



Shaping the sacred along the Silk Roads: the millenary artistic tradition of making “monumental *terracruda* sculptures”

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ABSTRACT

This paper presents a depth revision of the technological, material, and symbolic knowledge of what we advocate to be identified as “monumental *terracruda* sculpture” along the Silk Roads. Through a highly interdisciplinary approach, combining a) the latest results of archaeometric analysis carried out on Buddhist examples, b) the documentation of traditional knowledge in making *terracruda* sculptures in Buddhist and Hindu religious practices, and c) the systematic review of the archaeological and anthropological literature on this topic, this work brings new evidence for proposing the existence of a common pattern of elaboration of monumental *terracruda* sculptures, connecting traditional Buddhist and Hinduist artworks with a millenary artistic tradition that uses raw earth as the preferred material for the representation of the sacred. The recognition of this common pattern in the production of monumental *terracruda* sculptures led to the questioning of the prevailing archaeological narrative of a Hellenistic origin of the technique as well as the causes of its popularity within Buddhism from the 4th century CE onwards. Based on the qualitative and quantitative evidence discussed in this paper, new interpretations about the origin and spread of this cultural expression are finally proposed. Finally, the need for future research that takes a systemic view of the subject is advocated, proposing a multidisciplinary vision that integrates archaeology, archaeometry, ethnographic research and the study of ancient religious texts.

1. Introduction

1.1. Objectives

Clay, mud, soil... earth has traditionally been a preferential material for representing divinity. Thanks to its ubiquity and versatile properties, humans have used it since prehistoric times for artistic manifestations. Whereas different religions and myths describe these practices, it is in Central Asia, in the heart of what is known as the Silk Roads, that more than 2000 years ago, “*terracruda*” (as air-dried clay in contrast with fired clay or *terracotta*) acquired its most sacred significance, leading to the art of modeling the divinity in a monumental form. The first examples of this artistic tradition came into existence approximately around the 2nd and the 1st century BCE in Central Asia through the cross-fertilization of

Indian, Persian, and Hellenistic cultural influences, becoming one of the most significant manifestations of knowledge transfer along the Silk Roads, and has successively spread with Buddhism to East Asia and the Himalayas, where examples continued to be produced until nowadays.

These earthen-based sculptures, which can be smaller than human size or reach several meters in height, have been found in several historical contexts in Central, Southern, and East Asia and are displayed in many museums worldwide. Some famous cases are the sadly destroyed Bamiyan Colossi (6th – 7th century CE, Afghanistan) or the Buddhas of Bingling (5th–10th century CE, China), in both cases made from a stone core carved out of natural rock; the reclining Buddha of Ajina-Tepe (7th century CE, Tajikistan), in this case originally made from a core of masonry; and many of the 1000 Buddhas of Mogao (4th–11th century CE, China), most of which were made from a wooden core (Fig. 1).

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These works of art lack specific terminology to refer to them. Except in exceptional cases where it has been tried to describe the underlying modeling technique (Varma, 1970,1987), this type of sculpture has been studied and documented with a regional focus, linked to a specific art-historical period. This would be the case of the capital works of G. Verardi (1983), Z. Tarzi (1986), and C. Luczanits (2004). The first two address the question of the technology of clay sculpture from the Kushan period (1st to 3rd centuries CE) in Central Asia and the northwest of the Indian subcontinent, taking as main examples their archaeological works in the Afghan sites of Hadda and Tepe Sardar respectively, while the last one deals with the clay sculpture technology of the Western Himalayas between the 10th to 13th centuries. Other works focus on describing precise examples, mentioning, however, that these are artifacts whose production is the result of a common practice that has Central Asia as its epicenter (Kostrov 1963, Chiari 1993, Lippolis et al., 2019), while most address the methodological and material aspects of their production only superficially and focus mainly on establishing stylistic links, thus differentiating schools and traditions.

The starting hypothesis of the research presented in this work is that these sculptures, beyond corresponding to regional artistic currents and thus to different schools and influences, would follow a common pattern of elaboration transmitted through the Silk Roads over the centuries: this artistic technique spread and was adopted, together with Buddhism, in almost all the Asian places where this spiritual tradition arrived, adapting to the different regions and artistic currents. Demonstrating the

existence of a common technological pattern would allow us to establish a shared terminology when referring to this type of sculpture beyond local stylistic interpretations. Thanks to this categorization, it would be possible to trace its evidence throughout the different historical moments and places where they are found, propose new inferences and arguments related to their presence, and devise more accurate treatments for their conservation. Following this hypothesis, in this article, as we will explain below, we propose to use the term “monumental *terra-cruda* sculpture” to refer precisely to this sculpting technique that finds in raw earth the preferred material to represent the divinity in a monumental form. A common terminology that we advocate as a necessary to advance in the study of this type of sculpture and the artistic meaning behind it.

1.2. Background

1.2.1. The first examples and the spread of the technique

Although Buddhist art played a key role in the spread of monumental *terra-cruda* sculpture, especially from the 3rd century of CE onwards, the earliest examples of this artistic tradition date back to the 3rd-2nd centuries BCE, when Buddhism was not yet the dominant spiritual current in Central Asia, and this region was under the Hellenistic influence of the so-called Greco-Bactrian kingdoms.

These first examples were mainly found as part of sacred buildings. Particularly important are those found at the archaeological sites of Ai-



Fig. 1. A. Eastern Bamiyan Buddha (Pheceda 109, Wikimedia Commons) b. Reclining buddha of Ajina Tepe (d. Lundberg, Wikimedia Commons) c. Bingling Colossal Buddha (b. Gagnon, Wikimedia Commons) d. and e. some examples of Dunhuang sculpture (d. Stanley, Wikimedia Commons).

Khanum (2nd century BCE, northeast of present-day Afghanistan) (Bernard, 1969,1973) and Old-Nisa (2nd- 1st centuries BCE, south of present-day Turkmenistan) (Lippolis et al., 2019; Pilipko, 1995, 2002; Chiari et al., 1993). We could also include some of the “portraits in unbaked clay” found at the Bactrian sites of Takht-i-Sangin (present-day south of Tajikistan) (3rd – 1st BCE) (Litvinskiy & Pichikiyan, 1981), the “monumental sculpture in painted clay” of Khaltchayan (1st BCE – 1st CE, south of Uzbekistan) (Pugachenkova et al., 1994); and those found in ancient Khorasmia (present-day north-west of Uzbekistan): the “clay polychromed high reliefs from Elkharas” (3rd – 2nd BCE) (Bongard-Levin & Košelenko, 2005), and the “unbaked-clay modeled sculptural high-reliefs” from the Achaemenid sites of Akchakhan-kala and Toprak-kala -two royal seats and ceremonial centers located within 15 km of each other in present-day Karakalpakstan dated between the 1st century BCE and the 2nd century CE (Minardi, 2020).

Sculptural manifestations, product of a knowledge that, around the 1st century CE onwards, spread with Buddhist art through the “Silk Roads” from to almost every corner where the Buddha’s teachings reached, so that examples of monumental *terracruda* sculptures are known from Central Asia and the northwest of the Indian subcontinent (present-day Pakistan and Afghanistan) to the Himalayas (Ladakh, Tibet, Bhutan), China, Mongolia, and the Far East, being also Japan the country where historical-archaeological examples are documented located further east (Fig. 2).

1.2.2. The technique and its essentials

Although the historical-archaeological records of monumental *terracruda* sculptures are numerous and some authors, in their study of specific examples, suggest that these sculptures are the result of a same widespread technique (Kostrov 1963; Bao Zhong, 1990; Chiari 1993; Lippolis 2019; Vanleene, 2019), this type of sculptural manifestations are identified in many ways, including: “painted loess sculpture” (Kostrov 1963); “sculpture en argile crue” (Tarzi, 1986); “sculture in argilla cruda” (Bollati, 2005); “clay statues” (Chiari 1993), “clay sculptures”

(Bao Zhong, 1990, Luczantis 2004, Blaendsdorf & Tao 2010), “statues monumentales d’argile” (Paiman 2010); or “sculpture de terre” (Schlumberger 1963), to name just a few of the most representative examples and leaving aside the question, suggested by several authors (Varma, 1970,1987; Middleton and Gill, 1996; Lippolis et al., 2019) of whether many of those sculptures identified as “stuccos” are in fact a variant of the same artistic tradition and have been named by obviating their core raw earth based.

All these designations may evoke the idea that this type of monumental artworks are free-standing sculptures or statues when, on the contrary, they were always modeled in situ and linked to their surroundings. These can be architectural, in the case of sculptures that were part of a building, or natural formations, such as the examples of the Bamiyan Colossi, carved on the natural slopes of Bamiyan Valley (Afghanistan). High or very high reliefs, but also round, connected to a background or part of a monument, which is why it was considered appropriate to add the adjective “monumental” to the noun “sculptures,” meaning “part of a monument” or “large in size” (as these sculptures usually are).

Moreover, although clay can be considered the basic material for their modeling, the sculptures are “multi-material,” i.e., different essential materials are used in their making. Commonly modeled from a wood skeleton or brick/stone core, to which are superimposed earthen layers made through sands, silts, clays, and herbaceous/fibrous matter that play the essential role in adding volume, lightening the weight and facilitating the drying of the sculptures, suggest that using the term “earth” in its Italian form “terra” is the most appropriate, which together with the adjective “cruda” (raw/unfired), emphasizes its unfired nature, in contrast with the technical word “terracotta”, which is widely adopted in the scientific literature concerning fired clay sculpture.

If we wanted to propose a technological definition, monumental *terracruda* sculptures are characterized by the following essential elements:



Fig. 2. Some of the main historical documented sites featuring *terracruda* sculpture (elaborated by M. López-Prat).

- Construction of a core or base structure (usually of wood, brick, or stone) anchored to the wall and/or floor or being part of it (in the case of brick and stone).
- Superimposition of branches, herbaceous material, and/or ropes on the base structure when it is made of wood, giving volume to the initial skeleton.
- Addition of various clay-based layers ranging from coarse to more refined depending on their composition.
- Application of details modeled or applied with the help of molds.
- Finishing layer (called “stucco” when it is white).
- Polychrome and/or gilding.

The result is versatile, heavy, and fragile sculptures, which can be larger than human size.

2. Evidence from the traditional practices

A similar artistic tradition is today present in West Bengal (India). Here, a group of clay sculptors, the *kumors*, has preserved a long tradition related to the modeling of sacred clay sculptures for Hindu worship. This tradition is likely linked to “The Agamas,” a collection of scriptures related to the worship of God in idol form and belonging to the Shakta, Shaiva, and Vaishnava devotional schools. The *Vimanarchanakalpa* (8th century CE), *Kashyapashilpa* (‘Treatise on Arts’) (12th century CE), *Kashyapajnankanda* (16th century CE), and *Samurtarchanadhikarana* (16th–17th centuries CE) are among the agamic literature that specifically designates unfired clay, bronze, wood, and stone as suitable materials for representing a divinity (Varma, 1970). However, according to these sacred texts, between ‘unfired clay, bronze, wood, and stone materials,’ only unfired clay (fundamentally earth and water) contains life, making this material ‘supremely suited’ for the creation of images of worship (Bean, 2011). As such, these texts detail the seven materials for

constructing a clay-based image, which are metaphorically explained to be the same as the elements of a human body: the wooden armature (*sula*) represents the bones; the ropes (*raiju*) are the veins and sinew; the different layers of clay (*mrt*) are the flesh and muscles; the clothes (*pata*) in the final layers of clay are the skin; the glue (*astabandha*), prepared mainly from vegetable substances by cooking, is fat; the ‘white layer’ (*sarkara a-kalka*) is the blood; and the color (*varna*) is the life force (Varma, 1970).

These precepts are known and continued today by Bengali sculptors to produce *terracruda* images of deities (*murtis*) for the annual cycle of festivals in the Hindu tradition (*pujas*).

Different workshops around West Bengal were visited during the summer and autumn of 2019 by the author Mònica López-Prat thanks to an agreement with the University of Calcutta (West Bengal, India). Ethnographic observations were carried out primarily in two locations: in Kumortuli, the neighborhood in the city of Kolkata where the work of the clay modelers is concentrated, and in Krishnanagar, the capital of Nadia district in northern Kolkata and nowadays one of the largest centers of sculptors after Kumortuli (Fig. 3). Several interviews were carried out in both locations to document the different stages of the sculpture-making process and the raw materials used (López-Prat et al., 2021).

3. Evidence from archaeometry

In order to obtain a more accurate evidence-based view of the sculpture manufacturing technique, different samples of the sculptural repertoire from the Buddhist archaeological sites of Tepe Narenj and Qol-e-tut (5th and 11th centuries CE - Kabul, Afghanistan) were analyzed using a variety of diagnostic techniques aimed at better understanding the composition of the modeling pastes:



Fig. 3. *Kumors* at work (September 2019, Kumortuli, Kolkata, West Bengal, India).

- Optical microscopy: to understand the petrographic composition of the different modeling pastes or layers (López-Prat et al., 2024).
- X-ray Powder Diffraction (XRPD), Differential Scanning Calorimetry, Thermogravimetry (DSC/TG), Raman Spectroscopy, and Microchemical analysis (SEM-EDS and EPMA-EDS): to study the mineral and chemical composition of clays and aggregates in the different modeling pastes/layers (López-Prat et al., 2024).
- Gas chromatography/mass spectrometry (GC/MS) and epifluorescence: to investigate the possible presence of organic binding additives in the different modeling pastes/layers (López-Prat et al., 2024).
- Phytolith and fiber analysis: to identify plants and parts of plants intentionally added in the modeling pastes/layers (López-Prat et al., 2022).
- X-ray micro-computed tomography (micro-CT): to quantify the relative proportions of clays, aggregates, and herbaceous additives in the modeling pastes/layers (López-Prat et al. 2021b)

4. Results

Based on qualitative (literature review and ethnographic study) and quantitative evidence (diagnostic analysis), conclusive information on the raw materials and the technique of modeling “monumental terracuda sculpture” can be proposed.

4.1. The core

Monumental terracuda sculptures are made through a stratified system of modelling pastes built upon cores of various natures:

- Wood: Probably the most documented one. The use of a wood skeleton is reported in numerous examples along the Silk Roads. Among them are some of the earliest: Old Nisa (Turkmenistan, 2nd – 1st centuries BCE; Pilipko, 1995), Ai-Khanoum (Afghanistan, 2nd – 1st centuries BCE; Bernard, 1969,1973), Khaltchayan (Uzbekistan, 1st century BCE – 1st century CE; Fedorovitch, 1969). Today, Bengali artists often use bamboo poles to make the legs and spine of what might be considered a simplified skeleton of a life-size sculpture (López-Prat et al., 2021).
- Stone: The examples are also numerous and would be the case of Bamiyan Colossi (Afghanistan, 6th – 7th centuries CE; Blänsdorf & Melzl, 2009), some of the sculptures from Dunhuang, China (Li Zuixiong 2001), Bingling, China (Chi, 2023) and Nalanda Mahavihara sculptures (India, 5th – 8th centuries CE; Tiwary, 2018).
- Bricks: Probably the less documented up to now would be the case of the sculptures of Adjina-tepa (Tajikistan, 7th – 8th centuries CE; Fominikh, 2008), the slipping Buddhas of Tepe Sardar (Tarzi, 1986), one colossal Buddha of Krasnaya-Rechka, Kirguizistan (Torgoev et al. 2016) and some of the examples of Nalanda (India, 5th – 8th centuries CE; Tiwary, 2018).



Fig. 4. Different sculptures elaborated fixed to a wooden structure consisting of a back and platform with the aid of crosspieces or *upasulas* (the Sanskrit name to refer it) (September 2019, Kumortuli, Kolkata, West Bengal, India).

- Earthen mortar with inclusions of lime, gravel, pebbles or brick fragments: many of the heads from Hadda and/or Taxila (Varma, 1987; Middleton & Gill, 1996; Verri et al., 2019), but also documented in Nalanda sculpture (India, 5th – 8th centuries CE; Tiwary, 2018).

These cores are physically linked to a space. This implies an in-situ elaboration, so the sculptures always had to be projected in their context. Even modern Bengali statues that are mobile and not attached to their surroundings maintain this core or internal structure. The need for support is replaced by a movable wooden structure consisting of a platform or back + platform, where the artists anchor the sculpture (Fig. 4).

When the core consists of a wooden skeleton, it is noted that it is covered with branches, reeds, or straws. This is the case of the sculptures of Old Nisa (Turkmenistan, 2nd – 1st centuries BCE; Pilipko, 1995), Aï Khanoum (Afghanistan, 2nd – 1st centuries BCE; Bernard, 1969,1973), Khaltchayan (Uzbekistan, 1st century BCE – 1st century CE; Fedorovitche, 1969), Guldara (Afghanistan, Fussman & Le Berre, 1976), Tepe Sardar (Afghanistan, Verardi, 1983), Tepe Narenj (Forgione 2018), Krasnorechensk (Torgoev et al. de 2019), Tumshuq-Tagh (Lefevre & Pre, 1996), Himalaya (Luczanits, 2004), Mogao (Li et al., 2016), Shuilu'an (Blaensdorf & Tao, 2010). Today, Bengali artists prepare the skeleton of sculptures with bamboo poles covered with rice straw bundles tied with jute ropes (López-Prat et al., 2021). The use of ropes is also documented

in examples of ancient sculptures: Ai Khanoum (Bernard, 1969,1973), Guldara (Fussman & Le Berre, 1976), Hadda -where Tarzi (1986) mentions the use of jute as the most frequent material for its elaboration-, Tepe Sardar and Tepe Narenj (Forgione 2018), Himalayas (Luczanits, 2004; Bayerová et al. 2010; Gill et al., 2014), China (Blaensdorf & Tao, 2010), Japan (Moran, 1960) and on the Western Buddha of Bamiyan. In the latter case, ropes form the core of its draperies, together with wooden pegs fixed into the carved natural stone (Blänsdorf & Melzl, 2009). It is interesting to note that in some Kumortuli workshops, the artists employ the tradition of draping the sculptures using ropes attached to the body with small steel nails. These are covered with different layers of “stucco”, which in Bengali sculptures is a white primer made from kaolinite mixed with a tamarind gum-based compound to prepare the sculpture for polychromies (Fig. 5).

4.2. The modeling pastes

Whether the core was made, the monumental *terracruda* sculptures were produced by the superimposition of several layers of modelling pastes. This stratified system is largely documented in specific literature dealing with the technique (Varma, 1970; Verardi, 1983; Tarzi, 1986; Luczanits, 2004), in the scientific study of Tepe Narenj and Qol-e-tut examples (López-Prat et al., 2024), but also in the nowadays method of elaboration of Bengali sculptures (López-Prat et al., 2021). Contrary to the assertions of some authors who hypothesize a predetermined



Fig. 5. Different sculptures in different work stages (before and after adding the first “stucco” layer) featuring drapery with the aid of ropes and nails (September 2019, Kumortuli, Kolkata, West Bengal, India).

number of two clay-based layers for monumental sculptures (Tarzi, 1986), this number could vary according to the size of the sculpture or the part of the body to be modeled, as also noted by Varma (1970:148–149) in his study of the technique and has been documented today in Bengal (López-Prat et al., 2021).

In addition, the cross-checking of the data shows clear differences in the processing of the modeling pastes. Different types of pastes are recognizable depending on the finishing material of the sculptures:

- a) For sculptures finished with ground limestone, gypsum, or kaolinite, the literature often reports two types of modelling pastes: one for the inner layers, containing more binding clay fraction, and one for the outer, where the aggregate fraction is higher. This has archaeological parallels, as corroborated by analyses carried out at Old Nisa (Turkmenistan, 2nd – 1st centuries BCE; Chiari 1993), Bamiyan (Afghanistan, 6 – 7th centuries CE; Blänsdorf & Melzl, 2009), Nako (Himachal Pradesh, India, 12th century; Bayerová et al. 2010), Guanyin (Sichuan, China, 18th century CE; Zhao, 2014). This feature, pointed out by Varma (1970: 19) through their study of Sanskrit agamic literature, has been identified through the petrographic analyses performed in stratified samples of Tepe Narenj and Qol-e-tut (López-Prat et al., 2024) and has been ethnographically documented in West Bengal (López-Prat et al., 2021).
- b) For sculptures finished with lime-based plasters, the pastes performing the core are defined as a stratified system of earthen mortars, but in these cases are reported mineral inclusions of lime, gypsum, gravel or pebbles (Middleton et al. 1996; Verri et al., 2019).

All layers have a high vegetal component which is usually coarser (chopped straw and husk are often documented) in the inner layers close to the core and finer in the outer layers (wool, animal hair, cotton, hemp, jute, silk, or paper fiber are usually mentioned). This different use of plants and fibrous matter is documented in the sculptures of Hadda (Afghanistan, 2nd to 7th centuries; Tarzi, 1986), the Bamiyan Colossi (Afghanistan, 6-7th centuries CE, Blänsdorf & Melzl, 2009), monumental *terracruda* sculptures of Mogao (Dunhuang, China, 5th – 14th centuries; Li et al., 2016), Shuilu'an (Shanxi, China, 14th-17th centuries CE; Blänsdorf & Tao, 2010), Guanyin (Sichuan, China, 18th century CE; Zhao, 2014) and those of the Nara period (Japan, 8th century; Moran, 1960). The different use of plants and fibrous matter is reported in Sanskrit literature (Varma 1970: 22) and has also been documented in the analyzed sculpture fragments of Tepe Narenj and Qol-e-tut (Afghanistan, 5th to 11th centuries; López-Prat et al. 2022) and in the nowadays Bengali tradition: rice chopped straw and husk is added in the inner clay-based layers and jute fibers or nothing in the clay-based finishing layers (López-Prat et al., 2021).

The modeling pastes could contain gluing organic additives to modify their properties, as mentioned in Sanskrit literature (Varma 1970: 20-22) and documented by more recent studies (Forgione, 2019; Verri et al., 2019; Bonaduce et al., 2009; Bonaduce et al., 2011), including those of Tepe Narenj and Qol-e-tut samples (López-Prat et al., 2024).

4.3. The finishing

There are mainly two clear technical variants according to their finish:

- a) High, very high reliefs or round sculptures modeled through different clay-based layers and bleached with a preparation based on ground limestone, natural gypsum, or kaolinite. When this kind of finish is limited to a thin final “stucco” coat or “slurry,” it is usually identified as being made from natural gypsum, ground limestone or kaolinite, as would be the case for Old Nisa (Turkmenistan, 2nd century BCE, Chiari 1993), Khaltchayan (Uzbekistan, 1st BCE – 1st CE; Fedorovitche, 1969), Pendjikent (Tajikistan, 7th-8th centuries CE - Kostrov

1963), Kara-Koto (Mongolia 10th-11th centuries - Nagpall & Agrawal 1959), Krasnoredchensk (Kirgizstan, 7th-8th centuries CE; Torgoev et al. 2016), Nako (Himachal Pradesh, India, 12th century; Bayerová et al. 2010), Sumda Chun (Ladakh, India – 12th-13th centuries; Gill et al., 2014). Often, mixed in this final white coat, an adhesive, probably of plant origin, is mentioned or detected (Kostrov 1963; Torgoev et al., 2019). The resulting material could be defined as a primer before polychromies and would mirror the use of *gofun* (made from white mollusk shells) in the Nara sculptures of Japan (8th century CE; Moran, 1960). This would be the case of Tepe Narenj and Qol-e-tut examples, where crystals of grounded natural gypsum glued by some organic binding agent were identified (López-Prat et al., 2024) and of *kore-mati*, the primer applied by Bengali artists to prepare the sculptures for color, made from ground natural gypsum or kaolinite bound with a water-miscible tamarind gum-based preparation (López-Prat et al., 2021). In these cases, before the white primer layer, often a final layer of pure clay, sometimes with fibers, is documented. This is the case of Himalaya (Luczanits, 2004), Guanyin (Zhao, 2014), Bamiyan (Blänsdorf & Melzl, 2009), Tepe Sardar (Verardi, 1983), and the Nara sculptures of Japan (Moran, 1960). This layer has also been documented in some of the analyzed examples of Tepe Narenj and Qol-e-tut (López-Prat et al., 2022a, 2022b). Today Bengali artists apply a final slurry of pure adhesive clay (*etel-mati*) without fibers before applying the stucco coat (López-Prat et al., 2021).

- b) High or very high reliefs finished with lime-based plaster and identified mainly in the literature as “stuccos”, having earthen-based cores with inclusions of lime, gravel, pebbles or brick fragments. In these cases, the presence of an internal structure connected to the body is only occasionally reported in the form of a dowel or “safety stick” (Varma, 1987) connecting the head with the rest of the body. This means there is no internal wooden body skeleton, but a stratified core made of earthen-based mortars, modelled from thicker to thinner from the inside to the outside. This would be the case for some examples from Hadda (Afghanistan, unknown century, Middleton et al. 1996) and many of the “stucco” sculptures referred to by Varma (1987). These sculptures could be technically parallel to the sculptural decoration of Nalanda temples - India, 5th to 12th centuries CE (Tiworthy, 2018), and some temples preserved in South India that are still being repaired or remodeled following a traditional knowledge passed down from generation to generation (“Stucco figures”, The Madras Documentary Company; <https://www.youtube.com/watch?v=OuCa-uhv2iY> – last access on 20 January 2024). These examples would have a more decorative function and could be identified as the images or figures reported in Agama literature “that are to be made and fixed to the outer surfaces of temple walls either without niches or in niches (...) not all meant for worship” (Varma, 1970: 4, footnote 17). This argument would be consistent with the idea that the use of one or the other variant could be related to the location of the sculptures: in an indoor or weather-protected space or located outside monuments or temples -something pointed out by Varma (1987: 34) and Tarzi (1986)-.

In many cases, fabric is interposed between the earthen-based modeling mortars and the final coat commonly named stucco, for example, at Ai-Khanoum (Bernard, 1969), Hadda (Tarzi, 1986), Tepe Sardar (Verardi, 1983), Tepe Narenj (Paiman 2010), or between the layers of stucco as in the cases of Tepe Sardar (Verardi, 1983). Fabric seems to be replaced by paper in East Asia, as mentioned by Moran (1960) for the Nara sculptures (8th CE, Japan). The use of fabric in the final stage of sculpture modeling is reported in Sanskrit literature (Varma: 1970), it seems to be also documented in some of the analyzed fragments from Tepe Narenj and Qol-e-tut (López-Prat et al., 2024) and is today employed in the making of Bengali sculptures, where artists apply cotton fabrics before adding the final stucco primer for polychromies. These fabrics allow the camouflage of fissures and cracks that

usually appear during the drying of the final modeling layers (López-Prat et al., 2024).

4.4. The head, the hands, and the feet

In an archaeological context, feet, hands, and heads are better preserved. They are often found separate from the body, probably because they are more massive and heavier, but also, as is often commented in the literature, because they could have been worked separately, as mentioned by some authors studying historical examples: Litvinskiy & Pichikiyan (1981) in the case of Takht-i-Sangin, Verardi (1983) and Tarzi (1986) in their respective studies of Tepe-Sardar and Hadda sculptures, and Luczanits (2004) in Western Himalayan sculptures. The use of molds is often inferred or documented, especially in the elaboration of:

- Faces: Hadda (Barthoux, 1930; Middleton and Gill, 1996; Maillard 1967), Tepe Sardar (Verardi, 1983), Dalverzin-tepe (Pugachenkova, 1976), Western Himalaya (Luczanits, 2004);
- Fingers: Hadda (Tarzi, 1986);
- Ears: Western Himalaya (Luczanits, 2004);
- Garments: Guldara (Fussman & Leberre 1976), Tepe Sardar (Verardi, 1983), Tumshuq-Tagh (Lefevre & Pre, 1996), Western Himalaya (Luczanits, 2004).

The separated work for making faces, fingers, and garments and the use of molds has also been documented in Bengal (López-Prat et al., 2021) (Fig. 6). There, the artists add these parts in the final stages of the modeling process. They mix the two types of clay to reach a paste that is sufficiently malleable to model but also sticky to be attached to the rest of the figure. They add the head (once the internal layers of the body are completely dry), the hands and feet (once the external modeling of the

rest of the body is completed), and the garments (once the fabrics mixed with barbotine of sticky clay is finally added).

Under these premises, the modeling of the wooden skeleton variant of a monumental *terracuda* sculpture would conform to the schematic pattern presented in the technical drawing of Fig. 7.

5. Discussion

The results of the combination of quantitative and qualitative evidence seem to confirm that there exists one shared technique in the making of monumental *terracuda* sculptures spread along the Silk Roads from the 2nd century BCE, and it survives to the present day. The variations observed (different cores, different types of modelling pastes, different finishes, different species of herbaceous and fibrous matter) would be adaptations to specific geographical and cultural contexts and linked to a particular architectural site and/or the religious program represented.

Up to now, when debated, the origin of the technique has mainly been attributed to the arrival of Greeks in Central Asia -except Varma (1970), who argued an Indian origin. This is because the earliest examples of monumental *terracuda* sculpture (Ai-Khanoum, Old-Nisa, Takht-i-Sangin) were found in this region under the influence of the Greco-Bactrian kingdoms (3rd – 1st centuries BCE) before Buddhism became well established there. This led to the interpretation that the sculptural technique originated from Hellenistic knowledge/expertise imported from the West (Bernard, 1973; Tarzi, 1986; Bollati, 2005). To support this idea, the authors point to the Salamina necropolis in Cyprus, where remains of “partially fired” clay life-size sculptures from the 4th century BCE were discovered, associated with a funeral pyre. These sculptures showed traces of having an internal wooden support on the back and a large number of iron nails inserted to “hold the clay to a wooden post” (Karageorghis, 1967). However, this is the only example



Fig. 6. Modelling of feet and fingers (September 2019, Kumortuli, Kolkata, West Bengal, India).

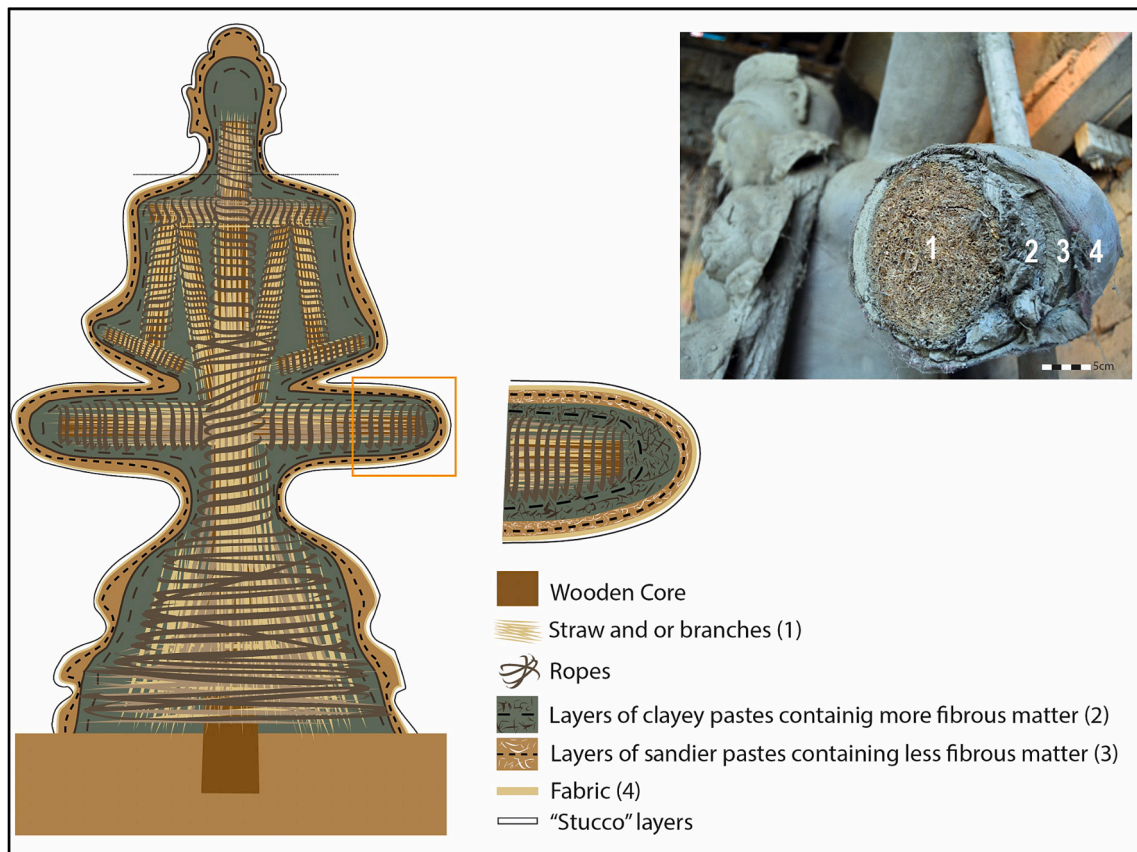


Fig. 7. Technical schematic drawing of a monumental *terracruda* sculpture in the variant with wooden skeleton (M. López-Prat re-elaboration from Z. Tarzi (1986) compared with an arm section of a not-finished sculpture of a Goddess Kali (Kumortuli, Kolkata 2019).

found outside of Asia that could be considered “similar” to the characteristic monumental *terracruda* sculpture of the Silk Roads.

The Hellenistic origin of this sculptural tradition is also justified in the literature by its initial connection with Gandharan art, an artistic current born in the ancient region of Gandhara and characterized, among other things, by presenting some of the first anthropomorphic representations of the Buddha, dated around the 1st century CE and initially made in stone (Tarzi, 1986) and in which several authors see a clear influence of classical or Hellenic styles, the reason why this artistic current is also known as “Greco-Buddhist art.” However, the assumption of the Hellenistic influence in the Gandhara region remains a weak argument to explain the exclusive presence of these sculptural manifestations in Asia, first in Central Asia to later spread with Buddhism eastwards, especially from the 3rd-4th centuries CE, when the use of *terracruda* will gain popularity over stone.

The change in material preference (from stone to *terracruda*) has been explained in the historic-archaeological context by the dissemination and rapid growth of Buddhism in the region from the 3rd century CE onwards, leading to a greater demand for temple and monastery construction along the routes connecting Central Asia with the Far East (Tarzi, 1986). As a consequence, the use of clay and stucco over stone for sculptural decoration would grow as these materials are considered cheaper when creating sculptures (Olivieri & Filigenzi, 2018) and readily available in the environment (Luczanits, 2004:11-note 19; Schmidt 2023). Conversely, in some cases, several stone quarries are found near Gandharan sites with a high prevalence of clay or stucco sculpture (Vanleene, 2019). As Vanleene argues, this would indicate that using these materials could be “a deliberate choice, a preference.”

The study of Bengali traditional knowledge demonstrates that the realization of *terracruda* sculptures, including the provision of the needed materials, the elaboration of the modeling pastes, and the

necessary drying times between the several layers, requires highly specialized knowledge and can take several months to complete. Furthermore, the preference for using clay as the favorite material to represent divinity has been maintained until today in some Buddhist countries, such as Bhutan, where it is documented from the 7th century CE onwards (Rai, 2009). In this country, Buddhist artists associate the fragility of unfired clay as a sign of “impermanence,” and the susceptibility of *terracruda* images to agents of degradation is understood as a reminder of the caducity of all things, highlighting the need for periodic repair or replacement as a symbol of *samsara* and the eternal “rebirth-death” (Bean, forthcoming).

Alongside this, the earliest written references to the worship of *terracruda* sculptures are found in the *Divyāvadāna* Buddhist stories, dating from the 2nd and 3rd centuries CE, in which the Buddha conveys his teachings referring to the worship of (unfired) clay images (Varma 1970: 227-228). Their compilation is attributed to the Buddhist community of Mūlasarvāstivāda, one of the first Buddhist schools in India. The Mūlasarvāstivāda-vinaya, the prevailing code in Vajrayana or Tantric Buddhism and the oldest in the Buddhist tradition (5th-6th centuries CE), refers to the technique of creating clay sculptures from a wooden skeleton (Varma 1970: 227-228). Although its origin is largely unknown, one theory suggests that the Mūlasarvāstivāda community was founded by the Sautrantikas, a branch within the Sarvāstivādin group of schools that emerged in Gandhara and Bactria around the 2nd century CE (Willemen et al., 1998). Their followers later became known as Mūlasarvāstivādins. Moreover, according to Varma (1987: 26), most Buddhist monasteries in the Gandhara and Bactrian regions belong to the Sarvāstivāda sect.

Interestingly, most of the earliest sites where non-Buddhist examples of monumental *terracruda* sculptures are found are around Bactria. These sites preserve the remains of material culture that, as some

researchers indicate, is related to the cult of the Oxus River and fertility, represented through female or aquatic divinities belonging to cultic traditions that predate the arrival of Hellenic culture (Pugatchenkova 1976; Francfort, 2012, Minardi 2016).

It is worth noting that the 4th century CE in India, when *terracruda* sculpture began to gain importance in Central Asia and Afghanistan, coincides with the Gupta period (300–650 CE) in India, during which Buddhism flourished strongly under royal patronage in the subcontinent adopting tantric forms (Barnes 1995). Eastern India and particularly Bengal, is considered a fortress of Shakta and the birthplace of Tantra (Robinson 1983: 237), and some authors argue that Vajrayana or Tantric Buddhism may have emerged in Bengal and spread to Central Asia and Tibet, becoming the main form (Barnes 1995). In India, Tantric Buddhism gained a strong foothold, especially in Bengal during the Pala dynasty (8th – 12th century CE). It is also where Buddhism survived the longest, until the 12th century CE when the invasion of Muhammad Bakhtiyar Khilji provoked the exodus of Buddhist laymen and monks to the Himalayas and neighboring countries, mainly Nepal, Tibet, and Bhutan, and the destruction of most of the architectural traces of the Buddhist past in the region (Barnes 1995).

Coincidence or not, it is in Bengal, where India has mostly maintained the tradition of using unfired clay for the representation of God, especially the mother-goddess Durga (Shakti), whose festival is the most awaited celebration in the Bengali spiritual calendar. And, in the Himalayan region (mainly in Bhutan), where the Buddhist tradition of clay-based divinity making is fully kept, and where the artists-monks that preserve it defend unfired clay as the most suited material for image-making because it contains all the precious substances, including gold, silver, and gems, as well as the essences of the five cosmic elements (Bean, forthcoming publication).

All this information led us to infer that the technology used to produce *terracruda* sculptures did not originate from imported Hellenistic knowledge and is not the result of searching for more ready-available materials. On the contrary, it suggests that the technique has a spiritual or religious motivation linked to the use of raw earth as a preferred sculptural medium aimed at representing the sacred, and may have originated near the Indian subcontinent, probably in the region of Central Asia-Afghanistan (where the earliest examples are documented), linked to cultic traditions in which the worship of fertility and female played a significant role. These cultic traditions may have seen raw earth, symbolizing the source of life, as the preferred material for embodying the sacred. This preference could have led to the development of a specific technique for creating life-size and larger-than-human sculptures from this material.

Regarding the adoption of the technique by Buddhism and its rapid spread from the 3rd – 4th centuries CE onwards, it seems reasonable to assume that it may have been influenced by the *Mūlasarvāstivādins* and their special connection with Tantric Buddhism and the Gandhara and Bactrian regions. This geographical link may have led the *Mūlasarvāstivādins* to adopt a technique of representing the divine developed within Bactrian religions, linked to the feminine and fertility. These attributes may have favored its success within tantric spiritual traditions. Particularly from the 4th century CE onwards, when tantric currents emphasized ritual as a component of meditation and the worship of female deities, symbols of fertility like Tara or Durga gained significant prominence under royal patronage in India.

6. Conclusions

This work offers an overview of the research carried out to understand the existence of a common tradition along the Silk Roads for the elaboration and production of “monumental *terracruda* sculpture”. The evidence discussed seems to confirm the existence of an uninterrupted pattern that originated in Central Asia around the 3rd-2nd century BCE and has evolved maintaining its main characteristics to this day in some Himalayan and Indian regions. The multidisciplinary character of the

study combining quantitative and qualitative evidence from history, archaeology, archaeometry, and ethnographic research, has brought forward advances in the technological knowledge of monumental *terracruda* sculpture, proposing a common denomination and new art-historical hypotheses to explain its origin and dissemination from the 4th century CE onwards.

The answer to why the artistic use of *terracruda* to represent the sacred along the Silk Roads is so popular may have been sought in multiple factors; however, the present work suggests that the main reason may be connected more with the symbolic value of raw earth in shaping the sacred than with the importation of Western knowledge or the accessibility of clay in the absence of other materials, as argued so far.

This paper proposes a systemic approach to the generation of new hypotheses for the understanding of monumental *terracruda* sculpture, however, only the advocacy of interdisciplinary research, combining archaeology, archaeometry, ethnography, history of art and Indology, will allow these hypotheses to be corroborated or confirmed, moving forward and giving this cultural tradition their rightful place in the broader context of Asian cultural heritage, and to help rethink and define new strategies for preserving, enhancing and promoting this unique heritage.

CRediT authorship contribution statement

Mònica López-Prat: Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing. **Alessandra Pecci:** Conceptualization, Data curation, Writing – review & editing, Investigation, Supervision. **Carla Lancelotti:** Data curation, Investigation, Writing – review & editing. **Domenico Miriello:** Conceptualization, Data curation, Investigation, Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare no competing interests that could have appeared to influence the work reported in this paper.

Data availability

The data presented are in the article or refer to data related to previous published work. The results of the analyses carried out on the TN and QT sculptures are available at 10.5281/zenodo.7634917.

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References

- Barnes, G.L., 1995. An introduction to Buddhist archaeology. *World Archaeol.* 27 (2), 165–182.
- Barthoux, J. J. 1930. Les Fouilles de Hadda III - Figures et Figurines. Memoires de la Delegation Archeologique Française en Afghanistan. <http://dsr.nii.ac.jp/toyobun/ko/La-187-4/V-3/page/0045.html.en>.
- Bayerova, T., Gruber, M., & Krist, G. 2010. Technical study of polychrome clay sculptures from the Buddhist temple complex at Nako, Himachal Pradesh, North India. In: *Multidisciplinary Conservation: A Holistic view for Historic Interiors* (Rome, 23–24 March 2010)—Joint interim meeting of five icom–cc working groups: Sculpture, Polychromy, and Architectural Decoration (pp. 1–11).
- Bean, S., n.d. forthcoming publication. *Earth Works — The Dynamics of Terracuda Sculpture in Southern Asia*.
- Bean, S.S., 2011. The unfired clay sculpture of Bengal in the Artscape of modern South Asia. A companion to. *Asian art and architecture* 604–628.
- Bernard, P., 1969. Quatrième campagne de fouilles à Ai Khanoum (Bactriane). *Comptes Rendus Des Séances De L'académie Des Inscriptions Et Belles-Lettres* 113 (3), 313–355.
- Bernard, P. 1973. Fouilles d'Ai Khanoum I (campagnes 1965, 1966, 1967, 1968), M.D.A. F.A. XXI, 2 vol., Klincksieck: Paris.
- Blaensdorf, C., & Tao, M. 2010. A Chinese–German Cooperative Project for the Preservation of the Cultural Heritage of Shaanxi Province: Conservation of the Polychrome Clay Sculpture and Investigation of Painting Materials in the Great Hall of the Shuilu'an Buddhist Temple. *Conservation of Ancient Sites on the Silk Road*, Los Angeles: The Getty Conservation Institute, 203–211.
- Blänsdorf, C., Melzl, E., 2009. Technique of modelling the buddha statues. *Monuments and Sites* 19, 201–214.
- Bollati, A. 2005. Antecedenti Delle Sculture Greco-Buddiste in Argilla Cruda Da Nisa Vecchia.. En *Art et Archéologie Des Monasteres Gréco-Bouddhiques Du Nord-Ouest de l'Inde et de l'Asie Centrale. Actes Du Colloque International Du Crpoga* (Strasbourg, 17–18 Mars 2000), 29–49.
- Bonaduce, I., Cito, M., Colombini, M.P., Lluveras, A., 2009. The characterisation of the organic binders. *Monuments and Sites* 19, 265–280.
- Bonaduce, I., Colombini, M., Blaensdorf, C., Lluveras, A., & Tao, M. 2011. “A first insight into the Asian clay sculptures painting technique and materials: western and eastern Buddha of the Bamiyan Valley (Afghanistan) and sculptures from Shuilu'an (Shaanxi, China).” In: *Art'11 - 10th International Conference on Non-Destructive Investigations and Microanalysis for the Diagnostics and Conservation of Cultural and Environmental Heritage*.
- Bongard-Levin, G.M., Košelenko, G.A., 2005. The puzzle of Elkharas. *East and West* 55 (1/4), 41–53.
- Chi, G., 2023. The influence of cultural exchanges along the silk road on the development of large stone portraits in ancient China. *African and Asian Studies* 1 (aop), 1–23.
- Chiari, G., Invernizzi, A., & Bertolotto, G. 1993. Investigation and restoration of clay fragmentary statues from old nisa Turkmenistan. In: *Conferência internacional sobre o estudo e conservação da arquitectura de terra (7a). Silves (Portugal)*, 24 a 29 de Outubro 1993 (pp. 228–230).
- Fedorovitch, E., 1969. Nouvelle methode de fixation des anciennes sculptures en argile brute. *Monumentum* 4, 97–100.
- Fominikh, V., 2008. The buddhist monuments of adjina-tepa. *Silk Road Silk Road Silk Road Silk Road* 38–43.
- Forgione, G., 2019. Clays and colours: tracking technologies and theories of vision in the ancient buddhist art of Afghanistan. *Restauro Archeologico* 27 (1), 130–141.
- Francfort, H. P. 2012. Ai Khanoum Temple with Indented Niches and Takht-i Sangin Oxus Temple in Historical Cultural Perspective: Outline of a Hypothesis about the Cults. Ai Khanoum Temple with Indented Niches and Takht-i Sangin Oxus Temple in Historical Cultural Perspective: Outline of a Hypothesis about the Cults, 109–136.
- Fussman, G., Le Berre, M., 1976. «le Monastère De Gul Dara». En *Monuments Bouddhiques De La Region De Caboul*.
- Gill, M.S., Rendo, C.P., Menon, S., 2014. Materials and techniques: early buddhist wall paintings and sculptures at sumda Chun, Ladakh. *Stud. Conserv.* 59 (5), 300–313.
- Karageorghis, V., 1967. Chronique des fouilles et découvertes archéologiques à Chypre en 1966. *Bulletin De Correspondance Hellénique* 91 (1), 275–370.
- Kostrov, P. Restoration of ancient monumental painting on loess plaster and painted loess sculpture. Joint meeting for the ICOM Committee for Scientific Museum Laboratories and the ICOM Sub-committee for the care of paintings, 63/84.
- Lefevre, L., & Pre, Y. 1996. Dessalement de statuettes en terre crue d'Asie centrale conservées au musée Guimet. In: *Le dessalement des matériaux poreux: 7èmes journées d'études de la SFIIC, Poitiers, 9-10 mai 1996* (pp. 91–103).
- Li, Z., 2001. Coloured clay sculptures and their protection at mo kao grotto at Dunhuang. *Monuments and Sites* 3, 174–177.
- Li, L., Du, J., Liu, H., Chen, R., Liu, T., 2016. Dynamic characteristics and seismic responses of painted sculptures of Dunhuang mogao grottoes. *J. Cult. Herit.* 22, 1040–1048.
- Lippolis, C., Davit, P., Turco, F., 2019. Stucco and clay in the decoration of the monumental building of old nisa. *Syria* 311–322.
- Litvinskiy, B.A., Pichikiyan, I., 1981. The Temple of the Oxus. *Journal of the Royal Asiatic Society of Great Britain and Ireland* 2, 133–167.
- López-Prat, M., Carrascosa, B., Miriello, D., Simón-Cortés, J., Bandyopadhyay, S.R., 2021. An ethnographic approach to developing new conservation strategies for the archaeological clay-based sculpture of the silk road. In: *In Transcending Boundaries: Integrated Approaches to Conservation. ICOM-CC 19th Triennial Conference Pre-Prints*, pp. 17–21.
- López-Prat, M., Agostino, R.G., Bandyopadhyay, S.R., Carrascosa, B., Crocco, M.C., De Luca, R., Miriello, D., 2022a. Architectural terracuda sculptures of the silk roads: new conservation insights through a diagnostic approach based on non-destructive X-ray micro-computed tomography. *Stud. Conserv.* 67 (4), 209–221.
- López-Prat, M., De Luca, R., Pecci, A., Mileto, S., Bandyopadhyay, S.R., Bloise, A., Guido, A., Cipriani, M., Lancelotti, C., Carrascosa, B., Noori, N.A., Simón-Cortés, J. M., Miriello, D., 2024. The modelling pastes of the monumental terracuda sculpture of the Silk Roads: archaeometric study of the Tepe Narenj and Qol-e-tut examples (Kabul, Afghanistan). *Archaeometry* 66 (1), 76–99.
- López-Prat, M., Lancelotti, C., Campo-Francés, G., Ray Bandyopadhyay, S., Carrascosa, B., Noori, N.A., Miriello, D., 2022b. The role of plants and fibres in modelling monumental terracuda sculptures of the silk roads: archaeobotanical analyses from the buddhists sites of tepe-narenj and qol-e-tut (Kabul, Afghanistan). *Heritage Science* 10 (1), 1–16.
- Luczanits, C. 2004. *Buddhist Sculpture Clay: Early Western Himalayan Art, Late 10th to Early 13th Centuries*.
- Maillard, M. 1967. *Les stucs de Hadda: essai de typologie* (Doctoral dissertation, École du Louvre).
- Middleton, P., Gill, A., 1996. Technical examination and conservation of the stucco sculpture. A Catalogue of the Gandhara Sculpture in the British Museum 1, 363–368.
- Minardi, M., 2016. The Hellenistic Chorasmian ketos of Akchakhan-kala. *Iranica Antiqua* 51, 165–200.
- Minardi, M., 2020. The ancient chorasmian unbaked-clay modelled sculptures: hellenistic cultural ‘impacts’ on an eastern iranian polity. *Religion, Society, Trade and Kingship. Art and Archaeology in South Asia along the Silk Road* 5500, 195–208.
- Moran, S.F., 1960. Structural features of clay sculpture of the nara period. *Artibus Asiae* 23 (1), 41–66.
- Nagpal, J. C., & Agrawal, O. P. Examination and preservation of a painted stucco head. *Ancient India* 15(15), 94–99.
- Olivieri, L.M., Filigenzi, A., 2018. On Gandhāran sculptural production from Swat: recent archaeological and chronological data. *Problems of Chronology in Gandhāran Art*. Oxford: Archaeopress 71–92.
- Paiman, Z., 2010. Kaboul: Les Bouddhas colorés des monastères. *Archeologia (Paris)* (473), 52–65.
- Pilipko, V.N., 1995. Clay sculptures from Nisa. In *The Land of the Gryphons: Papers on Central Asian Archaeology in Antiquity* 13–21.
- Pilipko, V.N., 2002. The second helmeted head from Old Nisa. *Iran* 40 (1), 273–276.
- Pougatchenkova, G., 1976. L'art antique de la Bactriane (IVe s. avant notre ère-IVe s. après notre ère), d'après les fouilles dans la République soviétique de l'Uzbékistan. *Comptes rendus des séances de l'Académie des Inscriptions et Belles-Lettres* 120 (2), 217–227.
- Pugachenkova, G.A., Dar, S.R., Sharma, R.C. & Joyenda, M.A. 1994. Kushan Art History of Civilizations of Central Asia Vol. II. The development of sedentary and nomadic civilization 700 B.C. to A.D. 250, Harmatta J. A. (Ed.), Puri B.N. & Etemadi G.F. (coeds.), UNESCO, 331–395.
- Rai, M. 2009. Origin and Development of Clay Images (Jim Ku/Sa Ku) in Bhutan. The Essence of Bhutanese Culture, Vol. II: 217–42. The Proceedings of the Fifth Colloquium. Paro: National Museum of Bhutan.
- Robinson, J., 1983. The worship of clay images in Bengal. University of Oxford. Doctoral dissertation.
- Schlumberger, D., Le Berre, M. & Fussman, G. 1963. La Sculpture de Terre. In *Surkh Kotal En Bactriane. Mémoires de La Délégation Archéologique Française En Afghanistan. Tome XXV., Vol. I*.
- Schmidt, B., 2023. Chapter 2. Climate and Resource Dependencies in Buddhist Art and Architecture along the Northern Silk Road. In: Hegewald, J. (Ed.), *Embodied Dependencies and Freedoms: Artistic Communities and Patronage in Asia*. De Gruyter, Berlin, Boston, pp. 33–68.
- Tarzi, Z., 1986. La technique du modelage en argile en asie Centrale et au Nord-Ouest de l'Inde sous les kouchans: la continuité malgré les ruptures. *Ktéma* 11, 57–93.
- The Madras Documentary Company. Stucco figures. Video available on YouTube (<https://www.youtube.com/watch?v=OuCa-uhv2iY>). Last visualization 27/09/2023).
- Tiwary, S.K., 2018. Stucco art of Nalanda excavated site, district Nalanda, Bihar: an archaeological overview. *Annals of Archaeology* 1 (1), 13–21.
- Torgoev, A. I., Kulish, A. V., Kiy, E. A. & Kolchenko V. A. 2019. The Buddhist Monastery of Krasnaya Rechka Settlement. The Main Findings 2010–2015. Proceedings of the First International Congress on Central Asian Archaeology, 4–6 February 2016, Urban Cultures of Central Asia from the Bronze age to the Karakhanids, 349–363.

- Vanleene, A., 2019. Differences and similarities in gandhāran art production: the case of the modelling school of hadda (Afghanistan). *The Geography of Gandhāran Art* 143.
- Varma, K.M., 1970. The indian technique of clay modelling. Proddu, Santiniketan.
- Varma, K.M., 1987. Technique of gandharan and indo-afghan stucco images. Proddu, Santiniketan.
- Verardi, G., 1983. Osservazioni sulla coroplastica di epoca kushana nel nord ovest e in Afghanistan in relazione al materiale di tapa sardar, seguite da una precisazione sulla natura e la data delle sculture di ushkur, *annali*. Istituto Universitario Orientale Di Napoli 43–3, 479–503.
- Verri, G., Luczanits, C., Borges, V., Barnard, N., Clarke, J., 2019. Investigations of a gandharan stucco head of the buddha at the Victoria and Albert Museum (IM. 3–1931). *technè. La Science Au Service De L'histoire De L'art Et De La Préservation Des Biens Culturels* 48, 136–149.
- Willemen, C., Dessein, B., Cox, C., 1998. *Sarvastivada Buddhist Scholasticism*, Vol. 11. Brill.
- Zhao, L., 2014. Selection of consolidants for the polychrome clay sculptures in the guanyin Temple, Sichuan, China. *Stud. Conserv.* 59 (sup1), S289–S291.
- Zhong, Z.B., 1990. The conservation of ancient chinese polychrome clay sculptures. *Stud. Conserv.* 35 (sup2), 20.