

# GeoArch

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Evaluation of archaeometallurgical  
residues from Kilroot, Co. Antrim

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# Evaluation of metallurgical residues from Kilroot, Co. Antrim

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## Abstract

*Clinker, mainly present in post-Medieval levelling and garden deposits, dominates pyrotechnological residues from Kilroot. Similar clinker was also recovered in very small quantities from several of the early graves, but it likely that this material is intrusive. The clinker is probably, but not certainly, derived from a non-metallurgical hearth. A very small quantity of charcoal-fuelled blacksmithing slag was also found, but the small quantities and scattered distribution precludes any detailed interpretation.*

## Contents

Abstract .....	1
Methods .....	1
Results .....	2
Interpretation .....	3
Evaluation of potential.....	3
References .....	3
Catalogue .....	4

## Methods

The archaeometallurgical residues have been evaluated by brief visual inspection and the use of a lower-powered binocular microscope. Descriptions and interpretations of material are necessarily limited by this approach.

## Results

Potential archaeometallurgical material from Kilroot divides into two categories: iron slag and clinker.

**Iron slag:** dense iron slags were recovered from three contexts (126, 150 and 196).

Context 126 yielded a block (292g) that can be interpreted as a large proportion of a plano-convex smithing hearth cake. The cake has a thickness of 55mm, and the preserved piece measures 65 x 70mm, with 70mm probably being the original width. The upper surface is lobate, with vesicular dark glass with a surface bloom of a maroon colour. The glass has partially melted inclusions of quartz up to a few mm across, which probably represent debris from the hearth wall, but which might be particles of flux. The glassy layer is superficial, probably being only a few mm thick. The main body of the piece is formed of dark fayalitic slag, which is moderately vesicular. The basal section of the cake forms a distinct crust with some tubular vesicles. On what is probably the proximal end there is a re-entrant, 30mm x 12mm, with slightly curved, perpendicular sides, suggestive of the use of a poker to remove the slag from the hearth. The lower face of the block is irregular, with some rusty adhering accretion. The lateral faces of the block show moulds of fuel fragments, which appear to be charcoal, although this is not conclusive.

Context 150 produced a very small fragment (4g) comprising a piece of iron slag with adhering accretionary material including charcoal debris, as well as both spheroidal and flake hammerscale. Accretionary material of this kind is often referred to a "smithing floor", although the floor of the smithy is not the only circumstance in which the reactive fine detritus of the forge may accumulate.

Context 196 yielded a small particle (3g) comprising what appears to be a partially melted stone or hearth-lining fragment, with impressed charcoal-rich material.

**Clinker:** materials broadly classifiable as clinker (residue from the burning of coal) were retrieved in moderate quantities from contexts late in the history of the site (113, 115, 162), as well as from the fills of a number of earlier graves (199, 200, 226, 248, 267, 270, 271).

The assemblage from context 115 includes approximately 750g of clinkers, with one block being particularly large at 338g. This large block comprises a piece of a low density, friable, clinker sheet, 60mm thick, with the preserved block measuring 115 x 90mm. The upper surface is strongly lobate, with a dark glassy, highly vesicular material, bearing abundant small (up to 10mm) fragments of white, but unmelted, shale fragments. The surface is a reddish-brown colour. Below the relatively solid surface layer the clinker is fragile and highly porous. Internal lobate surfaces may be maroon to brown in colour and there are abundant inclusions of shale. The texture becomes finer towards the base. The basal surface is a rough, sintery layer, with small lobes of melt admixed with ash and sand grains. The remainder of the assemblage comprises smaller pieces of dark glassy slag, often with included shale fragments, together with platy pieces that are probably shale fragments with vitrified coatings. The surface colours of the clinker fragments range from dark, almost black, glasses, through to glasses of a reddish-brown colour, sometimes paling as far as a tan colour. In addition to the clinker there is one piece (70g) of natural stone.

The assemblage from context 162 comprises a sample of approximately 90 fragments (344g), plus 10 other small finds, each of a single small fragment, totalling 43.7g. The surface of the glass fragments is often variegated, with the same black to brown to bronze variation seen in the material from c115. Many of the fragments are in the form of rounded blebs, but a significant proportion seemed to be pieces broken from a larger friable mass. Several of the rounded blebs are broken to reveal a pale siliceous material beneath the dark glass coating, which suggests these blebs have formed through the partial melting and reaction of small pieces of stone. In a four cases there are pieces of shale within the clinker, and one clinker bleb had small coal fragments adhering externally. The material from context 162 also included the shell of a winkle (*Littorina* sp.).

Similar clinker was recovered from the fills of several graves. This material is potentially of greater significance than the major clinker-bearing contexts of relatively modern age. The material comprises:

*Sf1390 c199.* A single piece of black vesicular glass with shale fragments which are variably vitrified.

*Sf1396 c199.* A rounded dark vesicular glass bleb bearing numerous shale fragments; has a variegated brown-black surface.

*Sf1393 c200.* An abraded small grain of dark vesicular glass.

*Sf1388 c226.* c38 pieces of dark glass, typically rounded blebs, but mostly fragmentary; includes several pieces with shale debris.

*Sf1397 c240.* A tiny sub-spheroidal bleb of grey slag with metallic lustre.

*Sf1398 c248.* 2 pieces of dark glass, rounded, with shale inclusions.

*Sf1389 c267.* A tiny fragment of dark, slightly greenish vesicular glass.

*Sf1391 c270.* A dark glass fragment, vesicular, with a brown surface.

*Sf1392 c271.* 4 pieces of black vesicular glass, some with brown surface variegation; one piece has a dark shale inclusion.

In addition to the material from the grave fills, the generalised graveyard soil (c122) yielded a single piece of rather impure coal.

To add to the macroscopic material supplied by the excavators, the possibility of the existence of microresidues that might aid interpretation of the clinker was examined through extraction of fines from three sources:

1. The material from c115 (sf# 1270) comprised a bag of unwashed clinker. Much of the adhering soil had disaggregated and fallen to the bottom of the bag. This soil was separated from the macroscopic clinker fragments and examined.
2. Also within C115 was a particularly large block of clinker, which contained lots of small particulate material in its crevices and voids. Frequently large blocks in secondary depositional environments may carry fines with which they were associated in the primary environment. For this reason the block was washed and the washings collected and sampled.
3. Fines present in the large bag of material from c162 (sf#1321) were separated from the macroscopic pieces in the assemblage and sampled.

In each case the sampling process included being washed, and then sieved at 212µm. The residue was then dried and the magnetic fraction then removed with a bar magnet. Both magnetic and non-magnetic fractions were inspected with a binocular microscope.

For each of the three samples the residues extracted were very similar (excluding the material derived directly by fragmentation of the large block in the second sample from context 115).

The non-magnetic fraction was dominated by fragments of broken vesicular glass, varying from green to black, typically with a surface with variegated colours from black to brown, maroon and tan. The non-magnetic fraction also contained a large proportion of fired shale fragments.

The magnetic fraction of each sample contained much fine detritus, but they were characterised by the presence of spheroidal blebs. The spheroids ranged from small (<0.6mm) particles, with high sphericity and typically either a glassy lustre or a metallic lustre (commonest in the smallest particles), to large spheroids which have a tendency to be of lower sphericity with increasing size and which generally are glasses with a brown surface. Few particles over 1.0mm diameter are of high sphericity, becoming somewhat pear-shaped and in some instances aggregated with other blebs. The largest magnetic blebs/spheroids are of about 4mm diameter.

The small spheroids with a metallic appearance are very similar in appearance to spheroidal hammerscale (Allen 1986, Starley 1995), but their occurrence in association with spheroidal particles of a rather different nature casts doubt on their attribution to iron-working in this instance.

Apart from the pyrotechnological residues, sample #150 from context 287 was of corroded iron (not slag) and may be a nail(s); it has mineralised wood fragments within the rust (this was the later inhumation which yielded other nails). Small find 1208, context 122 (sieve) is a fragmented piece of highly weathered coarse-grained igneous rock, probably granite.

## Interpretation

The attribution of the few pieces of charcoal-bearing slag to iron-working is strong, but provides little hard archaeological data. The two pieces in grave fills are fragmentary and weathered and may be residual. The larger piece derives from a post-medieval tree-planting hole. Close dating of such material is not possible.

The clinker is clearly derived from the burning of impure coal, but whether in a domestic or industrial context is more difficult to determine. The presence of sub-millimetre slag spheroids with a metallic lustre might be taken as indicative of iron-working. There has been little detailed description, however, of coal residues in archaeological contexts and it seems extremely likely that the localised elevated iron contents common in coal might lead to the generation of iron-rich melts. The complete absence in these samples of flake hammerscale, normally a common component of forge residues, provides additional evidence that these residues are unlikely to be from a smithy.

Residues from coal hearths are a common addition to recent garden soils, and more concentrated collections of clinker were frequently employed for garden path surfaces.

The clinker from the fills of the early graves is rather more problematic, because significant coal use in this area would be unlikely before the 18<sup>th</sup> Century. The relatively small quantities and small particle size of clinker from the grave fills means that an intrusive origin is extremely likely, with the material being derived from the overlying post-medieval garden deposits.

## Evaluation of potential

Unless a primary origin for the clinker in the grave fills can be demonstrated, there is little here that can benefit from additional study. If an early origin for the clinker could be demonstrated, then investigation of provenance of the coal would be worthwhile. However, given the likely intrusive nature of the clinker in the grave-fills no further work is recommended.

The occurrence of the iron-working residues on a site such as this is not unexpected, since most post-medieval estates would have had some smithing activity and the evidence from the earlier grave-fills is very slight. No further work on the iron slags is recommended.

## References

- Allen, J.R.L. 1986. Interpretation of some Romano-British smithing slags from Awre, Gloucs. *Historical Metallurgy*, **20**, 97-104.
- Starley, D. 1995. *Hammerscale*. Historical Metallurgy Society, Archaeology Datasheet No 10.

context	s#	sample#	Weight (g)	notes
113	1320	bulk 14-14.5	28	3 pieces of light glassy clinker: 2 very glassy, black to translucent brown on surface, 1 with pale interior; third piece less glassy and has shale inclusions, probably mainly a shale piece hidden by melted coating.
115	1270	6.5-14m	828	338 large block, mainly slightly friable vesicular clinker, but one surface, probably the top, comprises lobes of more flowed material 32 glassy
			200	23 pieces of stony-looking clinker, only partially glassy, with abundant shale chips
			20	glassy
			16	lobed, glassy
			96	fine debris
			72	natural stone
122	1208	0-6m	46	weathered dense igneous rock with some Fe-oxide concentration, probably granitic
122	1271	6.5-14	16.7	coal with shale
126	1252	6.5-14m	292	very dense slag block, probably from moderately large smithing hearth cake, lower surface has thick dense crust, upper surface has lobate surface in dark glass, charcoal inclusions laterally
133	1149	14.5-22m	0.77	glassy clinker bleb
150	1394	0-6m	4	weathered iron slag, corrosion attached has hammerscale (spheroidal and flake) and charcoal - so probably smithing floor
162	1321	22-22.5 baulk	344	c90 clinker pieces, plus debris; blebs, spheroids and lumps of material with black/brown glassy surfaces, but which are internally grey to white, with inclusions of white rock and shale.
162	1163	22-22.5 baulk	4.61	black/brown glass bleb. Vesicular and dark
162	1164	22-22.5 baulk	4.65	black/brown glass bleb. Vesicular and dark
162	1165	22-22.5 baulk	17.08	black/brown glass bleb. Vesicular and dark
162	1166	22-22.5 baulk	0.49	black/brown glass bleb. Vesicular and dark
162	1167	22-22.5 baulk	1.24	black/brown glass bleb. Vesicular and dark
162	1168	22-22.5 baulk	2.46	as others in this group, but is glaze on flat shale clast
162	1169	22-22.5 baulk	5.3	black/brown glass bleb. Vesicular and dark. Discoidal so probably coated shale piece
162	1170	22-22.5 baulk	0.56	black/brown glass bleb. Vesicular and dark
162	1171	22-22.5 baulk	4.28	black/brown glass bleb. Vesicular and dark
162	1172	22-22.5 baulk	3.04	black/brown glass bleb. Vesicular and dark
196	1395	14.5-22	3	fragmented weathered charcoal bearing iron slag, rusty, but internally probably melted stone/hearth lining
199	1390	6.5-14	0.16	dark glassy clinker
199	1396	63	1.65	dark glassy clinker
200	1393	22.5-28.8	0.05	dark glassy clinker (rounded transported grain)
226	1388	6.5-14	9.6	c30 pieces of dark glassy clinker, bearing shale chips, maroon bloom on surface
240	1397	136	<	small spheroid of dense slag
248	1398	90 14.5-22	1.28	dark glassy clinker, 2 pieces
267	1389	101 22.5-28m	<	dark glassy clinker
270	1391	102	0.24	dark clinker with brown surface
271	1392	102 6.5-14	0.55	4 pieces of dark glassy clinker
287	1387	150 0-1.5m	18	iron corrosion products, possibly from nail, containing fragmented wood

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