

II. MATERIAL TRADITIONS: RAW MATERIAL AND TECHNIQUES

This chapter examines the interrelation between properties of raw materials and the applied processing methods. The first part offers a general overview of the importance of the use of local terminology within the scientific research of materials. Scientific efforts are specifically emphasised. Three different crafts are discussed, i.e. construction of a flat roof, making of pottery and making of clay sculptures, all of which are based on mineral raw material. Raw materials and related processing methods are juxtaposed in a historical and present context.

1. SIGNIFICANCE OF LOCAL TERMINOLOGY WITHIN THE STUDY OF BUILDING TRADITIONS

Building traditions are carriers of information on functional aspects and social needs based on a particular agreement within a certain community. From a social-anthropological point of view, such information may give answers to questions on technical and related social conditions and developments at a certain time or over a certain period of time and within a certain local or regional context.

One approach to moving closer to a broad material understanding is research on technological and social aspects using local terminology. An example is the terminology used for specific types of clay that are known as fine material for plasters or roofs within the Himalayas. One material that is widely known as *markalak* in Ladakh (Feiglstorfer 2014: 378) is known by the similar term of *narkalak* several hundreds of kilometres further away in Purang, while in Upper Kinnaur, an area in northern India located between Ladakh and Purang, this material is known as *tua*. Further to the east, in Central Tibet, it is referred to as *thigsa*. Locally used terms support research on particular material properties and construction methods. They give evidence of the origin of materials and their use and become a local marker in a material and social-anthropological context. A striking result of this research (Feiglstorfer 2019: 252ff.) was the conclusion that over such a wide distance the material, which was described partially under a similar name, also shows similar material properties suitable for particular technical needs.

Regarding material properties, with this step in research on transmission of traditional knowledge, similarities in the use of particular materials become evident. It invites further investigations into the field of clay, since this material, due to its locally varying compositions and its characteristic to be mixed, is more complex to terminologically categorise compared to building materials such as metal or wood. Nevertheless, within historical sites, in particular religious buildings, which in many cases in the Himalayas are some of the oldest witnesses of local building traditions, we have to regard the complexity of local material specifications. Studying the network of origins of used materials such as clay, wood, stone, metal, etc. supports the understanding of traditional methods of processing and improves insights into crafts and craft traditions. Using local terminology is part of a building material's local identity and essential for further understanding of material properties in a coherent material-cultural context.

2. EARTH ROOFS AND *ARGA* ROOFS: A CONTINUITY OF A FLAT ROOF TRADITION

2.1 Two different types of a flat roof

Besides protection from natural elements, a roof also represents a social status. In the case of flat roof constructions, representation may be given by the selection of particular raw materials and a higher quality of the applied method of construction. Particular methods, which are applied for making flat roof constructions, are similar to those used for floor constructions. The use of *arga* as a specific stone instead of clay was historically mainly employed for structures belonging to a religious and aristocratic society. At several buildings in Tibet, we still observe the application of this technique. The need arises for an examination of the construction of such stone roofs and their juxtaposition to common flat roofs made of clay.

A current topic in the conservation of earth buildings is the leakage of traditional flat roofs. Over the last decades in regard to vernacular structures, several problematic measures have been taken due to a loss of knowledge on the right construction process, lack of understanding of the proper raw material, or simply due to a lack of time. Examples include the use of plastic sheets for water proofing, bringing too much load onto the roof or using improper raw material. By learning from traditions, we receive the necessary information on the proper way to construct a long lasting flat roof. It is not just a question of the appropriate quality of clay, but all the single components of construction go hand in hand to create the best possible structure.

In general, there are two different kinds of flat roof constructions in the Himalayas: the flat earth roof with clay as the uppermost layer, and the *arga* roof with a specific kind of stone as the uppermost layer (Feiglstorfer 2012a: 5–8). The earth roof can be found all over the Himalayas with regional and local specifications given by the available raw material. Such an earth roof may differ from the *arga* roof, for example due to a less heavy subconstruction. The use of stones as load-bearing subconstruction could be examined at various *arga* roofs. The *arga* tradition is still practised in Tibet, primarily for structures representing a higher social status. In a recent research project at the IAG / BOKU, *arga* raw material was examined and basic material features analysed (cf. Feiglstorfer 2019: 139ff.).

In the following, some basic features of a Central Tibetan earth roof are juxtaposed to a Central Tibetan *arga* roof construction. For both methods, a similar subconstruction is used.⁴⁷ Within the subconstruction, the basic carrier is a wooden construction consisting of *dungma* (Tib. *gdung ma*, “main beams”) and *cham* (Tib. *lcam*, “secondary beams”), with an initial layer of *delma* (Tib. *dral ma*, small pieces of wood of a tree or a bush) on top. This layer is used in such an amount that the *cham* is no longer visible. Previously, *tsherma* (Tib. *tsher ma*, “thorns” or “bush”), which is laid as loose pieces onto the wooden subconstruction, was commonly used, but today any species of wood is applied. If less *cham* is used, a larger amount of *delma* is necessary and vice versa. The use of an organic layer on top of the *cham* and below a next upper layer of clay is widely known in the Himalayas. The type of organic materials depends on the local availability. In the Western

47 At some examined *arga* roofs, the subconstruction is made with a higher content of stone to increase resistance against strong vibrations during ramming (see Fig. 2.2).

Himalayas for this organic layer materials, for example, grass such as *yaks* or *burze* are used (cf. Feiglstorfer 2019: 150).⁴⁸ The use of *yaks* and *burze*, in contrast, is not so common for building purpose in Central Tibet as it is in the Western Himalayas. When using stones for making the subconstruction, a layer of stones in varying sizes covers the layer of *delma* (cf. Feiglstorfer 2019: 145ff.). Not just flat but also round stones are used with the aim to press down on the layer of *delma*. In the case, where the layer of *delma* already shows high compression, fewer stones are necessary and vice versa. In-between the big stones rather small stones or sand (Tib. *sil bu*, “bits” or “pieces”)⁴⁹ are placed into remaining holes.

A layer of a slightly sticky clay taken from the field covers the layer of stones. Such clay has no particular required property, though, if possible, a reduced content of stones is preferred. On the one hand, it has to cover the stones below; on the other hand, it is the layer that carries the upper mineral layer, which consists either of clay or of *arga*. The clay on top of the subconstruction is of *earth-moist* (Ger. *erdfeucht*) consistency, and it is thrown over the layer below, which is either a stone or an organic layer, where it remains either uncompressed or is compressed by beating, e.g. with wooden sticks. When drying, resulting cracks are covered and closed by the next upper layer. Up to this layer, construction remains similar for both flat earth roofs and *arga* roofs.

2.2 Earth roof construction

For the earth roof on top in Central Tibet, a specific type of clay, the *thigsa* (Tib. *thigs sa*), is used (Fig. 2.1; Interview Penba Tashi 2015). It is much finer than the clay below and does not easily crack. It is compressed with wooden branches used as beaters. Whether or not the earth roof is waterproof depends on this layer. Before it starts raining, *thigsa* is applied onto the roof on a date chosen according to the Tibetan calendar. In relation to the orientation of the nest of the magpie, a differentiation is made between *tschogtsang* (Tib. *mchog tshang*, “best nest or house”) as the clean and good orientation, and *bumdong* (Tib. *bum stong*) as the “empty vase”, respectively, the wrong orientation.⁵⁰ These orientations influence the side of the roof, on which to start adding

48 The tradition of using organic insulation layers is not restricted to the Himalayas. In particular organic substances are connected to specific local building traditions. In Bam in Iran, for example, the bark of the date palm tree is used to waterproof the roof.

49 The term ‘*silbu*’ (Tib. *sil bu*) describes small pebbles; also known as *toshug* (Tib. *tho shrug*).

50 According to an interview with Penba Tashi in Lhasa on December 3rd 2015. He mentions the magpie (Tib. *skya ga*, written form; *kre skag*, spoken form), which lives in the close vicinity to settlements and builds a nest in the trees. The form of the nest is ball-like with one or two entrances. It is a common belief that, similar to humans, these birds have to protect their ‘home’ from precipitation. The entrance of the nest opens contrary to the main direction of the rain. For the builder, the choice of the right time to make the nest and the nest’s orientation are of high importance. Related to this traditional belief is the expression “*kyaka thigsa*”, which is also used for the application of *thigsa* according to this bird observation.

In the event of a roof leak, one can make a pilgrimage to Drag Yerpa (Tib. *Brag Yer pa*) in Phenpo. Legend says that the roof of the Lhasa Jokhang was not made of *arga* but also of clay, i.e. *thigsa*, and that the first material, which was used at the Lhasa Jokhang, originated from Drag Yerpa. On the one hand, this description emphasises the religious importance of Drag Yerpa also on a material-cultural level; on the other hand, it points towards a more common use of earth roofs in the imperial period of Central Tibet and a subordinate meaning of *arga* as roofing material.

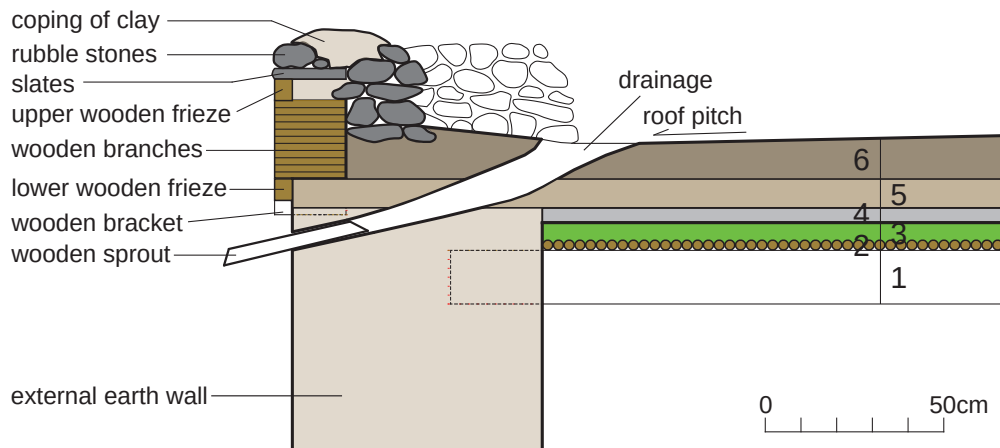


Fig. 2.1 Fig. 8.3 Section of a traditional flat earth roof construction.

CT = Central Tibet; WT = Western Himalayas (cf. Feiglstorfer 2019: 146).

1 = *cham* (Tib. *lcam*, secondary beam), often placed on the *dungma* (Tib. *gdung ma*, main beam), the latter resting on one or more *kawa* (Tib. *ka ba*, pillar).

2 = *delma* (Tib. *dral ma*, small pieces of wood of a tree or a bush), e.g. willow branches are commonly used in WT.

3 = organic layer; specific types of grass like *yaks* used in WT; the use of an organic layer is commonly known in WT, but not everywhere in CT.

4 (ground layer) = *yamba* (Tib. *gyam pa*, flat stones); often used in combination with an *arga* roof; often used in CT or Purang; rarely used in WT.

4 (upper layer) = *dorug* (Tib. *rdo hrug*, small stones); used in combination with the *yamba* below to fill gaps between the bigger stones.

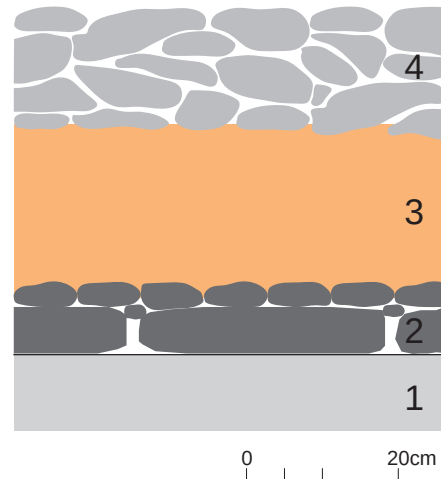
5 = *thogdag* (Tib. *thog 'dag*); is the first layer of clay.

6 = *thigsa* (Tib. *thig sa*); upper and fine layer of clay, which is in some areas traditionally replaced or simply added every year and maintained before rain falls.

clay. When of an *earth-moist* consistency, but not sticky enough to stick to one's fingers, *thigsa* is spread over the roof in a thickness of app. 2 cm to 4 cm. This layer remains uncompressed. *Thigsa* does not contain stones and is known all over Central Tibet. It is still common, e.g. in Lhundrup County and in Tölung (Tib. *Stod lung*), from where most of the *thigsa* for Lhasa comes from. Locations, where one can dig up *thigsa*, are locally known as *thigsa lensa* (Tib. *thigs sa len sa*). Penba Tashi explained *thigsa* in relation to his home village Grib in Lhundrup that it is commonly a material that is washed down from the hills by rain and that during rainfall, such places become muddy and slippery. This description points towards a type of clay with a high content of clay minerals. For maintenance of the roof, fresh *thigsa* is spread over the roof one to two times a year, while the layer of clay below remains unmaintained. Some families keep fresh *thigsa* for the next season at an edge of their roof. In winter, melting snow in particular has to be removed from the roof. Tashi Penba described this process of snow removal as being necessary as soon as shoe prints are visible in the snow. If not removed in time, the *thigsa* becomes moist and may leak in following seasons.

Fig. 2.2 Section of an *arga* roof. Showing a state before mixing clay and *arga* stones by ramming.

1 = Organic layer; 2 = Layer of stones; 3 = Layer of clay;
4 = Layer of *arga*.



2.3 *Arga* roof construction

The second preparation method for a flat roof in Central Tibet is applying *arga* stones in several layers, with the stones becoming finer towards the top layer (Fig. 2.2). Up to the top of the first layer of clay, the subconstruction remains similar as described for flat earth roof constructions. In some cases a stone subconstruction was made between the wooden rafters and the layer of clay on top without using organic fibres as insulation layer in-between. It is said that the quality of an *arga* roof increases from the bottom to the top, and it is the top that protects the roof from total collapse even in the case of the collapse of a pillar (Interview Kelsang 2014). A high-quality *arga* roof lasts many years, according to Grothmann (2011: 23) app. ten years, before the need for renovation arises.

In Feiglstorfer (2012a), a method for making an *arga* roof is described. After having collected the raw material and having crushed the *arga* stones into varying sizes, the work process is conducted in the following described steps (cf. Feiglstorfer 2019: 155ff.). With this technique, we also find several variations and descriptions about the size and preparation of the single layers. Fig. 2.2 shows average dimensions of surveyed *arga* roofs.

- A. Clay is spread out onto the roof in one layer of up to 35 cm (Alexander 2011: 71) and levelled (number 3 in Fig. 2.2).
- B. *Arga* is spread out layer by layer onto the roof, with each layer reducing the size of the pieces. The final *arga* will be between 10 cm and 20 cm (ibid. 71) (number 4 in Fig. 2.2). Each layer of *arga* is levelled, watered and compressed.
- C. The compression starts with a roller. Compression continues with use of the *bogdo*, a ramming tool with a stick to hold it in an upright position and a stone at its bottom end for crushing the *arga*. The surface is continually watered.
- D. As soon as the complete clay-stone mixture is saturated with water and water pressed above the surface of the upper *arga* layer, the ramming process is finished.
- E. In a further step the surface is burnished with stones to make it smooth. After finishing this step, the roof is ready for completion.
- F. The finishing is conducted with particular substances: first oil, followed by the use of vegetable substances. Mixtures and layers of finishing vary locally.



Map 2.1 Western and Central Himalayas. Sites related to *arga*.

GIS data based map: Jakob Gredler. Final graphics: author. Map based on data from Vector data (VD) and Basemaps (BM). Citations of VD and BM also see: Chapter IX, list of illustrations.

Construction can be explained in single steps but has to be understood as a composite construction, and as such it is efficient in a static and hydrophobic manner. The static effect is given by strong areal compression. Due to ramming and watering (steps A to C) that lasts several days, the compound of clay and *arga* becomes more and more homogenised. The small *arga* particles are pressed into the clay, and the clay from below is pressed towards the top, thus forming a homogenous mass (Feiglstorfer 2019: 191, 192). The quality of clay does not have any required specification, thus any clay with a low amount of stones can be used. As a result, up until now no hydraulic influence by the clay could be proven. Since not all examined types of *arga* contained smectite, its influence can also be excluded.

The hydrophobic effect is given by treatment of the surface, which starts with burnishing. Similar to what was mentioned for the finishing of pottery ware, the black paint used for window frames (*nagtsi*, Tib. *nag rtsi*) and wall plasters, by burnishing the surface is compressed, porosities are closed and the surface levelled. The substances used close the porosities and must be resistant to UV light and strong climatic changes. They must further be elastic and non-porous. These features are achieved with a combination of different fluid substances.

According to information given by two monks in December 2015 at the Uru Katsel Temple, *arga* was used for preparation of the monastery's new roof, but there are no *arga* quarries in the close vicinity. They received the *arga* raw material for recent reconstruction of the main temple from the Dogde (Tib. Dog sde) Valley, close to the Sera Monastery. Other places for quarrying *arga* include the village of Serme⁵¹ (Tib. Sa smad; see Hazod 2007: Map 2), which is close to the end of the Chuchod (Chu shul, also Chu shur) District on the way to Nyemo (Tib. Snye mo), Drag Yarpa (Drag Yer pa) in the Kyichu (Skyid chu) region, and several places are located in Phenpo ('Phan po) (Map 2.1).

Seven *arga* samples originating from pits in Central Tibet, West Tibet and Indian Himalayas were analysed regarding their bulk and clay-mineral composition, grain size distribution and colour (see Feiglstorfer 2019: 181). Marl, which is used as *arga*, shows a content of calcite, ranging between 46% and 80% with the highest amount in the Indian Himalayas and the lowest in Central Tibet. Minerals like dolomite, hematite, gypsum or pyrite were absent in general, and minerals like 7Å and 14Å minerals, mica, amphiboles, phyllo silicates, quartz, Kali-feldspar or plagioclase are either absent or available only in small amounts. Regarding the clay mineral analysis conducted for all four of these samples originating from Central Tibet and Indian Himalayas, the following was determined: Two samples show a rather high content of smectite, which supports the absorption of water during ramming and compressing. For three samples, the content of illite ranged between 17% and 42%, while the sample from Phugtal in Zangskar reached 100%, which differs strikingly from the other examined samples. A content of iron oxides, exemplarily of goethite in the sample from Phugtal, adds a yellowish colour. Inclusion of hematite, lepidocrocite or manganese adds a red, orange or black colour, respectively. This aspect seems important in a context of representing a particular social status, with a reddish colour being favoured for religious structures, for instance.

An important fact is that different crafts such as plastering of a wall or the preparation of the surface of pottery, of a clay sculpture or of an *arga* roof, are technically related to each other, even when they are connected to different crafts. Regarding the treatment of surfaces, these mineral-based crafts are interrelated regarding the use of similar raw material and the way of processing. An examination, which has so far not been conducted for the Himalayas, involves finding synergies between methods of construction and the raw material used. Such a study is inter alia connected to the correlation between raw material resources and methods of processing. This method of examination requires a higher level of research effort than just focusing on technical aspects of roof constructions, for instance, since a high effort in interdisciplinary exchange is needed. For that purpose, methodologically an architectural and natural scientific background complement each other well, as demonstrated in particular in Chapter III.

Bellezza (2015) describes the method of burnishing pots in the Chugong period in Central Tibet around 4,000–3,500 BCE. This technique is globally well known, leading us to further investigate this method of treatment of the upper surface of plasters. In research at the IAG / BOKU, experiments focused on this field showed clear differences in the burnishing behaviour of different mixtures. Further it turned out that the raw material used for plaster of the Nyarma Tsuglagkhang (founded in 996 CE) showed an ideal mineral composition for this treatment (Feiglstorfer 2019:

51 The village of Serme has not yet been clearly localised and will be part of future research.



Fig. 2.3 Uru Katsel Temple. Women creating a shiny surface on top of the clay plaster by burnishing with round stones.

33ff.). The same clay, which was collected from places close to the building site, was used for bricks and also for the lower and the upper plaster layer. For the single components, the clay was treated in different ways, by sieving, desludging and mixing with straw. In this way, the properties of the clay could be adjusted to its use.

Due to large wall surfaces within temple halls, the method of burnishing is rather time consuming. In 2014, the author observed this method at the Uru Katsel Temple in Central Tibet (Fig. 2.3). Here women standing beside each other in a row burnished the expansive wall surfaces to prepare them to be painted in the next stage. In 2015, the author examined the same surfaces at the Uru Katsel Temple again, which were now evenly burnished with a shiny mirror-like surface, and still free of cracks (see Chapter I, Fig. 1.15).

This brief review of burnishing brings us back to the treatment of the *arga* roof, for which a similar method is applied. Contrary to the surface of clay, which is burnished to a *leather hard* (Ger. *lederhart*) consistency in order to be used for pottery, plaster, or clay sculptures, the surface of the *arga* roof needs more humidity, in particular during the process of mixing and compacting the clay and stone layer. Before the application of water proofing fluids on the *arga*, burnishing is a proper method to compress the supporting material and to close its porosities. At the IAG / BOKU, material tests for the *arga* were performed to observe its behaviour after burnishing.

Several features are crucial for the functioning of the burnishing process. The grain size distribution of the burnished material is balanced between fine and coarse material. The results of the

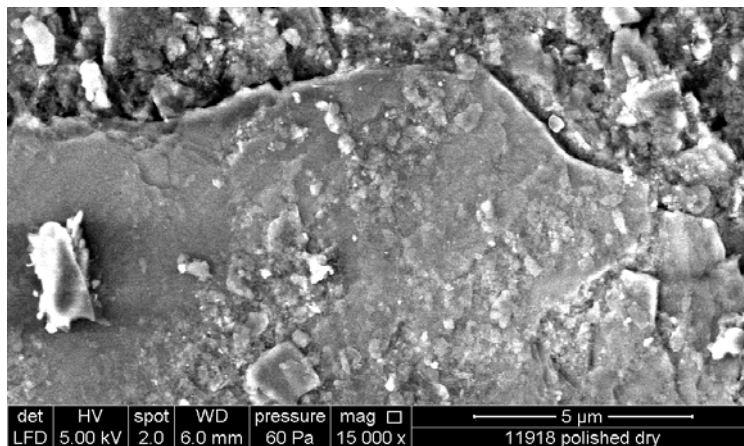


Fig. 2.4 Burnished surface of a clay plaster under the REM with 15,000 times magnification. Silicate sheets are homogenously compressed over a large part. Observation conducted at the IPM / BOKU in 2015.

test show that a too high content of clay minerals turns the surface of the substance into a greasy layer. An REM (scanning electron microscope) picture shows that for the burnished surface silicate sheets are laid horizontally and homogenously compressed (Fig. 2.4). Due to a high amount of phyllo silicates, these sheets slide onto each other and do not show cohesion. On the contrary, clay with a higher content of fine sand keeps the surface homogenous and stops the continuous sliding of the silicate sheets.

With proper grain size distribution, the time and pressure of burnishing becomes relevant. Application of pressure that is too high results in the effect described above, i.e. moving of silicate sheets against each other, leading towards a cracking of the surface. With a decrease of the water content, the pressure can be increased. The so-called “leather hard” consistency is an elastic term and is very much related to the particular use. The content of water leads us to another important precondition for the burnishing process. In general, it is material-related and certainly related to the craftsman’s experience. Under the REM, a humid clay mixture shows rather big channels between the silicate leaves for water transport – a condition being not ideal for burnishing. In such a case, the pressure leads to removal of water but not to a stabile compression of the mixture. For wall plaster or the surface of pottery, burnishing under such conditions causes unevenness. The surface must reach such a low water content that the pressure does not cause displacements of clay particles. This can be used as a simple explanation of the term ‘*leather hard*’ in the context of reaching a certain stage of compaction and dewatering (cf. Feiglstorfer 2019: 103ff.).⁵²

2.4 Discussion

Traditional Central Tibetan flat roofs include two different types of making: a flat earth roof and an *arga* stone roof. The *arga* roof is of a higher quality when it comes to longevity, and due to the great amount of needed construction effort and high costs, it is reserved for the upper social class, aristocracy and monasteries. Use of such roofs is related to the representation of a particular social status. By that, the short distance of transport is not of primary relevance, though of high importance is the representative quality. It is not clear when this tradition began. An early finding

52 In contrast to the process of a simple compression of the clay-*arga* mixture, according to Satish (2003: 528), burnishing with oil based on natural organics causes a chemical interaction with a hydrophobic effect.

of *arga* used for a floor construction dates back to the imperial period of Central Tibet (Martin 2013). There is evidence that in the original state of the Jokhang in Lhasa, for example, the roof was simply made of clay.

Arga stone itself shows a relatively high content of calcite, and, to the best of today's knowledge, no hydraulic properties. The way in which one stratifies and treats the single layers enables a compaction and conglomeration of the single components between the layers from below to the top and vice versa. In the course of ramming, fineness and density of the single layers are changed. The processing of the surface layer with burnishing correlates with methods we find in other crafts, for example, for clay plasters, pottery or stoves. This aspect clarifies the material relation between different crafts – an aspect that points towards an open border concerning the exchange of information between the craftspeople. A terrazzo-like pattern is given by the colour of the minerals, dominated by colours of iron oxides. Since mineral colours vary between the single quarries, the visual features of *arga* roofs show slight differences, though this can be controlled by choosing specific material from certain quarries. Local variations also derive from naturally changing mineral compositions. For example, some samples show a content of smectite and others do not.

Construction of an *arga* roof follows an economic and functional principle. The basic structure of the roof is kept simple, and follows the same pattern of construction of an earth roof. The upper levels are changed and combined with the bottom layers in a most efficient physical manner. The involvement of the observation of the behaviour of birds in the process of construction and the use of the Tibetan calendar to define dates of construction show the complex relationship between construction, nature and timely regulation within a Tibetan year.

The making of traditional flat roofs based on clay is in general decreasing. Flat earth roofs are dominant in the countryside, while *arga* roofs are related to social representative sites. Flat earth roofs are easier to make, and no special skills are required for processing, while *arga* roofs are technically more sophisticated and need to be supervised by a master. A labour force of up to eighty workers, as was the case for the renovation of the *arga* roof on the Gyümed Dratsang in Lhasa, comes with high costs. After the Chinese Cultural Revolution, *arga* roofs were substituted by cement, however, over the last years the tendency has shifted to a revival of traditional crafts. Concrete floors are being demolished and replaced with *arga* floors. However, some disturbing factors of modernisation remain and show the sensitivity of the whole compound towards modernising interventions, as the following example shows: During a visit at the Gyümed Dratsang in 2015, the *arga* roof, which was erected in 2014, showed cracks, which is atypical for *arga* roofs. In an interview in December 2015 with Jampa Kelsang, who coordinated the process of making the *arga* roof, he explained that contrary to the traditional method the clients wanted him to introduce a plastic sheet below the layer of clay. This sheet interrupts the air and moisture exchange between in- and outside and leads to different surface tensions. Humidity, which remained in the construction, was not able to circulate in all directions but was instead led to the surface, where it caused cracks during a process of drying and freezing.

From a technical point of view, the *arga* roof is not necessarily limited to Himalayan regions, and the adaptation of current modern resources and tools to these traditional material qualities is a further aim of research.



Map 2.2 Central Tibet. Sites related to pottery. GIS data based map: Jakob Gredler. Final graphics: author. Map based on data from Vector data (VD) and Basemaps (BM). Citations of VD and BM also see: Chapter IX, list of illustrations.

3. EARTH BUILDING MATERIAL: POTTERY AND STOVE MAKING TRADITIONS

3.1 Regional setting of this study

In Central Tibet we can still today find villages like Barab (Tib. Ba rab), which is located in Medrogongkar County, where pottery making is a living craft tradition (Map 2.2). In earlier days this craft was more common in centres of pottery such as in Lempa (Tib. Len pa) close to the village of Gyatso Shöl⁵³ (Tib. Rgya mtsho zhol) or in Kyilung (Tib. Skyid lung) Village in Phenpo (Tib. 'Phan po). In Barab, pottery ware was produced and sold in Lhasa, where the guild of potters was located along the Barkor until the Cultural Revolution when the central bazaar closed. Today, mobile traders coming from around Lhasa sell much of the pottery ware that is available in Lhasa. To sell pottery ware, potters either bring their products to Lhasa or customers, who trust in their potters' good quality, buy directly at their workshops. In Lhasa, along the Sangra road (near the Ngachen road), it is still possible to buy pottery ware at a fix-installed shop. Traditional pottery craft is also alive in the Shigatse region, but unlike in Barab, where natural colour use is common, the Shigatse region mostly does not utilise natural colours anymore. The use of natural colour is one essential criterion for the quality of the pottery produced in Barab and surrounding settlements. Chemical colours commonly used in central Chinese factories may spall easier when fired in comparison to natural colours. For the potter of today, the production of pottery is a side business in addition to farming and preferably conducted in winter on sunny days. In earlier days some potter families settled close to the observatory in Tagphu (Tib. Stag phu), which is about 9 km from Barab in a north-east direction, but in this village this craft is no longer alive.

53 The village of Gyatso Shöl has not yet been clearly localised and will be part of future research.



Fig. 2.5 Pottery wheel with a ceramic mould before being covered with fresh clay.

In the nearby village of Thaba⁵⁴, one or two families still practice the pottery craft. In contrast, in the village of Barab itself in 2015 about fifty families still kept this tradition alive.⁵⁵

The village of Barab, where field research was conducted, has a long history in pottery. Tashi,⁵⁶ a potter from this village, produces his pots in the courtyard (ground plan with app. 20 m x 15 m) of his house. In a northern corner of the courtyard, pottery ware is kept for drying, while finished pots are stored inside. The potter's wheel is fixed in the ground of the higher section of the courtyard that adjoins the house. From this position, it is possible to face the direction of the sun while working and to look out over the courtyard's walls to the mountains located in the south. Such a southern orientation of the house and the courtyard accelerates the drying process of the pottery ware.

3.2 Raw material for pottery and processing

Raw material for pottery is brought from different sites: From the village of Baklog (today: Tashigang; Tib. Bkra shis sgang) one type of red coloured clay is collected, known as *khampa* (Tib. *kham pa*). Ser (Tib. *gser*), which is locally described as yellow, originates from the hills south of Old Barab. Old Barab's ruins are located directly to the south of the new village of Barab. In order to process the basic material, these two types of clay have to be mixed to avoid later cracks. The proportion of the mixture depends on the kind of red of the *ser*. In the case of a strong red colour, the proportion of the mixture is 1:1, and if the red colour appears light, the proportion is changed to 1:½. Sand is added in a small amount to further avoid cracking in the case that the pottery is to be fired without glaze. This fine sand is brought from Tsangthog⁵⁷, a village that is mentioned by the potter Tashi to be also close by. In the case of glaze being used, sand is not added, since the colour would not remain on the sandy surface. Mixing different ingredients

⁵⁴ The village of Thaba has not yet been clearly localised and will be part of future research.

⁵⁵ Information given by the potter Tashi from Barab in December 2015.

⁵⁶ In December 2015, the author had the chance to observe the working process of the Tashi family in Barab, being very thankful to Tashi and his family for their hospitality and support of this research.

⁵⁷ The village of Tsangthog has not yet been clearly localised and will be part of future research.

for preparation of basic pottery material is commonly known in the Himalayas. In the Western Himalayas in the village of Likir in Ladakh (see Chapter III), a specific fine sand is mixed with a specific type of clay. In Nixi in the north-western region of Yunnan Province, so-called “black pottery” is prepared from three different substances (Zhang, Gu 2009: 13, 14).⁵⁸

At the Barab workshop, the mixture is sieved using very fine nets. Today the method is done with a sieve made of cloth, known as *sangre* (Tib. *sang re*), which are fine blue plastic coats, primarily made for building purpose. In earlier days, finely woven textiles, for example *khataks* (Tib. *kha btag*), were used (as described by Tashi’s wife). In Nixi, for comparison, a fine mesh of wooden baskets is used for sifting red clay and white sand (Zhang, Gu 2009: 16, 17). In general, before processing the mixture, it is kneaded and has to rest for a while in a covered condition. For that purpose plastic sheets are currently used. In earlier days, specific pots were prepared, in which the clay was stored and covered by a lid.

In Barab, pots are made in an economic fashion, wherein a series of pots is formed using a ceramic mould (Fig. 2.5).⁵⁹ The wheel itself is turned by hand, contrary to using a stick, which we know, for example, from Himachal Pradesh in India (Perryman 2000: 23), or one’s feet below ground, as we have seen, for example, from Maroc.⁶⁰ In Ladakh, in contrast, pottery made in the 1980s was still primarily moulded by hand (Bhan 1990: 190), contrary to the author’s observation in Likir in 2018, when the pottery wheel was commonly in use.

The use of a pottery wheel in Tibet goes back to c. 4000 BCE (Interview Shaki Ongdu 2015), while the pottery found along the Neolithic site at Karub (c. 4700 BCE) was at this time still formed by hand. Pottery at the archaeological site of Chugong at the periphery of Lhasa was already in c. 4000 BCE produced on the wheel, particularly in an advanced phase, while in an earlier state, pottery was produced by hand without using a wheel. Chugong pottery was fired at a higher temperature, resulting in a shiny black surface. A further feature of advanced technology in Chugong compared with Karub is the rounded bottom and the addition of three small feet instead of the preparation of a flat bottom (Chayet 1994: 55). The colour was primarily dark red.

John Bellezza (2015) also mentions a dark-grey ware. He describes a finer quality in a later phase of Chugong pottery ware and attributes this increase in quality to the advancement of the process of firing from open pits to kilns.⁶¹ As of recently, burnishing,⁶² which he mentions for Chugong pots, is no longer practiced in Barab, as such a process would greatly extend the processing time. These developments point towards a high standard of know-how during the Chugong period. In Central China, the first evidence of ceramic production goes back to c. 18,300 to 15,400 BCE in

58 At Nixi workshops, the three substances are explained as coarse red clay, a white sand (Zhang, Gu 2009: 16, 17) and quartz, which is heated until turning into a grey or black colour. It is thereafter cooled and pulverised (Elliott 2011: 11). All ingredients are gathered from nearby hills (Zhang, Gu 2009: 13, 14).

59 The use of a mould is also common in Nixi (Elliott 2011: 11).

60 In Nixi, only a banding wheel for modelling but not a pottery wheel is used (Elliott 2011: 12).

61 This indication is hypothetical. The finer quality of the pottery may also be related to the use of different raw materials or a development in the methods of processing.

62 For the method of burnishing mineral surfaces, see the information given on *arga* roofs in this publication.

Yuchanyan Cave and to c. 20,000 BCE in Xianrendong (Shelach-Lavi 2015: 57).⁶³ In the early Neolithic period, the earliest ceramic vessels were moulded by hand (ibid. 87), while already during the late phase of the Neolithic period the use of a potter's wheel was known. In contrast, in Kashmir, Bhan (1990: 191) describes the introduction of the potter's wheel to have occurred around 3000 BCE.⁶⁴

In Barab, at the beginning of the process on the potter's wheel, a small amount of finely crushed fired pottery material is spread over the mould to keep it from sticking together. In order to compress the clay onto the mould (see Fig. 2.5) and to bring it into form, a wooden paddle is used (Fig. 2.6).⁶⁵ The pot is continuously kept humid with brushes of different sizes made from pig's hair (2.7).

In order to smooth the surface, a certain pressure is applied onto the pot with pieces of soft yak leather.⁶⁶ Processing of one of the small incense holders takes app. 15 minutes. Thereafter the pot is covered with a textile to decelerate the speed of drying, thus avoiding cracks. Many pots are used just being fired but without a glaze. If the pot is to be glazed, the glaze is applied after drying and before firing. The mineral traditionally used throughout the region is *shado* (Tib. *zha rdo*), which in earlier days was collected at Muning⁶⁷. Today it originates from a valley called Ba located in Medrogongkar. Graining of this mineral is conducted without water, as it is necessary for minerals used for painting colours to be grained in trays of stone (Fig. 2.8). *Shado* is grained onto a stone plate after being crushed into small pieces. The whole process of graining *shado* to the size of a few cubic centimetres takes app. one hour. After graining, it is applied onto the pot with a brush.

In Barab, pots are fired only once, either with or without glaze. Without glaze the pot appears red (Fig. 2.9), while the surface colour turns light dark-dotted brown, when the traditional glaze is added. In order to fire the pots in the courtyard, an oven is erected temporarily with *lamak* (Tib. *la mag*) (Fig. 2.10), which is a substance with a slight amount of clay and a large amount of organic tubular stems. This material is obtained in the close vicinity to the settlement from a marshy terrain (Fig. 2.11). The *lamak* is filled into the gaps between and over the pots before setting the fire.⁶⁸ Small ceramic tripod spacers are put below the pots to lift them from the ground. The fire is kept for about 24 hours. On the following day, the fired pots are checked and, if necessary, fresh *lamak* is added.

63 According to Boaretto et al. 2009 and Wu et al. 2012 (in Shelach-Lavi 2015: 57), this is the earliest evidence of ceramic production in the world.

64 Until the introduction of the potter's wheel in Kashmir, kneaded *karewa* clay has been put in layers around a mass and the surface had been finished with wooden sticks or pieces of bone and at least with a dabber (Bhan 1990: 190).

65 For Nixi pottery, wooden paddles of different sizes are also frequently used tools (Elliott 2011: 16).

66 For Nixi potters, the use of deer skin chamois is common (Elliott 2011: 14).

67 The village of Muning has not yet been clearly localised and will be part of future research.

68 The use of peat is mentioned as fuel for potters in the Pulwana District in Jammu and Kashmir (GSI 2012b: 49), which points towards the use of a similar technique as used in Tibet. This material contains 10.4% moisture, 32.4% volatile matter, 4.21% ash and 11.99% carbon (ibid.).



Fig. 2.6 (Top) Use of a wooden paddle to mould the clay.

Fig. 2.7 (Below) Brushes made from pig's hair.





Fig. 2.8 (Top) Tools and minerals (*shado*) for graining.

Fig. 2.9 (Below) Fresh pots covered with textiles to prevent drying at too fast a rate.





Fig. 2.10 (Top) *Lamak* stacked in front of the potter's house.

Fig. 2.11 (Below) Marsh land in front of the village of Barab, from where *lamak* is collected.



Form and method of making are related to particular needs, one being the need for the *surkhok* (Tib. *zur khog*, “burning giving offering”), which is ritually used when someone passes away. The pot is filled with sweets, barley or *tsampa* and hung on the door of the respective family.⁶⁹ Other types of pottery ware include the following:

- Incense holder (Tib. *bsang phor*).
- Incense burner. For installation on the roof, some incense burners are home made from stones or clay, or bought as ready-made pottery ware.
- Butter lamp (Tib. *mar me*).
- Chang (Tib. *chang*) pot, also known as *zama* (Bhan 1990: 190). These kinds of pots are also used for storage of food like grains. For this purpose, the pots are of a bigger size.
- Teapot (Tib. *khog ldir*) with a bottom part that keeps the tea hot and the actual teapot as the upper covering portion.
- A *bumpa* (Tib. *bum pa*) is filled with five different kinds of grains, five different kinds of cloths, and five different kinds of minerals, (etc.) together with a religious text. It is taken to a monastery to be blessed. This kind of pot is known as *nönbum* (Tib. *gnon bum*). After the blessing it is hidden within one’s house in a position and orientation that, according to astrological prediction, is a carrier of wealth. The same kind of a *bumpa* may also be used as *lukhang* (Tib. *klu khang*), locally also-called “naga-pot”. In this case, it may have a snake painted upon its side.

In the village of Likir in Ladakh, the tradition in pottery has existed for generations. A son of the family Langdopa (house name) is still involved in production, and he explains the individual types of raw material (Feiglstorfer 2014: 372). As a material-cultural aspect, it is again the availability of clay with specific properties, which makes a particular clay appropriate for pottery making. At the IAG / BOKU, the material properties of the used raw material were examined. The use of a particular species of sand from a pit along the west side of the village helps to avoid the occurrence of cracks in the ceramics. This sand contains a small amount of smectite that enables better cohesion with the clay and supplements properties of the clay such as swellability (see Chapter III).

3.3 *Thab* and its material relation to pottery

This study has revealed similar clay properties between pottery and clay stove and furthermore between the two different settlements Likir and Basgo. This leads us to another important topic related to Himalayan pottery and architecture: the production of clay stoves, the so-called “*thab*”⁷⁰ (Tib.; “stove”). There are not many elders left to pass on this dwindling knowledge related to the *thab*. These massive stoves (see Chapter III) are produced in situ and become a non-moveable part of the building. They are modelled of clay and not fired. Their surface is treated with specific substances and burnished to make them waterproof. The clay itself must be fire-resistant, meaning it must not shrink or swell and be free of any cracks. In this matter, several places in Likir and Basgo have a specific clay, the so-called “*thabsa*” (Tib. *thab sa*). A description of the process of making a *thab* is given in Feiglstorfer (2014: 383, 384). Following further material research at

69 Interview with Penba Tashi from Nyemo on the way from Lhasa to Medrogongkar on December 18th, 2015.

70 Another matter in earth architectural materials is tiles. Their use in the Himalayas is of subsidiary importance due to the large amount of fire wood. Ceramics used in architecture we find in lower mountainous regions of the Himalayas – in China, Nepal or Jammu and Kashmir.

the IAG / BOKU on clay used for traditional Tibetan stoves and on the inner coating of a *tandoor* stove, it was possible to explore the basic material properties of specific proper kinds of clay. Knowledge of these properties enables us to reflect on their behaviour during processing and to categorise the requirements needed to reach particular qualities, for example fire resistance or low shrinkage. A detailed description of the used method of investigation is given in Chapter III.

In Central Tibet, a *thab* is commonly known, but how to process a high-quality *thab* is not as clearly observed in Ladakh. When talking to Penba Tashi⁷¹ from Nyemo, a 30-year-old Tibetan, who was our guide during field research in 2015, he did not indicate any differences between a stove made of ‘any’ kind of clay easily available from the surrounding areas and a stove produced with a specific kind of clay with particular properties, as the author could observe, for example, for the stoves made in Ne in Ladakh (see Chapter III). Just in reference to the material’s use, for Penba Tashi from Nyemo the term “*thab sa*” had no further meaning in terms of particular material quality. Another Penba Tashi, a Tibetan of around forty years of age from Phenbo,⁷² explained that in his village in Phenbo anyone can produce a *thab* whenever the need arises, which means that making a *thab* continues to be a living tradition in the countryside and the knowledge needed to construct a *thab* is still existent. In his description he mentioned a particular type of clay, of which he provided a sample for testing.

3.4 Discussion

The essence of the involvement of knowledge of the raw material of pottery and different methods in processing in regard to the building material is closely related to earth building methods. Regarding the vernacular use of raw material for waterproofing or heat resistance, surfaces such as roofs or stoves have not been fully examined. A technical understanding of these traditions can improve awareness of specific material and social preconditions needed to keep such traditions alive.

The way, in which pottery ware in Barat is fired, is an ecologic model for a sustainable approach in that it uses the material from the marshy terrain adjoining the village. This material and the short distance of transport is cheap and the energy required low. Similarly, the pottery material itself, i.e. clay and sand, is collected from a site that is as close as possible. In present day Barat, pottery tradition seems unaffected by tourism but suffers from reduced sales due to the import of cheap Central Chinese pottery ware and the use of chemical glaze for imported ware. In Ladakh, in comparison, the pottery tradition has decreased, with only one pottery village in Likir. For Yunnan, as another Himalayan example, Elliott (2011: 23–34) mentions tourism to Nixi in the east of Tibet as a main factor for change. In this case, the request for pottery does not necessarily correlate with traditional forms. In Nixi, firing is conducted with wood, which is rather valuable compared to the marshy terrain used in Barat. At this place, government regulations such as restrictions on wood harvesting have been endangering pottery tradition.

71 Penba Tashi describes the quality of clay from ruins to be better for making a *thab*, though this has yet to be verified. This information might point towards the preference of sticky clay for a better modelling with a certain proportion of sand as commonly used for building purpose.

72 Interviews with Penba Tashi from Phenbo in Lhasa on November 29th and December 18th, 2015.

For the *thab* made of a specific clay, we learn about a sustainable form of a firing place within a residential building. The stoves are located in the living room and serve as a kind of centre for social life and communication within the living and cooking space. The *thab* itself is a fixed piece of furniture. Other rooms in the house such as sleeping rooms are not heated, and the author observed for certain families that members sleep in the *chensa* (Tib.), which is a combined living / kitchen area. For warmth, thick blankets are used during the night and clothing is not necessarily changed for sleeping. Energy consumption for heating coincides with meal preparation. This situation also promotes communication within the family and with guests, since the main activities take place in the living room. A further social aspect is the operation of such stoves from a sitting position. On its top, several holes are made for the placement of pots, and side holes are needed for firing, air-conditioning and collecting ash. This work integrates elder family members, who operate the firing of the stove.

Maintaining such traditions is related to social conditions and constitutes an ecological way of living. Different changes may endanger the necessary social preconditions. At the end of the 19th century, Moravian missionaries introduced the metal stove to Ladakh (Clarke 1995: 10). This introduction is an example of early Western material-cultural influences.

An importance to keep pottery and stove traditions alive is the preservation of local knowledge of local material resources and of properties of materials. This knowledge is the main source for further use of the appropriate material for contemporary construction in a sustainable context. With today's open market, it is easy to introduce artificial and not sustainable building materials, for example for waterproofing flat roofs. Having the proper knowledge of local clay and related traditions of processing is essential for an ecological and sustainable approach. It emphasises the need to understand the specific properties of materials used for local crafts.

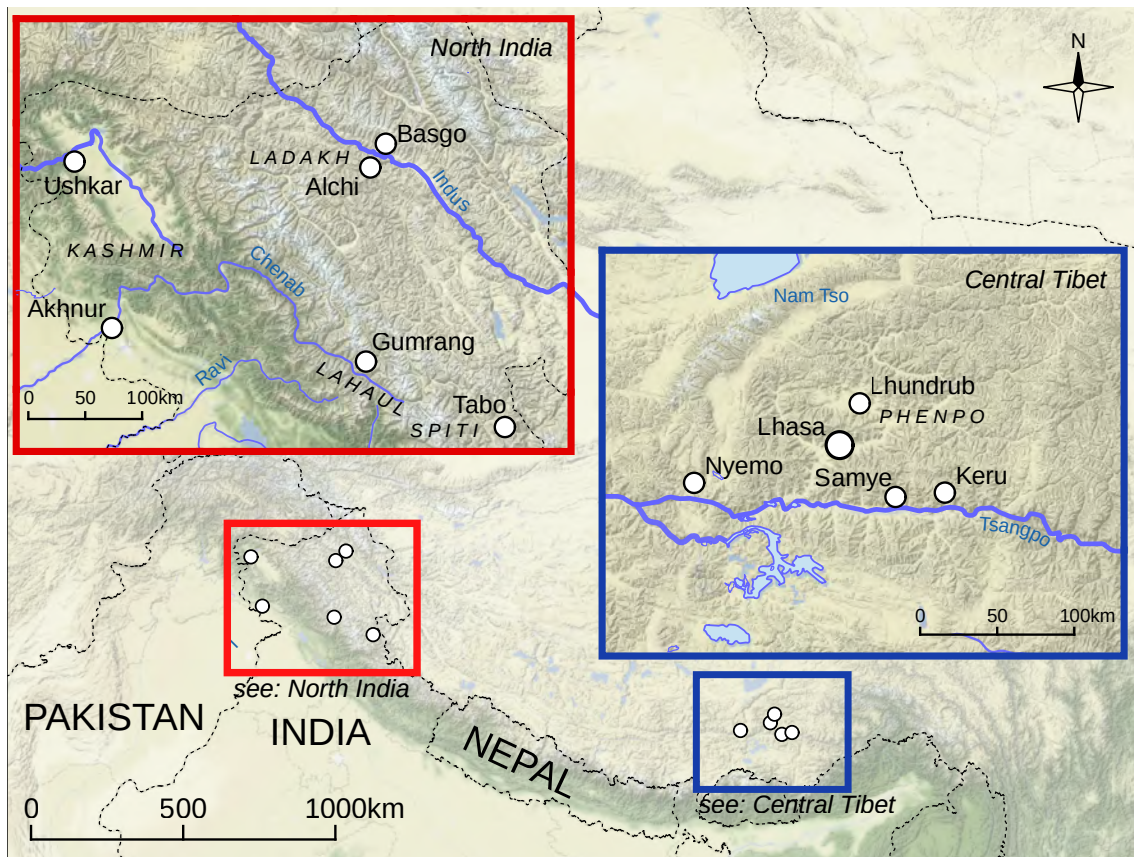
4. EARTH BUILDING MATERIAL AND BUDDHIST CLAY SCULPTURES

4.1 Regional and historical setting

Methods of making clay sculptures in Central Tibet follow a long tradition reaching back to at least the construction of the Samye Monastery in the 8th century CE. Using clay for sculptures shows a highly developed understanding of raw material and its processing, an aspect, which encourages the study of clay as a building material and to gain insight into different processing methods. The craft of the clay sculptor requires a particular high understanding of both the needed material and the great skills essential for its handling.

Clay sculptures from Akhnur (6th century CE) and Ushkar (8th century CE) as dated by Varma⁷³ (1970: 179–184) belong to the earliest examples of clay sculptures in the north-west Indian region

73 In his publication on *The Indian Technique of Clay Modelling*, Varma (1970: 2–4) uses several ancient texts. Among those are the *Kaśyapaśilpa* from the 11th/12th century, the *Vimānārcanākalpa* from the 8th century, the *Kaśyapajñānakāṇḍa* from a period earlier than the 16th century and the *Samūrtārcanādhikaraṇa* from the 16th/17th century CE.



Map 2.3 Western Himalayas and Central Tibet. Places mentioned in the text, being related to traditions of making clay sculptures. GIS data based map: Jakob Gredler. Final graphics: author. Map based on data from Vector data (VD) and Basemaps (BM). Citations of VD and BM also see: Chapter IX, list of illustrations.

(Map 2.3). Along the northern Central Asian silk route, clay sculptures are predominant, while for the southern route, stucco – a mixture of gypsum dust, sand and calcite – was primarily used for the heads of sculptures, and clay was preferably used for the bodies (Yaldiz 1987: 143, 212). Yaldiz also argues for the use of clay due to a lack of durable materials in this arid loess-dominated zone. Varma (1970: 116) describes a separate firing of the heads in a kiln and their attachment with a wooden peg to the relievo. In contrast, most of the mural decoration was modelled and fired in situ, mentioning that the quality of firing decreased towards the wall (*ibid.*).

In Central Tibet, sculptures in the Keru (Tib. Ke ru, former Kwa chu) Lhakang located east of Samye date back to the imperial period, and clay has been used as material for sculptures since early times (Chayet 1994: 203, 204) (Map 2.3). Contrary to the method described for the Western Himalayas – where a compact mass is modelled around a supporting construction – Chayet describes the sculptures as being made of a thin layer of clay around a wooden armature (see description below). Luczanits (2004: 18) mentions the statues of the Keru Lhakhang being partially hollow between clay and armature. This description refers to a method contrary to the one used in the Western Himalayas, in Kashmir or in Fondukistan. This method is still practiced today in a Lhasa workshop and possibly points towards a more than thousand years old Central Tibetan

tradition. The description of sculpture construction at Tsaparang – with straw first wrapped around a wooden subconstruction, which is covered with a textile before finally overlaying with clay (Chayet 1994: 204) – shows the application of a similar technique.

The tradition of making clay sculptures was continued in the Western Himalayas beginning in the late 10th century (Heller 1999: 61), and the highly sophisticated Western Himalayan technique ends with the sculptures of the late Alchi temple group (c. 1220 CE) (Luczanits 2004: 17). Compared to the amount of clay sculptures, the production of stone sculptures in Central Tibet was of a subordinate relevance, contrary to metal sculptures made of beaten brass.

Following a stagnation in carrying on the craft of clay sculpturing in Lhasa in the 1950s, various techniques have again been being practised since at least the 1990s. For the arid Himalayan zone, clay is a well-suited material. On the other hand, for the living clay sculpture tradition in areas with a humid climate, in particular in Bengal, the durability of the sculpture is subordinated to aspects like the ritual process of making or finally having the clay sculpture dissolved in a river. Regarding this concern, in Bengal the process of dissolution of the sculpture is to be seen as a favoured aspect, and sculptures are often immersed into water at the end of ritual ceremonies. In the Tibetan cultural zone, in contrast, clay sculptures aim for long durability.

As a support for this research, Könchog Tsering (Dkon mchog tshe ring)⁷⁴ gave permission to the author to study his methods of making unfired clay sculptures (Tib. *'jim sku*) at his workshop in Lhasa. In this contribution, recent techniques of clay sculpturing conducted as performed in his workshop are documented and juxtaposed to historical activities in Central Tibet and adjoining regions in the west.

4.2 Different techniques in clay modelling

First, we distinguish between sculptures made with a mould and those without, both methods following a predefined iconography. The use of a mould is mentioned for clay sculptures along the northern Central Asian silk route. Due to close regional similarities in the design of heads, the hypothesis is proposed that the production of clay sculptures for most monasteries in this area occurred in just a few workshops (Yaldiz 1987: 143). The use of moulds enables a quicker production of a given series of sculptures, and the following of a predefined design facilitates the work process; however, regional characteristics may appear in an attenuated form.

For such historical sculptures, of which no description about their production is available, it is difficult to be certain whether moulds were used. Similarities in the shapes of certain parts of the body between different sculptures may give evidence of the use of a mould. For this reason, for

74 The author is very grateful to Könchog Tsering for his hospitable support. At the time of the interview on the 4th of December, 2015, he was 48 years old. As a young man he worked as a house and furniture painter and started following his passion for clay modelling about 30 years ago. He went to a Tibetan master, where he learned and worked without payment for about ten years. At that time no school for clay modelling existed in Lhasa. Governmental support of this trade is today given by the acceptance of the production of sculptures for a monastery, which is today treated as a form of setting of taxes. According to Könchog Tsering, a new activity in traditional Buddhist crafts started in Tibet in the late 1990s.



Fig. 2.12 Mould used for a part of the clay sculpture.



Fig. 2.14 The master himself moulds the face with wooden sticks.



Fig. 2.13 After moulding the front and back side of the sculpture, the two halves are combined as shown. Along the right shoulder of the sculpture, the joint can still be seen.



Fig. 2.15 Back side of a Tara sculpture head. In a separate working step, the crown is attached to the head. A hole on top of the head is left for a later filling of the sculpture with sacred goods.

Tabo clay sculptures, the proposed hypothesis asserts the use of a mould for faces and main features of the body, including hair (Luczanits 2004: 270). In Fondukistan and in the Kashmir area, there is no evidence of the use of a mould for the preparation of the head (Varma 1970: 155), and in the entire Indo-Afghan regions no mould has been found (*ibid.* 156).

For several sculptures in the Lhasa workshop with a height of up to app. 80 cm, the torso was made with a mould, while all the other parts were modelled by hand, with small decorative details of moist clay applied onto the prepared sculpture. The moulds are prepared from gypsum into two parts (Fig. 2.12), a front and a back part, not including the head. Varma (1970: 206) describes the preparation of a mould either in stucco or in unfired clay itself, and the sprinkling of ash onto the inside surface of the mask for easier detachment from the cast.⁷⁵

The master models the head by hand without a mould, while the torso is prepared with a mould by his apprentice. The two sides are prepared separately, first the front followed by the back side. After stripping the front side from the mould, it is put onto the back side, which still remains in the mould, and the two parts are pressed together. The remaining joints are closed carefully after stripping the model from the mould as a whole, and the joints remain invisible after final treatment (Fig. 2.13). In general, the openings left at the bottom or at the top of sculptures are necessary such that the sculpture can be filled with sacred goods in a later step. Under a plastic sheet the torso is kept slightly humid so that the head does not have to be attached immediately. The result of this method resembles casted metal sculptures, which are hollow and free standing with a shell of a rather constant thickness.

The head is modelled in two stages. First, the face is treated with extreme care (Fig. 2.14), and thereafter the head is attached to the torso.⁷⁶ As a last step the back side of the head is modelled. A second method is free-hand modelling of the whole sculpture (not only of the head – which is applied for bigger sculptures – and masks – which are made without a mould). The use of a model is certainly a facilitation of Könchog Tsering's work, in particular for the production of a series of similar sculptures, but has nothing to do with the inability to create a sculpture (as is also emphasised by Varma 1970: 205, 206). Varma (*ibid.*) mentions that it is the choice of the sculptor to use a mould or to model by hand. In the Lhasa workshop, only additional elements like horns or crowns are attached as a final step (Fig. 2.15). Particularly, this has been described for a crown made for clay sculptures in Tabo, which was loosely affixed to the head (Luczanits 2004: 271).

Another differentiation influencing the method of production is if the clay sculpture is free standing without any further support – as in the case of Buddhist sculptures, which are often placed on a lotus base – or if the sculpture needs a wooden subconstruction due to its predefined iconographic design. This differentiation is basic for a method of clay modelling and done using a wooden subconstruction. The clay sculpture of a Yamāntaka as a standing figure with a height of app. 1.6 m is an example exhibited in the Lhasa workshop. Also early West Tibetan examples such as the ones from the main temple in Tabo belong to this category (Fig. 2.16).

75 For this kind of clay modelling, the term “cast” is not precise, since the clay is pressed into the mould in a viscous consistency and not cast with fluid consistency.

76 Casts are set in place by pressure after applying a still slightly moistened slurry to the splice (Varma 1970: 159).



Fig. 2.16 The vertical *vaṃśadaṇḍa* (inside the sculpture) is connected with the two horizontal *upaśūlas*, which are fixed in the wall.

Each of these clay sculptures has one vertical wooden brace, the *sogshing* (Tib. *srog shing*, Skt. *vaṃśadaṇḍa*), which refers to a tree of life as described by Kōnchog Tsering. This connotation is critically rejected by Varma (1970: 42). He argues that the *vaṃśadaṇḍa* (Skt.) is indeed also known as *Brahmadaṇḍa* but refers to *Brahman* as anything basic and not to a *Supreme God* or a *Universal Soul*.

Some sculptures additionally have a so-called “*rūshing*” (Tib. *rus shing*) as a wooden brace, possibly along the neck and elongating laterally with another vertical wooden brace on each side. *Rūshing* in its meaning as “tree of bones” refers to a kind of skeleton made of wooden sticks used to brace the statue. It is organised around the central vertical *sogshing*, and different *daṇḍas* and *śūlas* (Skt.) represent different kinds of bones.⁷⁷

77 Besides the use of a wooden support for bigger sculptures, the use of a core prepared of stone is known in the area of the Central Asian silk route (Yaldiz 1987: 143). Also the use of iron rods is known for Nepalese clay sculptures in the 12th/13th century (Luczanits 2004: 12, 305, fn. 36). Another technique is the use of straw added to a core of wood, for instance in Bengal. According to Varma (1970: 42, 43), *śūlas* – also called “*daṇḍas*” – define parts of the armature. In addition to the *vaṃśadaṇḍa* as the vertebral column, several other *daṇḍas* are known, including *vakṣodaṇḍa*, the stick across the chest, the *kaṭidaṇḍa*, the stick across the hips, or the *upaśūla* as a supporting part describing essential elements of the wooden armature.

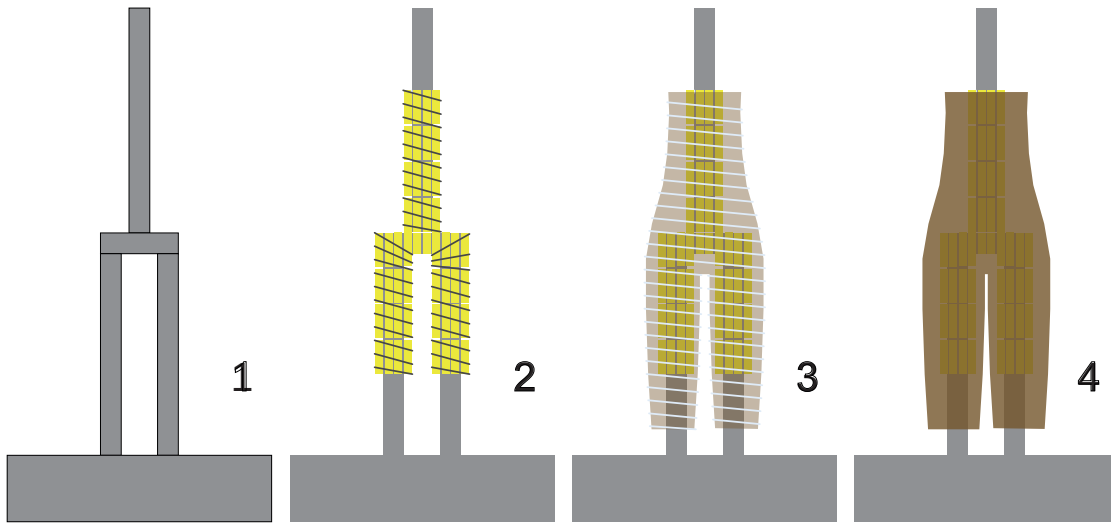


Fig. 2.17 Method of making the torso and head of a life-sized clay sculpture: 1 = Wooden subconstruction; 2 = Fixing rolls with mantras by wrapping textiles around the subconstruction; 3 = Twigs of *penma* are fixed with a rope onto the layer of mantra rolls; 4 = The *penma* is covered with clay.

Different materials were applied to clay sculptures, such as strips of hide and vegetable fibre cords for joining parts of the armature, as known from Western Himalayan sculptures. Vegetable fibre cords were furthermore wrapped around wooden parts as support for the clay (Luczanits 2004: 266, 267). In the ancient texts, ropes applied in two layers play an essential role in a functional and symbolic context. In the preparation of Bengal clay sculptures, ropes are replaced by a layer of straw and, particularly in the Lhasa workshop, vegetable fibres of the *somaradza* (Tib. *so ma ra dza*) are used. The length of this grass extends up to app. 4 m to 5 m. The preparation of a rope of grass (Tib. *dras thag*)⁷⁸ is similar to what could be found in Basgo in Ladakh.⁷⁹ This specific grass from Ladakh is locally known as *busho* (Lad.; see Chapter III). There it is twisted into a rope, which is also used to be wrapped around the pillars in the Maitreya Lhakhang in Basgo as a base for the application of plaster. This architectural use is close to the method described for clay sculptures. In Central Tibet in earlier days, the so-called “*tsadrema*” (Tib. *rtsa bre ma*) was brought from the mountains to be used in the construction of clay sculptures.

In the Lhasa workshop, a particular technique of using grass is known for larger statues (Fig. 2.17): Rolls with mantras (Tib. *gzungs*, Skt. *dhāraṇī*) are wrapped around the central pillar, the *sogshing*, together with yellow textiles, whereon they are pressed with *penma* (Tib. *spen ma*)

⁷⁸ In earlier days a *dratag* (Tib. *dras thags*) was also made of animal hair.

⁷⁹ In South Indian texts treated by Varma (1970: 13), the use of coconut fibres is mentioned, and a possible symbolic meaning of the ropes used is described with *nāḍī* (Skt.), arteries or veins. The three most important ropes are *suṣumnā*, *iḍā* and *piṅgalā* (ibid. 80). They are applied tight together at the point of the navel and run vertically in parallel to the armature before being tied horizontally (ibid.). There, after clay is applied onto the ropes and a second layer of ropes is fastened to the armature and again covered with clay, a following step includes repeating this process a third time (ibid. 86).

twigs⁸⁰ by fixing them with a rope of *somaradza* grass. In-between and upon this layer made of rope, clay is applied. This method, i.e. a wooden skeleton on which ropes and clay are added, resembles the traditional method as described for Western Himalayan and Kashmir sculptures. For this method, sacred texts are additionally mounted in the sculpture's centre. The wooden subconstruction is wrapped with long ribbons often made of paper and being printed with sacred texts. Hollow free-standing clay sculptures without any support (as mentioned above) or sculptures that are cast or wrought of metal, are filled with sacred scriptures and precious goods.

In Central Tibet we find another method for the preparation of clay sculptures. In this case a modelled block of clay is used as a stay-in-place formwork model, around which the actual sculpture is designed. This method is appropriate for bigger constructions, the weight of which would become too heavy to carry. Such sculptures are relatively light-weight and, according to Könchog Tsering, these kinds of sculptures were prepared for the Jokhang in Lhasa in earlier days. For this kind of construction, a scarf was twisted about seven times around the central model of clay. This base construction is covered with a mixture of glue (Skt. *aṣṭabandha*, “binding medium”) produced from yak skin (*pin yak kowa*; Tib. *spin g.yag ko ba*) and wheat flower. After drying for approximately one week, hardness is tested by knocking on the sculpture with one's fingers. A particular bright sound signals having reached the required hardness. Thereafter, the newly produced subconstruction for the sculpture is knocked until the clay model inside breaks and drops out.⁸¹ A light construction remains, on which the actual sculpture is again modelled without the use of clay. The substances used are a mixture of *shukpa* powder and *wanglag* (Tib. *dbang lag*, “particular herbs”), which are together with water put into a pot for ten minutes. The resulting mixture is a kind of a glue that is the base material for modelling the statue. Due to the use of herbs, such statues are also called “*mendam*” (Tib. *sman 'dam*, “clay of herbs”), and the final result is a sculpture made of glue and herbs. At first glance, this technique has from the point of processing – apart from its central clay block, which is in a first step used as formwork – nothing in common with a clay sculpture as described before. Upon further observation, this method, as it is described in the Lhasa workshop, seems to follow a long lasting tradition of preparing a clay sculpture, possibly dating back to early Central Tibetan imperial temple foundations. For the construction of the main statue in Samye in the Washe (see *Sba bzhed* 43–45 as mentioned in Chayet 1994: 204), this method is described. For this technique, grass or straw is covered with a textile of cotton, which is then held in place by fluid clay and covered with seven layers of yellow⁸² clay. Upon finishing the sculpture, the surface appears shiny and stone-like, which implies that the method of surface treatment potentially involves the use of a particular burnishing method.

80 The use of twigs is also reported for a Western Himalayan sculpture from Gumrang in Lahaul. In this case, the twigs are fastened around the central shaft (Luczanits 2004: 266).

81 A description given by Chayet (1994: 203) for a recent production of a clay mask is similar. The core of clay is used as a kind of mould, on which a layer of a mixture of glue and flour is applied and upon which a textile is modelled. This layer is repeated several times and after drying, the mask is detached from the core with a spatula and prepared with yak skin glue and chalk powder before being painted and lacquered.

82 The described golden colour may actually refer to a yellow colour, possibly related to the content of particular ferric oxides but perhaps also referring to any additives.

4.3 Quality of the clay

Regarding the base material in the Lhasa workshop, the clay originates from the village of Dreb⁸³ (Tib. Sgreb grong tsho), a village in Phenpo, and for the purpose of clay modelling it is said to be the best material available.⁸⁴ Its quality differs from that of a *thigsa* (Tib. *thigs sa*), which is used for roofs, in that the former is smoother. Similar, it is used for pottery⁸⁵ but it is still finer than commonly used pottery clay, and it does not show any content of sand.⁸⁶ Also in Lhundrub (Tib. Lhun grub) in Phenpo, the same type of clay is used and brought to Lhokha. The uppermost layer was not applied as an additional fine slurry or mixed with fine fibres as described for Western Tibetan sculptures (Luczanits 2004: 268). In the Lhasa workshop, the clay was applied as a single and rather fine layer, which is contrary to the description given for Tabo sculptures, wherein at least two layers of extremely fine clay are mentioned (ibid. 270). According to archaeological evidence, Varma (1970: 150) mentions difficulty in comprehending the number of clay layers that are used, and following his examination of heads from Tarimia, he hypothesises that the core was made of one piece, while the body was made in several layers. A clay mineralogical method of examination as described in Chapter III gives evidence about the quality of the materials and layers used. In the Lhasa workshop, various methods are practiced to avoid cracks, particularly for pieces up to about two metres in size. For larger pieces, reinforcement may be neglected. In this case cracks are filled in a semi-dry or dry state with fresh material. The following mixtures are used in the Lhasa workshop:

- *pödam* (Tib. *spos 'dam*) Clay mixed with *shukpa*-powder.
- *shagdam* (Tib. *shag 'dam*) Clay mixed with fine pieces of Tibetan paper.
- *tsadam* (Tib. *rtsa 'dam*) Clay mixed with long fibres of *somaradza*.

The ingredients are mixed with the clay as a kind of sheeting. This mixture has to be beaten intensely for a long period. For the sculptures of Tabo, Nako and the Alchi Sumtseg, a content of thin vegetable fibres is reported, while for the sculptures of Gumrang and the Alchi Mañjuśrī Lhakhang, the content of hair is described (Luczanits 2004: 268). For the northern silk route in Central Asia, the use of a mixture of clay with chopped straw (Ger. *Häcksel*) and animal fibres is mentioned (Yaldiz 1987: 143), similar to the use of chopped straw for Tabo sculptures (Luczanits 2004: 268).

83 The village of Dreb has not yet been clearly localised and will be part of future research.

84 According to the ancient texts treated by Varma (1970: 19), three different kinds can be distinguished, i.e. an arid clay (Skt. *jāṅgalā*), which is strong and too hard to dig, a damp clay (Skt. *anūpa*), which is easy to dig and contains black sand, and a mixture of both (Skt. *miśrā*) showing both qualities and containing a small amount of sand or stickiness. Following ancient texts, the three types of clay should be prepared each in twelve steps, which sounds rather ambitious and questionable from a practical point of view.

85 In general, pottery clay seems rather close to the quality of clay needed for clay modelling. For the extremities of sculptures made in Bengal, the clay is described as sticky, without sand or small stones, and ready to model the whole piece in one step (Varma 1970: 211).

86 For sculptures from Tabo, the use of purified clay and the addition of sand are mentioned, and for sculptures from Tabo and Gumrang, also the addition of chopped straw is described (Luczanits 2004: 268). Contrarily, the clay used in the workshop of Lhasa was described without the addition of sand, straw or further purification. This may simply have to do with different local raw material resources but does not enable any qualitative comparison.

At the Lhasa workshop straw was not added; instead just the described *pödam*, *shagdam* or *tsadam*. In this workshop, within one sculpture the use of several of these ingredients can be applied for different parts. For the Tara sculpture⁸⁷ with a height of app. 1.4 m – which was at the time of the author’s visit standing in the workshop and whose production took about two weeks – the torso was made with *tsadam*, delicate parts like the face were made with *shagdam*, and delicate decorative parts such as the extension of hair over the shoulders were created with *pödam*. A long history of incense powder made of *shukpa* is said to exist at Nyemo.⁸⁸

4.4 Surface of the sculpture

At the Lhasa workshop, in a semi-dry state the surface is pressed and smoothed with a wooden stick (see Fig. 2.15). A preferred stick is made of *depam* (Tib. *sde pam*), a hard wood. Remaining cracks and unevenness are smoothed but not burnished. After smoothing, a sublayer for the following layer of paint – particularly when adding gold colours – is applied with a brush. This fine layer is a mixture of a specific clay called “*serdam ngenpa*” (Tib. *gser ldam ngan pa*) with yak skin glue. *Serdam ngenpa* relates to the mode of painting and also the name of a colour. For the glue used, today we can distinguish between a modern artificial and the traditional version made of yak skin. For Western Himalayan sculptures, in particular from Tabo and Gumrang, the application of a white priming coat was common (Luczanits 2004: 275). For Gumrang, the use of a considerably thick limestone paste is described (ibid.). This paste is also mentioned as *śarkarā* or *śarkarākalka*⁸⁹ (Skt.) in early texts treated by Varma, and translated as limestone paste of which it is not clear if the limestone was burnt (Varma 1970: 24, 28, 29). Varma hypothesises that unburnt limestone was used, and he gives a translation of *śarkarākalka* as “a finer variety of clay” (ibid. 29), which would also correlate with its use in the Lhasa workshop.

According to Varma (1970: 153), two different methods in applying the final layers for coating are explained either as one single layer on the core with the second layer used for burnishing; or as two applied layers with one layer as the base for the application of a slurry (also known as “slip” or “thin clay wash”; ibid: 164). For the Bengal sculptures, after modelling the head, just a thin layer of silt from the Ganges is added (ibid. 210). According to the method, which was shown in the Lhasa workshop, no additional final layer for burnishing was applied. The core material already had the fineness needed for the uppermost layer. This method correlates with a method used for traditional Tibetan wall plasters. Examinations of Tibetan wall plasters at Nyarma show that the upper plaster layer after desludging the base material is capable of being burnished (Feiglstorfer 2019: 103ff.). In the case of the Lhasa workshop, the upper surface remained unburnished. The conducted smoothing left a homogenous and levelled but not shiny surface.

87 To carry the Tara sculpture, at least two strong men are needed, for the Yamāntaka sculpture, at least three.

88 A traditional method of producing the powder is with a water wheel. By activating the rotation of a wooden stick, a continuous beating on the piece of *shukpa* takes place. Due to the rubbing of the *shukpa* along the hard ground, the wood is powdered.

89 For the application of *śarkarākalka* (Skt.), two layers having thickness of two to three *yavas* are used. With the second, holes or cracks should be avoided. After one to two months, another three layers should be applied until the prescribed measurements are obtained (Varma 1970: 88). These layers are the last possibilities for adjustments to any measures or proportions to be made.

4.5 Discussion

The study of Sanskrit literature conducted by Varma (1970) gives rather detailed information on Indian clay sculptures. His comparative analysis by including ancient Indian texts of early examples of clay sculptures from Indo-Afghan regions, and Jammu and Kashmir, shows similarities with traditions in processing the clay and in making clay sculptures over the Tibetan cultural zone in a number of aspects. A comparison with Western Himalayan, Bengal and Central Tibetan methods of making clay sculptures provides insight into historical working processes. The connotation of the single parts of the clay sculpture with parts of the human body as described in Indian literature stands in a specific religious context. Comparison with present-day methods of making clay sculptures in Lhasa provides evidence of still remaining traditional knowledge. Since techniques used for modelling are related to a deep understanding of properties of the base material, clay sculpturing can be considered a highly developed skill. Various aspects seem to be of relevance also for studying traditions in Himalayan earth architecture.

Early findings of clay sculptures from the 6th century in the Kashmir / Fondukistan region, from the 8th century in Central Tibet, and the 10th and following centuries in the Western Himalayas show the long tradition of this craft. In Central Tibet, a tradition of clay sculpture modelling remains today and reflects historical methods through the use of moulds or modelling in thick layers by hand or preparation of thin-skinned hollow sculptures. A continuous transfer of knowledge from generation to generation and master to scholar shows a continuity of traditions such as particular modelling methods. This continuity in the transfer of related traditions is seen in the still existent knowledge in a Lhasa workshop being related to knowledge gained from the renovation of historical clay sculptures in the Jokhang in Lhasa.

The single methods can be ascribed as prevalent to particular regions between Fondukistan in the west and Central Tibet in the east. Using a mould or modelling in thick layers is found as a commonly used method in several regions (Western Himalayas, Kashmir, Bengal or Central Tibet), while the technique of processing thin layers around an armature and making hollow shells seems to be concentrated in Central Tibet. On the other hand, we can distinguish between different local technical variations based on varying local raw material conditions, such as the use of different kinds of materials for making the subconstruction, the firing of sculptures, or the use of different fibres to prepare stabilising ropes.

For vernacular architecture, an important fact seems to be that there is not just one solution for solving a technical problem, but rather there are local solutions dependent on local resources. Such problems concern a) the prevention and repair of cracks, b) the preparation of a proper adhesion of clay on wood, c) the collection and preparation of clay in general, or d) the treatment of surfaces.

- a) Prevention of cracks: At the Lhasa workshop, three clay mixtures are described by using *shuk-pa*-powder, paper, and fibres. In a historical context, the use of straw or animal and vegetable fibres is also stated. In order to repair cracks in the Lhasa workshop, hair cracks are closed with a fine slurry of clay and compressed with a wooden stick.

- b) Preparation of a proper subconstruction on wood: Using a wooden brace with ropes (or as seen in Bengal, the use of straw as an alternative to ropes) as a subconstruction for clay modelling is similar to the architectural problem of application of clay on wood. For example, this issue is known from wattle and daub or half-timbered constructions, where technical problems are experienced regarding how to fix clay on wood, and how to avoid cracks due to the different tensile moduli of the combined materials. An answer to this technical problem is the introduction of elastic fibres to improve the adhesion of clay on wood. A related example (which was found in Basgo in Ladakh) involves the use of ropes twisted around pillars to guarantee plaster without cracks (see below for technical analysis). This application shows close similarities to the technique used for sculptures with ropes twisted around the armature. Also the use of two layers of clay, each fixed on a rope, is a method known from clay sculptures that is used to reduce the possibility of cracks and to increase the technically possible thickness of the layer of clay.
- c) Collection and preparation of clay in general: Places for collecting the proper clay are traditionally known over a wide region. The very fine material quality at the Lhasa workshop is similar to the material used for pottery. Historical evidence for clay sculptures indicates the mixing of clay with sand. After mixing the clay with additives as given under (a), it has to be compressed by beating to maximise a consistent mixture. In the Lhasa workshop, for the preparation of hollow light-weight clay sculptures (similar to Tibetan clay masks), a mixture of clay, *shukpa* powder, herbs and water is modelled around a solid core of clay. According to a historical mentioning for Samye in Central Tibet, a block of grass or straw is covered with a textile of cotton, followed by a layer of fluid clay, which is covered by further layers of clay. Both techniques show similarities, and future examination should demonstrate their suitability for architectural purpose.
- d) Treatment of surfaces: Surfaces are in general reworked in a semi-dry state. At the Lhasa workshop, burnishing was not conducted but the last upper layer of clay was compressed with a wooden stick before covering it with a mixture of clay and yak skin glue (for glue in Indian texts, a limestone paste is described). For Indian sculptures, the application of a clay slurry and its burnishing are mentioned. The method of burnishing in general is conducted with rounded stones on interior wall plasters, particularly at religious Tibetan structures. For the plaster used at Nyarma, laboratory tests showed that the mixture used for the ground plaster was refined most probably by desludging to guarantee a burnishable upper surface (Feiglstorfer 2019: 103ff.). More so, a small content of fine sand on the upper layer of plaster increases the ability of being burnished (ibid.). Also this method seems to depend on the quality of the available raw material. Today in Bhutan, for example, the application of a fine slurry on the upper layer of plaster is used as a layer for burnishing (Interview Meingast 2015).

Several of the techniques, which teach us about the historical use of clay for sculptures, can be compared with recent application, a tradition being based on the fine balancing of raw material and applied techniques. In need of further examinations are possibilities for present-day use of such techniques in the creation of earth constructions and conservation.