Iron archaeometallurgy : slag inclusion and hammerscale

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Several chemical studies have highlighted the existence of a link between the compositions of the iron ores and those of the products/waste at the different steps of the production line. This study focuses on the potential information from hammerscale. This waste is produced during hammering on the anvil of hot iron. It is mainly composed of iron oxide and a silicate component.

During smelting of iron ore by the bloomery process a metallic bloom and a liquid waste, the slag, are produced. The non-reduced compounds from the system concentrate in the slag. The raw iron product always contains some inclusions of entrapped smelting slag. During hot forging the amount of smelting slag inclusions gradually decreases. The smithing slag, a plano-convex piece of slag forms at the bottom of the hearth by accumulation of various materials, including some remelted smelting slag inclusions. However, the contribution of slag inclusion from the processed iron is very small and altered by massive contamination (sand, ashes, ect). Moreover, one smithing slag can be the result of the processing of several different pieces of iron with different chemical signatures. On the contrary, one single particle of hammerscale is formed out of one single piece of iron.

Our ongoing research aims to investigate the potential chemical information extracted from hammerscale, mainly by in-situ chemical analysis with SEM-EDS. Preliminary results have been obtained from hammerscale produced during the hot forging of bloomery iron by Dogon smiths in Mali (Soulignac 2017). The non-reduced compounds in the hammerscale show significant contamination for the major elements resulting in variable ratios. On the other hand, specific minor and trace elements (V, Mn, Cr, Ti, Zr) show more consistent behavior. Within an archaeological assemblage of hammerscale, the study of these specific ratios, less sensitive to contamination, could be useful to evidence the chemical variability of the metals worked.

Key-words: Geochemistry, Archaeometallurgy, Slag inclusion, hammerscale

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