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Evaluation of Archaeometallurgical
residues from the M7/M8 Contract 3:
Trumra 4 (E2281)

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Abstract

The collected potential archaeometallurgical residues from Trumra 4 amounted to 116.6kg. Of this collection, almost half (48%) of the collection was either natural concretions or slag with sufficient concretionary overgrowth as to render the slag unidentifiable. Of the other 52%, almost all (99%) was slag derived from smithing hearth cakes (SHCs) or the closely related tongues. Amongst this material were 52 SHCs that were essentially complete and a further 5 for which the original weight could reliably be estimated. The SHCs and tongues have a size weight range of 92-3173g, with a mean weight of 727g. This indicates larger smithing cakes than would be typical for a blacksmithing-only site; it is likely that bloom-refining formed a significant part of the work undertaken here. The assemblage also contained a small number (21) of fragments of ceramic tuyères (1% of the overall assemblage by weight).

The material originated from two spreads (F4 and F11) and a nearby pit (F7 and F8, the tertiary and secondary fills of pit F5). Field relationships had suggested a connection between the spreads and a second adjacent pit (F12). Pit F12 has however yielded an Early Bronze Age radiocarbon date incompatible with the iron working evidenced by the residues. However, F3, the fill of F12, yielded a single vitrified piece of ceramic, which is almost certainly from the edge of a tuyère similar to those from the slag-bearing contexts. Pit F5 has given a radiocarbon date of AD390–550 (cal. 2σ), which is entirely compatible with the style of residue. Only a few pieces of residue were recovered from the pit fill, but these provide a link between the dated [pit and the more productive spreads, which are therefore presumably contemporary. Whether the evidence of the single tuyère sherd from F12 is sufficient to challenge to relevance of the early Bronze Age 14C date from its fill must be considered.

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Methods

All investigated materials were examined visually, using a low-powered binocular microscope where necessary. All significant materials were summarily described and recorded to a database (Table 1). As an evaluation, the materials were not subjected to any high-magnification optical inspection, nor to any other form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

Results

Distribution

Most material was recovered from F4, a spread of material, with lesser amounts from spread F11 and F7, the tertiary fill of pit F5.

The collection from F7 is slightly problematic, in that the stratigraphic report describes slag from the secondary fill of F05 (F08), but not the tertiary (F07).

Approximately 65% of the material collected from F4 was identifiable archaeometallurgical residue, with only

15% from spread F11, which showed a much higher proportion of ferricrete. The material from F7 showed a rather different taphonomy with widespread overgrowth of iron minerals into pre-spaces in the silty matrix, resulting in banded bog ore textures. The material from this context was only included 8% of identifiable archaeometallurgical residues. Although there were slag inclusions with the concretionary lumps, only 2 SHCs were readily identifiable, and it rests on these slags to provide the link between the 14C-dated pit and the more slag-rich spread.

Description

Smithing hearth cakes: observation of detailed morphology of these SHCs was often complicated by a high degree of concretionary overgrowth.

The SHCs show a very low degree of fragmentation and there was little sign of deformation. The cakes were dense, compact and frequently rather thin. Many of the cakes showed flat tops, with raised, frequently glassy, areas proximally.

Some of the slag cakes are described as tongues. This term is used here to describe thin sheet-like slag cakes, which typically have a smooth or dimpled glassy upper surface overlying a lower layer of more iron-rich slag, often forming short, stubby pendent prills. These have been interpreted (Young 2006f) as forming in front of the tuyère and above the main slag cake in bloom refining, but they are very similar to slag cakes formed during blacksmithing, and their certain distinction from conventional SHCs cannot be made with confidence. The tongues are therefore included within the SHC statistics here.

Within the 57 SHCs for which the original size is known or may be estimated, the weight range is 92 to 3163g, with a mean weight of 727g. 47% of the SHCs weighed less than 500g, with 25% weighing more than 1000g and 2% more than 3000g. The modal 100g range is given as 100-300g, since equal numbers of SHCs lay in the 100-200g and 200-300g ranges.

Tuyères: 21 sherds of tuyère were identified in the collection. Only one of these yielded useful morphological data on the bore, indicating a bore of approximately 20mm, but several suggested an external radius of curvature of about 70mm.

Concretions: Material from C7 mainly comprised 50-150mm rounded concretions. Some of these concretions appeared to be cored on slag fragments, but most were not. The concretions showed black, brown and yellow fringing cements on voids, presumably of iron oxides. These materials are therefore low-grade bog iron ores. These ores have grown *in-situ* in the deposit since it was laid down.

The two spreads both showed development of secondary iron minerals, but in the form of a ferricrete of somewhat "rusty" appearance, quite distinct from the diagenesis of the sediments in the pit. The two spreads differed in the degree of development of ferricrete, resulting in a difference in the possibility of identifying the slag fragments they contain.

Interpretation

Table 2 shows a comparison of the SHC weight distribution with other sites. None of the other sites is as old as Trumra 4 would appear to be on current dating evidence, but Trumra certainly fits into the same

iron-working tradition. If the 14C date for Trumra is correct then it provides new evidence for the onset of use of the ceramic tuyère in Irish iron-working. They appear ubiquitous in the early medieval period, but are not yet well documented from the Iron Age.

The weight distribution of the Trumra SHC assemblage compares most closely with sites such as Carrigoran (Young 2006c), Clonmacnoise new graveyard (author's unpublished data) and Ballykilmore (Young 2006b). These three sites are all locations at which it is likely that bloom refining was a significant component of the iron-working activity.

The apparently isolated nature of the spreads finds a close parallel in the iron-working site at Coolamurphy (on the N30, Co. Wexford; Young 2008a). Here shallow floor level hearths were closely accompanied by small spreads of residues, with no other indication of occupation. The Coolamurphy site differs from Trumra however in being characterised by much smaller SHCs, and it was suggested that Coolamurphy was primarily involved in blacksmithing (end use artefact production or repair).

The reason for such isolated iron-working sites is unclear. In the context (at Trumra) of bloom refining, it is possible that some refining was undertaken in locations either close to the smelting sites (themselves often in isolated locations) or in charcoal production areas.

Although pit F005 has been described as a "waste pit", it is of an appropriate size to have functioned as a hearth. No scorching of the subsoil was recorded, but this may not occur in a smithing hearth if the bed of fuel and ash is sufficiently deep beneath the tuyère.

The single sherd of tuyère from F3, the fill of F12, the supposed early Bronze Age pit, appears similar to the tuyère material from the other contexts, and there appears little reason to doubt it is from an early medieval tuyère. This is in direct contradiction to the 14C date for the pit. Re-evaluation of the 14C date would be essential (could the date have been from peat for instance?) before rejecting the sherd as intrusive in this context.

Evaluation of potential

Trumra has a particular significance because it shows a typical early medieval style of iron working at an apparently early age (although there is only a single 14C date at present).

The site also has potential to shed further light on the on-going development of ideas on the interpretation of smithing slag assemblages and the identification of bloom-refining residues.

On the negative side, the extensive development of ferricrete suggests a degree of mobility of iron within the deposit, and it remains unknown whether the slags are sufficiently unaltered to allow the subtle chemical differentiation of the traces of bloom-refining. It is possible the ferricretes have largely developed through the mobilisation of iron from fine metallic debris and reactive micro-residues within the sediment.

A limited campaign of analysis is therefore suggested, with chemical and textural analysis of a suite of half a dozen SHCs across the range of sizes present in the assemblage, hand-picked for apparent lack of alteration. These analyses should be supported by

chemical analysis of two tuyère sherds since these are likely to be the main silicate source for any blacksmithing slags.

Given the early age of the assemblage together with its homogeneity, it is recommended that the collection be retained in its entirety.

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context	sample	context wt	wt	no	notes	propn	orig wt.
4	6	11221	7444	c80	concreted slag fragments - much of this weight will be concretion and pebbles		
4	6	11221	1325	1	SHC, large piece of thick crust cake - ought to be from c.5kg piece, most of this weight is the attached concretion, total crust to 60 upper has very large vesicles, lowest 20mm has tubular vesicles		
4	6	11221	750	1	SHC, 100x120x60 double layer cake -looks eroded on edges but unclear by how much	1	750
4	6	11221	104	1	SHC, 60x55x20	1	104
4	6	11221	270	1	SHC, 120x90x30, bowl only, probably mostly present	1	270
4	6	11221	186	1	SHC fragment		
4	6	11221	264	1	SHC fragment		
4	6	11221	302	1	SHC, fragment from thick crust cake similar to 1325 piece above, tubular vesicle layer to 20mm then 20mm dense slag with very large flat rounded vesicles, with vesicles up to 40mm wide.		
4	6	11221	338	1	SHC, 90x100x35	1	338
4	6	11221	238	1	SHC, 110x60x30 - unclear if whole, very corroded		
4	7	17258	12527	181	ferricrete		
4	7	17258	782	1	110x110x45 dense bun-like SHC	1	782
4	7	17258	256	1	80x80x45 probably complete, small thin SHC	1	256
4	7	17258	108	1	50x60x25 possible small dense SHC	1	108
4	7	17258	156	1	60x80x35 pale-weathering tongue	1	156
4	7	17258	62	1	slag fragment		
4	7	17258	284	1	80x90x60 small SHC possibly sitting inside earlier burr, biconvex dense	1	284
4	7	17258	440	1	70x110x40 dense SHC, plano-convex with slightly raised vesicular proximal area	1	440
4	7	17258	222	1	60x90x45 biconvex small SHC/tongue. Dark glassy top, prilly base	1	222
4	7	17258	14	2	fragments of lining slag		
4	7	17258	1115	1	SHC, (100)x140x80 (distal part missing) from dense cake	0.85	1312
4	7	17258	182	1	60x110x30, transverse tongue with dark top and pale lumpy base	1	182
4	7	17258	862	1	100x120x110 bowl 45, dense SHC with charcoal-rich top	1	862
4	7	17258	38	1	steep lining slag below tuyère attachment - tuyère probably c100 diameter		
4	7	17258	94	1	50x50x320 tiny dense SHC, smooth top, lobate edges and slightly lobate base	1	94
4	7	17258	48	3	3 sherds of tuyère		
4	7	17258	68	1	slagged tuyère tip		
4	8	17246	7642	17	ferricrete		
4	8	17246	692	1	well developed burr apparently jutting from lip of large SHC, burr 50x80x35, dipping into cake (80)x(100)x(50) excluding burr, base of burr is dimpled with tiny prills		
4	8	17246	2505	1	(160)x150x110 dense, probably almost complete SHC	1	2505
4	8	17246	1085	1	SHC, 100x150x70, bowl 40, small proximal pedestal, lop-sided diamond in plan, transverse	1	1085
4	8	17246	832	1	SHC, part of complex triple layer cake, lower dark dense, middle tubular vesicles, top cavernous charcoal -rich	0.8	1040
4	8	17246	516	1	SHC, 100x110x60 transverse cake, been quite fluid with down-flow proximally with dimpled prills	1	516
4	8	17246	1715	1	SHC, 160x140x60 rather concreted so difficult to be certain if complete	1	1715
4	8	17246	1035	1	SHC, 110x150x60 transverse dense plano-convex SHC	1	1035
4	8	17246	824	1	130x130x35 dense plano-convex SHC with skewed semicircular outline	1	824
4	8	17246	400	1	SHC, 80x90x60 of which bowl 30, high point is narrow pedestal up to small dense slag nub	1	400

context	sample	context wt	wt	no	notes	propn	orig wt.
4	9	12388	6304	78	ferricrete		
4	9	12388	1490	1	160x110x110, bowl 70, good SHC, possibly some accretion on very top	1	1490
4	9	12388	136	1	possible tiny SHC in the form of coalesced prills, 50x80x40	1	136
4	9	12388	524	1	90x90x50 plano-convex SHC	1	524
4	9	12388	614	1	80x90x70 deep SHC formed of coalesced prills	1	614
4	9	12388	236	1	SHC fragment		
4	9	12388	644	1	fragment of large SHC		
4	9	12388	978	1	SHC, 90x130x90 transverse plano-convex, bowl 35 - lots on top	1	978
4	9	12388	1000	1	obscure lump of very dense SHC - proportion not known		
4	9	12388	116	1	55x70x30 pale glassy tongue	1	116
4	9	12388	146	1	50x90x45 pale tongue, vitrified stone or possible tuyère fragment on top, broken distally		
4	9	12388	88	1	SHC fragment		
4	9	12388	112	1	possible tiny SHC 50x70x35	1	112
4	10	13838	5294	63	concreted material		
4	10	13838	1045	1	SHC, (160)x(120)x60 crust 30, charcoal rich on top	0.4	2613
4	10	13838	844	1	SHC, very heavily concreted piece		
4	10	13838	274	1	SHC fragmentary bowl, 30 crust, with tubular vesicles to 10, very dense		
4	10	13838	618	1	120x120x40 dense SHC	1	618
4	10	13838	384	1	90x110x25 large tongue, green glass on top, rusty material under, D shaped in plan, pale weathering but dark glass remaining on upper surface	1	384
4	10	13838	790	1	115x30x30, dense flat SHC	1	790
4	10	13838	930	1	150x110x45, slightly concreted SHC	1	930
4	10	13838	1265	1	SHC, (130)x(150)x90 concreted, but probably only thinly, fairly thin crust cake	0.4	3163
4	10	13838	212	1	concreted plano-convex lump, possibly SHC		
4	10	13838	250	1	55x80x50 green glassy tongue with very iron rich lumps either above or below, semicircular in plan, recent fracture from tuyère face	1	250
4	10	13838	832	1	140x100x50, neat round SHC, biconvex, dark glass proximally on top	1	832
4	10	13838	790	1	heavily concreted block, shape suggests elongate SHC at core		
4	10	13838	310	1	80x65x60 possibly obscure SHC complete		
4	11	19315	9224	c90	concreted slag fragments, presumably mainly from SHCs		
4	11	19315	1065	1	SHC, 130x130x70 obscured	1	1065
4	11	19315	1220	1	SHC, 130x160x70 obscured	1	1220
4	11	19315	1065	1	SHC, 120x130x70 base rather prilly, rest obscure	1	1065
4	11	19315	1245	1	160x110x70 elongate SHC, well formed flat topped bowl 40mm, lining slag glass to 80% of way across then proximal slaggy bit rising another, 20 base smooth	1	1245
4	11	19315	392	1	SHC, 100x100x35 flat topped	1	392
4	11	19315	1755	1	SHC, 140x140x80 obscure	1	1755
4	11	19315	905	1	SHC, 130x130x60, top glassy raised proximally with gravel, rest of top has deep charcoal holes	1	905
4	11	19315	274	1	SHC, 100x70x30 neat, glassy top	1	274
4	11	19315	350	1	SHC, 80x95x40, not certain if complete		350

context	sample	context wt	wt	no	notes	propn	orig wt.
4	11	19315	366	1	SHC, 90x85x35, dense rusty	1	366
4	11	19315	990	1	SHC, 110x130x90, not certain if this is complete, obscure	1	990
4	11	19315	236	1	SHC, 90x80x25 very simple	1	236
4	11	19315	160	1	SHC, 60x70x45, biconvex, triangular in plan	1	160
4	11	19315	44	1	tuyère fragment c20mm bore		
4	11	19315	24	1	possible iron object		
7	12	7533	6477	35	large balls of indurated grey silt with abundant charcoal and plant remains. Very few of these appear to contain slag - maybe 2? 2 examples split with mattock to look at internal structure - one was lovely bog ore with both black, brown and yellow fringing cement on voids, the other was similar but had a small core of slag		
7	12	7533	420		80x110x40 transverse SHC with concave top, obscure	1	420
7	12	7533	636		SHC, 110x120x60, bowl 30, raised green glass proximal area	1	636
7	13	6000	6000	31	as above - several of these have/are slag		
11	14	11835	10067	180	ferricrete		
11	14	11835	92	1	60x70x20 tongue, dark top, pale lobate base	1	92
11	14	11835	242		SHC, 90x70x50, curious structure, lower half of bowl is iron-rich, truncated against the wall, upper bowl in green vesicular glass, dipping into the iron-rich part - could be slagged tuyère tip	1	242
11	14	11835	712		150x130x50 thin slabby SHC with long 130mm attachment - looks like scallop shell in plan	1	712
11	14	11835	468		120x85x55 incomplete or possibly folded dense SHC	1	468
11	14	11835	26		dense flowed slag		
11	14	11835	24		lining slag fragment		
11	14	11835	20		tuyère sherd		
11	14	11835	18		slag - sheet fragment		
11	14	11835	46		tongue fragment		
11	14	11835	50		tongue fragment		
11	14	11835	70	5	tuyère sherds		

Table 1. Summary Catalogue, by context and sample

	Mucklagh	Coolamurphy	Navan	Moneygall	Carrigoran	Trumra 4	Clonmacnoise (NG)	Ballykilmore	Woodstown 6	Clonmacnoise (WWS)	Clonfad
date	C18/19	C10-12	E. Med.	E.Med-Med.	C10?	C5/6	C7-10	C15/17	C9-10	C10?	C7-9
SHC count	66	41	17	22	18	57	117	43	140	38	513
SHC min. wt	98		60	114		92	100	80	68		
SHC max. wt	1206	2588	2990	1800	3866	3163	7815	4033	6310	5540	11000
SHC mean wt	373	386	507	527	553	727	843	898	1060	1087	1153
% <500g	77%	83%	82%	55%	72%	47%	50%	51%	40%	39%	29%
% <1000g	95%	95%	88%	95%	89%	75%	78%	74%	71%	68%	64%
% >1000g	5%	5%	12%	5%	11%	25%	22%	26%	29%	32%	36%
% >3000g	0%	0%	0%	0%	6%	2%	3%	7%	7%	8%	7%
Modal 100g interval	100-200	100-200	100-200	200-300	100-200	100-300	400-500	300-400	200-300	300-400	300-400

Table 2: Comparison of the Trumra 4 SHC assemblage with other Irish smithing assemblages. Ordered by mean SHC weight.

Mucklagh from Young 2008b; Moneygall from Young 2008c; Navan Site 1 from Young 2007; Carrigoran from Young , 2006c; Coolamurphy from Young, 2008a; Ballykilmore from Young 2006b; Clonfad from Young, 2006a; Clonmacnoise Waste Water Scheme from Young 2005; Woodstown from Young, 2006d; Clonmacnoise New Graveyard site from the author's work in progress.

The assemblages from Mucklagh, Moneygall, Navan, Carrigoran and Coolamurphy are interpreted as being dominantly blacksmithing residues. The assemblages from Ballykilmore, Clonfad, Clonmacnoise and Woodstown are interpreted as including bloomsmithing residues.

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