GeoArch

Report 2022/14

Assessment of pyrotechnological materials from Yatton (AWY19)

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28th September 2022

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Abstract

The investigated materials comprised a small quantity of vesicular glassy slag, some with abundant partially-melted sand grains (equivalent to a 'buchite' in petrological terms). Although there is a range of bulk density amongst the material, the assemblage is interpreted to be entirely of fuel ash slag (FAS) of non-metallurgical origin.

Non-metallurgical slags of this type may require other fluxing material to be present besides the fuel ash. Wood ash is rich in alkaline earth and alkali elements, mostly calcium and potassium, that can flux the melting, or partial melting, of a siliceous substrate. This effect is enhanced in cases where the substrate is itself calcareous – and that is likely to have been the case here.

The generation of FAS in thick sheets, as suggested by the fragments here, typically requires elevated temperatures over a considerable period of time. Such conditions may be encountered in, amongst other settings, cereal drying kilns and long-burning hearths. The latter appear to be a particular feature of the Middle Iron Age and are thus a strong contender for the origin of these examples. It is hypothesised that continuously-burning hearths were favoured in this period, leading to the formation of a slag type sometimes referred to as 'Iron Age grey slag'. Regional examples of this material include a large deposit of such slag within the rampart of the hillfort at Malmesbury, but smaller quantities are commonly recovered from Iron Age rural sites.

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Methods

All materials were examined visually, using a low-powered binocular microscope where required. As an assessment, 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.

This assessment was conducted in September 2022 and was commissioned by Tracy Michaels of Foundations Archaeology.

Results

Context (1007)

This context produced a single piece of slag from the margin of a slag block at least 30mm in thickness. The piece shows a contact between the slag and a purplish-red sandy substrate with siliceous grains of up to 5mm. The body of slag shows a partial melt with a vesicular glassy slag bearing abundant sand grains. The top of the piece has a slightly greenish (ashy?) surface with slight dimples and has the margin inclined at about 60 degrees below this. Other surfaces are all fractures

Context (1023)

The context yielded approximately 190g of FAS in 15 fragments plus some minor debris and dust. Most of the material (110g, 10pieces) is a greenish cream-coloured coarsely vesicular glassy slag. Vesicles range up to 12mm, rarely 25mm. Two pieces (10g) are of a sand-rich lithology, similar to that of the material from context (1007). A further 66g (3 pieces) are formed of a slightly denser, grey, vesicular glassy slag. In places this shows elongate crystals (possibly of olivine), but is mostly finely granular.

Interpretation

Fuel ash slags are formed from the partial melting of silica- and alumina-rich hearth materials under the influence of alkali and alkali earth elements present in fuel ash acting as a flux. In the most common situation, where the fuel was wood or charcoal, the major fluxing elements are calcium and potassium. Since the

melting of the hearth materials is rarely complete, the resultant material is equivalent to a 'buchite' – with a glassy matrix binding relict quartz (dominantly) grains. The process may be facilitated by the presence of additional calcium (typically as a component of lime) in the substrate as well as in the fuel.

The fuel ash slags are not characteristic of a particular process but indicate a hearth that has spent a considerable time at elevated temperature. Several archaeologically significant processes/installations may produce FAS under appropriate conditions.

Probably the most common of these is within cereal-drying kilns. (e.g. South Hook, Young 2010a, 2010b; Llandeilo, Young 2015; Bornais, Young 2012a, 2020).

A cake of FAS approximately 300mm by 400mm and up to 30mm thick (1755g) was recovered in situ in a medieval (dated to AD 1024-1181) cereal kiln near Llandeilo, Carmarthenshire (Young 2015).

The Llandeilo FAS closely resembles early medieval material from South Hook, Pembrokeshire, which occurred only as redeposited material with no recognised kiln (Young 201a, 2010b).

At Bornais, S. Uist, the Middle Norse phase kilns of Mound 2A produced both fine-grained FAS residues and larger sheet-like bodies (a total of 61kg), whereas the Iron Age kiln residues from Mound 3 (Young 2020) were all small in size (only 3 pieces were recorded as having weights over 3g, out of a collection of 850g).

Mound1 at Bornais, in contrast, produced a large quantity of FAS in much larger fragments of sheet-like cakes (Young 2012a), not from cereal kilns, but apparently from large Late Norse hearths.

Domestic hearths are the probable source for the 'Iron Age grey slags' that occur in Middle Iron Age contexts and that have been particularly recorded in central and eastern England (Cowgill 2000, 2008; Cowgill *et al*. 2001; Swiss & McDonnell 2001; Young 2009, 2011, 2013; Young & Bowstead Stallybrass 2003).

Although these FAS are common in small quantities on Iron Age sites in the region, a particularly large deposit was encountered in association with the hillfort bank at Malmesbury (Young 2011). In the present material, the coarsely vesicular pale glassy varieties probably derive from substantial slag masses and thus an origin in large hearths seems likely. The sandier varieties are probably those formed on some of the cooler hearth margins, where fresh sand and silt were incorporated from the hearth edge, but where temperatures were slightly lower, and perhaps the input of fuel ash may have been less, so the degree of melting is less.

The significance of FAS of this type being particularly associated with the Middle Iron Age is likely to be cultural, maybe due to the continuous maintenance of a substantial, perhaps communal, hearth fire.

Further work

No further investigation of the materials is recommended.

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Table 1. Catalogue of materials from Yatton submitted for investigation, by context. Weight in g.

context	weight	number	notes
1007	48	1	fragment from the margin of a slag block. Shows contact with a deep slightly purplish-red sandy substrate with grains of up to 5mm. Body of slag shows a partial melt with a vesicular glassy slag full of sand grains. Top of piece has a slightly greenish (ashy?) surface with slight dimples, the contact is inclined at about 60 degrees below this. Other surfaces are all fractures. Overall preserved thickness approximately 30mm.
1023	110	10	green/cream coarsely vesicular glassy slag. Vesicles to 12mm, rarely 25mm.
	66	3	denser slag fragments. Formed of a dark grey glassy slag, locally showing a finely granular texture.
	10	2	slag fragments showing a microstructure dominantly of relict sand grains bound by a grey glass

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