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Assessment of materials from Porth y Rhaw

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Abstract

The submitted collection comprised approximately 6.5kg of hand-picked materials from the field seasons of 2019-2022.

The assemblage included very few pieces of archaeometallurgical residue and none at all from the roundhouse excavated in 2022. This will necessitate a re-think of the purpose of the structure previously interpreted as a smithy and some suggestions are made. The burnt deposits associated with the multiple hearths in the building were rich in fuel ash slag, ash, charcoal and comminuted fired clay. The deposits frequently formed concretions around corroding iron objects (now completely mineralised); there is a rich assemblage of significant ironwork apparently including both socketed and tanged implements.

The areas near the entrance produced a small scatter of reworked metallurgical materials, including two sherds of crucibles, two small smithing hearth cakes and some fragments of hearth lining.

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Methods

All materials were examined visually, using a low-powered binocular microscope where required. The identifications of materials in this report, as an assessment during which no instrumental analysis was undertaken, are necessarily limited and must be regarded as provisional.

This assessment was conducted in January 2024 and was commissioned by Fran Murphy of Dyfed Archaeological Trust. The materials derive from excavations at Porth y Rhaw promontory fort conducted in 2019-2022 by DAT.

Results

General nature of the assemblage

The submitted collection comprised approximately 6.5kg of hand-picked materials (Table 1). The distribution of material types by context is given in Table 2

The collection included just 274g of archaeometallurgical materials, with evidence for both copper alloy and iron working. This evidence came from the 2019 and 2021 seasons from contexts outside the main roundhouse investigated in 2022.

A further 432g of materials associated with hearths (particularly those inside the roundhouse) were present, but these hearths produced just small quantities of fuel ash slag. Much of this material was collected *in situ*.

Concretions that had formed around decomposing iron artefacts through redistribution of the iron were a notable feature of the assemblage. They, and isolated mineralised iron artefacts amounted to 4.9kg (75% of the submitted collection by weight). These, too, were particularly associated with the stone roundhouse.

A concretion with a shaped piece of fired clay weighed 36g.

Natural materials (rocks and other concretionary materials) provided the other 862g of the collection.

Iron smithing residues

The principal items are this heading are two smithing hearth cakes (SHCs).

An incomplete SHC from context (105) was represented by two pieces (58g and 118g), probably from same SHC, but with no join preserved. The body of the slag was vesicular throughout. The top was

smooth from weathering, becoming lobate near margins. The base was prilly with charcoal inclusions. A 64g piece from context (1013) was tiny SHC measuring 45x70x35mm associated with some reduced fired hearth wall with stone fragments. The upper surface was rich in inclusions of coal.

Small fragments of vitrified hearth lining were also recovered from the same general area.

Several pieces of the concretionary hearth deposits from inside the roundhouse were carefully cleaned to look for hammerscale, but none was found.

Crucibles

The collection includes two sherds of crucible.

A 4.5g sherd from context (106) was from the wall extending to the rim. It was thick-walled, probably inturned, with red splashing (copper contamination) on the otherwise green glaze near the rim. The fabric was sandy with quartz grains to 4mm.

A 3.4g sherd from context (109) was thin, with a sharp angular rim. It was straight and vertical internally, but inturned externally. The fabric was pale and very fine fabric, bearing only rare sand grade quartz. The glaze was dark and bright red internally, locally intruding the wall, but clearer outside below the rim.

Close parallels for both these sherds can be found amongst the material previously published from the site (Young 2010c).

Hearth materials

The burnt deposits associated with the multiple hearths in the building were rich in fuel ash slag (FAS), ash, charcoal and comminuted fired clay. Several pieces of concretionary material from the hearth floors show these materials as layered deposits.

In some instances, the FAS is in those layers in the form of isolated spherules, in others as delicate sheets of material representing *in situ* vitrification of the surface and, in some cases, as narrow veins extending down into the substrate.

Isolated irregular masses of FAS were also recovered as hand-picked material. These are pale coloured and highly vesicular internally, but externally some pieces are quite dark for this type of slag.

FAS is typically generated in hearths where there was no contamination from metals being directly heated in the hearth. Thus, they do not usually occur in ironworking hearths. Fuel ash slags are not characteristic of any particular process but indicate a hearth, particularly one cut into an unconsolidated substrate, that has spent a considerable time at elevated temperature. Several archaeologically significant processes/installations may produce FAS under appropriate conditions. Probably the most common of these is within cereal drying kilns. (*e.g.* South Hook, Young 2010a, 2010b; Llandeilo, Young 2015; Bornais, Young 2012a, 2020). Larger hearths may produce correspondingly larger and thick FAS blocks. Mound1 at Bornais, for instance, produced a large quantity of FAS in much larger fragments of sheet-like cakes (Young 2012a), apparently from large Late Norse hearths. Similarly, domestic hearths are the probable source for the 'Iron Age grey slags' that occur in Middle Iron Age contexts and that have been particularly recorded in central and eastern England (Cowgill 2000, 2008; Cowgill *et al.* 2001; Swiss & McDonnell 2001; Young 2009, 2011, 2013; 2023 Young & Bowstead Stallybrass 2003). A particularly large deposit was encountered in association with the hillfort bank at Malmesbury (Young 2011).

In this instance the quantities are very small, so a persistent, but perhaps small-scale, activity is indicated.

Iron and concretions

The burnt deposits associated with the hearths were rich in ash, which, together with redistribution of the iron during corrosion, has created conditions suitable for the development of concretions within the sediment on the floor of the roundhouse.

These concretions frequently formed around corroding iron objects (now completely mineralised, there appears to be no metallic iron left in any of the objects). The rich assemblage of mineralised ironwork apparently including both socketed and tanged implements/weapons, as well as nails and possible chain links. This material has not been examined in detail but has been separated from the collection for transmission to an X-Radiographer.

Other materials

The collections included a small quantity of natural stone.

One piece of concretionary material from the floor of the roundhouse contained a large, curved piece of shaped fired clay. The piece has resemblance to a lug handle in general form, but is too incomplete for certain identification. It is not of metallurgical origin.

Interpretation

The residues represent a small collection of material derived from iron and copper alloy working outside the excavated area, together with evidence for a non-metallurgical pyrotechnological activity within the excavated roundhouse.

Discussion

The stone roundhouse, with its multiple hearths set near a drain, was interpreted as a smithy during fieldwork. The absence of any certain metalworking debris from the structure, either at a macroscopic level or a microscopic one (examples of ashy concretions were carefully cleaned to look for hammerscale, but one was found), means that interpretation is no longer tenable.

In the interpretation of the roundhouse as a smithy, the drain was seen as having a protective role – keeping groundwater from the hearths. One might have expected that the drain would intervene between the likely source of groundwater and the hearths in such a role, whereas the two appear to have been co-located. This perhaps makes he alternative suggestion, that the water being drained was directly associated with the

hearths. In this view, the interpretation of the roundhouse should perhaps be sought in processes requiring both heat and water.

Such processes might include fibre or cloth processing/dyeing, food processing, the steaming of timber for construction or boat-building, brewing, salt making or even simply acting as a sweat-house.

The presence of a large amount of comminuted fired clay in the hearth deposits (and the larger piece with the appearance of a crude lug handle) might, perhaps, favour the salt-making interpretation.

The presence of significant amounts of ironwork within the roundhouse might well provide useful evidence. These require a careful programme of X-Ray investigation, but the assemblage superficially appears to include both socketed and tanged tools or weapons, as well as possible chain components and nails.

Reinterpretation of the roundhouse as being associated with a process requiring water allows further consideration of the extensive apparent water features of the earlier phase of settlement too.

The metallurgical activity that was represented by the slag and crucible sherds was presumably undertaken in some other part of the settlement and may be part of the same activity as that recorded in the earlier excavations. For the small SHC from context (1013) at least, the presence of coal as a fuel implies that activity was of Roman, rather than Iron Age, date.

Further work

The investigation of both the ironwork (via X-Ray imaging) and of the crude fired clay object (by a pottery specialist) are both highly desirable for the furtherance of understanding.

From a materials science perspective, there are two potential further lines of enquiry.

Firstly, the two crucible sherds could be analysed no-destructively by pXRF to clarify the metal types they held. This data would complement that obtained for examples from the earlier excavations (Young 2010c). The sherds could also be checked for joins with the previously published material.

Secondly, it is possible that the fuel ash slag present in the ashy deposits might present chemical evidence (e.g. the presence or absence of unusually large quantities of sodium) that could clarify whether salt had been present in the hearths.

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Table 1: summary catalogue, weights in g.

C	SF	moved?	wt	no	notes
103	24		4.46	1	sherd of crucible rim, thick-walled, probably inturned, red splashing on green glaze near rim, very sandy fabric with quartz to 4mm
104	5		68	1	fired laminated clay/shale
			10	1	vitrified oxidised fired hearth lining
			18	1	stone, superficial red colouration - unclear if simple weathering or if also heated
105	4		58	1	two pieces, probably from same SHC, but no join found, vesicular throughout, top smooth weathered, becoming lobate near margins, base prilly with charcoal inclusions
			118	1	see above
106	3		7.8	1	darked lobed bleb of slag, has zones and splashes of FAS type material
109	8		3.43	1	sherd of crucible, sharp angular rim, straight, vertical internally, inturned externally, very fine fabric, pale, only rare sand grade quartz, bright red glaze internally intruding wall, clearer outside below rim, probably a cupel-like vessel
112	9		5.65	1	slag and vitrified surface from oxidised fired ceramic wall
112	16		10	1	weathered deformed shale
113	14		3	1	slightly clinkery looking slag fragment; dominant dark slag mixed with blebs of FAS
115	13		116	1	fired gravelly clay, oxidised, clasts to 25mm, mostly dense grey fine-grained rocks
134	30		0.9	1	tiny scrap of fired clay, mixed reduced oxidised fired
135	28	to iron	35	1	concretion on iron object, mineralised crust of c12x3mm iron in exterior but circular form to concretion, hint of 'head' on opposing face - but rectangular section of too drawn out to be the shank of a nail?
1010	59		40	1	irregular mass of FAS, formed of various fused 'lobes', only a small area fully glassy, brownish in colour
1013	55		64	1	tiny SHC associated with reduced wall with stone fragments, appears to have multiple coal inclusions, 45x70x35mm

1013	54	to iron	24	1	mineralised sheet iron
1013	53	to iron	36	1	iron object, like large nail
1056	71	to iron	18	1	concretion on mineralised iron
1056	74	to iron	4.3	1	discoidal concretion on iron
1056	60	to iron	28	2	two pieces of mineralised iron/concretion on iron. One appears to be shank of 6-7mm square nail; other piece may join
1060	73	to iron	94	1	concretion - core not visible
2102	107		24	1	oxidised fired clay
			4	1	sandy oxidised fired clay, possibly vitrified veins
2103		to iron	178	3	concretion on mineralised rectangular-sectioned iron rod, broken into three parts
2103	108		1.46	3	rounded blebs of low-density slag, surface possibly a little darker than typical FAS
2104	157		106	assm	concreted gravel with some fired clay, not particularly ferruginous. Fired clay has large straw? Moulds
2104	122	to iron	34	4	iron tang, c.75mm long overall, widens from 7mm square to 32mm x 7mm, broken into 4 pieces
2104	149	to iron	150	1	concretion, probably on large iron object (chain link?)
2104	190	to iron	42	2	concretion in two parts - probable iron nail
2104	152		23	assm	coarse gravel with Mn staining and mottles
2104	114		11.6	1	lump of green/grey/fawn clay
2104	140	to iron	76	2	broken gravelly, charcoal rich concretion, probably has iron inside
2104	151		48	assm	concretionary material - gravel, ash? Dark material - probably charcoal residue but some could be Mn mottling

2104	146		2.5	1	small fractured piece of highly vesicular slag - denser that typical FAS
2104	141		54	2	low density concretionary sediment, rich in charcoal and is altering, possibly in situ, into fuel ash slag
2104	145	to iron	18	1	mineralised and concreted iron artefact
2104	163	to iron	30	1	low density concretion with iron oxide films, possible object
2104	150	to iron	114	2	iron artefact - chain link? hook?
2104	144	to iron	50	1	low density charcoal-rich concretion, possibly on iron object
2104	148		0.16	assm	fractured piece of grey FAS
2104	142		96	3	block of concretionary material from hearth floor (?)
2104	166	to iron	21	1	elongate concretion on iron, square section revealed on one end of concretion
			7	1	small concretionary piece, tabular, 1 surface largely covered with charcoal, the other surface shows multiple pieces of mineralised iron in small-section and one larger piece, possibly part of a shoe sole with hobnails
2104	156	to iron	36	1	iron object
2104	153	to iron	46	2	broken elongate concretion
104	125	to iron	342	2	large elongate concretions, probably on iron
104	160	to iron	84	6	fragmented (?) concretion, possibly on small iron object(s)
2105	126	to iron	508	2	concretion with iron artefact with substantial spike (preservation as item from (2103)
2105	120		4.96	1	complexly blebby mass of FAS, ashy on lower surface, glassy on top
106			0.7	1	broken bleb of low density slag, FAS
136		to iron	96	2	two pieces of concretion in gravelly sediment, no core visible

136			84	1	piece of red natural quartz/lithic conglomerate
2138			506	7	plus bits… these pieces are silts cemented by a mottled ferruginous cement. There is no indication that there is a specific iron source here.
2174	164		22	1	ferruginous concretion in gravel
			10	1	charcoal-bearing soft concretionary material, possibly ash
2174	165	to iron	13	1	concretion on curved iron, nail?
178	(slag from hearth)		10.6	assm	fragmented lump, now in many pieces, probably a very low-fired gravelly clay - but may not even have been fired
2183	169		16	1	low density concretion fragment of charcoal-rich deposit, no indication this is cored on iron
184	(or 189?)	to iron	11.7	1	probably a clenched nail, 45mm head to bend, 20mm beyond bend,
			6.36	1	55mm iron rod with slight turn on end
2188	171	to iron	1760	5	plus dust. Large pieces of thick concretionary layer. Only large piece might be worth X-ray. Two small pieces washed - layered charcoal-rich sediment with fired clay, FAS, some dark slag, crusts of secondary iron oxides, but no visible hammerscale
2188	170	to iron	646	1	large concretion on iron object - large circular section of mineralised iron with void hints at socketed implement
			102	1	continuation of circular sectioned area
2188	72	to iron	134	2	concretions, one elongate, one rounded, elongate one for X-ray?
2188	173		36	1	fragment of curving fired clay in concretionary material, some iron staining but not an iron object. Clay comes from a larger object/structure. Appears low fired, so maybe daub rather than pottery, 60mm long mostly 20mm wide,' U'-shaped convex section, widens at one end at base (c.f. attachment for pot handle) but there isn't enough of this object to determine its purpose.
189		to iron	104	2	concretion in gravelly slag-containing sediment, but appears to be cored on elongate mineralised iron
2208	194	to iron	6	1	nail shank?
2209	179	to iron	27	1	concretion with gravel and iron nail

	221			3.8	1	small fragment of FAS
	223	slag in hearth		5.65	1	thin sheet of FAS type slag, locally slightly maroon on surface, lying on sediment rich in charcoal and tiny fragments of fired clay.
				2.58	1	bleb of dense FAS, similar to slag in sheet above
none				54	1	iron rich conglomerate, probably entirely natural
none				1.8	1	probable manganese mottles
none		130	to iron	6.9	1	flattened iron object (rectangular cross section c. 10x4, roundedly rectangular, 50mm narrows to one end
none		143		44	assm	fragments of a gravel/clay surface with black material on top, This seems to be organic (charcoal dust?) rather than slag
none			to iron	52	1	concretion in gravelly deposit, core not seen but potentially iron

Table 2: summary of assemblage by facies and context. Shaded contexts included material assigned 3 digit context number in 2022 season. Weights in gram.

C	Crucible	SHC	indet slag	hearth lining	fired clay/gravel	hearth floor	FAS	iron/ concretions	FC	Nat
103	4.5									
104				10	68					18
105		176								
106			7.8							
109	3.4									
112				5.7						10
113			3							
115					116					
134					0.9					
135								35		
1010							40			
1013		64						60		
1056								50.3		
1060								94		
2102					24	4				
2103							1.5	178		
2104						198	2.7	1050		140.6
2105							5	508		
106							0.7			
136								96		84
2138										506
2174								13		32
178					10.6					
2183										16
184								18.1		
2188								2642	36	
189								104		
2208								6		
2209								27		
221							3.8			
223						5.7	2.6			
no context						44		59		56

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