IDENTIFYING THE MATERIALS IN ARCHAEOLOGICAL TEXTILES

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ABSTRACT

Given their organic origin, textiles rank among the rarest archaeological finds. While the vast majority of these artefacts are preserved as small fragments or mineralised remnants, their detailed textile technology study provides interesting and important information about the use of textile techniques and the quality of processing. The most important information concerns the utilised textile materials, but for degraded textiles, these materials are among the most difficult information to obtain. Image analysis using electron microscopy (SEM) is a significant aide in this pursuit.

KEYWORDS

Archaeological textiles; Raw material; SEM; Image analyses.

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INTRODUCTION

Textiles from the prehistoric and medieval periods occur in archaeological contexts mainly as small fragments or mineralised remnants. Their professional evaluation by means of a textile-technological study provides a great deal of important information about the historical development of textile production, with the spectrum of textile raw materials ranking among the basic data produced by this research. The possibility of determining the raw material is directly related to the state of preservation of the textile fibres or the degree of degradation of the characteristic structure of individual types of fibres. In addition to optical microscopy, fibres are identified using various analytical methods connected with fibre sampling and an evaluation employing spectra of standards (e.g., infrared spectroscopy, Raman spectroscopy) [2]. Image analysis using electron microscopy (SEM) produces very good results. The advantage of this method is the possibility to analyse microscopic samples of textile fragments.

SEM

SEM analysis was conducted using a TESCAN VEGA3 raster electron microscope. The SEM depicts the studied item by means of a thin electron probe formed and swept by the microscope tube. The majority of the imaging qualities of the microscope depend on the parameters of this electron probe: the size of the electron track, the aperture angle and the current in the probe. The current in the probe is determined by the number of electrons passing throw the probe at a given moment. The microscope tube is an electron optical device that forms and positions the electron probe. A system of magnetic lenses and apertures forms the resulting beam used to display the studied item.

SELECTED RESULTS

A joint project conducted in 2012–2022 by the Institute of Archaeology of the Czech Academy of Sciences, Prague, and the Faculty of Textile Engineering analysed several dozen textile samples from archaeological excavations. The most interesting and important results in the establishment of textile materials – a major contribution to knowledge of the historical development of textile production in this country – came from the following three finds:

- a fragment of wool fabric on a bronze bracelet from the Tursko-Těšina site, which is one of the oldest finds of wool textiles in Europe, dates to the early phase of the Early Bronze Age [4];

- a mineralised remnant of fabric from nettle fibres preserved on an iron artefact from the 9th century from Břeclav-Pohansko, which is the first evidence in the Czech environment of the use of nettle in textile production [3];

- a minute fragment of silk fabric on a small piece of sheet metal from the important Great Moravian site in Mikulčice, which is highly significant and clear

confirmation of the presence of luxury silk fabrics imported into the environment of elite society from the Byzantine Empire [1].

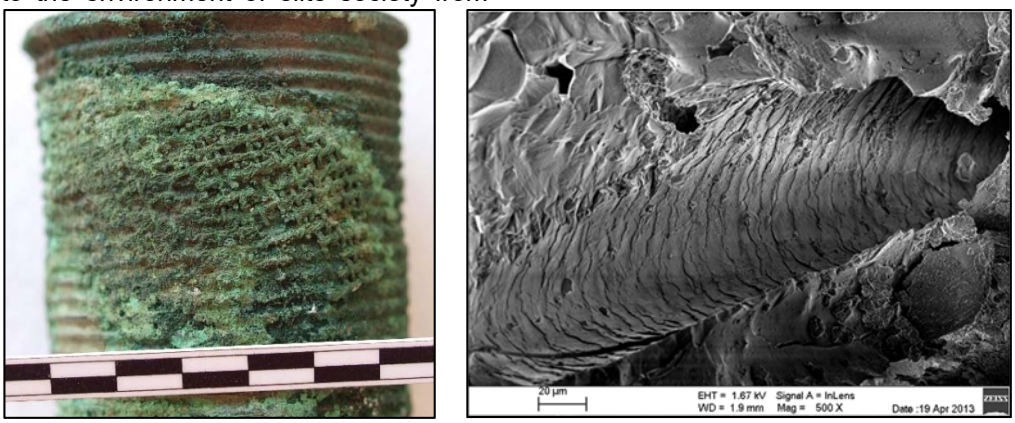

Figure 1. A mineralised fragment of wool fabric preserved on a bronze bracelet; Early Bronze Age Tursko-Těšina; ©Institute of Archaeology of the Czech Academy of Sciences, Prague. Imprint of wool fibre, clearly visible imprints of scales on the surface of the fibre.

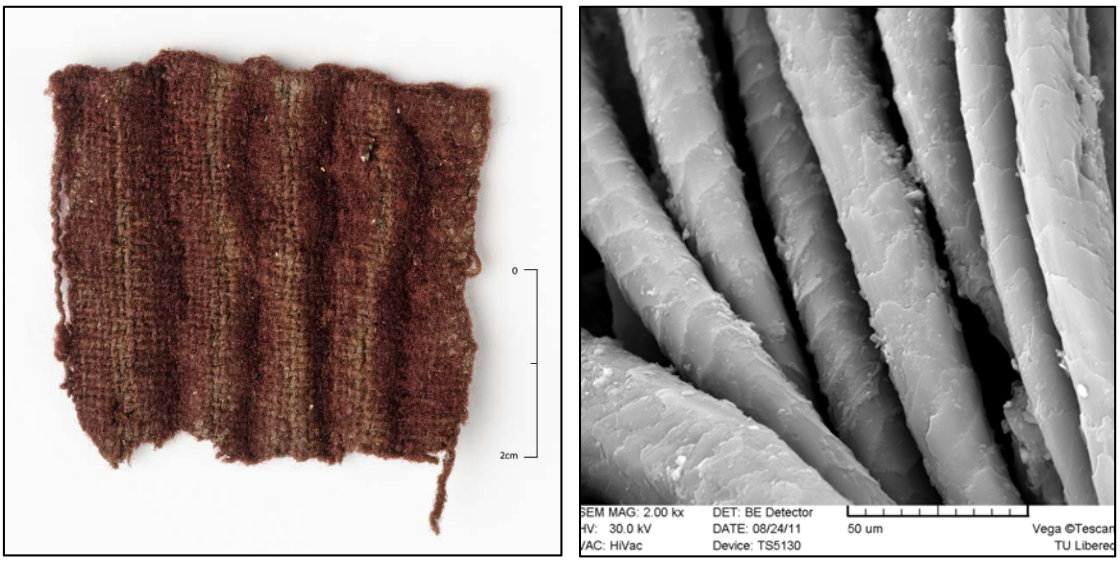

Figure 2. The fragment of wool fabric comes from the archaeological excavation of a medieval dump in the centre of Prague; ©Institute of Archaeology of the Czech Academy of Sciences, Prague. Fibres of “domestic wool” (containing fibres of varying fineness: guard hair, undercoat, intermediate hair).

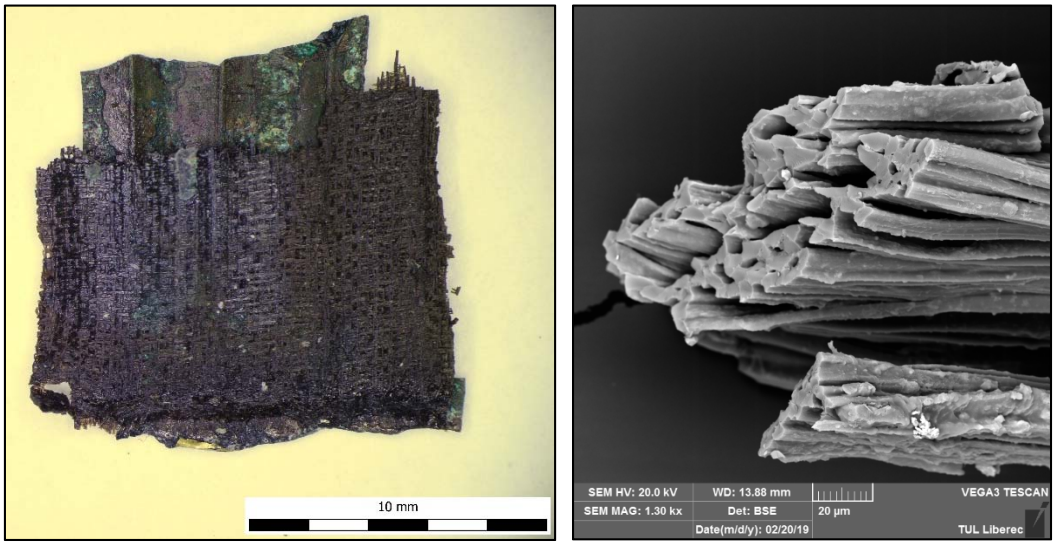

Figure 3. A fragment of silk fabric preserved on a small piece of sheet metal from the Great Moravian agglomeration in Mikulčice; ©Institute of Archaeology of the Czech Academy of Sciences, Brno; silk fibres, with the clearly visible typical shape of the fibre cross-section – a triangle with rounded vertices, also fineness of fibre is very typical.

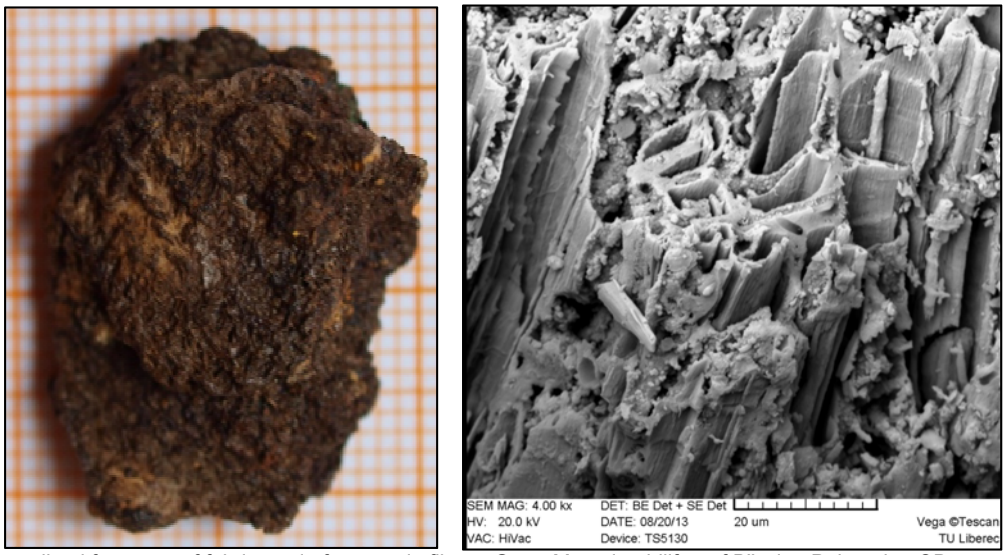

Figure 4. A mineralised fragment of fabric made from nettle fibres; Great Moravian hillfort of Břeclav-Pohansko; ©Department of Archaeology and Museology, Masaryk University Brno. Nettle fibre with the typical traits for bast fibres, which differ from others by the shape of the cross-section and size of the lumen.

Figure 5. A fragment of linen fabric preserved on the surface of a gombík (globular hollow pendant) from the early medieval cemetery in Vinoř. ©Department of Archaeology, Charles University; bundles of elementary flax fibres with the typical nodes and sharp edges of the regular 5–7-side cross-section.

CONCLUSIONS

The use of scanning electron microscopy is an example of important interdisciplinary and institutional collaboration playing a major role in expanding our knowledge of the history of textile production. Archaeological textile finds document the earliest phase in the development of this craft, which was always a key production activity. The study of textile production using the latest technical equipment is a common practice in archaeology throughout Europe today.

Knowledge of contemporary material engineering can be successfully used to identify fibre fragments. The fibres of natural origin show typical traits (cross-section shape, size and shape of interior "hollows", the surface pattern, fibre fineness) and are the same for the given fibres. If it is not possible to use other methods for the identification of a find due to its limited amount, contamination by other material, etc., image analysis is the only means of determining the textile material.

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