10. The Slag-Like Material
by Chris Salter

10.1 Introduction
Just over one kilogram of high temperature semi-fused slag-like material was recovered. None of this material was diagnostic of metalworking activity. All but 0.01kg of this debris was Fuel Ash Slag (FAS). Although FAS can be formed during some metalworking processes, other high temperature processes can also produce it. In this case the evidence from the FAS itself, and the lack of large amounts of other metallurgical debris suggests that the majority of this material was not produced as a result of metalworking. It is thought most likely that the majority of the material was the result of the burning of timber and clay structures (huts) or the over heating of oven walls.

A total weight of 3.8kg material was examined of which 72 per cent by weight was natural ironstone (see Table 10.3). The ironstone was largely in the form of naturally oxidised iron-sulphide nodules (marcasite, and pyrite). These occur in the chalk and are left as residual deposits as the chalk erodes. There were lesser amounts of other natural ironstones but again probably residual from the local geology. Some of the ironstone showed possible indications that it had been heated, but considering the small amount of material involved and the limited degree of heating it is thought that this was likely to have been the results of accidental, rather than deliberate, heating.[1]

The rest of the material consisted of fuel ash slag (1.06kg), together with a little vitrified clay (0.01kg). Nearly half, by weight, of the FAS was in the form of a single piece weighing 0.44kg, context (1253). Almost all of this type of material (99% by weight) came from Trench 1. Both fuel ash slag and vitrified hearth lining can be produced by a number of high temperature processes, and thus, are not indicative of any particular pyrotechnical process. In the case of Fuel Ash Slag, all that is required is sufficiently high temperature for alkali elements in the ash from the fuel to act as a flux on the more refractory material present in the hot zone.

10.2 Formation of Fuel Ash Slag
It has been suggested that FAS has been produced as the result of a number of different processes including copper-working, cremation (Henderson *et al.* 1987), pottery firing (Biek and Bayley 1979), the burning of timber and daub structures, and cattle-dung fires (Zeuner 1959). It may be possible to eliminate some of these modes of formation at Segsbury Camp.

At least some of the Fuel Ash Slag on this site has developed by heating of the soil, as some FAS fragments have structures transitional between that of a chalky soil and Fuel Ash Slag. However, here is no direct evidence for the type of high-temperature process that produced the Fuel Ash Slag. The lack of hammer-scale on the large-hearth bottom shaped piece weighing 0.44kg from context (1253), together with the absence of any other iron-working debris, more or less rules out the possibility that it was produced as the result of iron-working. There is limited evidence for copper working, in the form of two crucible fragments, context (1709). There was FAS-like material present in this context, material

[1] Ironstones can have a number of uses: unoxidised iron sulphide could be used as firelighters. Oxidised ironstone could be used as a pigment, a polishing material, and iron ore. But as there was no obvious deliberate human modification of the ironstone, it was considered that the material recovered was simply geological detritus.

described as "Furnace waste?" in Poole's Daub and Fired Clay catalogue, but this only weighed one gram. Also one of the fragments from context 1434 could be a fragment of over-fired crucible.

As it is likely that there was plenty of wood for fuel in the area, it is unlikely that it would have been necessary to go to the trouble of drying cattle dung for fuel.

There was no evidence of pottery making on the site in the form of wasters. Normally, it is unlikely that the pottery making techniques of the period would have reached the sort of temperatures required to generate FAS. However, even in a bonfire pottery-firing it is possible to generate these sorts of temperatures on a windy day. But, if that was the case, it might be expected that some pot-wasters as well as FAS would have been produced.

Finally, to consider the burning of timber and daub structures. There are two obvious candidates for supplying the right conditions for the generation of FAS given sufficient air supply: ovens and the huts both of which can be constructed of daub (clay) and wattle. An oven in normal use would not generate FAS, but with an over-stoked fire on a windy day high enough temperatures might be produced. However, in such a case, it might be expected that there would be a greater proportion of vitrified clay to FAS than was recovered.

The deliberate or accidental burning of a timber, clay and straw hut on a windy day would have provided the right conditions for the formation of FAS. In particular, the larger timbers around the doorway and structural uprights would have kept burning long enough to provide the high temperature for the prolonged periods required to generate the thickness of FAS recovered from Segsbury Camp. It is likely that the largest piece of FAS, context (1253) formed very close to a major doorway or other structural timber post-hole, as large pieces of FAS are very fragile and break up very easily and, therefore, would not move far. It is also unlikely that it would survive the initial packing of the hole around an upright timber; it is more probable that it went into the open hole left by a rotten or burnt timber.

The final possibility is that the material was generated as a result of cremation or burning of bone. On some Iron Age and Romano-British sites FAS is associated with burnt bone, usually animal bones rather than human. In some cases the burnt bone was incorporated into the FAS (Salter 1996). In the case of Segsbury, no burnt bone fragments or remnant structures indicating the incorporation of bone fragments were observed. However, this does not mean that cremation was not the source of this material. On those sites with large amounts of FAS, the fraction of FAS material showing evidence of association with burnt bone tends to be low.

10.3 The Distribution of FAS at Segsbury

Interestingly, FAS appears to occur predominantly in postholes rather than in pits or other types of archaeological feature (see Table 10.1). Whereas, over 69% of the finds of daub and fired clay occurred in pits and only 13% were associated with post and stake holes. Fuel ash slag occurrence seems to correlate with that of daub and burnt daub with nearly 80% of the contexts in which it occurs also containing daub, and over half containing burnt daub.

Table 10.1: Correlation of 'Slag-like' Material with context and material type

Fuel Ash Slag correlations		
With Material type	% Weight	% Number
Daub	78.9	40.6
Burnt Daub	56.8	32.2
With Context type		
Pit	2.6	7.7
Post-hole	81.7	52.4
Other	13.8	32.2
Unknown	1.8	7.7

The majority of the Fuel Ash Slag was found in undated contexts (Table 10.2). Of the dated contexts the MIA material is entirely from the fill of the southern roundhouse ditch (context 1004) whereas EIA material is from a variety of contexts, seven in total.

Table 10.2 – Fuel Ash Slag by Phase

Phase	Weight	%	Fragments	%
EIA	162.2	15.2	21	14.7
MIA	134.2	12.6	37	25.9
RB	0.9	0.1	1	0.7
No Phase	768.8	72.1	84	58.7

10.4 Summary

Although a small amount of Fuel Ash Slag could have been produced during copper working, the form of the larger pieces of FAS is such that they are unlikely to have been produced by that means. The two other possible modes of formation of the FAS are by the conflagration of a timber and daub structure, or by the over-heating of an oven. However, given that the formation of FAS requires a prolonged period at temperatures in excess of 1000^{o}C, to achieve this sort of temperature would have required some form of increased air supply compared with an open bonfire.

It is possible that an over-heated oven could be the source of the material. However, this is thought to be the less likely of the two possibilities, as normally the temperature would be controlled by a tended fuel supply. Ovens were not normally tall enough to induce draught by convection; such uncontrolled ventilation is only likely to have occurred with the help of a strong wind.

The burning of a hut is thought to be the more likely mode of origin, as this would be an uncontrolled fire, with any vertical space between the upright timbers and the daub acting as a chimney to induce sufficient draught to achieve the temperatures required. Such a chimney effect would be aided by the wind.

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Table 10.3 Segsbury Camp - Slag and possible metal-working debris Catalogue

Number	Context	Weight	Frags	Material Type	Slag description
6071	1000	91.2	5	Iron ore	Mixed fragments of ironstone
6072	1004	168.0	12	Iron ore	
6073	1004	128.0	36	Fuel Ash slag	A range of 'fuel ash slag' type material. These pieces vary from large slaggy fragments to small furnace vortex type material. The mode of origination is not clear in this case, but given sample 6074, the material is most likely to have formed by the heating of oven/hearth lining, or possibly the burning of daub.
6074	1004	6.2	1	Clay -Vitrified - moderate glaze	Piece of hearth lining or burnt daub, the external surface similar to some of the 'fuel ash slag' material from the same context.
6075	1010	3.7	1	Iron ore	Ironstone fragment
6076	1010	6.5	4	Fuel Ash slag	
6077	1014	19.7	2	Iron ore	One fragment of hard-pan, and one piece of iron-rich fine-grained sandstone.
6078	1016	47.5	4	Iron ore	Two pieces of 'hard-pan' type ironstone, and two pieces of oxidised iron sulphide nodules (possibly)
6079	1088	11.6	1	Iron ore	
6080	1088	23.5	11	Fuel Ash slag	
6081	1008	35.8	3	Iron ore	
6082	1008	26.3	8	Fuel Ash slag	
6083	1171	7.0	1	Iron ore	
6084	1192	3.1	1	Iron ore	
6085	1253	21.1	10	Fuel Ash slag	One piece with partially fired clay, again suggesting a hearth-lining mode of formation.
6086	1253	444.0	1	Fuel Ash slag	A large lump of fuel ash slag type of material in the form of a 'hearth bottom'.
6087	1254	1.7	1	Iron ore	
6088	1254	2.7	1	Clay -Vitrified -thin surface glaze	
6089	1266	66.0	4	Iron ore	
6090	1381	1.0	2	Fuel Ash slag	
6091	1386	9.2	3	Iron ore	Hard-pan type ironstone.
6092	1399	1.8	1	Fuel Ash slag	
6093	1399	2.0	1	Fuel Ash slag	
6094	1399	18.6	7	Iron ore	Hard-pan type ironstone.
6095	1409	3.6	1	Iron ore	
6096	1409	89.8	1	Iron ore	Fragment of botryoidal ironstone with haematitic colouration. Angular fracture, unlike most of the ironstone from the site.
6097	1411	140.0	35	Fuel Ash slag	
6098	1417	124.0	4	Fuel Ash slag	'Fuel ash slag' type material which has formed directly in contact with soil, rather than hearth lining.
6099	1423	1.0	1	Fuel Ash slag	
6100	1434	0.7	1	Fuel Ash slag	Fuel ash slag like material which could possibly be an over-fired crucible fragment.
6101	1446	40.8	2	Iron ore	
6102	1449	9.4	7	Fuel Ash slag	
6103	1455	1.9	1	Iron ore	

Table 10.3 Segsbury Camp - Slag and possible metal-working debris Catalogue

Number	Context	Weight	Frags	Material Type	Slag description
6104	1472	3.8	1	Iron ore	
6105	1474	5.0	3	Iron ore	Limonite ironstone
6106	1475	76.6	8	Iron ore	One piece broken and possibly heated.
6107	1476	22.0	6	Iron ore	
6108	1476	0.2	1	Fuel Ash slag	
6109	1489	112.0	8	Fuel Ash slag	
6110	1490	1.5	1	Clay -Vitrified -thin surface glaze	
6111	1490	3.8	1	Iron ore	
6112	1494	32.4	7	Iron ore	
6113	1498	43.1	7	Iron ore	
6114	1512	78.4	4	Iron ore	
6115	1522	23.1	1	Iron ore	
6116	1538	41.0	1	Iron ore	
6117	1541	30.4	1	Iron ore	
6118	1542	15.5	2	Iron ore	
6119	1555	24.5	1	Iron ore	
6120	1590	16.3	3	Iron ore	
6121	1594	23.0	4	Iron ore	
6123	1680	1.7	2	Fuel Ash slag	
6124	2008	11.1	1	Iron ore	Box-stone form of ironstone.
6125	2060	52.4	2	Iron ore	
6126	2083	4.7	1	Iron ore	
6127	3000	5.7	4	Iron ore	
6128	3008	33.5	3	Iron ore	
6129	3008	43.5	1	Iron ore	
6130	3009	41.1	3	Iron ore	
6131	3026	26.5	1	Iron ore	
6132	3067	11.6	1	Iron ore	
6133	1000	58.2	11	Iron	Various fragments of iron - one thin sheet, binding -tweezer-like, one bent nail-like object with triangular cross-section, one rod with rectangular section, and seven nails.
6134	1020	5.6	1	Iron ore	
6135	1536	12.0	2	Iron ore	
6136	1538	7.5	2	Iron ore	
6137	1697	3.7	1	Iron ore	
6138	1697	0.7	1	Fuel Ash slag	
6139	1698	34.1	2	Iron ore	
6140	1701	16.9	1	Iron ore	
6141	1707	3.4	1	Iron ore	
6142	1709	50.2	4	Iron ore	
6143	1718	7.4	2	Iron ore	

Table 10.3 Segsbury Camp - Slag and possible metal-working debris Catalogue

Number	Context	Weight	Frags	Material Type	Slag description
6144	1724	8.3	1	Iron ore	
6145	1729	22.1	1	Iron ore	
6146	1731	10.5	1	Iron ore	
6147	1732	34.1	1	Iron ore	
6148	4000	23.1	1	Iron ore	
6149	4000	31.8	1	Iron ore	
6150	4020	0.4	1	Fuel Ash slag	
6151	4047	76.0	7	Iron ore	
6152	4056	64.0	1	Iron ore	
6153	4056	1.9	2	Fuel Ash slag	
6154	4060	7.9	1	Fuel Ash slag	
6155	4063	0.7	1	Fuel Ash slag	
6156	4063	57.6	2	Iron ore	
6157	6003	8.6	1	Iron ore	
6158	6003	0.9	1	Fuel Ash slag	
6159	5004	19.6	4	Iron ore	
6160	5005	428.0	2	Iron ore	
6161	7015	9.3	1	Iron ore	
6162	7085	96.0	10	Iron ore	
6163	7311	12.1	2	Iron ore	
6164	7312	60.8	3	Iron ore	
6165	7316	15.8	1	Iron ore	
6166	7319	230.0	1	Iron ore	
6167	7319	51.2	2	Iron ore	
6168	7333	29.5	1	Iron ore	
6169	7380	14.9	2	Iron ore	
6170	7612	5.6	1	Iron ore	
6171	7617	92.4	1	Iron ore	