

Chapter 9

Materials and Techniques of the Polychromy of the Giant Buddha Statues in Bāmiyān



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Abstract Despite the world-famous status of the two Giant Buddha statues of Bāmiyān, their painting techniques had not been investigated in detail before the Taliban destroyed the monuments in 2001. Small fragments of the clay modelling rescued from the debris showed that they were originally painted in bright colors. Examination carried out by the Technische Universität Munich between 2007 and 2013 (with an extension until 2016) focused on characterizing the materials and stratigraphy of the paint layers. Analyses also demonstrated that the Eastern Buddha is slightly older than the Western Buddha. The examined fragments represent a small proportion of the entire sculptural polychromy. Findings are partial but instructive. Phases of painting are best preserved on the outer garments. Among the identified pigments is the precious blue, ultramarine. Different organic binders were identified; egg may have been used for the original paint layers. Despite their enormous dimensions, the statues were repainted at least twice between their creation in the sixth or seventh century and 977, when the region converted to Islam. While the sequence of paint layers can be reconstructed for probably large parts of the outer garments, this is not possible for other areas such as the undergarments, flesh tones and hair. These appear to have been completely destroyed in 2001.

Keywords Bamiyan · Buddha statues · Clay sculptures · Polychromy · Pigment analysis

9.1 Introduction

The two Giant Buddha statues, measuring 35 m (Eastern Buddha) and 53 m (Western Buddha) in height, were the most prominent works of art in the extremely rich context of Buddhist temple sites in Bāmiyān. When they were destroyed in March 2001 by the Taliban, they had never been examined regarding their polychromy. Although colors had been mentioned in connection with the Buddha statues and traces of paint

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layers had been observed, the perception of the Giant Buddha statues is still shaped by their appearance and the color photographs taken before the destruction. At that time, the Buddha statues appeared light brown, like the stone of the cliff around them. The knowledge that they were not cut directly from the rock and were not meant to look like a part of it had been forgotten.

In 2004 a campaign funded by ICOMOS and UNESCO began, aiming to secure the remains of the Giant Buddha statues. While removing the enormous piles of rubble left by the explosion, fragments of the surfaces of the statues came to light among rock fragments, powdered stone and ammunition. By 2007, about 6100 fragments had been catalogued. Clay fragments showing paint layers, some still brightly colored, motivated Edmund Melzl,¹ the conservator working on site, to send several hundred small samples to Munich for examination.

The aim of research carried out between 2007 and 2016 was to gain information about the materials and techniques used, as well as the history of the statues, including all intermediary steps from sculpting the rock to modern restorations. In addition, research on literary and pictorial sources was carried out to investigate the historical context of the Bāmiyān Buddhas. This paper summarizes the most important results regarding the polychromy.

9.2 Creation and History of the Buddha Statues

The production process and the history of the Bāmiyān statues have been described in detail elsewhere [1, pp. 197–280]. The important facts for the interpretation of the paint layers are briefly summarized here.

9.2.1 *Production Technique*

In terms of their fabrication technology, the Buddhas must be considered within the tradition of painted clay statues, even though their main bulk consists of rock. Clay statues have a long history in large parts of Asia, from the Neolithic Age to modern times. In Central Asia (Turkmenistan, Uzbekistan, Tadjikistan, Afghanistan, northern India, and China) there is evidence for the highly skilled production of clay statues since the first century BC, which became an integral part of the newly developing Buddhist art [2]. It can be assumed that in general Buddhist clay statues were painted.

There are technical variations in the process of making clay statues, depending on the size and use of the statues, their integration into architectural contexts, as well as local traditions and resources. In general, however, a clay statue is made starting with a rigid core that defines the rough design and carries the main load. This core can consist of wood, brick or stone. Modelling in clay starts with a coarse mixture of clay, often containing straw, which is applied and shaped by hand. One or two layers

of fine clay are then applied to reach the definitive shape. They often contain fine sand and plant fibers or animal hair to prevent shrinkage cracks. Besides bare hands, wooden tools, cloths or chamois leathers are used to smooth the surface. After drying, the statues are painted, usually on a white preparation layer. In architectural contexts such as temple halls or caves, statues and surrounding walls are often designed using the same (or similar) materials and techniques.

The Giant Buddhas were roughly cut from conglomerate rock. Since this rock contains coarse inclusions of variable hardness, it does not permit the sculpting of smooth or finely structured surfaces. All rock surfaces were therefore covered with applications of clay, which also completed the three-dimensional shape: smaller details thus are only modelled in clay. To increase the adhesion of the clay layers to the rock, a variety of keying methods were employed. On the smaller Eastern Buddha, numerous holes (about 7 cm wide and deep) were cut into the surface. Before applying the clay, pebbles were pressed into the holes to provide an anchor (Fig. 9.1). On the larger Western Buddha, details such as the garment folds were not carved from the rock. Instead, rows of holes (3.5–4 cm wide, 7 cm deep) were made along the fold ridges with a pointed chisel. Wooden pegs were inserted into the holes, connected with ropes made of an endemic plant (*astragalus coneifolius*)

Fig. 9.1 Eastern Buddha: right arm and right leg in the 1950s: the clay modelling of the *sangati* is preserved in large areas Taken by Edmund Melzl in 1955. By courtesy of Erwin Emmering



and then covered with coarse clay. The protruding forearms of both statues were modeled over massive wooden beams, which were inserted into the rock and then covered with clay; in the case of the Western Buddha, adobe bricks were also used. On the Eastern Buddha, a sacred relic was placed into the opening cut for inserting the beam. The coarse first clay layer contains wheat and barley straw as well as goat hair. The application of this plaster varies in thickness from 2 to 3.5 cm in the flat parts, to about 20 cm in the fold ridges, which were roughly modelled by hand.

The top layer is only 0.5–5 mm thick and contains sand, charcoal and fine sheep wool. The surfaces are smooth and show impressions of wooden modelling tools. A leather rag in which a round seed or nut had been tied up was found in the rubble, which may have been used as smoothing tool. The walls of the niches were also coated with clay plaster. Finally, the walls and statues were painted.

9.2.2 *Important Events in the History of Bāmiyān*

Since the examination allowed us to conclude that the clay modelling is original and thus dates to the same time as the rock-cut sculptures and niches,² radiocarbon (^{14}C AMS) dating was done on 22 samples of organic components of the clay layers and anchoring pegs. It resulted in the following dating [1, p. 235]:

- Eastern Buddha: 544–595 AD (2σ)
- Western Buddha: 591–644 AD (2σ)

This indicates that the Eastern Buddha was the first one to be created and is slightly older than the Western one.

The first scholar to mention the Giant Buddhas, who arrived in Bamiyan around 630, perhaps even before the Western Buddha was finished, was the Chinese monk Xuanzang.³ From 770 Islam became predominant in the region of Bāmiyān for a period of about a hundred years, which was followed by a second Buddhist phase. Archaeological evidence indicates that Islamic and Buddhist traditions co-existed peacefully. Since 977, Bāmiyān has been Muslim. Maintenance and repainting of the Buddha statues was therefore only undertaken during the four previous centuries [1, pp. 231–236].

In medieval times, Islamic scholars mentioned the giant “idols”,⁴ and not knowing their Buddhist origins, locals associated them with kings or heroes.⁵ Even today, they are regarded as a couple, the smaller Eastern Buddha representing the “female”.⁶ In the eighteenth century legends about the idols reached Europe.⁷ Around 1830, Europeans who came to Bāmiyān as adventurers or soldiers sketched and described the statues, such as William Moorcroft and George Trebeck [23], followed by Alexander Burnes [3], Charles Masson [24], and Vincent Eyre [4]; and in 1895, the first photograph, showing the Eastern Buddha, was published.⁸ The first descriptions of a more scientific nature were made in 1885 by Talbot and Simpson, with sketches by P. J. Maitland [5, pp. 303–350].

In the twentieth century there were two important campaigns that focused on the study and the conservation of the Bāmiyān Buddhas:

- In the 1920s and 1930s, the DAFA (Délégation Archéologique Française en Afghanistan⁹) carried out an archaeological survey and made structural interventions, building a buttress on the left side of the niche of the Eastern Buddha [6–8]. At the same time, the first analyses on colorants and binders were performed [9, pp. 168–193].
- Between 1969 and 1978, the Indo-Afghan project organized by the ASI (Archaeological Survey of India) restored the Buddha statues [10, 11]. This included partial reconstructions of the clay modelling. As a final intervention, a clay suspension was applied to all surfaces, probably to homogenize the overall appearance. Perhaps it was also assumed that this would reconstruct the original design, even though extensive traces of polychromy were found and mentioned. At the same time, Tarzi, described the technique of the clay modelling of the statues [12; vol. 2, p. 177]. Between 1978 and 2001, when most of the color photographs of the Buddha statues were taken, they consequently looked very much like the surrounding stone cliffs.

9.3 Examination of the Paint Layers

The main question, and thus the intended aim of the examination, was to understand what the statues looked like originally. This included research and interpretation on several levels:

1. Identification of the materials and
2. understanding the paint stratigraphy.
Step 2 proved to be the most difficult and was done before and in parallel with step 1.
3. Understanding how the individual parts of the statues were painted in order to reconstruct the painting scheme.
4. Reconstruction of changes in the painting schemes over time.

At present, step 3 and 4 can only be answered partially.

All fragments were examined using a stereomicroscope (max. 40 times magnification). Cross sections were imbedded in epoxy resin (Araldite® 2020) and observed using VIS and UV (bandpass 355–425 nm), at max. 500 times magnification. The identification of pigments was mainly done with polarised light microscopy (PLM); for a few farther-reaching questions micro x-ray fluorescence (μ -XRF), x-ray diffraction (XRD) and energy dispersive X-ray spectroscopy (EDX) could be applied.¹⁰

9.3.1 Preserved Paint Layers

After the destruction in 2001, almost no paint layers were preserved in situ: on the Western Buddha, no original intact surfaces remain; on the Eastern Buddha, small areas of painted clay layers are preserved below the right arm (Fig. 9.2) and next to the left leg, but only to a marginal extent compared with the dimensions of the statue.

Fragments found in the rubble were catalogued separately from the stone fragments, using the initials GBL for the Western and KBL for the Eastern Buddha.¹¹ Mostly each entry corresponds to one fragment, but tiny fragments were listed in groups of up to 40 pieces. For the Western Buddha, 3517 painted clay fragments were recorded, for the Eastern Buddha, 2574 clay fragments.¹² Despite the large number of fragments it is difficult to allocate them unambiguously to specific areas of the statues. First of all, they only represent a small portion of the clay layers that were still preserved before the destruction, at most approximately 2.5% for the Western Buddha, and 4% for the Eastern Buddha.¹³ Most of them are too small to draw conclusions based on their shape, but some larger fragments can be identified as fold ridges (Fig. 9.3). Due to the enormous height of the statues, fragments of the lower parts had a better chance of surviving the fall after the explosion. But large parts of the modelled surface, especially in the regions below the knees, were already lost before the destruction. Thus, no clearly discernible fragments from the heads of the statues and the murals around them have been found. Often the surfaces of the clay fragments are soiled with dirt or soot, or the paint layers are altered, so notes in the find list characterizing the surfaces as “dark,” “brown,” “yellowish” or “reddish” can refer to soiling, the clay support, or discolored pigments, as well as to the actual color of the paint layer. This means that a reconstruction of the polychromy of the statues based on the examination of preserved paint layers is only possible to a limited extent.

Fig. 9.2 Preserved clay modelling with blue paint layer under the right arm after conservation, October 2008 [© Bert Praxenthaler 2008. All Rights Reserved]



Fig. 9.3 Part of a fold-ridge from the Western Buddha (GBL 852). The paint layer originally was in red hues (fragment ID 48: group 2–4; ID 169: group 2) Taken by Edmund Melzl in 2005. By courtesy of Erwin Emmerling



The material sent to Munich for examination contained 276 painted clay fragments, 173 coming from the Western Buddha and 103 from the Eastern Buddha (Fig. 9.4). Most of the tiny fragments measure less than $3\text{ cm} \times 3\text{ cm}$. Fragments were selected with the goal of representing as large a range of different paint layers as possible, and thus do not correspond to the quantitative distribution of colors in the retrieved fragments. Furthermore, only tiny fragments found in isolation were

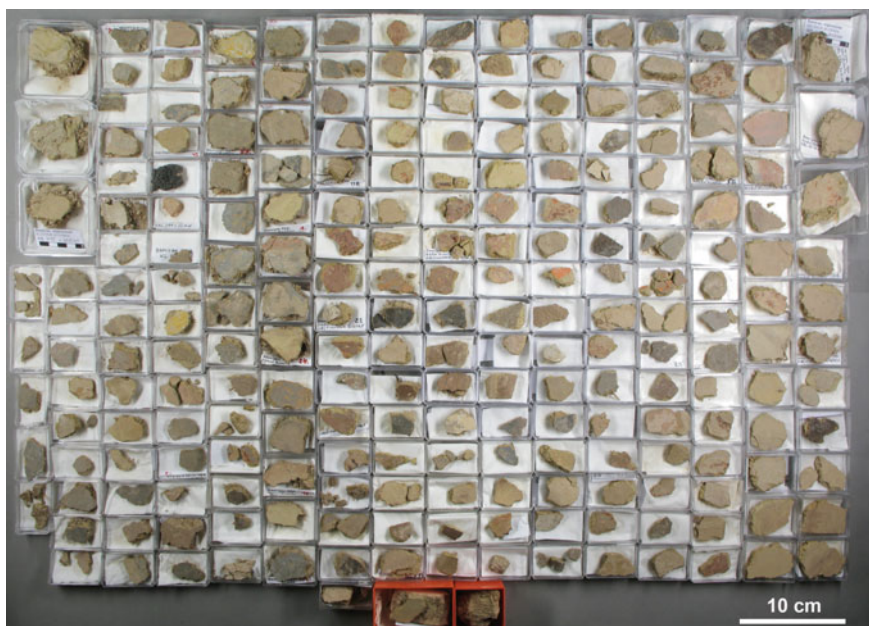


Fig. 9.4 Overview of the painted clay layer fragments examined in Munich [© Catharina Blaensdorf, 2007. All Rights Reserved]

taken in order not to damage preserved larger fragments by sampling. For practical reasons, the fragments received a numbering system independent from the find list (marked with ID + sequential number).

9.3.2 Classification of Paint Layers

During the recovery of the fragments, the presence of several paint layers was already noted. Underneath the clay suspension applied during the restoration by the ASI team (1969–1978) there are up to four layers. Mostly they have the same color though in different hues. This indicates that the original color scheme was repeated in the later overpaintings. Despite similarities, there are also differences that show that the history of (re)painting was not the same for both statues.

The fragments were classified into groups 1–6 according to the main colors. In a later stage, subgroups, e.g. 2–3, were introduced for stratigraphies with characteristics of two groups. The main colors are red [group 1 and 2, Figs. 9.5, 9.6, and 9.7] and blue [group 5, Fig. 9.8]. Numerous fragments show brown layers (group 3 and 4), sometimes covering remains of red and blue layers (groups 2–3, 2–4 and 5–1). The polychromy of a preserved fragment of ridge fold [GBL 852, Fig. 9.3] belongs to group 2 (ID 169, red without a white preparation layer), but in another sample, a brown layer is present over traces of red (ID 48, group 2–4). Thus brown layers seem to be a later modification, not belonging to the original color scheme. Fragments of group 6 have a white preparation layer and paint hues that do not appear elsewhere (dark red, blue, yellow ochre, white, pale blue, partly in translucent layers). Some of them preserve several colours applied adjacent to each other, reminiscent of mural painting techniques.

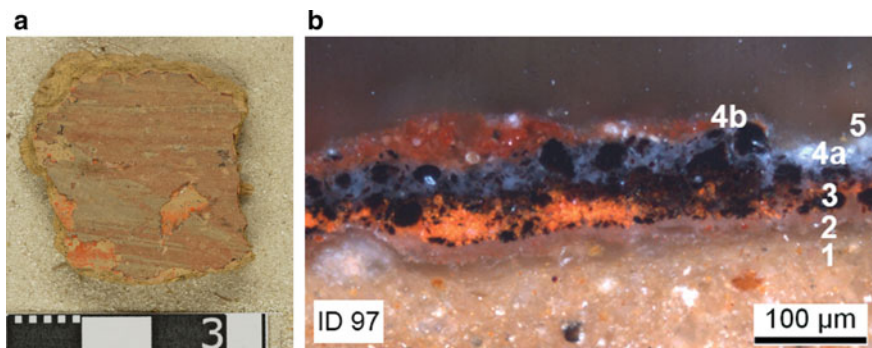


Fig. 9.5 a and b. Western Buddha, Fragment ID 97, paint layers in red hues (group 2): (1) clay, (2) original pink paint layer, (3) one or two layers of red lead, partly discoloured to black, (4a) white underpainting for (4b) red layer, (5) traces of clay suspension from 1969–1978 [© Stephanie Pfeffer //Catharina Blaensdorf 2007. All Rights Reserved]

Fig. 9.6 Western Buddha, Fragment ID 59, group 2, with visible black discoloration of red lead layers [© Catharina Blaensdorf 2007. All Rights Reserved]

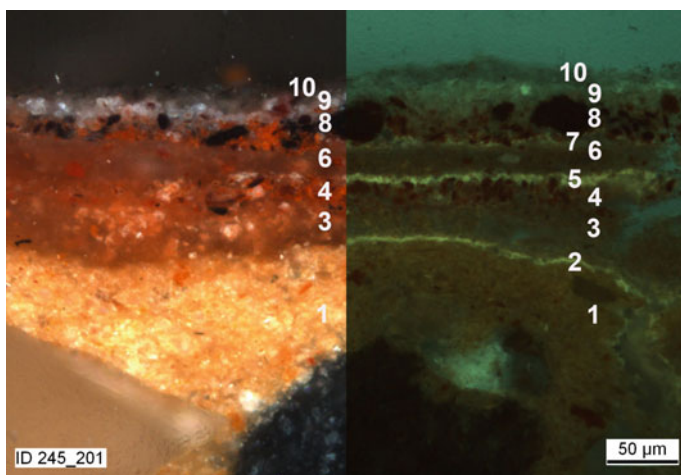
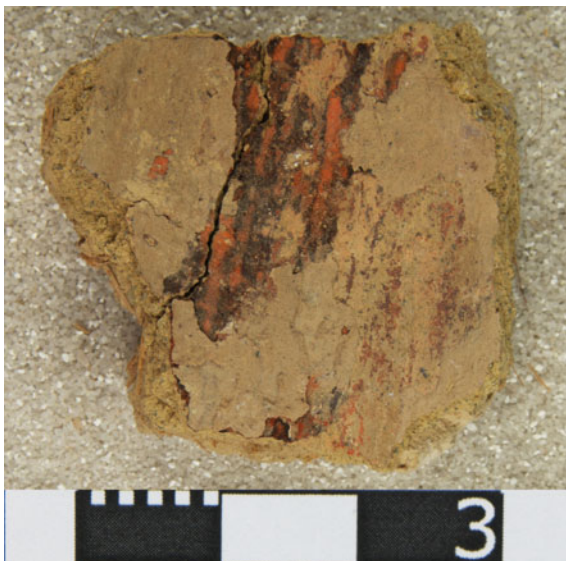


Fig. 9.7 Eastern Buddha, Fragment ID 245, group 2, VIS and UV: (1) clay, (2) sealant, preparation, (3) original pink layer, (4) partial red lead layer, maybe original (5) sealant, preparation, (6) pink overpainting, (7) sealant, preparation, (8) orange overpainting with partly discoloured red lead, (9) white overpainting, (10) clay suspension from 1969–1978 [© Catharina Blaensdorf 2013. All Rights Reserved]

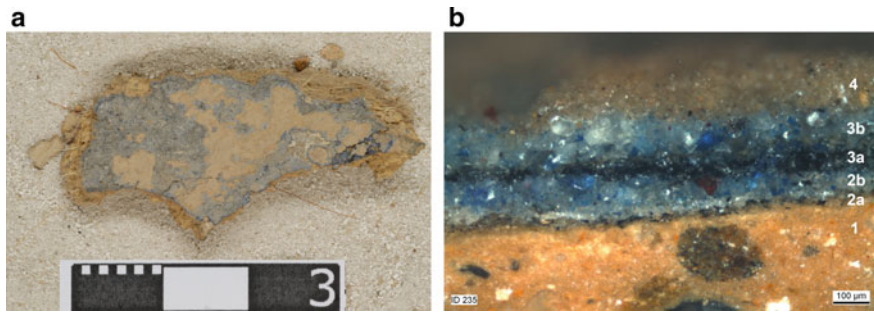


Fig. 9.8 a and b. Eastern Buddha, Fragment ID 235, blue paint layers (group 5): (1) clay, (2a) original grey underpainting, (2b) blue layer, (3a) grey underpainting, (3b) blue overpainting, (4) clay suspension from 1969–1978 [© Catharina Blaensdorf 2013. All Rights Reserved]

9.3.3 Preparatory Layers

A sealant layer underneath the first paint layer can be distinguished in most of the cross sections and also on some of the fragments. It has a strong white to yellowish UV fluorescence (Fig. 9.9, layer 2).

One puzzling observation is that on the majority of the fragments there is no white preparation layer underneath the paint layers. Only on a few fragments is there a continuous white layer, while others show only small traces or tiny splashes of white material. In wall paintings in the region, a white—or light-colored—preparation layer was usually applied before painting clay surfaces, containing gypsum, chalk or white clay minerals [1, p. 260]. This type of preparation layer is also present in the caves in Bāmiyān, and can be assumed from photographs for the murals of the niche vaults. On the niche walls it is not discernible, but their clay layers were already in a poor state of conservation before 2001, and little photographic evidence exists. The absence of a white preparation layer can either mean that the original polychromy was almost totally lost or removed at an early time, only leaving small traces of the white preparation layer; or that the original paint layers are still preserved, but were executed without a preparation layer.

Considering the enormous dimensions of the statues and the challenge craftsmen faced in accessing every surface, it is difficult to imagine that the polychromy would have been removed completely before repainting. Thus, the most recent conclusion is that only the niche walls, or at least the vaults, received a white preparation layer, but not the statues. Splashes of the white preparation may have dripped down on the still unpainted statues while working on the walls or vaults. The fragments with a preparation layer presumably come from these locations, or from adjacent surfaces that were accidentally covered. The fragments from group 6, which have a thick continuous white preparation layer superimposed by multiple colours, may belong to the murals themselves. This assumption is also supported by the fact that the clay layers of group 6 contain a very low amount of hair. The presence or absence

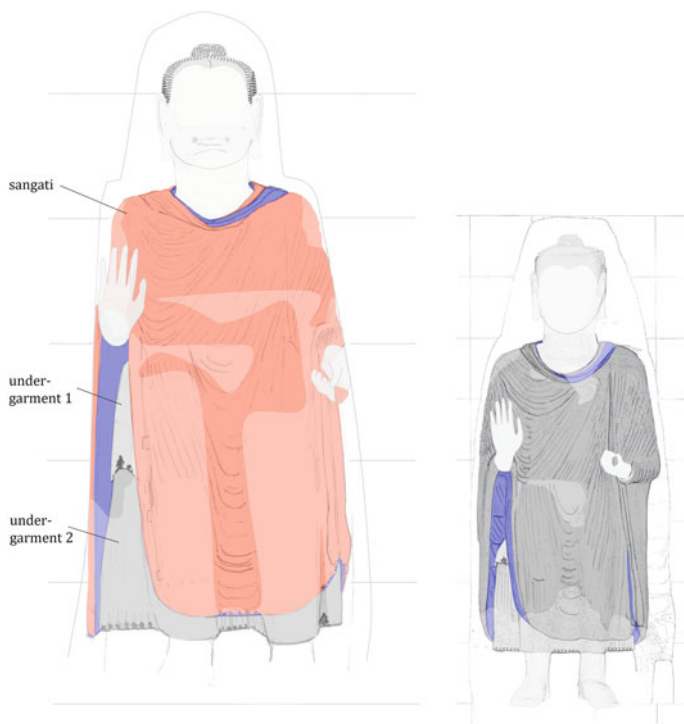


Fig. 9.9 Allocation of colors for the original paint layers to parts of the statues. In the light-colored areas, the clay layers were already lost before 2001. The outside of the *sangati* of the Eastern Buddha was also probably mainly pink. [© Catharina Blaensdorf 2019. All Rights Reserved]

of hair in the plaster was a characteristic used to distinguish paint fragments originating from the statues (plaster with hair) from those belonging to the murals of the surrounding caves (plaster layers without hair). On fragments from both statues, the white preparation layer contains white clay minerals, gypsum (probably natural calcium disulphate) and some calcite. On fragments from group 6, it consists of very finely ground gypsum with some calcite.

9.3.4 Paint Layers—Structure and Pigments

9.3.4.1 Oldest Preserved (Original?) Paint Layers

The first preserved layers in the red and blue groups (1, 2 and 5) are currently interpreted as remains of the original polychromy. They appear rather matt, with a soft and porous structure and no discernible craquelure. The thickness of the layers is about 20–50 μ for the reddish layers and up to 100 μ for the blue layers.

The first “red” was in fact a pink, composed of red iron oxide and a white containing white earth and/or gypsum, comparable to the composition of the white preparation layer mentioned above. The pink was of a slightly darker hue on the Eastern Buddha than on the Western Buddha. In cross sections of two fragments from the Eastern Buddha, there is a partial orange layer of red lead on top of the pink (Fig. 9.7, layers 3 and 4). This may indicate a two-layered structure of which the top layer is partly lost, or it may originate from a subsequent decoration, even though orange on pink seems a strange color combination. A third possibility is that an overpainting penetrated between separated older layers.

The blue layers were applied on a dark grey underpainting that was composed of black and white. The black is charcoal black, partly containing rather coarse particles with discernible cell structures (Western Buddha). White earth minerals and gypsum were identified as the white component in samples from the Western Buddha, and gypsum in those of the Eastern Buddha. A sealant layer, discernible by its strong UV fluorescence, was applied onto the grey underpainting before the application of the blue paint layer—probably to impede a contamination of the bright blue by the grey. The blue consists of rather pure and dark ultramarine.

One fragment from the Eastern Buddha (ID 256) probably comes from an area where painting in pink (paint layers as in group 1) bordered blue painting (paint layers as in group 5). A thin red line (based on its color, probably iron oxide) applied before the colours were applied is probably an underdrawing indicating the border between the pink and blue areas of painting.

The fragments of group 6 again differ from the ones of group 1, 2 and 5. The pigments are very finely ground. Ultramarine, red iron oxide and a very pure yellow iron oxide hydroxide were used. On one fragment (Western Buddha, ID 65) a mixture of red oxide and red lead was used.

9.3.4.2 Overpainting Layers

The red parts of both statues show two to three overpainting layers. On the Eastern Buddha the first overpainting was a pink of the same hue (Fig. 9.7, layer 6) as the oldest preserved paint layer. There is a sealant layer with a strong yellowish UV fluorescence between the two pink layers, probably applied as a preparatory layer for the overpainting (Fig. 9.7, layers 5 and 7).

The second overpainting is orange, containing red lead. On the Western Buddha the first overpainting is orange (red lead, Fig. 9.5b, layer 3). In some fragments there are two orange layers, indicating a total or partial repainting. On both statues the red lead has discolored to a considerable degree (Fig. 9.6). Especially on the Eastern Buddha many fragments have turned completely black, probably enhanced by the fact that the red lead layer is thinner than the ones on the Western Buddha. Using XRD, white lead sulfate (anglesite, PbSO_4) was found next to the red lead, which can also be seen as white inclusions in the orange layers. The brown to black transformation products could be identified as plattnerite (PbO_2 , black) and scrutinyite (PbO_2 , greyish to brown).

The discoloration of the orange red paint layers may have been the reason for the last overpainting. A white layer consisting of lead white was applied on both statues, perhaps with the aim of covering the partially blackened surfaces. On the Western Buddha a red layer containing iron oxide was applied over the white layer, which therefore can be interpreted as a preparation layer (Fig. 9.5b, layers 4a and b). On the Eastern Buddha no red layer was found and may never have been applied here (Fig. 9.7, layer 9).

The blue parts were overpainted once on both statues, following the same system as on the original polychromy: a sealant layer served as preparation for the new paint layers. They consist of a grey underpainting (a lighter hue than the original grey), a sealant layer, and a layer of ultramarine. The particles of the ultramarine are finer and the blue has a slightly lighter tone than the original paint layer (Fig. 9.8).

According to the interpretation of fragment ID 256, which shows a transition from red to a blue painting, the blue overpainting was done after the red lead layer had been applied, and thus belongs to the second (orange) or the third (white) overpainting. The reason why the red parts were overpainted more often than the blue ones may be that the red paint was more exposed, or showed more damages or changes that demanded repair. It may also be related to the cost of the pigments, with ultramarine being precious even in Afghanistan.

It is not clear to which parts the brown fragments may have belonged, and if the layers are really paint layers or soil/clay accidentally or intentionally soaked with binding material. Most fragments show two brown layers on top of each other, some with particles in between that may be soil or soot. The layers are translucent and show fine craquelure patterns, suggesting a higher amount of binding medium. The surfaces vary from glossy to matt, scaly to smooth. As some of the red layers preserved underneath the brown layers contain iron oxide, the brown layers may have been either applied rather late or come from parts that deviate from the main system of the red layers of the statues.

The clay suspension applied on all painted surfaces of the statues in 1969–1978 contains diluted earth, gypsum and an organic binder.

9.3.5 *Binding Media, Sealants and Mordants*

Very little is known about painting techniques of clay statues in Asia. Technical literature or treatises from the region and the time of the Bāmiyān Buddhas dealing with painting clay supports are not known. Studies on artistic traditions regarding painting technique and scientific investigations are still rare, and analyses have mainly concentrated on use of inorganic materials and wall paintings, not sculptures. Indian treatises on painting, written between the early Middle Ages (*Visnudharmottara*, dated between the fourth and the seventh century AD) and the sixteenth century mention organic binders and associated materials in all steps of painting on clay plasters, from the preparation of the walls to the final steps of decoration with gold leaf. The named materials comprise gums and saps of plants (probably mainly saccharides),

legume broths (containing proteins and saccharides), the addition of beeswax, and in the later texts, animal glue [13, pp. 11–54; 22, p. 43].

Analyses carried out on fragments of wall paintings from the caves in the Bāmiyān valley revealed the use of different types of binders—proteins (animal glue or egg white), plant gums, natural resins and drying oil—with a different binder or material mixture identified in each layer in the overall painting stratigraphy (i.e., surface of the clay wall, preparation layers and paint layers).¹⁴ This shows that a wide range of organic materials may be present in the samples, including a number that may not have been previously documented or identified through analysis (such as proteins from plants), and are thus more difficult to identify. Furthermore, different materials may have been used for overpainting layers and as restoration materials. Due to the porous structure of the layers and to losses that have occurred over the time, the more recently applied materials penetrated into the lower layers. Thus, it is likely that there has been some contamination of the sampled layers by materials applied later.

Several different analytical approaches were used in studies undertaken between 2007 and 2017. 19 fragments (14 from the Western Buddha and 5 from the Eastern Buddha) were selected as typical representatives of the groups 1–5. From each fragment up to 8 sub-samples were taken following the stratigraphy of the paint layers. CS/MS analyses were performed on all selected sub-samples [1, pp. 265–276], in order to identify polysaccharides, proteinaceous and glycerolipid materials, as well as waxes and terpenoid materials [14, p. 7]. A sub-set of 30 samples from 11 fragments was analysed in order to identify the source of the proteinaceous materials. Synchrotron Radiation micro-imaging techniques (SR- μ ATR-FTIR) were applied to a few cross sections to allocate organic materials to single layers [22, pp. 44–45].

GC/MS analyses proved evidence for the presence of proteins and polysaccharides, while natural resins and drying oils were not detected in any of the sub-samples. Proteins derived from egg, milk (casein) and animal glue were all identified, but in some samples the amino acidic profiles remained unidentified. Protein identification (proteomics) showed that the milk of cows, as well as goats or sheep was used [14, pp. 8–12]. Polysaccharides were found in a third of the sub-samples and always together with proteins. Tragacanth gum was indicated in most cases.

Interpretation of the results with regard to the painting materials and techniques used originally and in later phases is extremely complex, and this work has not yet been completed. Each additional tranche of analysis brought more results, often apparently contradicting earlier analyzes or those of comparable fragments. This can be explained by factors such as contamination by later applications, which penetrated into the lower layers, and probably not in the same way in all parts of the giant statues. The surface of the clay layers and the binding medium layer applied as preparation contains proteinaceous materials. It is possible that egg was used as a binder of the original paint layers, while milk and egg were used in the overpainting phases, although milk was also detected in original layers. Animal glue is never present alone, but is found combined with egg, and only in the top layers of the fragments from group 3 and 4, and thus may be interpreted as a material belonging to an overpainting or restoration. Polysaccharides were also detected in the clay suspension of the restoration of 1967–1978. Thus the last restoration may have been

the source, or a supplementary source, for the saccharide material analyzed in so many samples.

9.3.6 *The Colouration of the Statues*

To understand the principal color scheme of the Buddha statues, it is necessary to assign fragments or paint layers to specific compositional areas. Contemporaneous Buddha statues from Central Asia which are similar in style (although much smaller)¹⁵ show that different areas can be distinguished: the exposed parts of the body and three layers of garments, of which also the lining (inside) may be visible. The flesh tone can be “natural” (i.e. some hue of pink) or gilded. The main garment is the *sangati*, a large rectangular piece of cloth draped around the shoulders, which reaches to the lower legs. Underneath the *sangati*, portions of two undergarments may be visible, which usually have a color different from the *sangati*. Historical photographs of the Bāmiyān Buddhas show that the *sangati* covered the main part of the body. The lining was visible underneath the arms and, judging by the modelling, also at the left side of the neckline. The undergarments were visible below the right arm and at the hemline across the legs, both ending in undulating folds, where small areas of the lining could be seen. Of the shorter garment, ending above the knees, only a very small area was visible. This means that eight areas can be distinguished where different colors were probably used: 1. flesh tone, 2. hair, 3–5. three layers of garments, and 6–8. small parts of their linings (Fig. 9.9).

Historical descriptions of the colors include medieval accounts that were based on the rather well-preserved state of the statues at the time, but these do not provide any details. The medieval sources—as for example that of Yaqut al-Hamawī, who described Bāmiyān in 1218, just a few years before the city of Bāmiyān was destroyed by Genghis Khan in 1221¹⁶—mention a “red idol” (*surkhbud*) and a “moonwhite idol” (*khinkbud*). It can be assumed that these characterizations were based on an overall impression or the dominant colors of the statues. In descriptions from the nineteenth century, paint layers are rarely mentioned, indicating that they were probably not predominant anymore. In the twentieth century, colors are mentioned in the reports by the DAFA and the ASI, but the DAFA expedition did not focus on polychromy, and in the restoration by the ASI, it only played a minor role.

The Western Buddha can be identified as the one described as the “red idol” in the medieval sources. The DAFA and the ASI reports both mention red as the color of the outside of the *sangati*, but no other colors. The Eastern Buddha corresponds to the one described as the “white idol.” If we deduce that this also refers to the color of the largest part of the statue, the outside of the *sangati* would have been white or light grey, a very unusual color for the robe of a Buddha. The DAFA (1934) and the ASI reports (1965 and 1984) mention gold on the flesh tones, of which only the face was preserved (the forearms were already lost and the feet had no clay layers). Red and blue traces are mentioned for the garments: in 1934 “traces of red and blue” were described “on the sleeve.” The ASI report of 1965 gives contradictory information,

describing the *sangati* as “probably blue as opposed to the red robe” of the Western Buddha, but also as “reddish to pink” in a later paragraph [10]. In 1984 Sengupta only mentions blue [11, pp. 31–46].

Xuanzang (writing between 629–645 AD) mentions golden hues and precious ornaments. This may be reflected in a later description published in 1801 in London that mentions “embroidery and figured work” on the robes, and also says that one statue was painted in red and the other either painted in grey or the color of the stone [15, p. 464]. No traces of any decorations of the robes, neither plastically applied nor painted, could be found. There is also no evidence in drawings or photographs, and no mention in descriptions of the nineteenth and twentieth century.

Interpreting these descriptions in combination with the results of the examination led to the conclusion that most of the clay and paint layers of the undergarments and the flesh tones had already been lost before the destruction of the statues. Therefore, most of the preserved fragments probably belonged to the *sangati*. For the Western Buddha, fragments of fold ridges with reddish paint layers are preserved (Fig. 9.3). This supports the assumption that the outside of the *sangati* was of a red tone. Fragments with blue paint layers, which are less frequent, are classified as the lining of the *sangati*. On the Eastern Buddha, the lining of the *sangati* was definitely blue, as parts are still preserved on-site (Fig. 9.2). There are few fragments described as red in the find list, but this may be due to the strong discoloration of the red lead. As red is also mentioned as the color of the robe, the most recent interpretation is that the outside of the *sangati* was painted in red tones, either completely or partially. In the last overpainting, only the white layer, (probably a preparation layer) was applied, not the subsequent red layer. The reason for this is unknown: the question if it was intentional, or whether the work was interrupted by some kind of difficulties, cannot now be answered. However, it would explain the description of the Eastern Buddha as the “white idol.”

The pigments used to paint the statues are widely used all over Asia and were also found on the wall paintings at Bāmiyān [1, p. 260; 16, pp. 37–47]. What seems remarkable is that the original coloration of the outside of the *sangati* was not red, but *pink*. While cheaper materials—iron oxide, rather than cinnabar—were used for painting the largest area (outside of the *sangati*), expensive ultramarine was applied on smaller, but nevertheless still extensive parts. The only identifiable colors are pink and blue. Green, yellow, red, black, or white, as well as metal foils, which are present in the murals of the caves, were not found. This very limited range of colors can probably be explained by the fact that the polychromy of the body and the undergarments was already severely reduced before the destruction of the statues.

9.4 Conclusion

Thousands of fragments of the painted clay surfaces of the two giant Buddha statues of Bāmiyān were rescued from the piles of debris resulting from the destruction in 2001. They provide valuable material for study, allowing a technical examination

of the manufacture and polychromy of the Buddha statues for the first time in their history. Though abundant as material for a scientific examination, the fragments however only comprise a very small part of the original painted surfaces. Questions therefore remain over the complex processes involved in the production of the statues, their original appearance, as well as the physical history.

The most recent interpretation is that most of the identifiable fragments come from the largest area of the statues: the main garment (*sangati*). For the Western Buddha, the outside of the *sangati* was originally pink and was later repainted in orange and finally in red, while the lining of the *sangati* was blue. For the slightly older Eastern Buddha, a similar situation can be assumed. But the outside of the *sangati* may originally also have contained blue areas and partial decorations of which few, if any, traces remain. In the last overpainting, the outside of the *sangati* probably remained white. Two to three overpainting phases on both statues can be dated prior to 977: despite their enormous dimensions, on average the statues were repainted at intervals of about 100 years. The severe discoloration of the red lead may have been one reason for the overpainting of reddish areas. In the restoration of the 1969–1978, most of the colors were covered by a clay suspension ranging in color from light brown to grey.

The analyzed pigments—iron oxides, red lead, ultramarine, gypsum, white clay minerals, and charcoal black—are widespread in Asia. The use of precious ultramarine even for large areas is remarkable despite the extensive deposits of lapis lazuli in Afghanistan. Different kinds of organic binding media could be identified, comprising polysaccharides and proteins from egg, milk of cows and goats or sheep, as well as animal glue. Mostly there is more than one organic material in each layer.

The results achieved to date have answered many questions regarding the polychromy of the Buddha statues and their history, but understanding of the painting techniques used and a reconstruction of their original appearance remain at a very preliminary stage.

Notes

1. Edmund Melzl (1937–2015) lived in Afghanistan between 1956 and 1963. In 1958 he visited Bāmiyān. In 2004 he joined the team working in Bāmiyān to help with the conservation work on-site.
2. Larger repairs seem to be restricted to the twentieth century; they can be distinguished from the original clay layers. ICOMOS XIX [1, p. 225].
3. In 627 Xuanzang 玄奘 (ca. 602–664), travelled from Xi'an (China) to India where he arrived around 630. He described his journey after he returned to China in 645. For his description of Bāmiyān see Beal, S. [17, pp. 50–51].
4. For example, Yaqut al-Hamawi (see Note 16, below).
5. These legends are reflected in descriptions made by Europeans in the 18th and nineteenth centuries: Burnes reported that in the history of Tamourlane (or Tamerlane, 1336–1405) Sherif o deen, Tamerlane's historian, called the statues *Lat* and *Munat*, while in his own day they were called *Silsal* and *Shahmama*, representing king Silsal and his wife [3, pp. 185, 187, 188]. In 1798 Wilford

reported that “*the Muslims insist that they are the statues of Key-Umursh and his consort, that is to say, Adam and Eve*” [18, p. 464, cited in 6, p. 85].

6. In 1843 Vincent Eyre described the eastern statue as male (Eyre 1843, cited in [6, pp. 87–88]; Talbot and Simpson identified the smaller statue as female [5, pp. 303–350]).
7. Thomas Hyde was the first European to mention the Bamiyan buddhas, based on Arab literary sources (Hyde 1769, pp. 129–130, cited in [6, p. 3, reference [19]]). Even in the early nineteenth century, descriptions still based on hearsay were published, for example by Captain Francis Wilford [18, pp. 462–468; 15, p. 464] and Montsyuart Elphinstone [19].
8. For historical descriptions and records of the Buddha statues, see ICOMOS XIX [24, pp. 18–26], compiled by E. Melzl and M. Petzet, with the assistance of C. Blaensdorf.
9. The DAFA was founded in 1922 under the protection of King Amanullah of Afghanistan.
10. Equipment used for the examination: at the Technical University Munich, Chair of Conservation: stereo microscope: Stemi 2000 (Zeiss) and M50 (Leica); cross sections: DMLM (Leica) with camera EC3; polarised light microscope DMLP (Leica) with camera EC3; SEM-EDX (since 2013): Phenom Pro X (Phenom). Roman Germanic Central Museum Mainz: μ -XRF: MiniPal 4025/00 (Philips); Bayerisches Landesamt für Denkmalpflege, Central Laboratory: XRD: PW 1800 (Philips); SEM-EDX: DSM 960 (Zeiss), EDX (until 2012): X-Flash SDD detector (Bruker).
11. The initials GBL = *Großer Buddha Lehm* (Western Buddha clay) and KBL = *Kleiner Buddha Lehm* (Eastern Buddha clay).
12. The find list for the Western Buddha comprises 3672 entries, including clay layers, pegs, ropes and a few other materials. The find list for the Eastern Buddha has 1939 entries, of which 1924 are clay fragments, but the presence of paint layers was not always recorded, due to omissions of a system that had not been fully developed at the start of the project.
13. These numbers are rough calculations, based on estimates of the modelled surfaces preserved before destruction and the maximum dimensions of the fragments in the find list: Western Buddha, surface c. 900 m², fragments max. 23.048 m²; Eastern Buddha: surface c. 700 m², fragments max. 33.793 m².
14. See, for example, analysis of a paint sample from Cave 4 at Foladi [20, pp. 130–131].
15. Observations mainly of clay sculptures from the Museum für Asiatische Kunst, Staatliche Museen zu Berlin.
16. Yaqut ibn-Abdullah al-Roumi al-Hamawi (1179–1229) included a brief account of the Bāmiyān Buddhas in his *Geographic Dictionary*. For a translation, see Barbier de Meynard, C. [21, p. 80].

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Melzl and Bert Praxenthaler worked as conservators on-site and collected the fragments. The investigation included many scientists from different institutions and would not have been possible without their work. At the Technical University, Chair of Conservation, Stephanie Pfeffer, started the examination of the fragments and prepared the cross sections with the help of Vladimir Ruttner, Department of Engineering Geology; Christina Elsässer analysed selected cross sections. Maximilian Knidlberger identified many of the pigments with PLM. The analyses of binders involved many scientists, of whom only the responsible persons can be named here. GC/MS and FTIR: Ilaria Bonaduce and Anna Lluveras-Tenorio, Dipartimento di Chimica e Chimica Industriale, Università di Pisa; Proteomics: Leila Birolo, Dipartimento di Scienze Chimiche, Università di Napoli Federico II, Napoli; Marine Cotte, European Synchrotron Radiation, Grenoble: Synchrotron Radiation micro imaging techniques (SR- μ ATR-FTIR). Ursula Baumer, Doerner Institut Munich: FT-IR of the preparation layer on two samples. Analyses of inorganic components were done by Susanne Greiff, Roman Germanic Central Museum: μ -XRF analyses, Christian Gruber, Bayerisches Landesamt fuer Denkmalpflege, Munich: SEM-EDX, Vojislav Tucic, Bayerisches Landesamt fuer Denkmalpflege, Munich, and Klaus Rapp, Munich: XRD. Radiocarbon dating was performed by Marie-Josée Nadeau, Pieter M. Grootes and Matthias Hüls, Leibnitz Laboratory for Radiometric Dating and Isotope Research, Christian-Albrechts-Universität Kiel. Many more scientists were also involved, for analyses of clay, hair, and plant material (see ICOMOS XIX). Lilla Russel Smith, Staatliche Museen zu Berlin, Stiftung Preußischer Kulturbesitz, Süd, Südost und Zentralasien, Curator of Central Asian Art, kindly allowed close examination of the clay statues from Xinjiang in their collection.

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