



GREEN TĀRA'S GREEN: ANALYSES OF PIGMENTS ON MONGOLIAN VOTIVE PAINTINGS

Lenka Gyaltsso – Helena Heroldová – Jana Odvárková¹

ABSTRACT: A collection of small votive Buddhist paintings from Mongolia is kept in the Náprstek Museum in Prague. Research has recently been conducted into the Buddhist iconography of the votive paintings. During the research, analyses of pigments were conducted. The results show the employment of traditional mineral pigments, as well as modern artificial pigments including highly toxic colourants.

KEY WORDS: Tsakli – Mongolia – Buddhism – paintings – colours – pigments

Recent research of Mongolian Buddhist votive paintings kept in the Náprstek Museum has focused on Buddhist iconography. The first study devoted to the history of the collection was published in 2014², and a subsequent study of the iconography of female deities was accepted for publication in 2015³. Both articles were based on a descriptive study of Buddhist deities and their iconography, including the colours of their bodies and attributes. During the research, the necessity of analysing the pigments and dyes arose, especially with regard to whether natural or artificial pigments were used. The colour palette of natural pigments for Buddhist paintings has been established for centuries, and the detailed iconographical research posed the question of whether

¹ Jana Odvárková (odvarkova@ngprague.cz) is a Conservation Scientist in the Department of Conservation in the National Gallery in Prague, Lenka Gyaltsso (gyaltsso@ngprague.cz) is the Curator of the Tibetan Collection in the National Gallery in Prague. Helena Heroldová (helena_heroldova@nm.cz) is the Curator of the Chinese and Lamaistic Collection in the National Museum-Náprstek Museum. This work was financially supported by the Ministry of Culture of the Czech Republic (DKRVO 2014/30, National Museum, 00023272)

² Heroldová, Helena. Czechoslovak Collectors in Mongolia and Votive Paintings of Green Tara in the Náprstek Museum. *Annals of the Náprstek Museum*, 35 (2), 2014, p. 81-94.

³ Heroldová, Helena. Female Deities in Mongolian Buddhist Votive Paintings. *Annals of the Náprstek Museum*, 36 (1), 2015, p.60-73.

the use of artificial pigments changed the iconographic meaning of the colours. As the result, elemental analyses of the pigments of selected Buddhist votive paintings were conducted in order to determinate whether natural or artificial pigments were used.

Paintings under scrutiny

The paintings under scrutiny are “tsaklis” (*tsa ka li* ཙ་ཀ་ལི་ in Tibetan, *zagal zurag* *загал зурэг* in Mongolian), small votive paintings used during rituals in Tibetan and Mongolian Buddhism. *Tsaklis* are rectangular, and small in size. They are painted on canvas or printed and painted on paper. Usually they depict a single deity, or a Buddhist symbol. Often they are produced as thematic sets. *Tsaklis* are used as offerings and initiation cards. They are displayed on altars, or they are carried in personal charm-boxes.

Detailed study of their iconography and acquisition history shows that the paintings under scrutiny were produced during the 19th and the first half of the 20th century in Mongolia and the northern part of China. For the purpose of the analysis of the pigments, the following examples were chosen. The paintings of Hayagrīva (Inv. No. A5808) and Begtse (Inv. No. A17461) were chosen for the red shades, Hayagrīva and Vajrasattva (Inv. No. A17231) for the blue, and Tāra (Inv. No. A17230) and Hayagrīva for the greens.

Hayagrīva (हयग्रीव, *Rta mgrin* རྟ་མགྲིན་, “Horse neck”), Inv. No. A5808, purchased from a private owner in 1967, 8 cm x 6.5 cm.

Hayagrīva is a Tantric Buddhist deity. He is connected with one of the five Buddha families, known as the Lotus family (*padmakula* पद्मकुल, *pad ma'i rigs* པདྨ་མའི་རིགས་) and he is considered the wrathful emanation of *Amitābha* अमिताभ or *Avalokiteśvara* अवलोकितेश्वर. Hayagrīva's practice appears in the old Nyingma school and also in the “new” Sarma schools. Hayagrīva is an important deity in the Nyingma system of Eight Heruka (*he ru ka* ཧེ་རུ་ཀ་), male wrathful deities. His origin is probably in Hinduism as he was worshiped by the tribes of horse breeders. Later he merged with Lord Vishnu. In Mahayana Buddhism he is the protector of sacred scripts and he frightens bad ghosts by neighing like a horse.

He can have many forms, with a different number of faces and arms and different body colour (mostly red or black) but one characteristic attribute is common to all of them – the green horse's head on the top of his head. Therefore the name Hayagr va is translated as “Horse Neck”.

On the tsakli under scrutiny Hayagrīva is depicted with a red body, three faces, six arms and four legs. His main head is red, the right-hand one is white and the left-hand one is green, each of them with three eyes. He has a wide open mouth and a crown of five skulls on his head. In his upward-flowing hair is a green horse's head. In his hands Hayagrīva's attributes are a white lotus flower (hardly visible here), a skull cup, *vajra* hook, sword, stick and noose. With the same hand that holds the skull cup he is embracing his consort. She has a blue body, and is holding a skull cup in her left hand and wearing a leopard skin skirt. Hayagrīva wears a tiger skin skirt and his body is adorned with jewellery. On his back he wears an elephant skin; the elephant's head be seen hanging on his right hip. Hayagrīva also carries a set of wings of Garuḍa, a mythical bird-like creature.

He stands on a sun disc and a lotus throne of white petals, his right leg bent and his left straight. His body is surrounded by flames. There is a very simple background to

the painting – green grass and blue sky with light blue and pink clouds and the sun and moon.

There is a mantra written in red ink on the back side of the tsakli: *Om ahm hum soa ha*.

Green Tārā (तारा, Sgrol ma སྒོལ་མ་, *Dara Dapa*), Inv. No. A17230, purchased from a private owner in 1982, 8 cm x 7 cm

The goddess Tārā is the most venerated female deity, a bodhisattva, a personal and a meditational deity. She represents the compassionate saviouress who helps those in distress. She originated in India as a female companion to male gods, particularly of *Avalokiteśvara*. Later she appeared in Tibet with the arrival of Buddhism during the second half of the first millennium. Her worship gained immense popularity with the second arrival of Buddhism in the eleventh century. With the arrival of the Mongols in the 13th century, and especially later, during the 16th century, she became popular among them.

Since the earliest images in India dating to the 6th century she has been depicted as a beautiful woman holding a lotus in her hand. However, she can be depicted in numerous manifestations. The main visual trait of her various forms is the colour of her body. The most common is either green or white, although she appears also in red and yellow. The basic iconographical attribute is a lotus. She holds a single stem with a lotus flower of pink or blue, or two lotuses, one in each hand.

The Green Tārā on the *tsakli* in question is depicted sitting on a lunar disc on a lotus throne, her leg resting upon a small lotus flower. Two of three “jewels” are visible lying in front of her. She is semi-naked, wearing red and green skirts and fluttering shawls. She is adorned with bodhisattva jewellery, and with a crown of five jewels and red shawl resting on a bun of her black hair. Her hands are depicted in the gesture of protection. There are two pink lotuses, each with a flower and a bud, which seem to grow out of her body. There is a green and pink aureole and a pinkish halo with golden rays of protective light around her body and head. The simple background consists of landscape and sky filled with shaded clouds.

Vajrasattva (वज्रसत्त्व, *Rdo rje sems dpa'* རྫོག་མེ་སེམས་དབང་།, *Dorjembé Dorjsemé*), Inv. No. A17231, purchased from a private owner in 1982, 8 cm x 7.2 cm

Vajrasattva is the inner form of the primordial Buddha *Vajradhara* (*Rdo rje 'chang* རྫོག་མེ་འཆང་), the “Vajra-holder”, and represents all the five Buddha families. According to Tantra texts Vajrasattva is considered an additional, the sixth Dhyani Buddha (there are five Dhyani Buddhas who represent five Buddha qualities). He is the personification of the *Dharmakāya* (Truth body of enlightenment) and progenitor of the Vajrayāna system of Buddhism.

Originally Vajrasattva’s figure was used in Tantric praxis for the purification of sins and defilements. Vajrasattva has many forms, but he does not appear in either a peaceful or wrathful form. He is depicted in white, blue or green, with one or three faces and two or six arms. As a meditational *yidam* (ཡི་དམ་, *iṣṭadevatā* इष्टदेवता) deity he is depicted with his consort in a *Yab-yum* ཡཔ་ཡུམ་ (Father and Mother) position. His consort holds a skull cup full of blood in her left hand and a chopper in her right hand.

Vajrasattva on this particular *tsakli* has a white body and sits embracing his consort. He holds a thunderbolt, *vajra* (*rdo rje* རྫོག་རྩེ་), in his right hand, almost standing upright on his palm, and a bell, *ghaṇṭa* (*dril bu* རྒྱལ་བུ་) in his left hand. He has a blue topknot and a golden five-tipped crown. He wears a red skirt with a green hem and an orange shawl on his arms. He is adorned with golden Bodhisattva jewellery on his chest, arms and

ankles. He sits on a lotus throne with a white base and pink lotus petals. Vajrasattva has a green aureole around his head and a blue and pink one with gentle golden rays around his body. His consort has also an orange skirt with a green hem and is adorned with the same jewellery as him.

The background of the picture consists of simple green grassland and blue sky with a huge white cloud. There is a sun and moon on the sky above the main figure. There are offerings in the bottom of the picture – three pieces of ivory, three jewels and a twig of coral.

On the back side of the *tsakli* is an inscription handwritten with black ink: *ma'i don phyir grub bo* (“Accomplishment for Mother’s Welfare”) and a mantra written with red ink: *Om ahm hum sva ha*.

Begtse (*Beg tse chen* བེག་ཙེ་ཆེན་, *Jamsaran*, Жамсаран, “The Great Coat of Mail”), Inv. No. A17461, purchased on the antiquities market in 1987, 8.2 x 6.4 cm

Begtse is the “Dharma Defender”, the *Dharmapāla* (*chos skyong* ཆོས་སྐྱོང་) deity, one of the wrathful “Eighting Dharmapālas” (*drag gshed* འགྲུག་གཤེད་).

His origin is still shrouded in mystery. According to the Tibetan tradition he originated in India, but contemporary research placed his origin in Central Asia. As a pre-Buddhist god of war he was introduced to Tibet in 11th century by the translator Marpa Lotsawa (*Mar pa chos kyi blo gros* མར་པ་ཆོས་ཀྱི་བློ་གྲོས་, 1012–1096) and the Sakya master Sachen Kunga Nyingpo (*Sa chen kun dga' snying po* ས་ཆེན་ཀུན་དགའ་སྐྱིང་པོ་, 1092–1158) within the tradition of “New” Sarma, Karma and Sakya schools. In the Sakya school he is one of the Wisdom deities. He was mainly incorporated into the Gelug school, and became very popular in Mongolia.

In this particular *tsakli* he wears warrior’s armour on his chest, white trousers with blue patterns and dark red Mongolian boots. There is an animal skin around his waist. In his right hand he holds a sword and in the left hand a fresh heart of the enemy. On his left arm he holds a bow, an arrow and a stick with a trident ending. He wears a crown of five skulls and a necklace of fifty heads, besides armbands and earrings. His hair resembles flames and red-orange flames surround his body. His right foot stands on the corpse of a green horse and his left one on the corpse of a naked man. According to the *Mahāvīyutpatti* dictionary, his standing position, usually used when he is shooting an arrow, is called *pratyāliḍha* (प्रत्यालीढम्, *gyon brkyang ba* རྩོན་བརྒྱང་བ།), “extended to the left”.

Technology of Painting

The *tsaklis* are painted on canvas covered with white chalk gesso with animal glue on both sides. Unlike the elaborate, large paintings with numerous deities against complex backgrounds, *tsaklis* present a single deity against a simple background. Usually, as the paintings under scrutiny reveal, a careful sketch of the initial outline according to the rules of iconometry is missing. The coats of paint are laid down quickly and carelessly. Shading and outlining are simple.

Traditionally, thangkas and *tsaklis* were painted with mineral pigments ground into powder and mixed with gelatine binders.

Method and Results

A scanning electron microscope JEOL JSM-6460 LA (*SEM-EDX*) with the JED-2300 software was used for the elemental analysis of the pigments. The advantage of this technology is that it is non-destructive, since the destructive removal of samples is not needed, and the items are not damaged.

The analyses of paint layers were made under low vacuum. Each whole tsakli was inserted into the chamber of the microscope and mounted on a holder using double-sided adhesive carbon tape.

Several places on each painting were selected for the analyses. Each place provided several "samples": points in a diameter of 0.5 µm to 1.0 µm, and rectangular and square areas⁴. The places were chosen because they had a thick coat of paint and rich colour without admixtures of other colours. At the same time, places in the red colour margins were selected because a mixture of various pigments as well as dirt was expected.

Inv. No. A5808

Ten places were selected for the analyses: golden jewellery (three samples) and golden hair (four samples), blue sky (three samples), red hands (six samples), green background (two samples), the white skull and white chin of the deity (five samples). One sample comes from the margin.

The analyses show the following pigments:

White: Dominant lead (Pb) suggests ceruse or minium. The face and the skull suggest ceruse.

Red: Mercury (Hg) and sulphur (S) indicate vermilion. The darker shade indicates small amounts of various elements which suggest red ochre and soot. Lead (Pb) is also present, and probably indicates minium.

Blue: copper (Cu) is prevalent, which suggests azurite

Green: copper (Cu) and arsenic (As) suggest Sheele's green, or emerald green

Black: soot

Gold: gold (Au) and silver (Ag) in the ratio 6:1 (jewellery), also lead (Pb), probably ceruse (hair)

The margin indicates clays.

Sodium (Na) and chlorine (Cl) are also present, which suggests sweat from the hands of people who handled the painting. There were also small amounts of aluminium (Al), silicate (Si), iron (Fe), calcium (Ca), mangan (Mg). They probably come from later handling of the painting.

For detailed analysis, see Pict. 5 and Tables 1 and 2.

Inv. No. A17230

The samples were selected from fourteen places: the green face and green throne (two samples). The white throne with lotus petals gave five samples, the blue and green skirt (two sample), samples of golden, red and blue colour from the crown, and the blue aureole (two samples). Three samples are from the white and green clouds. Further samples come from the pink aureole (one sample), the pinkish flower (four samples) and the brown shawl (two samples). Two places in the margin provided six samples. A large dark spot provided two samples which indicate the presence of clays, vermilion and soot.

The analyses show the following pigments:

White: lead (Pb) dominates which suggests ceruse or minium

Red: mercury (Hg) and sulphur (S) indicate vermilion

Pink: lead (Pb) and calcium (Ca) suggest probably minium and calcium carbonate (chalk, limestone). The result cannot exclude white lead

⁴ The term „sample“ in the rest of the article refers to the analysed points and areas.

Blue: copper (Cu) dominates, probably azurite or malachite

Green: copper (Cu) suggests malachite

Brown: lead (Pb), or minium, clays, soot. The copper (Cu) and natrium (Na) suggest malachite or ultramarine.

Black: soot

Golden: Gold (Au) and silver (Ag)

The red margin indicates clays, minium, ceruse and soot. The white margin indicates ceruse or minium and clays.

For detailed analysis, see Pict. 6 and Tables 3 and 4.

Inv. No. A17231

The samples were selected from five places: the white face and the green aureole (three samples), the skirt (two samples) and pink flower (two samples).

The analyses show the following pigments:

White: probably ceruse and clays

Red: Mercury (Hg) and sulphur (S) suggest vermilion, probably also ochres

Pink: minium and calcium carbonate

Orange: minium and calcium carbonate (chalk, limestone)

Green: copper (Cu) suggests malachite, natrium (Na), aluminium (Al), silicate (Si), and sulphur (S) suggest ultramarine.

The orange margin indicates minium, and calcium carbonate.

Inv. No. A17461

The samples were selected from seven places: the blue, green and red shawl (four samples), red flames (two samples), the blue sky (five samples), orange throne and green horse (three samples) and green grass (four samples).

The analyses show the following pigments:

White: ceruse, lithopone

Red: mercury (Hg) and sulphur (S) indicate vermilion, minium. Barite (Ba) and sulphur (S) suggest barium white

Orange: chrome (Cr) suggest barium yellow and barium white

Yellow: chrome (Cr) suggest barium yellow and barium white

Green: copper (Cu) and arsenic (As) suggest Sheele's green or emerald green

Blue: iron (Fe), kalium (K), calcium (Ca) suggest ultramarine, but the use of Prussian blue cannot be excluded.

Interpretation

The traditional palette of Himalayan Buddhist paintings included calcite whites, carbon black, blue azurite, indigo blue, green malachite, yellow orpiment, ochres, red lead, and red vermilion (Boyer: passim, Duffy: 79, Mass: 115). Chemical elements suggesting similar pigments are found on the analysed Mongolian paintings. However, modern artificial colours were probably used as well.

Greens were used for the background to depict grass and leaves. Moreover, deities such as Green Tāra are depicted in green.

The analysed pigments suggest the mineral malachite ($\text{CuCO}_3 \cdot \text{Cu(OH)}_2$). However, the result of the analyses also suggests the possible use of emerald green and Sheele's green ($\text{Cu}_3(\text{As})_3\text{O}_{12}$).

Sheele's green, a copper arsenite (**A5808, A17461**) is a man-made pigment invented in 1775 by Carl Wilhelm Scheele (1742 – 1786), and was produced from 1778. It gives a wonderful deep shade of green. It was widely used during the 19th century as a textile dye, paint pigment and food colourant. However, as an arsenic compound it is poisonous. Emerald green, also called Paris green or Vienna green ($\text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{Cu}(\text{AsO}_2)_2$) is a more complex arsenic compound invented around 1814. It gave a particularly brilliant shade of green; however, both Sheele's green and Emerald green are highly toxic (Šimůnková and Karhan, 60).

Blue appears as the sky on the background. The bodies of some deities are painted in dark blue.

The analyses indicate the mineral azurite ($\text{Cu}(\text{OH})_2 \cdot \text{CuCO}_3$), and ultramarine ($\text{Na}_8\text{-10}(\text{Al}_6\text{Si}_6\text{O}_{24})\text{S}_{2-4}$). The probable employment of Prussian blue ($\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$) is also suggested (**A17461**). This is a cheap and non-toxic pigment produced since the early 18th century (Šimůnková and Karhan: 48).

Azurite and malachite are copper minerals, blue and green in colour. Both minerals are found together in copper ores. They have been widely used since antiquity. The natural ultramarine is one of the most complex pigments. It comes from grinding the semi-precious stone lapis lazuli. The pieces of stones are broken, ground, and washed out, until fine powder is produced. Artificial ultramarine has been manufactured since 1828.

Reds are used in abundance. The bodies of deities are painted in red. Red is also used for the flames around the bodies of wrathful deities. Shades of red and pink appear on flower petals, lotus thrones and clouds. Red and orange are found on the garments and sashes of deities.

Reds consist mostly of vermilion (HgS), red ochre and minium (Pb_3O_4), all known since ancient times. **Pink** is usually a combination of minium, red ochre and chalk or limestone. **Yellow, orange** and **brown** are used for garment, nimbuses, flames and jewellery of deities, and mainly consist of minium and ochres.

Golden colour enriches the paintings. The clothes of the deities are embellished with dots and lines in a golden colour. The jewellery is also gold in colour. The nimbuses of protective light behind the deities' bodies are enhanced by golden lines.

Gold (Au) and silver (As) were used for the golden colour. Sometimes a layer of red is added under the paint to give the gold a deep reddish shade.

White is found on the faces and the skulls. It is mainly ceruse ($2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$), calcium carbonate (CaCO_3 , chalk, limestone), and various clays. However, barium white (BaSO_4) and lithopone ($\text{ZnS} + \text{BaSO}_4$) are found (**A17461**).

Ceruse, clays and chalk have been known and used since antiquity, as well as the natural barium white. Lithopone is a mixture of inorganic compounds manufactured since 1847. **Black** was made of soot.

Conclusion

The small Buddhist votive paintings in question were either collected by Czech experts in Mongolia during the 1960s and 1970s or acquired on the Czechoslovak antiquities market during the 1970s and 1980s, and according to their iconography they are dated to the late 19th and the first half of the 20th century. The main aim of the elemental analyses was to identify the natural and artificial colourants in order to

answer the question of whether the employment of artificial colourants changed the traditional iconographic meaning of colours.

The paintings contain the traditional repertoire of natural pigments: azurite and malachite, minium, clays, vermilion, black soot and calcite whites. Malachite and azurite were used for the blue and green of sky and the landscape background. Clays, minium and vermilion were used in abundance to depict red, orange and pink flames, flowers and garments. Ceruse, lithopone and clays were used for faces and skulls. Gold with silver depicted jewellery and adornment.

Modern artificial pigments were indicated in the case of white and green colours. Changes in iconography due to the employment of artificial pigments were not observed. However, the suggested presence of modern man-made, highly toxic pigments such as emerald green and Sheele's green should be taken into consideration. Health and safety precautions should be followed when handling the *tsaklis* in the museum.

Literature:

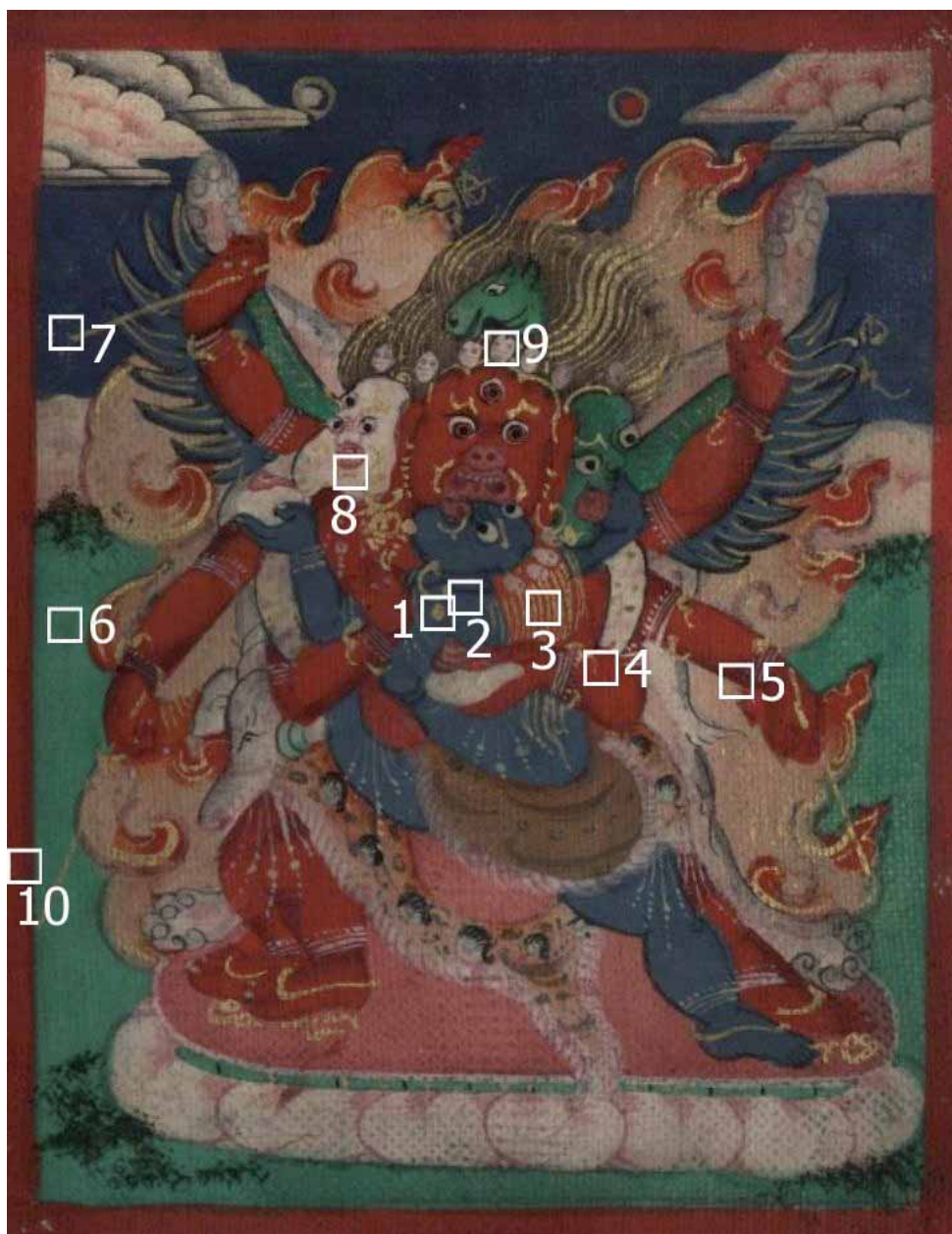
BOYER, Marion. *La Peinture bouddhiste tibétaine. Découvrir, comprendre et conserver les thangkas*. Eyrolles 2010

DUFFY K. and J. Elgar. "An investigation of palette and color notations used to create a set of Tibetan Thangkas". In Wallert, A., E. Hermes and M. Peek, eds. *Historical Painting Techniques, Materials, and Studio Practice*. Los Angeles: The Getty Conservation Institute, 1995, pp. 78 – 84

HEROLDOVÁ, Helena. "Czechoslovak Collectors in Mongolia and Votive Paintings of Green Tara in the Náprstek Museum". *Annals of the Náprstek Museum*, 35 (2), 2014, p. 81 – 94

MASS, Jennifer et al. "Tangka Production in the 18th – 21st Centuries: Documenting the Introduction of Non-traditional Materials into Himalayan Painting Practice". In Ballard, Mary and Carole Dignard, eds. *Proceedings of the Forum on the Conservation of Thangkas*, Special Session of the ICOM-CC 15th Triennial Conference, New Delhi, India, September 26, 2008, ICOM-CC, 2009, pp. 108 – 117

ŠIMŮNKOVÁ Eva and Jiří Karhan. *Pigmenty, barviva a metody jejich identifikace* (Pigments, Colourants, and Methods of Their Identification). Praha: VŠCHT, 1993



Pict. 1

Hayagrīva, Inv. No. A5808, the squares indicate the places analysed.
Their numbers correspond to Table 1. For place No. 6, see Table 2.



Pict. 2

Green Tārā, Inv. No. A17230, the squares indicate the places analysed. Their numbers correspond to the Table 3. For place No. 13, see Table 4.



Pict. 3
Vajrasattva, Inv. No. A17231



Pict. 4
Begtse, Inv. No. A17461

Table 1. Hayagrīva, Inv. No. A5808, elemental analysis

A5808, Hayagrīva-elemental analysis

The results of the analysis are given in % of the total mass.

File Name	Memo	Al	Si	Ca	Fe	Cu	Ag	Au
1 - golden	1	1,89	2,26		0,65	9,76	11,04	74,4
	2	0,37	1,2	1,83	0,95	16,03	11,14	68,5
	3	0,59	1,56	0,94	0,5	11,93	13,72	70,8

File Name	Memo	Na	Mg	Al	Si	P	S	Cl	K	Ca	Fe	Cu
2 - blue	1			1,49	3,74		3,33		0,64	3,14	1,99	85,68
	2		1,32	3,58	8,99	0,39	3,29		1,06	2,57	4,03	74,78
	3	3,18	4,04	6,88	28,4	1,75	4,49	2,69	2,97	1,92	3,34	40,29

File Name	Memo	Mg	Al	Si	S	K	Ca	Fe	Ag	Au	Hg	Pb
3 - golden hair	1		0,97	0,77			0,69	0,73	3,65	6,05		87,14
	2		5,11	13,8		9,71	1,51	1,26	3,86	26,14		38,61
	3		1,94	2,92		1,88	1,32	1	6,49	23,91		60,54
	4	0,58	1,13	0,63	16,8	1,79	0,64				44,71	33,74

File Name	Memo	Na	Mg	Al	Si	P	S	Cl	K	Ca	Fe	Cu	Ag	Au	Hg	Pb
4 - red hand	1		0,79	1,69	1,27		18,71		1,61	0,88					71,94	3,1
	2	1,52	1,86	4,8	8,78	0,51	12,5	7,03	5,44	4,47	2,68				16,08	34,34
	3											2,14	14,33	62,09		21,44

File Name	Memo	Na	Mg	Al	Si	S	Cl	K	Ca	Fe	Hg	Pb
5 - red hand-shadow	1	4,77	2,91	4,37	3,74	15,33	12,55	7,28	2,83	0,95	11,03	34,24
	2	0,84	1,09	2,91	2,51	17,11	5,36	2,88	1,8	1,38	32,7	31,42
	3	0,01	1,09	1,25	4,31	16,4	4,83	1,92	0,55		16,52	53,12

File Name	Memo	Al	Si	K	Ca	Cu	As	Pb
6 - green background	1		0,75		0,45	38,99	59,55	0,27
	2	1,06	1,7	0,46	0,36	38,64	57,21	0,57

File Name	Memo	Mg	Al	Si	S	K	Ca	Fe	Cu
7 - blue sky	1	1,59	5,9	42,2	2,38	2,22	1,86	2,96	40,9
	2	1,13	4,2	11,6	1,12	0,87	0,99	4,53	75,58

File Name	Memo	Mg	Al	Si	S	K	Ca	Fe	Hg	Pb
8 - white face	1	1,76	1,21	3,1		1,29	2,18	1,27		89,19
	2	10,58	1,43	14,2		1,4	0,54	0,64		71,23
	3	1,25	0,55	0,86	14,8				15,21	67,36

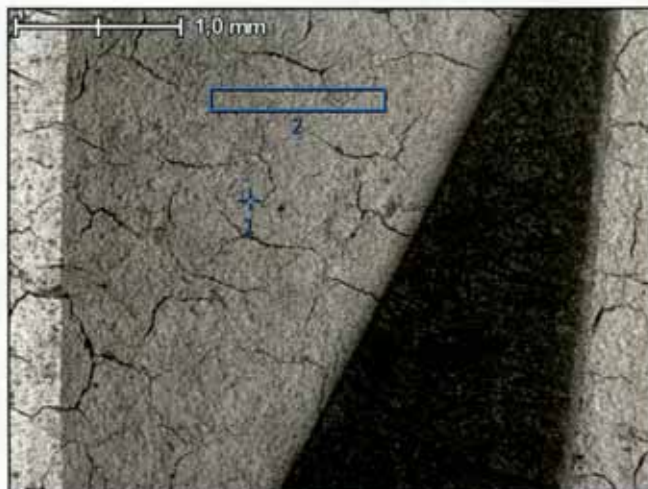
File Name	Memo	Mg	Al	Si	K	Ca	Pb
9 - white scull	1	1,36	0,55	1,17			96,92
	2	1,71	0,95	1,21	1,47	0,66	94,01

File Name	Memo	Na	Mg	Al	Si	S	Cl	K	Ca	Fe	Cu	Hg
10 - margin	1	1,84	2,18	8,62	11,8	7,76	4,88	4,66	3,09	2,01	2,51	50,68

Table 2

Hayagrīva, Inv. No. A5808, elemental analysis of place No. 6 (green background) with one point and one area. Copper (Cu) and arsenic (As) peaks suggest emerald green or Sheele's green.

6 – Green background



Title	: 38021
Instrument	: 6460 (LA)
Volt	: 20.00 kV
Mag	: x 33
Date	: 2010/05/07
Pixel	: 512 x 384



	Al	Pb	K	Ca	Cu	As	Pb	Total
1		0.75		0.45	38.99	99.55	0.27	100.00
2	1.04	1.70	0.44	0.34	38.64	97.21	0.57	100.00

Elemental analysis was performed on a scanning electron microscope with an energy-dispersive detector (SEM-EDX) JEOL JSM-6460 LA in the low vacuum mode (35 Pa) at an acceleration voltage of 20 kV.

The values for carbon (C) and oxygen (O) were annulated in the result, since carbon and oxygen are the basic building blocks of all organic matter (e.g. binders, textile fibers).

Table 3. Green Tārā, Inv. No. A17230, elemental analysis

A17230, Green Tara-elemental analysis

The results of the analysis are given in % of the total mass.

File Name	Memo	Mg	Al	Si	P	Cl	K	Ca	Fe	Cu	Pb
1 - green forehead	1	1,24	3,39	5,44	0,61	3,9	1,28	7,06	1,93	66,6	8,55

File Name	Memo	Na	Mg	Al	Si	P	S	K	Ca	Fe	Cu	Ag	Au	Hg	Pb
2 - crown	1		0,99	5,3	11,86		11	1,32	2,99	1,22	3,91			61,42	
	2								0,64		1,86	5,14	75,05		17,32
	3	7,07	3,22	15,36	36,53	2,59	8,59	3,99	17,81	3,32	1,52				

File Name	Memo	Na	Mg	Al	Si	Ca	Fe	Cu	Pb
3 - pink aureole	1	0,76	2,83	0,95	1,24	10,48	0,63	0,74	82,37

File Name	Memo	Na	Mg	Al	Si	P	K	Ca	Fe	Cu	Pb
4 - white and green cloud	1							0,9			99,1
	2	0,71	0,6	1,01	1,4		3,15	1,66	0,82	1,09	89,55
	3	0,74	1,01	2,58	4,67	0,59	2,55	13,38	1,74	4,65	68,09

File Name	Memo	Na	Mg	Al	Si	P	S	K	Ca	Fe	Cu	Hg	Pb
5 - margin	1	0,57	1,11	15,36	50,05	0,43	6,42	4,72	2,39	2,5		16,44	
	2	2,4	2,45	16,99	45,67	5,36		7,42	7,13	2,73	1,91		7,95
	3	2,86	2,73	7,55	26,14	1,48	11,6	4,78	23,07	2,53	1,26	16	0
	4			0,61	1,02		12,2	0,74	0,78			84,62	0

File Name	Memo	Na	Mg	Al	Si	P	S	K	Ca	Ti	Fe	Cu	Hg
6 - dark spot	1	2,72	3,01	13,38	27,09	3,05	10,9	8,54	7,32	1,17	12,51	1,36	8,94
	2	4,09	3,35	12	25,92	3,55	12,5	5,78	10,59	1,3	7,86	2,07	11,01

File Name	Memo	Na	Mg	Al	Si	K	Ca	Fe	Cu	Pb
7 - white margin	1	0,64	0,66	1,46	6,41	1,93	21	1,15	2,4	64,4
	2	1,19	0,75	3,21	7,34	2,55	21,7	0,88	1,79	60,61

File Name	Memo	Na	Mg	Al	Si	P	K	Ca	Fe	Cu	Pb
8 - flower	1		0,42	0,19	0,51	0,39		11,15	0,48	1,26	85,6
	2							1,31		1,58	97,11
	3							2,12		1,39	96,48
	4	1,59	2,18	1,16	2,51	2,08	2,86	7,22	0,54	2,72	77,15

File Name	Memo	Na	Mg	Al	Si	P	K	Ca	Fe	Cu	Pb
9 - brown shawl	1		7,75	4,57	7,48	2,25	2,24	17,54	7,64	19,76	30,76
	2	2,38	8,83	3,78	5,92	2,6	3,28	27,53	2,38	13,27	30,04

File Name	Memo	Mg	Al	Si	K	Ca	Fe	Cu	Ag	Au	Pb
10 - blue aureole	1	1,39	6,4	4,15	1,44	2,69	4,08	75,21	0,22	0,98	3,42
	2	2,25	11,66	9,49	1,81	3,39	6,94	58,53			5,94

File Name	Memo	Mg	Al	Si	S	K	Ca	Ti	Fe	Cu	Hg	Pb
11 - blud and green skirt	1	0,6	1,08	2,59	0,67	0,56	0,93		3,68	87,58	0,68	1,62
	2	1,01	2,14	5,37	1,48	0,9	1,42	0,45	4,04	77,51	1,84	3,85

File Name	Memo	Mg	Al	Si	Ca	Fe	Cu	Pb
12 - white throne	1	0,39	0,68	1,37	0,79	0,5	1,82	94,45
	2		0,24	0,75	0,88	0,51	2,32	95,29

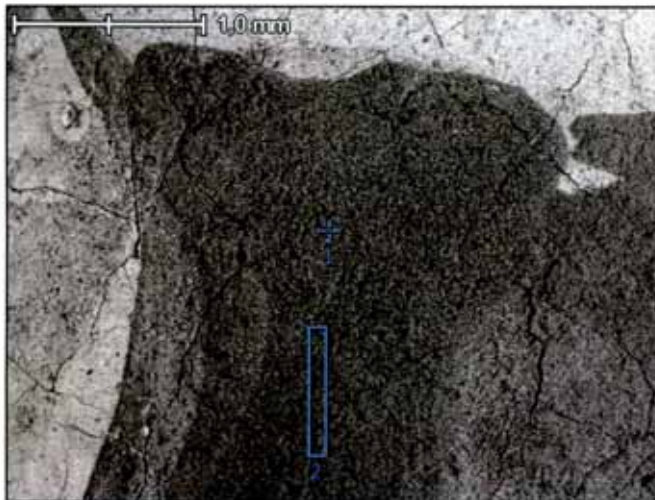
File Name	Memo	Mg	Al	Si	P	K	Ca	Fe	Cu	Pb
13 - green pedestal	1	1,86	3,1	6,85	0,39	1,8	5,69	1,94	55,77	22,6
	2	1,5	3,36	6,21	0,57	1,53	3,96	2,25	67,43	13,18

File Name	Memo	Mg	Al	Si	K	Ca	Fe	Cu	Pb
14 - lotus throne	1	0,49	0,36	0,91	0,8	1,87	0,83	1,46	93,28
	2	0,66	0,58	1,38	0,8	3,15		1,75	91,67
	3	1,01	1,54	2,46	1,02	3,81	1,46	2,76	85,93

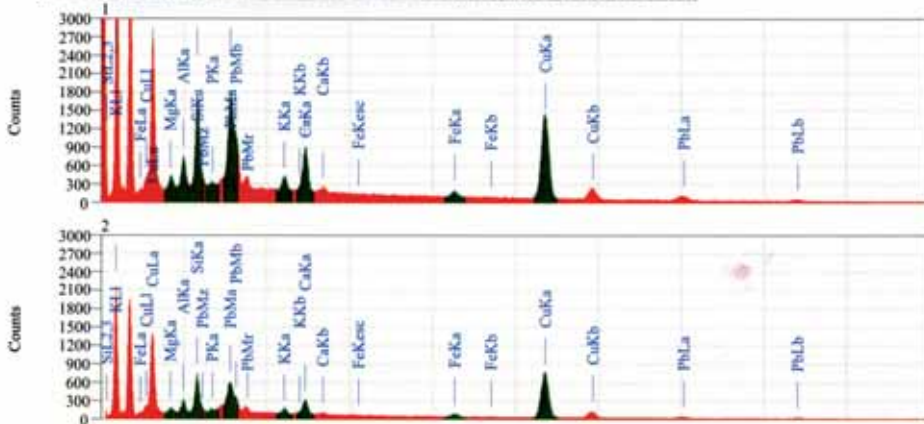
Table 4

Green Tārā, Inv. No. A17230, elemental analysis of place No. 13 (green pedestal) with one point and one area. The copper (Cu) peak suggests malachite.

13 - Green pedestal



Title	: IMG1
Instrument	: 6460 (LA)
Volt	: 20,00 kV
Mag	: x 37
Date	: 2010/07/28
Pixel	: 512 x 384



	Hg	Al	Si	P	K	Ca	Fe	Cu	Pb	Total
1.	1.86	3.10	6.85	0.39	1.40	5.49	1.94	55.77	22.40	100.00
2.	1.50	3.36	6.21	0.57	3.53	3.96	2.25	67.43	13.18	100.00

Elemental analysis was performed on a scanning electron microscope with an energy-dispersive detector (SEM-EDX) JEOL JSM-6460 LA in the low vacuum mode (35 Pa) at an acceleration voltage of 20 kV.

The values for carbon (C) and oxygen (O) were annulated in the result, since carbon and oxygen are the basic building blocks of all organic matter (e.g. binders, textile fibers).



Inv. No. 44.609, Swept-back bonnet, browband with loom-beaded strip. Southern Plains, end of the nineteenth century.