Conservation, restoration, reconstruction and display of fragments of wall paintings from Roman period, from the archaeological site Medijana near Niš

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1. Archaeological site

Archaeological site of Medijana is located near the city of Nis (Naissus), and is the place of birth of the Roman emperor Constantine the Great. The villa with a peristyle is the central and most interesting construction of the whole site. It contains mosaics and frescoes. The preserved fragments of its 4th century wall paintings testify to the glory and beauty of Roman painting, as the paintings on its walls were designed in such a way that they contributed to the historical ambience of each of the different rooms of the villa. Our present knowledge that all rooms of the villa were decorated with frescoes would not be possible without the use of the latest scientific techniques.

1.1. Archaeological excavations

Fragments of Roman decorative wall paintings, found during excavations carried out on the site of the northwest room W22, originate from the walls of that room. The fragments were found in excavations conducted in 2009 by the National Institute for protection of cultural monuments and were stored in the National...
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museum of Nis, in 2010. The room contained forty groups of fragments, with over twenty pieces of unstable mortar with painted layer, and over one thousand various fragments (Picture 1). The wall paintings collapsed for unknown reason (Picture 2). Based on the characteristic changes of pigments on the fragments, it may have been due to fire and the burning of the villa.

![Picture 2. Situation in situ (February, 2013)](image)

2. Situation in situ

The characteristic overlapping of some fragments protected the paint layer, creating a microclimate without oxygen and space for depositing of organic material and ground dust. Pigments were stable, while the mortar was very damaged. Stored fragments contained traces of floral growth and remains of plant roots. Also the paint layer of some fragments had been damaged in the shape of floral roots. Layers of dirt, dust, rodent faeces and char had been deposited on pigmented surface (Picture 3). During the destruction, the mortar layers were elastic and firm, so that the large dimensions of wall paintings were preserved even after destruction.
3. Storage and transport

The prepared fragments, wrapped in a layer of medical gauze, were placed in polyvinyl ethylene, and wooden containers filled with sand (granule size 0.5-1mm). The unsuitable transportation, organised by the concerned institutions, contributed to further damage to the fragments.

4. Situation after transport

The first contact with deposited material at the Faculty of Applied Arts was very difficult, because of the very complicated conditions of fragments. Most of them had been consolidated in situ by carboxy-methylcellulose facing. Some fragments had been consolidated using an unknown solution. Based on solubility in solutions of cethonic chemical functional groups, and based on consultations with associates who conducted the consolidation, Paraloid type synthetic resin was used. A few fragments were consolidated in the same manner on the back side, where the painted layer has been left unprotected.

5. Spectroscopic and technical analysis

As a consequence of full understanding of technological methods and possible toxicity of some pigments used in Roman wall paintings, a need for spectroscopic analysis has emerge. Documentation based on Greek and Roman resources, specifically Teophrast, Gaius Plinius Secundus and Marcus Vitruvius Polion, was the starting point for further research. The problem of characterization (identification) of the pigments, due to the unreliability of translations (of which many are free, or corrupted) has also emerged. However, it was agreed to make two types of analysis.

The first method of characterisation was XRF spectroscopy, and was carried out at “Vinca” Institute of Nuclear Science in Belgrade. The second method of analysis was micro-Raman spectroscopy, carried out at the Faculty of Physical
Chemistry of the University of Belgrade. Ten fragments were analysed, chosen according to color. Four results were interesting, and confirmed the assumptions.

5.1. Fragment no. 2

Hypothesis:
1. aerucca and chrysocolla (mineral malachite, copper pigments)
2. green chalk (iron-hydrosilicate)

Iron presence in the pigment pointed to green chalk, or medieval green earth.

5.2. Fragment no. 3

Hypothesis:
1. armenium (mineral azurite, copper-carbonate)
2. caerulleum (cyprorivaite, synthetic copper-silicate)

The dominant presence of copper confirmed the assumptions, but specific copper pigment could not be identified. Micro-Raman analysis confirmed that the pigment is caerulleum, because of the overlapping of the spectrum with the spectrum of pure caerulleum pigment.

5.3. Fragment no. 9

Hypotesis:
1. sillus (mineral hematite, iron-oxide)
2. auripigmentum (arsenic-sulphide)
3. sandaracus (lead-oxide)

Based on cold color tone and very shining gamma, the assumption that it was auripigmentum proved wrong. Spectrum, showing high peaks of iron and the small amount of lead proved that the pigment is sillus, with contamination of small amounts of lead. Traces of arsenic were not found.

5.4. Fragment no. 10

Hypothesis:
1. sinopius, rubricum (red iron-oxide)
2. rubeus sandaracus (lead-tetraoxide)
3. minni, minium (mercury sulphide)
Based on the presence of a big amount of mercury, as well as sulphur, the conclusion has been reached that the pigment is minium. This is also the most interesting result, because of the high price of minium, and an interesting data regarding the production and market information about this pigment.

5.5. Comparative analysis of fragment no. 10

Because of copper presence in both pigments, the final conclusion was undefined. Micro-Raman spectrum gathered from point Fr.3 and comparative spectrums of pure pigments available in databases led towards the conclusion that this pigment is caerulleum.

5.6. Photographs of samples under microscope (60x)

The samples were photographed under microscope (60x). Noticeable are different paint layers, damage traces, degradation processes and characteristic changes of pigments induced by burning.

6. Mortar cleaning and consolidation of the back surface

Since the very unstable mortar directly threatened the colored surfaces, cleaning and handling of fragments was highly unsafe (Picture 4). Cleaning of the back surface was carefully done with brushes (Picture 5). The consolidation is based on applying a few layers of Mowilith DM 6, 15% solution in water. After the drying of the consolidants, mortar fragments were joined and the cohesion of the carrier was achieved.

Picture 4. Difficult manipulating (February, 2013)
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7. Temporary mortar and the revealing of the surface

Processes that followed consisted of intensified strengthening of fragments. Temporary lime mortar was applied to the back of each archaeological composition, so that the colored surface could be revealed. After the removal of medical gauze, the true surface situation was discovered (Picture 6).

8. Colored surface cleaning

Cleaning of colored surfaces represent the most complicated action in conservation and restoration, because of irreversible decisions. These actions open
space for mistakes, even in the most respected institutions. Therefore, the cleaning of the layer containing pigments was conducted with great care. First tests was done with distilled water and than with organic solutions with high evaporation rate (ethyl alcohol and acetone). Based on test results, it was decided that the complete cleaning would be done with acetone (Picture 7 and 8).

![Picture 7. Cleaning of colored surface (February, 2013)](image)

![Picture 8. Probes of colored surface (February, 2013)](image)

9. Consolidation of fragments

Consolidation is conducted with three different consolidants. Mowilith DM 6 for mortar desagregation and high humidity induced lack of cohesion, Ledan TB 1 for cracks and lacunas, and methyl-cyanoacrylate for joining of related fragments (Picture 9). Firm and resistant for further processes, fragments become much easier to manipulate with.
10. Fragments reconstruction

Reconstruction of fragments has been based on four types of available information:

1. Position of fragments in situ (photo-documentation)
2. Documentation of archaeological excavations and in situ marks (drawings and markers)
3. Characteristic cracks and contact points
4. Specific characteristics of individual fragments (brush strokes etc.)

Although dedicated to analysis of documentation, the reconstruction was complicated and difficult (Picture 10). At the beginning, six groups of archaeological entities were defined and formed. In further operations, these six groups became six compositions of wall paintings. By introducing new carriers (extruded polystyrene) to which the fragments were adhered with lime mortar, the artefacts have been placed in the appropriate climate. This carrier is very light and portable, and can easily be removed.

Picture 9. Consolidation treatment (March, 2013)
11. Decorative mortar

Following the idea of minimal intervention, the areas surrounding the borders of fragment compositions have been left without retouch. The lines following the shapes of the depicted scenes have been marked off on decorative mortar (Picture 11). In three groups of fragments the decorative lime mortar has been made of refined lime putty and yellow carbonated breccia. The ratio is 3:1 in favour of breccia. In the other three, the colour of breccia has been modified with brick dust, as it is in the reference sources.
12. Retouching

Retouching with lime mortar, mixed with marble dust, was prepared and applied to consolidate lacunae (3-5 mm layer). Retouching has been carried out in *punteggiaro* and *trateggio* style (Picture 12 and 13). Considering the on site situation and dimensions of the fragments upon excavation, the final result was satisfying (Picture 13 and 14).
13. Display of fragments and hypothetical reconstruction of the villa

After the conservation and restoration treatment of the fragments, a few assumptions have been proved, such as the high quality of the pigments used, the likely appearance of the wall paintings and the historical ambience of the rooms of the villa, shedding more light on the glorious heritage of Constantine the Great.

*Picture 14. Final fragment 1 (May, 2013.)*

*Picture 15. Final fragment 2 (May, 2013.)*
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Picture 16. Final fragment 3 (May, 2013.)

Picture 17. Final fragment 4 (May, 2013.)
Picture 18. Final fragment 5 (May, 2013.)

Picture 19. Final fragment 6 (May, 2013.)
Acknowledgements

Thanks go to all associates and supporters of this project without whom the project would not have developed to this respectable level, with its interesting results and conclusions. Special gratitude goes to professor Radomir Samardžić, MSc, for his tact and patience in work on original samples. Special gratitude also goes to professor Ljiljana Damjanović, PhD, Faculty of Physical Chemistry, for her sincere support and for having made available the spectroscopic analysis of the samples. Our warm gratitude goes also to Maja Gajić-Kvaščev, PhD, for conducting XRF analysis, and to Danica Bajuk-Bogdanović, PhD, for conducting micro-Raman spectroscopy, as well as to Nemanja Smičiklas and Vladimir Bulajić, MSc, for making accessible the documentation from the site for the purposes of the project.

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