Ark Rep 3968 Site No 425

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Report on Material collected from the Warwickshire Museum Annexe, Alcester. Site AES 1976 Area I

The material is referred to by the site feature number, though the Aston Code is also given. Dimensions of hearth bottoms are of the form :- Major Diameter (cm) x Minor Diameter (cms) x Depth (cms)

All the material from the site was seen at Alcester, examples of the various types of the residues were removed for further study. Several other finds were also removed for analysis and/or identification.

The residues fall into three categories :- smithing slag, fuel Ash slag, and fragments of furnace lining, all of which are the typical residues of ironworking.

The fuel ash slag is characterised by its low density, resulting from its high silica content, highly gassed nature and light colour, (principally grey). It is derived from reactions between the incombustible material (ash), in the charcoal or wood fuel, and siliceous material such as sand, furnace lining etc [samples occurred in features F125, F128 and F218].

Furnace lining survives where the heat of the furnace or hearth has baked and stablised the clay, whose hot face sometimes shows reactions with slag or fuel ash slag. The surface is therefore often vitrified and the body clay is burnt red. The surviving heat affected lining sherds are rarely more than two centimetres thick. [Samples from F128 and F125].

The slag occurs as complete or fragmented hearth bottoms. There was no tap or run slag recorded. This indicates that the residues are the result of smithing. The hearth bottoms are hemispherical conglometations of slag, (of a typical fayalite composition, extruded from the wrought iron while it was heated in the smithing hearth), hammer scale, metallic iron, charcoal and fuel ash slag. They develop at the bottom of the smithing hearth, and hence often have hearth lining adhering to the sides. Samples from F124, F128 and F218 were subjected to varying analytical techniques.

F124 (80/21(a))

A hearth bottom measuring 9cm x 9cm x 6.5cm, with a typical agglomerated appearance, with a slight depression in the upper surface, (approximately one centimetre deep and this occurs on many hearth bottoms.) The fracture surface is dull crystalline, and in section it is black-grey in colour and only lightly vesiculated. There were some small high silica inclusions present but no metallic iron inclusions, the bottom was weakly magnetic.

Microscopic examination showed widely distributed fine globular iron oxide dendrites in a massive fayalite matrix with some anorthite present. When etched, very small metallic iron inclusions were identified.

A powdered sample was subjected to X-ray diffraction analysis and the patterns for Wustite (FeO) and Fayalite ($2FeO, SiO_2$) were identified. There were also some unidentified peaks, some of which could form part of the pattern for Magnetite. The powder was therefore subdivided into a magnetic and a non-magnetic fraction, the former fraction was subjected to further X-ray diffraction analysis but the presence of magnetite was not confirmed.

F128 (80/21(a))

A smaller hearth bottom measuring 7.5cm x 6cm x 4.5cm. The physical nature of the slag was very similar to that from F124. It had a very agglomerated appearance with several fragments of charcoal adhering to its underside. The sample is only weakly magnetic. The microstructure differed slightly from that on F124, in that there was a higher proportion of the iron oxide dendrites. Mineralogical constitution determined by X-ray diffraction showed the presence of Wustite and Fayalite, Magnetite was not detected.

F218 (80/21(a))

The specimen was a large hearth bottom measuring 11.0cm x 6.5cm x 8.5cm. It has a typical agglomerated structure, which when sectioned showed a large proportion of inclusions, principally charcoal, and on one side there is adhering furnace lining. The hearth bottom is non-magnetic, and the microstructure is similar to that of F124. No magnetite phase was present.

Further samples of possible metallurgical interest were removed to Aston for further investigation. They are listed by the Aston Reference Numbers.

80/22 AES 1976 Area I (49)

The sample was cream-grey in colour and of low density It was identified as bone by X-ray analysis.

80/23 AES 1976 Area I F124

The sample was furnace lining with adhering slag. It was thought to be closely associated with the crucibles (80/24), X-ray analysis showed the absence of Cu, Pb or Zn, and the sample is part of the iron working residues.

80/24 AES Area I F124

The specimens were two sherds of crucible, the smaller one was a rim sherd while the other was a body sherd with an external lug. Both were examined by X-ray fluorescence analysis. Only the larger body sherd provided satisfactory results showing that Ca, Fe, Cu, Zn and Pb as present. Both Ca and Fe derived from the crucible fabric The

remaining elements suggest the working of leaded brasses.

80/25 AES Area I (1) 74

A rectangular piece of as-cast lead measuring 6cm x 6cm (maximum width). Besides lead, elemental analysis showed the presence of silicon and sulphur.

Conclusion

The ironworking residues are typical of those associated with the smithing process. The fuel ash slag and furnace lining can be found in association with any industrial process involving hearths or kilns. The nature of the furnace lining fragments is the result of their being attacked by the slag and also exposed to high temperatures. The slag itself occurs in typical hearth bottom forms which are atypical in that the magnetite content is either extremely low or absent. The magnetite can be derived either from hammer scale, (which is often found as a separate deposit on sites) or from oxidation of the slag in-situ in the hearth.

Besides ironworking it is apparent from the crucibles that copper alloys (probably brasses), were also worked on this site.