

RELATIONSHIPS BETWEEN PLASTER COATS IN ROMAN WALL PAINTINGS (MILAN – ITALY)

Abstract

Intonaci dipinti provenienti da tre scavi milanesi, effettuati dalla “Soprintendenza Archeologica della Lombardia”, sono stati esaminati mediante metodi petrografici per individuarne le caratteristiche ed effettuare confronti tra materiali con diversa datazione. Si tratta di intonaci datati dal primo al quarto secolo della nostra era, realizzati mediante strati di malta sovrapposti e strati pittorici colorati con pigmenti. Il carattere più significativo è la composizione dell’aggregato dei diversi strati e soprattutto degli strati che supportano lo strato pittorico, composizione che varia (cristalli di calcite o cristalli di quarzo o sabbia silicatica) al variare del periodo di fabbricazione, stabilito secondo metodologie archeologiche. Anche la preparazione dello strato pittorico varia in maniera sensibile: dall’applicazione diretta sullo strato di finitura all’applicazione su di un sottile supporto di composizione specifica (cristalli di calcite). L’estensione delle indagini ad altri siti del territorio lombardo permetterà di raggruppare le caratteristiche degli intonaci e le tecniche di preparazione del dipinto secondo il periodo di fabbricazione.

1. Introduction

The study of the plaster coats supporting the Roman wall paintings is an important step in understanding the production techniques used in the course of time; the knowledge of these techniques must be linked to the archaeological categories based on the stylistic patterns of the painting.

The making of the painted plasters has been reported by Latin authors (*Vitruvius*, *Plinius Secundus*) describing the preparation of mortar, the plaster made of multiple coats of mortar, the use of sand for the inside coats, the use of marble powder for the outside coats and the different pigments useful for the wall paintings. The studies on Roman painted plasters have pointed out that some characters were widespread in the Roman province¹, partially matching the Latin authors’ rules: the use of multiple coats of lime mortar, the change of the aggregate composition between the coats and the use of a small number of inorganic pigments. These features were also found on many sites of the present-day territory of Lombardy²: during Roman times there were two *regiones* in this territory called *Venetia* for the eastern part and *Transpadana* for the western one.

The archaeological excavations, carried out at various Milan sites by the “Soprintendenza Archeologica della Lombardia” in the last two decades, uncovered a huge amount of plaster coming from wall paintings. Unfortunately, almost all these plasters were found in rubble layers containing different materials with various provenances.

The present study points out the relationship between plaster coat features (the mineralogical composition of the binder and of the aggregate of each coat, the coat thickness, the pigments’ composition and the application method) and their possible relation with the production period. The dating method, based on the patterns of the painting, could be uncertain in some cases because of the small size of these plaster fragments and the mixing of the provenances.

¹ Béarat 1996; Béarat *et al.* 1997; Sciuti *et al.* 2001, Baraldi *et al.* 2006.

² Bugini – Folli, 1997; Mariani *et al.* 2005.

2. Materials and methods

A considerable number of plaster fragments of Roman wall paintings was analysed by petrographic methods in order to investigate the mortar components and the technique used to apply the painting. The analytical methods used were: optical microscopy on a thin section for the aggregate mineralogy and texture and an X-ray diffraction for the binder composition. These methods were chosen for analysis, according to the great variability of plaster compositions and also to save time and money. The pigments were analysed by X-ray diffraction and in some controversial cases additionally by EDS scanning electron microscopy.

3. Sampling sites

The painted plaster came from three Roman *domus* of Milan (ancient *Mediolanum*) now located in: piazza Fontana³, piazza Meda⁴ and via Correnti⁵. The *domus* were located under buildings (Fontana and Correnti) or under the paving of a square (Meda) and in all cases the archaeological remains were destroyed after the excavations in order to build a hotel (Fontana) or an underground car parking (Meda, Correnti). The plasters were found in pieces, at the most a few decimetres large, in rubble layers used as wall foundations (Fontana) or as a basin filling (Correnti, Meda A–B). In one case the plaster remained *in situ* and some pieces were found still attached to their masonry (Meda C).

The examined samples come from a selection of plaster fragments recovered during the excavations and compared on the basis of macroscopic features.

4. Results

The plasters were always made of superimposed coats and they are called, starting from the masonry, “render” coat (i), “floating” coat (ii) and “finishing” coat (iii); the grain-size of the aggregate is always decreasing from the render coat to the finishing one. The painted film (v) containing inorganic pigments can lie on a thin support layer (iv) or directly on the finishing coat (iii).

Binder composition, aggregate composition, coat thickness, coupling of plaster coats and application of painted film were investigated as the features useful to make comparisons among the plasters.

4.1 Site piazza Fontana

Group A (before the third quarter of the 1st Century AD)

A1 (US 120/T, US 116).

Single coat plaster with painted film.

(v) Painted film: grey pigment (lamp black).

(iv) Support layer: white, 0,5 mm thick, lime binder with calcite crystals.

(iii-i) Render-finishing coat: whitish, 19 mm thick, fine grain-size, lime binder with quartz-silicate aggregate.

A2 (US 103, US 103/c.17, US 119).

Double coat plaster with painted film.

(v) Painted film: black pigment (lamp black).

(iv) Support layer: white, 0,5 mm thick; lime binder with calcite crystals.

(iii) Finishing coat: grayish, 14 mm thick, irregular grain-size, lime binder with quartz-silicate aggregate.

³ Ceresa *et al.* 2007.

⁴ Pagani 2009.

⁵ Pagani 2004.

- (i) Render coat: brownish, 13 mm thick, irregular grain-size, lime binder with quartz-silicate aggregate.

A3 (US 120)

Double coat plaster with painted film.

- (v) Painted film: red pigment (cinnabar).
- (iv) Support layer: white, 0,5 mm thick; lime binder with quartz-silicate aggregate.
- (iii) Finishing coat: greyish, 20 mm thick, fine grain-size, lime binder with quartz-silicate aggregate.
- (i) Render coat: whitish, 14 mm thick, medium grain-size, lime binder with quartz-silicate aggregate.

Group B (US 40, US 44 – first decade of the 1st Century AD)

Double coat plaster with painted film.

- (v) Painted film: black pigment (lamp black), 0,05 mm thick.
- (iii) Finishing coat: whitish, 11 mm thick, fine grain-size, lime binder with quartz crystals aggregate (size mm 0,1 – 3,0).
- (i) Render coat: brownish, 15 mm thick, medium grain-size, lime binder with silico-carbonate sand (average size mm 1,0) aggregate.

4.2 Site piazza Meda

Group A (US 1543)

Double coat plaster with painted film (i⁺-v⁺, second half of the 1st Century AD) superimposed to another double coat plaster with painted film (i^{*}-v^{*}, before the second half of the 1st Century AD).

Up

- (v⁺) Painted film: 0,04 mm thick, red pigment (ochre).
- (iv⁺) Support layer: pinkish, 0,4 mm thick, lime binder with calcite crystals aggregate (size 0,2 mm).
- (iii⁺) Finishing coat: whitish, 0,8 mm thick, lime binder with silicate sand aggregate (size 0,4 mm).

Down

- (v^{*}) Painted film: 0,3 – 0,1 mm thick, red pigment (ochre), with some very fine calcite crystals.
- (iii^{*}) Finishing coat: whitish, 10 mm thick, lime binder with silico-carbonate sand aggregate with crushed terracotta (size mm 2,0 – 6,0).
- (i^{*}) Render coat: brownish, 20 mm thick, lime binder with crushed terracotta (size mm 0,4 – 3,2), chert and polycrystalline quartz aggregate.

Group B (US 3137, second half of the 1st Century AD)

Triple coat plaster with painted film

- (v) Painted film: discontinuous, 0,03 mm thick, red pigment (ochre).
- (iii) Finishing coat: white, 3,0 mm thick; lime binder, rare quartz crystals as aggregate (size mm 0,4).
- (ii) Floating coat: whitish, 8 0 mm thick, lime binder and aggregate made of silicate sand (size 0,4 – 1,6 mm).
- (i) Lower coat: brownish, 15 mm thick, lime binder and aggregate made of silicate sand (size 0,4 – 4,0 mm) and crushed terracotta (size 0,6 mm).

Group C (US 3137, first half of the 4th Century AD)

Triple coat plaster with painted film

- (v) Painted film: discontinuous, 0,04 mm thick; greenish pigment (green earth).
- (iii) Finishing coat: white, 3,0 – 3,5 mm thick; lime binder, rare quartz crystals as aggregate (size 0,4 mm).
- (ii) Floating coat: whitish, 9,0 mm thick, lime binder, aggregate made of silicate sand with crushed terracotta (size 0,5 – 3,4 mm).
- (i) Lower coat: brownish, 15 mm thick, lime binder; aggregate made of silicate sand with crushed terracotta (size 0,9 – 2,2 mm).

4.3 Site via Correnti

Group A (US 320, 1st Century AD; US 276, 2nd Century AD; US 219, 3rd Century AD).

Double coat plaster with painted film

- v) Painted film: red or yellow pigment (ochre), green pigment (green earth).
- iii) Finishing coat: greyish, 2–3 mm thick, fine grained, silico-carbonate sand (size 0,1 – 1,2 mm) with quartz crystals, limestone and gneiss clasts, crushed terracotta.
- i) Render coat: brownish, 12–20 mm thick, coarse grained, silico-carbonate sand (size 0,2 – 3,8 mm) with quartz crystals, limestone and gneiss clasts.

Group B (US 276, 2nd Century AD)

Double coat plaster with painted film

- v) Painted film: yellow pigment (ochre).
- iii) Finishing coat: whitish, 1 mm thick, fine grained, calcite crystals (size 0,04–2 mm) and rare quartz crystals.
- i) Render coat: greyish, 12 mm thick, medium grained, silico-carbonate sand (size 0,2 – 4,0 mm) with quartz crystals, limestone and gneiss clasts.

Group C (US 276, 2nd Century AD)

Double coat plaster with painted film

- v) Painted film: greenish pigment (green earth).
- iii) Finishing coat: whitish, 2 mm thick, fine grained, limestone clasts (size 0,4 – 1,0 mm), calcite crystals (size 0,04 – 2,5 mm) and rare quartz crystals (size 0,2 – 2,0 mm).
- i) Render coat: greyish, 13 mm thick, medium grained, silico-carbonate sand (size 0,2 – 2,0 mm) with quartz crystals, limestone and gneiss clasts, crushed terracotta.

5. Discussion

The most interesting feature of the examined Roman plasters is the aggregate composition (sand with silicate or carbonate clasts, calcite crystals, quartz crystals): the variations of the composition are, in many cases, in accordance with a variation of the production period. The binder composition, on the contrary, does not allow any significant distinction because of the persistence of the use of magnesian lime; the differences of the binder structure (homogeneous or containing white lumps) are not suitable to make distinctions either. Another important feature is the application method of the painted layer: either directly on the finishing coat or on a support layer. The thickness of the coats supporting the painted layer is rather linked to the type of coat than to the making period: the support layers (iv) are very thin (about 0,5 mm), the finishing coats (iii) supporting the painting containing calcite crystals are thinner than the coats containing quartz crystals. The pigments are also not suitable to make a distinction and, therefore, the sampling does not represent the whole palette used by Roman painters. For the same reason, it is impossible to relate the use of one kind of pigment to the painting application method.

5.1 Site Fontana

- Group B, first decade of the 1st Century AD – Very thin painted film (v) laying directly on a finishing coat (iii) with quartz crystals; render coat (i) (sometimes lacking) with silico-carbonate sand.
- Group A, before the third quarter of the 1st Century AD – Painted film (v) laying on a support (iv) with calcite crystals; finishing (iii) and render coat (i) with quartz-silicate sand.

The different application technique of the painted film is noticeable, together with the use of calcite crystals in the support layer aggregate.

5.2 Site Meda

- Group A up, second half of the 1st Century AD – Painted film (v⁺), support layer (iv⁺) with calcite crystals, finishing coat (iii⁺) with silicate sand.
- Group A down, before the second half of the 1st Century AD – Painted film (v*) with very fine calcite crystals, finishing coat (iii*) with silico-carbonate sand and crushed terracotta, render coat (i*) with crushed terracotta.
- Group B, second half of the 1st Century AD – Painted film (v) lying on a finishing coat (iii) with rare quartz crystals, floating coat (ii) with silicate sand, render coat (i) with sand and crushed terracotta.
- Group C, first half of the 4th Century AD – Painted film (v) lying on a finishing (iii) coat with quartz crystals, floating and render coats (ii-i) with silicate sand and crushed terracotta.

The presence of two superimposed plasters (Group A) with different features is noticeable together with two different painting application methods in the same time period (Group A and Group B) and with the use of crushed terracotta in the render coats.

5.3 Site Correnti

- Group A, 1st–2nd–3rd Centuries AD – Painted film (v) lying directly on a finishing coat (iii) with fine-grained silico-carbonate sand; render coat (i) with coarse-grained silico-carbonate sand.
- Group B, 2nd Century AD – Painted film (v) lying directly on a finishing coat (iii) with calcite crystals and rare quartz crystals; render coat (i) with silico-carbonate sand.
- Group C, 2nd Century AD – Painted film (v) lying directly on a finishing coat (iii) with calcite crystals and limestone clasts; render coat (i) with silico-carbonate sand and terracotta.

The persistence of the same kind of aggregate in different periods (Group A) and, on the contrary, the change of the aggregate in the plasters of the same period (Group B–C), is noticeable.

6. Comparisons

6.1 The composition of the aggregate according to the different plaster coats.

- Aggregates of render coat (i): sand with silicate clasts (Fontana A); sand with silicate and carbonate clasts (Fontana B; Correnti A, B, C); – sand with silicate clasts and crushed terracotta called “cocciopesto” (Meda A, B, C).
- Aggregates of finishing coat (iii) not supporting the painted layer: sand with silicate clasts (Fontana A1, A2, A3; Meda A+).
- Aggregates of finishing coat (iii) supporting the painted layer: angular quartz crystals from mechanical crushing (Fontana B; Meda B,C; Correnti, C); sand with silicate clasts and crushed terracotta (Meda A*); sand with silicate and carbonate clasts and crushed terracotta (Correnti A); angular calcite crystals from mechanical crushing (Correnti B, C).
- Aggregates of support layer (iv): angular calcite crystals from mechanical crushing (Fontana A1, A2; Meda A+); sand with silicate clasts (Fontana A3).

6.2 The coat thickness (finishing coat or support layer) according to the aggregate composition.

- Finishing coats with painted film: angular quartz crystals, thickness 11,0 mm (Fontana B); angular quartz crystals, thickness 3,0 mm (Meda B); angular calcite crystals, thickness 1,0 mm (Correnti B) or 2,0 mm (Correnti C); angular quartz crystals, thickness 3,0–3,5 mm (Meda C); sand with silico-carbonate clasts and terracotta, thickness 2,0–3,0 mm (Correnti A).
- Support layers of painted film: angular calcite crystals, thickness 0,4 mm (Meda A+); angular calcite crystals, thickness 0,5 mm (Fontana A1, A2); sand with silicate clasts, thickness 0,5 mm (Fontana A3).

6.3 *The aggregate composition of the finishing coat or the support layer, according to the making period.*

- Finishing coats (iii) with painted film: 1st Century AD first decade, angular quartz crystals (Fontana B); 1st Century AD 2nd half, angular quartz crystals (Meda B); 2nd Century AD, angular calcite crystals (Correnti B, C); 4th Century AD (first half), angular quartz crystals (Meda C); 1st, 2nd, 3rd Century AD, sand with silico-carbonate clasts and terracotta (Correnti A).
- Support layers (iv) of painted film: 1st Century AD before second half, angular calcite crystals (Meda A+); 1st Century AD third quarter, angular calcite crystals (Fontana A1, A2) or sand with silicate clasts (Fontana A3).

6.4 *The pigments of the painted layers (v) according to the making period.*

- 1st Century AD (first decade): lamp black (Fontana B).
- 1st Century AD (second half): red ochre (Meda B).
- 1st Century AD (before second half): red ochre (Meda A+).
- 1st Century AD (third quarter): lamp black (Fontana A1, A2), cinnabar (Fontana A3).
- 2nd Century AD: yellow ochre (Correnti B), green earth (Correnti C).
- 4th Century AD (first half): green earth (Meda C).
- 1st–2nd–3rd Centuries AD: red and yellow ochre, green earth (Correnti A).

6.5 *Raw materials of the aggregates.*

- Sand from the deposits of the Prealpine river of Lombardy where the basins involve Mesozoic formations (limestone, dolomite, sandstone) together with glacial sediments from the Alps (granite, porphyry, gneiss etc.).
- Quartz crystals coming from the mechanical crushing of quartz veins as witnessed by the angular shape of the crystals.
- Calcite crystals coming from the mechanical crushing of marbles or of calcite veins as witnessed by the angular shape (cleavage) of crystals.
- Terracotta fragments coming from the mechanical crushing of brick or tiles.

7. Conclusion

The petrographic analyses carried out on some Roman wall paintings from Milan show interesting differences in the aggregates of the plaster coats, in the relationships between them and in the application method of the painted layer.

The aggregates almost always change their composition between the render coat (i – sand with silicates and carbonates) and the finishing one (iii). The aggregates change also between finishing coats (iii) supporting the painted layer (quartz crystals or calcite crystals or silicate sand with terracotta) and finishing coats (iii) not supporting the painting (silicate sand); in this last case the painting application involves the presence of a support made by a thin mortar layer (iv) with specific aggregate (calcite crystals or silicate sand). The thickness of the finishing coats supporting the painting varies according to the presence of quartz aggregate (thicker) or calcite aggregate (thinner).

The comparison with the time scale, established by archaeological dating, shows an interesting relation between the changes of the aggregate composition and the changes of the making period. The increase of the scientific analyses on plaster in the Roman sites of Milan and of the whole Lombard territory will allow the grouping of the plaster features and of the painting techniques according to the different production periods.

Bibliographie

- Baraldi *et al.* 2006 P. Baraldi – A. Bonazzi – N. Giordani – F. Paccagnella – P. Tannini, Analytical characterization of roman plasters of the Domus Farini in Modena, *Archaeometry* 48, 2006, 481–499.
- Béarat 1996 H. Béarat, Chemical and mineralogical analyses of Gallo-Roman wall painting from Dietikon, Switzerland, *Archaeometry* 38, 1996, 81–95.
- Béarat *et al.* 1997 H. Béarat – M. Fuchs – M. Maggetti – D. Paunier (eds.), Roman wall painting. Materials, techniques, analysis and conservation, Archeometry Work Group, Proceedings of the International Workshop, Fribourg 7–9 March 1996, International workshop on Roman wall painting 1 (Fribourg 1997).
- Bugini – Folli 1997 R. Bugini – L. Folli, Materials and making techniques of Roman republican wall paintings (Capitolium, Brescia, Italy), in: H. Béarat – M. Fuchs – M. Maggetti – D. Paunier (eds.), Roman wall painting. Materials, techniques, analysis and conservation, Archeometry Work Group, Proceedings of the International Workshop, Fribourg 7–9 March 1996, International workshop on Roman wall painting 1 (Fribourg 1997) 121–130.
- Ceresa Mori *et al.* 2007 A. Ceresa Mori – D. Consonni – C. Pagani, Milano piazza Fontana. Indagini archeologiche, *Notiziario Soprintendenza Archeologica Lombardia* 2005 (Milano 2007) 136–140.
- Mariani *et al.* 2005 E. Mariani – C. Pagani – R. Bugini – D. Biondelli – P. Naj, Caratteri delle pitture murali romane in Lombardia. Compendio di dati analitici su malte e pigmenti, in: G. Biscontin – G. Driussi (ed.), *Sulle pitture murali. Riflessioni, conoscenze, interventi*, Atti del convegno di studi, Bressanone 12–15 luglio 2005, *Scienza e beni culturali* 21 (Venezia 2005) 1147–1159.
- Pagani 2004 C. Pagani, La decorazione parietale, in: A. Ceresa Mori (ed.), *L'Anfiteatro di Milano e il suo quartiere. Percorso storico-archeologico nel suburbio sudoccidentale* (Milano 2004) 58–63.
- Pagani 2009 C. Pagani, Pitture parietali dalle indagini archeologiche preventive in Piazza Meda a Milano: osservazioni preliminari, in: A. Corralini (ed.), *Vesuviana. Archeologie a confronto*, Atti del Convegno Internazionale, Bologna 14–16 gennaio 2008, *Studi e scavi N. S.* 23 (Bologna 2009) 565–572.
- Plinius 1962 Plinius Secundus, *Naturalis Historia*, translation D. E. Eichholz, Cambridge, 1962. Book 36 chapter 53–55.
- Sciuti *et al.* 2001 S. Sciuti – G. Fronterotta – M. Venditelli – A. Longoni – C. Fiorini, A non-destructive analytical study of a recently discovered Roman wall painting, *Studies in Conservation* 46, 2001, 132–141.
- Vitruvius 1931 Vitruvius, *De Architectura*, translation F. Granger, Cambridge, 1931. Book 2 chap. 4–6; book 7 chap. 2–6.

Roberto Bugini
CNR – Istituto per la Conservazione e la Valorizzazione dei Beni Culturali
Via Cozzi 53
I – 20125 Milano
r.bugini@icvbc.cnr.it

Luise Folli
Mineralogist
Viale Calabria 18
I – 26900 Lodi
lufo@fastwebnet.it

Anna Ceresa Mori
Soprintendenza Archeologica della Lombardia
Via Corregio n. 1
I – 20149 Milano
anna.ceresa@alice.it

Carla Pagani
Società Lombarda Archeologia, SRL
Corso Giuseppe Garibaldi 125
I – 20121 Milano
cpagani@studiosla.it

