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Assessment of archaeometallurgical residues from Flint, Flintshire (DWF/16/EX)

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Abstract

This supplied materials comprised five bulk samples, taken from three features. The samples fall into two groups – those dominated by fuel residues (samples <6> and <7>) and interpreted as deriving from the ash-pits of truncated hearths/furnaces, and those comprising the sandy gravel fills of pit [1073] (samples <15>, <16> and <17>).

Both fuel-waste-dominated samples contained lead spills, with those from sample <7> being particularly abundant and comprising both small, granular, puddles and elongate 'drips' (with shapes like large ball-headed pins). The elongate drips suggest formation by suspension from a source of molten metal into free-space – perhaps by spills that were molten in the firebox of the hearth dripping into the ashpit below.

The fills of pit [1073] are rather more difficult to interpret. They include many examples of dendritic masses of lead, apparently from liquid lead flowing down through the unconsolidated gravel fill, some masses formed by cementation of the gravel into concretions by secondary lead weathering products, and a large right-angled sheet of lead suggesting moulding against the base of a box or wall. These too are likely to have mostly primary spills of hot metal, perhaps lost into the body of a casting pit containing a mould or perhaps simply accidental spillage, but then modified by post-depositional weathering.

The residues add little to the understanding of the processes being undertaken on the site. The metal appears to have been melted in one or more hearths (in which spills occurred) and perhaps cast or poured in an area floored with gravel. The residues contained no identifiable slag, suggesting the process involved metallic lead rather than any form of smelting or processing. The coal residues were dominated by partially burnt coked residues, with almost no clinker (melted coal ash), perhaps suggesting a relatively low-temperature process (compatible with the handling of lead metal).

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Methods

The samples were examined visually. Sub-samples were wet-sieved at 100µ and dried. The with a low-powered binocular microscope where required.

As an evaluation, the materials were not subjected to any high-magnification optical inspection, not to any form of instrumental analysis. The identifications of materials in this report are therefore necessarily limited and must be regarded as provisional.

The examined materials are listed in Table 1.

This project was commissioned by Kate Pitt, of Archaeology Wales.

Description of residues

The submitted materials comprised five bulk unprocessed samples, varying from approximately 2 to 4 litres.

The observations of the wet-sieved sub-samples are given in Table 1.

The metal-containing materials in samples <6> and <7> were various forms of drips and blebs, together with amalgamations of such material. The most characteristic form was one resembling a large ball-headed pin. In this 'drips' the head was formed by a droplet of lead up to 5mm in maximum cross-sectional diameter and 8mm in length, attached to a 'tail' of up to 60mm length, and approximately 1mm diameter. These are likely to have formed during the descent of a droplet from an upper supporting medium into free space. There were several accumulations of such drips into larger amalgamated masses.

There were also less significant blebs, including flattened forms suggestive of chilling on impact of a molten droplet of lead.

The fuel-residue dominated samples also contained some larger irregular masses and coatings on the fuel remains. These are likely to be dominated by secondary lead weathering products, and to what extent they indicate altered original spills and to what extent the lead has been substantially remobilised from its primary location is uncertain.

Rather similar masses of weathering products occur in samples <15> and <17>, but for these samples the host matrix is a sandy gravel, rather than fuel waste. Again, the precise relative role of primary spill and weathering processes in the generation of these granular masses is unclear. There are clear primary lead spills present as dendritic masses in <15> and <17>, in which the lead has penetrated down through prills passing into the gravel substrate, and by the large spill in sample <16> (apparently moulded against the base of a wall or box), all of which have retained metallic appearance and properties. This increases the likelihood that the white granular materials are associated with post-depositional processes.

Interpretation

Sample <6> is mainly fuel waste, with a relatively low level of lead contamination. The lead is mainly in the form of secondary mineralisation that bind some of the fuel waste. There are just a few pieces of lead that suggest that lead found its way into the hearth (rather than simply being mobilised post-deposition). The fuel waste was mainly coke, with very little clinker, perhaps suggesting a relatively low temperature process.

Sample <7> was also mainly fuel waste, but contained a large amount of lead contamination - both as secondary minerals, put also as pin-like blebs, probably chilled on descent through the fuel bed. Some of the blebs amalgamated into larger masses. The last use of this hearth was certainly 'messier' than that yielding sample <6>, but that does not necessarily mean they originated in different types of process or hearths. The elongate pin-like drips are compatible with the lead having chilled during descent from the hearth above to the preserved ash-pit below.

Samples <15>, <16> and <17> were all very closely related. There was the large mass of lead (moulded into the right-angle of some pre-existing object or feature) in sample <16>, whereas samples <15> and <17> included large lead mineral-cemented masses of the host gravel as well as spikey/dendritic masses of less-altered lead. These samples result from a spill of hot lead into the gravel - but whether as a single or repeated events is not known. This is unlikely to be a deliberate action, but some sort of spill from whatever was going on at a higher level. It is unclear whether pit [1073] was a deliberate component of the process (such as a casting pit for holding moulds) or simply the location of an accidental spillage

The supplied images of the features on the site showed little sign of intense heat alteration of surrounding brickwork, probably indicating the brick features were ash-pits (and possibly also ventilation channels bringing air to a hearth from outside a building into the hearth). The level of truncation makes reconstruction/interpretation of the hearth/furnace superstructure extremely difficult, and on the available evidence it is not possible to discriminate between reverberatory furnaces (suitable for handling larger amounts of metal) and crucible furnaces (suitable for smaller volumes).

Further work

The context (separated from the actual task) and nature (as spills of metal) of the archaeometallurgical residues means that there is little extra to be gained from their further scientific analysis. Accordingly, no follow-up analysis is recommended.

Table 1: summary catalogue.

Sample	Context	Context notes	Residues
<6>	1056	primary fill of oven 4 and adjacent pit	Mostly fuel residue (i.e. the remains of burnt coal), but with very little clinker. Some of the fuel residue is bound with white lead minerals, but there are just a very few pieces of apparent lead spill/waste.
<7>	1065	oven 3 and pit, lead ash fill	Ashy deposit with lumps of coke and shale, some dense blocks of granular lead mineral of uncertain nature, possibly oxidised puddles? Abundant lead drips with a morphology like a pin (with a large rounded droplet head up to 5mm in diameter and an elongate tail up to 60mm in length - probably formed as droplets with tails stretched during cooling. Occasionally these show a degree of amalgamation in large masses.
<15>	1126	fused lead in pit [1073]	Almost identical to sample 17. Reddish gravel-rich deposit with both masses of lead alteration forming a conglomerate (though smaller lumps than in sample 17) and small dendritic masses. These show dimpled lobes on dendrites indicating a primary texture.
<16>	1125	poured lead in structure in pit [1073]	Right-angled thin sheet of lead with textured outer surface suggesting it formed against a right-angled embayment in brick, wood or similar hard medium. On the concave side, there is a strong reaction between lead oxides and gravelly sand, probably post-depositional rather than a hot reaction.
<17>	1124	primary fill of pit [1073]	Reddish gravel-rich sediment with irregular masses of lead and lead alteration products. Some are dense and rounded conglomerates with included gravel - so presumably largely secondary minerals, other are spikey irregular dendritic masses, and so presumably primary. The dendritic masses are flexible - so contain metal not just alteration products. Lead is partially oxidised and reacted with substrate. Unclear if the lead penetrated into gravel when hot, but this appears the most likely interpretation (the spikey masses are unlikely to have survived as clasts to be reworked. Unusually, this contains no fuel residues.

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