

Conservative data on polychrome stucco, stone and clay sculptures and architectural decoration of Gandharan art

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opposite page

Paris, Museum Guimet,
Schist statue of Buddha
in the Miracle of Sravasti,
from Paitava monastery
(Afghanistan, Kapiça region)
(MG 17478, sample 12), detail of
gilding (photo S. Pannuzi).

Keywords

Stone artefacts,
stucco artefacts,
clay artefacts,
Gandharan art,
conservation,
guidelines.

Abstract

In the first phase of study on Gandharan artefacts (2014-15), the Istituto Superiore per la Conservazione ed il Restauro (ISCR) was focused on technological and conservative issues of some schist stone and stucco sculptures belonging to the collection of the Museum of Oriental Art of Rome (ex MNAO, now merged into the *Museo delle Civiltà*). Experts of different disciplines evaluated the conditions of the stone artworks, to define the best conservation approaches and treatments. Chemists and restorers compared cleaning methods and evaluated consolidation and sticking practices.

In our further studies we also consider stucco and clay artworks, deepening our research through scientific analyses and observation carried out on both archaeological finds (Afghanistan, Pakistan) and musealized sculptures (Civic Archaeological Museum of Milan, Oriental Art Museum of Turin and Guimet Museum of Paris).

This further work allowed, through the characterization of the materials and the observation of the working techniques, to deepen the study of the Gandharan stone, stucco and clay artworks and to formulate operational hypothesis for their conservation.

Introduction

In the first phase of study (2014-15) our Institute was focused on technological and conservative issues of some sculptures of Rome Museum of Oriental Art (ex MNAO, now merged into the *Museo delle Civiltà*). In most cases the sculptures and reliefs (schist, stucco and clay) were still covered by residues of the excavation dirt; both were rather fragile materials, as there were traces of pigments. Because of this problem, experts of different disciplines evaluated only the conditions of the stone artworks, to define the best conservation approaches and treatments. Chemists and restorers compared cleaning methods and evaluated consolidation and sticking practices.

In our further studies we also consider stucco and clay artworks, deepening our research through scientific analyses and observation carried out



Fig. 1
Paris, Museum Guimet,
Bodhisattva Maitreya,
detail (AO 2908, sample 5):
white layer on the schist statue
(photo S. Pannuzi).

Fig. 2
Paris, Museum Guimet,
Elephant, detail (MA 6295,
sample 1): white layer on the
schist statue
(photo S. Pannuzi).

pagina a fronte

Fig. 3
Milan, Civic Archaeological
Museum, Capital of a pillar,
detail (A.990.05.1, samples 30,
31): white layer on the schist
sculpture
(photo S. Pannuzi).

Fig. 4
Paris, Museum Guimet, Relief
from Shotorak monastery
(Afghanistan), detail
(MG 22148, sample 14): traces
of red bolus on schist relief
(photo S. Pannuzi).

Fig. 5
Milan, Civic Archaeological
Museum, Standing Buddha,
detail (A.09.10692,
sample 21): traces of gilding on
drapery dress of schist statue
(photo S. Pannuzi).

on both archaeological finds (Afghanistan, Pakistan) and musealized sculptures (Civic Archaeological Museum of Milan, Oriental Art Museum of Turin and Guimet Museum of Paris). We noted that some artworks kept in museums were subjected to previous restoration (bonding, consolidations, cleaning), also with incorrect or unsuitable products and methodology.

In such holistic perspective, the use of the materials (stone, stucco and clay artefacts), the sculpting process with the polychrome decoration of the surfaces and the conservative intervention were considered in a unified framework. Moreover, we highlight the need of precise guidelines to restore these fragile artefacts. During the restoration it is very important to have a collaboration with the diagnostic research, so a series of focused analyses could help to understand the compositional materials of the artworks and to identify the appropriate methodology and the suitable restoration products to use for the conservative intervention.

Stone artworks

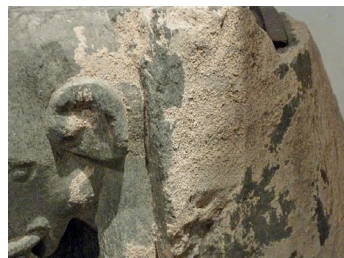
Materials and processing technique

After the first analyses about the Gandharan artworks of the Rome Museum (ex MNAO), our research carried on comparing the data related to artworks of other Museums and examining in depth the new analyses.

Analyses on the artefacts of the Museum Guimet and the Milan Museum allow to ascertain that the schist artworks can be covered by a whitish layer that we have to consider a ground layer for the polychrome decoration. After further analyses we identified different pigments and traces of gildings over different ground layers; furthermore, we found different kinds of binder.

Conservative conditions

Generally, all the examined artefacts preserved in the Museums have a fair conservative condition, although they were fragmentary, worn and covered by different whitish layers, more or less tough, often due to long deposition in the earth. In many cases these white layers are more evident after cleaning and are discontinuous and fragile, but quite joined to stone surface and sometimes thick (Fig. 1, 2, 3). The polychrome decorations are always preserved very partially, and it's often difficult to see them. Usually the red colour is the most evident: it is often due to red ochre¹, sometimes it is a bolus, but the overlapping gilding is lost² (Fig. 4).



¹ For artworks from Rome Museum see: Talarico et al., 2015, tab. 1 and p. 59.

² See Pannuzi, Talarico, Guida, Rosa in this issue.

Some small traces of gilding are preserved on the surface of the artefacts; sometimes the gilding is more evident but always very thin. We can observe by microscope that it is easily chipped and not smooth.

Little traces of gilding are sometimes visible only by optical microscope (Figg. 5, 6, 7). When the ground layer of gilding is red bolus, this is better preserved. The lime ground layers are often lost with the gilding and less evident.

Conservative intervention

During our previous studies, for the removal of residual films of excavation sediments on Gandharan sculptures of Rome Museum, carved in different types of schist, the ISCR équipe compared the results of two different conservation approaches, both with low environmental impact and safe for the operators and the artworks: a chemical one, involving the use of aqueous solutions with carbon dioxide (CO₂) and a physical one employing Laser, used for removing lime-rich concretions on sculptures whose fragility required an extreme care. The results were positive for both: the two approaches are complementary, as they can be combined in the same cleaning procedure. Otherwise, the characteristics of stone, that tends to split in parallel layers, made impossible the most common chemical cleanings³.

Our team also evaluated the methodological issues about consolidating and joining fragmentary stone sculptures: we tested some products for consolidation, both water-soluble or soluble in organic solvents, particularly in terms of concentration, application method and chromatic changes. We also considered various adhesives for refitting the schist flakes or more substantial fragments, evaluating their mechanical behaviour in the adhesive process, their sensibility to water and superficial colour changes.

The use of the laser cleaning is actually not usual for cleaning polychrome and gilded stone artworks, because the study about these particular artworks has recently begun. During the last research of ISCR on Gandharan archaeological sculptures the restorer M.Gigliola Patrizi successfully removed carbonate layers from polychrome artefacts by laser⁴. The laser was particularly useful cleaning very friable and fragile artefacts that could be damaged by water solution cleaning. On polychromy (red ochre in that case) a Nd:YAG with wavelength of 1064 nm (El.En. "EOS 1000") in Short Free-Running was used, because its action is more delicate and gradual than the Long Q-Switch mode, used for strong earth concretions.

Laser cleaning is also recommended in case of presence of gilding, as recently tested in ISCR on stone gilded sculptures of the Renaissance age with excellent results⁵.

During the next interventions the white ground layer for polychromy, now well identified⁶, has to be absolutely preserved with the use of suitable cleaning and consolidation methodologies.

In the next future new tests with innovative products will be carried on fragments of the schist sculptures. The recent researches about nanoma-



³ Sidoti and Patrizi, 2015; Patrizi, 2015, pp.70-72.

⁴ Patrizi, 2015, pp. 69-74.

⁵ See the conservative intervention on the gilded altar dossal of the Orte Cathedral (VT): Pannuzi, Montemaggiore, Galanti, 2018.

⁶ See for these theme: Pannuzi, Talarico, Guida, Rosa, in this issue.

materials have given a very good results on porous stones, but these products must undergo further tests because in a first experimentation on the Gandharan sculptures the results were not optimal⁷.

Also the ground layer for the polychromy, the traces of the pigments, the bolus and the traces of gildings absolutely require consolidation: it would be recommended the use of micro and nanoacrylic emulsions, because it's necessary to join the consolidation and adhesive effect with a deep infiltration.

An acrylic stucco with microsphere (Stuccoforte light, Max Meyer) with adequate characteristics of mechanical resistance and reversibility can be used for filling the gaps on the surface: it was recently used in ISCR on frescoes, stucco and gypsum artworks⁸.

Stucco artworks

Materials and processing technique

In our last research about Gandharan sculpture we examined stucco architectural decorations from Italian excavations in Swat, Pakistan (MAI), also with traces of polychromy. These stucco samples come from the external walls of some collapsed buildings of Buddhist sites in Swat (Amluk-dara, Barikot and Gumbat). Moreover, samples from important artworks preserved in Museum Guimet and in Civic Archaeological Museum of Milan has been analyzed.

These artworks show evident traces of colours (red and blue). By petrographic analyses, the stucco samples from the archaeological excavations in Swat show mostly a calcite plaster produced from limestone where the gypsum is always absent. Scientific investigations carried out on some art-

Fig. 6
Milan, Civic Archaeological
Museum, Standing Buddha
(A.09.10692, sample 21):
traces of gilding on schist
statue by Dinolite.



⁷ Sidoti and Patrizi, 2015, pp. 65-68.

⁸ Giovannoni et al. 2015, pp. 89-102.

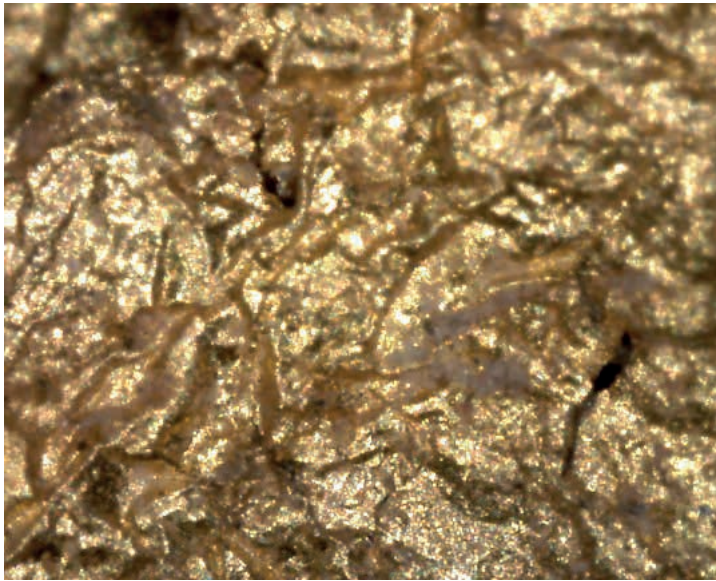


Fig. 7
Turin, Oriental Art
Museum, Schist corbel
(4581, samples 34-35):
particular of the gilding
by Dinolite.

works from the Museum Guimet (samples 6, 7) and Milan Museum (sample 22), show otherwise the presence of gypsum in the plasters.

Sometimes in the plaster of the Swat samples fragments of quartzite, granite, gneiss, garnet, marble and mica flakes are present, with the addition of a fraction of clay⁹; the artworks from the Museums revealed instead the presence of calcite, gypsum and clay (Museum Guimet, samples 6, 7) and a calcium carbonate matrix with heterogeneous grains (iron, potassium, sodium, silicon-aluminate) (Milan Museum, sample 23)¹⁰.

In a sample from Gumbat (GBK 17A) in a matrix of fine grained calcite, fibre-like pore structures of unknown origin are visible¹¹. All the plasters show large and angular grains, well visible to the naked eye, very granulose, unrefined and often with irregular fractures.

About the architectural decorations, we noted that the stucco in the malleable and plastic state was laid on the wall with 1,5-2 cm of the thickness; then it was smoothed on the surface with different instruments, including a wet brush (on the surface of a sample from Amluk-dara, AKD 14B, it is possible to see traces of the bristles) (Fig. 8). Decorative and relief parts were carried out with moulds or with modine on the wet stucco surface to create cornices and capitals, (see the sample from Gumbat, GBK 18 C) (Fig. 9 a, b). These decorative parts were added when the surface of the stucco was still wet and not completely carbonated.

Probably the granulose plaster of many artefacts was smoothed with the addition of lime without inerts (grassello); later the surface could be painted with pigments. In the sample from Gumbat, GBK 17 B, we noted that the finishing layer is rather thick (1 mm), made with lime but almost completely lost, spread dry (a secco) on the surface and then smoothed (Fig. 10).

On all the artefacts that preserved colour layer, it seems that the colour was laid dry on the already hardened surface. In the architectural samples the col-

⁹ See Rosa, Theye, Pannuzi, in this issue

¹⁰ Pannuzi, Talarico, Guida, Rosa, in this issue.

¹¹ See Rosa, Theye, Pannuzi, in this issue.

Fig. 8
Stucco artefact from
Amluk-dara (Swat,
Pakistan), sample 14 B
(photo E. Loliva ©ISCR).

our visible is always red, thin, vanished, not cohesive and with serious decay, due to the weathering of the external surface of the walls (Figg.11, 12, 13). Fortunately, the stucco sculptures conserved in the museums showed a better preserved surface and in a case by scientific investigations has been noticed that the red pigment, without a ground layer, was absorbed into the stucco surface, before the carbonation (sample 22 from Milan Museum)¹² (Fig. 14).

Conservative state

The architectural stuccos, from Italian excavations, served as decorations and protection of the walls of the buildings. Due to the weathering, with the decay of the painted layers, the stucco covering detached from the walls.

However, this stucco covering is not crumble, because the cohesion of the plaster is very strong; the painted surface is instead very consumed and sometimes the mineral components of the plaster are visible.

Moreover, over the surface of the architectural samples has been noted the presence of excavation earth, often very adherent to the surface: these earthy layers compromise the visibility of the sample and the conservation of the painted layers, but they did not cause the breaking of the plaster. The stucco artworks, kept in the museums, certainly show a good or a decent conservative condition, because certainly in the past they were subjected to a cleaning treatment. We noted that the stucco is solid and tenacious but for these artworks of the painted decorations are also only present in traces and their surfaces appear corroded.

In the previous research about the artworks of the Rome Museum (ex MNAO), we observed on a stucco cornice (n. 1240) the presence of successive ground layers of the painted decoration, to be considered as ancient maintenances¹³.



¹² See Pannuzi, Talarico, Guida, Rosa in this issue.

¹³ Talarico et al., 2015, pp.55 e 59. Instead, we supposed a modern maintenance, due to the presence of a modern pigment, for another artwork of the Rome Museum (Talarico et al., 2015, pp. 58-59).

Based on our new investigations we can assume that in ancient time these maintenances were periodically carried out on the outdoors walls, consumed by the atmospheric agents¹⁴.

Conservative intervention

Before the cleaning of stucco artefacts it's necessary to ascertain with appropriate analyses their composition and to verify the presence of layers of preparation or pigments.

If no surface finishing is present, the lime based stucco can be cleaned with aqueous systems.

In the opposite case, or when there is the presence of gypsum in the composition of plaster, a dry cleaning is needed, for example a laser cleaning, to be applied after testing the appropriate parameters.

In case of stucco with gypsum, the aqueous cleaning can be also performed using as supportant a rigid gel (Gellano, Agar-agar), that avoid the absorption of water.

In any case, a preliminary mechanical cleaning performed with scalpels and brushes can be effective removing earth and dust deposits and incrustations.

As the cohesion condition observed on the stucco artefacts so far examined is very good, a consolidation does not seem necessary. In case of very delicate polychrome artefacts, the finishing must be consolidated and fixed to the surface as previously described for stone materials.

The fragments can be reassembled with epoxy resins and reintegrated with the same material used for stone, the acrylic plaster with microspheres (Stuccoforte light, MaxMeyer).

If pins or supports are needed, fiberglass bars can be used, both for musealized and in situ objects.

In the last case, at the end of the intervention, the application of a surfactant (siloxanes or nanometric products) is recommended.

Clay objects

Materials and work techniques

Clay processing includes a big variety of materials and work techniques: from rough manufactures to very fine productions that needed a very high execution skill.

The objects examined are very different, belonging both to unidentifiable archaeological fragments (from Afghan excavations) and very fine artifacts exposed in very important museums such as Guimet Museum in Paris (from Fundukistan site) and the Civic Archaeological Museum of Milan (without provenance indication).

a) Fragments from archaeological excavations

The clay is very fragile, due to the addiction of various kinds of aggregates, broken in irregular and angled grains. The observation with optical and WDS scanning microscope evidenced the presence of various minerals and rock fragments inside the clay mixture.

Fig. 9A, 9B
Stucco artefact from Gumbat (Swat, Pakistan), sample GBK 18 C (photo E. Loliva ©ISCR).

¹⁴ See Rosa, Theye, Pannuzi, in this issue (sample AKD 14C).



Fig. 10

Stucco artefact from Gumbat (Swat, Pakistan), sample GBK 17 B (photo E. Loliva ©ISCR).

Fig. 11

Stucco artefact from Barikot (Swat, Pakistan), sample BKG 1123, 15 A: traces of red colour are visible (photo E. Loliva ©ISCR).

Fig. 12

Stucco artefact from Barikot (Swat, Pakistan), sample BKG 1123, 16 B: traces of red colour are visible (photo E. Loliva ©ISCR).

These minerals (feldspar, quartz) and rock fragments (phyllite, limestone, quartzite) are bounded by a low cohesion clay that works as binder.

In the composition of one of the samples (from Tapa Sardar, Afghanistan) has been also observed the tragacanth gum, used to add cohesion to the very fragile mixture (Fig. 15).

Mineral powders with degreasing properties were added to the very soft clay.

The small dimensions of the samples didn't allow any other valuation on the work techniques.

From the observation performed and a preliminary analysis, waiting for the results of specific thermal analysis to be carried out in the next future, is possible to hypothesize that the objects were cooked, probably at low temperature¹⁵. This cooking process allowed the clay to function as a binder, including the heterogeneous aggregates but not achieving a high mechanical strength.

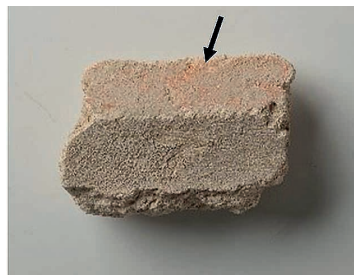
Regarding the artistic context of the late Gandhara, where the clay was largely used for artworks, we noticed that clay artifacts have been often classified as raw clay, based on the friable consistence of the mixture without any specific characterization. It would be necessary deepen the problem clarifying case by case the executive modalities.

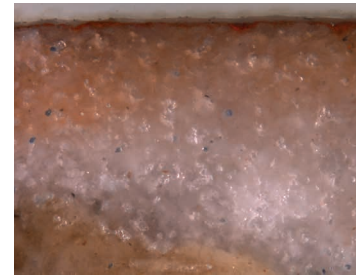
From various samples examined has been possible to observe the presence of a layer of painting on the surface, probably given after the cooking process. Some samples from Afghan archaeological excavation have a superficial black coloration; in one of them has been identified a protein binder used to fix the color, to be deepen with further scientific investigations.

b) Musealized artworks

Samples from clay sculptures of the Paris and Milan Museums allow to observe that the clay used is better in quality and consistence, as it has been employed for works of particular value. Inside the mixture can in any case be noticed the presence of different components, even vegetal fibers visible to the naked eye. Based on the SEM EDS and FTR analysis carried on by ISCR, it has been possible recognize gypsum and calcium particles, used as degreaser.

¹⁵ See Rosa, Theye, Pannuzi and Pannuzi, Talarico, Guida, Rosa in this issue.





Some sculptures seem to be realized with a mould (Fig. 16), others freely shaped with plastic clay. The protruding parts were made separately and in some cases assembled with pins, not found (Fig. 17).

The surface has a very fine finishing realized before cooking, giving a very smooth and compact aspect and evidencing details obtained separately with plastic clay.

A complex decorative technique with preparation layers and colors, like natural ultramarine blue (lapis lazuli), of which considerable deposits are in the Himalayan area, has been also observed.

The superficial color layer could be given on a preparation of minio and was constituted of various minerals (lapis lazuli, ochre, orpiment, vermilion). Cobalt stannate, found in traces, is related to recent intervention.

Proteinaceous binders (animal glue, milk and eggs together) in some cases are presented in the colored superficial finishing.



Fig. 13
Stucco artefact from Amluk-dara (Swat, Pakistan), sample 14 C: traces of red colour are visible (photo E. Loliva ©ISCR).

Fig. 14
Milan, Civic Archaeological Museum, Painted stucco Monk (A.988.O2.1, sample 22): detail of the red layer on the stucco surface by optical microscope (05_050x_part 2).

Fig. 15
Clay artefact from Tapa Sardar (Afghanistan), sample 1 (photo E. Loliva ©ISCR).

Conservation Conditions

a) Fragments from archaeological excavations

The clay samples are in very bad conditions: the heterogeneity of the material and the low content of clay binder, join to the insufficient cooking and the degradation due to the burial, caused fragmentations and hard disintegration. The original shape is visible only in very small areas (Fig. 18).

b) Musealized artworks

The clay sculptures of Paris and Milan Museums are in good or decent conditions, even with some missing parts, localized erosion, loss of pictorial film (Fig. 19). Some of the artworks have been recently restored to enhance the faded polychromy, using the same modern pigment (cerulean blue) used for the restoration of the stucco object from Rome Museum (ex MNAO)¹⁶.

Intervention

In case of very delicate artefact, before cleaning is essential to perform a consolidation with microacrylic resins to give greater mechanical resistance to the clay.

When a colored finishing is present the cleaning must be performed very carefully to avoid the loss of superficial layers, after a consolidation of the

¹⁶ Talarico *et al.*, 2015, pp. 58-59.

Fig. 16
Paris, Museum Guimet, Seated Buddha in *vajrasana* from Fundukistan monastery, Ghorband Valley (Afghanistan) (MG 21444): versus of the statue (photo S.Pannuzi).

Fig. 17
Paris, Museum Guimet, Seated Buddha from Fundukistan monastery, Ghorband Valley (Afghanistan) (MG 18970, sample 20): detail of the arm (photo S.Pannuzi).

most delicate and fragile areas carried on with microacrylic resins by brush. The superficial deposits can be eliminated with brushes, scalpel, dental stylets or laser with adequate setting.

The reintegration of the polychromy missing part is not appropriate, not to add different materials and to preserve the appearance of the original artifacts.

Conclusion

This work allowed, through the characterization of the materials and the observation of the working techniques, to deepen the study of the Gandharan stone, stucco and clay artworks and to formulate operational hypotheses for their conservation.

Some methodologies, for example on stone artworks, have been already tested, others need further studies that we hope will be performed during next restorations, both on musealized artworks and in situ.

Attention is drawn to the safeguard of the very delicate superficial finishing layers during the archaeological recovery. The conservation and the study of these finishes can allow further studies on the Gandharan work techniques that will shed light on this artistic context still today not well known.

In particular, during the recovery of a painted artefact, is recommended not to wash the fragment or use brushes to remove earth deposits. It's eventually possible to use carefully a soft brush paying a special attention to preserve delicate layers of finishing. Waiting for a targeted cleaning per-



formed by specialized restorers, the object must be stored in a dry place, avoiding the contact with other finds that can scratch the surface. During the transport the fragment must be protected against accidental bumps by positioning in containers with adequate shock absorbers.

As regards the artworks exposed in private or public collections, a periodic visual inspection, followed by a delicate dust removal performed by specialized restorer, is warmly recommended.

Critical situations or worsening of conservation conditions must be immediately reported.

The objects stored in deposits must be preserved respecting the microclimatic conditions already indicated and providing protection against accidental bumps and contacts with other artefacts.

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Fig. 18
Clay artefacts
from Tapa Sardar
(Afghanistan)
(photo E. Loliva ©ISCR).

Fig. 19
Milan, Civic
Archaeological
Museum, Clay Brahma
Head (A.09.9421, sample
33): detail of yellow
layer on the hair by
Dinolite.

