A technical analysis on modular systems in the production of Buddhist clay-based sculptures from Karashahr: connecting Silk Road collections in Berlin and London

Silk Roads

RESEARCH

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ABSTRACT

Clay-based sculptures are shown for the first time in dense displays in two galleries of the Museum für Asiatische Kunst (AKu) in Berlin's new Humboldt Forum. These artefacts were brought to Germany by the *Turfan Expeditions* (1902–14)[1] from Buddhist nodes along the ancient northern route around the Taklamakan desert (today´s Xinjiang Uyghur Autonomous Region). Grouped according to their archaeological sites, it is striking to note that almost identical heads and body shapes occur along the various oases, some of which are hundreds of kilometres apart. In this context, their variations can be considered as a phenomenon of modular production. This can be impressively illustrated in the Buddhist architectural layout along the edges of the lowlands of the Tarim Basin through the materials and production techniques of these sculptures. Although the compositions were limited by the naturally occurring materials, the modular character of their production made it possible to create an extensive variety in terms of details. In this pilot case study, two objects are selected to illustrate this modular system.

The two artefacts are both from Karashahr (Chinese: Yanqi 焉耆) from the collections of the AKu and the British Museum (BM), namely a mould made of gypsum (Inv. No. III 7987) and a head made of clay (Inv. No. MAS.1094).

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1 PREMODERN AND MODERN DISPLAY CONTEXTS

The AKu houses around 400 fragmentary clay-based sculptures from Buddhist sites along the northern Tarim (marked with red dots in Figure 1).

These fragmentary sculptures give insights into the art and material culture as well as the religious life of the inhabitants of those Buddhist monastic settlements. They bear witness to the once flourishing Buddhist culture in the first millennium of our time along the northern edge of the Tarim Basin. With the final opening of the Humboldt Forum in the heart of Berlin in September 2022, this collection of Buddhist clay-based sculptures from the AKu is presented to the public for the first time.[2] The objects are arranged according to their archaeological sites around a unique complete reconstruction of a Buddhist cave temple with original wall paintings from Kizil in the Kucha region (Ch. *Qiuci* 龜茲). Around 300 sculptures are shown in large display cases (see Figure 2). As a conservator I assisted Lilla Russell-Smith, the curator of this exhibition, with planning and realising this exhibition module.[3]

Since the interest of scholars and the public in the past century was primarily directed towards the wall paintings, an investigation of these connections has only become the increasingly focus of research in recent years. In this context, the works of Vignato (2021) and Vignato and Hiyama (2022) should be mentioned. The lack of focus on this material is certainly also related to the fact that *in situ* most of the clay-based sculptures have long vanished or been displaced. International research expeditions carried out at the beginning of the 20th century also contributed to the fact that a large number of objects were transferred to various collections worldwide.[4] This decontextualisation makes the study and investigation of the respective fragments themselves more difficult, and as a consequence this situation also affects the understanding of the architectural contexts on site.

Most of the objects in the Berlin collection are heads (many of which belonged to life-size figures) and a variety of mainly, smaller figurative fragments. Furthermore, with more than 30 examples discovered by the Third German Expedition in Karashahr, the AKu houses the world's largest mould collection from this site.[5] Next to other objects, a large number of them are now accessible to the public: https://recherche.smb.museum/?language=de&limit=15&controls=none&collectionKey=AKu*&collectionKey=AKuSudSudostundZentralasien (Recherche SMB museum 2022).

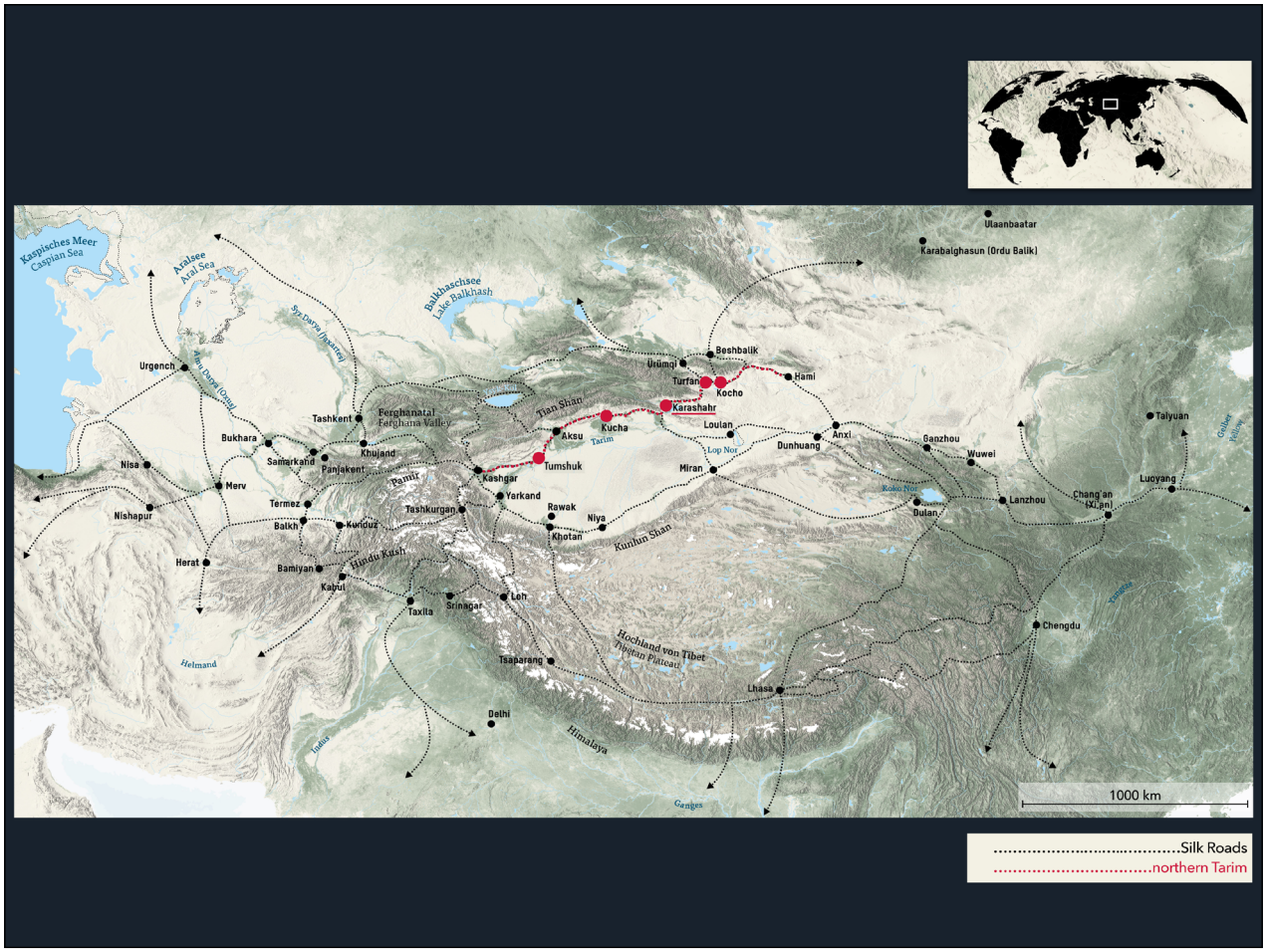

Figure 1 Map of the network of the Silk Roads. Adapted by the author © Staatliche Museen zu Berlin (SMB)/Stiftung Humboldt Forum/ Cartographer: Sheraz Khan.

Even if the hand modelled bodies were already destroyed by the beginning of the 20th century, the heads were often still scattered on the ground, mostly without context. The sculptures were in most cases part of much larger compositions, i.e. originally they belonged to a group of figures and had a meaningful connection with the wall paintings with regard to the content. In addition, they also had a technical connection to the walls, as they were usually attached to them.[6] It is therefore useful to refer to the term *relief* (see below) in this context. Within the decorative scheme, they appeared in different sizes, postures and proportions. The repertory of iconographic figures and types consists of hierarchically arranged Buddhas and bodhisattvas, deities and demons, but also secular characters such as donors, brahmins, monks and nuns. In this case study, the material and technical aspects of two selected objects are examined. They originate from Karashahr (underlined in Figure 1).

One object under consideration is a mould made of gypsum (see Figure 3) that was brought to Berlin in the course of the Third German Expedition (1906–07) and the other is a head made of clay at the BM in London from Marc Aurel Stein's Second Central Asian Expedition, (1906–08) (see Figure 4).

The cross-collection character of this study illustrates that dialogue and networking helps us to advance our research questions beyond national borders. The examination of the materials and the artistic production can help us to understand the transfer and the interactions of typologies and styles of Buddhist

Figure 2 Rendering of a section of the study collection gallery © Photo by the author.

Figure 3 Front and back view of the mould, Inv. No. III 7987 © Photo by the author.

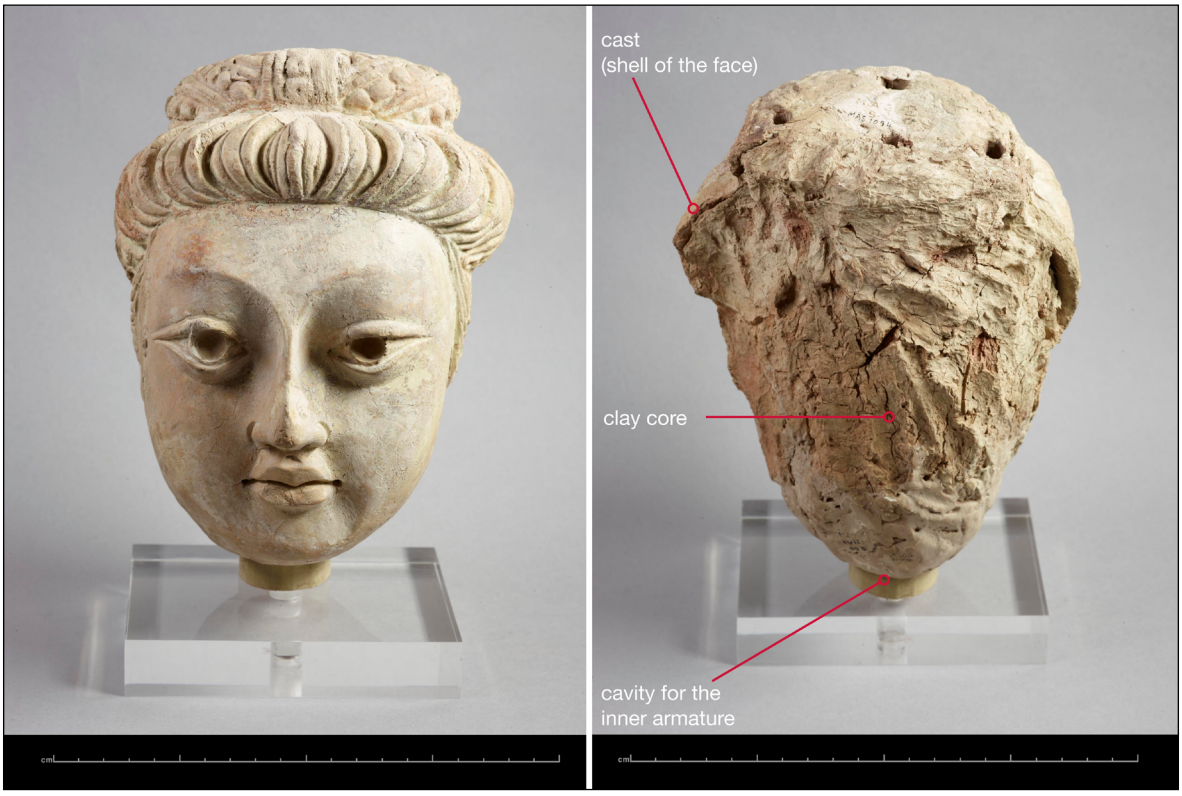

Figure 4 Front and back view of a '*head of a subsidiary male deity figure*', Inv. No. MAS.1094. Adapted by the author © The Trustees of the British Museum.

representations (e.g. forms and motifs) over long distances along the historical Silk Roads. This may also provide explanations of how objects and ideas may have moved within broader cultural frameworks in the long term.

2 RESEARCH QUESTIONS AND METHODOLOGY

In my methodological approach, I understand material culture itself as an important source of information. In the course of my research, each of the 400 sculptural fragments kept in Berlin have been examined by means of identifying different characteristics, based on visual observations and by performing scientific characterisation, using non-destructive and investigative techniques, such as microscopic imaging, ultrasonic velocity measurement and X-ray diffraction (XRD). By studying the materials and sculptural production, we can gain new insights, previously not possible by art historical methods alone.

It is considered undisputed in art historical literature that the repetitive faces with only very slight typological variations can be attributed to the use of moulds (Yaldiz 1987: 143–149).

Within this pilot case study, the applicability of this art historical theory will also be examined on the basis of my results of the technical and material investigations.

In addition, the topic of (partial) *terracotta*s represents a further focus of this study: Already at the beginning of the preparations for the exhibition and during the inventory and examination, it became apparent that the fragments of this large corpus of clay-based sculptures differ in terms of their material compositions, quite independently of their archaeological sites or size classes. My working hypothesis resulting from this, namely that some fragments or at least parts of fragments were apparently fired, will be discussed in more detail here. Therefore, thanks to the various data on historical and technical studies, these two objects, namely the mould made of gypsum (Inv. No. III 7987) and a head made of clay (Inv. No. MAS.1094), are brought together and placed in a meaningful context here for the first time.

I also argue that heads in particular have survived so well because of their more complex manufacturing technique. First of all, they are usually produced from the combined techniques of modelling and moulding, which meant that they were heavier than other fragments.

On the basis of these two examples, the question will be explored to what extent the possibility exists that certain parts of some sculptures were fired on purpose.

This working hypothesis presented in the course of this article offers another possible explanation for why some parts, such as heads, have been so well preserved. Furthermore, the possibility of an intentional firing process provides new insights regarding the production

of sculptures along the Silk Road, as it has always been assumed for fired objects that this condition occurred unintentionally (for example, caused by sites devastated by fire).

As a first step all accessible information was collected on the basis of archival research and previously published literature on the history and contexts of both objects. This was followed by a technical study, in an attempt to identify the manufacturing technology by recording the objects´ various material characteristics, ranging from simple visual observations (with and without the aid of magnification) to the scientific characterisation of their composition and microscopic structures, using analytical equipment, such as X-ray diffraction analysis (XRD).

3 MATERIALS AND TECHNIQUES

Regarding the region of interest, namely the archaeological sites along the northern Tarim, it must be noted that there are only a handful of technical investigations, for example Jo (2013), Wu (2018), and Vignato (2021) that explicitly focus on clay-based sculptural production. As mentioned at the beginning, the wall paintings have been studied intensively in the various collections and the structures have been studied *on site*. Research on the sculptures, on the other hand, is almost non-existent. Rather, comparisons must be made with the neighbouring regions of 'Greater Gandhāra'[7] in the west and 'Dunhuang and beyond' in the east, as more research has been conducted on these areas in recent decades.[8] In this context, I would like to highlight the work of Giulia Forgione (2021).[9]

To better understand the materials and techniques used in the art and architecture in the oasis sites along the edges of the Tarim Basin, it is advisable, in a first step, to put the attention on the climate and the naturally available resources in these regions because they were closely dependent on these factors (see chapter 3.1).

Next to that and based on these two examples discussed in this article, I would like to draw the attention to the often very confusing and misleading terminology with regard to the materials, discussed in chapter 3.2.

In the following the paper will focus on two techniques of working in clay, namely modelling (chapter 3.3) and moulding (chapter 3.4).

3.1 CLIMATE AND RESOURCE DEPENDENCIES IN ART AND ARCHITECTURE

Timber was used in architecture and art, but was a precious resource. Next to large reeds beds, there were tree populations along the northern and southern edges of the Taklamakan Desert. The occurring stone on the other hand, was of poor quality and was therefore not suitable as a building material or for sculpting. The conglomerate rock in this desert landscape has no sculptural quality, which explains why the vertical (i.e. sitting or standing) figures were modelled on a supporting framework above a certain size class (see below).

Naturally occurring clay-based mixtures, composed of weathering products, are the most common geological formations in these regions. Clay is a very complex sedimentary rock and forms the top layer of loess deposits. It varies in terms of its composition and properties, depending on the conditions of its formation and its origin (Baimatowa 2008: 26). This material is found everywhere in abundance. Clay loess soil, forming the foothills of the mountain ridges and the fertile fields of the lowlands, has therefore been the most important building material in the rock-cut and surface architecture and art along the Tarim. It could be prepared and processed for use as adobe bricks, for plastering and for modelling. Thus, it is essential to define the term 'clay'. Next to clay, that region is blessed with mineral wealth including gypsum, a common soft mineral of sedimentary nature, see below.

Monastic Buddhist settlements were often dug into steep eroded slopes as the porosity and softness of these sedimentary rock formations that made digging possible. This cave architecture was complemented by surface buildings, which certainly predominated in number. The characteristic rock-cut architecture has survived in parts until today and the monastery complex of Kizil is one of the most famous examples in this respect. Little of the surface buildings has been preserved. In this context, Vignato's (2016: 81–88) research on the adobe building techniques in the architectural ruins of Kocho in eastern central Asia is important. Another publication (Schmidt 2023) explains in more detail why in the clay-based sculptural production of this region, the modelling and moulding techniques had developed to such a high technical level that they were practised for centuries.

3.2 TERMINOLOGY OF MATERIALS AND TECHNIQUES

In regard to the knowledge of the materials and technical processes of these objects, there is a great deal of disagreement and the literature often contains misleading and confusing terms and incorrect material designations. This arises due to the languages being used or the fact that different disciplines each use their own professional terms. Here I give preliminary definitions of the terms relevant to this research to maintain continuity in the context of this paper. However, in the longer term, it would be beneficial to develop an index of terms with regard to the aspects of the Buddhist clay-based sculptural production in order to be able to describe and compare them with each other, regardless of their archaeological site.

Almost fifty years ago, K. M. Varma (1970: 109) already stated in a chapter on 'the problem of nomenclature'

that there is no clear idea of the distinct connotations of the words stucco, terracotta and (unbaked) clay figure.

According to Varma, for many Indian archaeologists, any small clay figure, whether fired or unfired, is considered '*terracotta*'. Likewise, any [unfired] clay figure of medium or large size is referred to as '*stucco*'. Stein certainly contributed to much confusion here (Varma 1970: 112) and in his texts there are countless examples of the misleading use of the term '*stucco*' for clay-based figures. In this context the object designation of the head discussed here, can be cited as an example (Stein 1921, Vol. III: 1218 & https://www.britishmuseum.org/collection/object/A_MAS-1094) (British Museum 2022). The head in London is made of clay not stucco.

Since this paper discusses 'clay-based' sculptures, a definition of the term 'clay' is essential. The word is commonly used by geologists, mineralogists, ceramologists, potters, archaeologists and art historians but, depending on the discipline, it often means different things. Clay (geologically) is a textural term, referring to grain size. Based on Guggenheim & Martin (1995: 257–59) the term 'clay' refers to a naturally occurring material composed of fine-grained 'clay minerals' (phyllosilicates and other materials that impart plasticity at appropriate water contents), silt, sand and gravel of various sizes and natural temper (such as minerals, bioclasts or organic matter). The 'clay minerals' form the binder in the clay, since their structure enables them to retain water. In summary, clay is a clastic sedimentary rock, generated by the accumulation of very fine particles on the Earth's surface (Gualtieri 2020: 2).

In art and architecture, clay can be used as a plastering material or in the form of sun-dried adobe bricks and rammed earth by adding intentional temper (such as minerals, bioclasts or organic matter like fibrous materials and/or animal hair). When discussing clay constituents, the term 'clay mineral' is useful. It refers to the phyllosilicate minerals and to minerals which impart plasticity and harden upon drying or firing.

When I use the term 'clay-based' I am referring to objects made from natural occurring sediments comprising a predominance of variable amounts of clay-size grains (the majority of which are clay minerals) and of variable amounts of silt-size and/or sand-size particles and natural temper, see definition above. In addition, here clay-based sculptures are defined as objects which, if not explicitly mentioned, are usually unfired.

It is therefore relevant that fired clay-based material, such as 'terracotta' is also discussed here. In literature, terracotta (unglazed), pottery and fired building construction materials made of clay (such as bricks and tiles) are classified as ceramics (Geschke 2019: 11). These consist of a clay mixture, which can often be characterised by an increased proportion of binding agents, i.e. 'clay minerals', see definition above. [When I refer to this clay mixture in the context of this paper I use the expression '*purer/purified clay*'.] The temper also differs if the clay mixture is intended for firing/further clay processing. The transformation of clay into ceramics takes place during firing, depending on the material composition, between 350°C and 700°C. During this temperature range, chemical changes take place in the crystal structure of the clay minerals, which lead to greatly altered material characteristics. The most obvious is that unfired clay decomposes into slurry in water, whereas ceramics are waterproof. Through firing, clay irreversibly becomes ceramic. The term 'clay' is no longer appropriate for fired objects.

'Slip' is sometimes used on ceramics to hide an imperfect tone (unattractive colour, inhomogeneous texture, etc.) or to create a whitish ground for painting. Slip is diluted or semiliquid *purer/purified* clay, either white or coloured, applied to surfaces before firing (Encyclopaedia Britannica 2022).

'Stucco' is a term often used imprecisely, as mentioned above. Middleton and Gil (1996: 363) have captured the problem regarding this term very precisely. Verri et al. (2019: 138) have written a short chapter on this topic entitled 'Stucco: lime, gypsum or clay?' in a publication on the investigation of a Gandharan 'stucco' head. They capture the central problem very precisely, but also provide systematic and comprehensible definitions, namely: stucco describes '[...] a plastic material that, upon setting, hardens to a solid, dense material, which is relatively durable. The plasticity of the material allows it to be modelled and moulded in complex sculptural forms.' From a material scientific perspective, the term 'stucco' therefore refers 'exclusively [...] to lime-($CaCO_3$) or gypsum-($CaSO_4$)-based compounds, which are the binding agent and whose properties can be modified by the addition of aggregates, such as sand and straw, and additives, such as organic materials, including gums, proteins, oils, etc.' Therefore, clay-based compounds are not included in the definition of stucco.

'Gypsum' is a common soft mineral of a sedimentary nature, a naturally occurring calcium salt. It is commonly known in its dihydrate form, $CaSO_4 \cdot 2H_2O$ (Encyclopaedia Britannica 2022). When heated to a temperature in the range 100–190°C three-fourths of the chemically combined water is driven off leaving the hemihydrate about 120°C it loses three-quarters of its water, becoming the hemihydrate $CaSO_4 \cdot {}^1/_2H_2O$, the so-called 'plaster of Paris'. When water is added to the hemihydrate, it reverts to its original chemical composition (Gourdin and Kingery 1975: 135) and can be modelled or moulded into shapes before it hardens by recrystallising to dihydrate form. It has been presented here in conclusion, as it is a component of the mould discussed in this paper.

3.3 THE TECHNIQUE OF MODELLING IN CLAY

Interiors of the Buddhist temples were decorated with an overall composition (*Gesamtkunstwerk*), consisting

of wall paintings and sculptures which refer to each other and were also technically connected to each other. The construction of the walls was therefore based on one material, namely clay (see definition above). The wall structure was partially made of adobe bricks, and sculptures and wall paintings were built up by layers of clay. Technically, the wall paintings and the sculptures were created in synchronised steps. They should therefore be studied together but this has rarely been the case.

Due to the climate and resources, this was basically a 'modelling school.'[10] The sculptures were thus built up, layer by layer, using mouldable and plastic clay-based plasters. Depending on decisive factors such as the size class or also the height of the reliefs/sculptures, they were also modelled around an inner armature, made of different materials such as wood, reeds and/or or straw, see below and Table 1: Preliminary systematic overview of the figurative reliefs within the Berlin collection. However, in the cases of the Buddha in a *paranirvāna* posture, the platform was carved out of the rock (Vignato 2021: 111). But the reclining figure itself was also modelled in clay.[11]

Regardless of whether rock cut or surface architecture, the three-dimensional sculptures and the lavish decorative features in architecture usually always appear in connection with the two-dimensional wall and can therefore be much more accurately described as 'reliefs'.

In addition, numerous statues existed in the round, especially representations of the Buddha in various postures. These served as the main image. In terms of materiality, these figures were not all made of clay; materials such as wood were also used. This made some of these figures portable, which would make sense in a ritual context. Vignato (2021: 105) deals more intensively with this topic. My research is mainly focused on clay-based relief sculptures, as these make up the main part of the Berlin collection. The height of the reliefs varies depending on the size class, posture and position (but also typology) of the figure within the architectural arrangement.

These factors, i.e. size, posture and position, therefore have a significant influence on the modelling (and moulding) techniques, or are mutually dependent and must be considered in context. It is therefore necessary to present a first classification into different size classes.[12]

This classification is based on the inventory of the entire corpus of fragments in the Berlin collection, which consists mainly of heads and only a few, almost completely preserved, figures. Due to their mainly fragmentary nature, these are estimates. The size of the surviving head is considered in relation to the lost body. The posture of the figure is often unclear. Whether the statue standing or sitting, or made in the posture of a half-figure or bust is often unknown. Relevant therefore, is the proportion based on the average dimensional ratio of a human body. Today the most common unit of measurement is the head of the figure, and the figure is generally thought to be between 7.5 and 8 heads tall.

But we also need to compensate for the perspective distortions due to the partially restricted view inside the

SIZE CLASS (in cm) (HEAD + BODY)		TYPE OF RELIEF	ANCHORING OF THE BODY TO THE WALL	INNER ARMATURE	HEAD	ANCHORING OF THE HEAD TO THE WALL
small	…–50	*low/bas relief	back side is fully connected = constitute a whole with the rear surface	not required	low/bas relief or high relief	back side is fully connected
smaller than life-size	50–150	**high relief	back side is fully connected = constitute a whole with the rear surface + **tenons** (?)	not required (?) or: bundles of reed/straw + (partly tied around with ropes)	high relief	back side is fully connected (?) + **tenon** (?)
life-size	150–170	**high relief & *** very-high relief	back side is fully connected = constitute a whole with the rear surface + **tenons**	bundles of reed/straw + (partly tied around with ropes) and/or a wooden frame	very-high relief	**tenon**
larger than life-size – monumental	170–…	***very-high relief	**visible** (?) **tenons** & **beams**	wooden frame made of beams + partly tied around with ropes (?)	very-high relief	**tenon**

Table 1 Preliminary systematic overview of the figurative reliefs within the Berlin collection.

Reliefs are classified according to the height of the figures' projection or detachment from the background.

*Low/bas relief: Figures are modelled on a flat surface so that they project only slightly from the (back)ground, there is little or no undercutting of outlines.

**High relief: Figures project at least half or more of their natural circumference from the background and may in parts be completely disengaged from the background/parts can be modelled fully in the round.

***Very-high relief: Figure is almost in the round and does not constitute a whole with the rear surface, as it is only partially connected to the back wall.

sometime narrow architectural arrangement, I assume, that the heads under investigation were proportionally larger. I therefore calculate that the figure is about 7 heads tall.[13] Based on my system, a figure is understood as 'life-size', for example, if its original total height was approximately 150–170 cm, whereby it is less a question of an exact specification in centimetres, but rather of an approximate orientation and classification that makes it possible to present a first overview here.

Depending on the size and layout of the interior and the pictorial composition, the figures varied in height from:

(1) small sizes (head and body; up to 50 cm)
(2) smaller than life-size statues (head and body; up to 150 cm)
(3) life-size statues (head and body; 150–170 cm) and
(4) larger than life-size/up to monumental statues (head and body; 170–... cm).

In this study I do not distinguish between *monumental* and *colossal* or *giant* statues. If the statues are several metres high, as is quite common with the main Buddha images, I use the term *monumental*. This lack of distinction is based on the one hand on the effort to create a uniform terminology here, because these oversize sculptures gave their name to one type of caves namely the *Monumental Image Caves* (Vignato 2021: 2). Furthermore, there are no *colossal* or *giant* Buddhas in these regions, as we know them in height from Bamiyan, for example, because the technique of modelling would not have allowed them to exceed a certain height.[14] Depending on the size class of the figures, different relief types appear at different heights. I use the following preliminary classification to distinguish them (see also Table 1). Reliefs are classified according to the height of the figures' projection or detachment from the background.

'Low/bas reliefs' can be cast from moulds, mainly due to the technical properties of the casting process.[15] But they are not necessarily made from moulds, and some were certainly also often modelled freehand. Figures are modelled on a flat surface so that they project only slightly from the (back)ground. Furthermore, as I understand it, the lavish decorative features in architecture also belong to this category. Their back sides are fully connected to the walls, so that they constitute a whole with the rear surface. Due to their small size (head and body; up to 50 cm) and low-relief, they do not necessarily require an internal armature. Sculptures which are smaller than life-size and life-size often appear in 'high relief', i.e. they project at least half or more than half of their natural circumference from the background.

They are often also fully connected to the rear wall, so presumably did not require any additional anchoring in the form of tenons. Due to intensive restoration treatment, which was carried out on these sculptures after they entered the Berlin collection, no traces of tenons are left anymore on the backside of almost all objects. Cavities may have been covered. As far as the anchoring systems and the inner armatures are concerned, this first classification is mainly based on a technical understanding and does not claim to be correct. There is still a need for research here and the possibility of an additional attachment to the wall cannot always be ruled out in principle.

In the case of life-size statues, it can occur that parts are completely disengaged from the background. These parts (such as the arms, for example) are then modelled completely in the round. From a certain size onwards, figures in high relief could also carry an internal armature, which could consist of straw or reed bundles (see Figure 5).

Figure 5 © Dyakonova 1995: 214, plate 69 & Dyakonova 2011: 294.

Due to the lack of material evidence, however, it is difficult to define the size at which an internal armature was required. Again, there is a correlation between the size class, the height of the relief and the position and posture of the figure. And even a distinction from 'very high relief' cannot be made clearly and unambiguously in some cases. This last category can be defined by large parts of the body that are completely modelled in the round (such as the projecting parts like the arms) and do not constitute a whole with the rear surface anymore. This type of relief, which characterises above all the large, monumental figures, necessarily requires a solid, inner supporting framework, generally made of wooden beams. At this size, tenons are necessary to anchor the statues to the rear wall (and the floor), and the construction of the inner armature had additionally to be connected to the wall. Only a small part of the modelled sculpture itself is still connected with the wall. Since these anchoring systems mean that the sculptures no longer form a unit with the rear wall, the term 'very high relief' can be used here to distinguish them from the panels with reliefs ('the high reliefs').

Along the northern Tarim it was rare, but quite possible, for monumental Buddha statues to reach a height of over 15 metres (such as the colossal Buddha in cave 47, the tallest statue that was hosted in a cave of Kucha), as indicated by the marks of their installation on the walls (Howard & Vignato 2015: 75).

The attempt to provide an initial overview here can be completed by a very pertinent statement by Forgione (2021: 147), namely that, 'as a general guideline, the artists clearly developed skills that cannot be schematized in fixed rules but may rather indicate areas of diffusion, economic aspects or chronological frames of reference.'

Irrespective of these categories and criteria, however, what all sculptures have in common is that they were constructed 'by proceeding from the inside [...] to the outside [...], modelled [...] from overlapping layers of progressively purer clay [...].' (Forgione 2021: 147)

Chopped straw, animal hair and plant fibres were added to the first layers to reinforce these coarse layers. The hand modelling of the figures was done *in situ*.

It can also be postulated, based on a theoretical but technical understanding, that from a certain size class, usually life-size, heads were made separately and attached afterwards.

Depending on their height and position in the interior, heads were very often almost fully round (Vignato 2021: 115) and due to their different production technique often comparatively heavier than the bodies. After the (life-size and upwards) bodies have been hand modelled immediately on the walls, the heads were anchored to the torsos by inserting them onto the inner armature (see Figure 6). Above a certain size, it was necessary to additionally secure each head to the wall by a wooden peg [tenon], see also Vignato (2021: 102 & 115).

Whether fine-modelling with layers of *purer/purified clay* was carried out on the bodies before or after the heads were attached has not yet been clearly clarified, or may also vary. However, it is considered certain that a thin layer of gypsum plaster (plaster of Paris) was usually applied to the entire figure as a painting ground. To adhere to the dried clay plaster layer, this was certainly modified with an organic binder and without

Figure 6 Front- and back view of a head that belonged to a (larger than) life-size figure. Inv-No. III 4502 Kocho (Turfan region) © Photo by the author.

additives, the mix tends to set quickly.[16] Various paint layers, consisting mainly of mineral pigments and plant or animal binding agents, and in some cases also gilding, were applied in the last steps.

3.4 THE TECHNIQUE OF MOULDING IN CLAY

That certain modules such as parts of the heads of (up to) life-size sculptures were cast from moulds, or that smaller figures were even partly completely moulded in low/bas relief, is considered undisputed.

Regarding the heads, the moulds were apparently used to cast shells or masks of faces. That 'shell/mask of the face' is cleary visible by a well-defined boundary (see Figure 4 (right)) 'and appears to have been cast as a hollow shell' Middleton and Gill (1996: 365). Moulds were discovered by the numerous expeditions at various sites along the northern and southern Tarim and some of them were also transferred to various collections, the most important being Berlin, St. Petersburg, Paris and London.

Based on these finds, it can be seen that the local workshops produced portable moulds for the production of a wide variety of motifs and figures from the Buddhist iconographic canon. They came in various sizes, from the miniature, a few centimetres high, to almost 70 cm high (see Figure 7). They were mostly representations of faces, body parts or low/bas reliefs of ornamental decorative elements. As the spaces between the figurative images were filled with landscape elements such as rocks, trees or architectural motifs, there were also partial moulds of appliqués for these.

Usually, the moulds were made of gypsum plaster (mixed with temper such as quarz sands), but smaller ones (a few centimetres only), such as an exhibit in Paris, could also be made of clay (*terre sechée*) (see Figure 8). By combining the hand modelled body parts with the casts made from the moulds in different ways, a great variety of figures, poses and attributes could be created with a small number of moulds.

Thus, one and the same mould of an ideal-type face served to produce a wide variety of heads finished by hand-modelling.

Vignato (2021: 116) suggests that the [shells of] bodies of life-size or slightly smaller statues may also have

Figure 8 'Moule à l'intérieur d'un visage plus grand et empreinte'. Inv. No. MG 17742 from Tumshuk, Musée Guimet © Photo by the author, 2022.

Figure 7 Inv. No. III 7981 from Karashahr © Photo by the author.

been partly made from moulds. However, our opinions differ on this point, as it would be much more efficient in terms of manufacturing techniques simply to carve drapery folds freehand into the still moist clay-based plaster modelled *in situ*, instead of elaborately producing them from heavy mould parts. Furthermore, there is no material evidence for the existence of moulds of such sizes. I therefore assume that monumental figures were largely hand modelled *in situ* without the use of moulds. This does not exclude the possibility that certain parts of the body (e.g. the heads) were modelled separately and then attached to the figure in a later work step, but in those size dimensions that was probably done without the aid of moulds.

In summary, it is reasonable to assume that the bodies of larger sculptures (life-size and taller) were hand modelled in clay at their intended place of purpose, usually indoors, very often in high relief. The heads and moulded parts of the bodies, such as the shells of faces, different appliqués and decorative ornaments, did not necessarily have to be made on site, but may have been cast (and finished by hand modelling with regard to the heads) in nearby workshops. They were then merely attached to the bodies along the walls that had already been pre-modelled there by hand and often stood on pedestals.

Middleton and Gill (1996: 365), suggest 'that shells could have been attached to the plastered wall using a quantity of coarser stucco as a 'cement'. Such a process would result in the hollow shell of the 'face mask' being filled by the coarser stucco. In some instances where fragments of the wall plaster remain attached to the figure there appears to be a sharp boundary between the figure and its 'background' [...]. This would seem to support the notion that a separate entity has been affixed to the wall rather than having been modelled in situ.'

The heads (very often in very-high relief or even almost in the round and so required additional fastening to the architecture) were each stabilised and fixed by means of a wooden tenon to the walls (as indicated based on the traces *in situ*).

Like most other collections around the world, Berlin houses only a few, almost entirely preserved life-sized sculptures, which of course makes the study of these figures immensely difficult. Material evidence is scarce for these objects and one has to rely on the archaeological reports, the historical photos of the expeditions and the actual situation on the walls *in situ*.

In summary, however, it can be said that these figures were made of modelling and moulding techniques that could have been combined from a certain size class upwards.

Understanding the respective techniques and being able to distinguish between them can, in the long run, assist in addressing the main themes and questions of this article. Both techniques offer opportunities but also have their limitations: For instance, the technique of modelling, as highlighted in chapter 3.3, permits the creation of figures of various sizes, facilitating rich and dense compositions. However, due to clay's material properties, modelling can only be achieved up to a certain height.

Chapter 3.4 further illustrates that by incorporating moulds, which led to the replication of specific parts, a myriad of variations could be achieved, and production processes were expedited. Nevertheless, moulds themselves could only be produced up to a certain size. The working hypothesis addressed in this article regarding the firing of certain parts can only be understood in the context of 'the Technique of Moulding in Clay' since only parts produced from moulds might have been intentionally fired.

4 THE CASE STUDY: ON THE HISTORICAL CONTEXT OF THE OBJECTS

The archaeological site of *Shikchin* (Ch. Qigexing 七個星/ Xigeqin 錫格沁 (derived from *Shikchin*) with its temple complexes is situated 25 km southwest of the city of Karashahr (underlined in Figure 1). Albert Grünwedel, the German expedition leader, named this site *Shorchuk* (see Figure 9). About one kilometre away, at the foot of the mountain northwest of *Shikchin*, are a series of 13 caves which were the main focus of his investigation. When Grünwedel refers to the 'Ruins at Shorchuk', he includes the surface as well as the rock-cut architecture.

Stein, on the other hand, worked primarily in the adobe buildings (Stein 1921, Vol. III: 1183–1223). The surface architecture of the main complex comprised more than one hundred individual buildings, which in Stein's opinion served exclusively religious purposes. All were built of sun-dried [adobe] bricks, the larger ones sometimes reinforced with daub and wattle. Stein named this study area, consisting exclusively of surface architecture, *Ming-oi* (see Figure 10). Sergei Fedorovich Oldenburg from Russia (1909–10) also excavated here, using the name *Shikchin* for the entire complex.[17]

Documentation thus exists independently in German (Grünwedel 1912: 191–211), English (Stein 1921, Vol. III: 1183–1223, with the respective illustrations in Vol. IV) and in Russian (Oldenburg 1914). Each uses different criteria for surveying the ruins. For example, the photographs taken by Samuil M. Dudin (1863–1929), who accompanied Oldenburg on his second expedition (1909–10), document the presence of extremely condensed compositions consisting of sculptures that decorated the walls and passages (see Figure 11).

As for the condition of the site at the beginning of the 20th century, Grünwedel repeatedly gives only scattered descriptions in which he refers, quite generally, to the 'destruction'. For example, he discusses the clay sculptures damaged by the frequent downpours, as well as fire debris found (e.g. in cave 5). In connection with another cave (3a) he mentions, among other things, that a fire had also devastated it (Grünwedel 1912: 196). In

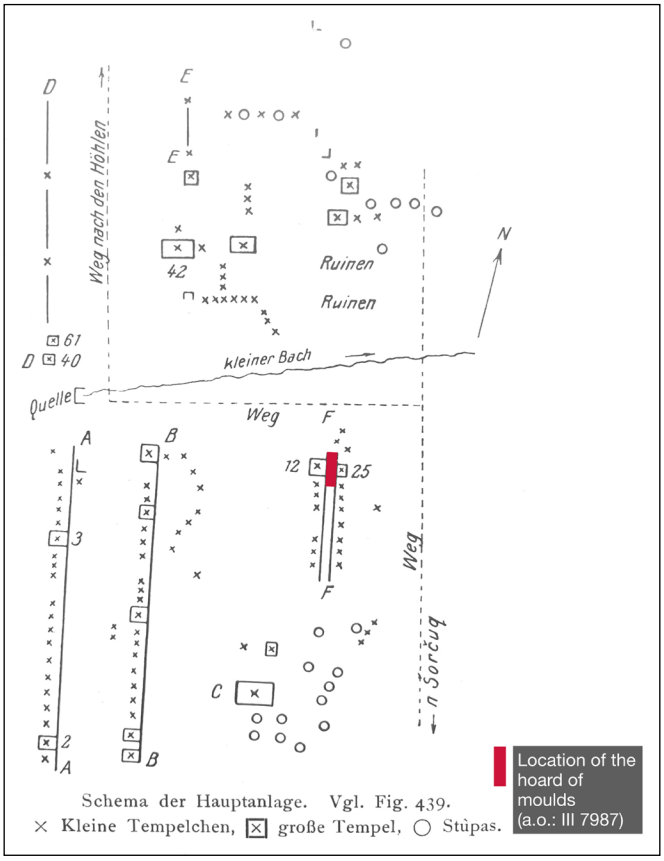

Figure 9 Schematic map of the main complex, drawn by Grünwedel 1912: 192. Adapted by the author.

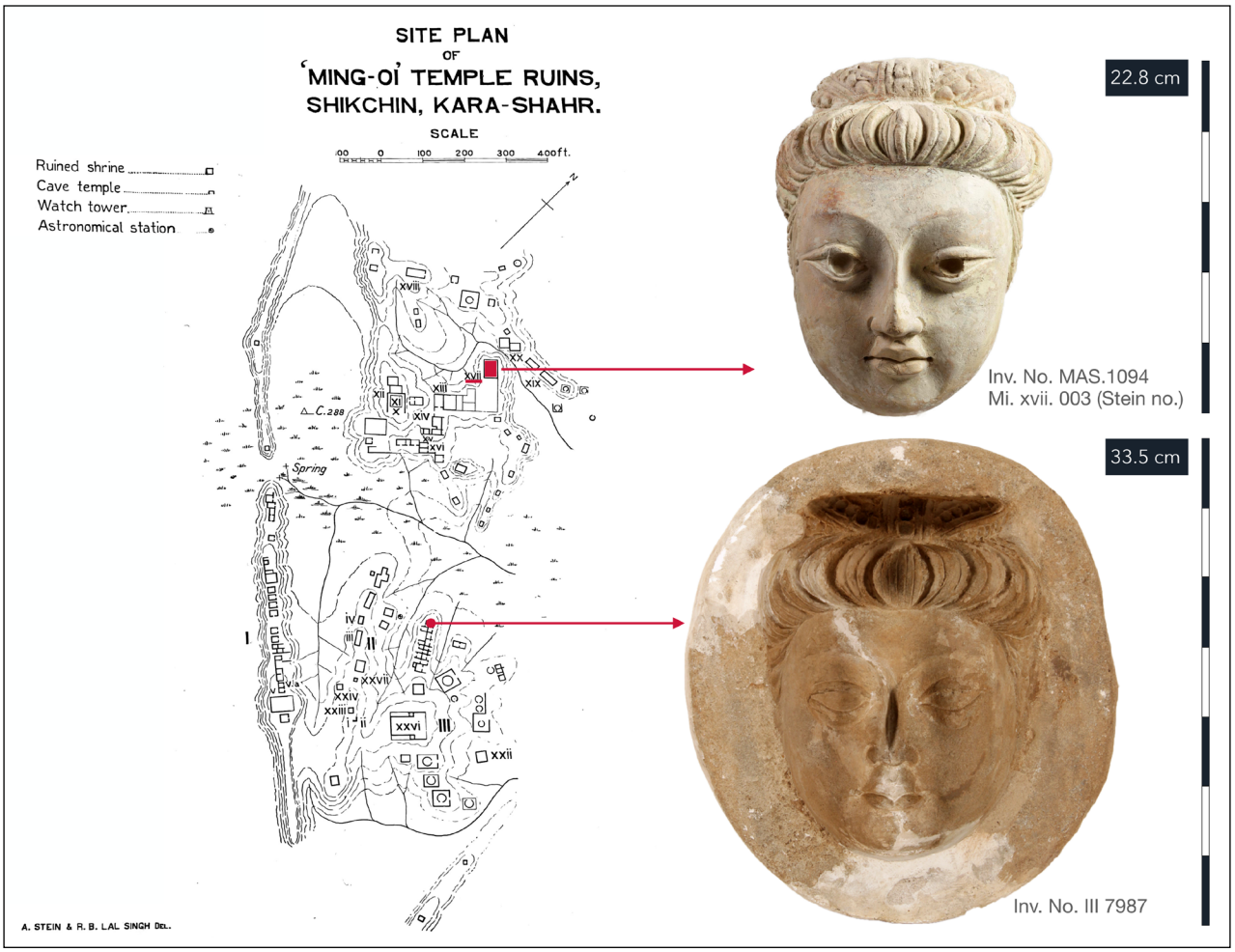

Figure 10 Ming-oi Temple Ruins drawn by A. Stein & R.B. Lal Singh Del. Adapted by the author © Stein (1921): Vol. III, Plate 51).

Figure 11 © Dyakonova 1995: 179, plate 34 & Dyakonova 2011: 239.

contrast, Stein's chapter on 'Kara-shahr and its Ruined Sites' (Stein 1921, Vol. III: 1177–1224) deals in great detail with the immense degree of destruction of this site [*Ming-oi*]. He clearly attributes this to a large fire. For him it is obvious that the damage caused by fire is more serious than that caused by moisture (Stein 1921, Vol. III: 1187). His observations of the larger buildings, in which many combustible materials such as timber were used and which then collapsed due to the fire, indicate that at this time the masonry and the ornamental figures were fired and hardened. In his opinion, this transformed the previously unfired, mainly smaller clay relievos into terracottas. This hypothesis is discussed below.

4.1 PHYSICAL AND TECHNICAL HISTORY OF THE OBJECTS

Although the mould under discussion here is not explicitly mentioned by Grünwedel (1912: 192), it can be assigned to a hoard of finds of more than 30 objects, which was discovered in 'a room between 12 and 25'. The location of this hoard and its context is marked in Grünwedel´s schematic map of the main complex in Figure 9. Stein also mentions this important find. According to Stein's plans, the site corresponds to two rooms (cella) of group 11 (Stein 1921, Vol. III: 1190), see also Figure 10. It is worth mentioning the carvings in the form of inscriptions on the back (see Figure 3), which can be seen on a large number of these moulds. This one shows a Brahmi inscription and is an artist's signature. Unfortunately, it is not yet clear which language it is.[18]

The documents and archival research with regard to the conservation history of this mould, give rather sparse information. Today, one can assume from the surface appearance that preserving agents such as shellac were used (Ulrich 1964: 73–78). These were presumably applied in their function as release agents since historical copies of this and other moulds were made in Berlin. A head cast in clay (Inv. No. III 8251(2)) and one cast in gypsum plaster (Inv. No. III 8251) were also produced in this context (see Figure 12). As these were also cast from the historical mould, a release agent was necessary. Next to that, the holdings of the archive as well as the main account books of the museums in the Zentralarchiv der Staatlichen Museen zu Berlin (Central Archive of the State Museums in Berlin) provide evidence that gypsum plastering on the back of the clay-based objects was being carried out into the 1930s (Gabsch 2012: 39–40). This makes a systematic study of the inner armatures

and their technical construction in general immensely difficult. In the long term, this will require the use of technical investigation methods such as Computer Tomography (CT).

The head now in London, MAS.1094, was given the site object identifier Mi.xvii.003 by Stein and is illustrated in Stein (1921), Vol. IV, plate CXXX, (see Figure 13).

In *Serindia*, Stein describes the location and context of this, among others, almost 'life-size head' (Stein 1921, Vol. III: 1198) and accompanies his documentation with an exterior view of the ruin of this striking shrine with his assigned number xvii (see Figure 14).[19]

Two other heads with the Stein numbers Mi.xvii.004 (see Figure 13) and Mi.xvii.005 (see Stein 1921, Vol. IV: plates CXXX, CXXXI) were discovered here in the rubble. Mi.xvii.004 has today the inventory no. MAS.1095. Mi.xvii.05 is marked in the index to *Serindia* as to be sent to India,[20] but I have not been able to find it on the online collections of the National Museum, New Delhi (National Museum, New Delhi 2022).[21]

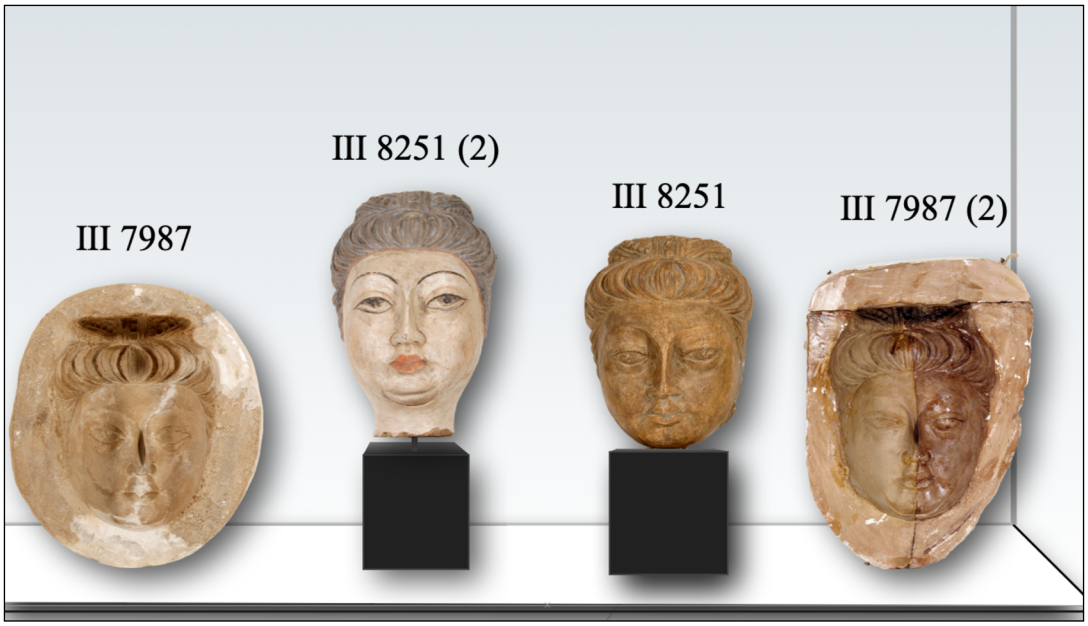

Figure 12 Detail from the exhibition plans for the Humboldt Forum © Photo by the author.

Figure 13 'Stucco Relief Heads from Buddhist Shrine, Mi. xvii, 'Ming-oi' Site, Kara-Shahr' © Stein 1921, Vol. IV: 1218.

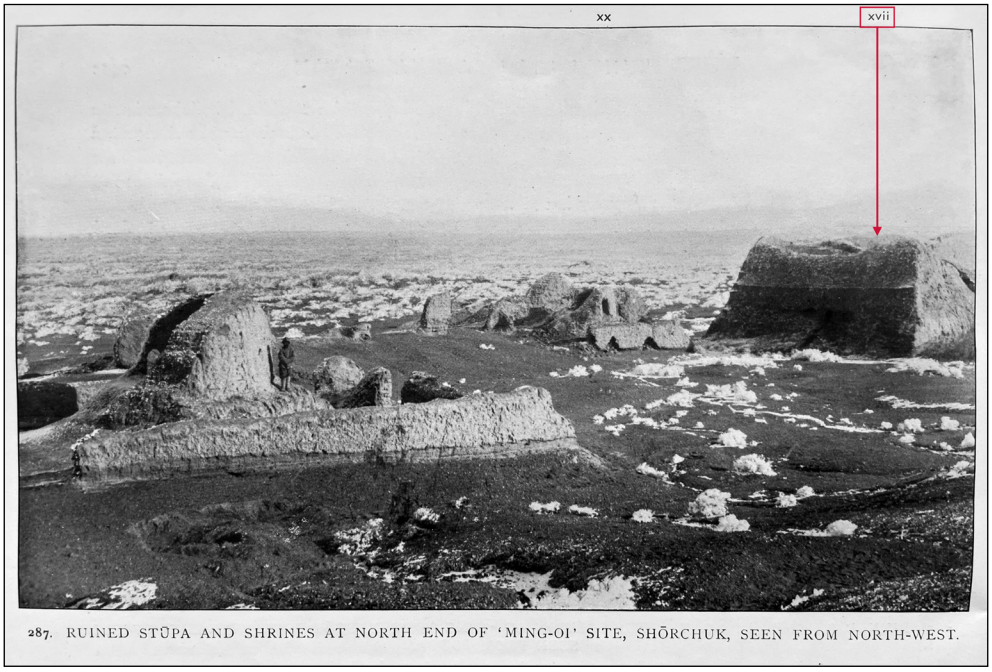

Figure 14 Exterior view of the ruin, as seen from the north-west. Adapted by the author © Stein 1921, Vol. III: Fig. 287.

The interior of this rectangular cella was discovered 'filled to a great height with hard burned débris' (Stein 1921, Vol. III: 1198). However, since no bodies belonging to the heads could be found there, Stein assumes that 'their plaster had evidently not been hardened sufficiently by fire before the walls fell in and completely smashed them'. This hypothesis is discussed below.

4.2 MATERIAL ANALYSES OF THE OBJECTS

The head at the BM consists of clay. The proportion of fine clay minerals[22] seems to be high, the matrix of the material appears, fine, homogeneous and uniform, so I speak about a *purer/purified clay* in this context. During my visit to the storage of the BM, I could only examine this object by visual evaluation methods. Therefore, no results of scientific examinations are available at present. According to this first examination, it seems to be (low?) fired. The extent to which this happened intentionally when the head was manufactured, or whether the present appearance is the result of an unintentional (secondary) fire, will be investigated in more detail below.

Regarding the mould in Berlin, X-ray diffraction[23] data of the mineralogical composition were obtained by analysing a powdered sample. A Seifert XRD 3000 TT (GE Inspection Technologies GmbH, Ahrensburg, Germany) with Bragg-Brentano geometry was used (probed area 1 × 12 mm^2, data acquisition time 16 minutes), with K_α-radiation at 1.542 Å of a copper anode operated at 40 mA and 40 kV with a nickel filter (Figure 15). In addition, aggregates were identified in the form of quartz sands of various sizes, as well as charred inclusions that could be identified under microscopic magnification (data not shown here).

5 RESULTS AND DISCUSSION ON THE INTERRELATION AND CONNECTION OF THE OBJECTS

In the following, I establish a connection between these two objects on the basis of all the information gathered so far. My working hypothesis is that the head in London is possibly a cast made from the mould in Berlin.

As briefly mentioned with regard to the mould, there are two casts in Berlin made from this mould. It is striking that these matching casts (III 8251 (2) and III 8251 (see Figure 12) show an impressive similarity to the head at the BM. Although it differs in some details, such as the depressed parts in the area of the pupils and the crown, and the head as a whole appears somewhat more compressed and squeezed and thus the face narrower, certain parallels are clear with regard to the sharply defined features and the details in the shaping.

Thanks to the BM's well-structured, online database and its use of thesauri, information on the size, material and production technique can be retrieved for all objects.

With a height of only 22.8 cm, the head in London is thus 2.2 cm smaller than the casts in Berlin, which are on average about 25 cm high. In other words, the head in London is 2.2 cm smaller than the internal dimensions of the mould kept in Berlin (see Figure 16).

The database describes the [manufacturing] technique of this object with the terms 'mould-made', 'slipped' and 'painted'. Under the associated definition of the term 'slipped' (see definition above), however, there is no mention in this database of the object having been fired for this purpose in a subsequent work step (https://www.britishmuseum.org/collection/term/x12347, 10.10.2022)

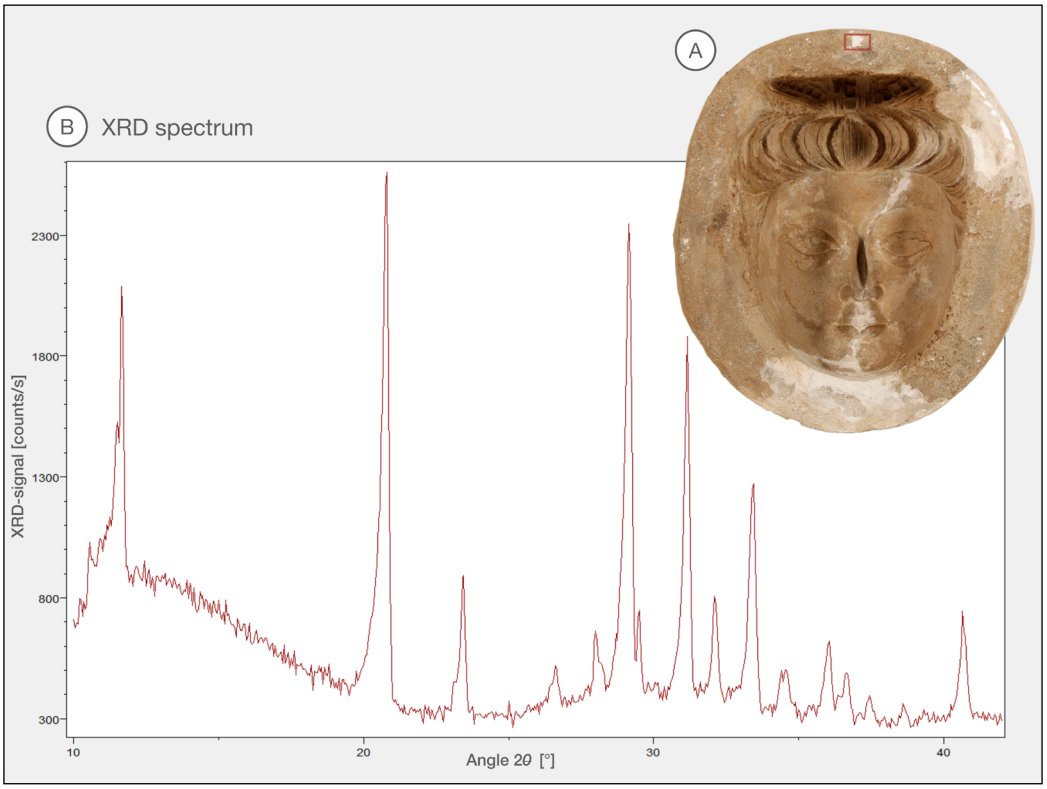

Figure 15 (A) shows the front of the mould and the sampling location is marked in red. The XRD spectrum **(B)** is characteristic for gypsum,[24] a sulfate mineral composed of hydrated calcium/calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$) as the main component (see definition above).

Figure 16 Photomontage depicting the mould (left: Inv. No. III 7987 © Photo by the author) and the head (right: MAS.1094 © The Trustees of the British Museum). Adapted by © the author.

(British Museum 2022).[25] Very often thin layers of fine plasters have 'been termed slips, by analogy with the layers of fine [purer/purified] clay applied to fired clay-ceramic vessels' (Middleton and Gill 1996: 367).

Although not described in the thesaurus of the BM, a study of this and other selected objects (mainly from the Ming-oi site) during my research stay at the storage suggested, that many of them appear to be

made of purer/purified clay and are very evenly fired.[26] They contain almost no visible intentional temper, such as organic aggregates,[27] but fine quartz sands were detectable.

In a 1985 exhibition catalogue, Roderick Whitfield, curator of the collection until 1984, makes a perceptive comment (Whitfield 1985). He notes the information given by Stein, namely that the head belonged to an almost life-size figure. He also cites Stein who explains the absence of the corresponding bodies because of their insufficient degree of firing in the conflagration that destroyed the temple and points out that, although the reports from other sites always confirm that the material is mostly [unfired] clay mixed with some fibre,

> '[…] it seems probable that the heads, moulded and fashioned separately, could have been hardened in the open, before being fitted to the bodies which, being necessarily modelled in situ, remained softer and more vulnerable. This might account for the preservation of so many finely detailed heads. As noted in the description of the tile [MAS.1108], Stein himself ventured the possibility of an actual firing of some pieces, besides the hardening and loss of colour during the destruction of the shrines.' (Whitfield 1985: 333)

Here Whitfield refers to Stein (1921, Vol. III: 1189–90), who mentions in the description of an architectural tile that it consists of 'fine evenly-fired clay', and describes the material as a fine buff clay, lightly but evenly fired and a surface treated with thin buff engobage [slip] or wash.

This find, whose deliberate firing is not questioned by Stein, is supplemented by a hoard of other tiles, in the context of which Stein even raises the possibility that their find site may have served as a 'kiln for firing such tiles' (Stein 1921, Vol. III: 1198). It can therefore be assumed that at least certain architectural elements were deliberately fired, even if no kilns could be clearly identified. Wherever there is fire and embers, in principle, ceramics can be produced, i.e. also in a campfire or in a pit in the ground filled with embers (Geschke 2019: 19).[28] But neither Stein nor Grünwedel mention such fireplaces, nor have I been able to find any references to such in literature on more recent archaeological work.[29]

Is it possible that this life-sized head was also fired on purpose? In Figure 4 one can clearly distinguish two layers when looking at the back of the head. Namely the clay core and the cast/shell of the face. The material composition of the clay mixture of these two layers obviously does not differ, except for imprints of burnt-out straw in the clay core. I assume that the cast/shell of the face was taken out of the mould in an air-dried and somewhat shrunken state and applied to a still wet clay core, in the next step. All clays shrink during drying and again during firing. It is technically not possible to simply fire the shell of the face/the cast and then place it on the moist clay core. The drying shrinkage of the clay core would lead to flaking and a lack of adhesion.

It can therefore be concluded that the complete head was fired, which is also indicated by the regular, even appearance of the back of the head and the few shrinkage cracks that can be identified only there (see Figure 4). Firing of thick-walled objects is possible, if the clay is strongly shortened (by adding intentional temper such as minerals) and a cavity is left inside, and if the firing process is carried out slowly.[30] Next to that, the small amount of cracking on the back indicates a very controlled firing process. The cavity is also necessary because the head had to be connected to the torso afterwards. This was done by impaling the head on a wooden stake which was part of the internal armature, see above.

Depending on what 'low firing' means in the first place, the firing time and the composition of the clay paste (type of clay minerals, natural and/or intentionally added temper), the drying and firing shrinkage for 'low' fired ceramics is around 3 to 9 %, with the drying shrinkage making up the largest proportion. Drying shrinkage and firing shrinkage together result in the total shrinkage. Ceramicisation processes already starts at 250°C. Between 350°C and 700°C, the chemically bound water of the clay minerals escapes and this is accompanied by the fire-induced transformation of clay into ceramics (Geschke 2019: 20).

In Figure 17 the 22.8 cm high head is paste into the mould with the inner dimension of 25 cm (see Figure 16). It is therefore 2.2 cm smaller and this corresponds to a total shrinkage of exactly 8.8 %. If one assumes that this head was cast from this or a comparably large mould, it shows a shrinkage of between 3–9 %, which is typical for a 'low-firing process'.

If we now consider the fact that this head belonged to a life-size figure, then according to the current state of research and also considering the material scientific aspects, we can continue to assume that the *in situ* modelled bodies of life-size figures were not fired.

Technically, it would be possible to place a pre-fired head (with a cavity left inside) on the internal armature. The neck section can be modelled with moist clay and any cracks that would occur in the course of shrinkage of the clay can simply be repaired again by moistening the clay. Stein is therefore correct when he states that the relatively high number of heads obtained without corresponding bodies can be ascribed to their hardening under the action of fire (Stein 1921, Vol. III: 1194).

However, based on my current observations the question arises whether some of these heads were not actually already intentionally (low?) fired during production. This would be, especially with regard to the

Figure 17 Photomontage depicting the mould (Inv. No. III 7987 © Photo by the author) and the head (Inv. No. MAS.1094 © The Trustees of the British Museum). Adapted by © the author.

life-size statues, a new perspective on the sculpture finds along the archaeological sites on the northern and southern edges of the Taklamakan, which have so far been classified in the literature almost entirely as unfired.

A large number of the heads in Berlin and London, and also illustrated here by one example from Karashahr, have a very regular and uniform material appearance and colouring, without any traces of smoke or soot. They are different from the heads from Akhnur[31] and Ushkur in present-day India's Jammu-Kashmir region whose current fired condition in the form of terracottas may also indicate an accidental, i.e. unintentional fire. According to Christian Luczanits (2008: 320), 'with the end of Gandhara art, [...] stucco was increasingly replaced by clay, although the share of terracotta production has been disputed since K.M. Varma pointed out that clay figures could also have been accidentally fired into terracottas.' Luczanits himself, however, adds in a footnote that the Gupta period (early 4th century CE to late 6th century CE) in particular is known for the production of excellent terracotta sculptures and reliefs, thus he may does not doubt their intended, fired condition?

Varma (1970: 114–121) already noted the 'Problem of Original or Accidental Terracottas' in the early 1970s. He attempts to discuss the extent to which the objects described today as terracottas were originally conceived as terracottas or whether they were 'transformed' into terracottas through singular events, such as fires caused by iconoclasm, for example. In this context, Varma quotes and criticises Charles Fabri (1955: 53–64), who studied the life-size Buddhist terracottas from Ushkur just mentioned. Fabri's observations are based on the condition in which he found the figural fragments *in situ* (Varma 1970: 116).

> 'An interesting technical point is that the heads were fired separately in a kiln, and attached to the relievo with wooden pegs; but the rest of this vast mural decoration was patted against the wall in wet clay, and fired in situ, so that the front layers become true terra-cotta, whereas farther back, nearer the wall, the clay did not get properly fired [...].' (Fabri 1955: 58–59)

Not only do I dare to doubt that life-size figures were fired in situ, but I strongly disagree with this observation by Fabri. Without going into detail here, Varma (1970: 117–18) also rebuts this and other aspects of Fabri's argumentation, but I am not convinced by his arguments. He makes assumptions that have not been scientifically verified and a systematic study of this question remains open.

The same criticism applies to his later publication (Varma 1987: 93) in which he postulates that the moulds discovered in 'Tamiria [Central Asia] [...] were meant to serve the unbaked clay technique.' Varma (1970: 121) himself concedes at the end of his chapter just discussed that the entire lots should be thoroughly re-examined. Thus, he formulates a demand that has remained valid to this day and which I would like to bring back into our focus after more than 50 years, by applying it to our field of research.

6 CONCLUSION

In the course of this work, the initial question, namely to what extent there is a connection between the mould in Berlin and the head in London, has been investigated. An ultimate answer, namely whether the shell of the face of that head was made from exactly that mould, can hopefully be conclusively answered in the long term by means of 3D photogrammetry. The evidence gathered in the course of answering this question has opened up a far more extensive field of research. Namely, that the modular character of the sculptural production along the archaeological sites on the edges of the Taklamakan has to be extended by additional observations and working hypotheses. For this, it is necessary to study systematically large groups of sculptures and put them in context.

The technology is not, as previously assumed, only defined by the use of moulds and the production of individual components that can then be combined with each other in a modular way. Within the framework of this paper, it has also been possible to clarify that the size, the posture and the position of a sculpture have a significant influence on the modelling and moulding

techniques. These factors are inter-related and their systematic description will be presented in more detail in further publications.

The material conditions, namely fired and unfired, also have to be taken into account. This opens up a completely new field of research, which, for the first time, deals with the subject of terracotta in the context of these clay-based sculptures. Reference should be made to neighbouring regions and research areas and recent publications that also draw attention to this topic or phenomenon.[32]

Regarding my region of interest, I can also state that different techniques (hand modelling and moulding) and materials (clay mixtures, temper) were used to produce each sculpture, which were then modified differently, depending on the planned process technique (fired or unfired). In this respect, the different clay compositions appearing, must be studied more systematically. The evidence and observations gathered so far have led to the working hypotheses presented here and should encourage us to question and systematically review our previous assertions in order to open up new discourses.

A systematic approach is also necessary with regard to the critical examination of the respective find situation of each individual object. To understand whether an object was fired intentionally or accidentally, it is necessary in the long term to study the individual find situation of each fired object in order to determine whether the context legitimates the statement, namely that the terracottas were usually accidentally made (Varma 1970: 115–16). In the case of the archaeological site of Karashahr this is a realistic objective and part of our current project planning.

An intensive study of the various excavation reports according to these criteria is necessary, as we could then systematically collect circumstantial evidence for the respective architecture and trace the degree of destruction and answer the question of whether these destroyed conditions and devastations were caused by a conflagration or not. On the basis of these findings, we would then have to carry out a 'mapping', marking the sites of the fired objects in it. Using this approach then uncover patterns that could provide us with further insights into many research questions. This could also include the use and function of the caves and the free-standing architecture. Such a systematically study should be accompanied by scientific investigations such as thin section petrography, thermoluminescence or XRD in individual cases.[33] But these are limited by the destructive sampling that is still necessary very often, as well as by the costs. It is also always critical to draw conclusions about a larger collection or a site on the basis of a result that is usually only valid for a specific sample material. At this point in time, however, it is still possible to formulate hypotheses that speak in favour of the firing of certain modules.

If, as assumed here, certain lots were produced and fired separately and not *in situ*, then these objects were also made more transportable and altogether more resistant to external influences through firing. Furthermore, this assumption raises interesting new questions about a possible division of labour in the manufacturing process and inevitably leads to a comparison with Fraser (2004) who describes the professional class of artisans in China and Central Asia and their specialisations according to craft and how they were hierarchically organised.

The possible positioning of the sculptures, in the now largely lost architecture, should also be addressed. Overall, this entire discussion will be more vivid in the long term if more is known about the original placement of the respective figures in the architectural complex. We can then investigate whether the original position and the fired or unfired condition of the objects are related.

NOTES

1 Named after the destination of the first expedition in 1902, the oasis site of Turfan, the total of four expeditions visited at a number of sites along the ancient northern route around the Taklamakan Desert.

2 For the Humboldt Forum see https://www.humboldtforum.org/en/. See also the exhibition report by Lilla Russell-Smith in this volume (Humboldt Forum 2022).

3 My tasks included measuring and photographing each sculpture, a historical survey, collecting all relevant information from the museum cards, grouping the objects according to their find site, assessing their condition, preparing condition reports, performing conservation where necessary, and signing them off for transport. Through these 18 months of work, I had unprecedented access to each object and could study them in detail. Technical issues regarding the materials and techniques are examined in: 'The Central Asian Clay-based Sculptures at the Museum für Asiatische Kunst, Berlin – Investigations into Materials, Manufacturing Techniques and Provenance.' Department of History and Cultural Studies, Institute for Ancient Near Eastern Archaeology, Freie Universität, Berlin. Funded by the Elsa-Neumann-Scholarship and the Bei Shan Tang Foundation.

4 The Hermitage at St. Petersburg, the British Museum in London, the Musée Guimet in Paris, the National Museum in Tokyo, the Hirayama Ikuo Silk Road Museum in Kamakura, and the National Museum in Seoul are just a few of the largest.

5 Almost half of them have been on display at the Humboldt Forum and are thus now part of the permanent exhibition. This is the first time most of them have been exhibited in their museum history, as they were previously mostly kept in the storage and had not been investigated systematically. Their examination is part of my ongoing research.

6 However, this excludes sculptures in the round, discussed further below.

7 'Situated in what is today northern Pakistan and eastern Afghanistan, Gandhāra was the name of one of the eastern satrapies of the Persian Empire. It comprised mainly the fertile valleys of the lower Kabul and Swat rivers and the lower part of the upper Indus river, and was centred around the ancient cities of Puṣkalavatī (modern Peshawar) and Takṣaśilā (modern Taxila). The boundaries of Gandhāra shifted throughout history, […]. Gandhāra cannot be isolated from the neighbouring regions that modern historians define as the Greater Gandhāra: the upper Swat valley, Dir, and the Bajaur agencies in the North-West Frontier Province and Begram-Kapisi and Hadda in Afghanistan.' (Bopearachchi 2020: 1–3).

8 For a first overview, the works by Tarzi (1986), Varma (1970 and 1987), Middleton & Gill (1996), Blänsdorf & Melzl (2009),

Ohlídalová et al. (2016), Pannuzi & Olivieri (eds.) (2019), Verri et al. (2019), Forgione (2021), Lluveras-Tenorio et al. (2022), López-Prat et al. (2022), Kimmet (2022) and Piqué (1997), Fan (2010), Wong & Agnew (eds.) (2013), Fan & Zhao (2016) and Agnew, Reed & Ball (eds.) (2016) should be mentioned.

9 Archaeologist & Art Historian, Research Fellow at the University of Naples 'L'Orientale' UniOr, Department of Asia, Africa and Mediterranean (DAAM), and member of the Italian Archaeological Mission in Afghanistan of the ISMEO – The International Association for Oriental and Mediterranean Studies. The exchange with her was crucial and helped me to think across disciplines and regions about a repertory of terms with regard to the material and technical aspects of the Buddhist clay-based sculptural production.

10 Alexandra Vanleene has defined this term in a very comprehensible way and thereby also clearly distinguishes it from a so called 'sculpting school' (Vanleene 2018: 143–163).

11 In the Kucha region, there is also evidence that the core of three statues was carved from the conglomerate of the rock face, as was recorded photographically by the German and the French expeditions in two caves (70 and 71) in Kumtura, dated to the Tang Dynasty (618 to 907 AD). The third exception with a core carved from the conglomerate is a very small statue in Cave 196 in Kizil. Apparently, this technique therefore does not describe the majority of the sculptures in my field of research.

12 This first classification is temporary. It has no claim to general validity and is intended primarily as an aid to reading this article.

13 Further literature on the system of measurement is given by Varma (1970: 35–41) and Ruelius (1974: 18–20). Luczanits (2004: 15) also refers to Ruelius (1974) and summarises that '[…] all parts of the image are measured in relation to the total height of the image […]. The principal measurement for the image is the length of the face (basic module) and the whole body is then nine times length of this module.'

14 In contrast, the core of the Buddha statues in Bamiyan (38 and 55 m large) was carved out of the stone of the cliff and then covered with clay-plaster layers to finish the modelling in the next step. Only their details were modelled in clay mixed with straw.

15 There is little or no undercutting of outlines in these moulds, otherwise it would not be possible to remove the cast without damaging it.

16 This information is based on personal communication with Toralf Gabsch, senior conservator at the Museum für Asiatische Kunst. See also Gourdin and Kingery (1975: 135).

17 Studies were also conducted by other international research teams, including Sven Hedin (1895) from Sweden, Paul Pelliot (1907) from France, the team of Ōtani Kozui (1909) from Japan and Huang Wenbi (1928), as well as Yan Wenru (1957–1960) from China. This concise summary is based on a table by Lu Tian, PhD candidate in East Asian Art History at the Freie Universität, Berlin. She is currently working on this site, and refers to the entire temple complex as *Qigexing* and the ancient kingdom as *Yanqi*. For more detailed descriptions, the cave site is referred to as *Shorchuk* and the temple site as *Ming-oi* in her work.

18 I have taken this information from personal correspondence with Hannes Fellner from the Department of Linguistics, University of Vienna, November 2022.

19 The numbering corresponds to the Russian designation 'L6'. I would like to thank Lu Tian for drawing my attention to the table of concordances in the Shikshin catalogue by Dyakonova 2011: 23.

20 Since the expedition was also partly financed by the Indian government, it was agreed that two thirds of the expedition's finds should also go to India.

21 Online search in September 2022 (https://museumsofindia.gov.in/repository/collection/ObjectType). But items also went to other museums in India, it is therefore quite possible that this object is in another museum.

22 'The term 'clay mineral' refers to phyllosilicate minerals and to minerals which impart plasticity to clay and which harden upon drying or firing.' (Guggenheim & Martin 1995: 258). A more detailed definition of the term 'clay' is given above

23 'X-ray diffraction (XRD) is a […] technique for characterizing crystalline materials. It provides information on structures, phases, preferred crystal orientations (texture), and other structural parameters, such as average grain size, crystallinity, strain, and crystal defects.' (Bunaciu, Udriştioiu & Aboul-Enein 2015: 289)

24 It exhibits the strongest peaks at 11.5°, 21°, 29°, 31° and 33.5°. (ICDD reference spectrum # 33-311 from the PDF-2 database was used for comparison.)

25 However, as Yu-ping Luk and Helen Wang have pointed out to me, the input of data onto the BM database has not always been done by specialists.

26 Michela Spataro (Scientist for Ceramics and Stone) from the Department of Scientific Research of the BM, also confirmed this observation for a selection of smaller heads from the Ming-oi site during a joint visit to the storage.

27 These are a clear indicator that the objects have not been fired, as otherwise the organic aggregates in the form of plant fibres such as hemp or straw, for example, would have burnt out.

28 Considerations on the burnt material are part of my ongoing research.

29 I do not read Chinese and so have not been able to check if there is any Chinese literature on this subject. Any references on this would be appreciated.

30 I would like to thank Rainer Geschke (conservator & ceramist), who shared his knowledge and experience with me.

31 More detailed material and technical considerations regarding the 'Akhnur Group' are discussed by Kimmet (2022: 9–10).

32 'Unbaked polychrome clay sculptures, mostly Buddhas and Bodhisattvas, were recently found in Mes Aynak [Afghanistan] excavations […]. […] The results obtained in our research on clay sculptures will need further analyses regarding the production of the clay mixture, always unbaked but in some cases baked at low temperatures, as we are checking with our analyses.' See Pannuzi et al. (2019: 48), for instance.

33 The firing temperature, for example, can be estimated, based on the presence or absence of clay- and other minerals.

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COMPETING INTERESTS

The author has no competing interests to declare.

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