burnt mound; dark grey-black clay silt with frequent charcoal and occasional burnt stones
Result: 3025±40 BP; δ13C: –26.8
Calibrated date range (95% confidence): 1410–1120 cal. BC
Posterior density estimate: *1400–1210 cal. BC* (95% probability)
Note: statistically consistent with SUERC-56046; T'=1.0; T'5%=3.8; df=1

SUERC-56046
Sample: 2808001, Maloideae charcoal
Context: upper fill burnt mound; dark grey-black clay silt with frequent charcoal and occasional burnt stones
Result: 3081±40 BP; δ13C: –26.5
Calibrated date range (95% confidence): 1440–1220 cal. BC
Posterior density estimate: *1410–1230 cal. BC* (95% probability)
Note: statistically consistent with SUERC-56042; T'=1.0; T'5%=3.8; df=1

SITE 28.08a BAIL Y LLWYD

SUERC-56047
Sample: 2808010, *Alnus* sp. charcoal
Context: 288005, posthole fill associated with use of burnt mound; mid yellow-brown clay silt with common charcoal

Result: 3085±40 BP; δ13C: –26.5
Calibrated date range (95% confidence): 1440–1230 cal. BC
Posterior density estimate: *1420–1230 cal. BC* (95% probability)
Note: statistically consistent with SUERC-56048; T'=1.9; T'5%=3.8; df=1

SUERC-56048
Sample: 2808010, *Corylus* sp. charcoal
Context: 288005, posthole fill associated with use of burnt mound; mid yellow-brown clay silt with common charcoal
Result: 3008±40 BP; δ13C: –25.3
Calibrated date range (95% confidence): 1400–1120 cal. BC
Posterior density estimate: *1400–1190 cal. BC* (95% probability)
Note: statistically consistent with SUERC-56047; T'=1.9; T'5%=3.8; df=1

NOTES

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2. Environmental Archaeology Consultancy, 25 Main Street, South Rauceby, Sleaford, Lincolnshire, NG34 8QG.
3. 7 School Place, Oxford OX1 4RG, seren@archaeologicaldating.com
4. Melbourne House, West Ness, Nunnington, York, YO62 5XE.
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