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THE IRONWORKING SLAGS FROM HEYBRIDGE, ESSEX

The purpose of this report is to examine some of the Heybridge slags in greater detail, and act as a supplement to the report provided by the D.O.E. Ancient Monuments Laboratory, Fortress House, London.

The visual inspection of three specimens of smithing slag, (from contexts 64, 70 and 83A), had shown an interesting structure in that they appeared specular, and on fracturing had a highly reflective "rhomboidal" crystal structure.

Smithing slag is formed in the smithing hearth primarily by the accretion of scale, (the oxidised layer formed on the artefact during heating), breaking off from the artefact. Scale may also contain droplets of slag which are present in wrought iron. Sand or other siliceous material is widely used as a 'flux' to combine with metallic iron to form a fayalite slag on the artefacts surface, which inhibits the formation of scale. Droplets of this slag would also add to the accretion of slag.

The microstructure of smithing slag commonly comprised of iron oxide dendrites with massive fayalite in a glassy matrix. The glassy phase is present in low percentages, and may be absent altogether. The iron oxide may constitute upto 50% or more of the mineral phases present and is normally in the form of wustite (FeO), though magnetite (Fe_3O_4) may also

be present. Smithing slags can be very vesicular. It must be stressed that a wide variety of microstructres have been observed in smithing slags.

Therefore the crystaline structure of the Heybridge smithing slags warranted further study. Samples were prepared from the three specimens for X-Ray Diffraction Analysis (X.R.D), optical metallography and Scanning Electron Microscopy (S.E.M.)

X.R.D. showed the presence of Fayalite and Wustite as the major mineral constituents in all three specimens. S.E.M. analysis of the specular surfaces (Plate 1)shows a plate-like crystal structure, energy dispersive x-ray analysis showed the major elements to be iron and silicon. Metallographic examination of a polished specimen (Plate 2) shows the faceted structure of the fayalite (grey), and the iron oxide (white) occurring dispersed throughout the structure, with some glassy matrix present.

The high percentage of fayalite present in these specimens indicates a low scale and high silica, (or silicate) ratio present during the slag formation. The faceted structure of the fayalite, as opposed to its usually massive form in smithing slags suggests that a high temperature was retained for some length of time. Such conditions would prevail if the articles being heated in the hearth were being fire welded.

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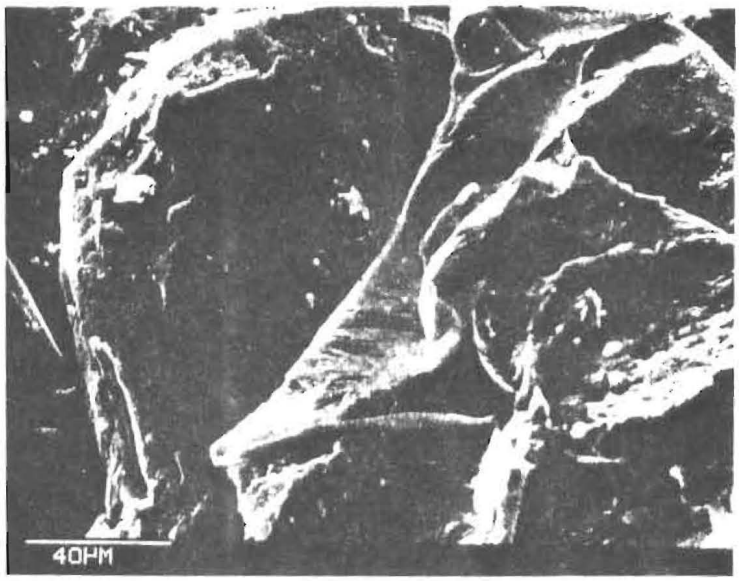

PLATE 1 : Electron micrograph of the surface of the "specular area" of a Heybridge Smithing Slag. The "plate" structure of the slag is apparent.

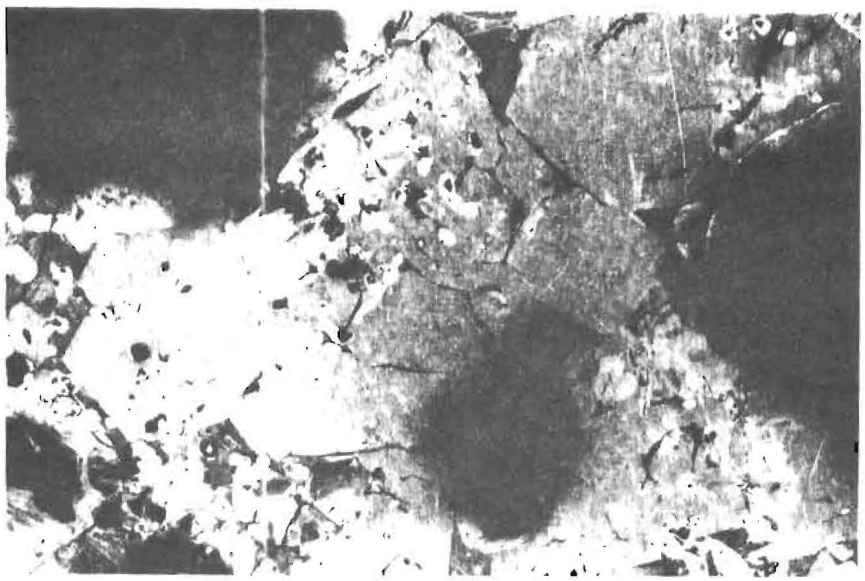

PLATE 2 : Micrograph of a polished specimen of the same Heybridge slag. The major phases present are :
Fayalite - light grey faceted phase
Iron Oxide - white rounded phase.
The glassy matrix occurs between some of the fayalite crystals. The black areas are voids.
(magnification x 54).