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Assessment of materials from TSSF23, Pocklington, East Yorkshire

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Abstract

The submitted materials comprised approximately 11.9kg from 9 archaeological contexts. The largest class of materials by weight were iron smelting slags produced in non-slag tapping furnaces with wood packed basal pits (10.3kg from 6 stratigraphic contexts). Furnaces of this type were employed both in the pre-Roman Iron Age and the early medieval periods. These examples are most likely to be Iron Age in date.

A second group of slags are indicative of ironworking (blacksmithing). This group, 262g from a single context (1011), was also accompanied by slags of indeterminate origin, mainly comprising single low flow lobes. Such flows are most likely also to have been generated in a smithing hearth but are not uniquely so. While this assemblage is not itself particularly indicative of age (Iron Age to modern), this context also yielded a single fragment of coke. If this is not intrusive, it would probably suggest a post medieval age.

The materials also include items that are interpreted as natural concretions, perhaps formed around plant roots or animal burrows.

A further concretion may be cored on an iron nail but did not produce a positive response on a metal detector and should be X-rayed for confirmation.

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Methods

All materials were examined visually, using a low-powered binocular microscope where required. The identifications of materials in this report, as an assessment during which no instrumental analysis was undertaken, are necessarily limited and must be regarded as provisional.

This assessment was conducted in August 2023 and was commissioned by Julie Franklin of Headland Archaeology. The materials derive from a field evaluation undertaken near Pocklington, E Yorkshire, (TSSF23) centred on NGR [SE7646].

Results

General nature of the assemblage

The submitted materials comprised approximately 11.9kg. The largest class of materials by weight were iron smelting slags produced in non-slag tapping furnaces with wood packed basal pits (10.3kg from 6 stratigraphic contexts).

A second group of slags are indicative of ironworking (blacksmithing). This group, 262g from a single context (1011), was also accompanied by slags of indeterminate origin, mainly comprising single low flow lobes. Such flows are most likely also to have been generated in a smithing hearth but are not uniquely so.

The materials also include items that are interpreted as natural concretions, perhaps formed around plant roots or animal burrows.

A further concretion may be cored on an iron nail but did not produce a positive response on a metal detector.

Iron smelting residues

The iron smelting residues comprise three elements: a very dense, apparently massive slag (blocks of 2280g and 4715g from (219008) and a block 286g, possibly from the same context but lost from its bag during transit). a slag rich in moulds of large pieces of split wood (material from contexts (1018), (212006) and (250024)) and smaller fragments of flow slags (fragments from contexts (250024) and (250035)).

These three classes are likely to have formed together as components of 'furnace bottoms' in the basal pit, with the massive slags towards the top and close to the blowing wall (their attached indurated ceramic representing the side of the pit). The present examples are particularly thick (thicker than, for instance, the examples from Fleethill Farm,Hardy & Young 2019, where the 'furnace bottoms' typically weighed 20-30 kg).

Similarly, the slags with moulds of a wood pit-packing, show evidence for the use of split wood with slightly larger dimensions than is typical. These slags would typically form the lower part of the furnace bottom.

The examples of amalgamated lobed flow slags are very small but are probably also from iron smelting. They typically comprise much of the less well consolidated part of the furnace bottom.

Iron smithing residues

Iron smithing is represented by an assemblage of material from context (1008) that includes fragments of small smithing hearth cakes (SHCs). These show finely dimpled bases and tops with deeply impressed holes (probably impressions of fuel clasts) with intervening raised lobes. There are also some examples of flowed slags that show large broad individual flow lobes with dimpled bases. Such flows could occur within smelting furnace, they too are more characteristic of smithing assemblages.

The materials do not include intact SHCs, but the fragments present are suggestive of rather small examples, which would be indicative of blacksmithing (fashioning and repairing artefacts in the end use of iron) rather than the working of raw blooms (bloomsmithing).

While this assemblage is not itself particularly indicative of age (Iron Age to modern), this context also yielded a single fragment of coke (the organic remains from partly burned coal). If this is not intrusive it would probably suggest a post medieval age. Coke is often found as an intrusive material derived from the waste from steam-driven agricultural machinery. There is no evidence that the certain smithing residues were produced in a coal-fuelled fire.

Other materials

The materials also include two items that are interpreted as natural concretions, perhaps formed around plant roots or animal burrows. One piece (182g) from context (26009) is in a very friable yellow mineralised sandy silt and has fractured into multiple pieces. It was originally tubular, with a slightly irregular central cavity. The second piece (a 266g piece from context (219008) is much harder and appears as several intersecting rods. This piece superficially resembles the slag rods from some slag tapping bloomery furnaces. No slag however shows on the surface of the piece, which is formed of a well cemented ferruginous sand. Although it is possible that this is a concretion cored on a complex slag fragment, it appears more likely to a natural concretion.

In both cases, the elongate nature of the concretionary material probably indicate formation during diagenesis in the area surrounding either a plant or an animal burrow.

A further concretion (unstratified) is darker and may be cored on an iron nail (the shape of which it closely resembles) but did not produce a positive response on a metal detector and should be X-rayed for confirmation.

Interpretation

The residues appear to be present in a rather low density across the site, although with concentrations in a few areas.

Only the blacksmithing residues from context (1011) need be particularly close to their source. As discussed above, the dating of these residues is unclear.

The iron smelting slags are most likely to be Iron Age, but it should be remembered that early medieval technology can be very similar. Even some classes of Roman furnace can produce dense slag blocks (furnace bottoms) with moulds of wood, but examples of this particular technology are very rare.

The iron smelting residues are interesting because they are suggestive of particularly large 'furnace bottoms' based on the evidence of the massive blocks from context (219008) and on the large size of the pieces of wood employed for the pit packing seen in the slag piece from context (1018). Very large Iron Age furnace bottoms have been reported in the area previously (Clogg 1999; Halkon 1997). They are known to occur in the Middle Iron Age of Southern England, with examples analysed from Tolgarrick Farm (Truro; Young 2016) as well as in the Wokingham area (Lewis *et al*. 2013; Young 2018; Young & Anelay in press). The Yorkshire examples have not however been examined in detail and no details of the technology are yet known.

Further work

This material is an indication of metallurgical activity in the vicinity of the test trenches. There would be no significant benefit any additional detailed work on the slags at this stage.

Glossary

Blacksmithing: the working of iron and steel. Often restricted to the secondary smithing – i.e. the smithing of iron to produce or repair artefacts, as opposed to the smithing involved in the production of billets or bar iron from raw iron blooms.

Bloomery: a furnace for smelting iron from ore in which iron is produced as a solid material. The bloomery process was employed mainly prior to the introduction of the later blast furnace from the late 15th century.

Bloomsmithing: The process of reworking a raw bloom, through repeated reheating and hammering, to reduce its content of slag, to remove unwanted inclusions and to draw out the remaining slag into elongate inclusions. The end product may be a bar or billet. Usually taken as an alternative term for bloom-refining.

Coke: a dark, highly vesicular material that is an organic material formed from the incomplete combustion of coal (compare **clinker**, which is the inorganic slaggy material remaining after the combustion of impure coal). Coke maybe either an material produced incidentally during the combustion of coal, or a material produced deliberately to produce a high temperature industrial fuel.

Flow slag: slag that had flowed before it chilled into a usually elongate prill, demonstrating its flow. Tapslag is a particular form of flow slag in which the slag flows out of the furnace and chills in the air. Bloomery tapslags typically generate a thin veneer of oxides with a maroon colour on their surface because of oxidation

Furnace bottom (FB): a slag block that accumulates during a smelt in a non-slag tapping furnace in its basal pit or chamber. The pit is typically filled with a packing of green wood or grass/cereal before the smelt and the furnace bottom replaces this, but often incorporates moulds where the organic matter had been.

Non-slag tapping furnace: a bloomery furnace in which the slag does not run out of the furnace during he smelt, but downwards to a pit or chamber below the shaft.

Olivine: a group of silicate minerals of the form $(M^{2+})_2SiO_4$ where M can commonly be iron, magnesium, calcium (up to half the M^{2+} ions) or rmanganese.

Smelting: a process involving the reaction of raw ore to produce a metal,

Smithing: the activity involved in forming a metal object, including, but not limited to, forging metal and joining metal by welding.

Smithing hearth cake (SHC): a slag mass that grown just in front of and below the blowhole in a smithing hearth, from the reaction of iron and iron oxides from the workpiece with melted cermaic from the hearth wall.

Vesicle: a void or pore, usually rounded and formed as a preserved gas bubble in a solidified melt.

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Table 1: summary catalogue, weights in g.

context	Item wt	Item no.	notes
Unstrat.	20.9	1	Mineralised iron-rich sand in shape resembling nail
1011	92	1	broad flow slag lobe with dimpled base, 50mm wide and 12mm thick
	62	1	vesicular iron slag, dimpled base, raised flow lobes and deep dimples on top, probably an SHC fragment
	132	1	similar to 32g pieces, but more heavily accreted; dimpled base, raised lobes on top
	370	1	sub-conical slag piece, 110mm long, max. 70mm wide, large open rounded void 55mm wide at wide end, micro-dimpled convex base, upper surface more granular.
	132	1	angular fragment of reddened slag with accretion
	128	1	prilly slags, iron slag internally but has lining slag coat on top - probably from an SHC. Joins 6g piece below
	6	1	small fragment dimpled lining slag rich iron slag
	36	1	small thin burr with lobes of lining slag attached to front
	52	1	flow lobe of slag slightly dimpled underneath, reddened on top with linin slag patches and a possible clast
	3	1	small fragment of coke
	66	1	very irregular shape, vesicular slag
	36	1	highly encrusted slag, no details visible
	2	2	small scraps of vesicular iron slag fractured from other pieces
	30	1	dense slag; dimpled base, smooth top; blebs of lining slag within upper part, row of vesicles just below top; probably the margin of a small SHC
	34	1	vesicular, rough slag, locally maroon-surfaced, irregular piece
1018	1710	1	185x115x95mm, dense grey slag; mould of split wood with face 65x150mm, void on one face shows extremely large olivine crystals as plates up to 12mm across.
26009	182	1	decomposed yellowish iron rich concretion with central void; ‘tubular’ concretion
39012	10	1	small fragment of vesicular iron slag with a charcoal clast
212006	120	1	dense slag, around probable wood mould
219008	266	1	complex piece with multiple rod-like components; appears to be a highly altered piece of multiple rodding casts, but the broken sections show only concreted sand
	2280	1	dense block of slag, highly corroded; 140x110x100mm
	4715	1	dense block of corroded slag, burr type contact on one face, possible wood mould on another perpendicular surface 160x185x95mm
?	286	1	dense slag attached to indurated wall - a small fragment from a burr

250024	1000	1	accreted and corroded slag block, but large wood moulds are visible, one surface appears reddened and there is a large bulbous concretion in one area that might suggest corrosion of an iron inclusion
	176	1	amalgamated flow slags, bulbous lobes on top, probable wood contact below
250035	24	1	small fragment of slag, highly weathered, with curved embayments suggestive of fractured flow slag lobes

Table 2: weight in g of slag classes by context. ? = block separated from its bag in transport, preservation resembles that of material from (219008).

context	smithing	Indet.	smelting	coke	concretion	Iron?
1011	262	846		3		
1018			1710			
26009					182	
39012		10				
212006			120			
219008			6885		266	
?			286			
250024			1176			
250035			24			
unstrat						21

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