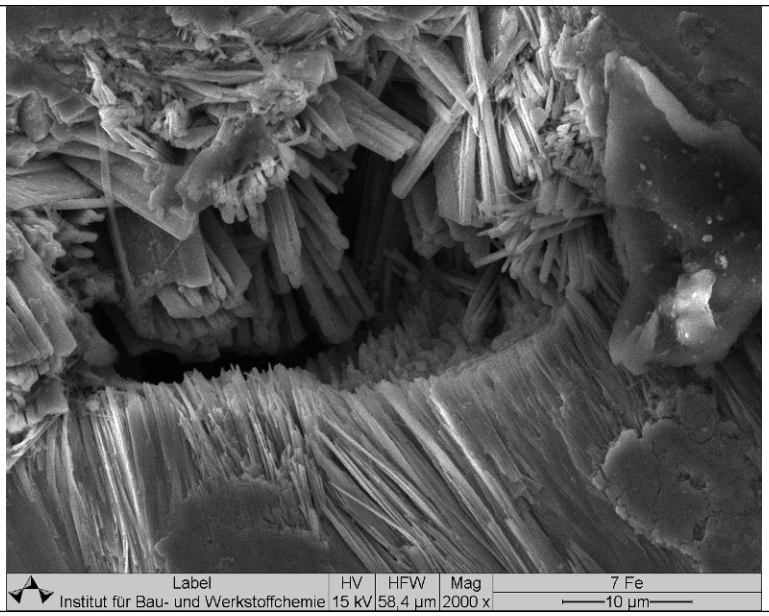
doi:10.1017/S1431927611009998
Microsc. Microanal. 17 (Suppl 2), 2011

Archaeometallurgy of iron in south central Iranian plateau according to the mineralogical investigation on iron crucibles

M. Emami,*

* Department of Archaeology, Art University Isfahan, Hakim Nezami St. PO Box 1744, Isfahan, Iran

Historical evaluation of science and technology in Iran has received sufficient emphasis. Ancient Iranian technology of iron and wootz steel manufacturing was not well documented. In the modern knowledge, the investigation as well as archaeological excavation has focused further on the techniques as well as provenance information [1]. A large amount of scientific objects were excavated by the archaeologist but non of the report has directly focused on the technology of great interest. One of the most important sites with high amount of archaeological samples is "Chahak" in south central of Iran in the province Shiraz. The iron technology according to the archaeological founds (crucible and slag) belong to the early 1^{th} B.C. and nominated for to the Achaemenian period.
The geographical and geological character of this field proved several raw material depositions for extracting and manufacturing of iron ore [2]. Chahak belong to the central part of the Zagros orogeny and with respect to the high temperature and low pressure metamorphism, mainly hydrothermal ore reservoir could appeared on the field. In such a system the great interest on this field would be focused on Iron, Copper, Lead and Zink mineralization on the field [3].
The goal of this research is to determine the technology of iron extraction in 1^{th} B.C. by means of archaeological reminding materials such as slag and either crucible. Iron technology is gone ahead by making of special crucibles that processed the ore to the useful phase and shape. For characterizing of crucible based on their micro-texture two analytic disciplines have carried out;
Firstly; chemical compositions of the crucible determined by XRF and SEM-EDX. Through out of these methods the chemical composition of crucible in a whole sample as well as in a phase in the texture determined. The results proved also the chemical composition of the samples as a group with different cluster system and by knowing distinguished factor in such a system, it is possible for classification of the samples according to their similarities [4]. Secondly; phase analyses and decomposition carried out by Polarization Light Microscopy, DSC and QXRD. The results show also the different phase constituents which are classified as primary as well as secondary phases (Figure 1). Similar structural features were revealed in all the samples [5].
As a matter of fact, according to the diffraction patterns and microscopical observations it obtains the difference between the middle of the crucible to the surface due to exposing the structure to the reduction furnace. The crucible walls are porous due to the admixtures as well as not completely sintering by contact with high temperature smelt. In the glassy and amorphous matrix on the outer surface of the crucibles primary fine crystalline mullite is detected by QXRD as well as optical microscopy. Well round iron fragments observed in a few case is a results due to reduction of iron oxide in the clay.
According to the mineralogical as well as chemical investigation, the crucible was used for iron extraction. Metallic iron appear as tiny droplets in the siliceous rich melt of remind crucible's wall and is a reason for occurrences of this phase after smelting of iron in the crucible.



References

[1] S. Jaikishan, *Iron and Wootz steel Industry I Northern Telangana*, Heidarabad, India, 2009.
[2] M. Emami, B. Yaghmai, *Metalla.* 15 (2009) 3-20.
[3] M. Emami, O. Oudbashi, International Conference AMITEM 2008. (2008) 351-370.
[4] M. Emami, et al, *Journal of applied microscopy research.* 5 (2010) 181-189.
[5] M. Emami, et al, *Journal of materials & manufacturing process.* 24 (2009) 934-941.

https://doi.org/10.1017/S1431927611009998 Published online by Cambridge University Press