

# Evaluation of slags from Clonfeacle

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## Abstract

*Metallurgical residues from three contexts were examined. The assemblage from context 112 was a subsample of the slag from this context. It contained 40 pieces of residue, totalling approximately 3.5kg. The material included plano-convex smithing hearth cakes (mainly fragmentary), irregular hearth slags and pieces of vitrified hearth lining. The assemblage was indicative of blacksmithing using a traditional clay lined hearth, with charcoal fuel. A smaller assemblage from context 115 contained similar slags, and can also be attributed to blacksmithing, although a single piece would be compatible with an origin in a non-slag tapping iron smelting furnace. The third assemblage, from context 152, only comprised three pieces, totalling just 130g and was less diagnostic of origin. Two of the three pieces might be from iron smelting, although all three could have been produced during blacksmithing.*

*In summary, the material appears to derive from blacksmithing, with just a few pieces less certainly so. The assemblage as a whole indicates an early style of iron-working technology. Survival of this style into the industrial period would be unusual, and if the material is not residual and the dates for the contexts are correct, this material represents an interesting addition to current understanding.*

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## Techniques

The specimens have all been examined in hand specimen and under a low-powered binocular microscope. Where required the specimens have been cleaned. None of the material has been cut, or subjected to further detailed analysis. Interpretation of the material is therefore limited, and made on the basis of its overall form and texture.

## Description

The material is listed and given a summary description in the catalogue (Table 1).

### Context 112

Context 112 was represented by a sample of approximately 3.5kg out of the c.10kg recovered. The subsample included 41 pieces of material, including 1 supplied separately as a possible piece of tapslag. Piece #1 was a complete plano-convex smithing hearth cake, measuring 130mm in length by 100mm wide by 55mm deep and weighing 710g. Pieces #2, 5 and 6 are also fragments from plano-convex smithing hearth cakes. These samples suggest total cake weights in the range of 500-700g. Items #3 and 7 are pieces of the zone of attachment (burr) between the hearth cake and hearth wall from just below the blowhole. Some slags appear to have flowed quite well, including #9, 34 and 41 (a piece separated by the excavator from the main collection as being a possible

tapslag). Several of the conventional cakes show well-flowed material, particularly around the margins and it seems likely that these pieces represent well-fluxed material flowing into the smithing hearth, rather than being derived from the smelting process.

The collection also includes several pieces of hearth lining, well vitrified surfaces. Of these, the largest, #4, is a large slab from close to the blowhole and includes some dense slags attached to the wall. Piece #13 is interesting for it is probably part of the margin of a blowhole, and is of fired sandy clay 10mm thick. The material from which this is formed is apparently more quartz-rich than the remainder of the lining, and may indicate differential use of material around the blowhole. The piece is slightly convex, and although this may be the result of corrosion of the wall adjacent to the blowhole, it might indicate that this piece is a ceramic tuyere: a separately-formed component containing the blowhole. If so, this tuyere would have been a gently convex plate, rather than an elongate nozzle. This interpretation is supported by the vitrification extending up the rear of the piece suggesting a slight gap had developed between it and the main hearth wall. The preserved arc of the blowhole is angular, so estimation of size is difficult, but it may have been approximately 40mm diameter.

The remainder of the small slag pieces include both small fragments of hearth cakes and smaller, more amorphous pieces of hearth slag. Piece #10 is a small nub of corroded slag which is "exploding", indicating corrosion of an included piece of metallic iron.

Many of the pieces have outer surfaces which preserve fine organics (straw?) and other materials. Pieces #3 and 5 have accreted material including both flake and spheroidal hammerscale, with #6 having just flake hammerscale.

### Context 115

The material from context 115 was 8 pieces, totalling 235g. The largest piece (#45) was a fragment almost certainly from a plano-convex smithing hearth cake.

The 135g piece had a lower dense slag crust approximately 8mm thick with tubular vesicles, overlain by 25mm of less dense, vesicular slag, with a smooth but lobate upper surface. One side of the specimen shows some explosion from the corrosion of iron within.

Piece #51 shows descent of a dense slag into fine charcoal, and is similar to textures on the base of some of the plano-convex slag cakes.

Pieces #46, 47, 49 and 52 are materials from the flowage of slag dominated by hearth lining.

Piece #48 shows descent of dense slag into rather coarse-grained charcoal, with some adhering lining, probably from the base of the hearth. Coarse charcoal moulds were also seen in other material from the site (e.g. #7, context 112).

Of the material from context 115, only piece #46 shows adhering flake hammerscale.

#### **Context 152**

This context yielded just three pieces of slag, totalling 130g. Although some specimens from all the contexts showed adhering pale ashy material, this was most marked in the material from this context.

Piece #42 was a very dense, angular slag fragment, with a very coarse crystal size, bearing fayalite crystals of up to at least 15mm. This indicates slow cooling of a substantial volume of liquid slag.

Piece #43 was an irregular piece of dense slag of uncertain origin.

Piece #44 was a dense slag show penetration of the slag between large charcoal moulds. The attached sediment contains a large piece of flake hammerscale.

## **Discussion**

The general physical condition of the slag pieces was good; there was little evidence for abrasion, and the breakage of pieces could have occurred at source. The material is unlikely, therefore, to have spent any period in, for instance, agricultural soils, before deposition into the features from which they were retrieved.

The majority of the material, certainly from contexts 112 and 115, can be identified as originating within blacksmithing. The presence of both characteristic macroscopic slags (particularly plano-convex cakes) and of associated micro-residues (flake and spheroidal hammerscale) indicate smithing, and the relatively small size of the slag cakes (below 1kg) indicates blacksmithing rather than bloomsmithing. Although both contexts 112 and 115 yielded flown material, the size and proportion of this is well within the limits of small-scale flows which may occur within smithing hearths (Crew 1996).

The small amount of material from context 152 is less certainly attributable to smithing, although the presence of flake hammerscale strongly suggests this. The dense slags with very coarse grain size and the material flowing into coarse charcoal are somewhat ambiguous, with such textures being recorded in non-slag tapping smelting slags, as well as in high-temperature smithing hearths. There is some indication in the form of piece #42, that it originates from a relatively thin (40-50mm?) slag body – which would support attribution of this piece to a large smithing cake rather than a smelting slag.

On balance, an origin for the whole assemblage in blacksmithing is not unlikely.

The style of slag present is interesting, for it represents iron working in a clay-lined hearth, using charcoal as a fuel. This technology remained essentially the same from the Early Iron Age through to early post-medieval times in some areas, but industrialisation brought a widespread (although not quite universal) use of coal or coke as fuel by the mid-19<sup>th</sup> century even to areas well away from the coalfields. Modern forges also have refractory ceramic linings, or even metal linings, so will not produce the sorts of slags seen in clay-lined hearths, in which the clay contributes significantly to the slag formed. Slags such as those in this assemblage are rare in post-medieval contexts; although it is quite possible that old technologies might linger in rural areas, it would be of some surprise if these assemblages were as recent as the 19<sup>th</sup> century.

## **Significance and potential for further investigation**

Further microtextural and chemical analytical studies might usefully be employed in investigating whether the slags from context 152 are indeed from smithing or whether they might be from iron smelting. Further analytical work on the main slag assemblages would probably not be worthwhile.

The main interest in this assemblage lies in its date. If the slag all derives from the same period and technology, then the date on the "hearth" may be useful. It seems quite likely the material is residual, but if genuinely 18<sup>th</sup>-19<sup>th</sup> century, it indicates an extremely late survival of early forge technology.

## **References**

Crew, P. 1996. *Bloom refining and smithing, slags and other residues*. Historical Metallurgy Society Datasheet No. 6.

<b>112</b>	<b>3.496 Total:-</b>	
1	710g	complete plano-convex smithing hearth cake, 130x100x55mm, charcoal fueled.
2	335g	broken 2 layer smithing hearth cake
3	470g	burr region of smithing hearth cake, lower surface has fine organics plus both flake and spheroidal hammerscale.
4	215g	slab of vitrified lining, probably from base of blowing wall - has both lining slag and descending dense slags.
5	140g	Slag piece flown around charcoal debris. One end with accreted material containing both flake and spheroidal hammerscale.
6	400g	Third to half of a plano-convex smithing hearth cake. A well flowed dense cake. Lower face with fine organics and one piece of flake; upper surface quartz-rich.
7	255g	Very open-textured slag from burr region of a smithing hearth cake; large charcoal cavities.
8	125g	Hearth slag. Possibly a contorted lump with dark dense and lining slags around charcoal, with clasts of lining and sandstone.
9	80g	A well-flowed dense slag puddle. Probably a small plano-convex hearth cake. Lots of fine straw-like organics.
10	50g	An exploding nub of slag with adhering debris including lots of fine charcoal.
11	60g	A dense piece of iron slag.
12	10g	A flow lobe of vesicular iron slag.
13	35g	A piece of vitrified lining, probably representing a blowhole margin.
14-29	135g	16 pieces of lining.
30	115g	A fragment of hearth cake.
31	85g	A fragment of hearth cake.
32	70g	A fragment of hearth cake.
33	70g	A fragment of hearth cake.
34	65g	A fairly well-flowed slag fragment.
35	35g	A slab of lining-dominated slag.
36-40	35g	5 small pieces of iron slag.
41	25g	A well flowed piece of dense fayalitic slag. (labeled possible tap slag)
<b>152</b>	<b>130 Total:-</b>	
42	65g	A very dense angular lump of slag with very coarse crystal size. Adhering "ashy" material. Fayalite up to 15mm.
43	35g	An irregular nub of dense slag with adhering ashy material with charcoal and ?straw
44	30g	A dense slag penetrating between large charcoal voids. Coated in white ashy material. Attached sediment has large piece of flake hammerscale.
<b>115</b>	<b>235 Total:-</b>	
45	135g	A probable plano-convex hearth cake fragment. Lower crust c8mm thick with tubular vesicles, overlain by 25mm vesicular slag with smooth upper surface. Rusty, one side showing explosion from iron alteration.
46	30g	A piece of irregular, vesicular, lobed slag with low overall density; some adhering flake scale.
47	25g	A fairly dense large flowed bleb of lining slag.
48	20g	Coalesced descending prills around moderately coarse charcoal. Lining on base. Could be from smelting
49	15g	Dense lining slag as #47 - slight red bloom on surface locally.
50	15g	Accreted lump of charcoal rich material with some flake. Probably not slag dominantly (but does have some small pieces).
51	5g	Flowed dense material descending into fine charcoal.
52	5g	A small lobe of vesicular lining slag

Table 1. Catalogue