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Evaluation of archaeometallurgical
residues from Carrickmines Castle
00E0525

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Evaluation of metallurgical residues from Carrickmines Castle, South Co. Dublin, 00E0525

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Abstract

The archaeometallurgical residues from Carrickmines Castle are almost entirely those from iron-working (smithing). They include some with firm evidence for the use of coal and others with evidence for charcoal as fuel. Some of the residues associated with the burning of coal may not necessarily be from metallurgical use, but may be from domestic or other uses. In so far as stratigraphic context can be determined without a full scheme being available at the time of report preparation, the contexts yielding coal-residues (metallurgical or non-metallurgical) appear to be post-medieval.

Smithing residues with clear evidence for the use of charcoal as fuel are widespread. Some materials appeared to contain both coal and charcoal (though more detailed inspection of these residues would be desirable to clarify the nature of the co-occurrence), and it is known from other areas that charcoal use was often not entirely abandoned by smiths when coal became available, particularly when high-quality work was required.

Smithing hearth cakes (SHCs) are typically small, although they may range up to an original weight of at least 1kg. Such an assemblage is typical of early Irish blacksmithing residues.

One context yielded an assemblage suggesting residues derived from iron smelting in a bloomery furnace. Little is yet known of medieval and early post-medieval iron smelting in the area of the Pale. This material is therefore worthy of further analytical work to clarify and confirm the interpretation.

The submitted collection included a variety of materials that were not archaeometallurgical residues, including corroded artefacts and various natural materials. The soil samples from the channels in the industrial area produced negative results and iron staining was the result of natural processes; none of the materials from this area identified as slag during excavation were confirmed as such, but were natural iron panning or corroded metal.

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Methods

All material has been examined in hand-specimen and also under a low powered stereo microscope as necessary. Observations and interpretations are necessarily limited in scope in an evaluation and should not be taken as equivalent to the interpretations possible after detailed analytical investigation.

This particular evaluation is also limited by the lack of availability of a comprehensive stratigraphic or geographic framework within which to interpret the archaeometallurgical residues.

The interpretation of this material should be revisited at such time as those frameworks become available, since it is likely that further information will be able to be gleaned from the assemblage.

The catalogue resulting from the evaluation is presented in two tables: firstly as a list structured by sample number, and secondly with the same information structured by residue type and context number.

Results

Iron-working (smithing)

The archaeometallurgical residues from Carrickmines Castle are almost entirely those from iron-working (smithing). They include some residues with firm evidence for the use of coal and others with evidence for charcoal as fuel. Table 2 presents the catalogue structured according to residue type, with separate listings for material probably produced in coal-burning hearths, charcoal-burning hearths and material for which there is no evidence of fuel.

In general the slag assemblage is of fragmentary material and there are no large collections of metallurgical residues. A few intact smithing hearth cakes were recorded, and much of the fragmentary material is clearly of similar cakes. The cakes range from small conventional smithing hearth cakes (45-270g), through to a few pieces of moderately large cakes (largest fragment 695g), at least some of which possessed a very thin basal crust and a charcoal-rich internal slag. The assemblage can be compared to larger assemblages from sites such as Coolamurphy Site 7 (Young 2006b and in prep.) and Carrigoran (Young 2006c), which have a dominance of small (<400g) SHCs, but with a few significantly larger examples.

It is very likely that almost all the indeterminate iron slags in the assemblage are smithing slags.

The smithing slags are accompanied by pieces of vitrified hearth ceramic. In several cases these have a morphology that hints at these materials being derived from tuyères. In no case was the identification as tuyère certain, but the blowholes were certainly situated on protruding ceramic bosses, in one case with a margin with a right angle corner in it.

Coal residues

Some of the residues (contexts 1058, 1539, 1539, 1353) from the burning of coal may not necessarily be from metallurgical use, but may be from domestic or other uses. Such clinkers are essentially indistinguishable from those of forges, but in the lack of true slags in the assemblage, they are equally possibly produced in domestic fires or other coal-burning hearths (such as steam boilers).

Iron-smelting

Material from context c922 (described as a fill of ditch F518) includes a variety of morphologies of dense, well-flowed slag. Specimens include examples with a smoothly lobate structure, as well as slags that solidified in the interstices of the charcoal fuel. These slags are accompanied by other forms of hollow bleb and by a fairly high concentration of reduce fired and locally vitrified furnace lining. The slag pieces are typically rather small, which precludes their firm identification as smelting slags on purely morphological grounds. If the material is from smelting, then the high proportion of flow lobes with smooth maroon surfaces hints, but does not prove, that these smelting slags may be from a slag-tapping furnace. Such furnaces are almost unknown in Ireland, but are the norm in Anglo-Norman Britain.

Soil samples

Subsamples were prepared from the bulk soils supplied and were wet sieved to 100µm. Samples were checked with a magnet to separate any magnetic particles. The supplied samples (420, 424, 435) all produced a negative result. The iron-rich material was all non-magnetic and appeared to have been precipitated as a result of natural processes.

Interpretation

Detailed interpretation such as would normally figure in an evaluation is not possible here because of a lack of information on the stratigraphy. However, a few general points can be made:

1. the overall slag assemblage is indicative of smithing
2. the small amount of residues recovered suggest that the excavation did not impinge on the main area(s) of activity or of residue disposal
3. blacksmithing using coal is known in Britain from the Roman period with a resurgence in the Middle Ages. At Carrickmines the coal would need to be imported and this is unlikely to have been before the 16th century and possibly rather later (based on the rather limited documentary evidence for coal exports to Ireland from South Wales).
4. slags from a few contexts indicated to be medieval are from charcoal-fuelled smithing.
5. limited evidence from the residues suggests small smithing hearth cakes, comparable with those from the rather earlier assemblages of Coolamurphy (Young 2006b) and Carrigoran (Young 2006c) where blacksmithing rather than bloomsmithing is suggested.
6. a few sherds suggest the use of ceramic tuyères. The use of such tuyères is now very well attested in iron-working during the Early Christian period, with some current evidence suggesting persistence of similar technology through into the 18th century (e.g. Young 2006a), after which time cast iron tuyères started to be used.
7. A single context (c922) yielded residues that suggest iron smelting in a bloomery furnace, possibly utilising slag-tapping.

The low level of blacksmithing waste is typical of that commonly found around castles and large farms, and is not necessarily indicative of any "industrial" scale of activity. The isolated possible occurrence of iron smelting is more unusual.

The negative evidence from the "West Field Industrial Area" makes it extremely unlikely that iron-working was a component of activities in that area.

Evaluation of potential

The evidence from blacksmithing is rather thin and patchy. The main point of potential broader significance in the Carrickmines assemblage would be any constraints the site stratigraphy may offer on the date of the introduction of coal for smithing. This date

is likely to vary by region and by type of site, but is very poorly constrained in general for Ireland at present.

The small assemblage of possible smelting slags is rather more significant. Analysis of these would confirm this identification and should shed light on the nature of the ore being smelted. Further investigation would also be useful for determining whether the slags were tapped from the smelting furnace. This technology has not yet been confirmed in Ireland, with described bloomery furnaces being of the non-slag tapping slag-pit type (Young 2003, 2005). In contrast medieval iron-making in Britain was almost entirely in slag-tapping furnaces, so the social and political context of this evidence makes the interpretation of great significance. Confirmation of the tentative interpretation from the evaluation would therefore be highly desirable.

References

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Table 1. Catalogue structured by sample number

Sample	Context	Feature	Area	Weight	Notes
424 (1)	1481	f683	w11b		3 probable nails and 1 copper alloy buckle
424 (2)	1481		w11a	35	corrosion with stones attached
524	922	f518	18b	1485	270 complete small smithing hearth cake
"					150 vitrified and/or fired furnace lining
"					95 flowed slag against wall
"					585 29 pieces of well-flowed iron slags, largest 105g
"					50 4 pieces of miscellaneous amorphous iron slags
"					185 16 small pieces of furnace wall
"					10 1 piece of possible ore
"					105 dirt and inner bag of fines
527	1935		s11	30	small piece of grey vesicular slightly magnetic slag
619	2055		s11		small bagged sample, iron rich soil
624	1539		j	55	associated with 1071, labelled "burnt coal", contains coal, coke and burnt bone
652	2139		Tio	45	broken nub of grey/fawn lining-dominated slag
704	2		w7	10	small corrosion lump in silt
730	1073		d1	60	1 piece vitrified hearth wall, 1 glazed stone
826	922		18b		bagged soil sample - same context as smelting materials; abundant iron working fines
838	1343			200	decalcified and silicified limestone with echinoderm fossils
971	1060	f549	s2	145	11 pieces light cinder with shale, 4 pieces denser iron-slag all with coke
1071	1539		j	10	burnt shale
1081	1366		s1	20	2 pieces of concreted sediment
1082	263		n	35	small nub of vesicular iron slag, some moderate flowage blebs on one side
1084	1058	f547	18a s2	175	nub of strongly magnetic iron slag, with irregular flow lobes
1117	1959		w3	60	one small piece of iron concretion; second larger 55g piece appears to be natural manganese nodule, possibly formed around a fragment of claystone ironstone
1148	1052	f540	18a s2	180	very dense, but small, probable shc. Lower surface lightly dimpled, upper smooth, but mainly covered by adhering concreted sediment and charcoal.
1149	1190		j	75	corrosion around wedge-shaped lump of iron
1150	1278		18a s8	25	corroded iron piece with thick sediment concretion?
1151	2540		tn	85	very small shc, top partially smooth but mainly charcoally, base irregular
1152	56		tk	170	dense iron-rich slag, irregular shaped cake, some included fuel may be coal
1207	2	f510	18a	1110	30 large pieces of shale encrusted with slag. Slag strongly magnetic in places
1208	2		18a s10	150	burnt stone, shale and coke
1209	1597		j	5	bleb from melted lining or stone
1210	2119		j	15	small piece of corroded slag or iron

1211	263		tn	90	very dense charcoal rich material with lots of corrosion, not clear if a charcoal-rich hearth slag or piece of smithing pan, no diagnostic form
1212	2793	f1036	q	40	grey slag piece with charcoal cf. 1225
1213	1058	f547	18a s2	35	amorphous lump of cinder with shale and other grains
1214	2793	f1036	q	35	small nub of magnetic iron slag
1215	1705	f506	p	15	dark slightly magnetic vesicular slag with shale and white grains
1216	2118		j	55	vitrified lining with slag accumulating at its foot, possibly below protruding tuyere
1217	2793	f1036	q	30	small piece of dense slag in ashy matrix
1218	2793	f1036	q	10	grey slag nub with charcoal, cf 1225
1219	1939		p	5	vitrified lining
1221	1597		j	145	light frothy dark slag with pale inclusions and large fuel impressions - from lime making or clinker?
1222	2793	f1036	q	20	single nub of ?smithing slag
1223	1939		p	20	vitrified lining
1225	2793	f1036	q	25	piece of iron slag with charcoal - smithing?
1226	1939	f797	p	15	2 pieces vitrified lining, magnetic
1227	2793	f1036	q	45	small smithing hearth cake, irregular, maroon glassy top, bulbous lower
1228	53		m?	20	very strongly magnetic overhanging lining with pendent blebs
1231	1580		w13b	55	two corroded lumps - smaller (10g) is "bladed nail", larger unknown
1233	902	f506	p	60	4 pieces of lining. Largest is flap from near blowhole - has shale fragments within.
1234	849		j	10	corroded iron piece with thick sediment concretion
1235	2141		t10	5	iron stained lining slag?
1236	1513		j	25	corroded iron piece with thick sediment concretion, in three pieces
1237	348		tn	15	small piece, possibly of smithing pan; lots of corrosion includes charcoal, sediment and slag fragments
1238	2793	f1036	q	230	5 pieces. 2 pieces of very dense dark slag with charcoal, dimpled ?lower face and flat ?top - so may be fragments of shcs. 1 piece of corrosion around iron, 2 pieces of corrosion (smithing floor?) around slag. The slag has a massive dense sheet flow 12 thick with a 4mm layer of dark (locally maroon) glass on top rich in quartz grains. 1 weakly magnetic, two strongly and three very weakly.
1239	2288	f233	tn	35	amorphous fragment of charcoal-rich slag with adhering concretion bearing lots of charcoal - may just be slag - or may be a smithing pan fragment
1240	2891		k	25	corroded iron piece with thick sediment concretion
1241	1910		p	60	magnetic, appears to be iron with adhering corrosion, possibly a nail with very wide head
1242	1923		s10?	10	platy slag with corrosion on 1 side, probably from basal crust of smithing hearth cake
1243	1199		ts1	65	corroded iron piece with thick sediment concretion, disc shaped?
1244	1706		t10	25	very heavily gritted vitrified lining, magnetic
1245	2344	f880	s18a	5	vitrified lining
1246	1945	f750	s11	510	approximately 36 pieces of slag, some smithing hearth cake basal crust, several pieces with shale, some with charcoal
1247	3142		q	10	heavily gritted vitrified lining
1248	1353		j	10	2 pieces of shale in clinker
1249	1960		s11	25	3 pieces of irregular ?smithy floor material

1250	2492		j	115	magnetic material resembling forge slag or clinker, much included shale and sandstone, 21 pieces
1252	1257	near boundary wall	q	45	6 pieces of clinker, 2 of grey slag
1252	1827		2	45	slag nub with shale
1253	1826		tt4	85	magnetic, appears to be iron with adhering corrosion, very dense
1254	2060		s11	560	siltstone with iron-rich crust on one face
1255	1360		t10	95	dense irregular slag in ash matrix, bearing coal and charcoal fragments cf 1357
1256	1562	f705	s1	20	vitrified lining or brick
1257	10		j	10	flown blebs of highly magnetic vesicular slag
1258	1977		p	10	black glazed pebble
1260	2027		18a s6	60	slightly magnetic slag with some corrosion, some flow drips, lots of admixed dark pieces which may be coal
1261	2438		tj	25	vitrified magnetic lining fragment
1262	7233		tn	185	180g fragment of (probably) large smithing cake. Three layer, lower dense, mid charcoal-rich, top dense with smooth top, 2 small pieces: 1 smithing slag fragment, the other a piece of corroded iron (?) with adhering charcoal.
1263	1351		s1	20	very strongly magnetic lining - possibly a blowhole margin
1264	7233		tn	65	magnetic, problematic, mainly iron-rich sediment on surface - probably a very corroded piece of iron
1265	1462	f24	18a s8	25	bulbous blowhole/tuyere opening, c23mm diameter, protrudes at least 20mm
1266	1935	f811		460	32 pieces of slag cf 1246 shale fragments, Coal(?) dust on basal fragments.
1335	348		tn	120	3 pieces of pale, lining-derived slag, with adhering lining, 1 piece denser, probably a corroded fragment of lower crust of an shc. Has attached tubes of ?bryozoans on underside
1336	381		n	50	corroded iron piece with thick sediment concretion
1337	2397		n	80	vesicular charcoal-rich slag, broken piece, no diagnostic form
1338	328		n	240	very dense iron-rich slag, with abundant included charcoal debris.
1339	3215		q	30	heavily gritted vitrified lining
1340	274		n	915	10 pieces of slag - 1 shc others all softer charcoal-rich furnace slag, partial shc/burr piece 155g
1341	3231	f233	n	80	large nub of charcoal rich iron-slag
1342	2118		j	45	vitrified lining with a right angle, possibly a tuyere/blowhole
1343	1366		s8	20	glazed sandstone pebble
1348	1		s3	35	magnetic slag on corner of ?tile - probably used deliberately in hearth side
1353	263		n	90	2 pieces charcoal-rich hearth slag
1354	273		n	10	concretion around corroded iron
1355	780		g2	60	single piece complexly lobed, reddened surface - possibly from smelting
1356	325		n	5	iron-concreted granitic material
1357	879		d1	75	2 pieces of irregular slag in ashy matrix bearing charcoal and coal
1358	1481	f424	w13c	600	concreted granitic gravel, with at least 2 pieces of corroded iron
1359	1597		j	125	appears to be stone with accreted slag, charcoal and other debris
1361	1932		t10	90	bulbous blowhole/tuyere opening, c25mm diameter, protrudes at least 25mm, cf 1265
1362	1109		s3	30	2 pieces coke-bearing forge clinker
1363	1560		n	695	distal part of large smithing hearth cake. 100x120x50
1364	3027	f1005	t11	140	broken grey charcoal rich slag piece; half shc maybe
1365	2694		s	65	slag with accreted sediment, slag, coal, charcoal and organics (straw?)

1366	162	f75	t7	90	corroded iron artefact
1367	1120	f591		30	2 pieces of dense slag, one with coalesced blebs, other more vesicular
1368	1969	f816	t10	40	concretionary sediment - not slag
1369	1569		j	35	2 pieces of frothy slag (lime kiln?); 1 piece of flown diverging prill, which could be from smelting
1372	1756		s11	565	approximately 20 pieces of variable but generally dark and dense slag. Also one probable corroded iron nail and at least 4 other corroded lumps - one quite large. Suggestive of general smithy debris. Some show accreted coal - and general morphology supports this as coal-fired material.
Find 10430	2		S4	115	Pottery with accreted smithing floor material including small copper alloy fragment

Table 2. Catalogue structured by residue type

Context	Sample	Feature	Area	Weight	Notes
Material certainly or probably corroded iron artefacts or scrap					
2	704		w7	10	small corrosion lump in silt
162	1366	f75	t7	90	corroded iron artefact
273	1354		n	10	concretion around corroded iron
381	1336		n	50	corroded iron piece with thick sediment concretion
849	1234		j	10	corroded iron piece with thick sediment concretion
1190	1149		j	75	corrosion around wedge-shaped lump of iron
1199	1243		ts1	65	corroded iron piece with thick sediment concretion, disc shaped?
1278	1150		18a s8	25	corroded iron piece with thick sediment concretion?
1481	424 (1)	f683	w11b		3 probable nails and 1 copper alloy buckle
1481	424 (2)		w11a	35	corrosion with stones attached
1481	1358	f424	w13c	600	concreted granitic gravel, with at least 2 pieces of corroded iron
1513	1236		j	25	corroded iron piece with thick sediment concretion, in three pieces
1540	1231		w13b	55	two corroded lumps - smaller (10g) is "bladed nail", larger unknown
1826	1253		tt4	85	magnetic, appears to be iron with adhering corrosion, very dense
1910	1241		p	60	magnetic, appears to be iron with adhering corrosion, possibly a nail with very wide head
2119	1210		j	15	small piece of corroded slag or iron
2891	1240		k	25	corroded iron piece with thick sediment concretion
7233	1264		tn	65	magnetic, problematic, mainly iron-rich sediment on surface - probably a very corroded piece of iron
Material derived from the burning of coal, not necessarily metallurgical					
2	1208		18a s10	150	burnt stone, shale and coke
1058	1213	f547	18a s2	35	amorphous lump of cinder with shale and other grains
1539	624		j	55	associated with 1071, labelled "burnt coal", contains coal, coke and burnt bone
1539	1071		j	10	burnt shale
1353	1248		j	10	2 pieces of shale in clinker
Material probably or certainly derived from iron-working using coal					
2	1207	f510	18a	1110	30 large pieces of shale encrusted with slag. Slag strongly magnetic in places
56	1152		tk	170	dense iron-rich slag, irregular shaped cake, some included fuel may be coal
879	1357		d1	75	2 pieces of irregular slag in ashy matrix bearing charcoal and coal
902	1233	f506	p	60	4 pieces of lining. Largest is flap from near blowhole - has shale fragments within.
1060	971	f549	s2	145	11 pieces light cinder with shale, 4 pieces denser iron-slag all with coke
1109	1362		s3	30	2 pieces coke-bearing forge clinker
1257	1252	near boundary wall	q	45	6 pieces of clinker, 2 of grey slag

1360	1255		t10	95	dense irregular slag in ash matrix, bearing coal and charcoal fragments cf 1357
1705	1215	f506	p	15	dark slightly magnetic vesicular slag with shale and white grains
1756	1372		s11	565	approximately 20 pieces of variable but generally dark and dense slag. Also one probable corroded iron nail and at least 4 other corroded lumps - one quite large. Suggestive of general smithy debris. Some show accreted coal - and general morphology supports this as coal-fired material.
1827	1252		2	45	slag nub with shale
1935	1266	f811		460	32 pieces of slag cf 1246 shale fragments, Coal(?) dust on basal fragments.
1945	1246	f750	s11	510	approximately 36 pieces of slag, some smithing hearth cake basal crust, several pieces with shale, some with charcoal
2027	1260		18a s6	60	slightly magnetic slag with some corrosion, some flow drips, lots of admixed dark pieces which may be coal
2492	1250		j	115	magnetic material resembling forge slag or clinker, much included shale and sandstone, 21 pieces
2694	1365		s	65	slag with accreted sediment, slag, coal, charcoal and organics (straw?)

Material probably or certainly derived from iron-working, fuel uncertain

1	1348		s3	35	magnetic slag on corner of ?tile - probably used deliberately in hearth side
10	1257		j	10	flown blebs of highly magnetic vesicular slag
53	1228		m?	20	very strongly magnetic overhanging lining with pendent blebs
263	1082		n	35	small nub of vesicular iron slag, some moderate flowage blebs on one side
348	1335		tn	120	3 pieces of pale, lining-derived slag, with adhering lining, 1 piece denser, probably a corroded fragment of lower crust of an shc. Has attached tubes of ?bryozoans on underside
780	1355		g2	60	single piece complexly lobed, reddened surface - possibly from smelting
1058	1084	f547	18a s2	175	nub of strongly magnetic iron slag, with irregular flow lobes
1073	730		d1	60	1 piece vitrified hearth wall, 1 glazed stone
1120	1367	f591		30	2 pieces of dense slag, one with coalesced blebs, other more vesicular
1351	1263		s1	20	very strongly magnetic lining - possibly a blowhole margin
1366	1343		s8	20	glazed sandstone pebble
1462	1265	f24	18a s8	25	bulbous blowhole/tuyere opening, c23mm diameter, protrudes at least 20mm
1560	1363		n	695	distal part of large smithing hearth cake. 100x120x50
1562	1256	f705	s1	20	vitrified lining or brick
1569	1369		j	35	2 pieces of frothy slag (lime kiln?); 1 piece of flown diverging prill, which could be from smelting
1597	1209		j	5	bleb from melted lining or stone
1706	1244		t10	25	very heavily gritted vitrified lining, magnetic
1923	1242		s10?	10	platy slag with corrosion on 1 side, probably from basal crust of smithing hearth cake
1932	1361		t10	90	bulbous blowhole/tuyere opening, c25mm diameter, protrudes at least 25mm, cf 1265
1935	527		s11	30	small piece of grey vesicular slightly magnetic slag
1939	1219		p	5	vitrified lining
1939	1223		p	20	vitrified lining
1939	1226	f797		15	2 pieces vitrified lining, magnetic
1960	1249		s11	25	3 pieces of irregular ?smithy floor material
1977	1258		p	10	black glazed pebble

2118	1216		j	55	vitrified lining with slag accumulating at its foot, possibly below protruding tuyere
2118	1342		j	45	vitrified lining with a right angle, possibly a tuyere/blowhole
2139	652		Tio	45	broken nub of grey/fawn lining-dominated slag
2141	1235		t10	5	iron stained lining slag?
2344	1245	f880	s18a	5	vitrified lining
2397	1337		n	80	vesicular charcoal-rich slag, broken piece, no diagnostic form
2438	1261		tj	25	vitrified magnetic lining fragment
2793	1214	f1036	q	35	small nub of magnetic iron slag
2793	1217	f1036	q	30	small piece of dense slag in ashy matrix
2793	1222	f1036	q	20	single nub of ?smithing slag
2793	1227	f1036	q	45	small smithing hearth cake, irregular, maroon glassy top, bulbous lower
2793	1238	f1036	q	230	5 pieces. 2 pieces of very dense dark slag with charcoal, dimpled ?lower face and flat ?top - so may be fragments of shcs. 1 piece of corrosion around iron, 2 pieces of corrosion (smithing floor?) around slag. The slag has a massive dense sheet flow 12 thick with a 4mm layer of dark (locally maroon) glass on top rich in quartz grains. 1 weakly magnetic, two strongly and three very weakly.
3142	1247		q	10	heavily gritted vitrified lining
3215	1339		q	30	heavily gritted vitrified lining
1597	1221		j	145	light frothy dark slag with pale inclusions and large fuel impressions - from lime making or clinker?
Find 10430	2		S4	115	Pottery with accreted smithing floor material including small copper alloy fragment

Material probably or certainly derived from iron-working using charcoal fuel

263	1211		tn	90	very dense charcoal rich material with lots of corrosion, not clear if a charcoal-rich hearth slag or piece of smithing pan, no diagnostic form
263	1353		n	90	2 pieces charcoal-rich hearth slag
274	1340		n	915	10 pieces of slag - 1 shc others all softer charcoal-rich furnace slag, partial shc/burr piece 155g
328	1338		n	240	very dense iron-rich slag, with abundant included charcoal debris.
348	1237		tn	15	small piece, possibly of smithing pan; lots of corrosion includes charcoal, sediment and slag fragments
922	524	f518	18b	1485	270 complete small smithing hearth cake
"					150 vitrified and/or fired furnace lining
"					95 flowed slag against wall
"					585 29 pieces of well-flowed iron slags, largest 105g
"					50 4 pieces of miscellaneous amorphous iron slags
"					185 16 small pieces of furnace wall
"					10 1 piece of possible ore
"					105 dirt and inner bag of fines
1052	1148	f540	18a s2	180	very dense, but small, probable shc. Lower surface lightly dimpled, upper smooth, but mainly covered by adhering concreted sediment and charcoal.
1597	1359		j	125	appears to be stone with accreted slag, charcoal and other debris
2288	1239	f233	tn	35	amorphous fragment of charcoal-rich slag with adhering concretion bearing lots of charcoal - may just be slag - or may be a smithing pan fragment
2540	1151		tn	85	very small shc, top partially smooth but mainly charcoally, base irregular

2793	1212	f1036	q	40	grey slag piece with charcoal cf. 1225
2793	1218	f1036	q	10	grey slag nub with charcoal, cf 1225
2793	1225	f1036	q	25	piece of iron slag with charcoal - smithing?
3027	1364	f1005	t11	140	broken grey charcoal rich slag piece; half shc maybe
3231	1341	f233	n	80	large nub of charcoal rich iron-slag
7233	1262		tn	185	180g fragment of (probably) large smithing cake. Three layer, lower dense, mid charcoal-rich, top dense with smooth top, 2 small pieces: 1 smithing slag fragment, the other a piece of corroded iron (?) with adhering charcoal.

Soil samples

922	826		18b		bagged soil sample - same context as smelting materials; abundant iron working fines
2055	619		s11		small bagged sample, iron rich soil

Natural materials

325	1356		n	5	iron-concreted granitic material
1343	838			200	decalcified and silicified limestone with echinoderm fossils
1366	1081		s1	20	2 pieces of concreted sediment
1959	1117		w3	60	one small piece of iron concretion; second larger 55g piece appears to be natural manganese nodule, possibly formed around a fragment of claystone ironstone
1969	1368	f816	t10	40	concretionary sediment - not slag
2060	1254		s11	560	siltstone with iron-rich crust on one face

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