Colours in the collection of medieval archaeological textiles at Lödöse museum

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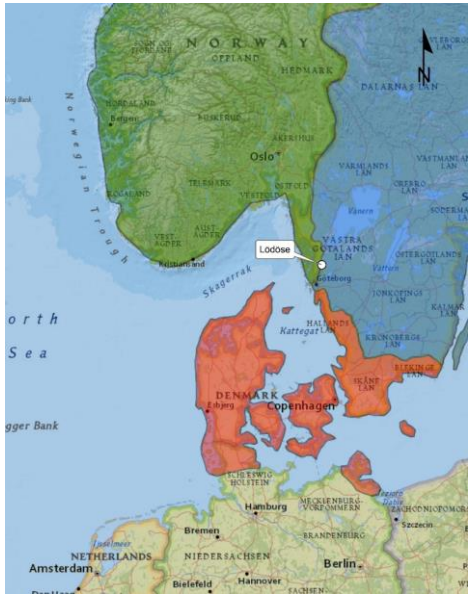


GÖTEBORGS MEDELTIDA FÖREGÅNGARE. LÖDÖSE MUSEUM

Background

Lödöse museum is situated on the west coast of Sweden, a few miles north of Gothenburg. During the 12th century Lödöse was the site of one of the first medieval towns in Sweden. Archaeologists have uncovered more than half a million objects during the past century, making Lödöse one of the richest sites in Sweden when it comes to medieval finds. Most of the artifacts are common items from everyday life, but after nearly a millennium in the muddy soil, they are not so common anymore. They now tell the story of the people who lived before us. Runic messages with warnings, promises of friendship and love, give life to the past. Names carved into tools tell us who once used and cherished the items a long time ago. Lödöse Museum also holds one of the largest medieval archaeological textile collections in Northern Europe, dating from 1050-1350 AD. The collection consists of 1700 fragments representing a large variation, from coarse packing textiles to delicate fragments of herringbone twill. Previous analyses show mainly textiles made of wool, but also flax, goat hair, horsehair and silk. As is often the case with archaeological textiles, the fragments display many shades of brown. While it is possible to discern visually that that some were more brightly coloured, the dyes had not previously been investigated.

A renewal of the permanent exhibition opened in 2021 and textiles are now on display for the first time since the museum's opening in 1994. During the course of this renewal, the textile colourants and their stability to light exposure were investigated analytically using HPLC-DAD, XRF, SEM-EDS, technical photography and microfading on up to 50 sample threads from 29 textile fragments. The samples chosen consisted of textiles of different qualities, from various parts in medieval Lödöse.

The particular fragment to the left is one of the most exclusive fabrics in the collection. We thought that this herringbone twill would to be dyed. However, no dyes were detected and maybe the fabric itself was exclusive enough. Or is it that so that the dye is long gone?

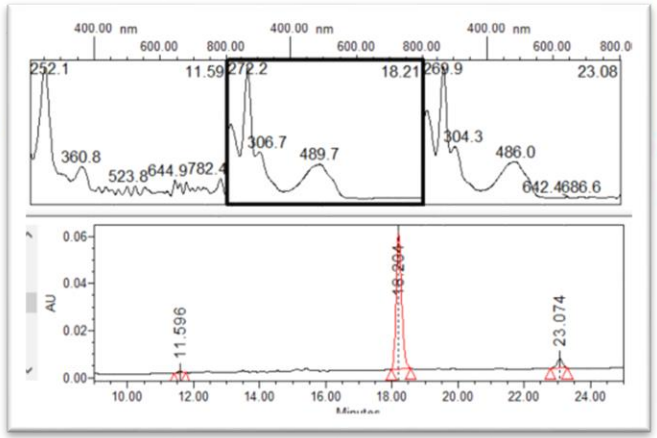
Results from the Textile Research Lab, Royal Institute for Cultural Heritage, Brussels, Belgium

Identification of the organic dyes. Analytical technique

The identification of the organic colorants was performed by High Performance Liquid Chromatography and photo diode array detection system (HPLC-DAD) with Alliance HPLC equipment and data analyses are done with Empower software, all from Waters. The colorants from the heavily contaminated sample set were extracted with hydrochloric acid, followed by ethyl acetate extraction (Vanden Berghe et al. 2009). Preliminary to the analysis, the samples are examined with a stereomicroscope Stemi, Zeiss, in order to examine the thread morphology and colour and to remove any visible contamination.

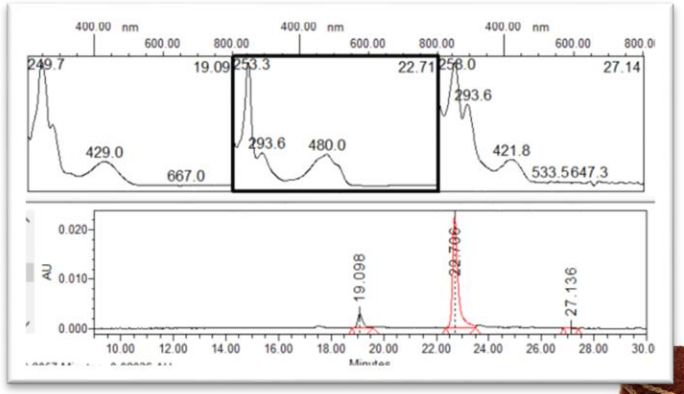
Organic dye analysis results

The HPLC results revealed the presence of the anthraquinone compounds purpurin and alizarin in several red wool threads, with small amounts of nordamnacanthal, munjistin, anthragallol, xanthopurpurin and rubiadin, indicating the use of **dyer's madder** (*Rubia tinctorum* L.). The flavonoid dye molecules luteolin and apigenin were detected in several brown shades, showing the use of a **luteolin-based yellow** dye source. In one textile, a greenish-brown fulled fragment, a combination of a luteolin-based yellow and **indigo or woad** was used (based on the detection of indigotin). **Ellagitannins** were present in many samples, which was inferred from the detection of ellagic acid.
Finally, one textile was found, fragments of a woollen tabby weave from a pleated fabric, which was dyed red with **kermes,** a clear indication that this concerns an important, highly valuated textile.



Two fragments of fold from a pleated fabric (tabby?)) (Dating: 1200 – 1225)

Red threads: **kermes** (kermesic acid) and a trace of tannins (ellagic acid)



Tabby with stripes.
(Dating: 12th - 15th century)

1 Brown stripe: **Tannins** *and trace of alizarin, likely cross-contamination*
2 Red stripe*:* **madder**
3 Light brown stripe: **luteolin-based dye source** and **madder**
4 Light brown: *trace of alizarin, likely cross-contamination*

Twill Fulled. Silk lining, silk decor.

1 Red threads: **madder** (purpurin, alizarin and nordamnacanthal)
2 Beige threads: *trace of alizarin, likely cross-contamination*

Reference

Vanden Berghe, I., Gleba, M. and Mannering, U. (2009) Towards the identification of dyestuffs in Early Iron Age Scandinavian peat bog textiles. Journal of Archaeological Science 36, 1910-1921

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Results from Heritage Laboratory, Swedish National Heritage Board, Visby, Sweden

Technical photography method

The textiles were documented by technical photography using visible, ultraviolet and infrared light.

Technical phtography results

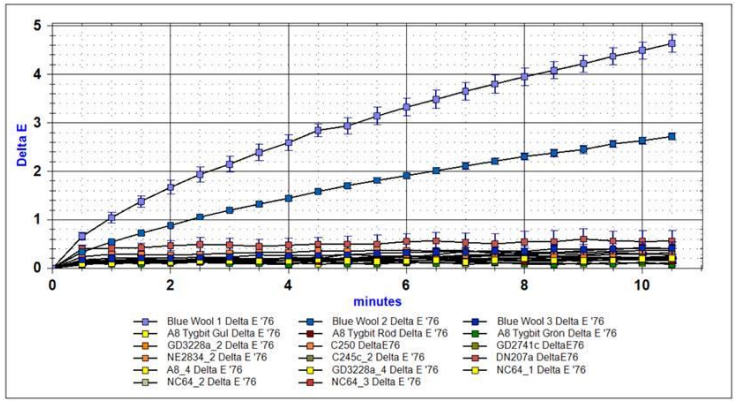
Through technical photography, the natural UV luminescence of undyed wool fibres was visualised. However, none of the dyes produced any detectable light induced effects.

Microfading method

An Ocean Optics HPX-2000 Xenon lightsource was used in the micro fader instrument. The illuminated spots were 400 micron in size and the reflected light was captured using a Control Development CD024216 spectrometer. Spectras were acquired at wavelengths between 400 – 700 nm. Three spots were measured for 10 minutes per sample and compared to Blue Wool Fade cards complying with the ISO 105-b01 and ISO 105-B02 standards.

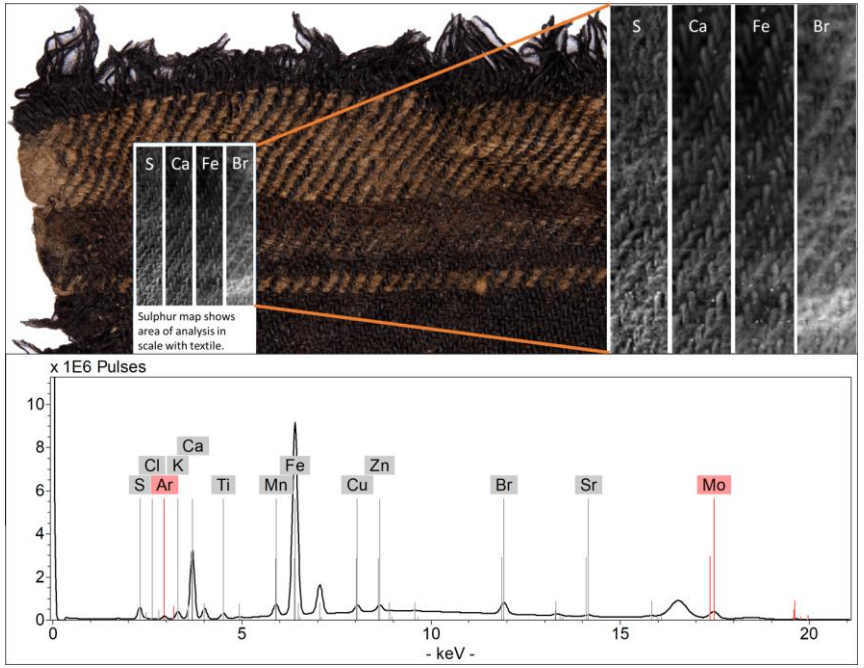
Microfading results

The microfading results showed that the colours of nearly all analysed textiles are stable to light exposure with colour changes detected below that of the Blue Wool 3 standard. Only two samples, one dyed red with madder and one with kermes, showed higher sensitivity to light exposure with colour changes slightly higher than Blue Wool 3.



X-ray fluorescence (XRF) method

The XRF map of textile GD3218 was collected using a Bruker ARTAX 800 with a molybdenum X-ray source at 50 kV and 600 µA without filters and in air. The analysed area was 4.86 mm x 30 mm with 0.18 mm spot distance, 4676 scans and 15:35 h total scan time. Within the project, XRF maps of textiles A8 and A17 and a map of thread samples were also collected using the same instrument with similar settings.



XRF results and discussion

The XRF map of GD3218 shows an even distribution of sulphur due to all threads being of wool; both warp and weft threads are visible in the map. Somewhat higher levels of calcium and iron were shown in the black warp threads as well as the two black areas near the bottom of the map. Dye analysis of a sample from the black area showed the presence of ellagic acid, indicating an iron-tannate dye. The light coloured stripe towards the bottom of the XRF map was relatively high in bromine. This area was not sampled for dye analysis. The source of the bromine can only be speculated upon. A brominated indigoid is unlikely in such a coarse textile as mollusc dyes tended to be expensive and reserved for the highest quality textiles. Many fungi, lichen and algae are known to contain halogens such as bromine [Cochereau- 2022]. Whether there may be a link between bromine in textiles and a fungi, lichen or algae dye source remains to be discovered.

The XRF mapping results of textiles A8 and A17 and the map of the thread samples showed variations in the levels of potassium, calcium, iron, copper and zinc in different samples. Higher iron levels often occurred in darker threads, indicating iron-tannate dyes. No other direct connections between the inorganic contents and the organic dyes could be inferred because the differences between samples from different textiles tended to be greater than the differences between variously coloured threads.

Reference

Cochereau B, Meslet-Cladière L, Pouchus YF, Grovel O, Roullier C. Halogenation in Fungi: What Do We Know and What Remains to Be Discovered? Molecules. 2022 May 14;27(10):3157. doi: 10.3390/molecules27103157