Tuuli Kasso

Fragment of a 4th Century Fresco from the Roman Palace of Szabadbattyán

Conservation and Examination

Helsinki Metropolia University of Applied Sciences

Bachelor of Arts

Conservation

Final Thesis

7.5.2014

Author(s) Title Number of Pages Date	Tuuli Kasso Fragment of a 4th Century Fresco from the Roman Palace of Szabadbattyán – Conservation and Examination 35 pages + 7 appendices 7th of May 2014
Degree	Bachelor of Culture and Arts
Degree Programme	Conservation
Specialisation option	Conservation of Historical Interiors
Instructor(s)	Tuula Auer, Principal Lecturer István Bóna, Principal Lecturer in Hungary

The topic of the Final Thesis was the conservation and examination of a fresco fragment, which was excavated from Szabadbattyán, Hungary from a 4th century Roman palace. Taking multiple decades to build, this enormous 13.000 m^2 palace was the fourth largest private palace not only in Pannonia, the Roman province, but also in all Europe at the time. After the complete destruction of the palace in 374 by the Sarmatians, it remained hidden until the archaeological excavations began in the 1990's. With abundant discoveries, and new items constantly discovered, the conservation of the findings is an ever-going process.

As a part of this process, a fragment was selected for this thesis to study and conserve. The goal of the conservation process was to bring the fragment from its state when excavated to a condition in which the fragment could be displayed and preserved. The conservation approved the fragile condition successfully of the fragment and enabled its display, but also it was assured that the chance of future treatments still remained possible.

In addition, the materials of the fresco fragment were analysed using various analytical research methods: i.e. polarization microscopy, cross sections, wet chemistry, and FTIR. The material examinations provided important knowledge about the ancient techniques, which were found typical to the relevant period in this case. Furthermore, some salt formations on the fresco and found samples from archaeological carbonated wood were studied. As a result it was possible to understand the wholeness of the fresco fragment and its history and need for preservation in the future.

The thesis was conducted in cooperation between the Metropolia University of Applied Sciences and the Hungarian University of Fine Arts Conservation Department in Budapest, Hungary. Through an exchange and a special opportunity with the permission of Szent István Király Múzeum in Székesfehérvár, it was possible to study and conserve this 4th century Roman fresco fragment.

Keywords	Fresco, Roman, Hungary, consolidation, temporary support, material research

Tekijä(t) Otsikko Sivumäärä Aika	Tuuli Kasso Szabadbattyánin roomalaisen palatsin 300-luvun freskofragmentti – Konservointi ja tutkimus 35 sivua + 7 liitettä 7.5.2014
Tutkinto	Konservaattori AMK
Koulutusohjelma	Konservoinnin koulutusohjelma
Suuntautumisvaihtoehto	Historiallisten interiöörien konservointi
Ohjaaja(t)	Tuula Auer, yliopettaja István Bóna, yliopettaja Unkarissa

Opinnäytetyön aiheena oli Unkarissa, Szabadbattyánissa sijaitsevan 300-luvulle ajoitetusta roomalaisesta palatsista löytyneen freskofragmentin konservointi ja tutkimus. Palatsin rakentaminen kesti useita vuosikymmeniä, ja lopulta tämä valtava, 13 000 m^2 palatsi oli aikansa neljänneksi suurin yksityispalatsi Rooman provinssissa Pannoniassa ja myös koko Euroopassa. Vuonna 374 sarmatialaisten hyökkäyksen ja totaalisen tuhoutumisen jälkeen palatsi pysyi kätkettynä, kunnes laajat arkeologiset kaivaukset alkoivat 1990-luvulla. Runsaiden ja jatkuvasti uusien löytöjensä johdosta Szabadbattyánin roomalaisen palatsin löytöjen konservointi on jatkuva prosessi.

Osana tätä prosessia yksi fragmentti valittiin konservointia ja tutkimusta varten tämän opinnäytetyön aiheeksi. Konservoinnin tavoitteena oli pystyä tuomaan fragmentti tilasta, jossa se on löydetty kuntoon, jossa se voidaan säilyttää sekä laittaa esille. Konservointi vahvisti fragmentin haurasta kuntoa onnistuneesti sekä mahdollisti sen asettamisen näytteille. Konservointi toteutettiin käyttämällä poistettavia materiaalia sekä varmistaen fragmentin mahdolliset käsittelyt tulevaisuudessa.

Lisäksi freskofragmentin materiaalit tutkittiin käyttäen useita analyyttisia tutkimusmenetelmiä, kuten polarisaatiomikroskopiaa, poikkileikkauksia, märkäkemiaa sekä FTIR-analyysia. Materiaalitutkimukset antoivat tärkeää tietoa muinaisista tekniikoista, jotka osoittautuivat tässä kohteessa ajalleen tyypillisiksi. Myös freskon pinnan suolamuodostumia ja löydetyt näytteet arkeologisesta, hiiltyneestä puusta tutkittiin. Tuloksena oli mahdollista ymmärtää freskofragmentin kokonaisuutta, sen historiaa sekä suojelemisen tarvetta tulevaisuudessa.

Opinnäytetyö toteutettiin yhteistyössä Metropolia Ammattikorkeakoulun ja Hungarian University of Fine Artsin konservointiosaston kanssa Budapestissä Unkarissa. Vaihdon ja erityisen tilaisuuden kautta Székesfehérvárin Szent István Király Múzeumin luvalla oli mahdollista tutkia ja konservoida tämä 300-luvun roomalainen freskofragmentti.

Avainsanat	Fresko, roomalainen, Unkari, konsolidointi, väliaikainen tuki, materiaalitutkimus

Contents

1 Introduction

The subject of this thesis is the conservation and examination of a fragment from a fresco that was excavated from Szabadbattyán, Hungary from a 4th century Roman palace. The building of the palace took multiple decades and after its destruction in 374, it remained hidden until the 1990's, when large archaeological excavations started and thus the findings were transferred to Szent István Király Múzeum in Székesfehérvár. The conservation of the findings is an ever-going process, as new items are constantly being found from the ruins of the palace. In the future, however, the final goal is to reconstruct as many rooms from the site as possible, with the fresco fragment on display.

As a part of this process, a fragment was selected to study and conserve for a subjective focus for this thesis. The aim of the conservation was to bring the fragment from its state after excavated to a form which would enable it to be displayed and in the future to be connected to the wall of the reconstructed rooms. Also the materials of the fragment were analysed using analytical research methods. Despite the fact that some of the fresco fragments from the palace from Szabadbattyán have already been researched, a thorough research of the materials of the fragment subject to this thesis was considered necessary to provide more information.

2 Origin and background of the frescoes of Szabadbattyán

The fresco, which is the subject of this thesis, was excavated with several other fragments from the ruins of a Roman palace from Szabadbattyán some 15 years ago. In the midway between Budapest and the Lake Balaton, Szabadbattyán is located close to the city of Székesfehérvár in Hungary. The palace was an enormous, 13.000 m^2 peristyle Roman building constructed in the 4th century. Located in the ancient province of Pannonia of the Roman Empire, the building of the palace started under the reign (306-337) of emperor Constantine I and was finished later in the century. Szabadbattyán's Roman palace was the fourth largest private palace not only in Pannonia, but also in the whole of Europe at the time. The owner of the palace was most likely a high-ranking person, perhaps a senator. (Bóna 2013; Pecze & Váli 2009, 1.)

The palace was destroyed in 374, when the Sarmatians attacked. The whole building burned and the walls came down, leaving the palace demolished except for some of the terrazzo pavement. (Pecze & Váli 2009, 1.)

Figure 1. Location of Szabadbattyán (A). Screenshot from Google Maps. Figure 2. The Roman Province Pannonia in 214 AD. Fitz 1982.

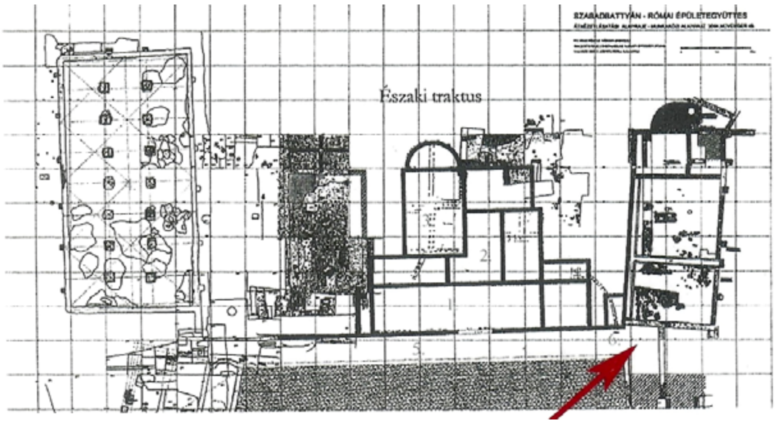
2.1 Style and technique of the frescoes of Szabadbattyán

The Roman palace in Szabadbattyán was an adobe building, also with limestone used in the palace (Pecze & Váli 2009, 1). Most of the rooms of the palace were decorated with frescoes with geometrical motifs, except for one image, which portrays an over-sized head. The geometrical motif style is very unique, but was typical to this area of Pannonia. The author of the frescoes in the Roman Palace in Szabadbattyán is unknown. This is not an exception, as the authors of Roman frescoes are usually unknown possibly due to the unfavourable status they had. In Roman historiography only a few names of Roman artists are known, like the examples mentioned by Gaius Plinius Secundus, who died in 79 AD as a victim of the destructive eruption of Mount Vesuvius. (Bóna 2013; Gassiot-Talabot 1971, 13 & 183-184.)

Based on the inspection on the fresco fragments, the frescoes were made with Byzantine-type plaster. In this type of plaster the filler media used with lime were pieces of plants with other fibrous material instead of sand. Pieces of the plants can also be seen on the backside of the fresco subject to this thesis. Furthermore, on the backside there are traces of clay – this indicates that the frescoes were manufactured with mortar on a wooden surface that was reinforced with clay – this also confirms the assumption that the structure of the palace in Szabadbattyán was made like an adobe. (Bóna 2014.)

2.2. Excavation and conservation work of the frescoes of Szabadbattyán

The excavations of the palace in Szabadbattyán began in 1993, led by archaeologist Gabriella Nádorfi and new items are constantly discovered (Dudás, Papp & Tóth 2012). The fragments of the frescoes are currently held in the Szent István Király Múzeum in Székesfehérvár. The final aim of the conservation of the frescoes is to reconstruct as many rooms as possible at the site in Szabadbattyán; the frescoes will be on display on the walls and ceilings of the reconstructed rooms (Bóna 2014). On the other hand, at the time of the execution of this thesis, no plans for the project of the reconstructed rooms to be continued in the immediate future are active. However the finished work will be displayed in the annual exhibition of the Szent István Király Múzeum.



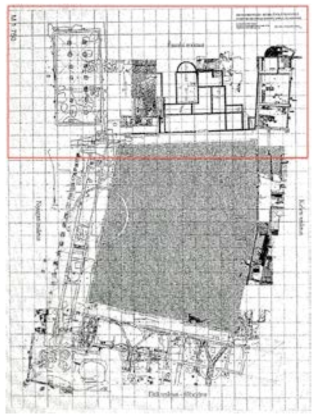


Figure 3. Northern tract of the palace. Location of the excavation of the fragment is marked with a red arrow. Figure 4. Location of the northern tract of the palace. Pecze & Váli, 2009.

3 Representation and description of the subject

Before conservation the fragment is supported by polyurethane foam with Styrofoam pieces on the face side. Under the foam on the painted surface of the fresco there is paper and gauze. The size of the actual fragment is 68 x 45 cm. The fragment consists of dozens of pieces, a few of which are placed so that some deep red and warm yellow colours from the face side can be detected. The plaster is in a very fragile condition, unstable when touched and covered with dust. Between the pieces there is dirt and soil from the excavation site.

The inventation number for this fragment in the Szent István Király Múzeum in Székesfehérvár is 99/112, 28-29.

Figure 5. Generic photo of the fresco fragment before conservation.

3.1 Description of the materials

Traces of two layers of plaster can be seen on the fragment of the fresco from Szabadbattyán. The plaster used is the Byzantine-type plaster, which has been made using lime with plant pieces. The second layer of plaster is clearly thinner than the first one, with the first layer being approximately 3-5 cm, while the second layer is 1,5-2 cm thick. On some parts on the areas where the first layer still remains, there are clay fragments from the adobe wall of the palace from Szabadbattyán. A few small pieces have been attached backwards, showing some red and yellow colour.

When excavated by István Bóna some 15 years ago the face side of the fresco was protected with paper and gauze using Paraloid B 72 and Plextol B 500 as adhesive. Then polyurethane foam was inserted around the fragment with some pieces of Styrofoam. This made it possible to lift the fresco from its place. The fresco fragment has remained like this in the Szent István Király Múzeum in Székesfehérvár after the excavation until the conservation. (Bóna 2014.)

4 Condition survey

At the beginning of the work the condition survey was made only from the backside for obvious reasons. For the face side still being covered with the temporary support, the survey from this side could only happen after the examination and conservation on the backside. Removing the temporary support could not have been possible due to the poor condition of the plaster – only through consolidation and securing the backside could the work on the face side begin and the condition of it to be exposed.

Evaluation of the condition is made by close visual inspection and carefully examining the object. The view of the condition in visible and raking light can be viewed from documentation photos (Appendix 1). Also the mapping of damage from the backside can be examined (Appendix 2).

4.1 Backside before conservation

Before conservation, the condition of the backside is rather weak, as the plaster is crumbling very easily. On some areas the pieces of the fragment are almost completely scattering, while all of the pieces are breaking especially around their edges. The whole backside is very dirty, and there is dirt and soil from the excavation site deep in the cracks and between the pieces. The fragment has been kept in a museum storeroom close to a leakage on the storerooms ceiling, from which some salts have fell and are scattered to the backside to the fresco.

4.2. Face side after removing the temporary support

After the removal of the protective layer of paper and gauze, the exposed surface of the face side was revealed to be extremely dirty. In addition on some areas on the face side the binding media from the protective layer still remained. Originally the paper and gauze were applied with Paraloid B72 and Plextol B 500, and some of the materials did not dissolve completely during the removal of the layer. Many pieces are loose and fragile. Nonetheless the general feeling of the structure of the fresco is quite stable, due to the successful consolidation, which was implemented from the backside.

The motif of the fragment consists of some geometric lines. Red like the framing colour, some yellow with red dots can be seen. Also white with green leaf-like dots and yellow shadowing is present.

5 Material analyses

Since many fragments of the frescoes from the Roman palace of Szabadbattyán have already been examined thoroughly, including a piece of the same fresco the fragment subject to this thesis is from, knowledge about the pigments and materials that were used were already available. According to previous research, pigments used in the frescoes in the Roman palace of Szabadbattyán were such as green earth, red and yellow ochre and Egyptian blue (Tóth, 2012). Thus the focus for the material analyses in this thesis was more or less to verify the presence of the same materials. Both the face side and the backside of the fragment were inspected with UV light. Samples from the fragment were examined with stereomicroscope and then cross sections and specimens for examination with polarized light microscope were prepared. Furthermore samples from the pigments and plaster were studied also with FTIR, to ensure their chemical compounds. A variety of different analytical methods were used as they complement each other resulting in a more reliable research. Apart from FTIR, all of the examinations were conducted in the Hungarian University of Fine Arts.

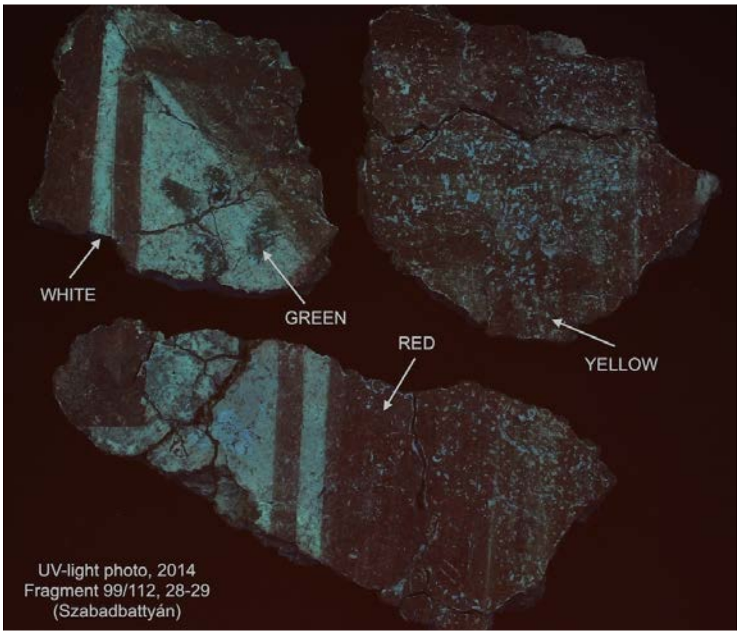
As an individual addition to this case, also the salts formed at the surface of the backside were also examined. Additionally, during the cleaning of the fragment some pieces of carbonated wood were found. Since the Roman palace from Szabadbattyán was destroyed and burned down in 347 by the Sarmatians, these pieces of wood are most likely remnants of the palace. The wood samples were researched in order to find out if it is still possible to identify the wood that was used in the building of the palace.

The analyses were conducted with the three levels of material examination defined by Ulla Knuutinen after Jonathan Ashley-Smith: Simple visual identification, microscopic identification and chemical analyses to determine the chemical compounds of the materials. In the analyses, solely destructive research methods were used. (Knuutinen 2009, 51-55.) However, the samples were all redundant, loose and small (approx. 0,5-1 cm in diameter) pieces of the fragment, with their places no longer identifiable. No destructive methods for the major fresco fragment itself were implicated and all of the samples were kept for possible future examinations.

5.1 Pigment analyses

5.1.1 UV-light inspection

Different materials and minerals have diverse fluorescence, which also differ depending on whether the UV light is long- or short-wave (Simpson Grant 2000, 1-4). For instance, copper and iron-derived materials are shown very dark in the UV light, whereas lime is very white. The examination in this case was made using long-wave UV light. The backside of the fresco was inspected with UV light before conservation, but as there was no fluorescence, no photo of this was taken. However, results with some nice fluorescence on the face side were documented.



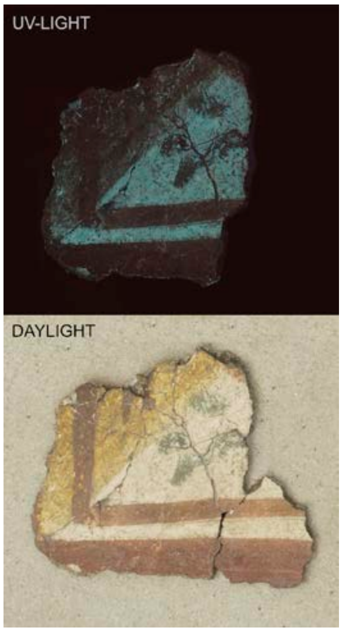


Figure 6. A photo from a few pieces of the fresco fragment in UV-light. Figure 7. Comparison of the colours in day and UV light.

As can be seen from the photo above, the white colour of the fresco has a very bright white luminescence in UV light, whereas the other colours are dark. This indicates that the yellow, red and green most likely contain iron, and the white is lime-based, possibly only the surface of the plaster.

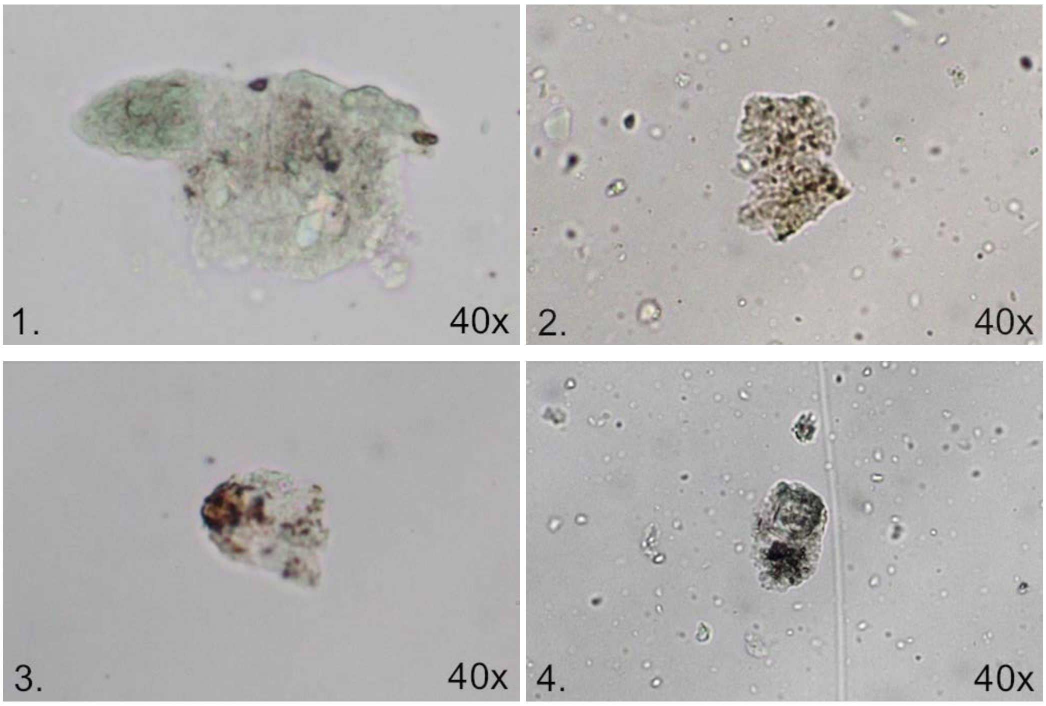
5.1.2 Inspection with polarized light microscope

Pigments have individual diverse crystals characteristics, which are studied in polarization microscopy (Knuutinen & Mannerheimo 2009, 43). All materials that crystallize and are anisotropic, such as pigments, have two refractive indexes. The various differences between the two refractive indexes are seen as birefringence, which can be used for characterization of materials. (Váli 2014.)

To identify the pigments with the polarized light microscope, a small amount of powdered sample was placed on an objective glass, and the particles were separated with a fine tungsten needle. Mounting the sample with a drop of Canada balsam, the cover slip was pressed gently so that the sample would massage into the balsam: otherwise detecting the particles would be difficult.

Finding the pigment particles with the microscope was not completely successful. Only some particles were detected but their shape and especially the birefringent properties were not clear enough for a full characterization. In plain polarized light, some characteristic features and single pieces were found, but the examination proved the necessity for further studies. Overall the particles in the samples were extremely small and were deduced to be too little for identification with microscopic inspection or through their birefringent properties. This may be because the pigments used in the fresco fragment from Szabadbattyán were probably some cheaper pigments with principally fine particles. (Kriston 2014; Varga 2014.)

Note: in all of the microscopic photos only the magnification of the microscope’s objective has been mentioned. This has been the custom in the Hungarian University of Fine Arts.



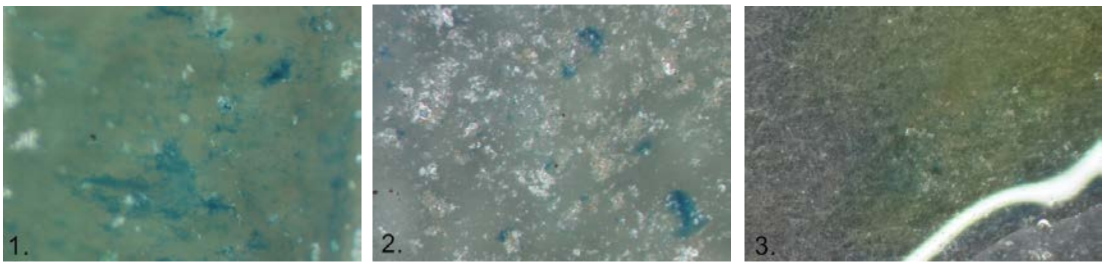
Figures 8-11. Pigment samples in plain polarized light with 40x objective. From left to right, top to bottom: green, yellow, red, white.

1. Green sample: Reminiscent of green earth by optical inspection. Green earths can have some impurities or "burnt" form with brown-coloured iron oxides.
2. Yellow sample: Reminiscent of yellow ochre, the morphology of which can vary from well-formed crystals to fine divided particles as present here.
3. Red sample: Hardly any red colour was found, as the particles were considerably small. This reddish piece might be an aggregate of the small pigment particles and impurities, which is characteristic for red ochre.
4. White sample: In the sample there are some aggregates and abundant calcite. The pieces of the particles are too small, and it would seem that no white pigment was used.
   (Eastaugh et al. 2004, 362-365 & 370-371.)

5.1.3 Iron content test

As the examination with the polarized light microscope did not result in a specific pigment definition, the pigment examinations were continued by an iron (Fe^{3+}) content test. Based on the previous results from the pigment analyses from the frescoes from Szabadbattyán, the pigments found have been red ochre, yellow ochre and green earth. All of these pigments contain iron, which was also indicated by the inspection of the colours with UV light showing luminescence quite dark on the red, yellow and green areas.

The principle of the iron content test is that the iron (III) ions dissolve in hydrochloric acid and react with potassium ferrocyanide ($K_4Fe(CN)_6$), to form ferric ferrocyanide ($Fe4(Fe(CN)_6)_3$), a bright blue complex, Prussian blue (Knuutinen 2010). Scraping the sample with another objective glass to avoid iron contagion from a scalpel, the samples were given a drop of 32 % HCl, and after drying a drop of 10 % HCl. While the hydrochloride was still wet, a drop of potassium ferrocyanide was applied. The potassium ferrocyanide coloured the samples accordingly:



Figures 12-14. Iron content test micrographs. Samples from left to right: green, yellow, and red.

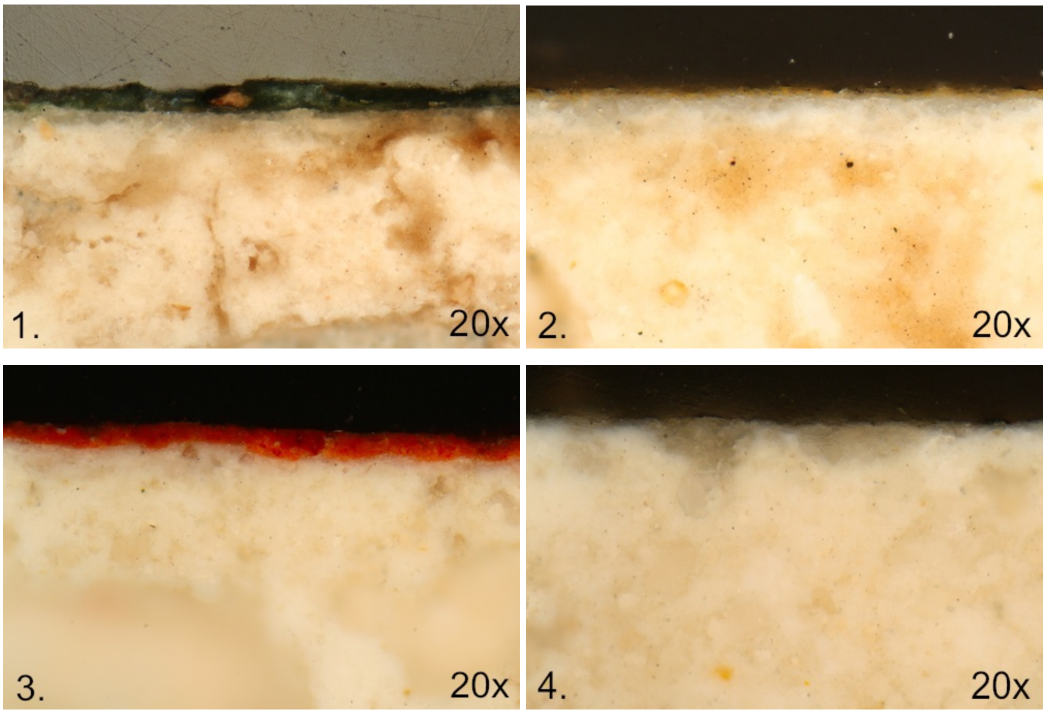
1. Green sample: Green background with abundant blue particles
2. Yellow sample: Clear background with various blue particles
3. Red sample: Yellowish background with some light blue hues

Therefore, the result of the iron content test was positive for all of the samples. This supports the presumption that the pigments used in the Szabadbattyán fresco are iron-containing red and yellow ochre and green earth.

5.1.4 Cross sections

The structure of the fresco paint layer was examined with a stereomicroscope. In order to study the layers, the samples were embedded in epoxy resin, then ground and polished into a smooth surface. In general, no large separate pigment samples can be detached from cultural-historically valuable objects (Knuutinen & Mannerheimo 2009, 40). In this case, however, as mentioned before all of the remnant parts of the fresco fragment that could not be reused in the compilation, were retained for material examinations.

Cross sections were prepared from all of the four colours present in the fresco fragment. The samples that had the most even-tempered colour were chosen for the embedding. The results of the cross sections were quite successful, although after the first trials some re-polishing had to be done.



Figures 15-18. Cross section micrographs with 20x objective. From left to right, top to bottom: green, yellow, red, white. In all of the cross sections the paint layer can be seen over intonaco.

1. Green sample: More or less thick layer of green with bigger particles amongst it and possibly some filler agent (brown particle).
2. Yellow sample: A considerably thin, almost invisible layer of yellow, with very small particles. Thinness of the layer in the cross section might be due to loss of colour while cleaning the sample of dirt, or the sample being originally located on a yellow-white gradient area on the fresco.
3. Red sample: Thicker, even layer of red consisting of small pigment particles.
4. White sample: No obvious layer or pigment particles of white can be detected. Most likely the white colour is only part of the intonaco layer of the fresco. However, the presence of white pigment cannot be completely left out.

5.1.5 FTIR-examination

Having already some results for the pigment characterization, the final examination was made using FTIR. With FTIR the presence of certain chemical compounds and atomic groups can be detected. The information obtained from the spectrum is formed by IR-wave number range transmission i.e. a spectra from permeable IR-radiation (Knuutinen 2009, 92-93). The spectrum obtained from the samples was compared with the spectral database of IRUG, Infrared and Raman Users Group. Therefore the spectrum here is presented as absorbance spectrum, on the axes y the absorbance, and on the x the wavelength.

As the white on the fresco is probably the intonaco layer, and in another case possibly a lime-derived pigment, the identification of the white was considered as a vain attempt with FTIR, as the calcium carbonate would dominate the spectrum due to the presence of lime also of plaster. Red and yellow ochre and green earth, are all part of the earth pigments group, which is a pigment group based on a wide range of materials. These are pigments identifiable by FTIR. Because they occur abundantly naturally in ground deposits, they are typically rich i.e. in clay minerals, iron oxides and other minerals and even organic components, that give some distortion to the spectrum. Ochres, such as the red and yellow ochres in this case are predominantly iron oxide- and hydroxide-rich earths varying in colour. Green earths are green-coloured due to concentrations of the clay minerals celadonite and glauconite. (Eastaugh et al. 2004, 146.) There are numerous mineral forms of green earth, but two forms of it contain glauconite and celadonite (Knuutinen 2009, 92).

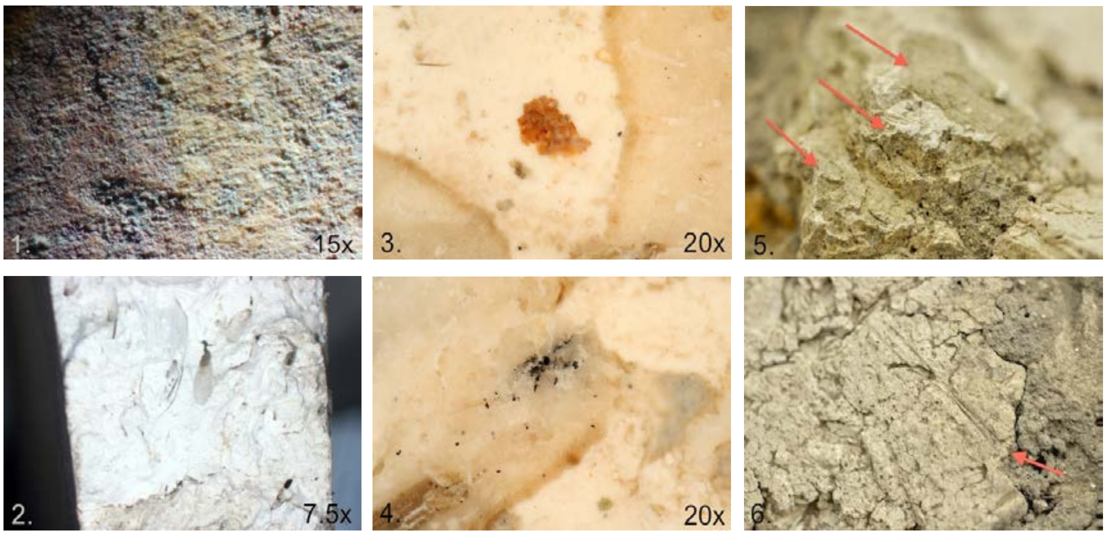
The FTIR spectrum gave some good results for the examination. When comparing the spectrum with references from IRUG Spectral Database, the colour green had some resemblance with green earth pigment containing celadonite and glauconite. Also the red and yellow had a reasonable congruent compared to the reference spectrum of red and yellow ochres. However, is must be noted that the wavelength area of the FTIR apparatus used in this case is not capable of detecting material with small wavelength area. Thus the celadonite, glauconite and hematite appeared in these pigments could not be detected. Nevertheless, the presence of calcium carbonate with strong peaks on the 1550-1350 cm^{-1} area and silicate peaks on the 1200-800 cm^{-1} area, indicates that the pigments at issue are earth pigments. The FTIR spectrum of the pigments with reference spectrum can be viewed from Appendix 6.

5.1.6 Conclusion

The study of the pigments of the fresco fragment concludes, that in the painting of the fresco earth pigments red and yellow ochre and green earth were used. These pigments were important and well-used in the Roman times, as they were abundant and readily available (Eastaugh et al. 2004, 146). The white colour of the fresco might possibly be only the intonaco layer of the fresco, as no particular use of white pigment was detected. To use the bare plaster as a white background was very common in the Roman wall painting. If a white layer of paint had been applied, it would probably have been readily detectable. (Bóna 2014.) The variability in chemical compositions and the occurrence of multi-component mixtures makes the identification of earth pigments challenging (Helwig 2014, 90). In many cases, as also in this study, only with the use of several methods that complement each other could the pigments be understood and identified (Helwig 2014, 90).

5.2 Examination of the plaster

5.2.1 Optical inspection of the plaster



Figures 19-22. Micrographs with stereomicroscope of the plaster.

1. From the sample some of the artist’s brushstrokes are visible horizontally.
2. Traces and holes of the plants used as fillers in the plaster.
3. A brick piece in the plaster.
4. Some charcoal within the plaster.

5. Visible layers from the backside of the fragment: On top clay from the adobe wall, first thick layer of plaster (arriccio) and the second, thin layer (intonaco). Depending of the piece, the thickness of the arriccio is 3-5 cm in the fragment, and the thickness of the intonaco is 1,5-2 cm.
6. Depression trace of a twig from the adobe wall.

5.2.2 FTIR-examination

The main focus of the FTIR examination was to compare the contents of the first and second layers of plaster to see if there is any difference. As it was anticipated, the two layers are next to identical to each other. The plaster contains a lot of calcium carbonate (peaking on the 1550-1350 cm^{-1} area) and silicates (peaks on the 1200-800 cm^{-1} area). The FTIR spectrum of the plaster layers with reference calcium carbonate can be viewed from Appendix 7.

5.2.3 Conclusion

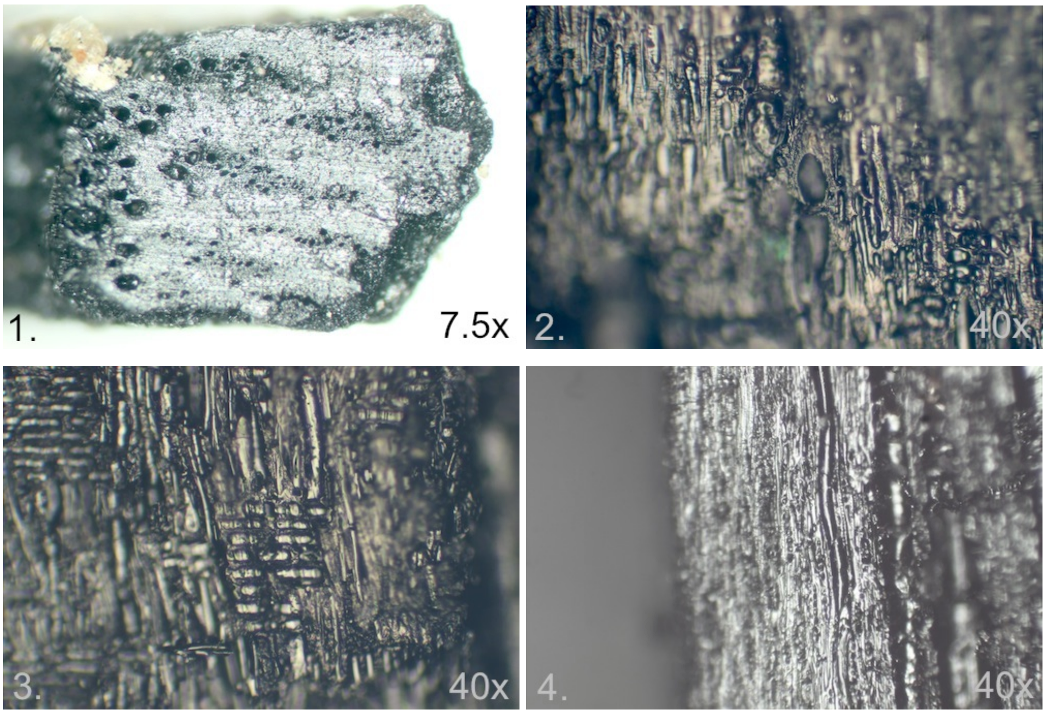
Due to the weak condition of the plaster of the fragment, hardly any of the first layer of the plaster was remaining. On the few places, where some of the first layer was still left, some traces of clay from the adobe wall from the Roman palace in Szabadbattyán could be detected. As evidence of the palace’s structure as an adobe, also depressions of twigs and plants were visible. It can be seen that hardly any sand has been used for the plaster, which is the Byzantine-type plaster with fibrous material as filler instead of sand. The binder content of the plaster is very high, with the first layer (arriccio) almost solely made with lime and plant pieces.

5.3 Examination of the carbonated wood

During the cleaning of the fragment, some small, 2-4 mm pieces of carbonated wood were found. The pieces were deduced to originate from the destruction of the palace, when it burned down and collapsed in 374. Therefore the finding was a valuable opportunity to gain more knowledge about the history of the palace. Archaeological wood, like most of the natural materials, slowly decomposes due to various biological factors, so discovering such small pieces was considered fortunate. One of the concerns in archaeological research is the degraded or altered nature of the sample. (Heron & Pollard 1996, 341-344.) Nonetheless, a 1,5-4 mm piece of the wood was examined successfully with its xylem still possible to study. (Fagerstedt et al. 2004, 14.)

5.3.1 Cross sections

The cross sections were cut for xylotomical inspection from the sample with a sharp razor blade from three directions: transversal, radial and tangential.



Figures 23-26. Wood cross section micrographs. 1. Transversal section, stereo microscope 7.5x obj. 2. Radial section 1, polarized light microscope 40x obj. 3. Radial section 2, polarized light microscope 40x obj. 4. Tangential section, polarized light microscope, 40x obj.

1. Transversal section: Hardwood. Obviously oak since the vessels of the earlywood are considerably large, which is very characteristic to oak.
2. Radial section 1: Simple perforation plates.
3. Radial section 2: Homogenous ray structure.
4. Tangential section: Dense rays.

(Fagerstedt et al. 2004, 156-157.)

5.3.2 Conclusion

The archaeological wood is definitely oak (*Quercus* sp.). This indicates that in the building of the Roman palace from Szabadbattyán oak was probably used in some way in the adobe structure. This is likely since oak is a common tree in Hungary. (Tuzson, 2014.)

5.4 Examination of the salts

Humidity causes wide damage in wall paintings through leaks, condensation and rising dampness from the ground. The elimination of humidity-derived damages is practically impossible if the source of moisture is not identified and obviated. (Brandi 2005, 99.) In addition to the increased humidity raising the risk of growing micro flora, water dissolves from the plaster any soluble salts that it encounters in its passage, depositing them elsewhere in the wall. Either dispersed within the porous materials or locally concentrated, soluble salts are present practically in all walls (Arnold & Zehnder 1991, 103). Migration and recrystallization of the soluble salts resulting from the presence of water, is a principle cause of alteration in wall paintings. (Espinosa 1987, 88; Mora 1983, 178-179.)

Easily dissolvable salts cause great harm and destruction to walls. Hygroscopic salts that build crystals in the water have changes in volume, which is the biggest problem as they grow and break the stones within the pores. The more porous the stone is, the more sensitive it is to deterioration caused by salts. (Váli 2014.) In order to remove or combat against the salts present, possible solutions depend on the type of the salt at issue. Therefore, examination of the features of the salts is important.

During the preservation of the fragment in the Szent István Király Múzeum in Székesfehérvár, the fragment had been exposed to some salts from the museum's ceiling which has a leakage. The salts had fell on the backside of the fresco from the ceiling. Even though the salt conformation was only superficial, the examination of the salts was found important, as they still can be harmful for the fresco. (Bóna 2014.)

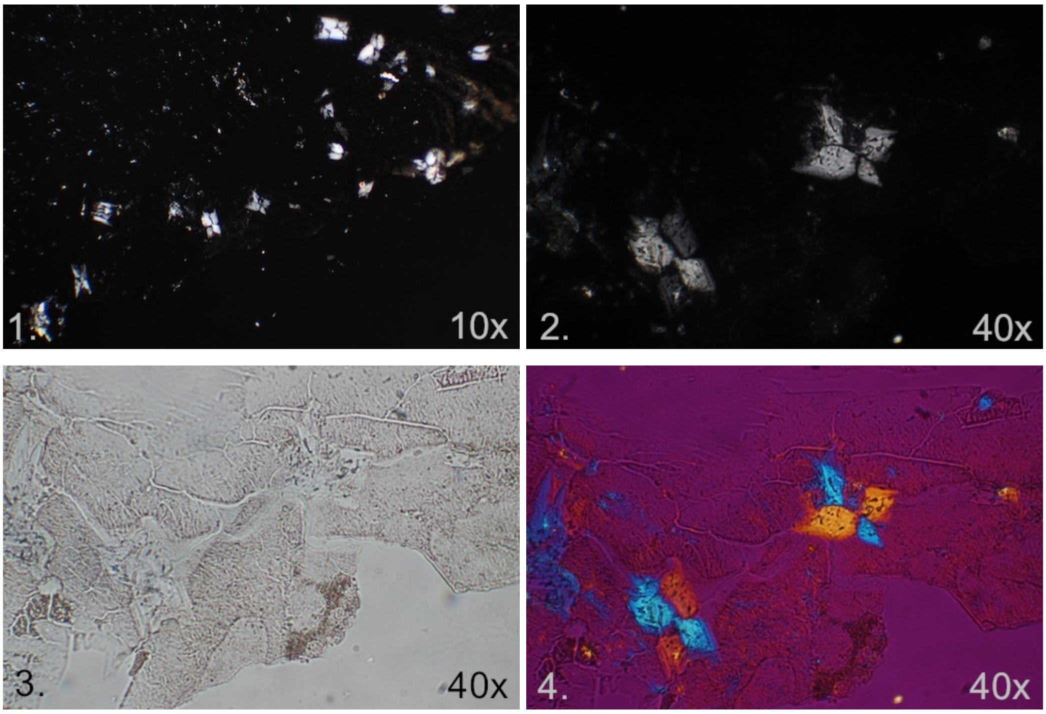
5.4.1 Extraction of the salts

The salts were covering the backside of the fresco as an unattached layer of powdery substance. Therefore no crystals could be measured, but the consistency of the salts could still be examined. The collected sample weighing 0,56 g was diluted in 8 ml deionised water, letting it dissolve overnight. The result was a very yellow liquid, proving the presence of abundant salts. After drying a drop of the liquid taken from the top of the sample, the quick sample dried under a lamp and resulted in some very big crystals too crowded to identify. The sample liquid was then diluted with deionised water 1:15, and some slow samples were dropped onto objective glasses.

Growing the salts in regular room temperature over a few days with slow water evaporation usually results in bigger crystals, which makes the identification of the salts easier. However, surprisingly some diluted quick samples turned out to be better for the identification. The dry, ready samples were covered with a drop of Canada balsam and a cover slip.

5.4.2 Inspection with polarized light microscope

Through the examination of the samples with the polarized light microscope some salts were found. Mainly the visible crystals showed gypsum, and some very small particles that might be magnesium sulfate, due to the small cracks on the surface on the sample. Also, some other compound is present that might also cause the cracks.



Figures 27-30. Quick evaporation sample micrographs. 1. Crossed polarized light, 10x obj. 2. Crossed polarized light, 40x obj. 3. Plain polarized light, 40x obj. 4. Lambda filter, 40x obj.

1. Multiple "butterfly-shaped" gypsum ($CaSO_4$) crystals. Small, scattered particles are crystals of some kind of magnesium sulfate ($MgSO_4$).
2. Close up from the gypsum crystals, showing the characteristic, twinned crystals.
3. Cracks on the surface of the sample, caused by the presence of magnesium and organic material can be seen as veins between the crystals.

4. Since the refractive index of Canada balsam is almost the same as gypsum, the Lambda filter was used. The filter modifies the wavelength of the polarized light forwards by 530 nm. This moves the colours closer to their birefringence value in the Michel-Lévy Interference Colour Chart. Here the big gypsum crystals are shown orange and blue, but the magnesium sulfate crystals are too small to detect.

(Schwarz 2012; Váli 2014.)

5.4.3 Conclusion

The salts found from the surface of the backside of the fresco fragment are mostly gypsum, magnesium sulfate and probably some organic compound. These salts can be very harmful for wall paintings. The humidity within the structure of the museum's ceiling might have resulted in the decomposition of its materials and the felling of the salts on the fresco. Due to the threat salt formation poses to wall paintings, hereafter it is recommended to protect the fragment against this kind of exposure.

6 Conservation plan

The conservation plan was discussed with the instructor of the practical work of this thesis, István Bóna, who has been the instructor in several conservation works of the frescoes from Szabadbattyán. Thus the main outline for the work could already be structured, but of course as in many conservation works, some additions or details of the plan, change or will be determined during the progress of the work.

As a guideline, as generally considered important in all aspects of conservation, all of the treatments or solutions applied to the object must be reversible and enable future treatments. Nevertheless, the main focus has to be on ensuring the lengthening of the life cycle of the object. Also every conservation process, above the obvious objective treatments, is at the same time a unique, unrepeatable opportunity to study the object: the structure, art, the genesis, chronology and so forth. As it is in an archaeological excavation, the documentation and research are vital, as via the intervention, the previous state of the object becomes past. (Mancinelli 1991, 60.)

Since the future of the conservation process of the frescoes from Szabadbattyán is to display them in the reconstructed rooms of the Roman palace, the fragment needs to be stable enough to stand further handlings of it. Before this, on the other hand, the fresco fragment will be on display as such, and so the final form of the conservation should be presentable and support the preservation of the fresco.

6.1 Backside

6.1.1 Cleaning and consolidation

The dirt and soil from the backside of the fresco fragment are to be cleaned mechanically cautiously since the plaster is fragile and comes apart very easily. As much of the dirt as possible should be removed to make the separation of the pieces easier later, moreover not to consolidate the dirt to the fragment.

The consolidation will take place in many parts. First, the entire fragment must be treated with a consolidant, which will improve the strength of the plaster on a micro-level. After the fragment feels more stable, the consolidation of the smaller cracks and fissures will be carried out by treating them with a different consolidant, developed to fill in the cracks. This will provide the needed stability to areas, which are missing the original material. For the areas of the fragment, where the original plaster has been lost, some new plaster will be added.

6.1.2 Appliance of a support for the backside

Since the future aim of the conservation of the fresco is to display it, some support for the fresco must be added to the backside to make it possible to work with it in the future. This fact will also function as a strengthening treatment for the fragment. The support should be removable, but also long-standing.

In addition to the support made of plaster, a temporary protective and supportive layer will be added on the backside. This is to ensure that the fresco fragment can be safely turned over and working with the face side can be accomplished without stressing the backside. For the support some layers of cellulose paper will be added firstly with some light glue, which can be easily removed after the support is no longer needed.

6.2 Face side

6.2.1 Removal of the temporary support from the face side

The removing of the polyurethane and Styrofoam support will be done mechanically. The removal of the protective layer containing of gauze applied to the face side firstly with Paraloid B72 and then paper applied with Plextol B 500 must be accomplished carefully in order to prevent any possible damage to the face side. To soften the glue, a poultice with solvent will be created. The protective layer must come off easily, so the duration for the poultice to soften the glue must be examined, since removing the paper and gauze layer too stiff might cause damage to the fresco.

6.2.2 Cleaning of the surface of the face side

The face side must be cleaned with the smallest amount of stress. Any abrasion to the painted surface must be avoided during cleaning. Depending on the success of removing the protective layer of paper and gauze with solvent poultice, some glue might be left to the surface. If the leftover glue cannot be cleaned with solvent directly after removing the gauze, softening it with some solvent for mechanical removal can be tried. Dirt and soil on the surface of the fresco and between the pieces will be removed mechanically with constant observation.

6.2.3 Levelling and adjusting the pieces

Originally the fresco had a sleek, uniform surface. However, as the detached pieces of the fragment are in this case positioned very differently in relation to each other, the pieces must be cautiously adjusted so that they can be displayed as evenly as possible, as this was the primal form of the fresco. Only pieces that can be surely marked as cohesive can be glued together. While connecting the pieces, the attachments should be tried to carry out to form an even surface. Imprints such as unification of colour and brush strokes, fracture edges etc, affirming the cohesion must be carefully followed and surveyed for making the levelling.

6.2.4 Support for displaying the fragment

In order to be able to display and simultaneously store the fresco stably, a permanent support for the fragment will be built. The support must be steady, light and enable an aesthetic presentation for the fresco fragment. The lightness of the support is a significant feature, as in accordance with the conservation ethics no original plaster will be removed. However, the whole structure must not be too strenuous, so that the pieces of the fragment can be safely removed if needed in the future.

6.2.5 Retouching

Any loss of colour on the face side that is considered distracting from the image of the fresco will be retouched. Nothing else but watercolours will be used in the retouching. Although the retouching cannot be explained from an objective view, retouching the damages that interfere with the overall aesthetic look of the fragment, will improve the readability and aesthetic values of the fragment.

7 Conservation report

The conservation of the fresco fragment was divided into two sections, as, since the excavation, the face side of the fresco had been covered with care. Although the most valuable part of the fresco from a certain view is the painting, only by treating the backside first could the preservation of the face side take place. A large part of the work was the constructing of the support for preservation and displaying the fresco fragment.

7.1 Backside

The conservation of the backside of the fresco fragment begun with removing some of the polyurethane and Styrofoam support, since the managing of the fragment was found to be difficult. With the excess material off, it improved the moving and reaching to work with the fragment. As much as possible of the dirt and soil from the fragment was removed mechanically. During the cleaning several small pieces of the loose plaster fell off, and serious need of consolidation was proved when removing the dirt made the pieces move even more. Any potential loose pieces of material that were evaluated not to be able to use as a part of the fresco again, were taken as samples.


Figure 31. Crumbling plaster. Figure 32. Soil and dirt was completely surrounding the pieces.

To make the fragment more stable, 4% Aquazol 500 in alcohol was impregnated throughout the fragments backside. This synthetic resin with high viscosity was impregnated 4-5 times to the surface, and let dry overnight. Aquazol 500 was chosen based on the experiences with the same kind of material and the quality of that making it dissolvable in water and different polar solvents – thus theoretically removable. Due to the bigger molecular size of the Aquazol 500, the strength of it is higher (Bóna 2014). Aquazol was applied generously in a few layers, and while working it was clearly noticeable that all of the consolidant was being absorbed by the fresco completely. In addition, an important note was made that absolutely no discoloration could be detected. The next day the plaster was already in an extremely better condition after only one treatment. Next the smaller cracks and still fragile areas were injected with VAPO 0/1, which is marble dust with lime, with calcium oxide content of almost 60% (Kürtosi 2010, 121). Mixing VAPO with water, thicker or thinner substances based on the area's need were made. Injection of VAPO worked beautifully, as it impregnated easily to the surface. Some areas had to be treated multiple times, but this consolidation proved to be very successful too, as the next day after drying the whole plaster felt very stable and stronger.

On several areas of the fragment the pieces are rather thin due to the loss of the plaster. In order for these areas to be protected from breaking, a new plaster was inserted. The plaster was made with VAPO and glass foam, which was grinded to powdery substance. These two dry materials were mixed with ratio 1:1. The glass foam powder is made from waste glass, and the colour is light rose. The reason for the colour is not known. The glass foam is manufactured by Geofil Kft. for building construction and grinded to powder only for the conservation purpose. The differing colour makes the removal of the plaster in this case easier, if necessary in future conservation. The lightness of the glass foam powder is an eminent feature, as it can be used also for the backing support of the fresco. After adding water and having the plaster-like substance, 5-10% of Euroacrylic glue was added for added strength. More VAPO and glass foam powder was added after this since the Euroacrylic liquefies the mixture. Wetting the surface of the fresco before applying the plaster, it was added to the areas were risk of breakage or thinner plaster due to missing plaster were observed. When dry, the plaster was trialled by scraping lightly on some places to ensure that the removability of it was still assured.

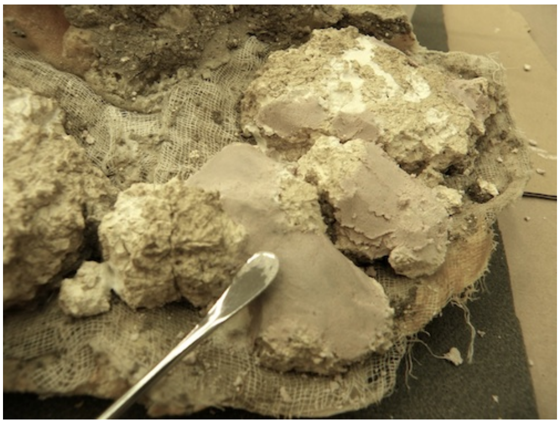



Figure 33. Consolidation of cracks in the plaster with VAPO can be seen as white. Figure 34. Applying supportive plaster, which has the differing light rose colour.

After consolidation and filling the areas of missing plaster the backside felt very stable, and thus the lasting support for the backside could be applied. The support was made with using the same plaster as before. For bigger pieces of the fragment, 1-2 layers of Dryvit net were applied. The Dryvit net is a glass net embedded in plastic and used in building construction, and it is a very flexible and light material. The pieces of the Dryvit net were cut 1-2 cm smaller than the actual piece, so that the plaster could safely cover the edges. First wetting the surface, the plaster was applied and then the Dryvit net in 1 or 2 layers with plaster in between before the final layer of plaster on top. For improving future attaching of pieces, the wet surface of the plaster was scraped and drizzled with rough sand. On the very small pieces of the fragment some plaster was applied for strength, but no Dryvit net or sand. This stage after conservation with the support on the backside is documented and can be seen on Appendix 3.

To enable safe working with the face side, some background support was needed for protection. After the drying of the plaster applied in the previous phase, the fragment was decided to be cut in four pieces so it could be treated more easily. The temporary support for the backside was constructed by building it layer by layer using absorbent cellulose wadding. The highly bleached cellulose wadding had thin layers and due to this fact, applying it was easy as it took the shape of the fragment's surface quickly after wetting it. The first few layers were applied with 1% Klucel M in pure water-free alcohol, since using water-based glue would dissolve the water-soluble consolidant, Aquazol 500. However, the last 4-5 layer of the cellulose wadding was applied using only water, to maintain the easy removability of the support later. The completely dry, soft support of cellulose wadding was then covered with polyurethane foam, adding an aluminium batten in the middle. This support gave the perfect stable support and protection for the fragment to begin the work on the face side.

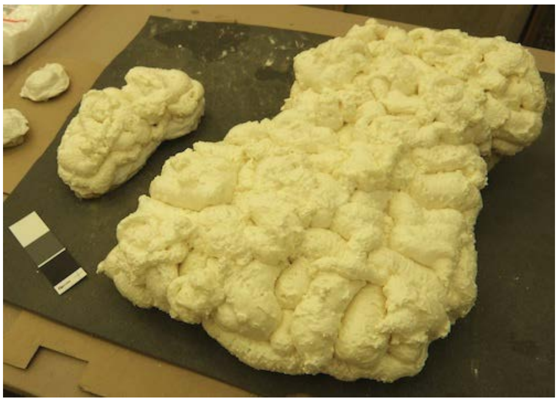


Figure 35. Applying Dryvit net with plaster in layers for the backside. Figure 36. After applying the polyurethane foam over the cellulose wadding.

7.2 Face side

Beginning with the removal of the old polyurethane foam support on the face side, it was removed mechanically by cutting it piece by piece off the surface. Coming off very easily, the polyurethane foam was successfully removed completely mechanically from the protective layer of gauze and paper on the face side.

After this a test for the removal of the gauze and paper was tried. Some of the smaller pieces were covered with cellulose wadding saturated generously with nitro thinner, and left completely covered with plastic for some time. After 20 minutes the layer of gauze and paper was still stiff, and so some more nitro thinner was applied and then left again for impression. After around 40 minutes the nitro thinner had completely softened, almost liquefied the Paraloid B72 and Plextol B 500 in the paper and gauze, and the layer could be easily removed from the surface without any effort in pulling. Immediately following this the surface of the fresco was wiped with a cloth dipped in nitro thinner.

As this method was very successful and the surface of the fresco came out clean, the same technique was decided to carry out for the rest, big piece of the fresco. However, using nitro thinner is hazardous, so the usage of this solvent must be committed accordingly so that any possible risks can be deleted. In the etiquette of the used nitro thinner by Erdőkémia Kft. the composition is announced to consist of toluene, acetone, isobutyl acetate, methyl acetate, isopropyl acetate, ethyl acetate, isopropyl alcohol, anhydrous ethanol with Hazardous g. hold. 100%. The tests with nitro thinner were conducted in a room with high air exhaust, and also a gas mask was used. Any skin contact with the nitro thinner was avoided by using gloves, as the solvent absorbs easily through the skin.

Due to the quick evaporation rate of nitro thinner, some xylene was added to the solvent in order to increase impression as xylene evaporates slowly. While working with this harmful chemical, same precautions as before were taken to prevent any damage during the work. Using the nitro thinner with around 10 % of xylen, the surface of the gauze and paper layer was first wetted completely. Next a quantity of paper pulp wet with the solvent was applied tightly to the surface, pressing the mass carefully to ensure total connection. Covered with cling film and plastic to ensure the minimum of solvent evaporation, the impression was given 45 minutes. After this time the impression was examined, and since softening had yet to happen, some solvent was added and the impression continued. At the 1,5 hour mark the layer of the gauze and paper had relaxed and was completely loosened from the surface of the fresco. Quickly the layer was rolled away parallel to the surface, before the majority of the solvent could evaporate. As before, some excess of the glue was cleaned with the solvent. However, even though the layer of paper and gauze came of beautifully from the surface, it was clear immediately that a quantity of the Paraloid B72 and Plextol B 500 was still left to the surface, completely impregnated with the dirt on the fresco. The removal of the gauze and paper also revealed a great amount of soil still between the pieces, many of which felt loose.

The selection of nitro thinner with xylene was made from the viewpoint of softening the glue in order to remove the protective layer with as much glue as possible not harming the fresco, but of course the harmfulness of these solvents is nothing to be careless about. Since quite a lot of the solvents were used, it resulted for the big and final piece of the fresco being completely saturated with it. Therefore before any work could be continued with the face side, the cleaned pieces had to bet let alone until the solvents had completely evaporated. This took all together 4-5 days before no presence of the solvent was detected and the work could be continued.

Cleaning of the remaining glue on the surface of the fresco fragment was found to be somewhat manageable mechanically directly after the removal of the gauze and paper. This was successful with the smaller pieces that could be treated soon after the poultice treatment. Due to the impossibility of working with the big piece of the fresco still with remnants of the solvent, after the complete evaporation of the nitro thinner and xylene the layer of glue and dirt was found extremely hard and slow to remove. Some 1% Klucel M in pure water-free alcohol was applied to the surface in order to try if the swelling of the glue could possibly ease the cleaning. However, after various tests with the swelling only more damage to the surface was detected. Finally the cleaning was tried again only mechanically and although slow, it was found to be the least abrasive to the surface. Checking the result with Saphiro^2 LED illumination headset by ZEISS, mechanical cleaning was detected not to be harmful for the surface, as some lime crust layer was providing the protection against abrasion.

During the cleaning of the face side of the fresco the different conditions of the colours was noticed. While the condition of red, white and green was found to be excellent, the yellow colour was found problematic. Even the feel of the yellow areas was found different from the others: more porous and weak. The yellow areas were cleaned with great care, but not being as strong and uniform as the other colours, the yellow areas suffered some small damages because of the cleaning. In addition, a few places of the fragment were treated with the 4% Aquazol 500 inserting it between some cracks of the pieces that had remained unstable after the consolidation applied from the backside.

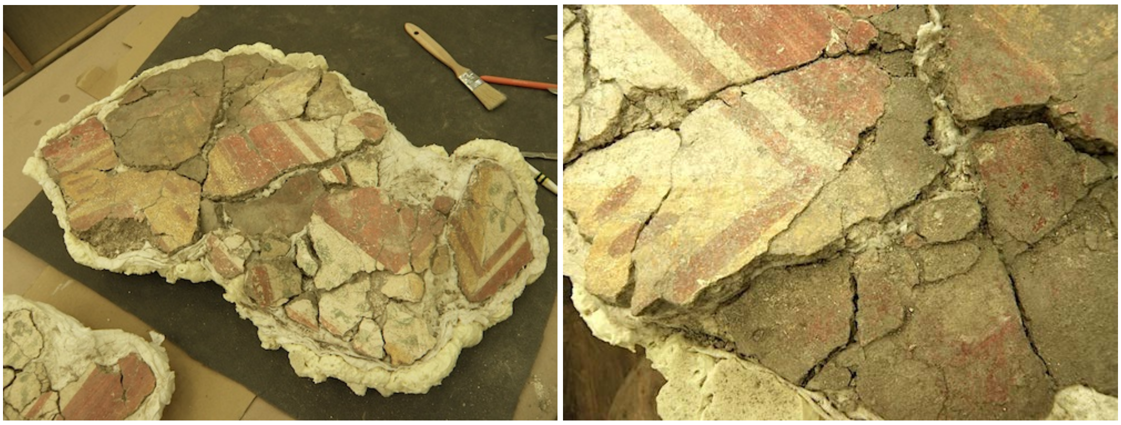


Figure 37. Generic photo of the fragment during cleaning. Figure 38. Difference before and after cleaning the surface from the glue and dirt.

When the face side was completely cleaned, the next phase was adjusting and levelling the pieces. As the cleaning was conducted carefully, no original places of the pieces still remaining were lost. Piece by piece, the fragment was inspected and pieces removed from the temporary support. The cellulose wadding paper came off easily leaving no marks. Most of the pieces lying next to each were found or confirmed to be matching by the examination of the artist's brush strokes, colours and edges. These pieces could be therefore joined together for the assembling of the whole fragment. Because the whole fragment had been impregnated completely with the consolidant, this had led to the fact that some of the dirt was also impregnated to the lime, resulting to containing too much material between the edges of the pieces. To be able to match the original pieces back together, some material had to be removed from the needed areas.

Pieces that were found matching were glued together using Euroacrylic glue. Joining the pieces was made so that the surface of the fresco could continue as even as possible. Behind the new joints some plaster was added to ensure the stability of the pieces. Not all of the joining pieces were glued however if there were too much material missing between or joining them would possibly make the future handling harder.

7.3 Building a support for the fragment

After the final assembly of the pieces was complete, the building of the support for the fragment could begin. According to the experience and trials with fresco-carrier models by István Bóna in his DLA dissertation, a support built with polycarbonate sheet, polystyrene hard foam and plaster had resulted to be a durable and light solution, so this combination was chosen also to build the support for this fragment (Bóna 2007, 1-17). Metal for the support must be avoided, as it leads heat and thus is a very bad material for supports especially in outdoor conditions (Bóna 2014).

The material chosen for the support was a SPC polycarbonate sheet by Quinn™ with UV-protection on the other side. The Quinn™ SPC UV sheet is used for roof building, so it is highly tolerant towards hard stress caused by rain, sun and heat. For embedding the pieces of the fragment, a plate of extruded polystyrene hard foam, Universalplatte by Austrotherm was chosen. These foam plates are used as thermal insulation construction material in buildings. The lightness of these two materials are an extremely important advantage, as the final support for the fresco cannot be too heavy, as the suspension of it might be difficult. (Austrotherm 2014; Quinn™ 2014.)

Since a ready cut sheet of the polycarbonate was available sizing 58,5 x 58,5 cm, it was experimented with the fragment pieces to find out that the size of the sheet was perfect for an aesthetic display of the fresco. A matching piece of the polystyrene hard foam was cut and glued to the polycarbonate sheet with an acid-free silicone, which is approved by the manufacturer as the proper way to attach the Quinn™ SPC UV sheet (Bóna 2014). Once dry, a tight fitting, wooden, 5 cm high frame glued together and reinforced with staples was glued with instantly drying INSTA-STIK polyurethane foam by DOW. For a more repellent surface, the wood had also been impregnated with 3 % Paraloid B 82 in alcohol. After cleaning this excess dry polyurethane foam, a plaster layer to embed the pieces of the fragment was applied.

The plaster was made with the following recipe:

1. 3 ½ parts Styrene-acrylate –based tile adhesive (Csemperagasztó by ProGold)
2. 2 parts water
3. 9 parts fine white sand
4. 6 parts perlite (P1 Perlit by ANZO Perlit)

For this support, a double amount was made. While mixing all of the ingredients together, it was noted that some substantive in the glue was causing the plaster to become more and more orange-red colour. However, appearing somewhat nice light pink colour, the plaster was decided to apply nevertheless. Using the edges of the wooden frame as guidelines, a smooth 5 mm layer of the plaster was applied after impregnating the surface of the polystyrene with Euroacrylic 1:1. Using tile adhesive and glue it was ensured that the plaster would stick to the polystyrene.

After having dried overnight the colour of the plaster had turned remarkably red. In this case it was decided that a thin layer of white plaster using different glue would be applied on top of the first plaster layer for a more aesthetic look not too distracting from the fresco itself. First assembling the pieces according to their cohesiveness, the proper places were marked and then cut through the plaster and to the polystyrene to make space for the fragment pieces. Depth of the cuts were modified while taking into account the different thicknesses of the pieces, so that the overall finished set would result in a level as even as possible, depending on the deformation of the pieces.


Figure 39. Inserting the pieces of the fragment to the polystyrene hard foam. Figure 40. Filling the gap between the fragment and the plaster with polyurethane foam.

Pieces of the fragment were then inserted to their places one by one attaching them to the polystyrene with the INSTA-STIK polyurethane foam. Polyurethane foam is removable, and it does not impregnate the fresco (Bóna 1014). Using nails for securing the pieces during the polyurethane drying, the result was successful with the pieces aligned aesthetically according to their original placement. As the schedule for building the support for the fresco was strict, the empty space between the pieces of the fresco and the cut space in the support was decided to fill up with polyurethane foam, as the finishing layer of plaster could thus be inserted on the same day. First filling the sides and then also under the pieces of fragment, after the polyurethane foam had solidified through policondensation, the excess of it was cut away to the level of the plaster.

Plaster for the finishing support was made with the following recipe:

1. 3 parts Euroacrylic glue
2. 1 part water
3. 10 parts fine white sand
4. 5 parts perlite (fine B2 Perlit by ANZO Perlit)

Once more, the recipe was doubled. However, after mixing all the ingredients the consistency of the plaster was found to be very wet, so some more dry material was added: three parts of perlite and five parts of sand. Applying a 4-5 mm layer on top of the first layer, the new plaster was inserted tightly against the edges of the fragment and also inside and in-between some bigger gaps of the fragment for increased support. The plaster was worked to as smooth as possible, though having already the pieces of the fragment inserted in, some unevenness was left. After the plaster had dried to a pleasant greyish colour another wooden frame was decided to insert around the support, as the new layer of plaster was spread over the edges of the previous wood: thus the edges of the plaster would be very delicate for breaking. The new frame was slightly higher, 5,5 cm and attached to the first frame with screws. The ending result of the support was perhaps slightly heavier due to the second layer of plaster, but a debonair display for the fragment. The wooden frame was left unpainted, as the previous fragments from the Roman palace in Szabadbattyán also had unpainted wooden frames. However, the frame was impregnated with a few layers of 3 % Paraloid B 82 in alcohol for a protective coating against cleaning etc.

Finally, the retouching of the fragment was done using Panno’Akvarell watercolours. The Panno’Akvarell watercolours were chosen based on the long lasting quality they have according to the experiences with retouching in various other conservation projects over a long period of time (Bóna 2014). Retouching was done on areas with loss of colour due to the cleaning or previous damage, but also some features were also slightly enhanced to approve the readability of the image. This means the retouching of the almost destroyed green leaves, which fortunately still got traces marking the original areas of the leaves. Retouching the damage and the leaves was considered absolutely necessary since without it the original pattern of the fresco would not be so evident. The result was found very serene after the retouching, and the paintings of the fresco could be viewed as a cohesive work of art. The pictures from the construction of the support and the documentation photos from the face side after conservation can be viewed from Appendix 4 and Appendix 5.

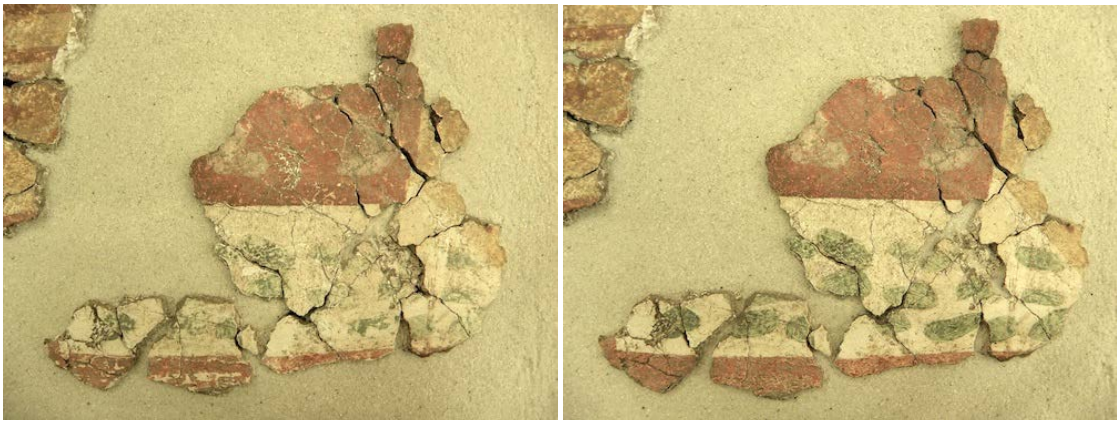


Figure 41 & 42. A piece of the fragment before and after retouching.

7.4 Preservation of the fresco after conservation

The finished fresco fragment from the Roman palace in Szabadbattyán will be displayed by the end of the year 2014 at the annual exhibition in the Szent István Király Múzeum in Székesfehérvár. Also, the fragment will be displayed as part of the yearly exhibition of student work in the Hungarian University of Fine Arts. Before and between the exhibitions, the fragment is stored covered with paper in a side room in the university. After the exhibition in Székesfehérvár, the fragment will be stored in the museum. The fragment should be stored horizontally in a dry environment as stable as possible protected against dust and mechanical damage (Dinsmore & Hanna 1991, 82). Hopefully in the future the project to reconstruct the rooms of the Roman palace will soon take place, and the fragment subject to this thesis can be a part of the reconstructed room that once stood in Szabadbattyán's Roman palace in the 4th century.

8 Final words and acknowledgements

This thesis was conducted under a tight schedule, as the practical work and great majority of the material examinations were done in Hungary under a two-month exchange in the University of Fine Arts in Budapest. Nevertheless, the whole thesis and the whole project has been a success for me. No concession had to be made for the conservation quality despite the shortness of time, and the ending result of the fresco fragment is nothing less than extremely satisfactory. In the first instance, this entire process has been a great and rewarding learning experience. Also I am thankful for having had the opportunity to study the materials so profoundly in the laboratories in

Hungary and Finland, and without this liaison my personal immersion for analytical research methods would not have been possible.

In conclusion I am satisfied that being almost a 2000-year-old artefact, the fresco fragment from the Roman palace of Szabadbattyán has gained the possibility to abide at least a fraction of the time it has already seen. The results of the material examinations can benefit further conservation work with the frescoes from Szabadbattyán, but also the thesis can perhaps provide a useful source of information and experience internationally. Displaying of the work and sharing information is important as education plays a major role in the preservation of the cultural heritage. In all essentials, after all it is the people who will make the decisions affecting the survival of the heritage. Enthusiasm towards cultural heritage must be encouraged.

Finally, I want to thank my mentor Tuula Auer for encouragement, guidance and advice. With great gratitude I thank my mentor István Bóna for this unique opportunity for the thesis, his presence, wonderful guidance and inspiration for wall paintings. I thank warmly Brigitta Kürtosi, Tímea Varga and Zsuzsanna Váli from the DLA Doctorate School of Hungarian University of Fine Arts. Also I would like to thank the Hungarian University of Fine Arts, the Szent István Király Múzeum in Székesfehérvár, the Metropolia University of Applied Sciences, and everyone who has given their sincere share during this thesis.

References

Arnold, Andreas & Zehnder, Konrad 1991. Monitoring Wall Paintings Affected by Soluble Salts. In Cather, Sharon 1991. The Conservation of Wall Paintings: Proceedings of a Symposium, London, July 13-16, 1987. 103-133

Austrotherm, 2014. Austrotherm – EPS, XPS, Inslulation – Austrotherm Universalplatte. [Web page] <http://www.austrotherm.com/fr/front_content.php?idart=2084> (read 19.4.2014)

Bóna, Istvan 2007. 1st Appenidx in Régészeti feltárásokból származó falkép leletek restaurálásának új módszerei. DLA Dissertation. Budapest: Hungarian University of Fine Arts Doctorate School. 1-17 & Summary table photos

Brandi, Cesare 2005. Time in Relation to the Work of Art and Restoration & Restoration of Ancient Paintings. In Basile, Giuseppe (edit.), Brandi, Cesare & Rockwell, Cynthia (trans.) 2005. Theory of Restoration. 61-64 & 96-100.

Chaplin, Tracey, Eastaugh, Nicholas (edit.), Siddal, Ruth & Walsh, Valentine 2004. The Pigment Compendium – A Dictionary of Historical Pigments. Oxford: Elsevier Butterworth-Heinemann, 2004. 146

Chaplin, Tracey, Eastaugh, Nicholas (edit.), Siddal, Ruth & Walsh, Valentine 2004. The Pigment Compendium – Optical Microscopy of Historical Pigments. Oxford: Elsevier Butterworth-Heinemann, 2004. 362-365 & 370-371

Dudás, Jelena, Papp, Mónika & Tóth, Alexandra 2012. Restaurálási dokumentáció: Római kori falkép töredéke Szabadbattyánból. Restoration Documentation. Budapest: Hungarian University of Fine Arts, Conservation Department. 2

Dinsmore, J.K. & Hanna, S.B. 1991. Conservation of Central Asian Wall Painting Fragments from the Stein Collection in the British Museum. In Cather, Sharon 1991. The Conservation of Wall Paintings: Proceedings of a Symposium, London, July 13-16, 1987. 82

Espinosa, Agustín 1987. Conservation and Restoration of the Murals of the Temple of the Paintings in Bonampak, Chiapas. In Corzo, Miguel Angel & Hodges, Henry W. M. (edit.) 1987. In situ archaeological conservation: proceedings of meetings April 6-13, 1986, Mexico. & Mexico City: Instituto Nacional de Antropologia e Historia de Mexico & The Getty Conservation Institute, 1987. 89

Fagerstedt, Kurt, Pellinen, Kerttu, Saranpää, Pekka & Timonen, Tuuli 2004. Mikä puu – mistä puusta. Helsinki: Yliopistopaino, 2004. 14 & 156-157

Gassiot-Talabot, Gérald (trans.Tiura, Yrjö) 1971. Taiteen maailmanhistoria: Roomalainen ja varhaiskristillinen maalaustaide. Helsinki: Ex Libris 1971. 13 & 183-184

Helwig, Kate 2014. The characterisation of iron earth pigments using infrared spectroscopy. [Web-document] <http://www.academia.edu/1006437/11._The_characterisation_of_iron_earth_pigments_using_infrared_spectroscopy> (read 22.4.2014)

Heron, Carl & Pollard, Mark A, 1996. Archaeological chemistry. Cambridge: Royal Society of Chemistry, 1996. 341-346

Knuutinen, Ulla 2009. Kulttuurihistoriallisten materiaalien menneisyys ja tulevaisuus: konservoinnin materiaalitutkimuksen heritologiset funktiot. Jyväskylä Studies in Humanities 1459-4323; 114. Jyväskylä: Jyväskylän yliopisto 2009. 51-55 & 59-93 & 92-93

Knuutinen, Ulla & Mannerheimo, Hanne (edit.) 2010. Course materials. Identification of historical pigments: Non destructive and micro-methods. Study Materials Series D 2006:4. 1-98

Knuutinen, Ulla & Mannerheimo, Hanne 2009. Pigmenttitutkimus. In Kaarto, Pasi (edit.) 2009. Exercitia: näin näyttely tehtiin, 2009. Metropolia Ammattikorkeakoulu, Vantaa 2009. 40-43

Kürtosi, Brigitta Mária, 2010. Aquincumi mozaikpadló töredék restaurálása és viszgálatai. Thesis. Budapest: Hungarian University of Fine Arts, Conservation Department. 121

Manicelli, Fabrizio 1991. The frescoes of Michelangelo on the Vault of the Sistine Chapel: Conservation Methodology, Problems, and Results. In Cather, Sharon 1991. The Conservation of Wall Paintings: Proceedings of a Symposium, London, July 13-16, 1987. 57-64

Mora, Laura, Mora, Paolo & Philippot, Paul 1983. Conservation of Wall Paintings. London: Butterworths 1983. 178-183

Pecze, Éva & Váli, Zsuzsanna, 2009. Restaurálási dokumentáció: Római kori falkép töredéke Szabadbattyánból. Thesis. Budapest: Hungarian University of Fine Arts, Conservation Department. 1-6

Leithäuser, Sandra (trans.) & Schwarz, Hans-Jürgen 2012. Microscopic identification of salts. [Web-document] <http://193.175.110.91/saltwiki/index.php/Microscopic_identification_of_salts> (read 7.5.2014)

Simpson Grant, Martha 2000. The Use of Ultraviolet Induced Visible-Fluorescence in the Examination of Museum Objects, Part II. Conserve O Gram, December 2000 (1/10), 1-4.

Tóth, Alexandra 2012. Restaurálási dokumentáció: Római kori falkép töredéke Szabadbattyánból. Restoration Documentation. Budapest: Hungarian University of Fine Arts, Conservation Department. 3-6

Quinn™ SPC, 2014. Quinn™ SPC Techincal manual. [Web page] <http://www.plastintime.se/sites/plastintime.se/files/attachments/quinn-spc-technical-manual-24-06-2008.pdf> (read 19.4.2014)

Personal communication

Bóna, István 2013. DR, senior lecturer, Hungarian University of Fine Arts. Diploma work [e-mail message] (read 27.10.2013).

Bóna, István 2014. DR, senior lecturer, Hungarian University of Fine Arts. Verbal communication: Various days between February 10th – April 11th 2014.

Kriston, László 2014. Physicist, chemistry teacher, Hungarian University of Fine Arts. Verbal communication: 27th March 2014.

Tuzson, Eszter 2014. Wood examination teacher, Hungarian University of Fine Arts. Verbal communication: 4th April 2014.

Váli, Zsuzsánna 2014. Painting restorer, student in the DLA Doctorate School of Hungarian University of Fine Arts. Verbal communication: February 12th, March 3rd, April 3rd, 4th, 10th 2014.

Varga, Tímea 2014. Painting restorer, student in the DLA Doctorate School of Hungarian University of Fine Arts. Verbal communication: March 3rd, 27th, April 9th 2014.

Picture references

Figure 1. Caption from Google Maps web mapping service. Google Maps [https://www.google.com/maps/place/Szabadbattyán/] (Image retrieved with keywords "Szabadbattyán, Hungary) 20.2.2014.

Figure 2. Scanning from an article. Járo, Márta 1996, after Fitz, J., 1982. Pannonok évszáda (The century of Pannonians). Budapest: Comparison of the painting materials used for wall painting in four sites of the Roman province Pannonia. Béarat, H., Fuchs, M., Maggetti, M. & Paunier, D. (Editors): Roman Wall Painting: Materials, Techniques, Analysis and Conservation. Fribourg: Institute of Mineralogy and Petrography, 1997. 77.

Figure 3 & 4. Scanning from a diploma work. Pecze, Éva & Váli, Zsuzsanna, 2009. Restaurálási dokumentáció: Római kori falkép töredéke Szabadbattyánból. Thesis. Budapest: Hungarian University of Fine Arts, Conservation Department. Appendix photo 63. A szabadbattyáni palota alaprajzán nyíl jelöli a falképek származási helyét.

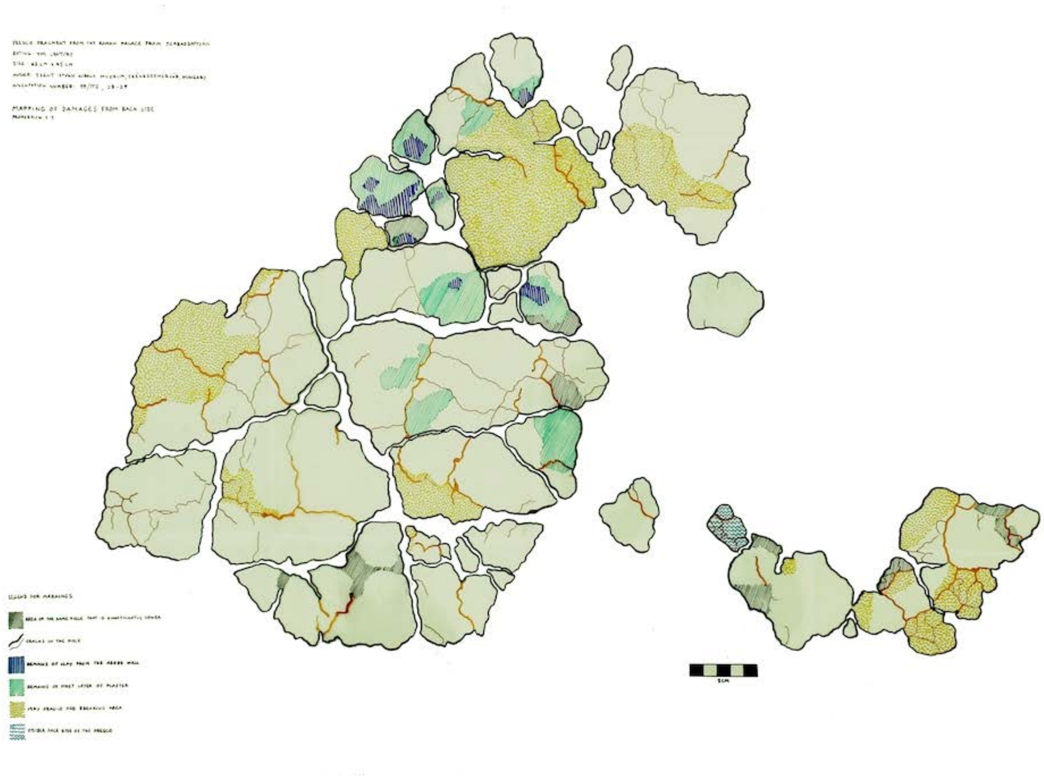
Appendix 1. Documentation before conservation from the backside

Symmetric daylight

Raking light from left side

Appendix 2. Mapping of damage from the backside

Documentation of the damage from the backside before conservation



Appendix 3. Backside after conservation with supportive layer

Backside of the fragment with the applied support

General view of the fragment

Appendix 4. Construction of the support for the fragment

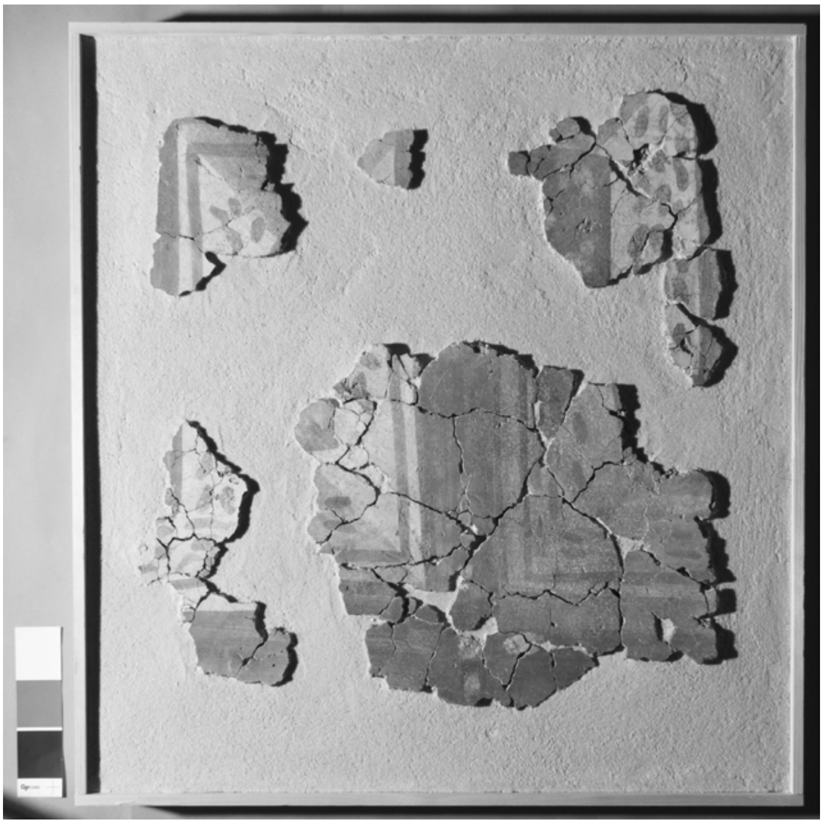
The support - first plaster layer, pieces of the fragment inserted

The support – second layer of plaster, before applying the second wooden frame

Appendix 5. Documentation after conservation from the face side

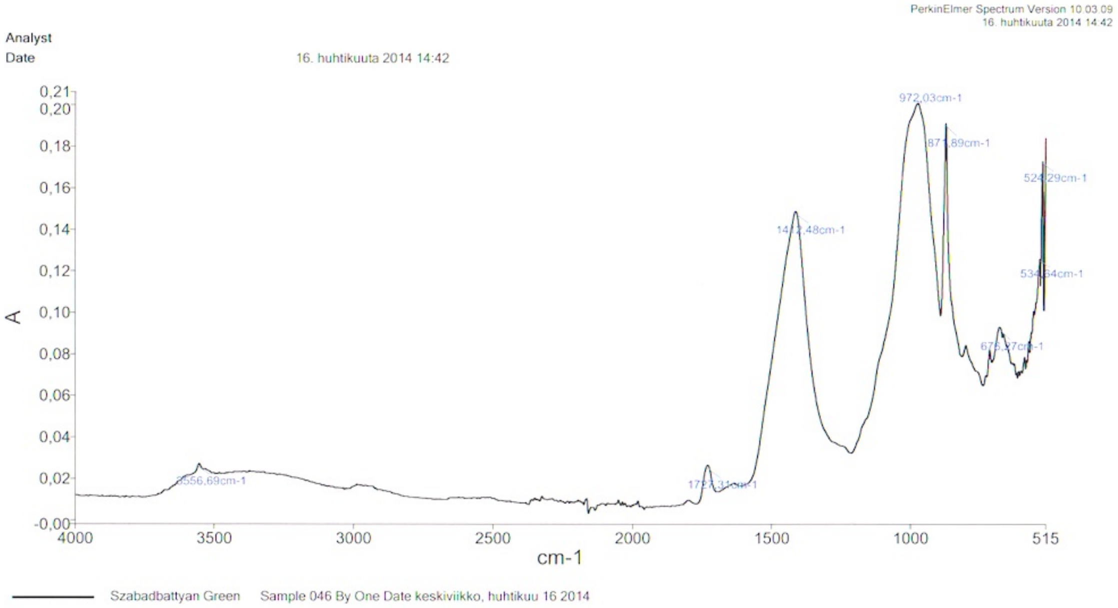
Symmetric daylight

Raking light from left side

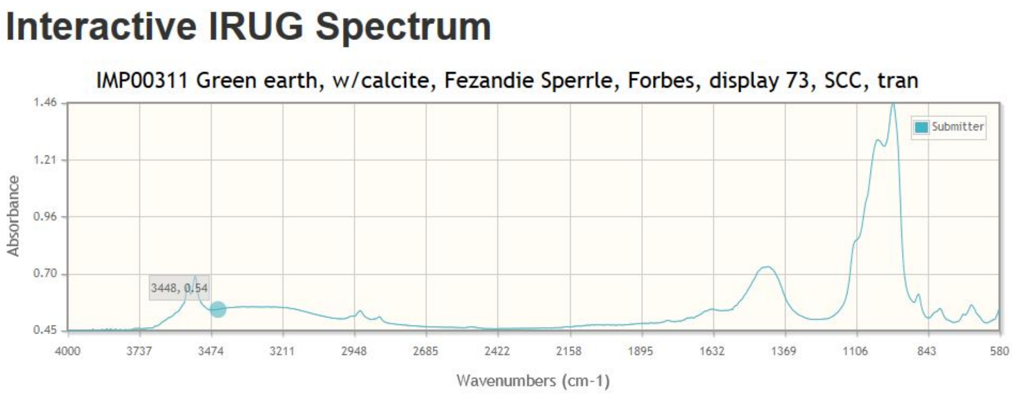


Appendix 6. FTIR spectrum from the pigments

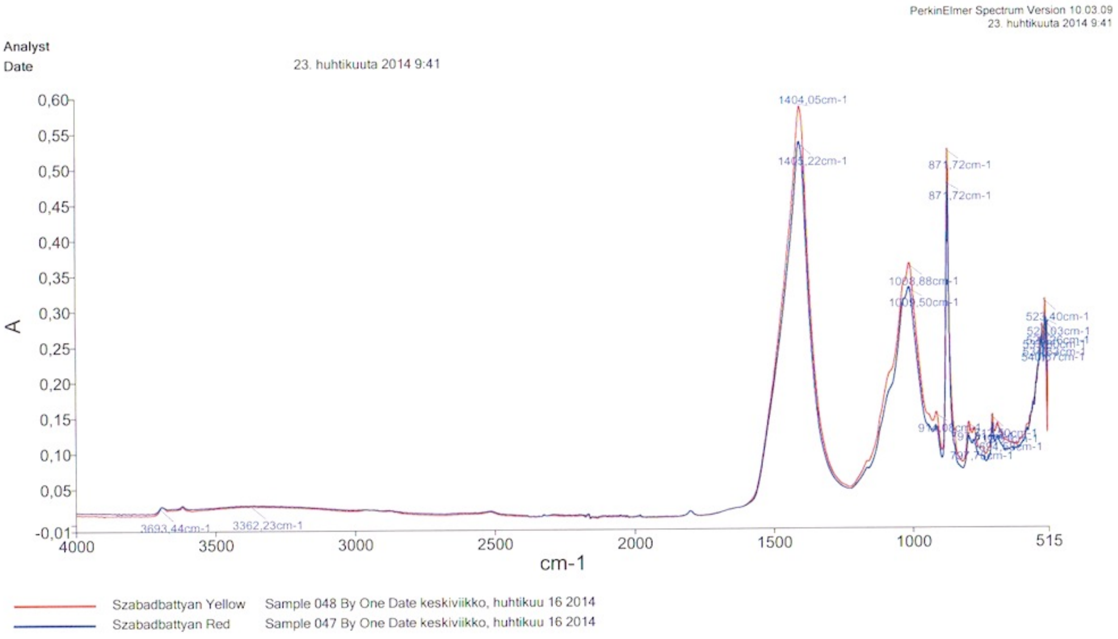
Absorbance FTIR-spectrum from the green sample.



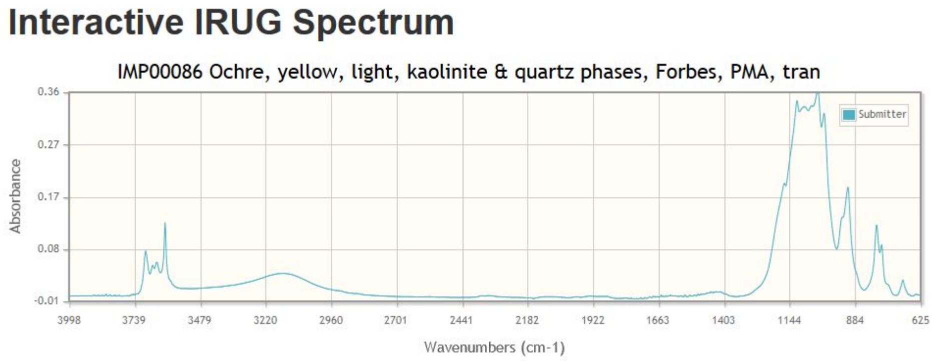
The reference spectrum: Green earth (IRUG.org).

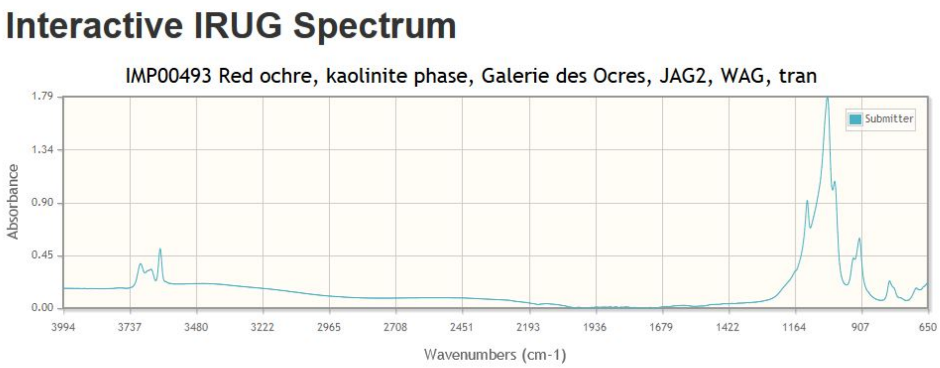


Absorbance FTIR-spectrum from the yellow and red sample.



The reference spectrum: Yellow ochre and Red ochre (IRUG.org).





Appendix 7. FTIR spectrum from the plaster

Absorbance FTIR-spectrum from the two layers of plaster with a reference calcium carbonate spectrum.