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Assessment of residues from Llanstadwell

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Abstract

The submitted material comprised bulk sample <223> from context (3005), weighing approximately 12kg, and a hand-picked macro-residue assemblage with a total weight of 1.3kg (87 pieces), all from contexts within Trench 3 that were fills of ditch [3008] .

The bulk sample was wet-sieved and produced 15g of macroresidues (8 pieces) and approximately 28g of magnetic material. The magnetic residue was dominated by particles of rock, with some fired clay (often difficult to distinguish at a fine grain size), but also contained a modest proportion of flake hammerscale and various small slag spheroids, splatters and wisps. Some of this material appeared clinker-like. The coarser-grained macroresidues from the bulk sample included clinker fragments, bloated ceramic or stone, fragments of fired hearth lining and a single tiny fragment of a denser microprilly slag. The sample also contained abundant burnt material, including both charcoal and coal residues (burnt coal shale and coke) as well as small fragments of fresh coal.

The hand-picked macroresidues from the excavation came from the fills of the same ditch [3008]: the lower fill of the ditch (3006) produced a single smithing hearth cake (SHC) fragment, the overlying localised dark lens (3005) produced two small fragments of hearth ceramic (in addition to the contents of bulk sample), and the main upper fill (3004) produced the majority of the assemblage (1.19kg) of mixed smithing residues (clinker, slag, hearth ceramic), together with a few small fragments of corroded iron and one small clay fragment possibly from a mould.

Evidence for the form of the smithing slags within the hearth was provided by three examples of prilly to lobate slags attached to fragments of the hearth wall, parts of two small dense SHCs and an accreted example of a small SHC or slag pad. All the evidence indicated very small SHCs (possibly all <100g)

The archaeometallurgical residues (both macro- and micro-), with the exception of the single possible mould fragment, are all compatible with an origin in blacksmithing. The evidence from the slags and clinker suggests the dominant use of coal as fuel, but the burnt material also included a significant quantity of charcoal.

The use of coal is indicative of a Roman age, in agreement with the evidence for pottery is the same contexts.

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Methods

The bulk sample was wet sieved at 90µm, 2mm and 10mm following extraction of the flot by suspension in a bucket. Subsamples were then air-dried. The 90µm – 2mm and 2mm –10mm fractions were subsequently picked by magnet to extract the 'magnetic' fraction of each.

All materials were examined visually, using a low-powered binocular microscope where required. As an assessment, the materials were not subjected to any high-magnification optical inspection, not to any form of instrumental analysis.

The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

This assessment was conducted in April/May 2020 and was commissioned by Ken Murphy of Dyfed Archaeological Trust and Adam Gwilt of National Museum Wales.

Description of the assemblage

General

The submitted material comprised a bulk sample <223> from context (3005), weighing approximately 12kg, and a hand-picked macro-residue assemblage with a total weight of 1.3kg (87 pieces) all from contexts within Trench 3 and which were fills of ditch [3008] .

The bulk sample was wet-sieved and produced 15g of macroresidues (8 pieces) and approximately 28g of magnetic material

All pieces capable of confident attribution to a particular process are from the working of iron (smithing), although one small fragment of fired clay might be a fragment of mould from non-ferrous metal casting.

Smithing macroresidues

All the identifiable metallurgical macro-slag within the assemblage was from the working (smithing) of iron. Characterisation of the nature of the smithing is inhibited by the small size of the assemblage.

The smithing slags included examples of smithing hearth cakes (SHCs) and fragments of hearth ceramic with parts of adhering slag masses; all were fragmentary.

The only relatively complete SHC was a tiny (66g) example from fill (3004). A slag 'pad' (similar to an SHC, but with parallel planar lower and upper faces) from (3004) weighed 82g and may have been complete but was overgrown by accretion.

Fragments of prilly slag masses attached to the hearth ceramic were recorded with total weights of 78g, 104g, 80g, 66g and 48g – all from fill (3004).

These various cakes show a typical range of internal textures, often prilly internally, though sometimes massive, often with a glassy upper surface. There were no burrs to indicate sustained high-temperature interaction of slag and hearth wall.

Where seen, fuel particles included within the slags were exclusively coal.

The hearth ceramics included both vitrified and slagged oxidised-fired material and glazed and fissured reduced fired pieces. One piece suggested that the blowhole may have been on a slightly convex region of wall, but no pieces actually preserved the blowhole itself.

Smithing microresidues

Small quantities of microresidues were extracted from the bulk sample in both the 90µm – 2mm and 2mm – 10mm 'magnetic' fractions.

The 2mm –10mm 'magnetic' fraction was estimated to be approximately 80% granules of rock. The metallurgical material was dominated by flake hammerscale, mostly quite fine, but grading into thicker sheets and blisters. Some of the flake scale appeared brecciated and haematitised. There are some spheroids, many of which appear to be clinker droplets (some showing a morphology as 'splatter' suggesting impact or adhesion) and the proportion of true spheroidal hammerscale is very low. There is a small proportion of slightly 'spikey' tiny clinker particles.

The 90µm – 2mm contained a lower proportion of rock particles and was dominated by very fine flake hammerscale. A small quantity of spheroidal hammerscale was also present.

Concretions on iron

Collections of metallurgical residues commonly contain fragments of concretion of 'rusty' appearance that have formed around pieces of metallic iron as it has corroded. Two pieces of such material (total weight of the concretionary material 11g) were present in this

collection (both from context (3004)): the larger of unknown morphology, the smaller suggestive of the head of a nail, possibly from a hobnail.

Possible metallurgical mould

A single small (6g) fragment of fired clay showed a convex external surface. It was oxidised fired with a buff surface layer. This piece lacks diagnostic features, but the form of the external surface may suggest that this is a fragment of a mould from non-ferrous metal casting. The internal face is not preserved.

Other archaeological materials

The bulk picked collection of 'fuel residue' from context (3004) sample <223>, 2-10mm fraction, weighed 4.49g. Most of this material was either fresh or partly burnt coal and coal shale, but there were also a number of charcoal fragments and two fragments of burnt bone.

The flot has not been examined in detail.

Distribution of the assemblage

The materials described in this report all derive from four contiguous fills of a single ditch [3008] in Trench 3.

Interpretation

The archaeometallurgical residues provide evidence for blacksmithing with coal as fuel. Charcoal was also present, but not as inclusions within the slag, so it is unclear whether the charcoal was part of the metallurgical residue, or waste from unrelated activities dumped into the same ditch.

The assemblage is very small so any interpretation of the nature of the smithing must be tentative. The use of coal supports the Roman age indicated by the pottery within these contexts. The fuel, small size of the smithing slags and the fine hammerscale all point towards relatively light blacksmithing, rather than activity employing a high proportion of welding. Thus, the ironworking would be blacksmithing (the end use of iron) rather than bloomsmithing (part of the *chaîne operatoire* of the production of raw iron).

The apparent dominance of very small slag cakes (SHCs and equivalent slag masses), with weights below 150g, is a feature seen on many Roman rural sites. The size of slag cake depends on both the rate of iron loss to the hearth (approximately half the weight of a SHC is iron; high rates of iron loss result particularly from high temperature processes, such as welding) and on the length of the work period between clearance. Thus, populations of small SHCs might be due to a low proportion of high temperature work or short work periods. It has been argued (Young 2018) that in some rural settlements there might have been insufficient demand for smiths to work continuously and that intermittent forge use might contribute, perhaps alongside a higher proportion of light work, to the small SHC size on those sites.

Assemblages of this general type have been recognised on many Roman sites. Possibly the best documented to date is that at Cleevelands (near Cheltenham, Gloucestershire; Young 2018) which produced a large assemblage of 176 slag cakes covering a range of morphologies including classic SHC shape, all-attached clinker masses and pucks, with a range of weights from 44g to 530g, with a mean weight of 125g. Smaller assemblages with similar statistics include those from Exminster (Young 2014), Uffington (Young 2015) and Ebrington (Young 2016). An assemblage of very similar character, but also with a small assemblage size, was recently described from Caerau hillfort, Cardiff (Young 2020).

The use of coal for smithing is known from several sites across Wales, from locations close to potential coal sources such as Caerau (Young 2020), Cardiff Castle (Young & Kearns 2011), Trowbridge (St Mellons; Young 2009a, 2009b), Bulmore (Young 1999a) and Caerwent (Young 2006), to locations much more distant from the coalfields, such as Tai Cochion (Young 2012) and possibly Tremadoc (Young 2011).

The presence of a low level of evidence for some working of copper alloys is typical for sites of the Roman period otherwise dominated by smithing residues. A relatively local example of the working of both metals is provided by the assemblage from Port y Rhaw (Young 1999b, 2010).

The nature of the assemblage, with discrete lenses of dark, fuel-rich material, suggests dumping of material from the cleaning of a smith's hearth or floor. If the dark material has a dominantly in-hearth origin, this might explain the relative paucity of spheroidal hammerscale (which is created during hammering, particularly welding, at the anvil, as opposed to flake hammerscale which forms during the heating of iron and may be lost both at the anvil and from the workpiece at other times). Larger pieces of slag, with a lower proportion of fuel, may be disposed of by hand-picking debris from the forge (either being placed or thrown into the ditch, or not the any adjacent bank, from where they have been redeposited by erosion). Since the volume of the dark lenses appears small, it is unlikely these represent re-deposition of a primary waste dump at the smithy.

Further work

The slags are, as described above, are a rather small assemblage and only capable of yielding very limited further evidence if they were to be subjected to detailed analysis. There are two aspects, however, of the assemblage that would be worthy of pursuing further, although it is unclear whether the project will generate sufficient material for them to be addressed.

Firstly, it would be useful to know if the coal employed was relatively local, or imported from further afield, because the Pembrokeshire anthracite is not a particularly good fuel for blacksmithing. Provenancing coal requires a combination of estimation of coal grade and identification of the contained microflora – and thus requires a pieces of a much larger size than currently in the assemblage.

Secondly, detailed investigation of the microresidues might allow some evidence for metal type and provenance to be extracted, following the methodology of Young (in review). This too ideally requires a larger sample of material than is currently in the collection, although this approach has permitted some useful data

to be gathered from comparatively small sample sizes at Parc Cybi (Young 2019).

On this basis, no further work is recommended at this time, but should future sampling processing produce larger assemblages of hammerscale and/or larger pieces of coal, then those areas of potential investigation should be considered.

The macroscopic residue assemblage together with the selected and magnetically-extracted residues from the processed bulk sample, should be retained as a part of the site archive.

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*Table 1: summary catalogue of submitted macroscopic materials. Weights in g. * = sample may be from 3004.*

Context	Item wt	Item no	Notes
3002*	1	4	charcoal - small twig
	104	7	oxidised hearth wall ceramic overlain by thickening wedge of slag with glassy surface, resembles material from 3007.
	2	1	fissured and glazed reduced-fired hearth wall ceramic
	10	1	concretion on iron object
	1	1	concretion on iron object, form suggests a small nail head
3004	78	1	oxidised fired wall with openly lobate slag attached, upper surface has fuel dimples, now broken in two
3004	36	3	prilly dense slags, locally some glass, locally coal shale fragments
3004	136	6	vitrified and slightly slagged oxidised hearth lining
	18	1	slightly convex and only slightly oxidised hearth wall with rounded margin, some glassy slag adhering
	104	3	dominantly rather open-textured slag attached to reduced fired ceramic
	2	3	coal
	6	1	spalled surface of rounded oxidised fired clay with buff-coloured surface, fired clay object, possibly mould fragment
	82	1	dense slag pad, mostly sheet 18mm thick, but irregular, top has some raised lobes showing through accretion, base deeply and very finely dimpled with abundant very small coal fragments
3004	104	4	vitrified oxidised lining, largest piece shows gently convex front face with arcuate margin of oxidation close to one edge of fragment.
	2	2	small fragments of oxidised fired ceramic
	80	2	lobate slag attached to oxidised fired hearth wall
	20	1	crudely lobate slag with one planar, slightly concave, surface, probably a non-wetted detachment
	64	5	concretions on corroded iron fragments
	1	5	coal
3004	66	1	down-wall flow of slag, glassy top, arching away from wall, base dimpled, both carry coal.
	90	12	vitrified and slagged oxidised fired hearth lining
	7	9	coal
	66	1	most of small concavo-convex dense SHC, well-formed, dense
	48	4	low density lobate clinkery slags attached to reduced fired lining
	24	1	internal lobate slag fragment
	8	1	coal, coal shale, slightly slagged
	28	1	very finely dimpled irregular twist of slag, probably rather lobate in its original form
3005	30	2	curved fragment of oxidised (increasingly so into wall) hearth ceramic, surface fissured with rounded edges to adhering glass suggesting some ablation, one edge surface slagging fades to simple grey ceramic
3006	74	1	central section of very small SHC, dense, lobate top with maroon colouring, top has coal clasts between raised lobes, base very finely dimpled
3007	8	2	vitrified oxidised fired hearth wall

Table 2: processing of sample <223>

Wet sieved fractions:		
>10 mm	2281g	Includes 15.43g of macro-residues
2 to 10mm	2105g	Includes 14.85g magnetic material, 4.49g fuel
<2mm (>90micron)	690g	Includes 12.79g magnetic material
flot	18g	
total sorted	5094g	
loss	6951g	*(material <90µm plus incidental losses)*
total sample:	12045g	

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