

WERE WALL PAINTINGS IN UNTERFERLACH AND FEISTRITZ AN DER DRAU CARRIED OUT BY THE OLDER VILLACH WORKSHOP? ANALYSIS OF MATERIALS AND TECHNIQUES

SCIENTIFIC PAPER

Anabelle Križnar

This paper is based on a presentation at the ICOM-CC Scientific Research Working Group Interim Meeting in Pisa, Italy, 7-8 October 2010.

Guest editor: Dr. Ilaria Bonaduce

Department of Art History, Faculty of Philosophy, University of Ljubljana, Askerceva 2, 1000 Ljubljana, Slovenia

corresponding author:
akriznar@us.es

The so-called "Older Villach Workshop" was an important painting circle in Carinthia in the south of Austria, of the first half of the 15th Century, founded by the master Friedrich from Villach (Friderik Beljaski). Several wall paintings have been attributed to it by art historians; however some attributions were doubtful. The present research was carried out to obtain more information on the materials and painting techniques, which would allow us to distinguish between works that are genuine and those made by various followers. All works were studied in situ, and subsequently, small samples of plaster and pigments were extracted from selected areas. These were studied using different instrumental techniques: optical microscopy, SEM-EDS, FTIR and XRD. The results showed important similarities and also differences between wall paintings, observed in the composition of plaster, the use of incisions, pouncing, preparatory drawings, colour modelling, the choice of pigments and the combination of painting techniques (a fresco, a secco, lime technique). These differences confirmed that two of the selected wall painting cycles were painted by two different masters, who were, however, closely related to Friedrich.

1 Introduction

The present research is the result of an interdisciplinary project carried out on a group of wall paintings from the first half of the 15th Century in Carinthia in the south of Austria, produced by the Older Villach workshop, and not previously studied in either Austria or Slovenia. This is why there is no reference literature available on the subject. On the other hand, intervention reports in the Archives of the Austrian Federal Office for the Care of Monuments (Bundesdenkmalamt) in Vienna or in the department of Carinthia in Klagenfurt (Landsdeskonservatorat für Kärnten) are very rare and contain little or no information on the materials and painting techniques applied in selected wall paintings. This workshop was founded by Friedrich of Villach (Friedrich von Villach, Friderik Beljaški) and was based in the town of Villach in Carinthia. It produced both wall and panel

received: 30.11.2011
accepted: 04.05.2011

key words:
Wall paintings, pigments, painting techniques, instrumental analysis



Figure 1: Older Villach workshop: *The altar painting with saints, Deutschgriffen* (around 1455).



Figure 2: Anonymous painter: *Crucifixion, Unterferlach* (1420-1425).

paintings, although few of either now survive. Several wall paintings have been attributed to it on the basis of art historic interpretation.¹⁻⁶

Among the most important wall painting cycles are those in the parish churches of Mariapfarr (1420-1425), Millstatt (signed and dated in 1428), St. Gandolf an der Glan and Deutschgriffen (choir after 1452, nave around 1455, Fig. 1), which were attributed to Friderik's workshop. They are all within 40 km from Villach, with the exception of Mariapfarr (ca. 100 km), which is in the Salzburg County. Within this radius there are also wall paintings in parish churches in Unterferlach (1420-1425, Fig. 2) and Feistritz an der Drau (ca 1440), which were attributed to Friedrich's workshop when discovered. Later on, several art-historic hypotheses appeared, arguing that the two works must have been painted by two different artists, who were however stylistically very close to Friedrich. It is possible that both of them started their career in the Older Villach workshop, but later on became independent masters.⁴⁻⁶

In order to confirm that these two paintings were really the work of independent artists and not Friedrich's workshop, all the previously mentioned wall cycles were selected for technical and material analysis. The main aim of this study was to examine the materials and painting techniques used in the production of these murals, with a particular focus on the composition of plaster, the quantity and cleanliness of lime and sand used, the nature of the sand grains, mixtures of binding media and aggregates, surface polishes, number of plaster layers, the use of *giornate* and possible applications of lime-wash. Secondly, the choice and combination of pigments and the selection of binding media and the way of their application to the painting surface were of interest. Not only materials applied in the selected paintings but also the process of the execution of every painting, starting from initial incisions, pouncing, through under-drawings and under-paintings to the final colour modelling, shadows, highlights and the use of different brushes, were subject to examination. This interdisciplinary research, which does not only take into consideration laboratory results, but also the style and painting technique of each mural, provides comprehensive information on the selected paintings and therefore makes it possible to draw comparisons.

2 Experimental

All paintings were first studied *in situ* to obtain information on plaster and pigments, and above all on the style and the painting procedures. By the naked eye and under raking light, the roughness of the painting surface could be observed, as well as the position of *giornate*. Incisions, pouncing, under-drawings, under-

paintings, the superposition of colour layers, details of final strokes and the selection of brushes were observed in detail, in order to identify characteristics and differences among paintings. Subsequently, small samples of plaster, pigments and colour layers were carefully selected and removed. Depending on their size and the analytical technique used, these samples were prepared either as powders, KBr pellets or as polished cross-sections in a resin. Cross-sections allow the study of different layers of plaster as the support and the painting itself, and can give important information not only on the structure and technique of the painting (*a fresco*, *a secco*, lime-wash), but can also provide identification of some pigments with characteristic morphology (azurite, green earth etc.). The analysis of samples was carried out using laboratory procedures and instrumental techniques commonly applied in materials characterization:⁷⁻¹¹ optical microscopy (OM), scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDX), Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD).

OM was carried out by means of a conventional reflected light microscope (Nikon model 115, with fibre optic illumination fitted to a Nikon Coolpix 5000 digital camera). SEM was undertaken using a JEOL JSM 5400 instrument. The cross-section samples were previously covered with a thin layer of Au. EDX microanalysis of these cross-sections was performed using the SEM equipment with an Oxford Link analyser with a Si(Li) detector, Be window, at 20 kV. For additional information concerning the plaster, the pigments and possible organic substances, FTIR spectra of the cross-sections were obtained with a FTIR Nicolet instrument, model 510. In some cases, 1 mg powdered sample and 400 mg KBr were mixed and ground, preparing pressed pellets used for the analysis by FTIR transmission spectroscopy. For plaster analysis, XRD was used. Selected samples were ground to a very fine powder and studied using a Siemens D-501 diffractometer, at 40 kV and 20 mA, with CuK α Ni-filtered radiation and speed 0.5°/min.

3 Results and Discussion

The results of analyses showed interesting similarities among the selected mural cycles, but also several important differences which helped to distinguish between the Older Villach workshop and the murals in Unterferlach and Feistritz an der Drau. This can be observed in the composition of plaster, but especially in the painting techniques used.

3.1 Plasters

The plasters used in the wall paintings directly attributed to Friedrich's workshop (those in Mariapfarr, Millstatt, St. Gandolf an der Glan and Deutschgriffen) are all made as a standard mixture of lime and sand. The XRD analyses show that they generally contain relatively low proportions of lime and high levels of sand, which is why they are not very consistent and tend to powder. The sand grains vary in form, colour and size from one location to another, which can be best observed on cross-sections. Sand was normally obtained in a location close to the church painting was being carried out, and therefore depends on the geological characteristics of the area.

In Mariapfarr (Fig. 3) there are mostly light square grains of quartz, in Millstatt and Deutschgriffen (Fig. 4) the sand grains are oval and dark brown, grey or black, while in St. Gandolf a mixture of both types of grains was found. In Mariapfarr, Millstatt and in the nave of Deutschgriffen the sand is well washed and clean, which was confirmed also by XRD analyses that indicated very low presence of clay and feldspars (Fig. 3). On the contrary, plaster in more complex

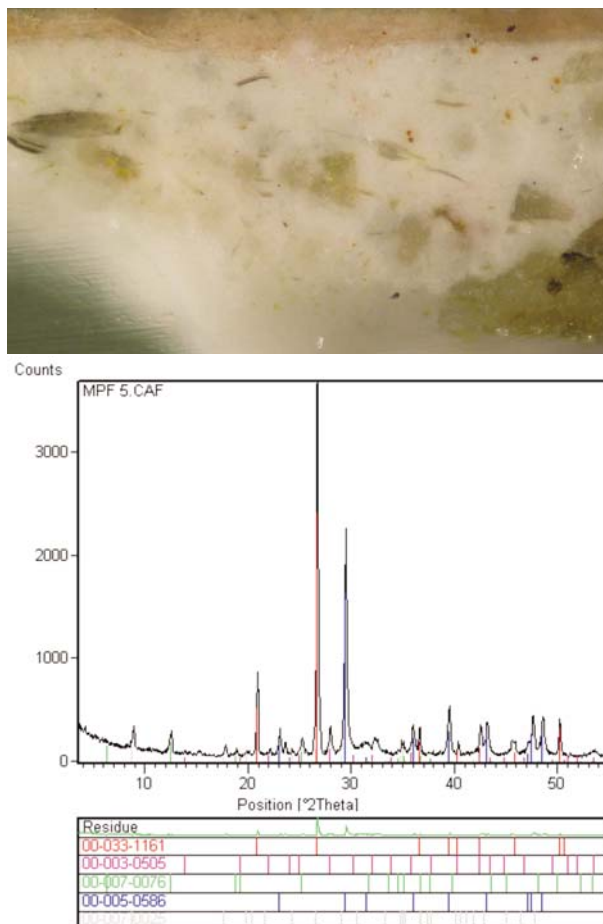


Figure 3: OM micrograph (x100) of a cross-section of the plaster and the colour layer: plaster of lime and sand; reddish colour layer *a fresco*. XRD pattern of the analysed sample shows a compound present (silica, anorthite, clinocllore, calcite, muscovite), from Mariapfarr.

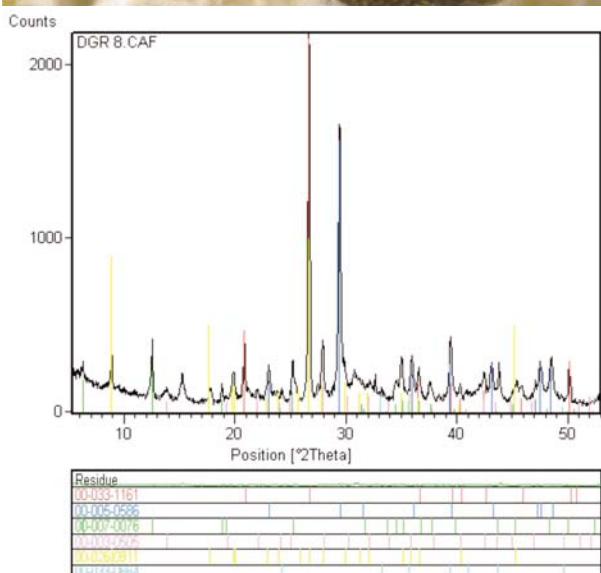
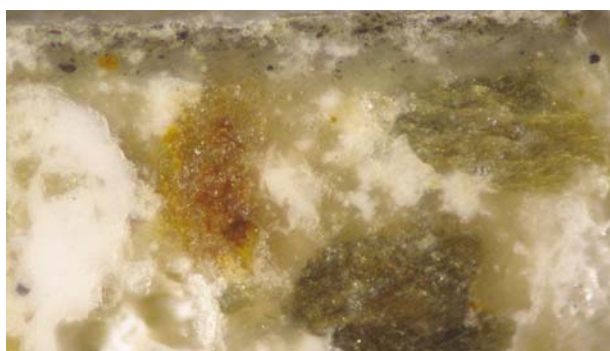


Figure 4: OM micrograph (x100) of a cross-section of the plaster and the colour layer: plaster of lime and sand; black colour layer *a fresco*. XRD pattern of the analysed sample shows a compound present (silica, calcite, clinocllore, anorthite, illite), from Deuschgriffen (choir).

murals carried out by an expanded workshop in St. Gandolf and in the choir of Deuschgriffen contains more impurities (mainly silicates such as anorthite, chlinocllore and muscovite, Fig. 4). Generally, the surface of all plasters in this group is well polished and smooth, as observed *in situ*. In this way it is well prepared for the painting layers. By polishing it, the pressure brings more lime to the surface, which helps the pigments applied *a fresco* to bind better. This procedure was well known in antique Rome, it can be found on several Italian Trecento paintings, but it is rarely found outside this area.¹²⁻¹⁵

Similar plaster made of lime and sand was used in Feistritz an der Drau (Fig. 5), however there is more lime than in the works of the previous group, as confirmed by XRD analysis. On cross-sections, dark and oval grains can be observed, but the general image of the plaster looks clean and clear. Practically no impurities were detected with XRD. Binding media and aggregates are thoroughly mixed together and the surface is well polished. In conclusion, the plaster is more solid and therefore of better quality.

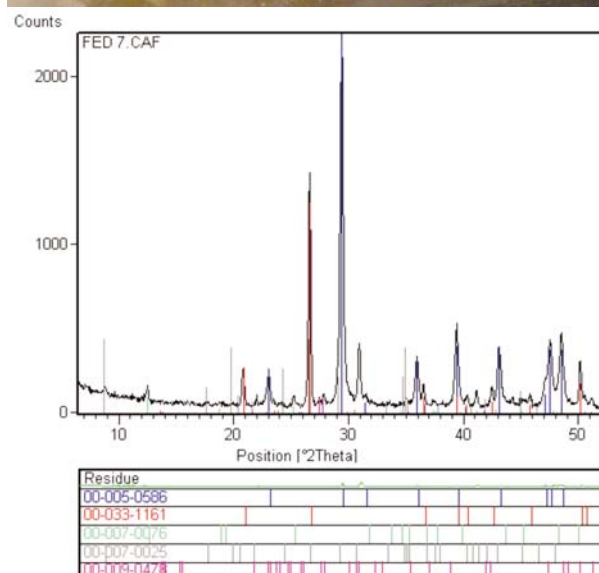


Figure 5: OM micrograph (x100) of a cross-section of the plaster and colour layer: plaster of lime and sand; a layer of lime-wash applied on a dry plaster; orange colour layer *a fresco*. XRD pattern of the analysed sample shows a chemical compound present (calcite, silica, clinocllore, muscovite, anorthoclase), from Feistritz an der Drau.

In contrast, the plaster found in Unterferlach has a different composition; it is made of lime and crushed marble or lime-rock as aggregate. Only a low quantity of sand was added (Fig. 6). No such plaster has been found in Friedrich's works. XRD analyses show the presence of dolomite, calcite and quartz, while there is practically no presence of clay, feldspars or other impurities. Such plaster is white and offers the perfect support for an *a fresco* painting, known from the Italian Trecento. Nevertheless, the binding media and aggregates are not thoroughly mixed together and the surface is not well polished, as in Friedrich's paintings.

In all selected mural cycles the plaster was applied on walls by *giornate*, usually using downward strokes from left to right, before being thoroughly polished and prepared for painting. Bigger scenes were divided into smaller portions which could be painted in one day. The *giornate* in murals of the Older Villach Workshop are normally smaller than those in Unterferlach and Feistritz an der Drau, showing an important difference in the work process.

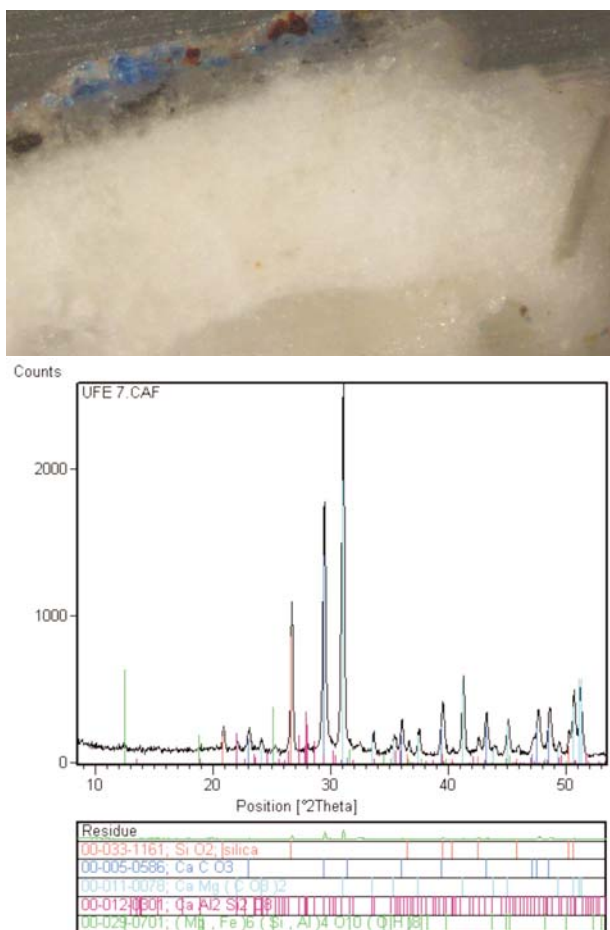


Figure 6; OM micrograph (x100) of a cross-section of the plaster and colour layer: plaster of lime, crushed marble or limerock and small quantity of sand; grey underpainting; blue azurite. XRD pattern of the analysed sample shows a compound present (silica, calcite, dolomite, anorthite), from Unterferlach.

3.2 Lime-wash

The lime-wash technique is very common in the regions north of the Alps due to the humid climate. It can be a painting technique covering the entire painted surface (mostly in the 13th and 14th centuries) or it can serve as a support to the *buon fresco*. In the second case it is applied only partially on the areas where the plaster was drying too quickly and the lime stopped acting as a binder. In this case, a fresh lime layer refreshed the painting surface and gave the artist more time to finish the work.¹²⁻¹⁵ Although it is a common technique in Carinthia, in murals made by the Older Villach workshop the lime-wash was very seldom found. A very thin layer of lime could be observed only locally under carnation, draperies or animals. Due to the composition of Friedrich's plasters explained above, which contain less binding media and therefore probably do not provide the painting surface with enough lime to bind the pigments well, the lime technique was expected to be found more often. Similar use of lime-wash was identified in Unterferlach, where a very thin layer of fresh lime was used under carnation. In contrast to



Figure 7: The thick layer of lime-wash falling from the wall together with overlaid paint layers, from Feistritz an der Drau.

Friedrich's works, in Unterferlach we deal with a high quality plaster, with an increased content of lime, which serves to bind the applied pigments. On the other hand, paintings in Feistritz an der Drau are made almost entirely on a thick layer of lime wash, which can be observed *in situ* by the naked eye and was later confirmed in cross-sections (Fig. 5). The areas of lime-wash are expansive; however the entire surface is not covered by it. There is more lime-wash on the southern wall, where it is falling from the walls in several areas, together with the paint layers (Fig. 7).

3.3 Incisions and pouncing

Another aspect of this research was the study of the work procedure applied by artists, from initial incisions and pouncing, through preparatory drawings and under-paintings to final colour modelling. Murals produced by the Older Villach workshop seldom show evidence of the use of incisions and pouncing. They were mostly used for borders, halos, belts or other decorative elements, in a few cases also a more complex drapery or the entire figure was incised. Lines are thin, shallow and not easily observed. In all paintings by this workshop a string was used to impress straight lines into fresh plaster for borders. In Mariapfarr, St. Gandolf and the choir of Deutschgriffen the rope was dipped in red colour, so the engraved marks could have been observed better.



Figure 8: Thin incisions for the drapery. Female saint from Unterferlach.

Similar thin and shallow lines were used by the Master of Unterferlach, who applied engravings more often than Friedrich. He incised the coats of all figures (Fig. 8), their attributes and their aureoles. However, there was no pouncing applied in this cycle of paintings, not even for aureoles, as well as there are also no signs of snapped rope for horizontal or vertical lines.

In contrast, incisions and pouncing are used abundantly in the murals in Feistritz an der Drau. The artist applied it for standard decorative elements, as well as for entire figures or draperies much more often than in other works studied. Such abundant examples of engraved figures and draperies suggest that the painter must have used pre-prepared patterns. The incisions are very strong, profound and wide (Fig. 7), totally different to those made by Friedrich's workshop or the Master of Unterferlach. On the other hand, the artist did not use a snapped rope for horizontal and vertical lines. Carrying out so many incisions must have required a considerable input of time, during which the plaster started to dry. This fact diminished the optimal time to paint *a fresco* and caused a greater use of lime-wash over the painting surface.

3.4 Under-drawings and under-paintings

In wall paintings by the Older Villach workshop, under-drawings were produced in yellow, red or black colour, often using a combination of two in a single mural cycle. One was usually applied for figures, while the other for straight lines, in cases where no rope has been used. In Millstatt the preparatory drawing on *intonaco* was executed in black, in Mariapfarr in yellow and red, in St. Gandolf in yellow (Fig. 11), while in Deutschgriffen red and black (Fig. 9) were chosen. Yellow colour is usually ochre, while, surprisingly, in Mariapfarr and in St. Gandolf lead-tin yellow was added. Red colour is red ochre, while black pigment is of organic origin, probably carbon black. In Unterferlach two colours were applied for under-drawings. The yellow can be found for the figures of the saints, while the black was used in the *Crucifixion*, which is considered to have been painted some years later. Yellow ochre and an organic black were used. In Feistritz an der Drau the painter used green earth and carried out his under-drawings in a dark green colour (Fig. 7), which is quite an exception in the region north of the Alps.

Under-paintings in all selected murals are mostly a uniform grey layer under blue azurite or green malachite, produced by mixing lime white and an organic black pigment (Fig. 6). It is a characteristic under-layer applied under azurite or malachite in wall paint-



Figure 9: Black under-drawing, from Deutschgriffen.

ings north of the Alps, known as *veneda* and described as early as the 13th century by Theophilus.^{12-15,17} On the other hand, in Italy the use of *morellone*¹²⁻¹⁶ is more common, which was not found in these Carinthian paintings. This under-layer gave more strength to the blue or green colour of these pigments. Azurite and malachite, expensive semi-precious minerals, were both usually ground to a very fine powder to get as much painting material as possible. In this process they lost colour intensity and were normally applied *a secco* over *veneda* or *morellone*. Nevertheless, being minerals, they are both acceptable to be used *a fresco* and can be found as such in many wall paintings all over Europe.^{12-15,18,19} Beside gray, yellow ochre was applied as under-painting, but only under browns or greens of soil or grass.

3.5 Colour modelling

In all selected cycles, colour modelling was produced by initial application of a basic light tone followed by the addition of darker shades, culminating in highlights and final details such as contours or facial elements. The figures, faces and draperies follow Friedrich's forms of the late international Gothic style (Fig. 1). The figures are slim, elegant and bend slightly backwards in the typical Gothic S-form. Female and young male faces are oval, with high forehead, straight nose, small and full lips and a small chin.



Figure 10: Different colour modelling of faces in murals in Mariapfarr (a), Unterferlach (b) and Feistritz an der Drau (c).

Older male faces have rougher features and darker carnation. Hands are elegant, slim and with long fingers. Secondary figures, mostly produced by apprentices, are of lower stylistic and technical quality, with less elaborate forms and faces. There is no fine transition between darker and lighter tonalities; the use of wider brush-strokes can be observed. However, they all still follow Friedrich's style.

There are several details typical for Friedrich's workshop and can provide a means of determining the authorship of a painting. Among the most important ones are a thin red line for lower eyelids, and a thick brown line for the upper eyelids or grey shadows for carnation (Fig. 10a). These details can be found in all paintings attributed to the Older Villach workshop, but they are not used in Unterferlach and in Feistritz. The faces in Unterferlach are more oval and pale; probably the upper layer of modelling has fallen off. There is the characteristic thin red line, but it is used for the entire eyelid contour and not only for the lower one (Fig. 10b), as well as the brown line. However, the modelling is very fine and the use of thin brushes for *tratteggio* effect can be observed, as in Friedrich's paintings. The figures in Unterferlach are even slimmer, conserving the characteristic S-line, while the draperies fall down in heavier folds. Figures in Feistritz an der Drau are more corpulent and not as elegant and the S-line is not as pronounced. Faces (Fig. 10c) are rounder, carnation is darker, eyes are narrower, lips are thinner and the modelling is less precise. There are no red lines for eyelids, but the painter did apply strong brown lines for the upper eyelids. No gray shadowing can be observed. The use of fine brushes is very rare, and the artist painted mostly in wider brushstrokes, which is why there are no fine transitions between darker and lighter tonalities. All these details in the modelling reflect the artist's style and demonstrate an important difference in his hand, as pointed out already by some art historians.⁴⁻⁶

3.6 Pigments and binding media

The Older Villach workshop applied mostly natural inorganic pigments, earths and minerals, well suited to a *fresco* painting (Table 1):^{12-15, 18-20} lime white (CaCO_3), yellow ($\text{Fe}(\text{OH})_3$) and red ochres (Fe_2O_3), natural or burned umbra ($\text{Fe}_2\text{O}_3+\text{MnO}_2$), green earth ($\text{K}\cdot\text{Mg}(\text{Fe},\text{Al})\text{SiO}_2\cdot 3\text{H}_2\text{O}$), green malachite ($\text{CuCO}_3\cdot\text{Cu}(\text{OH})_2$), blue azurite ($2\text{CuCO}_3\cdot\text{Cu}(\text{OH})_2$),

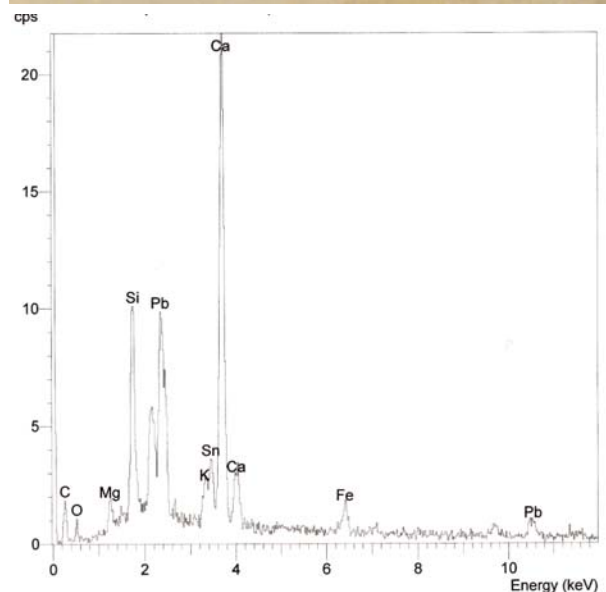


Figure 11: OM micrograph (x200) of a cross-section of a plaster and colour layers sample. Under-drawing carried out with yellow ochre (Fe) and lead-tin yellow (Pb, Sn); green earth (K, Mg, Si, Fe) in the upper layer. EDX of the under-drawing showing the presence of Pb-Sn yellow. From St. Gandolf an der Glan.

and occasionally cinnabar or vermilion (HgS). Pigments were identified mostly with SEM-EDX on the basis of characteristic chemical elements (Fig. 11) and in some cases also with FTIR that showed silicate and carbonate groups. There was also an organic black pigment used, probably carbon (high C peaks in EDX). Cinnabar (or its synthetic version vermilion)²⁰ was confirmed only in Mariapfarr, while malachite in Mariapfarr and St. Gandolf. Other pigments, including the expensive azurite, were found in all studied locations. Lead pigments were also detected, which are not suitable and therefore not common for a fresco painting.^{12-15,18-20} As mentioned above, lead-tin yellow (Pb₂SnO₄) was used in the yellow under-drawing in Mariapfarr and St. Gandolf (Fig. 11), and was also found on the surface in Deutschgriffen, while other lead based pigments were applied on some aureoles. There could have been no samples taken from those areas, but the presence of lead pigments can be suspected by their characteristic chemical changes to black due to sulphur-containing pollutants. It is not possible to confirm whether the use of lead pigments on the surface is original or if it is a later addition; nevertheless lead-tin yellow is surely part of the original Friedrich's palette.

In Unterferlach the choice of pigments is very similar (Table 1), however no malachite was found. It is, nevertheless, the only example besides Mariapfarr where cinnabar/ vermilion was confirmed (Fig. 12). The presence of lead pigments can be suspected due to their surface darkening, not only on aureoles (Fig. 10b), but also on some draperies. However, no samples could have been taken to prove the hypothesis.

Other lead-based pigments are suspected on the basis of blackening of some areas (due to the presence of S), though samples were not collected from those areas. The same situation can be observed as well in Feistritz an der Drau. They could be original or a later addition as part of a restoration work; in any case they were applied on a dry plaster as final details. The original pigments selected by the painter are earths and minerals (Table 1), including azurite and malachite (Fig. 13). There is no cinnabar/ vermilion present, but an organic black pigment was used for final details.

The principle binding medium for all studied murals is lime from fresh plaster, identified with high Ca peaks in EDX and high carbonate peaks (around 1440 cm⁻¹) in FTIR results. This could be also observed in several stratigraphic sections that allow us to confirm that the basic painting technique was a fresco, as discussed in the next paragraph. For the application of azurite and malachite over *veneda*, for lead pigments and for final details of the modelling carried out *a secco*, some organic binders (egg yolk, casein or animal glue) must have been used. However analysis by

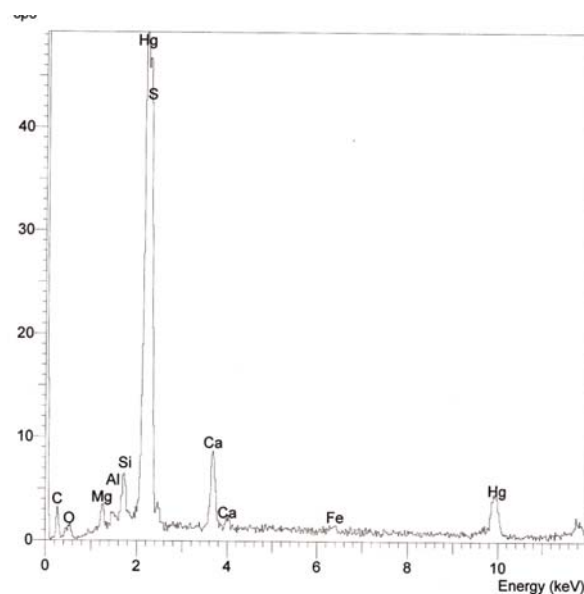


Fig. 12. EDX of a powdered red pigment sample taken from St. Mary Magdalene's red drapery. Hg peaks reveal the use of vermilion. From Unterferlach.

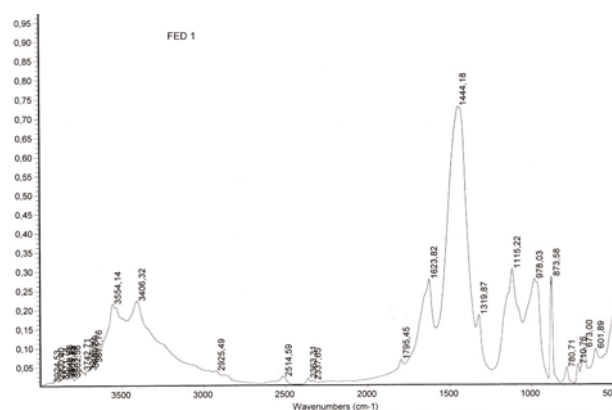


Figure 13: FTIR spectrum of a green pigment prepared as a KBr pellet (resolution 4 cm⁻¹; number of scans: 100). Peaks showing carbonates (1444 cm⁻¹, 873 cm⁻¹) and silicates (1115 cm⁻¹) identify the pigment as a mixture of malachite and green earth.

FTIR of pigment samples where their presence was expected, did not give any results that would allow their identification.

3.7 Painting techniques

The Older Villach workshop used mainly a fresco technique (Fig. 3, 4, 11). This can be observed very well on cross-sections, where there is no solid line between the plaster and the first colour layer. Lime from the plaster penetrates upwards through the process of carbonization, surrounding pigment particles.^{10,12-14} Friedrich is considered a master of *buon*

	Lime + Sand Plaster	Lime + Marble Plaster	Lime - Wash	Thin Incisions	Wide Incisions	Rope	Underdraw in Yellow	Underdraw in Red	Underdraw in Black	Underdraw in Green	Underpaint in Grey	Underpaint in Yellow
Mariapfarr	X		X	X		X	X	X			X	X
Millstatt	X		X	X		X			X		X	X
St. Gandolf	X			X		X	X	X			X	
Deutschgriff	X			X		X		X	X		X	
Unterferl		X		X			X		X		X	
Feistritz	X		X		X					X	X	
	Lime White	Yellow, Red Ochres	Vermilion	Green Earth	Malachite	Azurite	Organic Black	Lead Pigments	Lead-Tin Yellow	Fresco Buono	Lime Technique	a Secco
Mariapfarr	X	X	X	X	X	X	X		X	X	X	X
Millstatt	X	X		X		X	X	X		X	X	X
St. Gandolf	X	X		X	X	X	X	X	X	X		X
Deutschgriff	X	X		X		X	X	X	X	X		X
Unterferl	X	X	X	X		X	X	X		X		X
Feistritz	X	X		X	X	X	X	X		X	X	X

Table 1: Comparison of all studied wall paintings, considering the composition of plasters, the process of technical execution, pigments and painting techniques applied.

fresco in Carinthia and therefore wall paintings made by his workshop are still quite well preserved. Lime-wash was applied very seldom in very thin layers, as an auxiliary technique. Only final details and the application of azurite over *veneda* were carried out *a secco*. Although the plaster quality was poor, it was overcome by a very good technical execution in which the painters managed to carry out the daily work on time.

Even better *fresco* technique can be observed on the paintings in Unterferlach (Fig. 6), where only some final modelling and details made *a secco* are lost. The high quality plaster with almost no lime-wash applied show a very good artist. As in Friedrich's works, only azurite, last details and final contours were carried out on already dry plaster. Also the mural cycle in Feistritz and der Drau is basically *a fresco* painting, where incisions, pouncing, under-drawings and under-paintings were carried out on a fresh plaster. However, extensive preparatory work took too much time, the *giornate* were too big and the plaster started to dry before the actual modelling could start. The painter had to refresh the surface with lime-wash on several occasions, which is why the lime technique has a more important role in these murals. This can be well observed on a cross-section (Fig. 5) where a line between the plaster and the lime-wash is clearly seen. The plaster was too dry and the constituent lime could not penetrate to the upper layer, hence it stopped serving as a binder. This role was taken by the lime wash, which penetrated through the colour layer and bound the pigments. A much bigger part was also finished *a secco* with the help of an organic binder, which could also not have been identified with FTIR. Many final details have been lost and paint layers and lime-wash are delaminated in many areas,

which makes this painting in the worst conservation state among those in this study (Fig. 7). In conclusion, we cannot talk about pure *fresco* in any of these cases. However, the *fresco* part in the works of the Older Villach workshop and in Unterferlach is very high. The majority of the work was finished on the fresh plaster, with only small additions of lime-wash and on a dry surface. However, lime and *a secco* technique are present in much higher proportion in the murals in Feistritz, while on the fresh plaster only preparatory works could have been carried out.

4 Conclusions

The so called Older Villach Workshop was an important painting circle in Carinthia of the first half of the 15th Century, which carried out mostly wall paintings. Several murals have been attributed to it by art historians, however the authorship of two of them was in doubt. The aim of the present study was to obtain information on painting materials and techniques used in selected murals, in order to confirm/reject the hypotheses.

The major difference can be seen in the composition of plasters, which in Unterferlach is made of lime, crushed lime-rock or marble and only small amounts of sand, in Feistritz of high quantity of lime and sand, while Friedrich's plasters are poor in binder and contain a higher proportion of sand. The surfaces of the latter are well polished, as are those in Feistritz, but the surface in Unterferlach is rougher. Friedrich and the Master of Unterferlach applied the lime technique very seldom, while the Master of Feistritz had to use it often and on more extensive areas, due to bigger

giornate and due to a lot of time spent on preparation work such as incisions and under-drawings.

In the works of the Villach workshop, thin and shallow incisions were used only for decorative elements and rarely for figures or draperies, and pouncing was applied only for aureoles, belts and attributes. In Unterferlach all draperies are finally engraved in fresh plaster, but there is no pouncing. In contrast, the master of Feistritz used wide and deep incisions and pouncing for numerous decorative elements. The modelling in Friedrich's paintings is very fine; he combined wide and thin brushes to obtain soft transitions between lights and shades, as can also be observed in Unterferlach. But the colour modelling of Master of Feistritz is less precise.

Although figures in all murals are stylistically similar and follow the late gothic style, there are considerable differences between all three painters/ workshops. They can be appreciated in the form of more or less elegant figures and especially in the faces, which differ in the colour of carnation, and the form of eyes, nose and lips. The typical Friedrich's elements such as a thin red line for the lower eyelid, a strong brown line for the upper eyelid or light grey shading can be found neither in Unterferlach nor in Feistritz.

Also the conservation conditions are different. Paintings in Mariapfarr, Millstatt, St. Gandolf an der Glan and Deutschgriffen, as well as those in Unterferlach, are still quite well preserved, while those in Feistritz an der Drau show loss of paint and lime-wash layers. There is no pure fresco painting; in all cases the artist combined the basic fresco technique with lime and *a secco* techniques. However, the ratios of these are quite different.

On the bases of observations *in situ* and of analytical results of extracted samples it could be confirmed that paintings in Unterferlach and in Feistritz an der Drau were not carried out by Friedrich's workshop, but by two different artists/workshops, although stylistically closely related.

5 Acknowledgements

The support of CSIC Thematic Network of Cultural Heritage is acknowledged.

6 References

1. E. Bacher, *Mittelalterliche Wandmalereien, Funde 1959–69*, ÖZKD, 1969, **23**, 120-155.
2. J. Höfler, *Die Gotische Malerei Villachs, Bd. 1, Neues aus Alt-Villach*, 19. Jahrbuch des Stadtmuseums, Museum der Stadt Villach, Villach 1981.

3. J. Höfler, *Die Gotische Malerei Villachs, Bd. 2, Katalog, Neues aus Alt-Villach*, 19. Jahrbuch des Stadtmuseums, Museum der Stadt Villach, Villach 1982.
4. J. Höfler, *Einige Gedanken zum Meister Friedrich und seiner Werkstätte anlässlich der neuen Ergänzungen seines Oeuvres*, in: F. Nikolasch, Ed., *Symposium zur Geschichte von Millstatt und Kärnten*, s. l.: s. n., 1998, pp. 2-11.
5. F. Kirchweger, *Wandmalerei: Aspekte der Technik und Erhaltung*, in: G. Brucher, Ed., *Geschichte der Bildenden Kunst in Österreich. Gotik, Bd. 2.*, Prestel Verlag, München, 2000.
6. G. Biedermann, K. Leitner, *Gotik in Kärnten. Kunstgeschichte Kärntens*, Styria, Klagenfurt, 2001.
7. F. Mairinger, *Naturwissenschaftliche Untersuchungen an Wandmalereien*, Historische Technologie und Konservierung von Wandmalerei, Verlag Paul Haupt, Bern, 1985.
8. M. Matteini, A. Moles, *Sienza e restauro. Metodi di indagine*, Nardini, Firenze, 1994.
9. A. Palazzi, *Analisi chimica per l'arte e il restauro: Principi, tecniche, applicazioni*, Nardini editore, Fiesole, 1997.
10. M. L. Gómez, *La restauración: Examen científico aplicado a la conservación de obras de arte*, Instituto del Patrimonio Histórico Español, Cátedra, Madrid, 2000.
11. K. Janssens K, R. Van Grieken, Eds., *Non-destructive micro-analysis of Cultural Heritage materials*, Elsevier, Amsterdam, 2004.
12. A. Knoepfli, O. Emmenegger, M. Koller, A. Meyer, Eds., *Reclams Handbuch der künstlerischen Techniken*, I–II, Phillip Reclam Jun., Stuttgart, 1990.
13. P. Mora, L. Mora, P. Philippot, *La conservazione delle Pitture Murali*, Editrice Compositori, Bologna, 2001.
14. A. Križnar, *Slog in tehnika srednjeveškega stenskega slikarstva na Slovenskem*, ZIFF, ZRC SAZU, Ljubljana, 2006.
15. K. Wehlte, *Werkstoffe und Techniken der Malerei*, Urania, Stuttgart, 2005.
16. M. Serchi, Ed., *Cennino Cennini, Il Libro dell'arte*, Felice le Monnier, Firenze, 1999.
17. Theophilus, *Schedula diversarum atrium*, A. Ilg, Ed., Verlag Edelberg, Wien, 1874.
18. G. Montagna, *I pigmenti. Prontuario per l'arte e il restauro*, Nardini editore, Firenze, 1993.
19. E. West Fitzhugh, R. L. Feller, A. Roy, B. Berrie, Eds., *Artist's pigments. A Handbook of their history and characterisation*. National Gallery of Art, Oxford University Press, Washington, New York, Oxford, 1987-2007.
20. N. Eastaugh, V. Walsh, T. Chaplin, R. Siddall, *Pigment Compendium: A Dictionary of Historical Pigments*, Elsevier, Amsterdam, Boston, Heidelberg, London, New York, Oxford, Paris, San Diego, San Francisco, Singapore, Sydney, Tokyo, 2008.