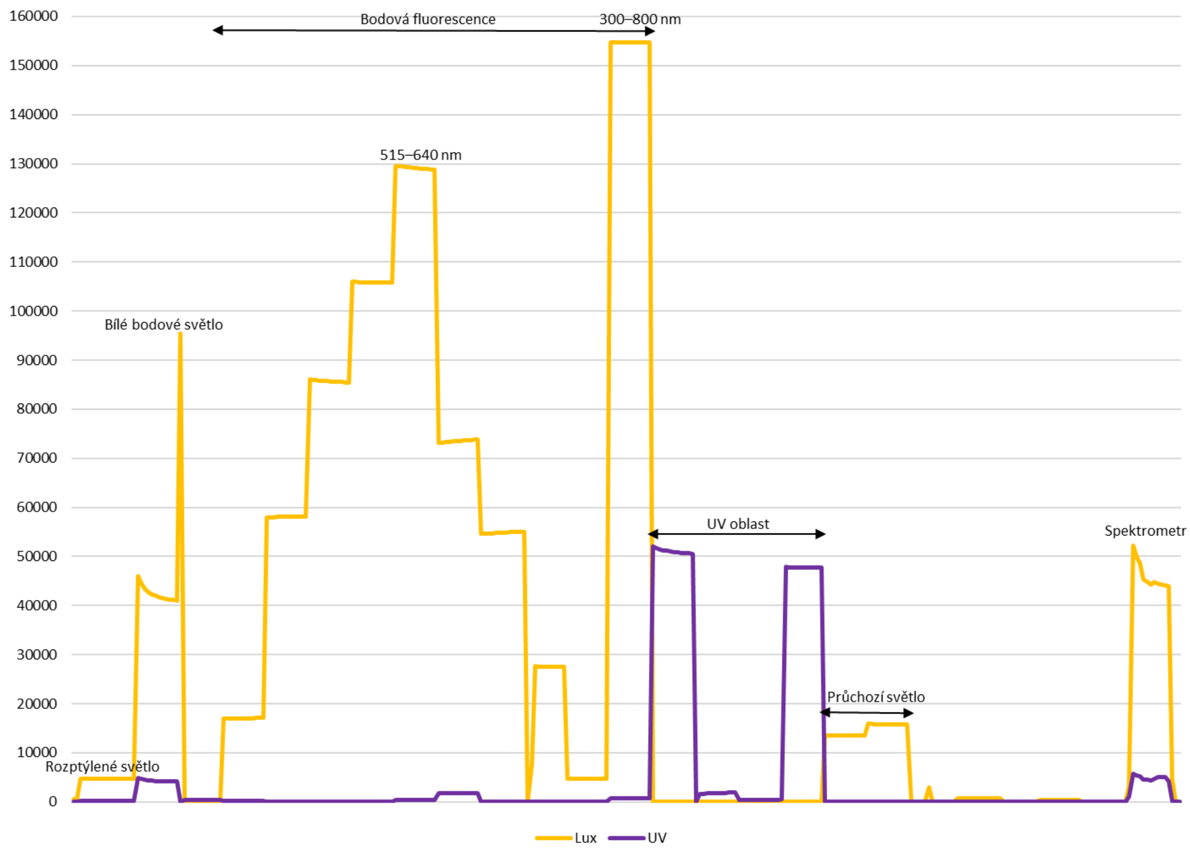
Testing of Selected Methods

In the initial part of the project, the selected imaging and documentation methods were tested on test specimens created or acquired for this purpose. In particular, the safety of the selected visualization methods for individual materials was verified. At the same time, the possibilities of the selected methods and their limitations were charted. The test specimens were subjected to artificial ageing in climate chambers and light ageing in a laminar box. The aim was to controllably partially or completely remove textual or pictorial information from the sample, including mechanical removal of texts for their re-visualisation by selected technologies. Mechanical abrasion, water washing or burning of the paper material was used to damage textual information. The types of radiation used were also tested for their ability to detect infestation by microbiological organisms.

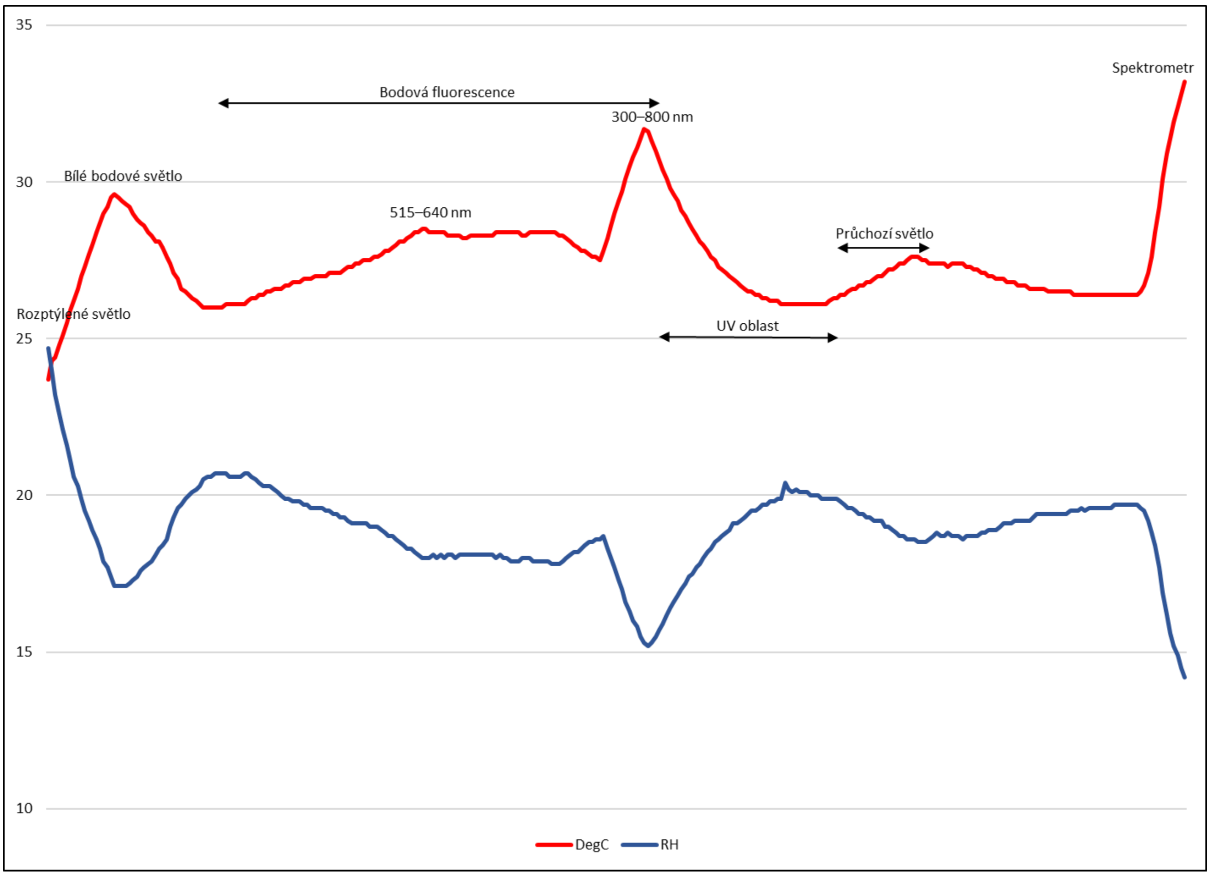
After the application of each imaging method, especially those using energy-rich radiation, the resulting effect on the investigated and documented materials was monitored. Structural changes in the surface of the materials, changes in mechanical properties, changes in physicochemical properties (pH value, chromaticity, etc.) were monitored.

The safety of selected visualization methods (video spectral comparator, forensic lamp, X-ray lamp) was verified on paper and collagen materials. Samples were created from these materials to simulate a standard survey of real documents. Changes in colour, mechanical properties and pH were measured on the samples at least 24 hours apart. The shrinkage temperature was also measured for the collagen materials. In order to monitor the post-radiation effect, the same measurements were performed on the samples after 365 days. The observed changes in the measured properties were well below the levels that could cause damage to the examined documents.

For the VSC 8000, light intensity, temperature and humidity were repeatedly measured. The observed light intensity values are apparently high, but only a very short exposure occurs during the survey. It should also be assumed that documents are examined on a one-off basis and that for particularly sensitive documents, the most intense illumination can be avoided. Increases and decreases in temperature and relative humidity correspond to changes in radiation intensity. The rise in temperature in the instrument along with the drop in relative humidity must again be taken into account before using the instrument to examine a given document, especially for materials sensitive to these fluctuations such as parchment.



Light intensity in the VSC 8000 across the full range of possibilities

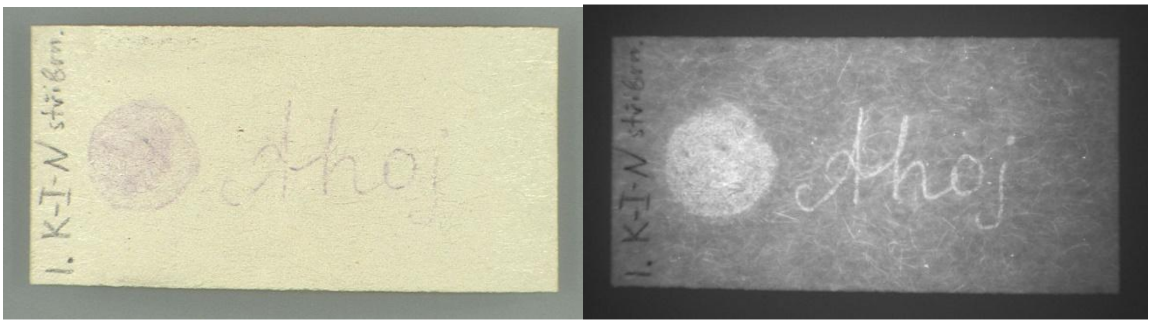


Temperature and humidity in the VSC 8000 during light intensity measurement

The imaging capabilities of the video spectral comparator and forensic lamp were investigated on samples of recording media applied to a paper surface material. These samples were damaged in a controlled manner mechanically, with distilled water, UV light, temperature and by being pasted over with another layer of paper. For each sample, the chromaticity was measured before damage, after damage and after imaging.

Six samples of Koh-i-Noor Hardtmuth red/blue ink pencil recording medium on Holmen paper. From left: reference sample, mechanical damage, distilled water damage, UV light damage, thermally damaged sample and overglued sample.

According to the results of the investigation, the investigated recording media can be divided into two groups. For the first group, it was possible to find a clearly effective light setup for making the pigments and their traces visible in the material. This group of pigments was often characterised by a special composition containing heavy elements. The settings found for a given pigment could always be used for all ageing methods, but the quality of the resulting image depended on the amount of material retained. The second, much larger, group of pigments did not have a clear effective light setting and it was necessary to find a different light setting for each ageing method. Each pigment studied was subject to ageing in its own way, but the amount of preserved recording medium remained the main condition for effective visibility.



An example of the imaging of the recording medium, a Koh-i-Noor Hardtmuth beige lacquer ink pencil, which was able to be imaged in 585–720 nm spot illumination with a short wave pass RG780 nm filter even after mechanical removal.

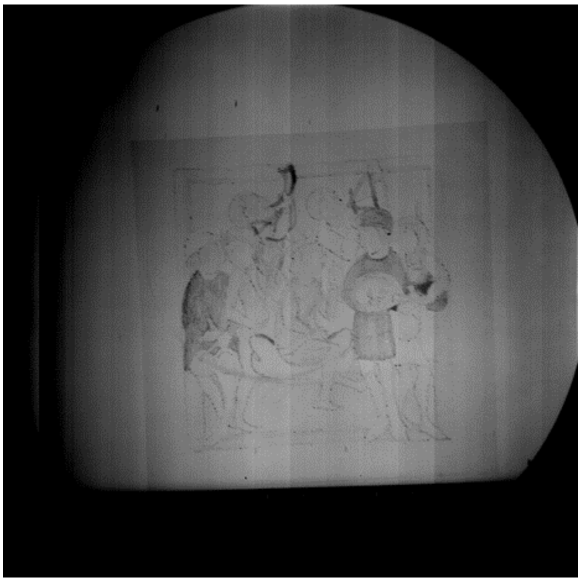
Test illuminations were made to test individual methods of making damaged, missing, washed out or otherwise indistinct illuminations visible. The basis for the illumination was the historical illumination, which was simplified. The technique of painting with egg tempera and pigment bound with Arabic gum was used. The underdrawing was done with lead pencil, pencil and iron-gall ink. Handmade paper or vellum were chosen as bases.

The prepared illuminations were examined using an X-ray system to investigate the possibilities of imaging different pigments and underdrawings produced by different writing media.

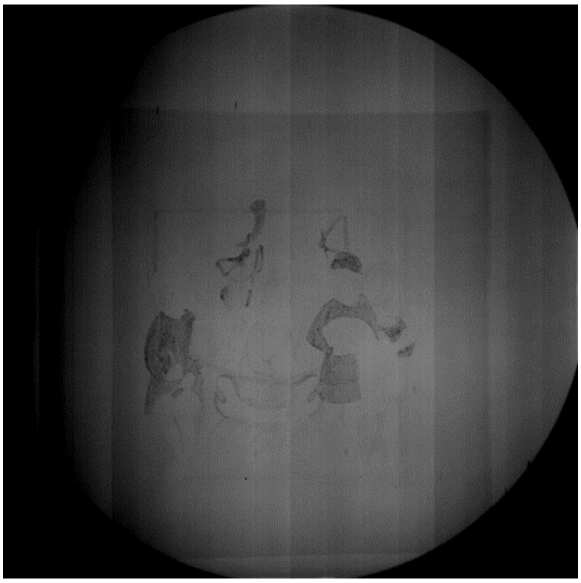
Using X-rays, we were able to image only the lead pencil underdrawing, thanks to its property of absorbing X-rays well. This underdrawing is well and clearly legible. For the illuminations where a paper surface material was used, less pigment was used as they are generally lighter. Thus, there was less absorption of X-rays.

No major differences could be clearly discerned between the use of vellum or handmade paper as surface materials. The differences lie in the intensity of X-ray absorption of the individual pigments (their brightness in the image). The differences may be due to the fact that the samples were handmade and a different thickness of the pigment layer may have been applied, or the paper may have been more absorbent, thus partially dispersing the pigment particles.

The two pigments observed in the X-ray images contain cobalt and zirconium. Other pigments include, for example: sodium, magnesium, aluminium, silicon, potassium, calcium, titanium, chromium and iron in various forms. The pigments that can be visualised with the NK CR X-ray system are those that contain cobalt and heavier elements. Therefore, only the underdrawing made using the lead pencil was visible. The ability to image the underdrawing will also depend on its overlay with other pigments.

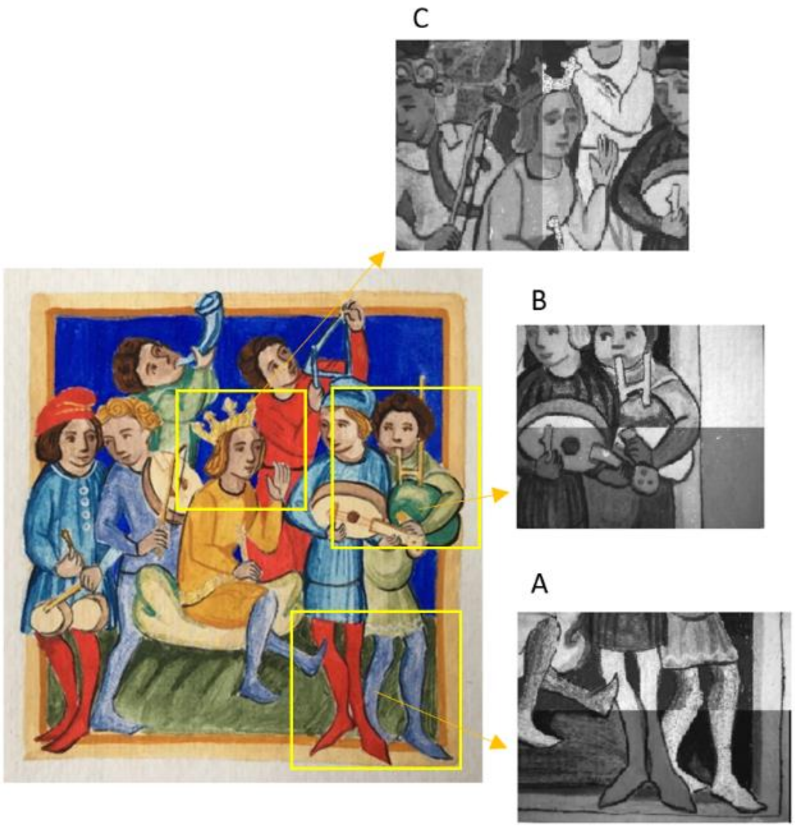


Illumination on vellum with lead pencil underdrawing



Illumination on paper with ink underdrawing

Illumination research using the VSC 8000 was conducted primarily to find the best light settings to visualise the characteristic behavior of individual illumination pigments. As an example, we can show the light settings for the observation of pigment A. This red pigment is characterised by low absorption in the 485–610 nm spotlight with a short wave pass filter RG630 nm and high absorption in the 400–535 nm spotlight with a short wave pass filter RG645 nm. Pigment B is characterised by low absorption in the 515–640 nm spotlight with a short wave pass filter RG695 nm and high absorption in the 485–610 nm spotlight with a short wave pass filter RG630 nm. Pigment C is characterised by low absorption in the 515–640 nm spotlight with a short wave pass filter RG665 nm and high absorption in the 515–640 nm spotlight with a short wave pass filter RG695 nm.



An example of observing the characteristic behaviour of individual illumination pigments