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A Comparative Study of the Traditional Iron Works in Manipur and Bagan District of Myanmar by Physical Techniques

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Abstract

Physics plays an important role in studies of cultural heritage of a nation [1]. Scientific methods are being widely used to study many aspects of our cultural heritage taken in its broadest sense: works of art, sculpture, artifacts, museum collection, ancient manuscripts, drawings, archive documents, musical instruments, ethnographic objects, archaeological findings, oral history, natural history collections, historical buildings, industrial heritage objects, and buildings [2]. The ancient iron smelting site in Manipur has been studied by using thermo luminescence and X-ray Spectroscopy methods [3]. The ancient iron smelting sites in Bagan District of Myanmar has also been studied by scientific methods [4]. The characterization of the iron slag obtained from the two sites reveals us an important result leading to the establishment of a cultural relationship between the people of Myanmar and Manipur. The physical methods of Thermoluminescence(TL) analysis, X-ray diffraction (XRD) analysis, X-ray fluorescence (XRF) analysis, Differential thermal analysis (DTA), Fourier transform infra- red radiation (FTIR) analysis, Scanning electron microscopy (SEM) analysis, etc. are used in the studies[5].

Keywords: Slag, XRD, Thermoluminescence, FTIR

Introduction:

Heritage Materials Science is about identifying and understanding the materials that make up objects which are part of our cultural heritage, the way they deteriorate, and the means to preserve them [6]. We do this through our knowledge of materials science and applications of the latest technologies to heritage materials. The power of modern scientific methods in preserving and authenticating works of art, documents

and antiquities for forensic scientific examination is increasingly being recognised. Scientific techniques developed in materials science offer invaluable information to archaeology, art history, and conservation. A rapidly growing number of innovative methods, as well as many established techniques, are constantly being improved and optimised for the analysis of cultural heritage materials. The result is that on the one hand more complex problems and questions can be confronted, but on the other hand the required level of technical competence is widening the existing cultural gap between scientists and end users, such as archaeologists, museum curators, art historians, and many managers of cultural heritage who have a purely humanistic background [7].

Field work:

Recently our team has undertaken an excavation of some ancient iron – smelting site of Kakching in Thoubal District of Manipur for providing a chronology of iron smelting in N. E. India. The site locally known as *Tumu Ching* lies in an area which according to historical records is famous for ancient iron smelting. It lies about 70 Km east of Imphal the capital city of Manipur and is just about 40 Km away from the Indo – Myanmar border. The area is full of slag. Historical records tell us that when King *Khuiyok Tompok* (154 A.D.-264 A.D.) was having a tour to Kakching, iron deposits were found at this place [8]. During excavation just below the surface two large pieces of slag that formed the ancient furnace could be found [3].

Bagan is a district in Upper Myanmar near the Kabaw Valley which was once a part of Manipur. It reached its peak in terms of the construction of religious monuments and political dominance over the upper Irrawaddy valley region between the 11th and 13th centuries AD. The origin of the city, or at least the origin of settlement in the general area that later became Bagan, is traditionally attributed to a confederation of nineteen villages dated to 107 A.D. [9].

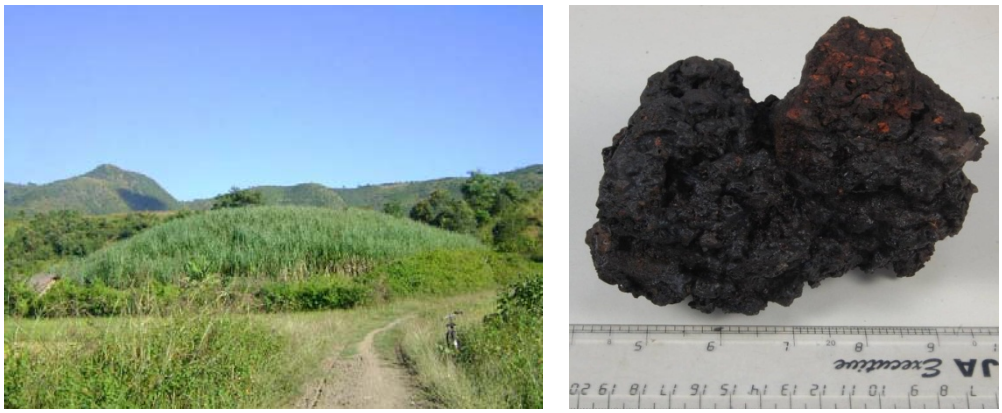

Fig.1. Tumu Ching (Hills), Manipur and Slag that formed the Part of the furnace found at Tummu Hills

From the historical records it is known that King *Khuiyoi Tompok* (154-264 CE) founded the iron deposits at Kakching area [8]. But, the wide spread use of iron during the ancient period as evident from the historical records suggests that apart from the iron smelting colony that had been established at Kakching during the chieftainship of Lord *Khamlangba*, iron might have also been smelted in any other areas in the south eastern part of Manipur.

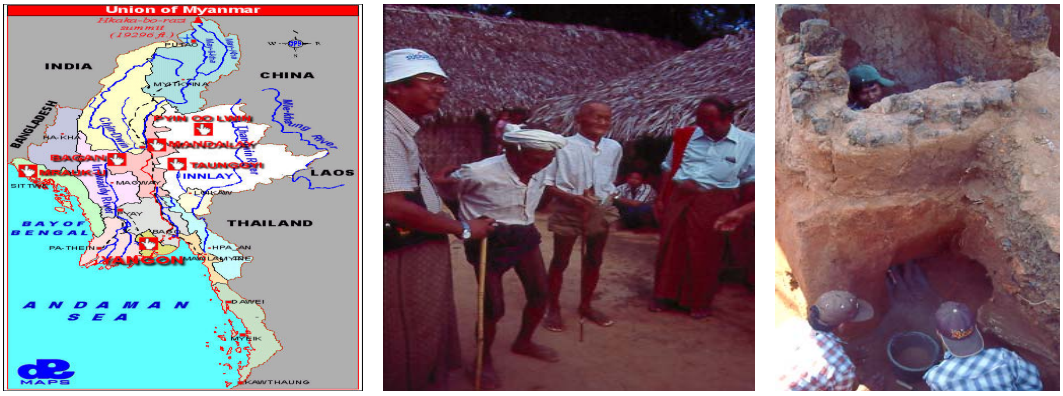

Fig.2. Maps showing Bagan District in Myanmar and People of Myanmar bearing thigh tattoos indicating that they are the traditional iron smelters and a traditional iron smelting furnace at Bagan

Experiment and Results:

The characterization of the slag by Optical Microscopy (OM), X-ray diffraction (XRD), Fourier Transform Infrared spectroscopy (FTIR) Differential Thermal Analyzer (DTA), Scanning Electron Microscopy (SEM) and X-ray fluorescence (XRF) techniques are also documented [5].

Fig. 3. The shiny glassy matrix that formed the slag from Kakching, Manipur and same is found attached at the lumps of bricks that formed the furnaces of Bagan in Myanmar

XRF analysis shows high content of silica and iron oxide present in the slag. X-ray diffraction revealed the presence of fayalite (Fe SiO3) as major phase. Wustite and metallic iron were also found to be present in small amount in the slag. The phosphorous content has been found to be more compared to the conventional iron produced in India. The presence of Fe2O3 and also Fe3O4 were also recorded. In ancient times, high amount of P (0.05 to 0.5 wt %) has been reported to be present in the iron implements [5].

The TL measurement of a piece of the sample collected from Tumu Ching, Manipur reveals that iron had been smelted at this site around 300 to 500 CE. The large quantity of slag found at the site suggests that iron ores must have been richly deposited in the adjoining areas and iron smelting must have been done at large scales [3].

TL dates of Tumu Ching, located practically on the border of the present Indo – Mayanmar border lies between 3rd and 4th century A.D. This work is just the beginning of establishment the chronology of the beginning and end of ancient iron smelting in the Indo – Mayanmar border where in ancient time must have been dominated by Tribes moving freely in this zone of North Eastern India [10].

Conclusion:

The present work reveals that the tribes present in the area of Kakching were using charcoal from the native sources for this iron smelting. The optically stimulated luminescence (OSL) and TL dating carried out on this sample gave the age to be 1600 ± 80 years. During this time the King Ura Konthouba was ruling Manipur and it is reported that the King used to give presents in various forms of swords to other Chieftains like the king of Manipur at Kangla, the kings of Tripura and even to the king of Kabaw (Myanmar)[11]. The similarities in the styles and works of iron smelting which were carried out by the people of Myanmar and Manipur indicates that there was a cultural relationship between the two countries which is still going on in some parts of the region.

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