Ziyang
Beiwusheng huiguan

Final report
Part 1: Technique and materials

BMBF Forschungsprojekt / *Research project*
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Technische Universität München,
Lehrstuhl für Restaurierung,
Kunsttechnologie und
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Research Institute for Conservation of
Cultural Heritage of Shaanxi Province
陕西省文物保护研究院

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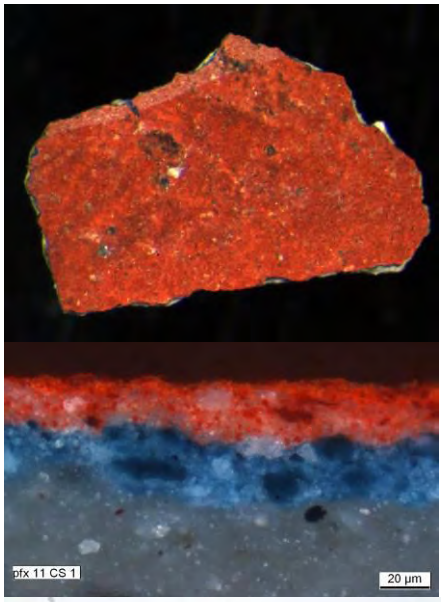
Photographs: if not mentioned otherwise, taken by the team of TUM

CONTENTS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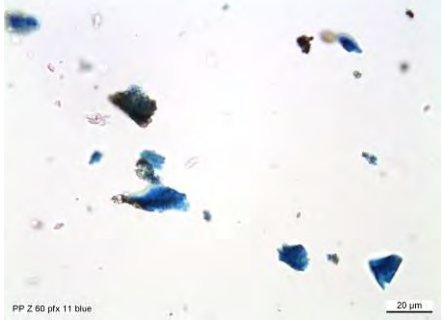
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Fig. 1
Work team at the start of the work in 2011: Catharina Blaensdorf, Liu Dongbo, Miriam Schanz, Elke Thiessen, Isabell Wagner; Zhu Boxuan, Hu Kejia (student); Wang Yiwei (driver); local staff: Jiang Bo (Bureau for the Administration of Cultural Heritage), Kang Yongfu with grandson from Wafangdian

Fig. 2
Work team in May 2013: Judith Regensburger, Zhang Hong, Isabell Wagner, Ma Linyan, Fan Binbin, Zhao Han, Zhao Yanjie Miriam Schanz, Wang Yiweu

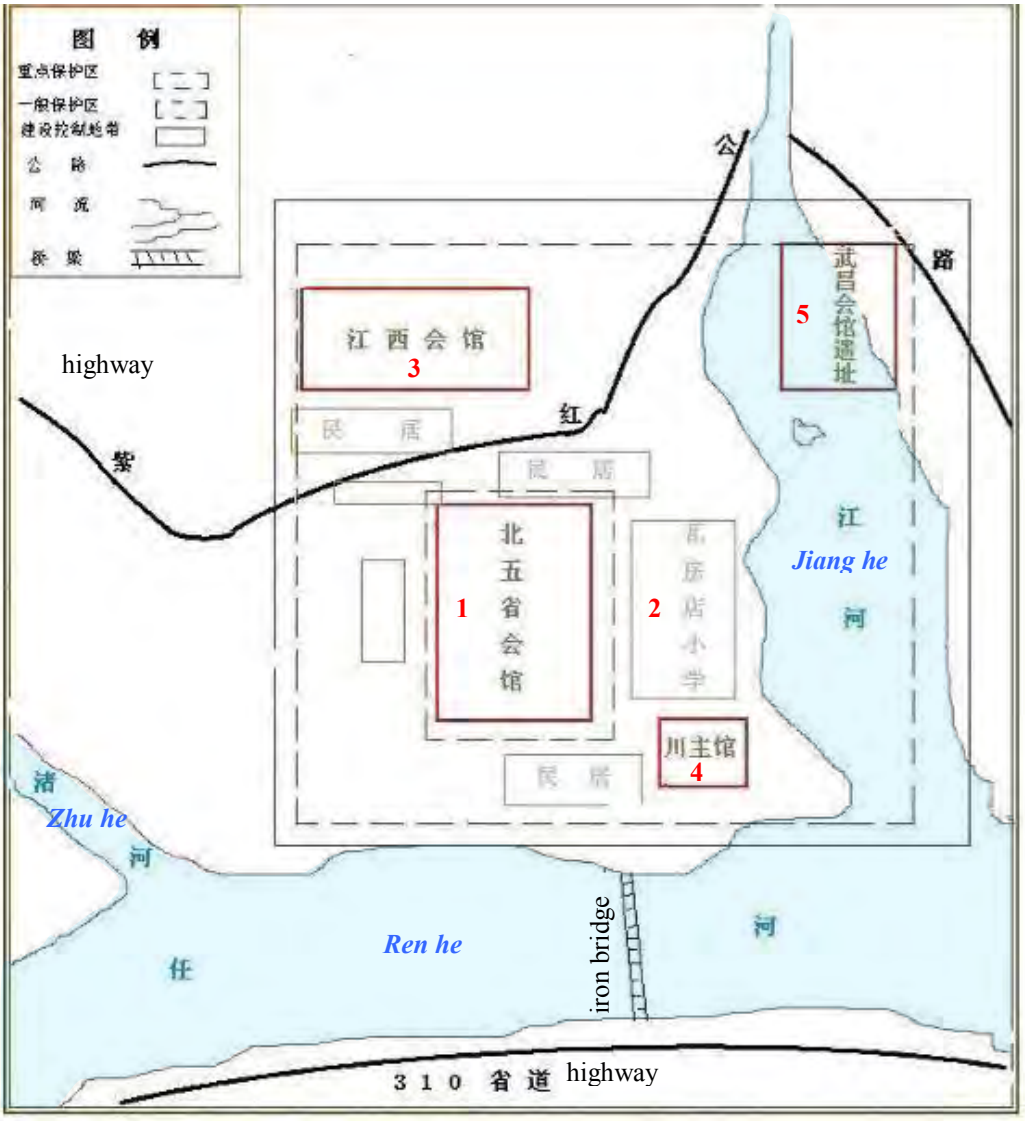
INTRODUCTION

The conservation of the Qing Dynasty wall paintings in the two halls of the *beiwusheng huiguan* 北五省会馆 ("Meeting hall of the Five Dynasties") in the village of Wafangdian near Ziyang was proposed in 2009 as a new subproject of the German-Chinese co-operation in the preservation of cultural heritage by the experts of the Center for Conservation 西安文物保护修复中心, recently renamed as: Research Institute for the Conservation of Cultural Heritage of Shaanxi Province 陕西省文物保护研究院 (in the following abbreviated as: Shaanxi Institute for Conservation). In 2010 the *beiwusheng huiguan* was included in the new German research project 01 GU 1001 financed by the German Federal Ministry of Education and Research (BMBF). The work was calculated for four years (2010-2013). Because the street to the *beiwusheng huiguan* was impassable in the summer period of 2010 after heavy rain falls and a flood, the work on-site started in July 2011.

This report includes information on the history, the technique and the used materials collected and researched in 2011 to 2013. Four work visits with the examination of techniques, damage assessment and conservation work took place in August/September 2011, August/September 2012, April 2013 and August 2013. The report mainly concerns the *pingfeng xi*-wall, i.e. the Western wall of the *guodian* (transit hall) which had been selected as the mural to be examined and conserved as joint German-Chinese co-operation work. Information on the other walls, however, as well as the tests for the conservation and the exemplary conservation treatment carried out there are described as well.
The head of the Ziyang project in the Shaanxi Institute for Conservation is Mrs. Ma Linyan. In 2011, two restorers from the Shaanxi Institute for Conservation, Mrs. Fan Binbin and Mr. Liu Dongbo, worked together with the German team, and in 2012 additionally Mr. Bai Ke joined the team. Mr. Zhu Boxuan and later Ms. Hu Kejia, students of the *xibei daxue* (North-West University) in Xi'an, participated in the work and functioned as interpreters. In 2012, Hu Kejia, though still a student, performed a large part of the analyses done in China and participated in the conservation work. In 2013, the restorers Mrs. Fan Binbin, Mrs. Zhang Hong, Mr. Zhang Jiafeng and the two junior restorers Zhao Han and Zhao Yanjie worked in the team on-site. The experts from the Shaanxi Institute for Conservation provided an internal report on the *beiwusheng huiguan* in 2006, titled *Ziyang beiwusheng huiguan bihua boahu yanjiu* 紫阳北五省会馆壁画保护研究. It served as the base of information on the history, depictions and damage to the wall paintings.[1]
The organisation on the German side was done by Catharina Blaensdorf from the TU Munich (2010-2012) and Miriam Schanz (2012-2013). In 2011, the German work team consisted of two German free-lance restorers, Miriam Schanz and Elke Thiessen, as well as a student from the TUM involved as assistant, Isabell Wagner. In 2012, Miriam Schanz worked in the *huiguan* as employee of the "China project" together with Isabell Wagner.
During the two work stays in 2013, the conservation/restoration of the *pingfeng xi*-wall was finished. The first work team included Judith Regensburger and Miriam Schanz as staff of the "China project" and again student Isabell Wagner supported the team. In the second team Miriam Schanz was backed by the two freelance restorers Kathrin Adelfinger and Judith Schieber.
Support by local staff was given especially by: Mr. Jiang Bo from the Cultural Heritage Administration and Mr. Kang Yongfu from Wafangdian village.

[1] The report *Ziyang beiwusheng huiguan bihua baohu yanjiu* 紫阳北五省会馆壁画保护研究, was given to the restorers in Munich by experts from the Shaanxi Institute for Conservation, and translated into German by Mrs. Cai Jiehua (Studie über den Schutz der Wandmalereien des Beiwusheng Gasthauses im Kreis Ziyang).

In November 2011. Prof. Ledderose from the Institute for East Asian Art History at the Ruprecht-Karls-Universität Heidelberg suggested that art historical and iconographic studies on the *beiwusheng huiguan* could be carried out parallel to the ongoing conservation work. In the beginning of 2011, Dr. Zhao Zhou from the Institute for East Asian Art History in Heidelberg started this work.[2]



1 *Beiwusheng huiguan*
2 Wafangdian primary school (formerly *taishan miao*)
3 Jiangxi *huiguan*
4 Chuanzhu *huiguan*
5 Wuchang *huiguan* ruin (not existing anymore in 2011)

Fig. 3
Wafangdian, schematic plan.
[*Ziyang beiwusheng huiguan bihua baohu yanjiu*, p. 5]

[2] The results of these studies are published separately. The report 陕西安康紫阳北五省会馆壁画研究报告 by Zhao Zhou et al. (to be published in 2014) will describe the contents and iconography of all wall paintings.

WAFANGDIAN AND THE *BEIWUSHENG HUIGUAN*

The village of Wafang(dian) 瓦房(店) is located 6.5 km east of the city of Ziyang 紫阳. Ziyang is located in the south of Shaanxi, 270 km south of Xi'an, near the border to Sichuan. Situated south of the Qinling mountains, it is counted as part of the South of China.
Wafangdian is a small countryside village today with few streets, but during the Qing dynasty it was a small town, and it was important due to its position along the travelling and trade routes formed by the rivers. At Wafangdian the *Zhu he* 渚河 flows into the bigger river *Ren he* 任河.[3] At Ziyang the *Ren he* flows into the Han river (*Han jiang* 汉江) which is the longest confluence of the Yangzi (*Changjiang* 长江) thus allowing the trade from the south east coast via navigable waterways.
The confluence of the *Zhu he* and the small creek *Jiang he* 江河 extending into the *Ren he* form a peninsula on which Wafangdian is situated. The village was called *Wafangdian* ("roof tile houses") because most of the houses were roofed with tiles instead of plates of schist as it is usual in this area. From the river the ground rises steeply to the tea plantations located on top of the hills. In the Qing dynasty six building complexes called *huiguan* ("assembly hall") and five temples (devoted to *taishan*, *tudi*, *caishen*, *guanyin* and *luban*) were built.

The *huiguan* were built (or donated) by groups or federations of merchants from different regions, and therefore *huiguan* is also translated as "guild house" or "guest house".[4] A more correct term for *huiguan* would be "merchants' association assembly house" Each building complexe consisted of one or more buildings, at least in two cases including a theater house with a stage and stands for the audience. Each *huiguan* was named after the region where the builders came from[5]:

- Wuchang *huiguan* 武昌会馆 (*huiguan* of Wuhan?, in Hubei Province)
- Jiangxi *huiguan* 江西会馆 (*huiguan* of Jiangxi)
- *Beiwusheng huiguan* 北五省会馆 (*huiguan* of the Five Northern Provinces)
- Hunan *huiguan* 湖南会馆 (*huiguan* of Hunan)
- Huangzhou *huiguan* 黄州会馆 (*huiguan* of Huangzhou in Hubei Province)
- Chuanzhu *huiguan* 川主馆 (*huiguan* of Sichuan).

When the Ankang hydropower plant was built in the late 1980's, the *Ren he* was retained by the dam, resulting in the rise of the water. The statements about how much the water level rose differ between 10 and 60 m, and it is difficult to estimate the difference in the water level form the few existing old photographs. The only dated photograph (fig. 5) was taken in 1985. The photographs show that formerly the main road ran along the river shore. A bridge spanned the mouth of the *Jiang he*. The three *huiguan* which had been built on the lower levels of the town were submerged or destroyed (Wuchang, Hunan and Huangzhou *huiguan*).

In 2005, an iron bridge was built across the *Ren he* ending behind the *beiwusheng huiguan* (figs. 3, 9 and 7). It is used by peasants who were moved to the other side of the river in the 1980's and thus were cut-off from the village centre.

In 2012, all the houses built on a level lower than the the *beiwusheng huiguan* were destroyed with the exemption of the Chuanzhu *huiguan* as a preparation to transform the place into a tourist attraction. A big pier for tourist boats and a new bridge over the mouth of the *Jiang he*

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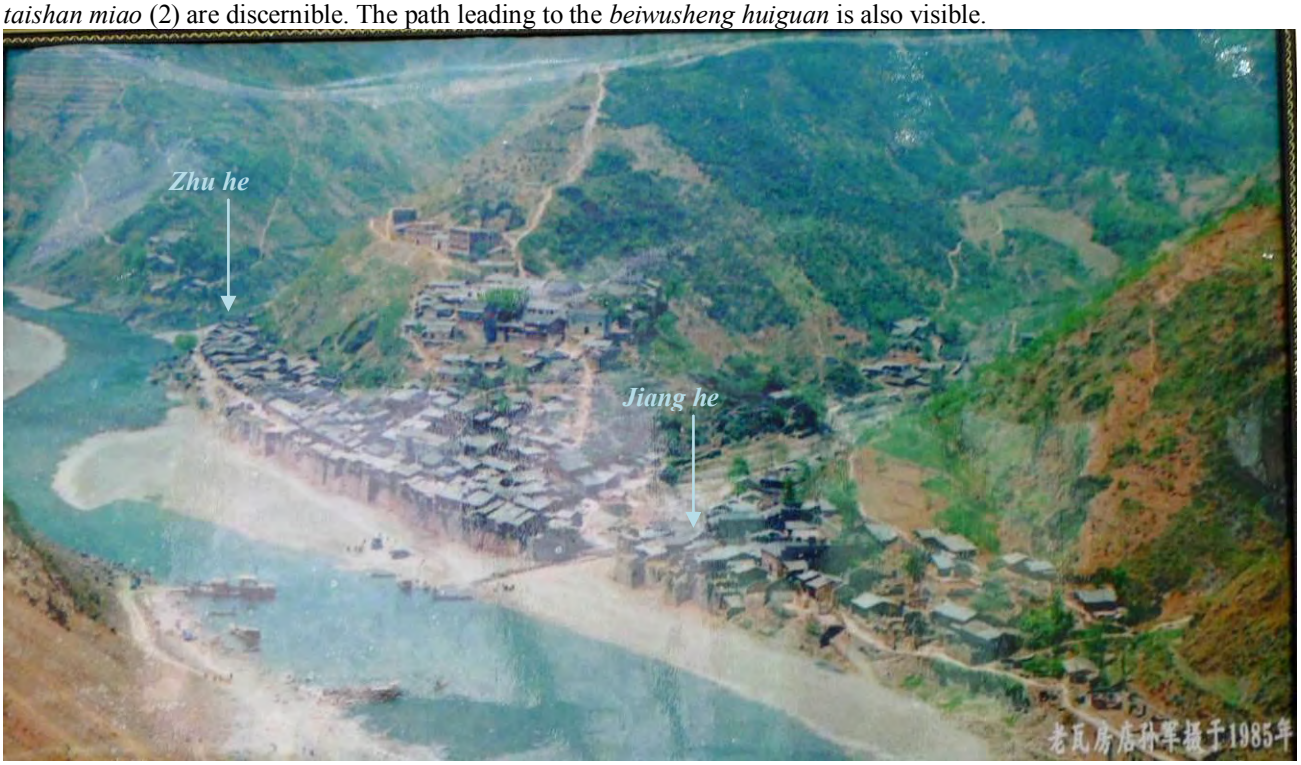
3 *Ziyang beiwusheng huiguan bihua baohu yanjiu*, p. 2.

4 The term "guild house" is used on road signs leading to Wanfangdian, the term of "Gästehaus" (guest house) was used in translations into German made for the German-Chinese co-operation project.

5 List of *huiguan* according to *Ziyang beiwusheng huiguan bihua baohu yanjiu*, p. 1.

Fig. 4
Wafangdian before the late 1980's seen from across the *Ren he*-river

Fig. 5
Reproduction of an old photograph of Wafangdian in 1985 in the restaurant *nongjiale* (农家乐, 'Happy farmer') between Wafandian and Ziyang. The low level of the water and the street leading from the river bank to the *taishan miao* (2) are discernible. The path leading to the *beiwusheng huiguan* is also visible.



were built; the construction work started in July 2012 (figs. 9, 8). The *beiwusheng huiguan* is the only building complex which still is quite intact, while the other *huiguan* and temples are in a deplorable condition or even beyond remedy:

The large and very interesting **Jiangxi *huiguan*** (figs. 11-14) consisted of three connected halls (front hall, rear hall and an entrance building). The walls are built of quarry stones in the lower part and fired bricks in the upper part. The bricks are stamped with characters 萬寿宫 (*wan shou gong*, 'Ten thousand - longevity - palace'). The same bricks had been used for other buildings that were demolished in the 1980's (the bricks are piled up in the complex of to the *beiwusheng huiguan* now). The fact that none of the houses was a palace may indicate that originally the bricks were made for another place.
The front hall and the rear hall have different shapes of gables: while the front hall has a trilobate gable, the rear hall has a stepped one. The gable tops are decorated with stucco and painted with ornaments and flowers. There also are stucco elements and imitations of stones in stucco inside the halls, surrounding large paintings on the gable walls. The murals in both rooms are of high artistic quality and showed folding screens with eight frames with strong similarities to the ones in the *guodian* of the *beiwushseng huiguan* (fig. 14; see: *Comparison of different walls*, p. 193-200).
According to information of the local cultural Heritage Bureau, the Jiangxi *huiguan* was built earlier than the *beiwushseng huiguan*. The bricks were produced for this *huiguan* and later on also used to build other ones. The inscription indicates that they were produced by potters from Jiangxi or in the style typical of Jiangxi. The Jiangxi *huiguan* is a typical building of this region with its history of immigration in the 19th century, as it combines the southern tradition (trilobate gable) and the northern one (stepped gable).[6] Originally the Jiangxi *huiguan* had a theatre as well: The tier with its stone parapet of the audience stand is still preserved, though partly included into a hut. An older farm house below may conceal part of the original stage building (fig. 11).
Today it is in a lamentable condition: The roofs have caved in in 2001, and the walls are in danger of collapsing. The wall paintings are still partly preserved, but will perish in the course of a few years. In 2012, plants had started to grow high inside, and the painted stucco of the facades is falling off. Though there is the decision to protect and to restore the Jiangxi *huiguan*, no emergency protective roof was built yet.

The small **Chuanzhu *huiguan*** is in a condition of far-reaching decay. Mainly the external walls are preserved. The inside of the building was overgrown with copiously developing vegetation. The surfaces of the walls which still show plaster are covered with a recent whitewash (fig. 10). Underneath partly traces of an older plaster with a white layer, either a priming layer or a whitewash, could be distinguished. In 2013, the vegetation was removed, and scaffoldings were erected inside and around the *huiguan* to start a repair of the building.

The temples have disappeared as well except for small traces: At the former ***taishan* temple** *taishanmiao* 泰山庙, opposite of the *beiwusheng huiguan*, the stone supporting wall of the sloping southern side with a part of the stone gate has been preserved. Originally there was a theatre building at the south side. The halls were standing on the higher northern part. The staircase was rising behind the large tree that is said to be older than the temple was. The area now houses new buildings of the Wafangdian primary school (fig. 3: 2). There are plans to relocate the school and to rebuild the temple or at least remove the modern buildings.[7]

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[6] Oral information by Jiang Bo, Cultural Heritage Bureau Ziyang.

[7] Notes on the *taishanmiao* taken during a visit of the village with explanations by Jiang Bo (without translation), written down by C. Blaensdorf who could not understand all the details.

Fig. 6
Wafangdian before the late 1980's seen from across the *Ren he*

Fig. 7
Wafangdian in 2011. In front iron hanging bridge built in 2005. The large concrete construction behind the village supports a new highway.

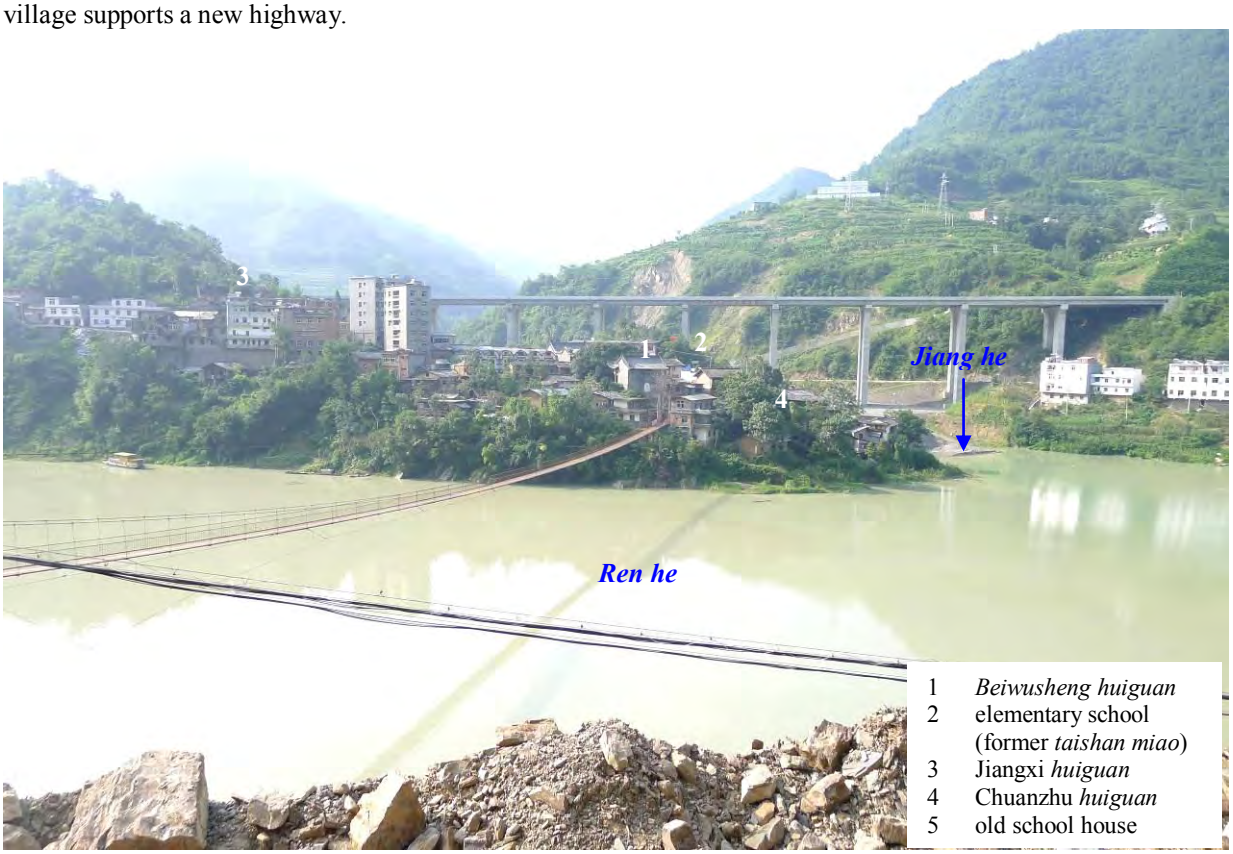


Fig. 8
Wafangdian in August 2012, with view of the mouth of the *Jiang he*.

Fig. 9
Wafangdian in August 2013 at a time of unusually low water level

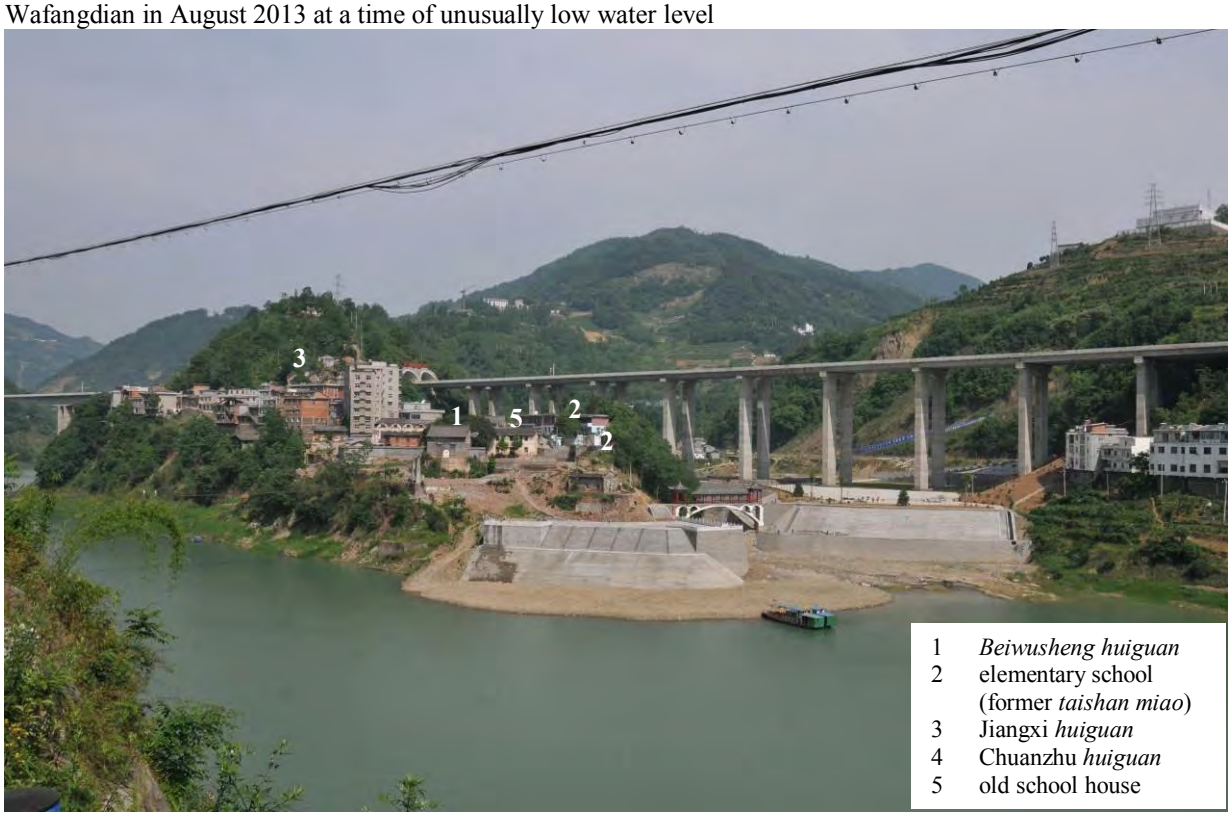


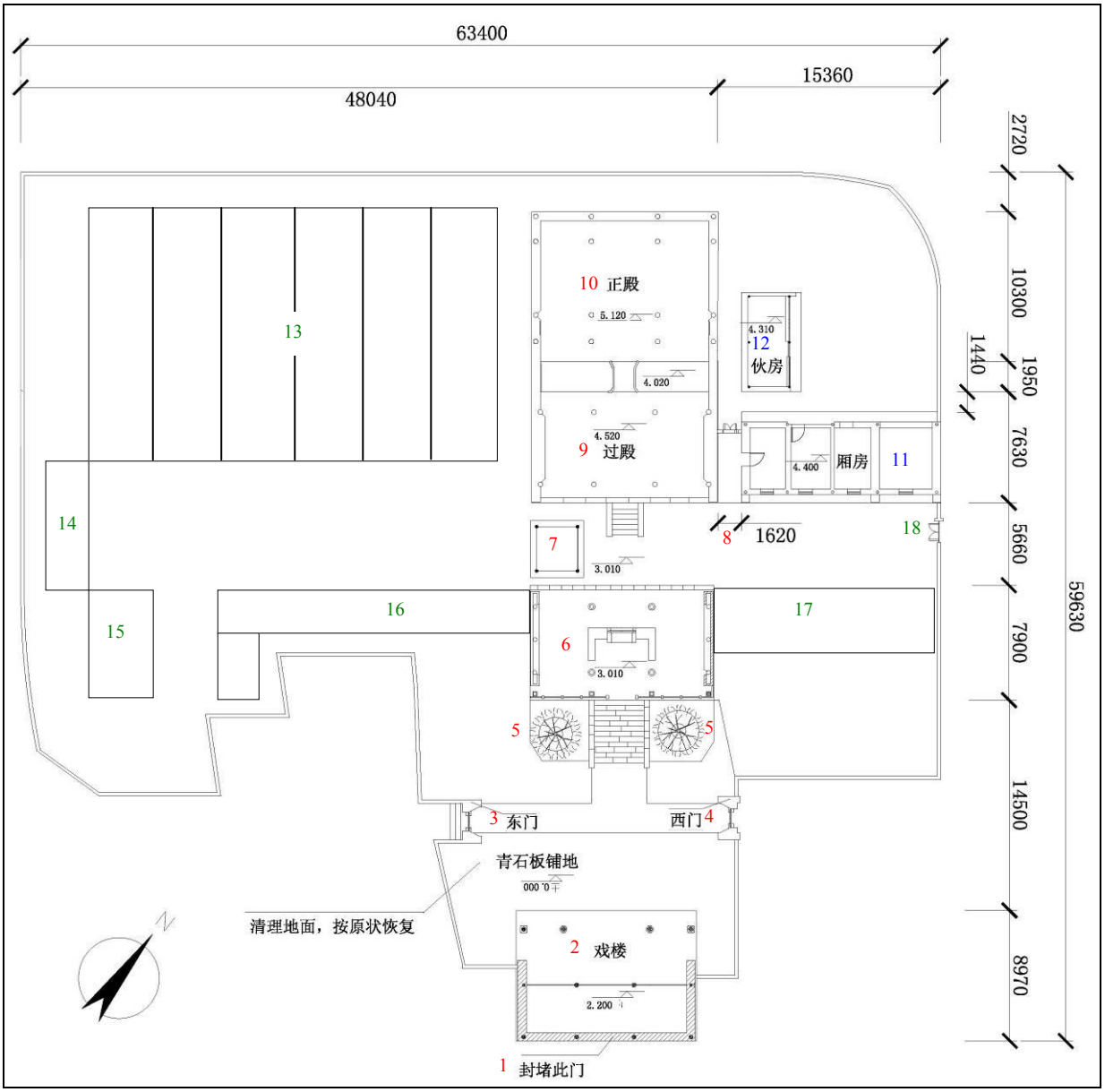
Fig. 10
View into the Chuanwu *huiguan*, August 2012.

Fig. 11
Jiangxi *huiguan*, in April 2011

Fig. 12
Jiangxi *huiguan*, front hall, east wall, April 2011.

Fig. 13
Jiangxi *huiguan*, front hall, August 2012.

Fig. 14
Jiangxi *huiguan*, August 2012, *pingfeng*-painting of the east wall; stamped bricks and stucco decoration



Buildings from the Qing dynasty
1 illusionary door
2 stage house
3 west gate[8]
4 east gate[9]
5 ancient tree
6 audience building with stand
7 drum tower
8 site of bell tower
9 *guodian*, transit hall
10 *zhengdian*, main hall

Old buildings, not existing any more
11 *xiangfang*, subsidiary building
12 *huofang*, community kitchen

Buildings of the 20th century
13 granaries, built in 1952
14 shed
15 barn and toilet
16 administration (empty, partly dilapidated)
17 old primary school, dilapidated
18 entrance

Fig. 15
Plan of *beiwusheng huiguan* in 2011
[Shaanxi Institute for Conservation; rotated about 180° and modern buildings added by C. Blaensdorf]

[8] Falsely labeled as east gate in Chinese.

[9] Falsely labeled as west gate in Chinese.

THE *BEIWUSHENG HUIGUAN*

Description

The *beiwusheng huiguan* consists of five buildings from the Qing dynasty and surrounded by buildings of the 20th century. The ground is sloping down towards the river from northwest to southeast. Therefore, the buildings are set on two levels or terraces with a difference in altitude of almost 10 m.[10]

Originally there was a path from the river up to the building complex. The visitor would arrive at the western gate (fig. 15: 3, now blocked), and enter the courtyard on the lower level. To the south of the courtyard there is the stage house (fig. 15: 2). The south façade overlooking the river is decorated with a magnificent fake door (fig. 15: 1). Inside the stage house, there is a solid wall: The door is only illusionary and cannot be opened: According to a legend it was sealed directly after building it for reasons of *fengshui*. Opposite the stage house, there is a building used as auditorium, set 3 m higher (fig. 15: 6). In the middle there is a stone staircase leading to a parapet which served as stand for the noble audience while the commoners stood in the courtyard. Two big trees (fig. 15: 5) flank the staircase: They are said to be as old as the buildings.

Taking the staircase in the middle of the auditorium house and passing through the building, the visitor reached the upper level. In the axis of the audience house there is the building complex consisting of the transit hall (*guodian*, fig. 15: 9) and the main hall (*zhengdian*, fig. 15: 10). Stairs leading up to the *guodian* are flanked by a drum tower (*gulou*, fig. 15: 7) on the western side. On the eastern side there originally was a bell tower (*zhonglou*, fig. 15: 8) which was demolished in the second half of the 20th century. Inside the *guodian* and *zhengdian*, the walls are decorated with nine murals. The like-wise painted wooden architecture is mostly still concealed underneath a whitewash, but shows paintings of a surprisingly high quality with narrative scenes and floral ornaments.

Until 2008 there were two buildings on the eastern side of the *guodian–zhengdian* complex: A subsidiary building with four small rooms (fig. 15: 11) and a kitchen (fig. 15: 12). It is not clear when they were built, They have disappeared except for the foundations.

The historical buildings are surrounded by houses built in the 20th century. The building on the east side housed a school once, though the last use must have been storage or administration (fig. 15: 17). The other buildings were connected to this use as a centre for storage and distribution of grain installed in 1952 or 1956. There is a row of six granaries (fig. 15: 13), a barn house with a toilet (fig. 15: 15) and a two-storeyed building used for administration which is now empty and out of use (water leaking through the roofs in all rooms, fig. 15: 16).). A half-open shed (fig. 15: 14) was demolished in 2012.

[10] *Ziyang beiwusheng huiguan bihua baohu yanjiu*, p. 3.

Fig. 16
Sanuo dong, painted screen behind the mother of the king with inscription giving the first month of the year as date for the "writing".

Fig. 17
Pingfeng xi, panel 7 *d*, detail of painted screen (height 15 cm, width 12 cm) with inscription by the painter containing a date in ancient Chinese calendar, referring to the eight month of the year.
In the upper left corner, the painter or another craftsman unintentionally left finger-prints in the grey wash of the background (white arrows).

Time of edification of the *beiwusheng huiguan*

According to the report *Ziyang beiwusheng huiguan bihua baohu yanjiu* 紫阳北五省会馆壁画保护研究 the erection of the *beiwusheng huiguan* started at the end of the Qianlong era (about 1790), financed by businessmen from Shaan 陕 (Shaanxi) and Shan 山 (Shanxi). The first building was the theatre house which was finished in the 27th year of the Daoguang era (1809/10). The drum tower, the bell tower, *guodian* and *zhengdian* are said to be built in the Tongzhi era (1861-74). As the construction was financially supported by businessmen from Qin 秦, Jin 晋 and Yu 豫, the complex was finally called "*huiguan* of the five northern provinces" (*beiwusheng huiguan*).[11] Differing from this description, in 2011 the paintings inside the *guodian* and *zhengdian* were dated much earlier by the Chinese experts: They assumed an origin about 1700 or in the 18th century, not in the second half of the 19th century. Two inscriptions hidden in the painted folding screens, in the *sanguo dong*-mural (southern end of the wall, fig. 16) and in the *pingfeng xi*-mural (panel 7 *d*, fig. 17), give the date of their execution using the ancient Chinese calendar in which the possible combinations of days and months recur every 60 years. According to these, the *sanguo dong*-painting was carried out in the first month (January/February) and the *pingfeng xi*-painting in the eight month (August/September) of the same year. The dating can refer to 1848 or 60 years earlier.[12] Three stelae set up between the two halls give the names of merchants who donated money to the *huiguan*. The only one containing a date (1866) is set out as supplement to other stelae by the inscription. Some peculiarities of the construction may indicate that the walls on which the murals were painted were built later than the halls themselves. Regarding the traditional dating and the inscriptions, the year 1848 seems the most likely dating for the murals.

[11] *Ziyang beiwusheng huiguan bihua baohu yanjiu*, p. 3. – While Shaanxi and Shanxi are provinces, Qin, Jin and Yu do not correlate to modern provinces. Qin 秦 and Jin 晋 are the names of states during the Zhou dynasty: *Qin* or *sanqin* (三秦) refers to modern Shaanxi; Jin was a state in northern Shanxi. Yu 豫 is not a state, but may refer to Henan.

[12] Reading of the inscriptions and calculation of the dates by Hu Kejia and Bai Ke, 2012.

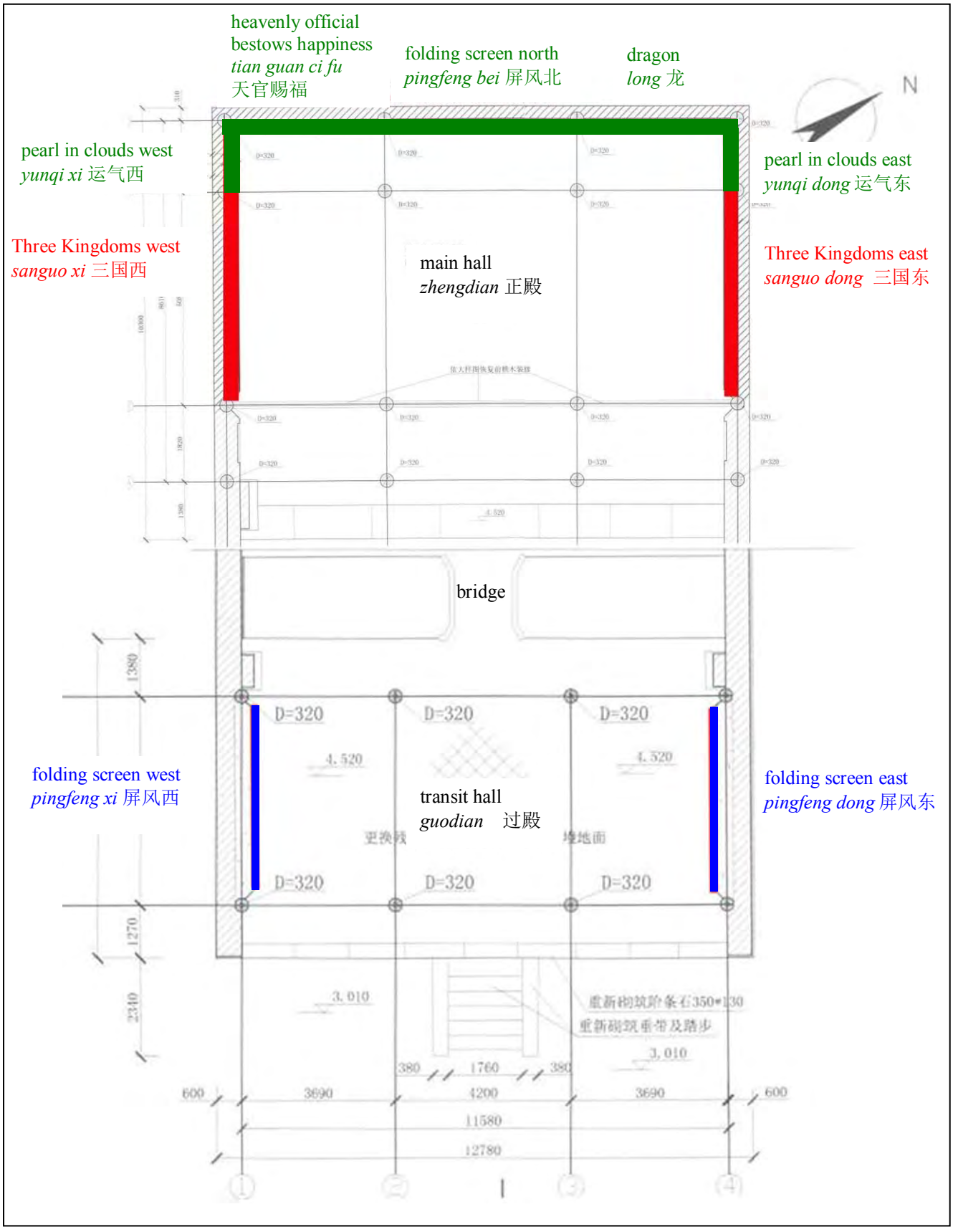


Fig. 18
Ground plan of *guodian* and *zhengdian* with wall paintings
[Combined from 紫阳北五省会馆壁画保护研究, fig. 11 and 12]

THE HALLS OF THE *BEIWUSHENG HUIGUAN* – THE *GUODIAN* AND THE *ZHENGDIAN*

The *guodian* (transit hall) and the *zhengdian* (main hall) are the main buildings of the *beiwusheng huiguan*. They are built one behind the other in the same axis and form a joined building complex because the walls of the gable sides are connected with each other. The orientation of the walls is not parallel to the geographic directions, but to simplify the description the walls were assigned to the directions, defining the eaves' sides as south and north walls and the gable sides as east and west wall. Figure 18 shows a ground plan of the two halls.

The halls are 12.8 m wide (West to East, including walls) and have three bays (*jian*[13]). As usual, the entrance is on the eaves' side. As the rear side of the *zhengdian* is closed, there is only one entrance to the complex of the halls: Climbing the stairs in front of the central bay, the visitor enters the *guodian*. Crossing the *guodian*, there is a small open space between *guodian* and *zhengdian*, like a small courtyard, which mainly consists of an approx. 2 m wide basin to collect the rain water. Today there is a bridge in the centre of the courtyard crossing the basin and serving as passage from one hall to the other.
In south-north direction, the *guodian* is 7.63 m wide and has only one bay. The *zhengdian* is 8.61 m wide and has a main bay of 5 m width with a narrow bay of about 1.8 m in front and behind. The *zhengdian* is built according to the Ting-Tang construction system with longer columns in the centre and shorter ones at the eaves' side.
Currently, the south and north side (i.e. both eaves' sides) of the *guodian* are completely open: There are no walls or doors between the columns. The *zhengdian* is open on the south side, but closed on the north side with a solid brick wall.
The solid wall parts - the gable walls of the *guodian* as well as the gable walls and the rear wall of the *zhengdian* - are decorated with wall paintings.

Painted architectural parts

All the wooden elements are painted: The columns are monochrome red. Lintels, beams, purlins and the parts connecting them show paintings with scenes and ornaments (figs. 19-22). The lintels and beams on the outside show figurative scenes. According to Ma Linyan, the scenes on the lintels on the outside of the *zhengdian* probably show folk stories or opera scenes. Fragments of figurative scenes can be detected on the inside of the lintels. On the inside, most of the wooden elements are still painted over with layers of whitewash.
The upper part of the columns are painted as well. On the *guodian*, there are two men painted (gods?, fig. 20), on the *zhengdian* the columns show lotus flowers and cranes (fig. 22). The paintings are colourful and finely painted, but less fine and artistic than the scenes on the murals. The figurative scenes have a dark blue background. Figures and objects show bright colours with light and white highlights (fig. 21). The technique of *lifen tiejin*, raised lines applied with a priming paste and leaf-gilded, were used for ornaments and weapons in the figurative scenes as well as for the depiction of dragons and parts of the framing of the figurative scenes (fig. 23).
Carved elements inside the halls are painted colourfully. On the beams, traces of floral ornaments are visible. On the gable walls, ornaments arranged in roundels are still recognisable.

[13] A *jian* 间 is the interspace between two columns. In traditional Chinese buildings, the number of *jian* is used to characterise the design of a building.

Fig. 19
Guodian, northern side (rear side), central bay. All original wooden elements are painted. Inside the hall traces of paintings can be recognised. Some parts are the beams are still covered with whitewash from the 1950's.

Fig. 20
Guodian, southern side (front), eastern column, during dismantling of the brick walls in December 2008. [Jiang Bo]

Fig. 21
Guodian, southern side (front), next to western column [Zhao Zhou, University of Heidelberg 2012]

Fig. 22
Zhengdian, southern side (front), 2012, eastern column showing a crane under lotus flowers, and lintels painted with figurative scenes. All original wooden parts were painted with figures and ornaments as the few preserved parts show.

Fig. 23
Zhengdian, southern side (front), 2012, detail of figurative scenes on the lintel, with the use of *lifen tiejin*.

Table 1.
Overview on the depictions of the wall paintings in the *guodian* and the *zhengdian* of the *beiwusheng huiguan*

position	*wall dimensions (h x w)*	*named as*	*abbre-viation*	*depiction*
guodian (transit hall)	Western gable wall 2.66 x 4.60 m	*pingfeng xi* („Folding screen West“)	*pfx*	eight-part folding screen with depictions of the *Twenty-four Filial Exemplars* in the *d*-panels
	Eastern gable wall 2.71 x 4.57 m	*pingfeng dong* („Folding screen East“)	*pfd*	eight-part folding screen with depictions of the *Twenty-four Filial Exemplars* in the *d*-panels
zhengdian (main hall)	Western gable wall 3.85 x 4.83 m	*sanguo xi* („Three Kingdoms West“)	*sx*	scenes from the *Romance of the Three Kingdoms* with a battle scene on the right and a ruler being worshipped on the left
	Eastern gable wall 3.80 x 4.87 m	*sanguo dong* („Three Kingdoms West“)	*sd*	scenes from the *Romance of the Three Kingdoms* including Liu Bei asking to marry the daughter of Sun Quan and the flight of the couple
	Western gable wall in the corner to north wall 2.38 x 1.37 m	*yunqi xi* („Pearl in clouds, West“)	*yx*	pearl in clouds
	Eastern gable wall in the corner to north wall 2.40 x 1.40 m	*yungqi dong* („Pearl in clouds, East“)	*yd*	pearl in clouds
	Northern wall, western bay 2.92 x 3.47 m	*tianguan cifu* („The heavenly official bestows happiness and prosperity“)	*tg*	The heavenly official pours happiness out from a vessel in the shape of a stream of bats
	Northern wall, central bay 2.96 x 3.95 m	*pingfeng bei* („Folding screen North“)	*pfb*	six-part folding screen
	Northern wall, eastern bay 2.90 x 3.32 m	*long* („Dragon“)	*long*	Dragon in the clouds over the water

The wall paintings of the *guodian* and the *zhengdian*

There are nine areas with wall paintings showing different types of motifs. Eastern and western wall parts are designed as counterparts. The wall paintings thus can be divided into three groups:
- *guodian*, gable walls (blue in fig. 18)
- *zhengdian*, gable walls (red in fig. 18)
- *zhengdian*, northern bay: small areas on the gable walls and three areas on the north wall (green in fig. 18) as background of a lost platform

The *guodian* has two murals on the gable walls, each showing a painted folding screen. The figurative scenes are painted in the style of Chinese brush paintings and are of high artistic quality.
The *zhengdian* shows two paintings on the gable walls (west and east wall) and five paintings on the rear part of the hall (north wall and adjacent bays of the gable walls). The largest paintings of the halls and probably the most important ones are those on the gable walls of the *zhengdian*: they show scenes from the *Romance of the Three Kingdoms*. They are elaborate in technique exhibiting a multi-layered structure of the pictorial layer, numerous intricate patterns and decorations and ornaments highlighted with gold. The paintings on the rear part of the *zhengdian* show scenes promising happiness, wealth and longevity. There is another folding screen in the central bay. The depictions of the wall paintings are listed in table 1. There are no detailed investigations on the iconography or the contents of the painted scenes yet.[14]

All paintings are set into the same type of framing, consisting of a white framing strip, surrounded by a black framing. A black line serves as separation between the depictions and the white framing. This concordant framing style provides a relation and a bond between the otherwise rather different paintings.

Technically and stylistically the paintings show significant differences. Partly these differences can be explained by the rank of importance of the paintings: The gable walls of the *zhengdian* with the *sanguo*-paintings were painted elaborately and meticulously with gold applications while the paintings of the north wall which served only as background of statues were painted in a comparatively simple way. It is interesting that the architecture of the *zhengdian* was also painted as intricate as the *sanguo*-walls.
There are also differences in technique and style of painting: While the *pingfeng*-paintings of the *guodian* resemble classical Chinese watercolour paintings dominated by the black ink drawing, the *sanguo*-paintings in the *zhengdian* are executed as a multi-layered system with rich gilding. In addition, stylistic distinctions, especially concerning the faces and the built of the figures, indicate that several painters were involved in the work. Partly the technical differences correlate to the stylistic ones.

[14] The decipherment of the depictions is part of the art historical research by Dr. Zhao Zhou.

Fig. 24
guodian, *pingfeng dong*, before treatment
[Shaanxi Institute for Conservation 2011]

Fig. 25
guodian, *pingfeng xi*, before treatment
[Shaanxi Institute for Conservation 2011]

The wall paintings of the guodian – pingfeng xi) and pingfeng dong

The gable walls of the *guodian* show painted folding screens or panel screens, in Chinese: *pingfeng* 屏风 (figs. 24 and 25). Movable screens, either consisting of one or several panels, were used in China as partition element of a room or background of a throne. A screen with landscape design, which is not foldable, is painted in panel 3 *b* of the *pingfeng dong* as background of a group of three men sitting at a table. In the panels 3 *b* of the *pingfeng xi* and in 1 *b* of the *pingfeng dong*, a painted panel door shows a design very similar to that of the folding screens.

Movable screens had practical purposes and aesthetical values and could be made of different materials. Besides landscapes and decorative ornaments, depictions of great achievements of virtuous and respected persons were a widespread motif. As it is usual for traditional Chinese paintings often poems annotate the depicted scenes.

Constructional parts of the folding screens

The paintings are approximately 4.60 m wide and 2.70 m high. The wall paintings show eight-fold screens on a white background. The folding screens have the same dimensions and subdivisions. The design is based on the same scheme, including the type and shape of the decorations. Differences only occur in details.

The background is surrounded by the broad black framing. The lower edge of the black framing also serves to indicate the floor on which the screens are standing. A thin accompanying line is set on the white background, separating a white framing strip next to the black one from the likewise white background.

The screens are painted as frame-and-panel constructions. There are eight frames, each measuring 242-243 cm in height and about 52.5 cm in width.[15] Each frame contains five panels and a foot zone. For the documentation, the eight frames were numbered 1 to 8 (from left to right, fig. 26: red). The five panels and foot zones were labelled with the letters *a* to *f* from top to bottom (fig. 26: blue).

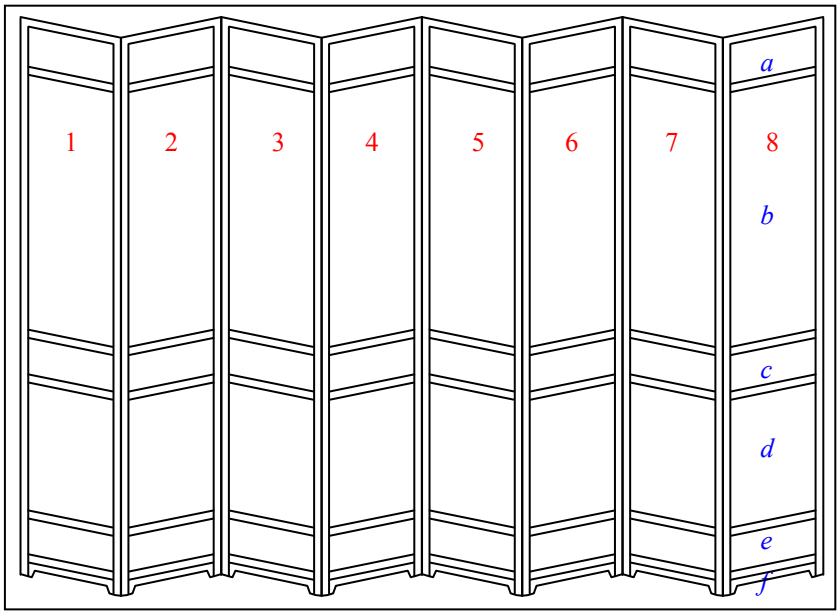
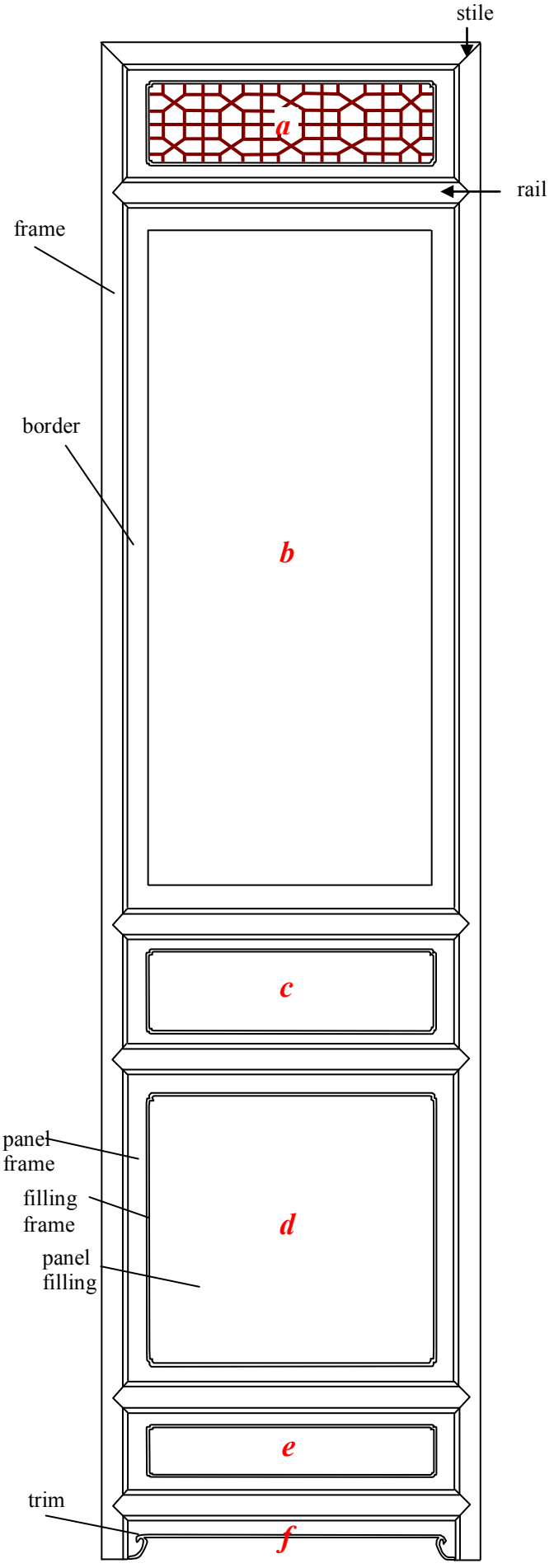


Fig. 26
System for labelling the frames and panels of the folding screens

The zigzag shape of the standing screen is depicted in parallel perspective. Figure 27 gives an overall view of the constructive parts and the subdivision of the screen panels. The connections between stiles and rails with mitre joints show that the intention was to depict a

[15] Height: Measured on both sides at the joint of the stiles. Width: Measured horizontally. The width differs slightly between the single frames.



Folding screen

Eight frames (frame 1 to 8), built up as frame construction with fives panels and legs, numbered *a* to *f* from top to bottom.

Framework

Wooden frame, consisting of two vertical stiles and horizontal rails connected with mitre joints. Each frame measures about 243 cm (stiles with legs) and is about 52.5 cm wide (measured horizontally). The dark brown stiles are 3 cm wide, the sloping edges are 0.6 cm wide. Contour lines: 2 mm wide.

Panels

The panels consist of a panel frame, a panel filling and a narrow filling frame. Panel frames of the panels *a*, *c*, *d*, *e* and *f* are pinkish brown or yellowish. Filling frames are black *on pfx* and green on *pfd*.

panels *a*
H. 18-18.7 cm. Decorative lattice (H. 12-12.8 cm) in red with black shadows and yellow highlights. Background: white on *pfx* and greyish blue on *pfd*.

panels *b*
H. 115 with border. Decorative depictions with poems: persons in landscapes with pavilions, framed by borders of 3.3 cm width with geometrical decoration. Towards the painting, the border has a black contour line.

panels *c*
H. 18 cm, without filling frame 13 cm. Persons (panels 2, 4, 5 and 7) or still lives (panels 1, 3, 6 and 8) in front of dark background (*pfx*: dark violet-tinged dark brown, *pfd*: dark brown as frame).

panels *d*
H. 51 cm, without filling frame 41 cm. Tales from the *24 Exemplars of Filial Piety*

panels *e*
H. 13.8 cm, without filling frame: 8.3 cm. Ornamental designs (*pfx*: floral design as on *pfb* on very dark violet brown; pfd: angular spiral *yunleiwen* in light blue on dark brown)

***f* (legs)**
Legs in the colour of the panel frames with a painted moulding or trim at the lower edge. Curvature of legs different on *pfd* and *pfx*.

Fig. 27
Construction scheme of painted folding screens

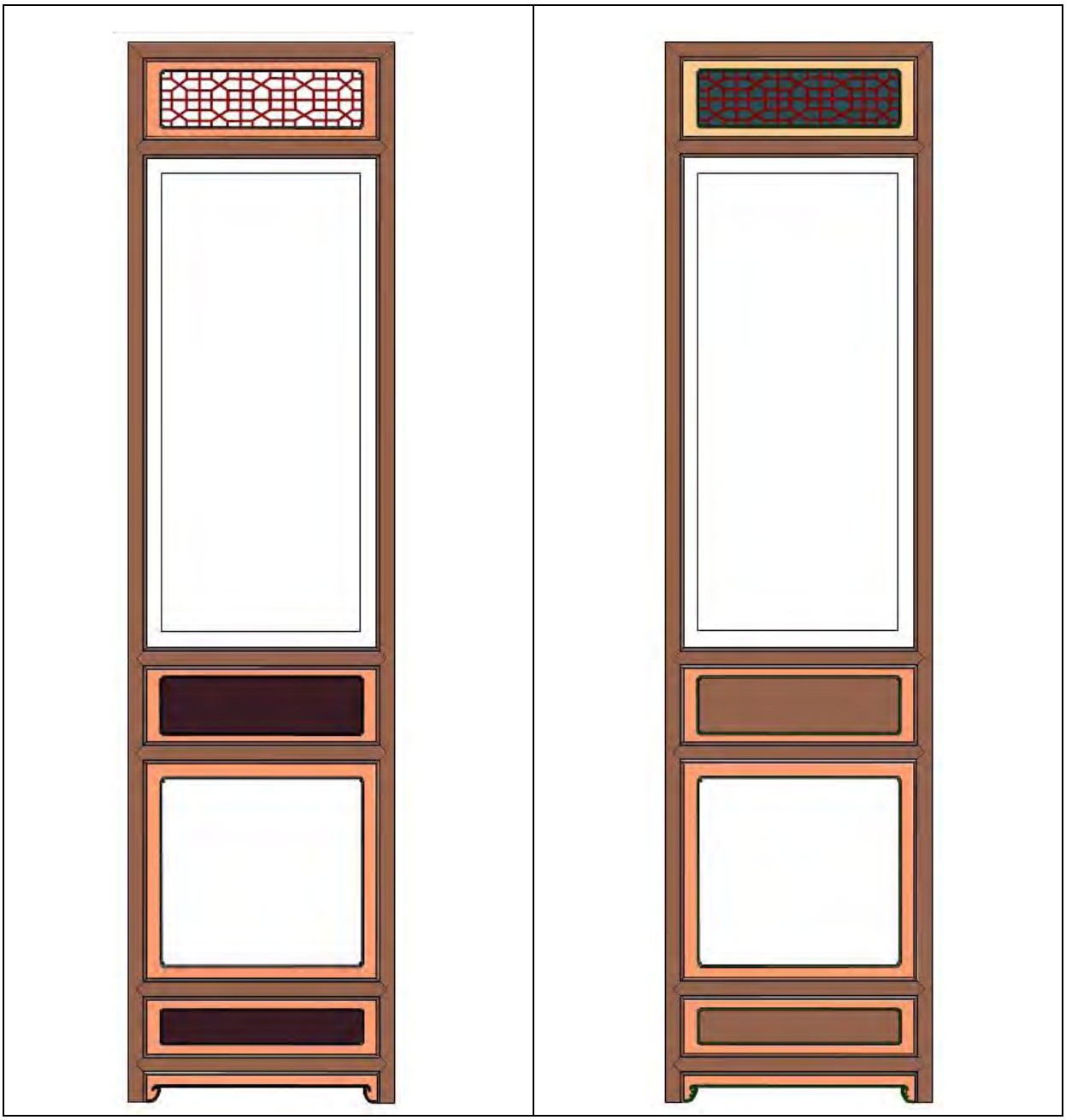


Fig. 28
Scheme of colour distribution on *pingfeng xi* (left) and *pingfeng dong* (right)

framework made of wood. Towards the panels a narrow strip of a dark brown indicates sloping or bevelled edges of the frame. There is no accurate rendition of the foreshortened perspective, as is visible in the perspective of the lattice and the edges of the frame. In the *pingfeng x*i-painting the paint of the frame was prolonged below the oblique contour lines at the end of the – visually receding – legs so that they end at a vertical line. This was done to fill the gap that otherwise would have been visible between the black framing and the legs: As the oblique angles of the legs were obviously not calculated correctly the folding screen would seem not to stand on the black framing, but to hover above. Another difficulty in realising a perspective depiction becomes obvious here. On the *pingfeng dong*-side, however, the receding legs are coloured correctly: they are long enough to stand properly on the black framing.

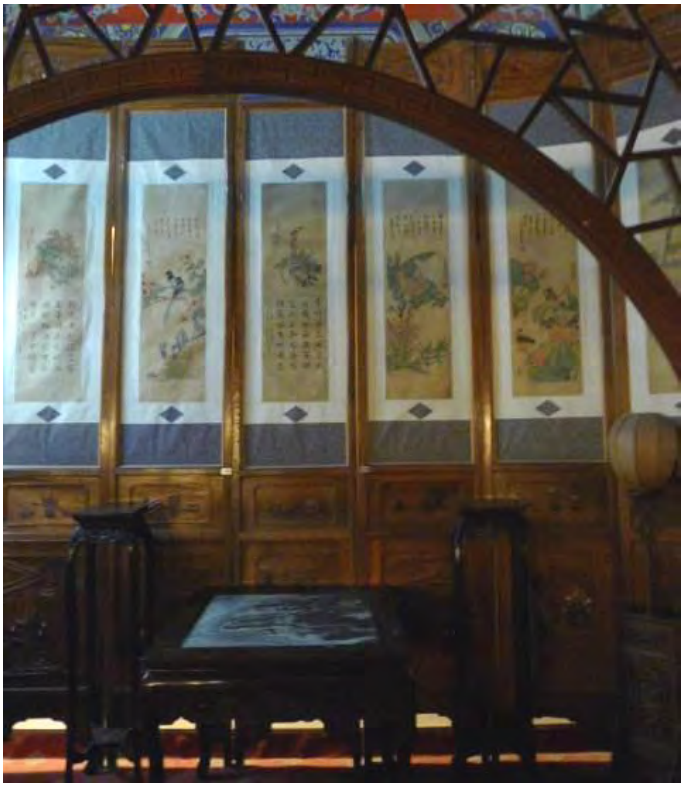


Fig. 29
Qing dynasty folding screen displayed in the top level of the drum tower in Xi'an.
The paintings in the large panels are mounted on a support and surrounded by textile borders.

Fig. 30
Panel screen door in a side wing building of the Great Mosque in Xi'an: The paper was mounted onto a lattice-shaped wooden stretcher and then painted.

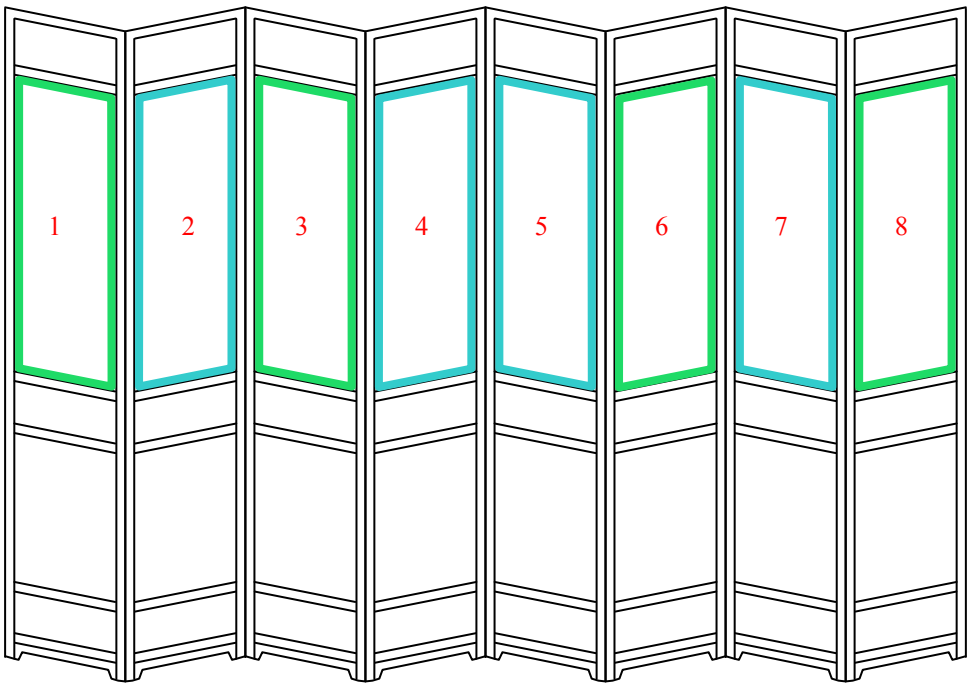
The panels have a rectangular *panel filling* in the centre, surrounded by a thin ornamental strip or trim with curved edges, in the following referred to as *filling frame*, and a wider *panel frame*. The *f*-zone shows a part coloured like the panel frames ending in curved legs. A double-contoured decorative line, corresponding to the filling frames, runs along the lower edge. In reality the panel frames would be made of wood, as the legs prove. The filling frames and the decorative line along the legs may represent a trim or moulding or a painted decoration.
The general colour scheme is demonstrated in fig. 28. All contour lines are black. The framework is painted in a dark brown with even darker sloping edges. The panel frames of the panels *a, c*, *d*, *e* and the *f*-zone are of a pinkish brown that ranges between red and yellow. The filling frames are coloured black on the *pingfeng* x̲i-wall and green on the *pingfeng dong*-wall.
Two folding screens preserved in the drum tower in Xi'an (fig. 29) and panels next to a door in the side wing building of the Great Mosque in Xi'an (fig. 30) show how this kind of screens could have looked like in reality: Folding screens and folding doors were made of a wooden construction. Carved decorations in smaller panels were set at the top (comparable to the *a*-panels in the painted *pingfeng*). Below the top panels, water-colour paintings are set into the highest panels (comparable to the *b*-panels). The damaged doors in the Mosque reveal a supportive lattice stretcher to mount the paper without borders. The paintings on the screens in the drum tower were probably mounted onto a paper support stretched over a wooden support. The paintings themselves are surrounded by textile borders with damask pattern. Smaller panels below (comparable to the *c*-panels) show still lives as carved decorations and are surrounded by trims. The larger panels below them (comparable to the *d*-panels) show carved narrative scenes. There is no equivalent to the *e*-panels, but the carved legs zone is higher and more richly decorated.

Ornamental borders of the b-panels

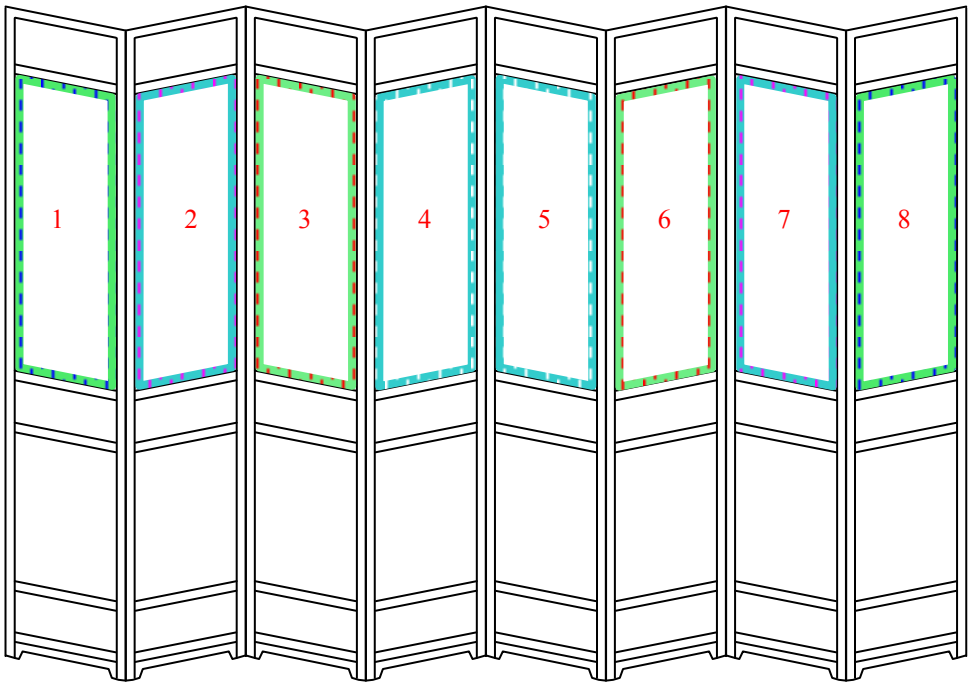
In the *b*-panels, the panel frame is decorated with colourful patterns of stylised blossoms, stars and geometrical elements. The design resembles textile borders used for the mounting of Chinese paintings on paper and may represent a textile border. The lines of the pattern grid are painted in white. Figure 32 shows a schematic depiction of the different designs.

- *pingfeng xi*: There is only one pattern, consisting of six pointed stars, alternating with small flowers. The corners have geometric designs (stylised cloud pattern). At the frames 1, 3, 6 and 8, the stars are blue on a greenish blue ground (fig. 32: a). At the frames 2, 4, 5 and 7, the stars are bright red on a blue background (fig. 32: b).

- *pingfeng dong*: There are four different patterns arranged mirror-inverted along the vertical axis of the folding screen. The corner decorations are stylised blossoms.
  -- Frames 1 and 8 show eight-pointed stars alternating in red and blue on a green ground. In the space between the stars, stylised flowers are inserted (fig. 32: c).
  -- Frames 2 and 7 show a pattern based on six-pointed stars, only half of them is visible (stars cut off on both edges of the framing). The colour sequence is red, light green, red, dark green and so on. Two rows of stars are staggered, resulting in hexagonal areas in between which are painted blue. Stylised blossoms are inserted into the hexagons (fig. 32: d).
  -- Frames 3 and 6 are decorated with eight-pointed stars, alternating in red and blue on a green ground. In the space between the stars, stylised flowers are inserted (fig. 32: e).
  -- Frames 4 and 5 show a pattern on a light blue ground. White lines mark half visible octagons alternating with half visible squares. Stylised flowers are inserted into the octagons, a small cross was spared when painting the squares dark blue (fig. 32: f).



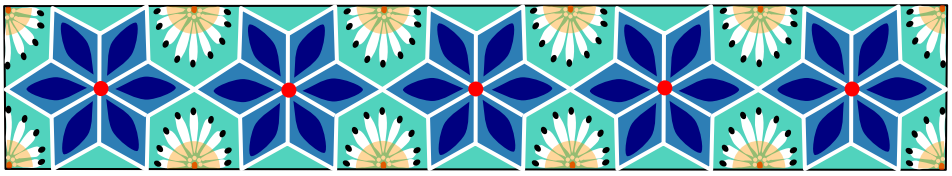
pingfeng xi



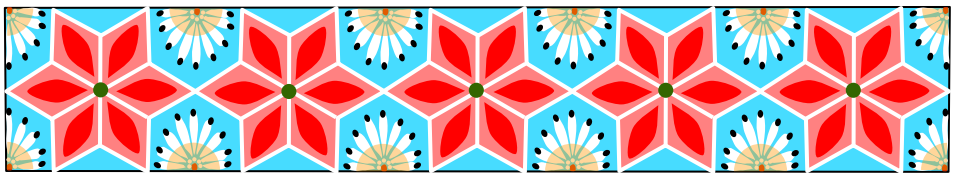
pingfeng dong

Fig. 31
Scheme of distribution of ground colours in the borders of the *b*-panels

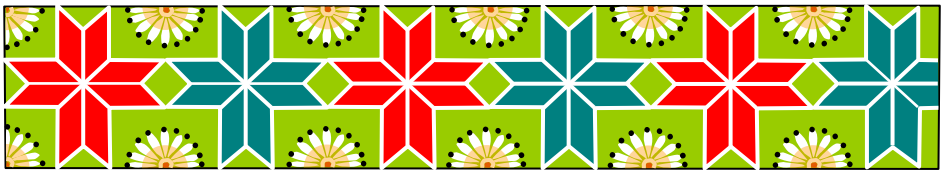
a
pingfeng xi,
frames 1, 3, 6 and 6



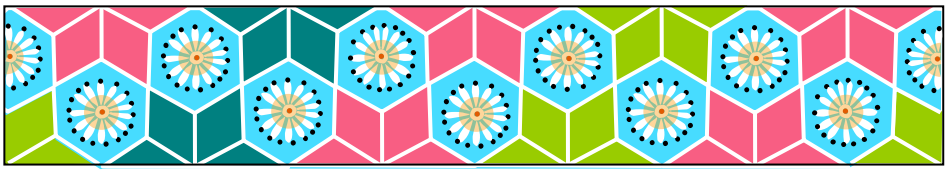
b
pingfeng xi,
frames 2, 4, 5 and 7



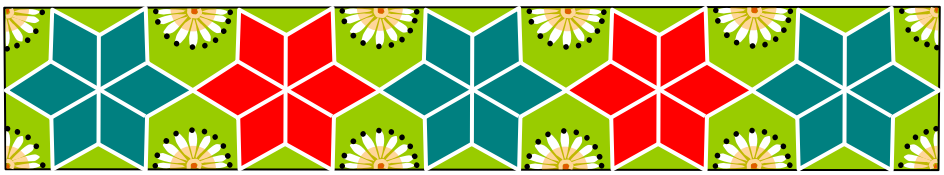
c
pingfeng dong,
frames 1 and 8



d
pingfeng dong,
frames 2 and 7



e
pingfeng dong,
frames 3 and 6



f
pingfeng dong,
frames 4 and 5

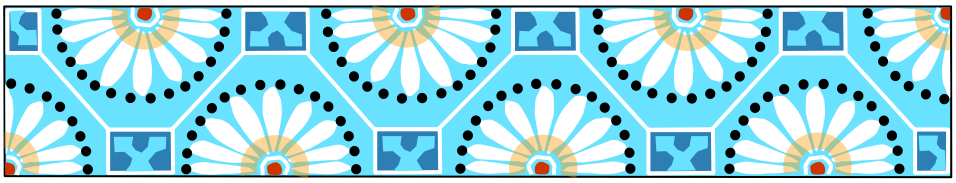


Fig. 32
Schematic depiction of the designs of the panel frames of the *b*-panels of the folding screens of the *guodian*.

Fig. 33
Pingfeng xi, panel 4 *d*: Exemplar of Filial Piety *danyi shun mu* (tale no. 4): The son kneeling in front of his father pleads with him to let the stepmother, who treated him badly, stay to take care of her two sons. The stepmother is listening behind the wall.

Depictions of the panel fillings
The five panel fillings show decorative or narrative paintings or ornaments. The motifs are described in tables 2 and 3. The scenes are restricted to one panel and do not continue on the adjacent ones, although some pavilions in the *b*-panels find a correspondent in the next scene.

b-panels
The scenes of the *b*-panels can be identified by the inscriptions of each field. The inscriptions have been published by Mrs. Zhang Fang from the Shaanxi Institute for Conservation[16] and checked by Zhao Zhou.[17]

d-panels: The 'Twenty-four Exemplars of Filial Piety'
The *ershisi xiao* 二十四孝, in English called *Twenty-four Filial Exemplars*, *Twenty-four Exemplars of Filial Piety* or *24 Stories about Filial Piety*, is a text written by the scholar Guo Jujing 郭居敬 (1260–1368) during the Yuan Dynasty (1279–1368). The 24 tales illustrate the Confucian ideal of filial piety with the examples of (seemingly) historical persons. The tales of the *Twenty-four exemplars* are listed in table 4.[18]
At the *pingfeng xi*, the scenes have inscriptions with the four characters of the name of the example. At the *pingfeng dong* the inscriptions are missing.
13 of the 16 paintings could be identified as tales from the *Twenty-four exemplars*. Three scenes on the *d*-panels of *pingfeng x*i and *pingfeng dong* could not be interpreted yet (*pfx* 1 (mainly destroyed), *pfx* 7 and *pfd* 6. The scene in *pingfeng x*i 7 *d* with the title 庄 (x) (x) 母 (two characters partly destroyed) does not belong to the *Twenty-four exemplars*.

[16] Zhang Fang 2011, p. 61-63.

[17] See 陕西安康紫阳北五省会馆壁画研究报告 by Zhao Zhou.

[18] For text and translation see: http://weber.ucsd.edu/~dkjordan/chin/shiaw/xiao12.html (access 2012, Feb. 12).

Table 2. Depictions of *pingfeng xi*

frame	1	2	3	4	5	6	7	8
a	lattice with white background	lattice with white background	lattice with white background	lattice with white background	lattice with white background	lattice with white background	lattice with white background	lattice with white background
b	*Li Bo in a restaurant in Chang'an* Mainly destroyed: A part of a roofed gallery is preserved.	*Cui Zongshi drinking and staring in the sky* Cui Zongshi sitting on a terrace in a garden, behind him a screen. He is looking at the sky, holding a wine cup; a woman behind this chair, holding a large fan. In the foreground a female servant arrives carrying a teapot.	*Prince Teng's palace* Two men with officials' caps are standing in a pile construction pavilion which is built in a lake. A simple clothed man (a secretary?) sits at a table and writes on a scroll. Two flying cranes in the background.	*Dongting lake* A river in a hilly landscape. A man crosses the river in a boat. In the foreground a man with a ruddy face and a fur jacket and gloves, carrying a sword, looking at the boatman. Another man leads a horse.	*Drunken old man with flowers on his head* A man with officials' cap walking in a landscape, a flower on his cap. Two boys hold on to his clothes. A boy leading the groups carries a pot with a blossoming bonsai tree.	*Good dreams of the mandarin for a new year* A pile construction pavilion at the edge of a lake. A man sitting inside holding a fan in the shape of a lotus flower. Two boys with rolled-up trousers are wading in the shallow water and pick water lilies.	*Drunk poet He Zhizhang riding a horse* A man with officials' cap riding a horse, accompanied by a man with a large fan (behind him); in front of the horse a boy carrying a teapot; in the background landscape with pavilion	*Ouyang hearing sounds in the night* A man sitting in a pavilion, a boy leaves the premises through the lattice door in the front
c	lost	*women (longevity and luck)* two sitting women with flower baskets; a crane standing behind the left one, the right one sitting on a deer	*still life* in the centre tripod censer, on the right side behind it blue bowl with peaches; lying behind it a *ruyi* sceptre; on the left side fruits or flowers	*men* two old men, the right one (red robe) reclining on a pillow and have a bag over the shoulder, the left one (green robe) kneeling, holding a basket	*men with kite* two old men, talking to each other, the right one raising his arms to guide a kite (floating on the right side), behind him a broom	*still life* in the centre tripod censer; behind a long box with a roaring lion on top; on the left side a chime stone hanging from a stand; right side: another object	*women (longevity and luck)* two sitting women with flower baskets; the left one has a white monkey on her knee which holds a peach; the right one is sitting on a tiger	*still life* in the centre trpod censer, left to it chess board (xiangqi or go?), with small vessels to collect stones; on the right a wrapped *qin* zither (?)
d	mainly destroyed	tale no. 15 *qi guan xun mu*: He abandoned a mandarinate to seek his mother The man wearing an officials' cap is greeting the old mother in front of a garden. The old woman is accompanied by another person whose head is lost, probably a young woman.	tale no. 13 *wei mu mai er*: He buried his son for his mother The father is standing, holding a hoe; the mother is bringing the infant boy. A deity stands on a cloud holding a *ruyi* sceptre. A boy next to him pours a stream of bats down to earth from a jug.	tale no. 4 *danyi shun mu*: He obeyed his mother in simple clothes The father is sitting in front of a table with writing utensils and a painting. The son kneels in front of him. The stepbrothers stand further back (lower right corner) and the stepmother listens from behind the edge of the painting	tale no. 8 *xing yong gong mu*: He hired out to support his mother The man kneels on the ground pleading to the two bandits, his mother standing next to him, pleading as well. One bandit is clothed in a rich suit of armour and a helmet, the other wears a tiger hide scarf cap.	tale no. 12 *wo bing qiu li*: He lay on ice in search of carp The son is lying or walking on the (frozen) lake. The dragon king appears in the clouds, next to him an boy holding up a standard.	? not from the 24 Exemplars A man kneeling in front of an old lady who sits on a bench accompanied by a young female servant. Next to the man, another one is standing. It is probably showing an important man kneeling in front of his mother.	tale no. 10 *ru bu bu dai*: She suckles her mother-in-law Lady Tang is standing and breast-feeding her mother-in-law. On the left there is man (?, mainly destroyed) with two little boys.
e	destroyed	ornaments on black-brown background	ornaments on black-brown background	ornaments on black-brown background	ornaments on black-brown background	ornaments on black-brown background	ornaments on black-brown background	ornaments on black-brown background

Table 3. Depictions of *pingfeng dong*

frame	1	2	3	4	5	6	7	8
panel								
a	lattice with greyish blue background	lattice with greyish blue background	lattice with greyish blue background	lattice with greyish blue background	lattice with greyish blue background	lattice with greyish blue background	lattice with greyish blue background	lattice with greyish blue background
b	*Houses built of bamboo from Nangang* A bamboo pavilion standing in the water. Inside a sitting man holds a scroll, and a standing boy holds a book; behind them a table with rare stone top, a painted scroll, cabinet. In the foreground two men crossing a bridge.	*Boy with relation to the immortals offers delicious food* On a landing of a mountain path two men play Chinese chess, the board resting on a tree stump, next to it cups and a dish with fruits. Behind them a standing boy; a kneeling boy offers a bottle.	*Tang Emperor Minghuang and Empress Guifei ordered the drunk Li bo to write three poems* In front of a painted screen in a garden surrounding, two men and a lady are sitting at a table; the men are writing. In the foreground a maid with a tray brings a teapot	*Praise of immaculate jade* In a landscape a group of a young lady, an old woman and a child meet a man carrying objects on a yoke. Mountains in the background.	*Driving on a boat on a foggy river* The men and a monk sitting in a boat play Chinese chess. In the background islands and mountains.	*Court officials inspired by aromatic smoke write poems* A garden (?) next to a house: A man sitting at a table on which a cabinet and a paint brush container are standing. A boy is rubbing ink. Another boy is kneeling on the floor, holding a fan. In the foreground an old man is holding a basket with a fan.	*Walking fearless through the filed, accompanied by a servant boy carrying books and a* qin *zither* A man with an officials' cap walking in a landscape with defoliated trees. A boy in front carries a book, a second boy behind the man holds an elongated object (umbrella?)	*"Two hands push the moon outside the windows;* *One stone breaks the sky amid the water"* A house with a terrace, a man looking inside the house holding up a flower, where a young lady is standing. In the foreground a young man walking away from them towards a fish pond.
c	*still life* in the centre three- or four-legged vessel with gold-fish decor, left to it bundled scrolls; right edge: small bucket	*man and woman* a man (right side) offering a cup to a lady (left side), who seems to refuse	*still life* in the centre tripod censer, on the left two paint brushes lying on a stand and a book, on the right four-lobed disk pendant on a string	*men* on the left side an old man with white hair, sitting on a horse and holding a musical instrument?,; on the right a man playing a traverse flute	*men and demon* two men sitting, a demon spirit offers a cup to the one on the right; the one on the left holds a fan	*still life* in the centre tripod vessel; on the left rock-shaped pendant with a seal; on the right a *xiangqi* chess board with vessels for stones	*men* on the left man with dark skin and curly beard (foreigner?) reclining on a water container made of hide?, on the right a boy with a basket	*still life* four-legged vessel, on the left chime stone pendant, on the right *qin* zither and fruit (peach or persimmon) or fruit-shaped vessel
d	tale no. 3 *nie zhi tong xin*: She bit her finger and pained his heart. The boy returns with a bundle of firewood, the mother waits for him in front of the door of the house	tale no. 14 *e hu jiu fu*: He strangled a tiger to save his father A man fighting a tiger in a hilly landscape	tale no. 2 *qin chang tang yao*: The emperor tastes medicine for his mother ? The emperor stands, presenting a cup, to an old lady accompanied by a younger lady	tale no. 7 *lu ru feng qin*: He fed his parents doe's milk The man covered in a deer skin kneels before a man with a pheasant cap and another man with a standard	tale no. 9 *xing yong gong mu*: He concealed oranges to present to his mother The little boy who took the oranges is kneeling in front of the general with a pheasant cap	Tale no. 5 *(fu mi yang qin*) or tale no. 6 (*mai shen zang fu*) ? A boy carrying a sack arrives at a house. A young woman offers him something small and red in her hand, an old woman looking	tale no. 19 *shan zhen wen qin*: He fanned the pillow and warmed the quilt A boy kneeling in front of the bed, a stick in his hand.	tale no. 1 *xiao gan dong tian*: The feeling of filial piety moved heaven (Emperor Shun ploughs with elephants and birds) A man with simple clothes and straw hat work the ground, behind him an elephant
	yunleiwen decoration on brown ground	*yunleiwen* decoration on brown ground	*yunleiwen* decoration on brown ground	*yunleiwen* decoration on brown ground	*yunleiwen* decoration on brown ground	*yunleiwen* decoration on brown ground	*yunleiwen* decoration on brown ground	*yunleiwen* decoration on brown ground

Table 4.
Contents of the tales of the *The Twenty-four Filial Exemplars* (二十四孝 *ershisi xiao*) by Guo Jujing and position of depiction in the three folding screens painted in the *beiwusheng huiguan*

No.	*name*	*meaning*	*content of story*	*painted in*
1	*xiao gan dong tian* 孝感动天	The feeling of filial piety moved heaven	Emperor Shun 舜 ploughed with elephants and birds, thus remaining/and remained a humble man.	*pfd* 8 *d*
2	*qin chang tang yao* 亲尝汤药	Her son tasted soups and medicine	Emperor Liu Heng 刘恒 tasted the medicine for his sick mother.	*pfd* 3 *d*
3	*nie zhi tong xin* 啮指心痛	She bit her finger and pained his heart	Zeng Shen 曾参 went to the mountains to collect firewood. His mother bit her finger and he felt the pain and returned home.	*pfd* 1 *d*
4	*danyi shun mu* 单衣顺母	He obeyed his mother in simple clothes	The mother of Min Sun 闵损 died early, the step mother had two sons and dressed Min sun in simple clothes. When the father found out, he wanted to divorce the wife, but Min Sun restrained him from this because of his step brothers. The wife changed her heart.	*pfx* 4 *d*
5	*fu mi yang qin* 负米养亲	He shouldered rice to nourish his parents	Zhong You 仲由, called Zilu, carried rice for his poor parents and after their death got rich, but still would have preferred to carry rice for them.	*pfd* 6 *d* ?
6	*mai shen zang fu* 卖身藏父	He sold himself to bury his father	Dong Yong 董永 gave himself as security to borrow money. On the way to his master, he met a woman who wanted to marry him. She wove the required silk for him and then vanished.	*pfd* 6 *d*?
7	*lu ru feng qin* 簏乳奉亲:	He fed his parents does' milk	The parents of Tan Zi 郯子 suffered of a malady of the eyes for which they wanted a doe's milk as medicine. Tan Zi disguised himself in a deer skin to get the milk and was almost shot by hunters.	*pfd* 4 *d*
8	*xing yong gong mu* 行佣供母	He hired out to support his mother	Jiang Ge 江革 fled after his father's death, carrying his mother. Bandits wanted to force him to join them, but he begged them to let him go because he had to carry his mother. Finally he sold himself as a labourer to support his mother.	*pfx* 5 *d*
9	*huai ju wei qin* 怀橘遗亲	He concealed oranges to present them to his mother	Lu Ji 陆绩, also called Gongji: As a sixyears old boy he met general Yuan Shu who presented him some oranges because he was the guest. The boy concealed two of them, but dropped them at the door. Asked why he stole the oranges, he said he wanted to give joy to his mother.	*pfd* 5 *d*
10	*ru gu bu dai* 乳姑不怠	She suckled her mother-in-law	Cui Nanshan 崔南山 had a great grandmother called madam Zhangsun 长孙夫人. Cui Shannan's grandmother Tang 唐 fed her mother-in-law with her own milk until the old lady died.	*pfx* 8 *d* *pfb* 1 *d*
11	*zi wen bao xue* 恣蚊飽血	He let the mosquitoes consume his blood	Wu Meng 吴猛 was eight years old, and the poor family had no mosquito nets. So he offered himself to the mosquitoes so that his parents could sleep.	
12	*wo bing qiu li* 卧冰求鲤	He lay on ice in search of a carp	Wang Xiang 王祥 had a bad stepmother who made him loose the love of his father. The stepmother loved fish, but in the winter the water was frozen, so Wang Xiang lay on the ice to melt it. A crack opened and a carp sprang out. (On *pingfeng xi* 6d the dragon god appears and provides the fish).	*pfx* 6 *d*

No.	*Name*	*Meaning*	*Content of story*	*painted in*
13	*wei mu mai er* 为母埋儿	He buried his son for his mother	Guo Ju 郭巨 was poor and had a threeyearsold son and an old mother. He wanted to bury the child to give the food to his mother. When he dug the pit, he found a golden cauldron.	*pfx* 3 *d*
14	*e hu jiu fu* 搤虎救父	He strangled a tiger to save his father	Yang Xiang 杨香 , fourteen years old, was working on the field with his father when a tiger attacked the father. Yang Xiang attacked the tiger without a weapon, and the tiger fled.	*pfd* 2 *d*
15	*qi guan xun mu* 弃官寻母	He abandoned a mandarinate to seek his mother	Zhu Shouchang 朱寿昌 was seven years old, when his mother, a concubine, was married to another man. When he was an official, he left his position to find his mother. When he succeeded, she was already 70 years old.	*pfx* 2 *d*
16	*chang fen you xin* 尝粪忧心	He tasted dung with an anxious heart	Yu Qianlu 庾黔娄 was a magistrate. Alarmed by a sign, he returned home to find his father sick. The doctor told him someone had to try the patient's defecation, and he did so. In the night he prayed to the North Star of longevity to let him die instead of his father.	
17	*xi cai yu qin* 戏彩娱亲	He amused his parents with plays and bright clothes	Lao Laizi 老莱子 was over seventy years old, when he dressed in colourful clothes and made childish actions to amuse his parents.	*pfb* 6 *d*
18	*shi shen gong mu* 拾桑供母	He picked mulberries to serve his mother	Cai Shun 蔡顺 collected mulberries at the Wang Mang period. Red-eyebrow rebels asked him and he said, he collected the black ripe ones for his mother and the red, unripe ones for himself. The rebels were impressed and gave him rice and an ox leg.	
19	*shan zhen wen qin* 扇枕温衾	He fanned the pillow and warmed the quilt	Huang Xiang 黄香 fanned the bed for his father in summer and warmed the blankets in winter for his father when he was a boy.	*pfd* 7 *d*
20	*yong quan yue li* 涌泉跃鲤	The fountain bubbled and the carps leapt out	The wife of Jiang Shi 姜诗 got water from a faraway well for his mother and prepared fish for her. Suddenly a fountain sprang up at the house with the taste of the well and also produced two carps every day.	
21	*wen lei qi mu* 闻雷泣墓	He heard thunder and wept at the grave	The mother of Wang Pou 王裒 was afraid of thunder. After she was dead, he always went to her grave when a thunderstorm came to tell her not be afraid.	
22	*ke mu shi qin* 刻木事亲	He carved wood to serve his parents	Ding Lan's 丁兰 parents died when he was young. He made wooden images of them and served them as if they were the parents. His wife in mockery pricked the statues with a needle; blood came out, and the statues cried tears?/shed tears when they saw Ding Lan. He divorced the wife.	
23	*ku shu sheng sun* 哭竹生笋	He wept till the bamboo sprouted	Meng Zong 孟宗, also called Gongwu, lost his father as a child. His mother was ill and wanted to eat bamboo shoots in winter. He could not get them and wept over the bamboo groove, and bamboo shoots appeared.	
24	*di qin niao qi* 滌亲溺器	He washed his mother's bedpan	Huang Tianjian 黄庭坚, also called Shangu, was a government compiler, but served his mother. Each day he cleaned her bedpan.	

Fig. 34
zhengdian, *sanguo dong*, before treatment. On the left side, part of the adjacent *yunqi dong*
[Shaanxi Institute for Conservation 2011]

Fig. 35
zhengdian, *sanguo xi*, before treatment
[Shaanxi Institute for Conservation 2011]

The wall paintings of the gable walls of the zhengdian – sanguo xi *and* sanguo dong

The gable walls of the *zhengdian* (figs. 34 and 35) show the largest paintings of the halls, being 4.82-4.87 m wide and 3.80-3.85 m high, above the brick pedestal zone which measures 1.15 m. Between *yunqi*- und *sanguo*-painting, a column is hidden behind the wall: It becomes visible above the level of the upper edge of the *yunqi*-paintings. The rectangular framing of the *sanguo*-paintings has an offset here, receding towards the depiction of the *sanguo*-painting. Both walls show scenes from the *Romance of the Three Kingdoms*. Most of the figures and small scenes of the wall are not interpreted yet. In battle formations, the same type of uniforms or suits of armour appear in all groups and all flags and banners bear the inscription 帥 (*shuai*) in a roundel. The figures and some other parts appropriate for the orientation have been numbered. The numbers are given in figure 36.

Both paintings show narrative stories in which the protagonists are present several times. The general designs with the arrangement of the main elements are corresponding to each other (antithetically arranged): On both sides, the lower southern quarter of the wall shows architecture with two buildings, the southern one being a reception hall or throne hall. The other three quarters of the wall show lively groups of men meeting in a landscape. At closer examination, the background which now is almost uniformly dark brown, reveals elements of landscape and nature such as a river, trees and shrubs and stones. The clothes of the men are painted in bright colours. In groups, similar figures next to each other often wear contrasting robes, for example a red, pink or purple tunic is painted next to a green one.

The Romance of the Three Kingdoms[19]

The period called 'The Three Kingdoms', *sanguo* 三国 (220 to 280 AD), is the time following the Han Dynasty. China disintegrated into three states:

- (Cao) Wei 魏, in the north, ruled by the former general Cao Cao,
- Shu (Han) 蜀, in the southwest, ruled by Liu Bei,
- Eastern Wu 吳, in the southeast, governed by Sun Quan.

In 280 AD the next Chinese Dynasty, called Jin, arose from the state of Wei.

The events of this era were described in a historical record, the *Record of the Three Kingdoms*, *sanguo zhi* 三国志, by Chen Shou 陈寿 (233–297 AD). Stories connected to this period inspired generations with novels, opera and folk stories. The most famous novel is *sanguo yanyi* 三国演义, the *Romance of the Three Kingdoms*, attributed to Luo Guanzhong, who lived approximately between 1315 and 1400 (late Yuan to early Ming Dynasty). His work is regarded as one of the four great classical novels of Chinese literature. An important aspect of the novel is the moral standard of loyalty which is connected to the Confucian values of loyalty towards family and friends. Important persons in the novel who are also depicted on the *sanguo*-walls are:

The general Guan Yu 关羽 (died 219 AD), loyal supporter of the ruler Liu Bei, was deified as early as the Sui Dynasty (581–618), and was also integrated into Buddhism and Daiosm. He is worshipped as a virtuous hero, representing loyalty, justice and bravery. Paintings and sculptures depict him as a warrior with a red face and long beard, wearing a green robe over his suit of armour and holding a mighty sword, the *qing long yan yue dao* (Green Dragon Crescent Blade which was said to weigh 48 kg), and sometimes riding a red horse, *chitu ma* (red hare horse). He fought with Liu Bei against Cao Cao and was finally put to death by a general of Sun Quan.

Liu Bei 刘备 (161-223 AD), founder and emperor of the state Shu Han in Sichuan (221-261) and a personification of the benevolent ruler, was worshipped as deity.

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[19] The following information has been compiled from various articles related to the Three Kingdoms, mainly from: *en.wikipedia.org* (checked between Dec. 2011 and June 2014).

Zhuge Liang 诸葛亮, Liu Bei's cunning counsellor and genius strategist, was revered as a wise man who stayed close to the common people and untouched by corruption even after becoming chancellor. He is venerated as a god for his moral qualities.
Zhao Yun 趙雲 (c. 168-229) was Liu Bei's officer and rescued Liu Bei's baby son and his wife in the battle of Changban in 208 AD.
Zhang Fei 張飛 (assassinated in 221) was a general and sworn brother of Guan Yu and Liu Bei. He fought in many battles for Liu Bei. In the *Romance of the Three Kingdoms* he appears as loyal, but also short-tempered and an alcoholic. His weapon was a very long steel spear with a head shaped like a serpent. He is often shown with a dark face and a wild beard.
Zhou Yu 周瑜 was a famous general of the kingdom of Wu. In the Battle of the Red Cliff (*chi bi zhi zhan* 赤壁之战 in 208 he fought for Sun Quan and defeated Cao Cao.

Scenes depicted on the sanguo dong-*wall*

The painting shows the story of the marriage of Liu Bei to Sun Shangxiang (in the novel called Sun Ren 孙仁) which took place in 209 AD. Sun Quan, ruler of Wu, had offered Liu Bei his daughter as bride, but the offer was a trap to allure Liu Bei to come unarmed to Wu and take him hostage in exchange for Jing province (which belonged to Liu Bei). Because the marriage took place in the *ganlusi* 甘露寺 ('Temple of Refreshing Dew' or 'Morning Dew Temple') near Zhenjiang in Jiangsu which at that time was a small palace, the story is also known as 'The Temple of Refreshing Dew'. The plot failed, and Liu Bei returned home with his new wife. When stopped by guards of the State of Wu, Sun Ren forced them to let them go. There are 73 human figures depicted in the painting.
The buildings have red columns and green lintels. The entrance building or gate, in the centre of the painting near the lower edge, bears the inscription *ganlusi* 甘露寺. The southern building (pavilion no. 1) has a tablet with the inscription *dafodian* 大佛殿 (Big Buddha hall) above the entrance. In front and inside there are seventeen persons. The furnishing of the room consists of a table at the southern end, with a cabinet and a flower vase and a four-panel folding screen showing landscapes with inscriptions, among the one with the dating of the painting (fig. 16). A lamp is hanging over the hallway leading to another room. In front of the folding screen, an old lady, mother of Sun Quan (figure no. 16) is sitting on a throne, flanked by two young ladies (figures no. 15 and 17). The floor is covered with a patterned carpet. Liu Bei, dressed in a red robe (figure no. 12), is kneeling in front of the old lady. Six men are standing on the sides (two men on the southern, two groups of two men on the northern side, figures no. 6 to 11), discussing with each other. In the centre of the carpet, unnoticed by the others, a man (figure no. 13) is held and threatened by another one, probably Zhao Jun (figure no. 14) who is brandishing a sword. In front of the pavilion, four guards in magnificent armours and golden helmets are positioned (figures no. 2 to 5). A man is approaching the steps, carrying a cup, maybe a servant (figure no. 1).
The annex building (pavilion no. 2) shows a railing like a porch and is furnished with two tables with precious stone tops. A man wearing an armour under his robe is drawing a sword from behind the textile drapery around the table in the back. Two groups of two soldiers in uniforms are sneaking up through a corridor, the ones in the front holding knifes, the ones in the back sabres. These men are probably told to assail Liu Bei. In a small garden, in which a palm tree and two cranes can be recognised, another man in a uniform, with the character 军 ("military") on his tunic, is steadying a horse while looking at the scene in the main hall. All of them are alert and in high spirits. In front of the building, next to a gate a servant in a simple dress and without weapons is dozing unsuspectingly while guarding three horses. He probably belongs to Liu Bei.

Above the reception hall, two riders appear in a cloud. One is skinny and riding a grey horse, he is holding out a document (figure no. 58). The other is more portly with a beard, riding a yellow pink horse (figure no. 59).
In the lower left quarter of the wall painting, the flight of the couple is depicted: Sun Ren (figure no. 29) is sitting in a chariot, a soldier (figure no. 28) is holding the reins of the black carriage horse. Liu Bei (figure no. 26) is riding in front of the carriage, turning back on his horse and drawing his sword. Zhao Yun (figure no. 30) is guarding the chariot form the rear. Four men of the guard of Wu pursue the chariot, riding through a hilly landscape (figures no. 31-34). Above the scene a single deer is standing in the landscape.
On the northern edge of the painting, near Liu Bei, an old boatman (figure no. 25) is waiting in his boat (figure no. 25). Above the boatman, men are grouping behind Guan Yu (figure no. 35) who is sitting on his red horse. Next to him there is a black-skinned man on a black horse, probably Zhang Fei (figure no. 36). Two flag bearers are holding up flags. Opposite of them, there is a group of men which appear to prepare resistance to them, but seem to be discordant and still in discussion about what to do: Two kneeling men (figures no. 45 and 46), holding up shields, are looking back to discourse with others who are also discussing. A man in a red tunic (figure no. 53) seems to be injured as he is supported by another, while a second seems to feel his pulse or to loosen his collar (figure no. 52), and a third (figure no. 51) comes running up. The scene may depict Zhou Yu who fell from his horse. The other soldiers and horsemen around the group are looking unimpressed or even cheerful.
In the upper part that was covered with whitewash there is a landscape with mountains and trees. On the southern end, above the cloud with two riders, there is a group of four riders and three flag bearers. Among the riders, wearing a green robe and riding a red horse (figure no. 69), is Guan Yu. Another rider is depicted close to the upper edge. In the centre of the painting a man is standing at a table holding a tray (fig. no. 74), a beam with a pearl comes down to him, while a man holding a golden vessel kneels in front of the table (fig, no. 65).

Scenes depicted on the sanguo xi-*wall*

The architecture is designed as counterpart of the *sanguo dong* wall. The tablet above the reception hall (pavilion no. 1) reads 大和殿 (*dahedian,* 'Hall of Grand Harmony'). Here, too, seventeen persons are gathered inside and in front of the building: In the middle of the room, a man in a yellow imperial robe is sitting, probably Liu Bei as emperor (figure no. 13). He is holding a document (?). Two ladies are flanking him (figures no. 12 and 14). Some men approach him submissively (figures no. 4, maybe 11 and 1), while others are watching (figures no. 5, 6, 16 and 17), and four men in armour are keeping guard (figures no. 2, 3, 7 and 8). Figure no. 4 may depict Zhao Yun returning the infant prince (son of Liu Bei), though no baby is visible. Figure no. 11, dressed in a black robe, may represent the minister Zhuge Liang. The room is designed and furnished like that at the *sanguo dong* wall: there are a table on which a small cabinet with drawers is placed, paintings with inscriptions (or a folding screen) in the background and a lamp hanging from the ceiling. The walls are peach coloured. The framing in black and with a black contour line corresponds to the ones of the wall paintings themselves. In the background, a door leads to another room.
In the building on the right (pavilion no. 2), a man in a red robe is sitting on a table and writing or drawing (figure no. 19). This may be the self-portrait of a painter, perhaps the one whose signature can be found in different places of the walls and who may have been the head of a team of painters. In the background of the room, there is a five-panelled decoration with landscapes and inscriptions and an open hallway. The cloth on the table is bright ochre. Two or three more men are standing in or in front of the building which seems to have a porch surrounded with a railing. In front of the building, there is a smaller entrance gate over which the inscription *wufeng lou* 五凤楼 ("Five phoenixes' building") can be read, which indicates that it leads to the imperial palace.

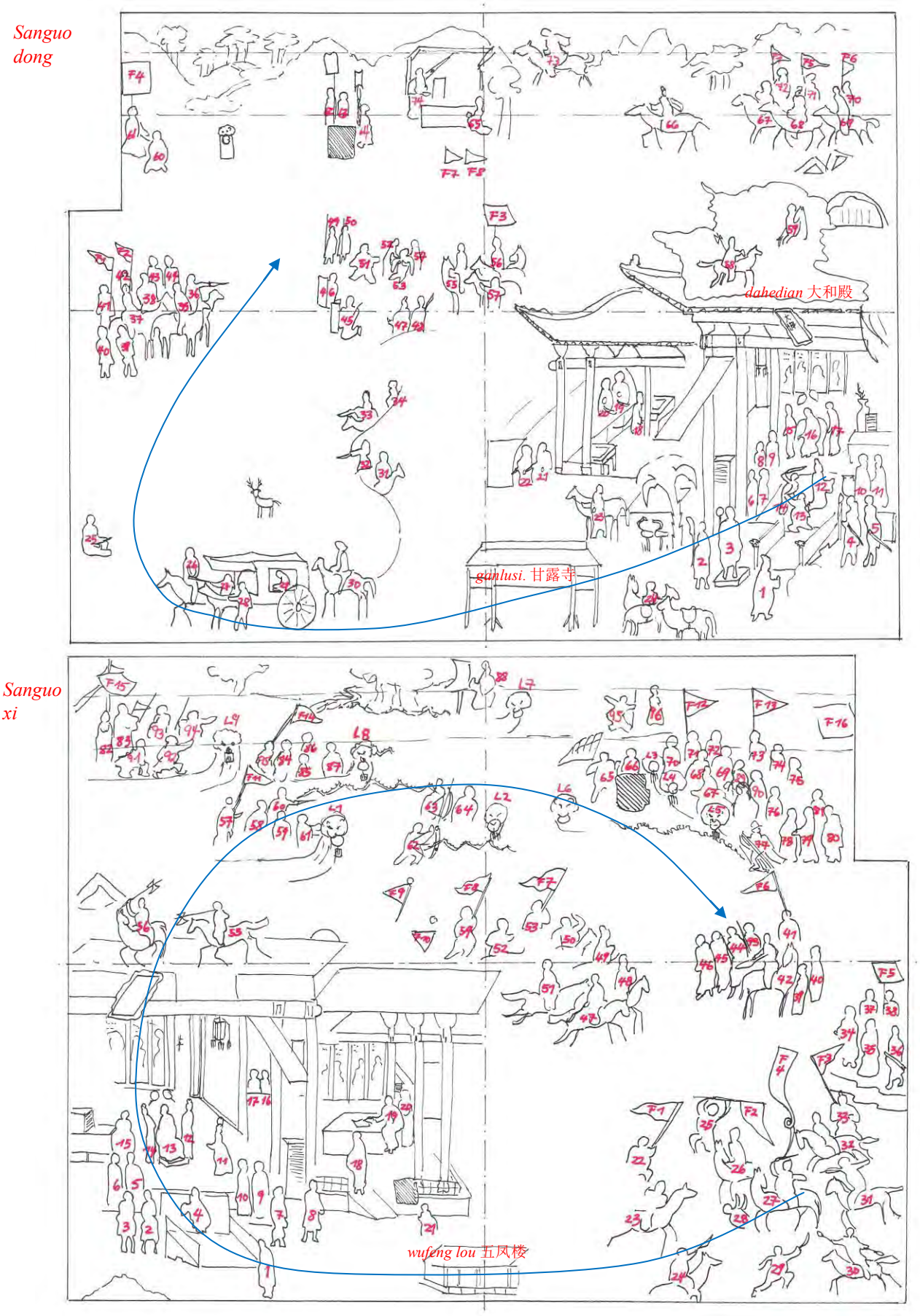

Fig. 36
Zhengdian, numbering of the human figures and flags in *sanguo dong* (top) and *sanguo xi* (below); hatched: holes in the wall. The blue arrows indicate the course of the scenes according to the novel.

Above the roof of pavilion no. 1, there are two riders (figures no. 35 and 36) in a cloud whirl comparable to the one at the *sanguo dong*-painting, but difficult to recognise due to the absence of opaque white paint in the cloud.
In the lower right part (figures no. 22 to 33), a fierce battle is going on between seven horsemen and two men on foot, one of them (figure no. 28) falling down under the advancing horse of Zhao Yun (figure no. 27) with the infant Liu Shan tucked into his robe (the head of the child is damaged). The nowadays whitish flag-like object above his head (F4) represents the "red light" described in the novel after he had fallen into a pit.
Above them, there are three groups of men standing or attacking (figures no. 34 to 54). A group standing above a ravine (figures no. 34 to 38), four men and a flag bearer, seems to watch the battle in the lower right corner. Figure no. 35 can be identified as Cao Cao (in a red robe). Guan Yu (figure no. 42), riding his red horse, wearing a green robe and brandishing his sabre, is surrounded by a group of footmen. The man leading a group of advancing cavalrymen, wearing a red robe and riding a grey horse, the hands put together thanking Guan Yu, is Cao Cao (figure no. 48). This scene is interpreted as the depiction of Guan Yu releasing Cao Cao after the lost Battle of the Red Cliff.
The upper part above the offset that was partially covered with white paint shows the scene of the Battle of the Red Cliff. There are nine boats with a decoration shaped like a lion's head at the prow (L1 to L9). Figure no. 83 shows General Zhou Yu of the State of Western Wu, figure no. 78 shows Cao Cao in a red robe. There is a landscape in the background with some trees and a waterfall (above flag F14).
According to 紫阳北五省会馆壁画保护研究, p. 8, two more scenes from the Romance of the Three Kingdoms are depicted: the *Oath in the Peach Garden*, an oath of fraternity sworn by Liu Bei, Guan Yu and Zhang Fei to protect the Han Dynasty from the Yellow Turbans, and *Riding Alone for Thousands of Miles*, the story of Guan Yu's dangerous journey to re-unite with Liu Bei. During the work in 2011, these episodes were not yet identified.

Fig. 37
zhengdian, *yunqi dong*, before treatment: At the lower edge in marks of the lost platform.

Fig. 38
zhengdian, *yunqi xi*, before treatment
[Shaanxi Institute for Conservation 2011]

Fig. 39
zhengdian, *tian guan cifu*, before treatment
[Shaanxi Institute for Conservation 2011]

Fig. 40
zhengdian, *long*, before treatment
[Shaanxi Institute for Conservation 2011]

The wall paintings in the rear part of the zhengdian

These paintings are less detailed and less fine than those at the *sanguo*-walls and different in style. The *yunqi*-paintings, executed with few brilliant colours on a white background and showing large, plump shapes, stand in such a strong contrast to the adjacent *sanguo*-walls that it seems astonishing that they should date from the same time.

The situation becomes comprehensible with the marks lost elements have left: There was a platform covering the northernmost bay at the height of the brick pedestal zone (1.15 m). On top of the platform, pedestal-shaped elements were set in front of the paintings of the north wall, one pedestal in the centre of each painting. The wall behind the lost pedestals was never painted, what proves that the pedestals were there before the paintings were executed. Wooden vertical elements (nowadays lost) intersected the north wall between the paintings. In this way, originally the paintings were just a background decoration of a niche-like situation probably with figures arranged on the platform.

Yunqi-*walls*

The *yunqi*-paintings were at the sides of the platform. They are approximately 2.40 m high and 1.40 m wide (figs. 37 and 38) and show a pearl in the clouds. The pearl is painted in four shades of orange and red in rings, the clouds with blue lines and outlined in black.

Tianguan cifu

The painting of the *tianguan cifu* (The heavenly official bestows happiness, fig. 39), in the Western bay of the north wall, is 3.47 m high and 2.92 m wide. The picture shows the sea or a lake with a narrow strip of land in the lowest part of the foreground: On both sides of the lost pedestal, a river or waterfall flows down from the sea between two hills into the landscape.

There are no persons depicted in the centre of the wall (as they would have been covered by figures arranged in the centre of the niche). At the upper right (eastern) part of the wall, the heavenly official is standing on a cloud, holding a *ruyi* under his left arm. He is accompanied by two boys, the one to his left side holding up a staff, the one to his right side releasing five red bats (*wu hong fu* 五红蝠) from an upturned vase. The bats are flying in a kind of 'beam' starting at the vessel and extending towards the lower left side where the other group of figures is standing. A similar depiction can be found in the scene of *wei mu mai er* 为母埋儿 ('He buried his son for his mother') in the *pingfeng xi*-painting where a heavenly official is standing on a cloud accompanied by one small boy releasing five bats which fly in a stream towards the couple with the baby standing on the earth. The 'beam' is a parallel to the *long*-painting, where the beam-shaped dragon's breath with a pearl connects the two dragons (*see below*).

The second group of figures, consisting of two persons, is standing on a dark-coloured patch, probably a lotus leaf. A young man in a yellow robe raises the hands like in prayer of thanks to the heavenly official and the five bats coming down on him. He is accompanied by a demon-like figure, holding up a fan or a flag. The 'demon' wears a cap or a mask covering the crown of the head and the forehead, a skirt, boots, but no shirt. On his back, he carries a large snail or conch shell. A similar demon-like figure (without the shell) is depicted in the *sanguo dong*-painting in the panel 5 *c*, offering a cup to a sitting official.

Long

The *long* ("dragon") painting in the eastern bay (fig. 40), is 3.32 m high and 2.90 m wide. It shows a dragon flying in the clouds and blowing a pearl down to a smaller dragon which is swimming in the ocean. The dragon's breath extends from the upper right part to the lower left part of the painting. In the foreground there are a tree (eastern side) and some mountains

Table 5.
Overview of the scenes on *pingfeng bei*

frame / panel	1	2	3	4	5	6
a	lattice with white background, yellow framing	lattice with white background, yellow framing	lattice with white background, yellow framing	lattice with white background, yellow framing	lattice with white background, yellow framing	lattice with white background, yellow framing
b	*flowers* peonies and a small tree with white flowers	*gods and men* the god of wealth standing on a cloud, with two boys a landscape with two men and a boy catching and collecting gold ingots which came down from heaven	*landscape* landscape with pavilion (or stupa ?) and a red mountain peak in the background	*landscape* landscape with river and pine trees streaked by clouds, building complex concealed by the trees	*gods and men* the god of longevity standing on a cloud, with two boys three old men to the fore, two other men standing on raised ground and praying	*flowers* lotus in blossom
c	*still life* in the centre tripod censer, left of it bundled scrolls and small vessel with spoon; some flowers	*still life* twig with pink blossoms (azalea?)	*still life* in the centre a flower pot with a green plant; to the left a *ruyi* (?), to the right a white flower	*still life* in the centre a teapot, to the right two books, to the left a red fruit (pumpkin, khaki or peach ?)	*still life* twig with white blossoms (peony?)	*still life* in the centre a tripod censer, to the left a chime stone pendant; to the right a lost object
d	*24 exemplars of filial piety, no. 10: ru gu bu dai* She suckles her mother-in-law	only black background (mainly covered by lost pedestal)	only black background (mainly covered by lost pedestal)	only black background (mainly covered by lost pedestal)	only black background (mainly covered by lost pedestal)	*24 exemplars of filial piety, probably no. 17: xi cai yu qin* He amused his parents with plays and bright clothes
e	floral yellow ornament on black ground	not painted	not painted	not painted	not painted	floral yellow ornament on black ground

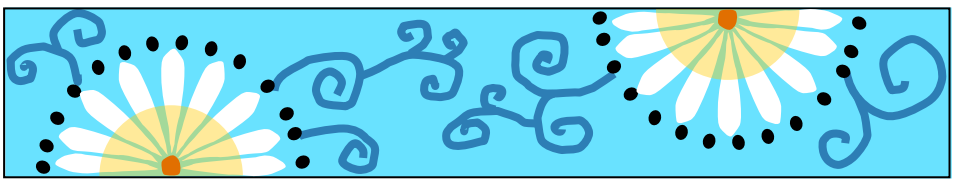

Fig. 41
Schematic depiction of the designs of the framing zones of the *b*-panels of the *pingfeng bei*.

(western side). The scene may be a variation of the popular motif *er long qi zhu* ("Two dragons playing with a pearl"). The arrangement of the scene is parallel to the one of the *tianguan cifu*.

Pingfeng bei

The *pingfeng bei* (northern folding screen), is 2.96m high and 3.95 cm wide (fig. 42). The screen is the only six-fold screen, maybe because it is about 65 cm narrower than the *pingfeng*-paintings of the *guodian*. Different from *pingfeng xi* and *pingfeng dong*, the bevelled edges of the frame had been painted only on two edges (the upper edge and alternately left or right edge), to increase the impression of foreshortened perspective. The *pingfeng bei* is also painted as if standing on the lower side of the black framing.
The *pingfeng bei* is designed in the same way as the *pingfeng xi* and *pingfeng dong*, but there are differences in the style and execution of the ornaments and patterns, the choice of the colours and the style of the figures. Table 5 gives and overview of the depictions. The single parts are labelled using the same system as for the folding screens of the *guodian*.

The panel fillings of the *a*-panels show angular decorative ornaments (*yunleiwen*), maybe meant as a lattice.
The panel fillings of the *c*-panels show still lives and flowers.
The panel fillings of the *e*-panels show floral designs painted in yellow on a black background. The ornament is irregular and painted without model.
The *f*- zone shows elements made of a lattice with geometrical a design below the lowest brace. They are painted bright yellow.
The *a*-, *c*-and *e*-panels have a bright yellow panel frame and a dark filling frame.

Fig. 42
zhengdian, *pingfeng bei*, before treatment [Shaanxi Institute for Conservation 2011]

The panel fillings of the large *b*-panels show three types of paintings which are arranged antithetically: large flowers (frames 1 and 6), depictions of gods and humans (frames 2 and 5), landscape scenes (frames 3 and 4). The depictions can be identified as:

- Panel 1 *b* (flowers): Two peonies rise behind a bizarrely shaped rock. Behind them there is a small blossoming, but leafless tree (fruit tree or magnolia?). In the foreground there are three small mushrooms.
- Panel 2 *b* (gods): The god of wealth or prosperity is standind on a cloud, accompanied by a small boy holding a banner, while another one kneeling in front of him empties a bowl. On the earth below, in a landscape with rocks and trees, three persons are picking up and collecting the gold ingots that fell down from heaven. They are depicted as an old man, a young man and a small boy.
- Panel 3 *b* (landscape): Rocky landscape with a splendid pavilion on a mountain in the background (western edge) and a small wooden shed in the foreground (lower eastern edge). There are no persons or animals.
- Panel 4 *b* (landscape): Flat landscape with large conifers surrounded by floating mist or clouds and a river. Behind the trees at the lower eastern edge, a building complex is visible. There are no persons or animals.
- Panel 5 *b* (gods): The god of longevity (*shoushen* 寿神) is standing on a cloud (upper right/eastern part), accompanied by two small boys, one with a kind of standard, the other one holding something (a yellow bird?). Below the group, there is a walkway with a white parapet trailing through rocks and trees. Three old men are standing in the foreground in front of the marble parapet, two more are praying to the god while standing on a rock (middle of western edge). This scene is designed as counterpart to panel 2 *b*, but the arrangement of the figures is not antithetic.
- Panel 6 *b* (flowers): Lotus flowers rise from shallow water. A small bird is sitting in the highest of them, and a crane is walking through the water in the foreground, in front of the flowers.

The border decorations are the same on all panels (fig. 41): On a blue background stylised flowers surrounded by climbers are painted. Compared to the *pingfeng*-paintings of the *guodian*, the patterns are less exact and geometric, preferring rounded and slightly irregular shapes. There are no corner decorations.

As the lost pedestal once covered the frames 2 to 5, only the panels 1 *d* and 6 *d* are painted. The panel frames are red. The panel fillings show narrative scenes from the Twenty-four Exemplars of Filial Piety: Panel 1 *d* shows exemplar no. 10 (She suckles her mother-in-law) which is also painted at the *pingfeng xi*, panel 8 *d*. Compared to the *pingfeng xi*, the artistic quality is very low. Panel 6 *d* probably shows exemplar no. 17 (He amused his parents with plays and bright clothes), in the same inexpert style. The surfaces are covered with a whitish material which affects the legibility. The paintings which today appear to be painted in a kind of grisaille style with brown foreground and black background are apparently discoloured and may have been much lighter and coloured with pale washes originally.

The history of the *guodian* and *zhengdian* and their appearance until the 1950's

Nowadays the historical buildings of the *beiwusheng huiguan*, stage house and auditorium house, drum tower, *guodian* and *zhengdian*, are empty. There is no furnishing, and the original use and appearance of the halls cannot be reconstructed from the preserved parts. The marks of the lost platform on the rear part of the *zhengdian*, and mortises and grooves in the columns from lost doors or wooden partition elements are the only traces left from wooden parts.

Recollections of Kang Yong fu

Mr. Kang Yongfu, born in 1939, formerly teacher, now living as a tailor in a small house attached to the Jiangxi *huiguan* wrote an account about the *huiguan* (he talked about *seven* of them) which he presented as a handwritten text (fig. 43). He told what he remembers about the appearance of the *beiwusheng huiguan*.[20] Although parts of his account were not completely consistent, this extremely valuable information should be completed by asking him further details.

Fig. 43
Kang Yongfu presenting his account on the Wafangdian *huiguan* to Ma Linyan

According to his account, the transformation of the buildings occurred in 1954 or 1956, after the *huiguan* had been transformed into a grain distribution center (according to official records this took place in 1952).[21] Asked for the causes of damage to the wall paintings which must have occurred before this time - rows of holes caused by wooden pegs driven into the wall paintings and rough repairs of holes with clay -, he said that in that time people were living in the *beiwusheng*. *huiguan* Firstly he mentioned employees of a company that built a railway (to Chongqing?). On a later occasion he mentioned "members of a not regular army" which had lived there since 1937. (It is not clear if he was referring to the same persons.) It seems strange that he should have been able to visit the halls and see them in full furnishing and ritual use (he talked about bringing incense sticks to the hall) if people were living there. The traces of use of the *guodian* and *zhengdian* as dwelling houses or storage rooms, however, are evident.

According to Mr. Kang, the buildings of the *beiwusheng huiguan* were devoted to the worship of Guan Yu (*jiang jun,* "the general"). The drum tower and the rear (northern) part of the auditorium house were included into the cult by figures set up there. Figure 45 shows a ground plan indicating the parts of furnishing which Mr. Kang described.

Fig. 44
Mr. Kang Yongfu in 2011

[20] He gave the explanations while walking around in the halls. Mrs. Ma Linyan translated them into simple standard Chinese for C. Blaensdorf.

[21] It is unclear if the modifications of the buildings took place after the official new function or if he was just mistaken about the date.

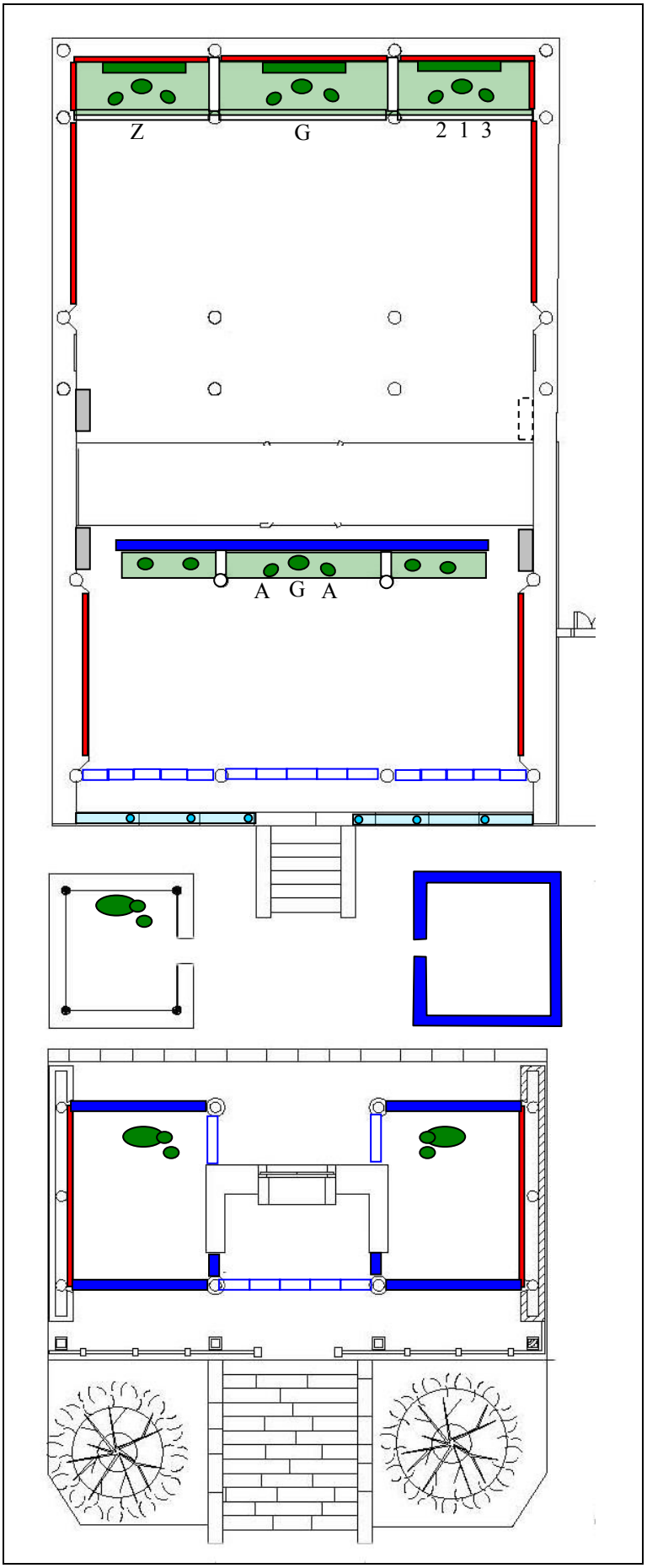

Fig. 45
Reconstruction of the furnishing of the historical buildings following the recollections of Mr. Kang Yongfu

wall paintings
podium, lost
pedestal, lost
sculpture of man or deity, lost
G Guan Yu
A assistant figure
Z Zhang Fei (or Yue Fei)
1 *guanyin*
2 *yue nü*
3 *jin tong*

sculpture of a horse, lost
wooden partition element, lost
door, lost
brick wall, lost
wooden balustrade, lost
stone stele from other context, existent

The auditorium house

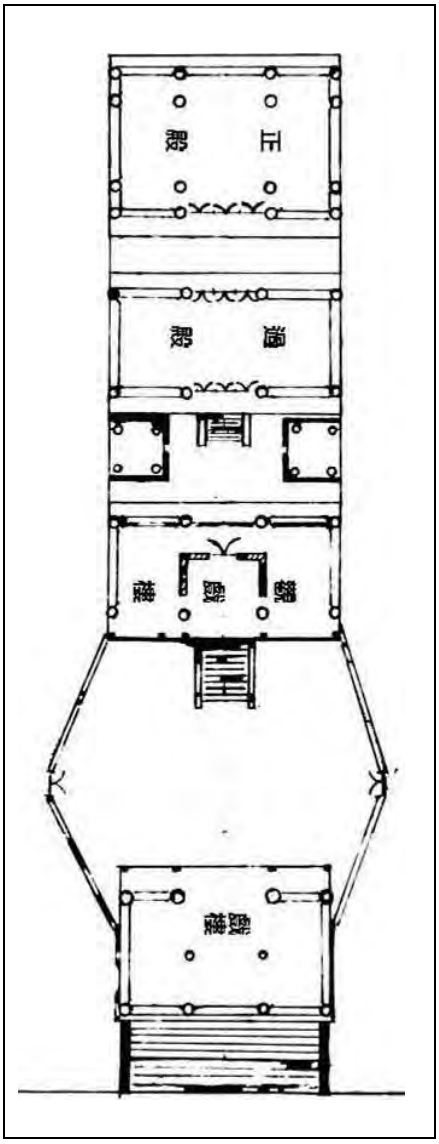

Fig. 46
Reconstruction of the historical situation of the *beiwusheng huiguan*
[MA LINYAN 2014, fig. 4]

The auditorium house had two functions: While the southern part belonged to the theatre buildings, the northern part was used in connection with the Guan Yu cult.

The southern part, which overlooks the southern courtyard and the theatre house. served as tier for the auditorium. Important guests could watch the performances sitting behind the parapet while the common people were standing in the courtyard. (The two old trees which today obstruct the view from the terrace to the stage then were either small or cut in shape).

The central bay of the auditorium building served as a passage from the theatre to the *guodian*. Towards the tier terrace, there was a door, and the walls towards the side rooms were closed at the southern end.[22]

The side rooms were closed with brick walls and had a door towards the central bay at the northern end. In both rooms, there was a statue of a horse of Guan Yu with a groom leading the horse. The clay statues were about 120 to 130 cm high. Mr. Kang also told a story connected with these horses. One day in the years between Emperor Guanxu (1874-1908) and the early Minguo (1912-1916?), the horses (or: some horses) ran away and ate the grain in the fields. After the horses were captured, people ran to the *beiwusheng huiguan* and nailed the horse sculptures to the floor to prevent them (or the village horses) from running away again.

Mr. Kang insisted that the two columns at the north side originally were not there. Indeed the existing columns are new: the shafts have been inserted during the renovation of 2008. The bases however are old and from the static point of view, the columns are necessary. Photographs from the time before the renovation show that there was a brick wall on the northern side of the building concealing the columns.

Drum tower and bell tower

Mr. Kang said that the existing tower is the drum tower and that the bell tower was demolished in 1954.[23] In the ground floor of the drum tower, there was a third sculpture of a horse with groom. On the open upper floor, there was a large drum, the *jiang ju gu* (drum of the general [Guan Yu]).

[22] The latter statement seems strange, because there would have been no reason to shorten the walls between the central bay and the side rooms during the renovation of 2008. Maybe the passage was blocked here, and Mr. Kang's recollections are not precise (he insisted that there were brick walls).

[23] According to 紫阳北五省会馆壁画保护研究 the bell tower was torn down in the 1960's or 1970's.

Guodian

The access to the *guodian* and *zhengdian* was the still existing stone flight of stairs in front of the central bay of the *guodian*. The platform on which the *guodian* is standing had a wooden parapet or balustrade to both sides of the stairs. The wooden lattice showed a decoration of overlapping rhombuses which Mr. Kang described and C. Blaensdorf tried to draw (fig. 47).

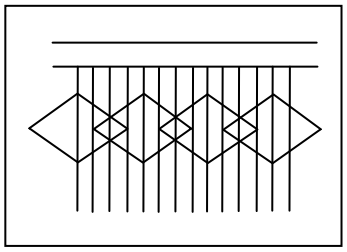

Fig. 47
Tentative reconstruction of decoration of lattice of balustrade of *guodian*

The holes for inserting the posts of the parapet are still visible, but at the walls there is no mark of a handrail.
Between the columns of the south side of the *guodian* there were three doors with five wings (*wu shan men*). The threshold was high, in the height of the stone bases of the columns.
According to Mr. Kang, the north side of the *guodian* was closed with a brick wall close to the edge of the basin, with exits on the both sides (west and east), not in the centre. The bridge crossing the basin did not exist (instead there must have been other kinds of passage on both sides). The exits were narrow and had no doors.
A brick wall and openings without doors seem unconvincing, because it then would have been impossible to close the *guodian* and because it does not seem reasonable to demolish a brick wall and erect a new brick wall in 1952, just 70 cm south of it and thus even reducing the room size.[24] There are no traces of a connection of the lost wall to the gable walls. It seems more probable that there was a wooden wall construction (either a wall or panel doors) like those in other historical halls.
In front of the lost wall, there was a platform, a *shentai* 神台 (platform for ghosts or gods), in the height of the brick pedestal zones at the gable walls and about 70 cm wide. Between the north wall and the columns south of it, wooden elements were inserted in south-north direction, dividing the platform into three niches. Curtains could be drawn preventing the view into the niche. Inside the niches, there were figures depicting protagonists of the *Romance of the Three Kingdoms*. They were about 100 to 120 cm high and made of clay. The central bay contained three figures, each of the narrower side niches two (altogether seven figures). The central bay showed Guan Yu and two assistant figures.

Zhengdian

The situation of the southern side was not discussed yet. Either in between the front row of columns or the ones behind, there must have been doors or wooden walls.
In front of the northern wall (rear wall), there was a *shentai* (platform) which reached from the wall to the next row of columns and thus was about 1.40 to 1.50 m deep. The horizontal groove for inserting the top into the wall, just above the brick pedestal zone, is still recognisable, and there are marks of paint where the front once touched the gable walls. Mr. Kang reported that the platform front and top were made of bricks and that the platform was hollow inside, but this is technically not possible.[25]

Like in the *guodian*, wooden partition elements (panels or lattices) divided the platform into three niches. The wooden elements were painted reddish brown, in the colour of the innermost circle of the *yunqi* pearls. To the front, there were decorative frames or lattice elements. Figure 48 shows a schematic reconstruction. Figures 49 and 50 show similar niches in temples in the same region.

[24] The modern brick wall was inserted at the position of the columns.

[25] The platform may have had a front constructed of bricks or adobe bricks, but the top must have been made of wood, or the platform would have been solid and not hollow inside.

Fig. 48
'Niche' of the northern wall of *zhengdian* today and schematic reconstruction of the wooden decoration

Fig. 49
sanyimiao 三义庙 in Chengdu, built 1662-1722, with figures of Liu Bei, Guan Yu and Zhang Fei in stage-like niches on platforms
[*suncallmoonbright.blogspot.com*]

Fig. 50
Stage-like niche in the Daoist temple *siwangmiao* 四王庙 in Ziyang (originally built in the 18th century, rebuilt on higher grounds in the 1980's). The figure is sitting on a throne which could give a similar outline as the lost pedestal in the *zhengdian* of the *beiwusheng huiguan*.

Each niche held three figures modelled in clay (*nijiang*), the larger one in the center (at least 1.5 m high), flanked by two smaller assistant figures. The central niche showed Guan Yu, the western niche (*tianguan cifu*) maybe Zhang Fei (or Yue Fei).[26] For the eastern niche (dragon painting), Mr. Kang remembered a *guanyin*, flanked by the *yue nü* (jade girl) on the eastern side and the *jintong* (golden boy) on the western side. *Guanyin* is usually linked to water[27], but the depiction of *guanyin* seems not convincing in the context of the pictorial program of the *zhengdian*.[28] According to Mr. Kang the pedestals in front of the wall paintings were made of would, about 8 cm deep and decorated with carved reliefs of figures in landscapes with mountains, trees and buildings. The largest human figures were about 50 cm high.
There are various examples of statues *sitting* on pedestals in temple halls (fig. 49 and 50). Mr. Kang, however, remembered the clay statues *standing* in front of the highly decorated pedestals, but maybe the possibility of sitting figures should be discussed again.
Between *guodian* and *zhengdian*, four limestone stelae are standing next to the water basin (underneath the eaves of the two halls). One of them is missing today (*zhengdian* east side), but a pedestal is preserved. Two of the stone stelae are standing at the place where, according to Mr. Kang, the exits from the *guodian* should have been. Mr. Kang said that the stelae were transported here in 1954 as support for the panelling, but this does not seem convincing.[29] He also said that the stelae were older than the building and came from another place, but the inscriptions on the stelae prove that they belong to the *huiguan*, listing the names of donors. The stele on the *zhengdian*, west side, bears the date 1866 and is labelled as supplement in the inscription.[30] The stelae thus date from the same time as the buildings. If they were transported to their present places in the 1950's, they must have come from a place within the *beiwusheng huiguan* complex.

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[26] C. Blaensdorf had problems of understanding the Chinese explanations. Yue Fei was a military leader and a folk hero who lived in the Song Dynasty. Zhang Fei seems more likely in combination with Guan Yu.

[27] Explanations on the motif by Dr. Zhao Zhou, Heidelberg.

[28] Guanyin seems a bit out of place in the arrangement of war heroes, Liu Bei would be more likely to round off the trio as he is often depicted together with Guan Yu and Zhang Fei.

[29] The ground plan (fig. 53) shows that the panelling of the wall was not connected to the stelae. There is a mark of whitewash running vertically through both steles, but this is not the end of the panelling, but of the whitewashed brick walls. Next to the brick walls, the steles were impedimental, not supporting. It seems that the stelae were already there and left in place as they provided a heavy obstacle which was difficult to remove. So the brick wall was built around them.

[30] Hu Kejia studied the inscriptions. Single merchants or groups of them donated 900 to 10 000 *wen* to the *huiguan*. The two stelae at the north side of the *guodian* have no inscriptions giving dates.

Guodian and *zhengdian* in the 20th century

Before 1952

In the 1950's the *beiwusheng huiguan* was transformed into a grain distribution place used for storing the state rations of grain. Obviously the worship of Guan Yu the halls of the *beiwusheng huiguan* had stopped even earlier. There are cases of damage on the wall paintings which must have occurred before the modifying of the halls into granaries:

- graffiti with ink or chalk written on the wall paintings (fig. 33, 52). A check of the graffiti proved that all of them are written in traditional Chinese (not simplified Chinese) and thus have to be dated definitely before 1950.
- sketches with ink imitating details of the drawings (fig. 51)
- scribbling with blue paint on the paintings of *pingfeng dong*, panels 4, 6 and 8 *d*
- pieces of newspaper glued to the wall
- rows of pegs driven into the wall maybe to use them as coat hooks or to hang up tools, some of them stabilised by shards of brick or slate (fig. 33, 52); the holes were closed again with clay (repair before 1952)
- rough repairs of holes in the wall with clay, maybe to prevent loose clay powder trickling down (fig. 33, 52)
- scratches (fig. 52) and other deliberately caused damage, for example scratching out eyes or faces
- scorch marks, often marring the faces, for example in *pingfeng xi*, panel 4 *d* (fig. 33), 5 *d* (fig. 52) or 8 *d*.

Jiang Bo confirmed that all these types of damage were found when the panelling was removed and thus must have happened before 1952.

Fig. 51
pingfeng xi, 2 *c*: Graffiti in black ink, repeating a crane in the painting

Fig. 52
Pingfeng xi, 5 *d*: Graffiti in ink and pencil, scratches (left side) and scorch marks (left side and faces), in the upper part rows of holes from pegs and nails, some of them roughly closed with clay

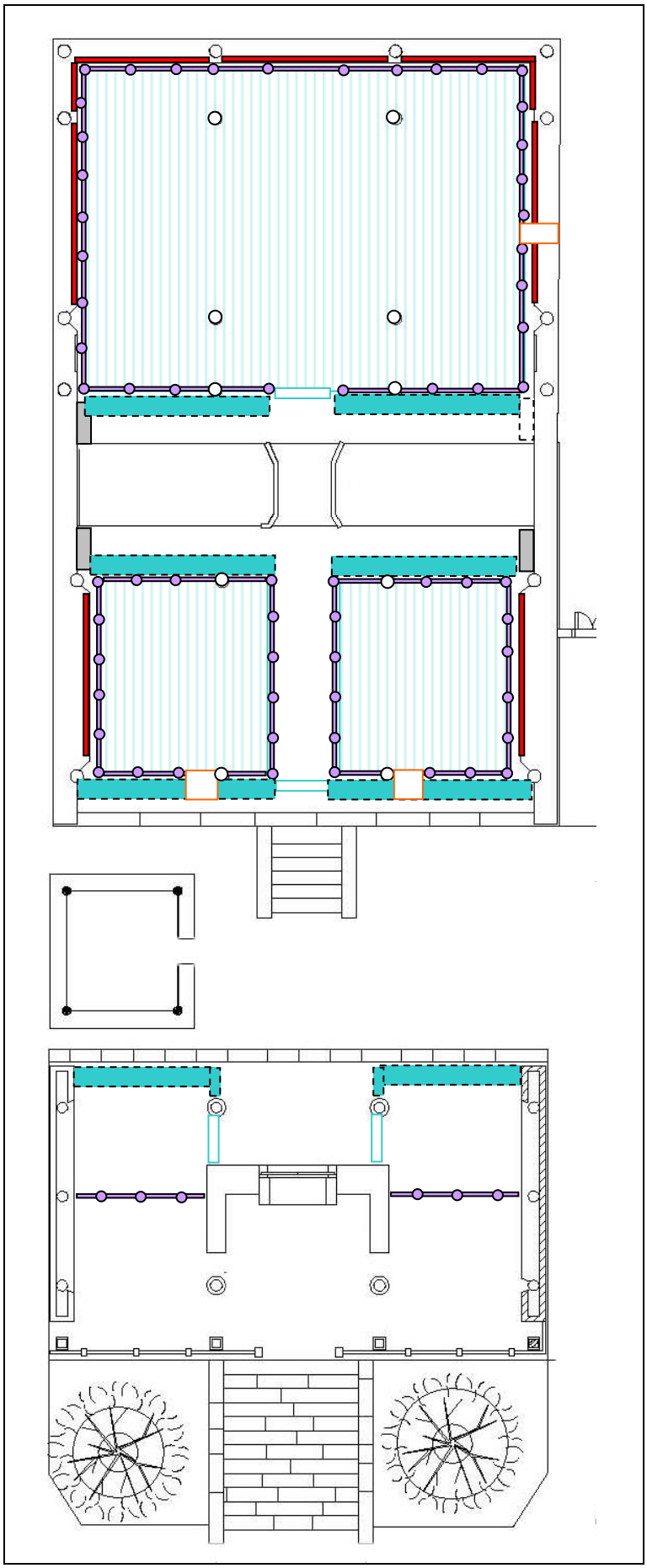


Fig. 53
Changes of the buildings made for the grain storage in the 1950's

- wall paintings, existent
- raised wooden floor
- brick wall
- wooden panelling
- door
- window
- stone stele from other context, existent

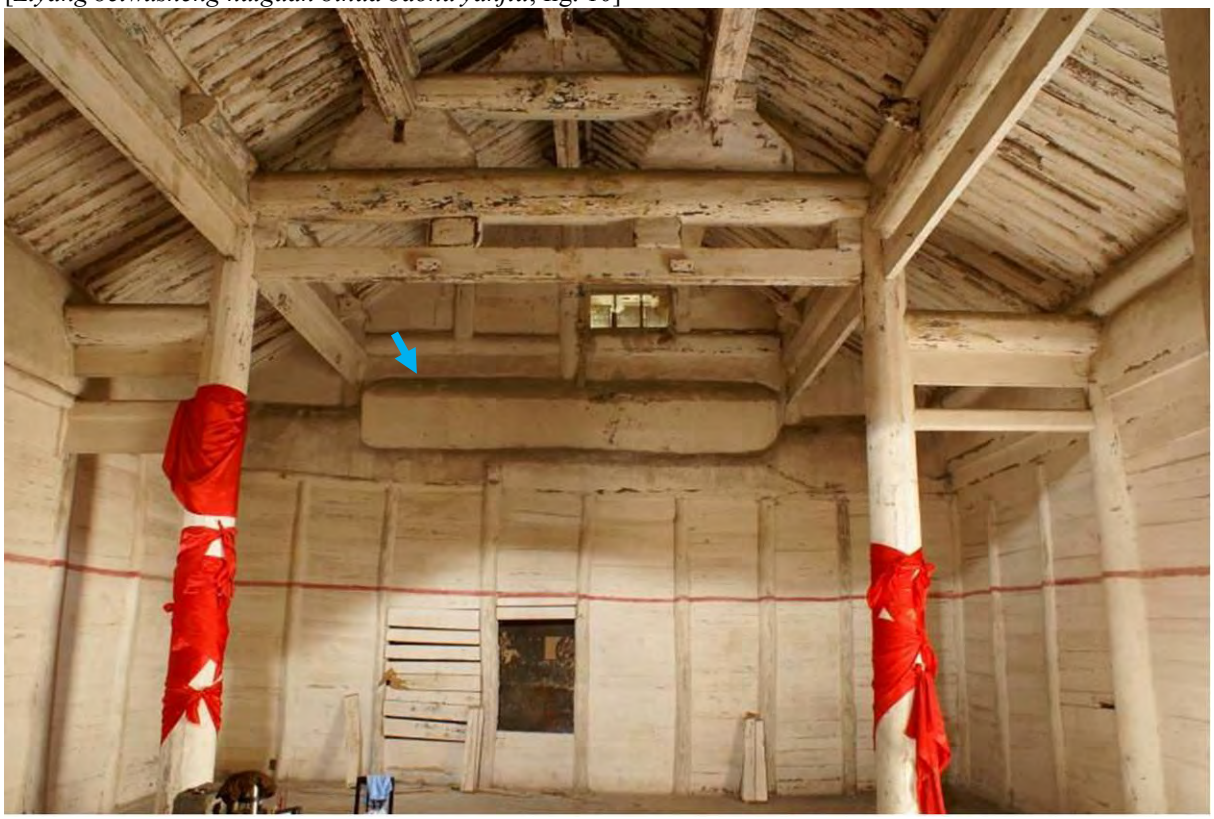
Transformation into a granary in 1952

In 1952 – or according to Mr. Kang Yongfu in 1954 or 1956 – the *beiwusheng huiguan* complex was transformed into a grain distribution centre.[31] *Guodian* and *zhengdian* served as granaries and supplemented a storage house with five rooms erected west of the halls.

The buildings were modified according to the new needs: The furnishing of the halls was removed. Mr. Kang told that the clay figures were smashed. The platform and the wooden elements and doors were removed. Wooden walls and doors were replaced by brick walls (turquoise in fig. 53). The roofing was renewed. The bell tower was demolished in the 1960's or 1970's because it obstructed the passage to the other buildings.

Inside the *guodian* and *zhengdian* wooden floors and walls were fitted in. The floors were raised and the walls were covered with a panelling to keep the grain dry: Wooden poles were set up along the walls. Panels were inserted horizontally into a groove in the pole. Blocks of wood were inserted between the poles and the wall painting to keep a distance from the walls. The *guodian* was divided into two chambers, leaving a passage in the middle. This passage ended on the bridge over the basin, which according to Mr. Kang was also built at that time. The new walls and the visible parts of the wooden construction were painted white. The lime wash served to keep the grain dry and to keep insects out. As the upper parts of the *sanguo*-walls were protruding above the panelling, the wall paintings were overpainted here (fig. 54). There are at least two layers of whitewash.

Fig. 54
Zhengdian, view onto the *sanguo dong*-wall in 2008. The walls are still covered with the panelling. The upper part of the *sanguo dong*-painting protrudes above the panelling and is covered with white wash (blue arrow). Above that, a window has been broken into the gable wall.
[*Ziyang beiwusheng huiguan bihua baohu yanjiu*, fig. 10]



[31] *Ziyang beiwusheng huiguan bihua baohu yanjiu*, p. 3, gives the year 1952.

Fig. 55
Zhengdian, *sanguo xi*-wall during uncovering in 2006. The holes made by wooden pegs are closed with clay; runs of whitewash. [Shaanxi Institute for Conservation]

Fig. 56
Zhengdian, *sanguo xi*-wall in 2011 New runs of water probably date from the renovation of the roof in 2008.

Fig. 57
Guodian, south west corner during uncovering of the paintings in 2006. The southern edge of the *pingfeng xi*-painting is damaged by water penetrating through the edge of the building. [Jiang Bo]

Rediscovery and renovation of the buildings, 1981 to 2008

In 1981, during a compilation survey of preserved cultural heritage, the *beiwusheng huiguan*, Wuchang *huiguan* and the Jiangxi *huiguan* were classified as 'Number One' (highest level) of cultural heritage of the Ziyang county. In 2003 they were listed as provincial cultural heritage.[32]

In 2008, the wall paintings were uncovered and the buildings were renovated and repaired in an intervention organised by the Institute for Ancient Architecture Xi'an.
The changes made in the renovation phase can be reconstructed by means of photographs given to the German restorers by Mr. Jiang Bo from the local Cultural Heritage Department (figures 57-67): The buildings were deserted and had been neglected. Weeds were growing on top of the leaking roofs. The renovation comprised the following steps:
- removal of walls, floors, panelling and building elements added in the 1950's (fig. 66, 62)
- removal of the old roofing (fig.)
- repair of the wooden construction and reconstruction of missing parts
- closing holes in the brick walls caused by windows inserted in 1952
- new roofs (fig. 67)
- new floor with terracotta tiles in the *guodian* and *zhengdian*
- white-wash of the walls in the auditorium building. According to Jiang Bo, the original wall paintings were in a very poor condition and only preserved in traces.

The doors and wooden wall elements of the *guodian* and *zhengdian* have not been reconstructed yet (fig. 68). Some door panels, wooden railings and decorative elements, probably from the niches, are still stored in the granary house of 1952.

Fig. 58
Zhengdian, *sanguo dong*-wall during uncovering of the paintings in 2006 [Jiang Bo]

[32] *Ziyang beiwusheng huiguan bihua baohu yanjiu*, p. 3. The listing of the Wuchang *huiguan* may be a mistake as the text states at another place that it was destroyed in the late 1980's when the water level was raised. Maybe the protected *huiguan* was the still existing Chuanzhu *huiguan*.

Fig. 59
Stage house before renovation
[*Ziyang beiwusheng huiguan bihua baohu yanjiu*, fig. 6]

Fig. 60
Stage house during renovation
[Jiang Bo]

Fig. 61
Stage house after renovation
[Jiang Bo]

Fig. 62
Guodian during removal of brick walls; the wall paintings of the *pingfeng dong* is protected under the white-blue-red striped plastic fabric
[Jiang Bo]

Fig. 63
Guodian during renewing of the roof; on the right an older annex building
[Jiang Bo]

Fig. 64
Guodian in 2011. The annex building has collapsed. In front of it?, a semi-circular flower bed at the place where the bell tower had been standing until the 1960's

Fig. 65
South side of *guodian* before renovation seen from the auditorium side; on the left side: drum tower [*Ziyang beiwusheng huiguan bihua baohu yanjiu*, fig. 8]

Fig. 66
Guodian during removal of brick walls [Jiang Bo]

Fig. 67
Guodian during renewing of the roof [Jiang Bo]

Fig. 68
Guodian in September 2011

Fig. 69
Meeting in the *beiwusheng huiguan* at the start of the work, April 2011: Left to right: Mr. Bai Chongbin, Mrs. Ma Linyan, Mr. Yan Min and Mr. Zhang Yinglan (at that time director) from the Shaanxi Institute for Conservation; Prof. Erwin Emmerling, Technische Universität München [Shaanxi Institute for Conservation]

Fig. 70
Visit of the Provincial Bureau for the Preservation of Cultural Heritage (*Shaanxisheng wenwuju*) in the *beiwusheng huiguan* in April 2013: Director of the Bureau Mr. Zhao Rong, head of project Mrs. Ma Linyan and German-Chinese work team discussing in front of the *pingfeng xi*-wall

THE GERMAN-CHINESE CO-OPERATION IN THE CONSERVATION OF THE WALL PAINTINGS

SETTING AIMS AND PRECONDITIONS

Definition of damage

The experts of the Shaanxi Institute for Conservation listed the cases of damage to the wall paintings in the internal report *Ziyang beiwusheng huiguan bihua baohu yanjiu* 紫阳北五省会馆壁画保护研究. According to this preliminary description, the damage comprises:

- flaking paint layers resulting in loose flakes and losses
- damage from water penetrating though a leaking roof (especially on *pingfeng xi*, south end)
- salt accumulating and efflorescing on brick walls, plaster and paint layer
- whitish spots, maybe caused by micro-organisms
- holes, scratches and other mechanical damage caused by deliberate actions or neglect
- graffiti.

During the discussion on site in April 2011, an additional phenomenon was included: All paintings show a discoloration of certain parts, mainly in the background, that seems to come from a formerly transparent layer. The degree of discoloration ranges from light greyish brown to dark brown. Mr. Bai Chongbin assumed that the layer is a later coating and may consist of Tung oil. After this observation, two aspects were added to the list of damage:

- residues on the surface (scorch marks, dust, whitewash or other traces of paint etc.)
- darkened later coatings.

Preconditions and work done before the start of the German-Chinese co-operation activities

Between 2008 and 2011 the Chinese experts already worked at the buildings and thus enabled to start the conservation work in the summer of 2011:

- The Institute for Ancient Architecture in Xi'an removed the additions of the 1950's from the old buildings of the *beiwusheng huiguan*, renewed the roofs and reconstructed parts of the damaged or lost wooden elements. These actions prevented the continuation and increase of damage and allowed to work inside the halls.
- After the panelling inside the halls was removed, the Shaanxi Institute for Conservation made a comprising photographic documentation with pictures of all wall paintings (total and details). In co-operation with the staff of the local Bureau for the Preservation of Cultural heritage (*wenwu ju*), the Shaanxi Research Institute for Conservation of Cultural Heritage started to collect information on the history of the buildings and the village in which they are situated. The information was compiled in *Ziyang beiwusheng huiguan bihua baohu yanjiu* which served as a base for the preparation of the work. Further information was presented to the German experts during the work stay in 2011.

Schedule of work

Project planning 2010

After discussion of the situation between the Chinese and the German experts, the aims of the German–Chinese co-operation were defined in the application made by the German part of the project in the end of 2009 as follows:

The aim of the co-operation work is the development of a plan for the conservation of the wall paintings focussed on the development and evaluation of the conservation methods. The work comprises the following aspects:

- mapping of the damage
- analyses of plaster and painting materials and investigation into the causes of damage
- development of suited conservation methods
- test of the conservation methods on test areas
- evaluation of the developed methods
- development of a plan for the conservation

Planning during the visit in April 2011

During the first visit of German experts on-site in April 2011, the focus was slightly shifted as the Center for Conservation had scheduled the whole conservation of the wall paintings for the years 2011 to 2013. Director Zhang therefore proposed and offered the German experts to collaborate in the conservation and not only in preparing tests and test areas. A schedule for the work was drafted after the discussion between Director Zhang and Prof. Emmerling (*see page 61*).

Discussion in the begin of the work stay in July 2011

In July 2011, Mrs. Ma Linyan, Mrs. Blaensdorf and Mrs. Schanz discussed the situation on-site before the work started. The aim of this discussion was to decide which area should be the first to be treated and which steps of conservation should be done in 2011. The discussion resulted in the following list:

1. Conservation of the margins of the paintings (“Randsicherung”) on the north wall of the *zhengdian*
2. Fill the holes in *pingfeng xi* on the level of the *cu ni*, if necessary supporting fillings (“Stützkittungen”)
3. Mapping of condition and damage
4. Tests for cleaning of the surface on *pingfeng xi*; testing the materials and checking the effect using UV light
5. Demonstration of the single steps of investigation and conservation for the CCTV documentary film on 2011, Sept. 1
6. Investigations with XRF
7. Consolidation and levelling of paint layers on *pingfeng xi*
8. Test for grouting on *pingfeng xi*
9. Removing plants and finding a way for drainage of rain water on the east side > checking if the walls and the floor get drier afterwards
10. Checking the soft and crumbling clay layers on the north wall and exploring a method for the consolidation

Schedule of work agreed on in April 2011

2011

1. Research on the historic and art historic background, including the history of Wafangdian, the history of the *huiguan*, the collection of historical photographs, studies on style and iconography of the paintings: This work will be carried out by the Chinese experts. The Chinese side will also provide topographic maps and aerial surveys.
2. Climate monitoring: This work will be done by the Shaanxi Institute for Conservation using a new system with remote control. The measuring period will be May 2011 to May 2012 (measuring devices were set up in July 2011, no humidity measurements).
3. Samples of the plasters, the preparatory layers and the paint layers will be taken for the analysis of painting materials. The samples will be taken by the experts of the Shaanxi Research Institute for the Conservation of Cultural Heritage (the sampling was done in June 2011 by Mr. Bai Chongbin and Mr. Liu Dongbo). The sampling should also include samples from the wall paintings of the Jiangxi *huiguan* (not done yet).
4. Analyses of inorganic damage factors as salts.
5. Tests for grouting and filling materials will be made in the laboratory. Afterwards a test area will be treated in the hall, in joint German-Chinese work.
6. An expert meeting will take place from June 15 to 18. Chinese experts for traditional painting will meet and discuss questions of style, dating and conservation.
7. The first work phase on-site will be carried out between July and September 2011.
8. In autumn 2011, three experts of the Shaanxi Research Institute for the Conservation of Cultural Heritage will come to Munich to start the analysis of the samples (in October 13 to 28, Mr. Bai Chongbin, Mr. Liu Dongbo and Mrs. Fan Binbin came to Munich).
9. An annual report will be written.

2012

1. After evaluating the analyses of materials and damage factors, tests for cleaning and, if possible, removal of discoloured coatings will be made in joint German-Chinese work.
2. Tests for the consolidation of loose plaster layers and flaking paint layers will be made. After laboratory tests, the intended methods will be tested in joint German-Chinese work on site.
3. Voids inside the walls will be investigated, maybe by using radar.
4. Sampling and analyses of micro-organisms will be done.
5. The efficiency of cleaning agents and methods will be tested.
6. Materials and methods for the consolidation of plaster layers will be tested.
7. Materials and methods for fillings and grouting will be tested.
8. Materials and methods for the consolidation of the paint layer will be tested.
9. An annual report will be written.

The joint work on site is scheduled to start in April 2012 (in November 2011, the work period was planned for August and September 2012).

2013

1. Execution of the conservation of the plaster layers.
2. Execution of the grouting of voids.
3. Execution of the consolidation of the paint layer.
4. Treatment of the surfaces (cleaning / removal of coatings).
5. Compiling a research report on the work.

The time for the joint work on site still has to be decided.

Preliminary investigations including microscopic examination and observation under UV light led to the opinion that the painting technique and the causes of damage on the *sanguo*-walls are very complex, ant that it is not possible to understand them in a few days of examination on-site. For this reason, Ma Linyan and C. Blaensdorf decided to postpone further examination of the *sanguo*-walls until the samples would have been investigated. Especially the examination of cross sections to understand the paint layer sequence seemed necessary before further decisions could be made. So far, it could be assumed that the dark brown layer(s), at least partly, are *not* a later coating but belong to the original structure of the paint layers.

As the aim of the work stay was to test conservation treatments on the wall, the decision was made to start on the wall paintings of the *guodian*:

- Compared to the *sanguo*-walls, the painting technique and the paint layer sequence is simpler and easier to understand
- The coating is not as brown and disturbing as on the *sanguo*-, *tianguan cifu*-, *pingfeng bei*- or *long*-paintings.
- The damage to the plaster layers is not as severe as on the rear walls of the *zhengdian*.

The decision was made to start with the *pingfeng xi*-painting. The following steps of work were defined as the aims of the six weeks of work stay (August 2 to September 11, 2011):

Pingfeng xi:

- investigation into the painting technique
- survey and documentation of damage (written text, photographs, mapping)
- tests for cleaning of the surface (removal of dust)
- tests for removal of clay repairs from the painted surfaces
- small test series for adapting mixtures for filling and grouting developed in Shuilu'an to the situation in Ziyang and examination of local materials (this preliminary test series does not replace the necessary laboratory tests, but just serve to check certain properties of materials and mixtures in addition to the conservation work)
- filling holes up to the level of the under coat (*cu ni*) layer (fillings in the level of the plaster surface, *xi ni*, will be executed in 2012 to allow the fillings to dry properly)
- tests for the consolidation of flaking paint layer

North wall of the zhengdian

- emergency treatment of very endangered layers of plaster, especially in the lower part of the *long*- and the *pingfeng bei*-painting

Building situation/situation of the building

- understanding the climatic situation
- understanding the problems of water drainage, if possible, solve them to allow the consolidation of permanently moist plaster layers

In 2012, it was decided that the German team would focus their work on the *pingfeng xi*-painting and finish all steps of the conservation work at this wall as an exemplary work. After discussions about a prolongation, the deadline for the restoration of the wall paintings was set by the Chinese institutions to the end of September 2013.

CONSTRUCTION OF THE HALLS

The *guodian* and *zhengdian* are built in the traditional system of post constructions. The load-bearing construction consists of wooden columns and beams. The walls are inserted between the columns and just serve to close the walls. The murals are painted onto wall sections which were erected in front of the external walls. Towards the small courtyard between the halls, the walls are covered with a brick revetment.

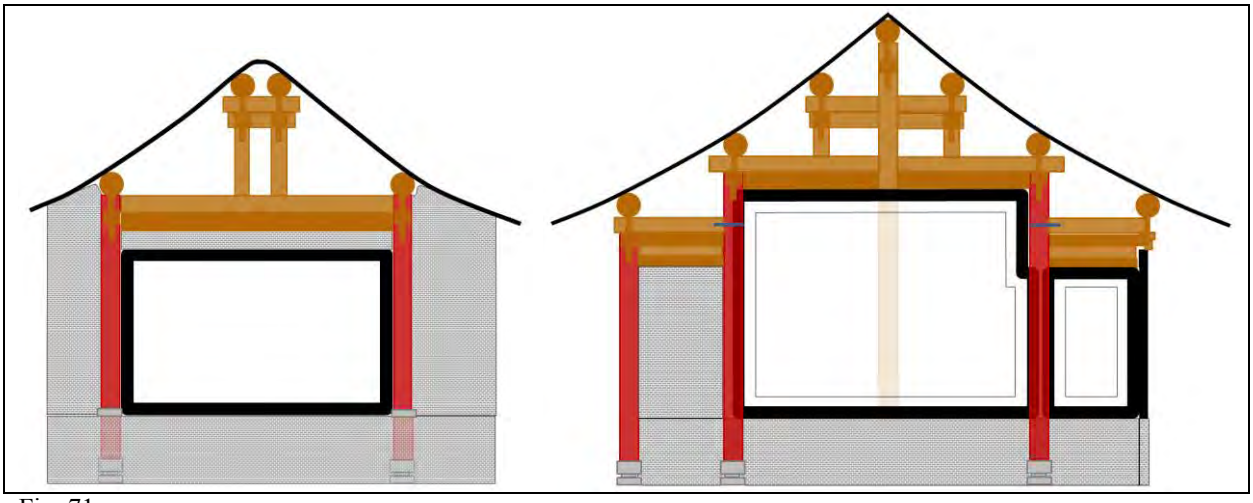


Fig. 71
Post construction of the gable walls of *guodian* and *zhengdian*

WOODEN CONSTRUCTION

Fig. 71 shows a scheme of the construction of the halls. The *guodian* is only one bay deep. The *zhengdian* is three bays deep, with a wider bay in the centre and two narrow bays along the eave sides of the building. Inside the hall, the columns are longer than along the eave side walls. In both halls, lintels and beams connecting the columns are mortised into the column shafts. The wooden construction of the gable walls is visible above and partly next to the paintings.

In the *zhengdian*, iron bands reinforce the connection between the column shafts and the horizontal beams or lintels, connecting the beams inside the gable walls (fig. 73 and 76). The bands are about 3 cm wide and attached with handmade, forged nails. The band is partly concealed behind the paintings. This means that the bands were applied before the walls were prepared to be painted.[33] Iron band reinforcements, nails and similar implements are not part of the traditional building technique, they were rather used as repair. This may mean that the wooden construction is older than the paintings. There is no proof, however, that reinforcements were never used during the erection of a building in historical times.

In the corners above the *yunqi* walls (*xi* and *dong*), wooden panels with carved ornaments are inserted above and below the lintel beams of the load-bearing construction (fig. 72). The upper panel with carved flowers and a document scroll had been painted: fragmentary white lines located under the white wash are visible. It is completely visible from below, as it is situated above the murals.

[33] In the upper right corner of the *sanguo xi*-wall, the colour of the plaster differs from the rest of the wall (the roughly triangular part starts 66 cm below the upper edge of the painting), giving the impression that the plaster may have been repaired at the spot where the iron band is attached. The wall painting, however, does not show traces of a repair. At the opposite side, on the *sanguo dong*-wall, there definitely are no traces of a repair where the iron band is running underneath the plaster.

Fig. 72
Wooden construction above the *yunqi xi*, next to the *sanguo xi*

Fig. 73
Iron band proceeding underneath the mural of the *sanguo dong*

Fig. 74
Corner setting *yunqi xi*/ *tianguan cifu*, lower board concealed by *tianguan cifu*-wall

Fig. 75
Two carved wooden boards above *yunqi xi*, lower board partially concealed by the plaster of the murals

Fig. 76
Column between the *sanguo xi* and the *yunqi xi*-painting: iron band at column (red arrow) and mortise of lost lintel (green arrow).

Fig. 77
Top edge of the *yunqi xi*-painting: Sequence of adobe bricks with one stretcher, one header, three stretchers (from left to right)

The lower panel, showing a *yunleiwen* ornament with incorporated dragons, is not painted, but covered with a glossy brown coating (maybe *qi* lacquer or tung oil). Although carved rather finely and painted, it is partly concealed behind the walls of the murals (figs. 74 and 75). This may indicate, too, that the wooden construction is older than the wall with the murals, but it is also possible that the design of the wooden elements was carried out without considering the exact position of the wall paintings: Carpenters, brick layers and painters probably were separate teams of craftsmen who may not have communicated the final design in detail.
A flat mortise in the column between the *sanguo xi*-and the *yunqi xi*-painting served to insert the tenon of a now missing lintel in W-E direction (fig. 76, green arrow; dimensions: 16.2 cm x 6.6 cm x 2.4 cm; 29 cm above the top edge of *yunqi xi*-wall). It once connected the column to the next one to the east. The lintel was part of the front decorations of the niches between the columns and the north wall (see above: *recollections of Mr. Kang Yongfu*, p. 50-51). The lower panel with the dragon/*yunleiwen*-decoration thus corresponded to the partition elements between the niches. This may explain the reddish brown coating as the partition elements are said to have been painted in that manner.

WALLS OF THE MURALS

Brick construction

The supports of the murals are walls built in front of the external walls.[34] They were built, at least in the upper part, with adobe bricks while the external walls were built with fired bricks. The dimensions of the adobes are 28 x 16 x 8 cm. The thickness of the adobe walls measures 28 cm, covered with plaster layers of 3-3.5 cm thickness. Layers of lying adobe bricks alternating with standing ones were visible in damaged areas. On the top side of the *yunqi xi*-wall, a sequence of adobe bricks is visible (one stretcher - one header - three stretchers, fig. 77). The *yunqi xi*-wall is slightly thicker than the *sanguo xi*-wall, measuring 32.6 cm in thickness, with 29 cm of adobe bricks (and joints towards the external wall) and 3.6 cm of plaster layers.[35]

Adobe bricks, alternating in lying and standing layers, were also visible in holes in the *d*-panels of the *pingfeng xi* wall.[36] It can be assumed that the horizontal rows of holes in the *sanguo*-paintings and the *pingfeng xi* / *pingfeng dong*-paintings (a damage from the early 20th century) give evidence of the brick system behind, because it was only possible to drive wooden pegs into the joints between the adobe bricks or between the layers of bricks. The rows thus probably follow the levels of the lying brick layers.

Plaster layers

At all the walls, three layers of plasters can be distinguished. There are two layers of an undercoat of a light brown colour containing straw, and an almost white fine coat. Following the Chinese tradition, the plasters can be characterised as described in table 6.
There are no visible differences between the plaster layers of the single walls or between the two halls. The murals of *sanguo xi* and *yunqi xi* were carried out on the same level, on the same coat, as were the murals of *sanguo dong* and *yunqi dong*.

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[34] The construction of these walls could be examined in the upper part of the *sanguo xi*-painting, at a hole from a beam inserted before 1952. The *sanguo dong*-wall had a hole at the same position.

[35] The thickness was measured at the top edge in front of the carved wooden panel, see fig. 77.

[36] The holes were closed during the restoration 2011 to 2013.

Table 6
Characterisation of plaster layers

Chinese	*English*	*characterisation*
xi ni 细泥 ("fine clay")	fine coat	containing clay, lime, sand and plant fibres
upper / second *cu ni* 粗泥 (coarse clay)	undercoat, 2nd layer	containing clay, sand and plant parts as straw
lower / first *cu ni* 粗泥	undercoat, 1st layer	containing clay, sand, plant parts as straw, more coarse than the second layer

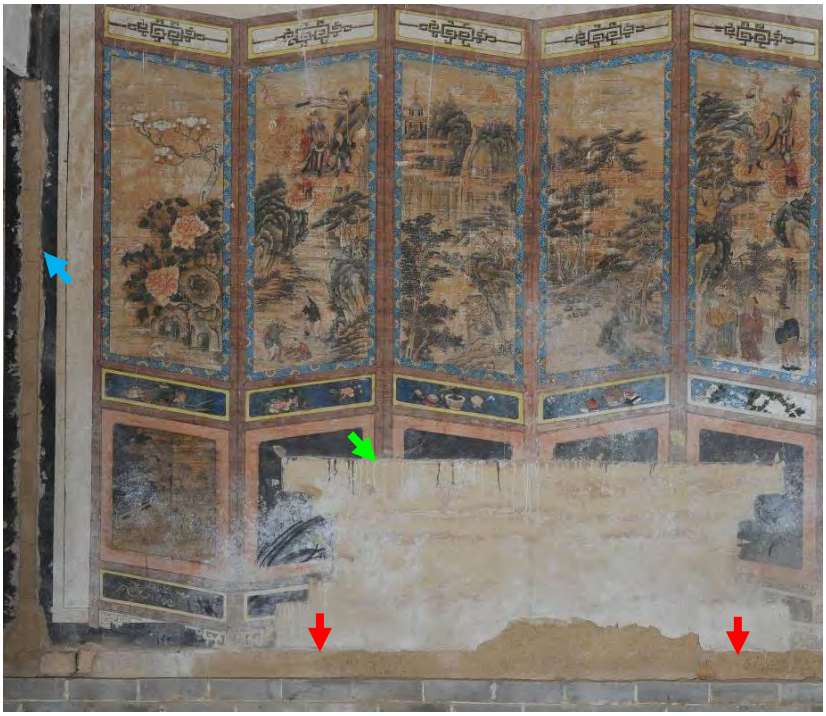

Fig. 78
Pingfeng bei: Groove from lost top of platform (red arrow), outline of pedestal (green arrow), closed grove from lost vertical separation element (blue arrow) [Shaanxi Institute for Conservation 2011]

Fig. 79
Chalk line marking the centre of the *pingfeng bei*-painting or the vertical axis of the pedestal (green arrow).
Runs from low viscose white ground, reddish and black paint at the upper edge of the lost pedestal.

Cu ni

The two layers are similar in composition, but the lower layer is more compact. Both consist of clay with a very low content of calcium. The light colour of the plasters can be attributed to the content of white minerals, as there are muscovite, albite, corrensite and calcite. The sand / quartz grains are rather fine. The organic additives were identified as rice straw.

Xi ni

The fine coat (*xi ni*) contains a light clay, fine sand grains and fibres. SEM-EDX on cross sections showed that there are areas rich in calcium without recognisable structure. The matrix-like accumulation seems to indicate the addition of lime. The fibres consist of fine bast fibres (microscopically similar to fine hemp fibres) and cotton fibres (see: *Analyses*, pp. 207). White inclusions consisting of gypsum were found in all types of plasters, though not in all parts of the walls. The white efflorescence on the *long*- and the *pingfeng bei*-murals also consists of gypsum. The gypsum may have been added to increase the plasticity and adhesive strength of the clay.[37]

Chalk lines and lost wooden furnishing

After the adobe walls had been built and covered with the first layer of undercoat, the wooden top of the platform in the rear part of the *zhengdian* was inserted. The vertical separation elements between the murals of the north wall, too, were probably inserted at the same time, as their removal left grooves which are filled today (fig. 78). Afterwards the finer clay layers and the fine coat were applied.

The vertical elements between the *sanguo*- and *yunqi*-walls and the pedestals on top of the platforms were built-in after the plasterwork had been finished. Vertical black chalk lines were used to mark the borders between the *yunqi*- and *sanguo*-murals. Between the *yunqi*- and *sanguo*-murals, the holes of nails or pins to attach the strings are still visible. The strings were dipped into paint, pinned to the wall and gently snapped against the surface. Splashes beside the lines (fig. 80) prove that a liquid medium like ink was used and not dry materials like soot. Black 'chalk lines' also mark the vertical middle axes of the paintings of *tianguan cifu*, *pingfeng bei* and *long* on the north wall (fig. 79).[38]

Fig. 80
Chalk line with black ink, on the strip between *yunqi dong* and *sanguo dong*-painting: splashes of liquid material next to the chalk line.

[37] Information of Prof. E. Emmerling from his practical experience.
[38] The technique used for producing these lines was not examined in detail.

Fig. 81
Pingfeng xi, panel 6 *d*, repair with brown mortar

Fig. 82
Pingfeng xi, panel 8 *b*, horizontal repair in the roof, on which the paint layer is partially lost

Fig. 83
Pingfeng xi, panel 8 *b*, repair under UV light

Table 7
Positions and dimensions of plaster repairs observed at the *pingfeng xi* wall:

panel	*position*	*approximate dimension maximum height x width [cm]*
6 *b*	- right boy picking water lilies, lower part of back - left post of pavilion in the water, above the willow tree - star border: right (northern) edge: 2nd star above the lower edge - stile of framework next to the 4th star above the lower right edge - framework, right stile in the level of the man in the pavilion	- 5 x 3 - 3 x 1.5 - 2 x 4 - 3.5 x 2 - 2 x 1.5
6 *d*	- in the cloud to the left of the dragon king - to the left of the larger repair, in the landscape - left lower border of the painting, in the ice	- 4 x 2 - 0.8 x 0.8 - 2 x 4.5 (thin layer spread on top of *xi ni*)
8 *b*	- in the roof on the right (northern) edge, three connected places of damage	- total area: 5 x 30 cm
8 *d*	- to the left of the daughter-in-law, below the azalea shrub	- 0.8 x 1.2

PAINTING TECHNIQUE

The technique of the wall paintings has been studied mainly at the *pingfeng xi*-mural. Observations from the other murals are included, but they could not be examined systematically. Reconstruction tests were made to understand some phenomena and characteristics of the *pingfeng xi*-mural.

PREPARATORY STEPS

After the fine coat (*xi ni*) had been applied, the preparation of the walls for painting started. The following steps could be ascertained:

(1) Repairs of the plaster surfaces using brownish clay plaster (*pingfeng xi* wall)

(2) Isolation layer (sizing) of the *xi ni*

(3) Application of a white ground layer; polishing of the surface

The disposition of the painting using chalk lines and the preliminary drawing may have been done before the sizing was applied onto the ground layer.

(4) Isolation layer (sizing); penetrated into the layer without forming a film on the surface

Repairs of the plaster layer

At the *pingfeng xi*-painting, repairs of the plaster surfaces are visible. They concern the fine coat, maybe also the 2nd undercoat layer. The repairs were carried out before the priming layer was applied. The repair plaster is partly spread onto the surrounding undamaged fine coat surface as a result of smoothing the repair.

The repair mortar is reddish brown and has a fine homogeneous structure without discernible fibres or other additives. Clay is assumed to be the main component.[39] Its colour, structure and composition are different from the light yellowish white fine coat. It also seems to have divergent adhesion and swelling properties: Paint layers are not as well-preserved on repairs as on surrounding areas, and along the edges of the repairs there are cracks and even losses (fig. 81). The repaired areas have no UV-fluorescence (fig. 82, 83) whereas other areas of the priming layer and the fine coat have a bluish white fluorescence. There may be a fluorescing binding medium in the fine coat that is missing in the repair plaster. The reddish brown colour corresponds to local loam deposits at the mountains behind Wafangdian. Maybe the kaolin containing whitish material used for the plasters was brought from farther away and the craftsmen ran out of material and thus used local clay for repairs carried out as a last step of preparations on the wall.

On the *pingfeng xi*-painting, repairs have been discovered in the areas 6 *b,* 6 *d*, 8 *b*, 8 *d* and below the left (southern) style of frame 8 (dimensions: see table 7).[40]

The other paintings were not examined regarding this kind of repair. The upper right corner of the *sanguo xi*-painting may contain a large original repair. The *sanguo dong*- and the *pingfeng dong*-paintings show at least one spot where the plaster layers had already been damaged before the walls were painted: The deeper irregular holes were not filled before painting.

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[39] The material was not analysed.

[40] No repairs could be detected in the following panels: 2 *d*, 3, *d*, 4, *d*, 5, *d*, 6 *c*, 7 *c*, 8 *c*. The other panels could not be checked due to lack of time.

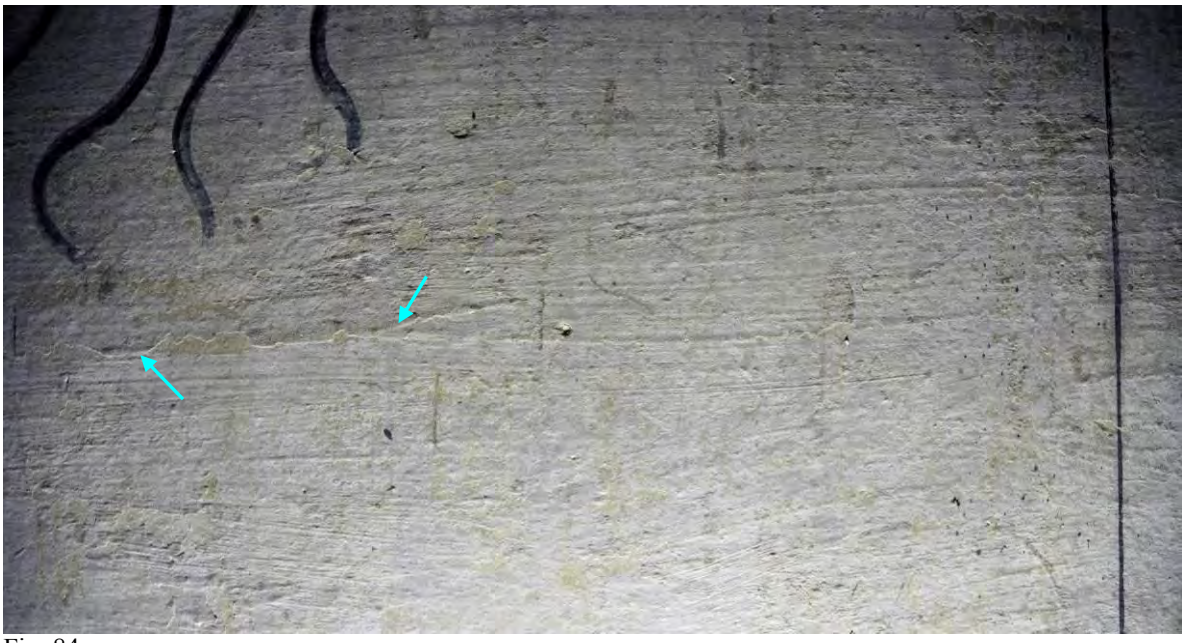

Fig. 84
Yunqi dong, detail in raking light: horizontal brush-marks in the ground layer and accumulations in bulges (blue arrows)

Fig. 85
Sanguo dong, detail in raking light: brush marks from the ground layer running diagonally

Fig. 86
Sanguo dong, detail in raking light: overlapping brush marks from the ground layer running diagonally in both directions. The lower part shows the white framing of the painting where the white ground is not covered with a pictorial layer.

Isolation layer

The fine coat surface had been covered with an isolation layer before the priming layer was applied.[41] Under VIS the layer is partly visible as a transparent layer. Under UV light, the isolation layer shows a bluish white UV fluorescence and appears brighter than the priming layer.

White ground layer

The white ground layer consists of white earth rich in kaolinite, muscovite and quartz, and varying but low amounts of calcium-containing minerals (calcite or gypsum). Low amounts of charcoal black and red or yellow iron oxide found in most of the slide preparations and cross sections may be a contamination rather than a deliberate addition and do not influence the colour. In Wafangdian, no kaolin is found, but there are three places in Ziyang (county) known today, so the use of local material can be assumed.[42]
The ground layer was applied as a thin, watery suspension which ran down the walls. The runs are long and of low pastosity (fig. 99). Some cross sections show a layering (two to five layers) without a discernible soiling of the surfaces in between. The diluted suspension of kaolin may have been applied several times. Reconstruction tests showed that with a suspension diluted to the degree that enabled to reproduce runs of equivalent length and thinness, at least four applications were necessary to achieve a homogenous thickness and sufficient opacity. The use of highly diluted clay suspensions probably served to avoid distinct brush marks and thus at least a more extensive polishing of the ground layer.
Exposed surfaces of the priming layer nowadays look slightly greyish and semi-transparent. The isolation layer may have saturated the ground layer and may have discoloured slightly. It is possible, too, that coatings were applied later.
The ground layer has a light slightly bluish UV fluorescence when observed at the wall, in cross sections the fluorescence is yellowish. Different from the sizing of the fine coat (underneath the ground layer), the isolation material on top of the priming layer seems to have penetrated into the priming, so no layer is visible in cross sections. Binding medium layers underneath the pictorial layer could be observed in few samples and may be restricted to areas with a special painting technique.[43]

The surfaces of the *pingfeng xi*- and *pingfeng dong*-paintings are very smooth, even under raking light. The lower part of the wall (panels *c* to *e*) is even smoother than the upper part (panels *b*), where slight, vertical brush marks can be distinguished. The horizontally running brush marks become more distinct under UV light (ridges appear brighter, recessions darker, fig. 156/157, 164/165). The walls may have been polished either before or after applying an isolation material onto the ground layer. In the recessions, the isolation layer or accumulations of other materials seem to be thicker. The murals of the *zhengdian* are less smooth. Slight irregularities in the fine coat were not repaired. Brush marks from the application of the ground layer remained visible. In the *yunqi*-paintings the brush marks are more prominent than on the other paintings. Maybe less attention was paid for these inferior positions, but the brush marks are also better visible because large areas of ground layer remained visible here, serving as white background (fig. 84). The brush marks from applying the ground layer run horizontally on all paintings except for the *sanguo*-walls, where they often run diagonally and

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41 Examination of cross sections. The presence of the isolation layer could be confirmed for all paintings of which cross sections including the fine coat-surface have been taken: the paintings of *sanguo xi*, *sanguo dong*, *pingfeng xi* and *pingfeng dong*.

42 MA et al. 2012 (no page numbers).

43 Mainly for lead white layers serving as reflector for glazes.

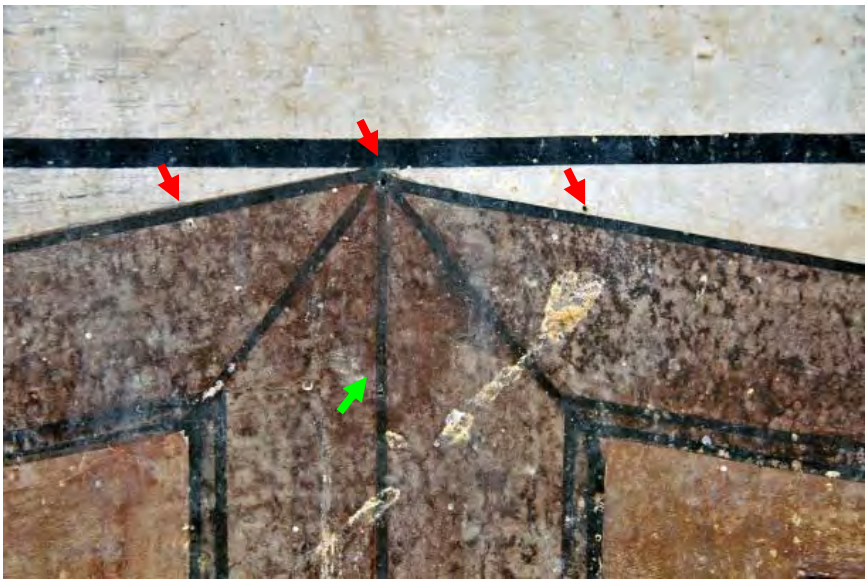

Fig. 87
Pingfeng xi, nail holes for pinning strings to mark the stiles (red) and the panel frames (green)

Fig. 88
Pingfeng xi, nail holes for pinning strings to mark the filling frames (green)

Fig. 89
Pingfeng dong, lower edge (zone of *e*-panels): the horizontal line marks the black contour of the white framing of the painting.

sometimes overlying in different directions (fig. 85 and 86). The differences may indicate that the ground layer was not applied by one person, but maybe separately by the respective team that was responsible for painting that particular wall.
The ground layer was also used as white colour. It is visible in the white framing of all the paintings and white parts of the background. In the narrative scenes of the *pingfeng xi*-painting, which are executed in a water-colour technique, the white ground also serves as white highlights (i.e. highlights left out during painting). In the painting of *pingfeng dong*, *yunqi*, *tianguan cifu, pingfeng bei* and *long*, the white ground served as light coloured area, whereas highlights were applied with a lead white (or a mixture of lead white and colours).

Construction lines

The straight lines of the framings and the construction of the folding screens were marked with chalk lines. Preliminary drawings were only found in the *zhengdian*.

Folding screens in the guodian

As the first step of transferring the design of the folding screens, the outlines and the subdivisions of the framework were marked with chalk lines. Many of the holes caused by small nails or pins inserted into the wall in order to attach the strings are still noticeable at closer examination. The vertical lines for marking the stiles were made using plumbs which were pinned to nails at the upper edge or above the folding screen (fig. 87, red arrows). The delineation of the panel frames was marked with an additional set of strings (figs. 87 and 88, green arrows). Figure 91 shows an overview of all the detected nail holes in the *pingfeng xi*-painting. Figure 92 and 93 show a tentative reconstruction according to the construction lines.
At the *pingfeng dong*-painting, too, black lines starting at nail holes mark the filling frames of the *d*- and *e*- panels. They are visible through the translucent light red paint layer of the panel frames (fig. 90). The lines are thinner and more homogeneous than the chalk lines found in the *zhengdian* on the strip of plaster between the *sanguo* and *yunqi*-murals, and they do not appear to be made with a liquid matter like ink, but with a dry black material like e.g. soot. The same technique was used at the *pingfeng bei*-painting: chalk lines are visible in the panel frames, marking the outlines of the filling frames (comparable to the situation in fig. 90).
The black contour lines of the framing (black framing and contour of white framing) around the folding screens were marked with black lines as well (fig. 89), but no corresponding holes for strings could be detected.

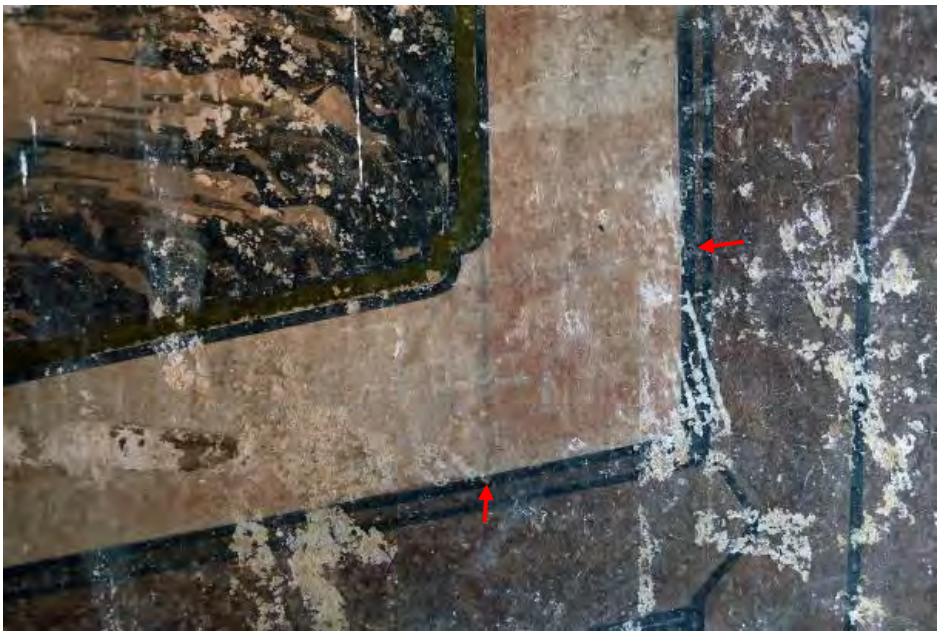

Fig. 90
Pingfeng dong, chalk lines mark the outlines of the green filling frame. The nail holes to attach the strings could be detected (red arrows).

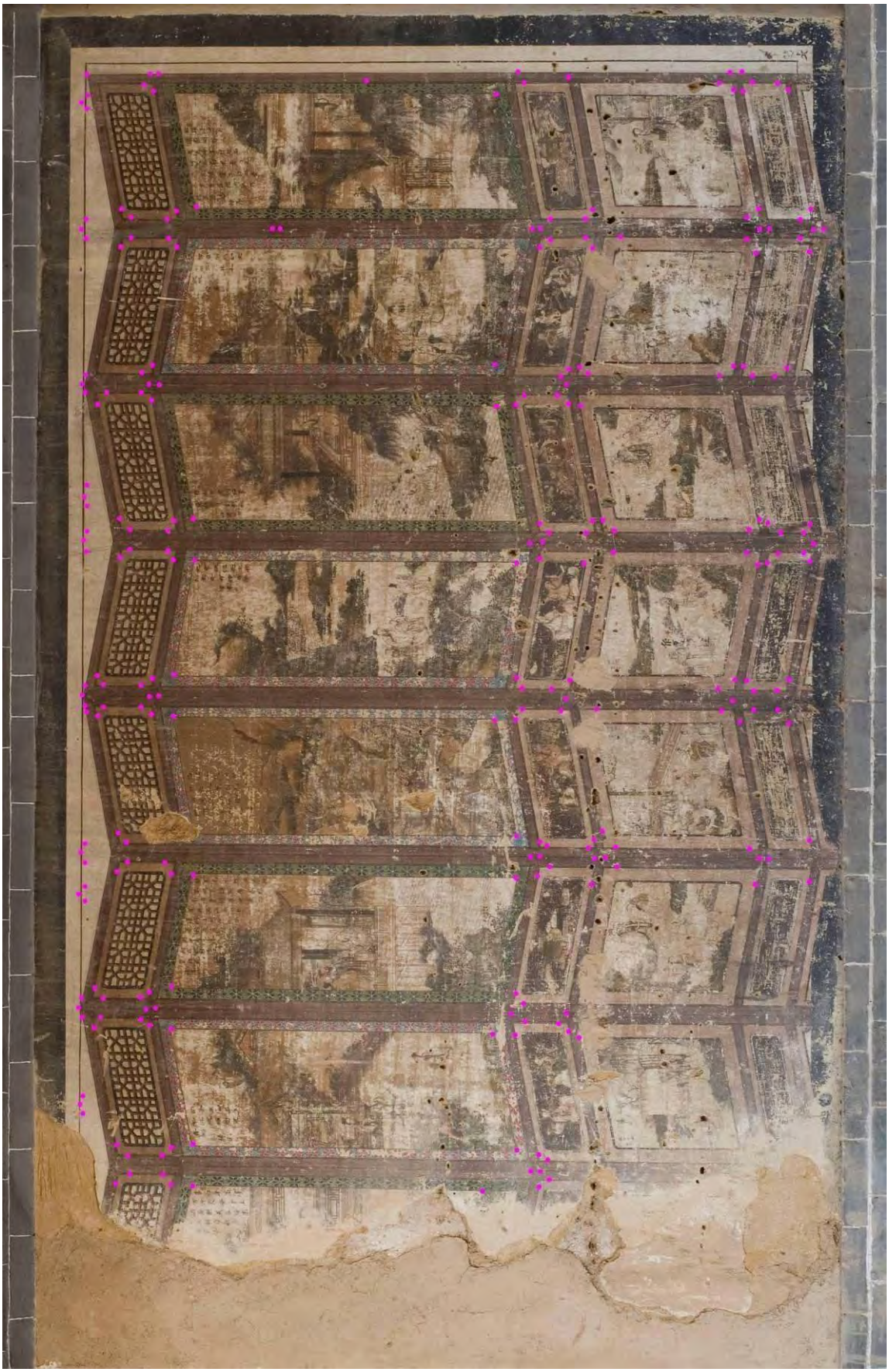

Fig. 91
Overview of visible nail holes from pinning strings for snapped lines (pink dots)

Fig. 92
Reconstruction of strings used for the construction of the folding screen, (photograph not rectified)
[Photograph: Shaanxi Institute for Conservation]

Fig. 93
System of strings used for the construction of the *pingfeng xi*-painting according to fig. 92.

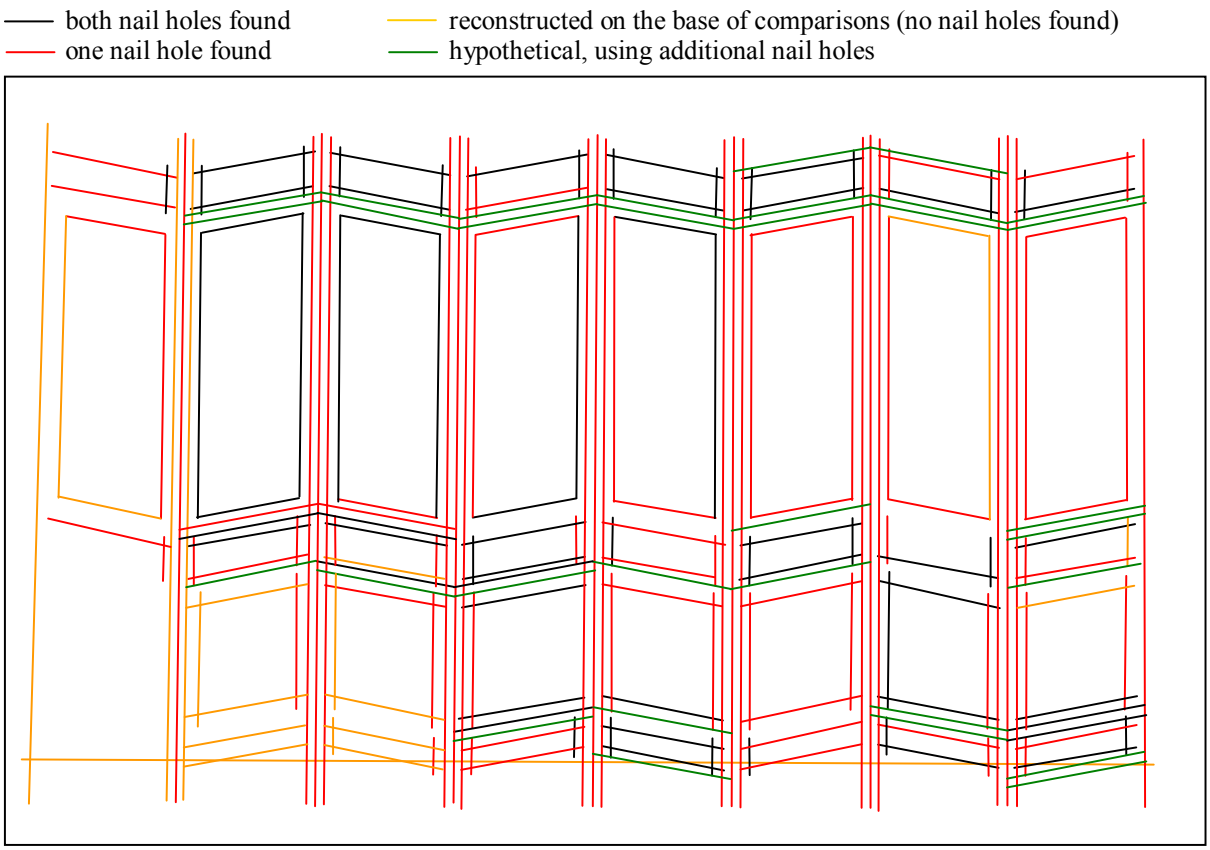

Fig. 94
Pingfeng xi, panel 2 *d*: two grey vertical lines running through a narrative scene of the panel filling 2 *d*

▼ Fig. 95
Tentative reconstruction of the first (discarded) draft (of a six-fold screen?):
Black: lines visible in the painting
Blue: holes visible
Red: lines reconstructed according to distances given by the black lines.

Discarded design in the *pingfeng xi*-painting

In the *pingfeng xi*-painting, vertical construction lines are found running through the scenes in the panels 2 *d* (fig. 94), 3 *b* and 3 *d,* 6 *d* and 8 *d* (fig. 95). They do not belong to the construction system described above. They correspond to additional nail holes detected at the top edge of the *pingfeng xi*-painting. Obviously, the painter either changed the concept or made a mistake. The holes are marked in the sketch of the nail holes in figure 91. The pattern of three holes close to each other and in staggered arrangement is the same as the one used for the actual folding screen. The first draft may have been for a six-fold screen (like *pingfeng bei*) although the subdivision rather shows deviances which would have resulted in an irregular width of the frames (fig. 95).

The observations allow to reconstruct the working process in general:

The first step probably was to define the subdivision into frames by means of vertical lines. The distances may have been measured and then marked by hanging a plumbed string from a nail. The outlines of the stiles were then marked with two more lines, to the right and left of the first ones, resulting in a subdivision of the wall by groups of three vertical lines. If the reconstruction of the unfit lines is correct, the initial planning with a six-fold screen was discarded at this step of work: Some of the black lines marking the borders between framework and panel had already been marked, but seemingly not all of them. The lines marked in black could not completely be removed from the surface of the priming layer and remained faintly visible.

The construction of the definite design of the eight-fold screen may have been done in the same way. After defining the vertical lines, the subdivision for the position of the filling frames was marked with additional strings. The holes may have been made into the vertical lines marked for the discarded design.

Paintings in the zhengdian

At the *sanguo xi*-wall, there is a faintly visible, vertical construction line running along the contour line of the framing and proceeding through the white framing (located at the northern edge of the *sanguo xi*-wall at the offset of the framing, next to the upper edge of the *yunqi*-painting). The dark line here seems to lie underneath the surface of the priming layer (fig. 96). This construction line may be a painted and not a chalk line.

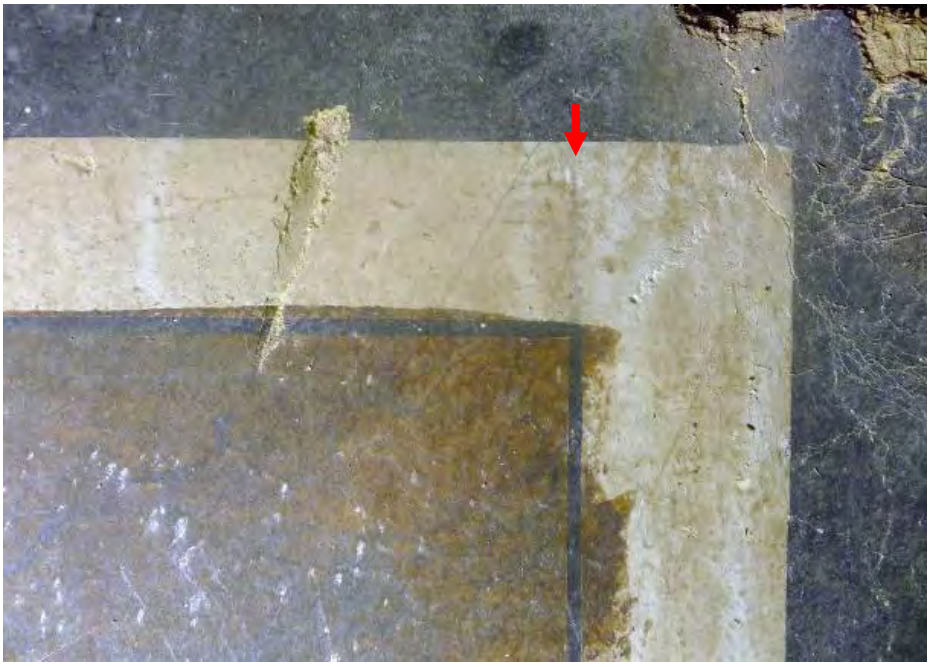

Fig. 96
Sanguo xi, offset on northern edge, vertical construction line (underneath a white layer?)

Fig. 97
Pingfeng xi, panel 2 *a*, decorative lattice: orange red underneath the priming layer

Fig. 98
Pingfeng xi, panel 4 *b*, dab of orange red on fine coat underneath the priming layer

Fig. 99
Tianguan cifu, grey lines of preliminary drawing of waves underneath the black lines

Fig. 100
long, greenish lines of preliminary drawing of waves underneath the black lines

Preliminary drawing (delineation)

There must have been design drawings for the narrative scenes, defining the arrangement of the larger scenes, especially the rather complex arrangements of the *sanguo*-walls. Most obvious are the antithetic lay-outs of the architecture, the riders above their roofs and the arrangement of groups. Similarities between single figures regarding posture, clothes and features as for example the heavenly officials in the paintings of *tianguan cifu*, *pingfeng xi* (panel 3 *d*) and *pingfeng bei* (panel 2 *b*), may indicate the use of master drawings of single figures which served as templates wherever such a figure was planned. A practised painter may have been able to copy it free-handed in the required scale and to adapt it to the respective scene or to make an intermediate drawing to transfer the figure to the wall (see: pp. 181). There are different possibilities of transferring designs to walls. The use of cartoons can be traced back as early as the Tang Dynasty[44] and seems to have been commonly used in China. Free sketching based on an auxiliary grid or few sketch lines is another possibility. Traces of designing or transferring the narrative scenes, however, could not be detected.

At the *pingfeng xi*-painting, traces of preliminary drawings are not visible (except for the construction lines of the folding screen). In two lacunae, lines of orange-red paint are visible underneath the ground layer, on the surface of the fine coat (fig. 97 and 98). The orange traces may either belong to a preliminary drawing directly on the plaster surface or be marks of paint not connected to the mural, e.g. from painting the wooden construction.

Pingfeng x*i-painting*

In the figurative depictions of the *b*- and *d*-panels, no traces of transferring, e.g. impressed or incised lines, could be observed. It can be assumed that at least the rough outlines were transferred as traces of composing could not be found either and all outlines are very precise. It is possible that a technique was used that did not leave any visible traces (as spolvero / pouncing[45]) or that it was of a kind that is completely concealed underneath the visible lines today. Reconstruction tests showed that a transfer of the outlines with lines traced through a paper with only slight pressure becomes invisible after painting.

Fig. 101
Sanguo xi, northern edge: oarsman (figure no. 77, h 22 cm)

Fig. 102
Sanguo xi, left leg of the oarsman, drawing visible inside a lacuna

Fig. 103
Sanguo xi, oarsman, robe: drawing visible inside a lacuna

[44] Cartoons dating from the Tang Dynasty were found in the Library Cave in Dunhuang. SHEKEDE et al. 2009, p. 431.

[45] It is not clear if this technique was common in China.

Fig. 104
Sanguo xi, black preliminary drawing visible through translucent yellow layer of flag: the black lines visible underneath the folds shaded with dark ochre glaze

Fig. 105
Sanguo xi: Cursive Chinese characters reading "light purple" (*qian*? *zi* 淺? 紫) in a pink flag

Fig. 106
Sanguo xi: Chinese characters reading "moon white" (*yue bai* 月白) in a green robe

Sanguo-*paintings*, tianguan cifu *and* long

In both paintings a detailed drawing of the depiction was made in black or dark grey before the colours were applied. These lines can partly still be seen through semi-translucent pictorial layers (fig. 104) or become visible in losses of the paint layer (figs. 101 to 103). In the waves of the *tianguan cifu*- and the *long*-painting, a detailed preliminary drawing can be observed, appearing grey in the *tianguan cifu*-painting (fig. 99) and greenish in the *long*-painting (fig. 100). The first drawing seems to lie underneath the last application of the white ground. It is possible that this is the case with the oarsman in the *sanguo xi*-painting as well. Sometimes, the black or grey lines deviate slightly from the final contours, for example in the waves of the *tianguan cifu*-painting and a yellow flag (fig. 104) in the *sanguo xi*-painting, but mostly they are either underneath the pictorial layer or included into the visible contours.
After the removal of the whitewash from the topmost part of the *sanguo*-paintings, the original paint layer showed many lacunae and areas of reduced and abraded paint layers. In these layers, the Chinese restorers detected small characters of colour names, indicating the colour to be filled-in into the respective area, for example in a pale pinkish purple flag in the upper part of the *sanguo xi*-wall (fig. 105).[46] There seems to be different handwritings (cursive and grey, but also straight in black brush strokes). The characters were written with fine brushes or pencils. In some cases the inscribed colour and the existing one differ, for example in a green robe where "moon white" was indicated (fig. 106). The inscription of the colours can be seen as implemental aid of the painter, maybe by copying a template, but may also indicate that the colouration was done by a group of painters and the colour names served as guidelines set by the master.

Infrared reflectography was used for further examination of the *sanguo*-murals. The technique did not give results for all areas, depending on the colours and pigments of the pictorial layer: Red, pink and purple showed a good transmittance, while layers containing lead white were much less permeable. Some more characters regarding the colours could be detected (fig. 107 and 108). Lines of the preliminary drawing became visible or more distinct in the robes, the horses and the saddlery, sometimes deviating from the final drawing (fig. 109/110 and 113/114). The hair of the horses' manes and tales was sketched with extremely fine, dark grey to black lines, before they were carried out in the horse's coat colour (fig. 112). With IR reflectography drawings of details became distinct which are not recognisable because of the ageing of the brown layers in the background, like waves or clouds in the background (fig. 116) or folds of dark green garments. The fine drawing indicating grass, however, that is faintly visible underneath the brown layers as greyish lines, is not visible in the IR reflectography pictures. Under UV light, too, the fine drawing, is almost invisible.

Pingfeng bei-painting

In the *b*-panels of *pingfeng bei*-painting, the figures and details of the landscape were delineated in black or grey and repeated during the painting process in black, comparable to the other paintings in the *zhengdian*.
In the *d*-panels only one application of delineation is visible, drawn in dark black lines. Either the delineation was not repeated as no opaque colours were used here or the first delineation is completely hidden underneath the visible black lines.

[46] Translation by the restorers of the Shaanxi Institute for Conservation, 2013.

Fig. 107
Sanguo xi, right lower corner, horseman (figure no. 30) with a pink tunic, a purple "skirt" and a pale pink cloth around his buttocks

Fig. 108
IR reflectography of the horseman, revealing colour names in the tunic and skirt. Areas containing lead white (buttocks, horse) have no transmittance for IR radiation. Grey lines in the structure of the landscape next to the body of the rider are visible in VIS, but not in the IR reflectography.

Fig. 109
Sanguo xi, right lower corner: leg and knee of a rider on a pink horse (figure no. 31)

Fig. 110
In the IR-reflectography, fine grey lines of underdrawing are visible in the cloud-ornaments on the saddle and the knee, the wrinkles in the dark bootleg and the red footpart of his boot. In the red robe, the fine drawing was repeated with contour lines on top of the paint layer, but the lines are not exactly congruent.

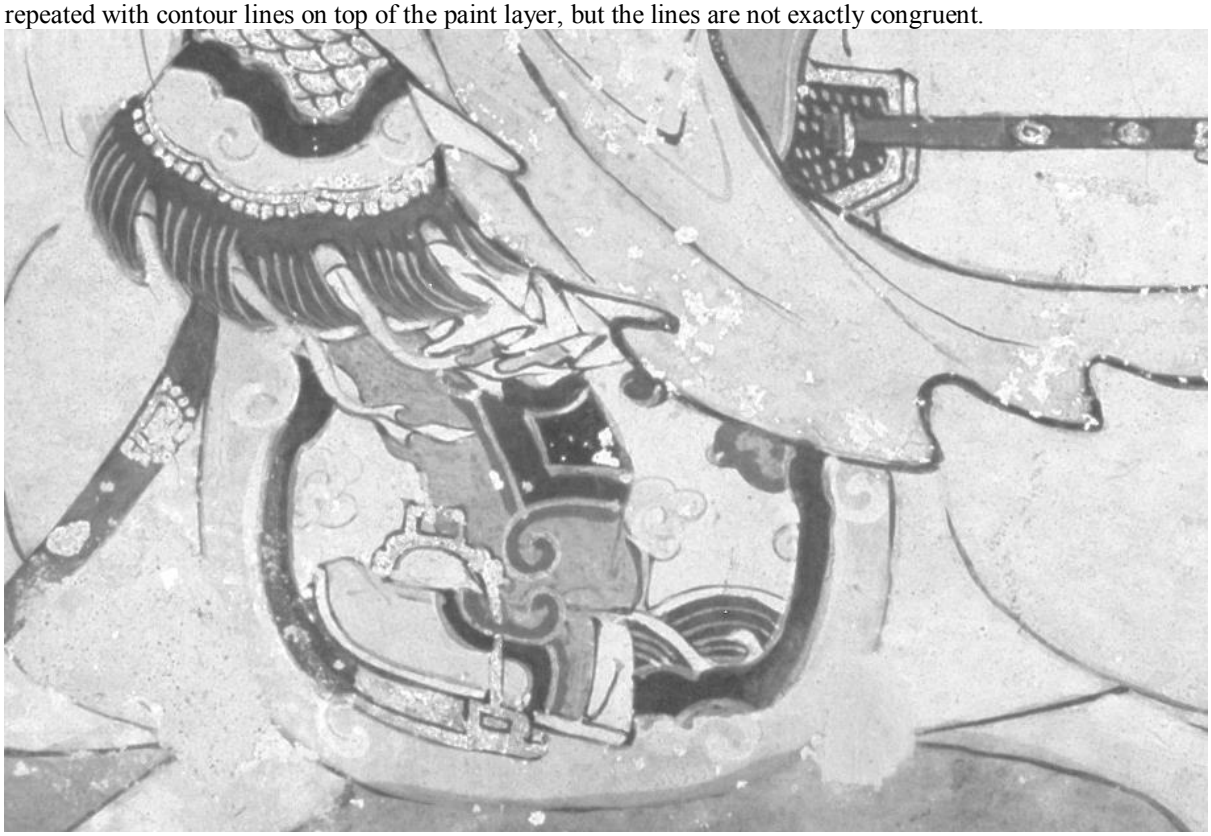

Fig. 111
Sanguo dong, Guan Yu on his red horse (figure no. 35), left (northern) edge of the painting

Fig. 112
The red paint of the horse shows good transmittance for IR-radiation. Differences between the drawing and the visible painting can be seen in the nostrils, the wrinkles on the nose and the shape of the chin bone of the horse. The mane was sketched with much finer lines and slightly different curvature.

Fig. 113
Sanguo dong, soldier with horse (figure no. 23)

Fig. 114
IR: The preliminary drawing becomes more distinct; the spiral ornaments (arrow) were not painted with opaque colours.

Fig. 115
Sanguo dong, red flag (F 4)

Fig. 116
Preliminary drawing in the flag, the drawing of cloud and the waves are more distinct

Fig. 117
Sanguo dong, upper part; small dish on the table next to figures no. 74 and 65

Fig. 118
IR: Scale-like structure of the cover

Fig. 119
Sanguo dong, Liu Bei (figure no. 12) kneeling in the *ganlusi* hall. Black contours painted on top of red paint layer

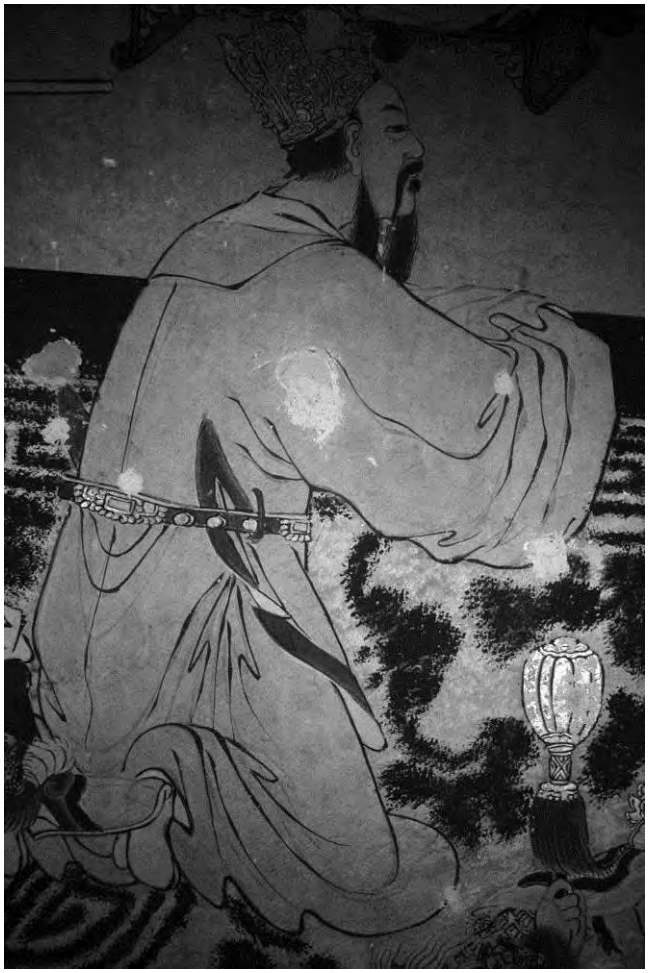

Fig. 120
Sanguo dong, Liu Bei (figure no. 12) IR reflectography: the preliminary drawing in the robe is visible as light grey lines, deviating from the visible black contours

PAINT LAYERS

Principally, the painting process started with a black delineation, in which washes and opaque paint layers were filled in. Details are described separately for each wall.

Guodian: Pingfeng xi-painting

Before the painting process started the contours had been marked with the chalk lines. The painting process of the *pingfeng xi* wall can be reconstructed as follows:

(1) A light, reddish brown wash was applied on the framework or the black delineation (including the framing of the mural).

(2) A transparent isolation was applied on the folding screen, overlapping the outer contour slightly.

(3) Borders with star pattern (frames of the *b*-panels)

(4) Scenes of the panel fillings (figurative scenes) / Light pink wash on the panel frames

(5) Black colouration of the filling frames / Black and green dots on the figurative scenes / black framing?

(6) Lattice of the *a*-panels: red lines, yellow lines

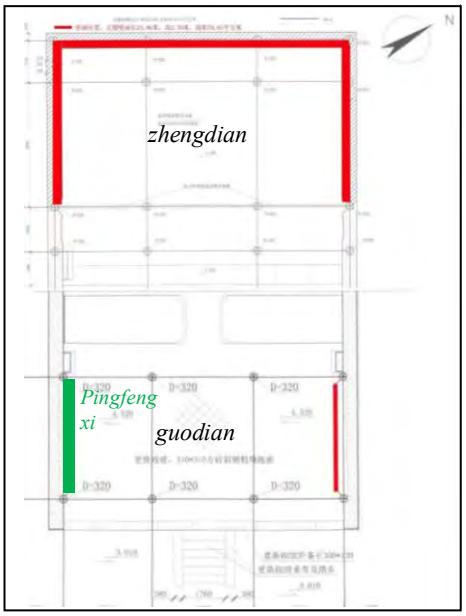

Fig. 121
Position of *pingfeng xi*-painting

It is not clear at which step of the painting process the brown washes were applied on the framework. They overlap the black colour of the framing.

In the figurative scenes, a transparent, originally probably colourless binding medium layer was applied which can be interpreted as protective coating.

Framing

The black framing is 10 to 11 cm wide. The white framing inside the black one is bordered by a 0.5 to 0.7 cm wide black line separating it from the likewise white background.
The black paint for colouring the black framing was darker than the one used for its contour lines and slightly pastose. It was applied with a broad brush leaving visible brushstrokes. It has the same characteristics as the black used for the filling frames (see below: *Black filling frames of the* a-, c-, d-, e-*panels and the legs,* p. 97). Near the corners the black is lying directly on the finish coat, without a visible layer of white ground layer. This indicates that the white ground layer may have applied less carefully in the corners or that the black was repainted later on, although no traces of that are recognisable in the paint layer.

Framework

Contours

The contours were drawn with 1.5 to 2 mm wide black lines. They were drawn using an auxiliary device like a ruler.

Isolation layer underneath the brown washes

There is a margin of transparent material following the outlines of the folding screen (fig. 114, green arrow). Under UV light, the material does not differ from the light bluish

fluorescing ground layer. As the transparent layer cannot be detected in the painted parts (neither with VIS nor with UV or in cross sections), it is difficult to define in which step of the painting process it was applied: it may be a sizing before the painting was started, an intermediate layer or a protective coating. Close examination showed that the material is lying underneath the brown wash of the framework (fig. 115).[47] It can thus be assumed that the material either is a sizing or an intermediate layer at an early moment in the painting process. It is not clear if it was applied before or after the black contour lines were drawn.

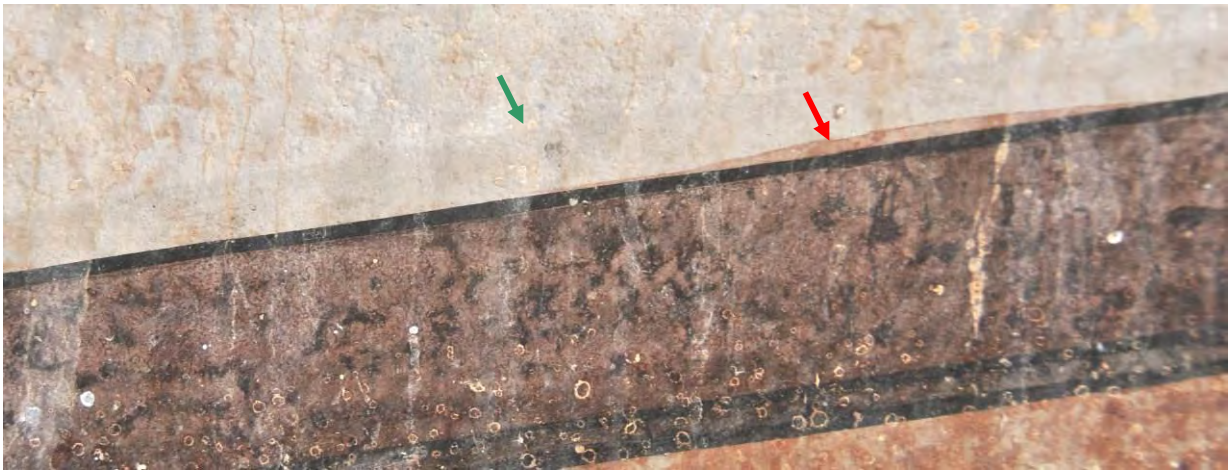

Fig. 114
Pingfeng xi, top above panel *a*: light brown next to the contour of the dark brown frame (red arrow); transparent layer next to the outline of the folding screen (green arrow)

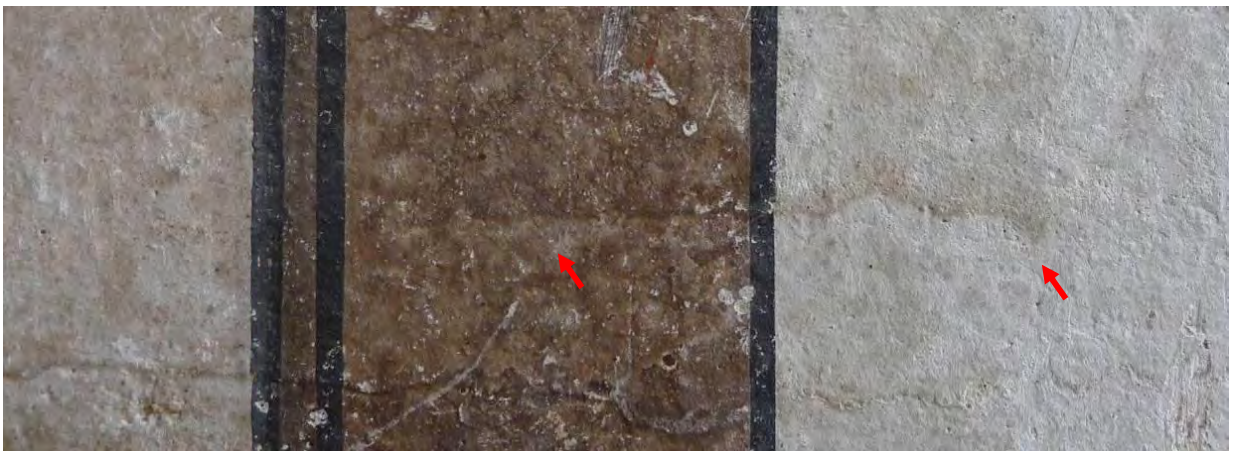

Fig. 115
Pingfeng xi, next to panel 8 *d*, end of a brush mark from applying the isolation layer. The mark is visible through the brown paint layer of the framework (red arrows).

First reddish brown wash on the framework

The first layer applied to the framework was a light pinkish brown wash. It is visible in few places where the layers do not overlap precisely (fig. 114, red arrow).[48] It could not be ascertained if a light reddish brown wash or the delineation was applied first.

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47 Visible next to panel 8 *d*. In the stiles between panel 3 *a* and 4 *a* a similar phenomenon is visible.

48 Three layers are visible in the framework between panel 3 f and 4 f: a light brown underneath two layers of darker brown which both overlap the black contour lines.

Brown paint layer of framework

The brown colouration was applied after the black lines were drawn. It consists of at least two semi-translucent washes, the lower one being lighter in colour. Two layers are recognisable as their edges are not superimposed precisely in all parts (fig. 116) and could also be distinguished in cross sections. Iron oxide and a fine-grained black (probably flame carbon) were identified as pigments.[49] In many areas the layer is blotchy and has accumulated in irregularities of the ground (fig. 117). Reconstruction tests showed that the same phenomenon occurred when two layers of a wash were applied to a slightly irregular ground (fig. 118).

Fig. 116
Pingfeng xi, panel 5 *d*, to 6 *d*, the two brown washes are not superimposed precisely (arrows).

Fig. 117
Pingfeng xi, brown washes have accumulated in irregularities of the ground.

Fig. 118
Reconstruction test: irregularities of the ground became visible after second application of brown wash.

Bevelled edges of framework

The bevelled edges of the framework are shaded with a deep greyish brown wash which probably was applied onto the darker brown wash of the framework (fig. 119).[50]

Fig. 119
Pingfeng xi, panel 5 *a*, the bevelled edges of the frame are shaded to give the impression of three-dimensionality

[49] Sample *pfx* 7, CS 1 and CS 2, framework next to panel 2 *e*. PLM, slide preparation PP Z 49. A high amount of iron was confirmed using XRF. - Sample *pfx* 22, CS 1: brown wash overlapping black line.

[50] No samples were taken from the bevelled edges of the framework.

Fig. 120
Pingfeng xi, black delineation accompanied by white margins.

Fig. 121
Pingfeng xi, northern edge of frame 8, next to *c*-panel: The second application of brown overlaps the black line and the white margin.

Fig. 122
Reconstruction test. White margins produced by omitting the black line during the application of the brown wash.

Fig. 123
Reconstruction test. White margins resulting from the "repelling effect": The brown wash was brushed across the black line.

Technical peculiarity: black lines with white margins

The black contours of the framework often have a very thin white margin towards the brown washes filling the framework. At first glance, the white margins seemed to be scribed or traced with a sharp tool (fig. 120), but closer examination revealed that they result from the absence of brown paint.

Reconstruction tests showed that it is possible to create white margins by omitting a very thin strip when applying the brown next to the black (fig. 122, right side). This, however, is only possible if the direction of the application is parallel to the black lines. In some cases, however, the brown wash(es) run *across* the black line, and sometimes overlap it. Closer examination also showed that sometimes there is lighter margin that has been covered by the second application of the brown wash (fig. 121).

This indicates that the thin white margins result from a "water-repelling effect" as it is used in batik dying: If a line is painted with a non-aqueous medium, a water-based material afterwards will not adhere on the lines and thus prevent the ground from being stained. The effect could be reproduced by using a fatty medium for the black lines (flames carbons in egg yolk) and by painting a wash with a binding medium diluted with water (gum arabic or diluted egg yolk) over it (fig. 122). The effect became even more distinct if the sizing of the ground layer with animal glue was applied after the black line had been drawn. Like on the murals, the white margins are not as straight as if scribed, and they slightly vary in broadness (fig. 123).

The same phenomenon of white margins was observed at the black outer contour on the *sanguo*-paintings (*see*: p. 145).

Technical peculiarity: ring-like losses in the brown paint

Very often, tiny white "circles" are visible in the framework, mostly in the black contours and the brown washes (fig. 124), consisting of small ring-like lacunae (up to 2 mm in diameter). Sometimes they also appear in groups. Reconstruction tests indicate that these rings are connected to air bubbles which formed during the application of the upper layers of the ground layer: after the bubbles had burst, a ring with a raised ridge remained (fig. 125). These ridges may have flaked off or have been abraded later on. If this consideration is right, the walls have not been polished after the final application of the ground layer.

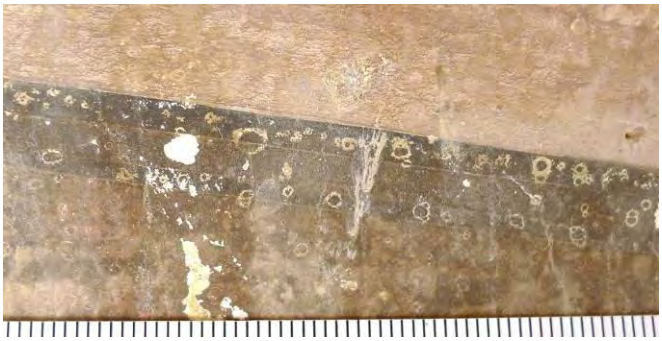


Fig. 124
Detail of framework with ring-like small lacunae

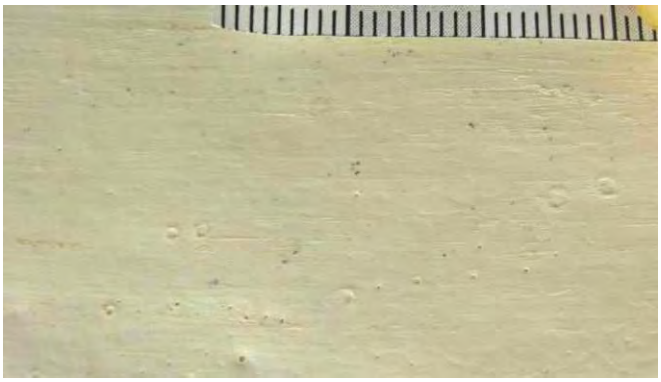


Fig. 125
Reconstruction test with rings caused by small air bubbles forming during the application of the ground layer

Fig. 126
Pingfeng xi, *a*-panels: at the panel frame, the light pink paint, which is of a coagulated consistence, overlaps the black delineation of the framework and filling frames.

Fig. 127
Pingfeng xi, panel frame of panel 2 *d*: yellow particles in streaks of paint with coagulated accumulations of pigments (the longer side of the photograph is equivalent to 4 mm)

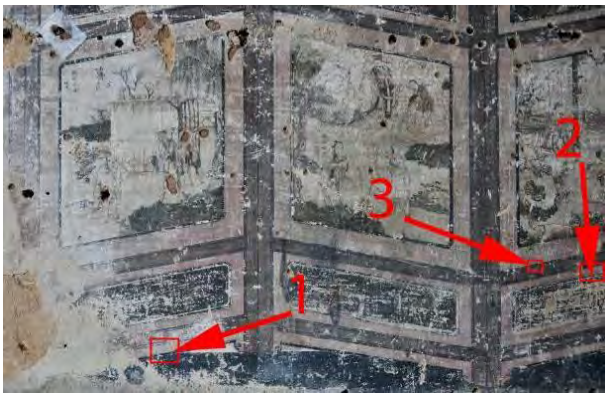


Fig. 128
Pingfeng xi: map of spots where orange red lines were observed

Fig. 130
Spot no. 1, panel 2 *f*: orange line visible in lacunae of the black border overlapping the light pink panel frame

Fig. 129
Spot no. 2: red orange line underneath the black filling frame of panel 4 *e*

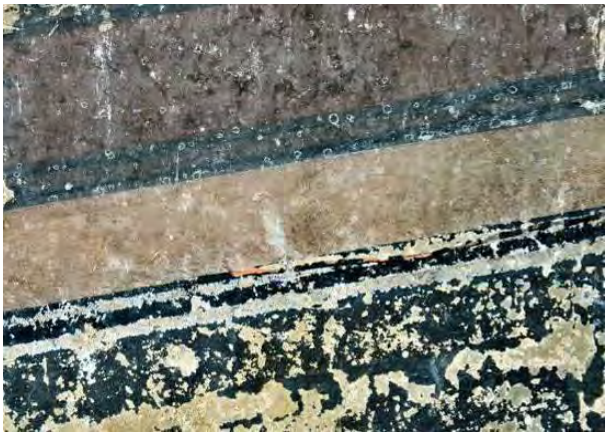
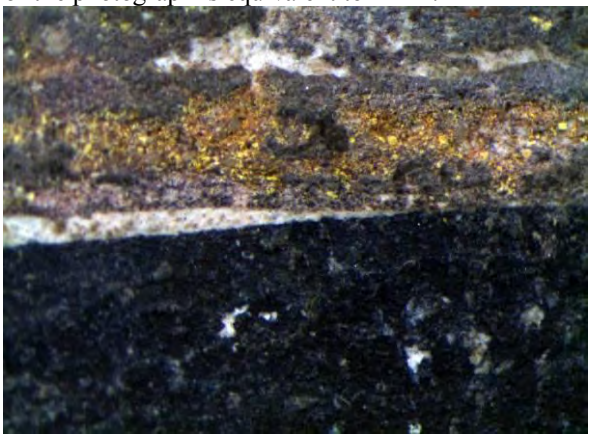


Fig. 131
Spot no. 3, panel frame of panel 4 *d*:
Photographed under the microscope, the longer side of the photograph is equivalent to 4 mm.



Panel frames and filling frames

The panel frames are formed of 3 cm wide borders surrounding the panel fillings. At the *pingfeng xi*-painting, the panel frames of the *a*-, *c*-, *d*-, *e*-panels and the *f*-zone are coloured in a light pink. A narrow black filling frame (corresponding to a trim in a wooden construction) surrounds the figurative depictions.
The *b*-panels have a multi-coloured geometric pattern and no filling frames.

Pink panel frames of the a-, c-, d-, e-*panels and the feet*

On-site microscopic examination of the pink paint that ranges between red, yellowish and brown, revealed the presence of rather large yellow bright particles imbedded between reddish brown clusters (fig. 127). They were identified as clusters of orpiment, red lead and a very fine brown iron oxide that is identical with the pigment used on the framework.[51]
The paint layer is translucent, but slightly turbid. In many parts, it has an inhomogeneous texture as if the paint coagulated or did not contain enough binding medium (fig. 126). The cross section revealed that the incoherent paint layer consists of clusters of pigments in a medium that seems to have penetrated into the priming layer.[52]
In some parts, the application of the last layer seems to have dissolved a lower layer wiping off the pigments of the surface and redistributing them. Occasionally a brownish pink or light red could be observed lying underneath the black contours of the framework, while the turbid pink overlaps the black lines.[53] This indicates that two layers of paint were applied, although this is not visible in cross sections. Maybe a light brownish wash containing iron oxide was applied first (corresponding to the first wash on the framework), followed by a semi-opaque layer containing orpiment and red lead.
The pink paint layer overlaps the black delineation of the framework and the filling frames whereas it is overlapped by the black colour of the filling frames (fig. 126).

Pastose orange-red 'lines' which are drawn freehand have been observed in three spots underneath or next to black contour lines (figs. 128-131):
- 1. Below panel 2 *e*, underneath the black contour line of the filling frame (fig. 130)
- 2. Panel 4 *e*, underneath the black contour line of the filling frame (fig. 129)
- 3. Panel 4 *d*, next to the contour of the framework (more yellow than red, fig. 131)
- 4. Panel 3 *e*, lower rail, next to the contour of the framework.

Under the microscope, red and yellow pigment particles were visible. The yellow pigment clusters are much bigger than the fine red particles.
There seems to be a connection with the light pink turbid paint layer of the panel frames: it is possible that the 'lines' are accumulations of the pink paint which may originally have been more orange and much brighter than today.

Black filling frames of the a-, c-, d-, e-*panels and legs*

The filling frames and the trim border along the legs are 0.8 cm wide. They were delineated with two lines before the light pink of the panel frames was painted, and filled with deep black paint after the light pink paint had been applied to the panel frames. The black colour is darker than the black delineation and was drawn as a single thick line using a ruler (figs. 132 and 133). At least partly the contours were drawn again.

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[51] Analysis with polarised light microscopy (PLM). Sample *pfx* 8, slide preparations PP Z 51, 52, 73.

[52] Sample *pfx* 8, CS 1.

[53] This was observed in the areas between panels 3 *e* to 3 *f* and in panel 3 *a*.

Fig. 132
Pingfeng xi, lower edge, back framing and border of *f*-panel: the black paint is of deeper colour than the contour lines

Fig. 133
Pingfeng xi, trim along the legs: The black paint overlaps the light pinkish paint of the frame.

Fig. 134
Pingfeng xi, panel 2 *b* to 3 *b*: star borders

Fig. 135
Pingfeng xi, panel 4 *b*, corner ornament of star border

Fig. 136
Pingfeng xi, panel 3 *b*, corner ornament of star border

Borders of b-panels ("star patterns")

The *b*-panels are framed with 3.3 cm wide borders showing colourful geometrical patterns based on six-pointed stars (fig. 134). Interspaces are filled with stylised blossoms. The corners are decorated with a multi-coloured cloud ornament (fig. 135 and 136). The colours used for the ornament alternate in two colour schemes (table 8).

Table 8
Pingfeng xi: Type of patterns in borders of *b*-panels

Frame	*colour of background*	*star colours*
1, 3, 6, 8	greenish blue	dark blue on blue
2, 4, 5, 7	lighter blue	red on pink

The painting process (see table 9)

The outlines of the borders were already marked by the black contour lines of the folding screen. As the first step, the ground colour was applied (blue in frame 1, 3, 6 and 8, and greenish blue in frame 2, 4, 5 and 7). The star pattern was set out with the white lines. A straight device like a ruler may have been used to draw the lines, but a practised painter can also draw them free-hand, maybe on the base of marks to obtain pattern units of approximately even size. The dimensions of the stars vary visibly, but the strict repetition of small details (each blossom has nine petals and five dots as stamina) results in an impression of regularity. Afterwards the colours were filled in. Reconstruction tests showed that the execution of the pattern is not difficult, even without much practise.

Details of the narrative scenes in the panel fillings sometimes overlap the ground colour or even details of the star borders. Black lines overlap the star patterns in panel 1 *b* (fig. 137) and 2 *b*. Green leaves are overlapping the star border in panel 3 *b*, as are the green glaze of panel 7 *b* (fig. 138) and many of the green dots (fig. 139). This shows that the star patterns had been finished before the figurative scenes were painted.

Fig. 137
Panel 1 *b*: black lines overlapping onto the star border (arrows)

Fig. 138
Panel 7 *b*: green wash overlaping onto pink of star border (arrow)

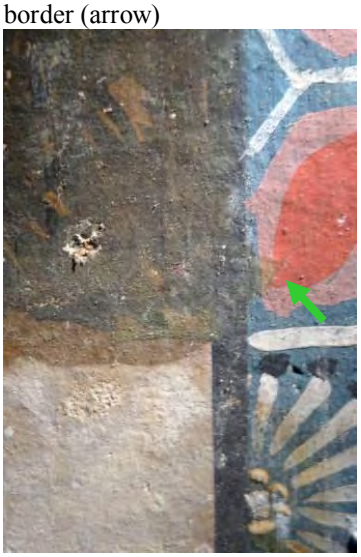


Fig. 139
Green dots on the black outline from floral frame (arrow)

Fig. 140
Pingfeng xi, borders of panels 5 and 6 *b* in VIS

Fig. 141
Pingfeng xi, borders of panels 5 and 6 *b* under UV light. In the upper left corner of panel 6 *b* (arrow), a mistake made by the painters is visible: Some of the lead white-containing paint from the border seems to be spread on the brown framework.

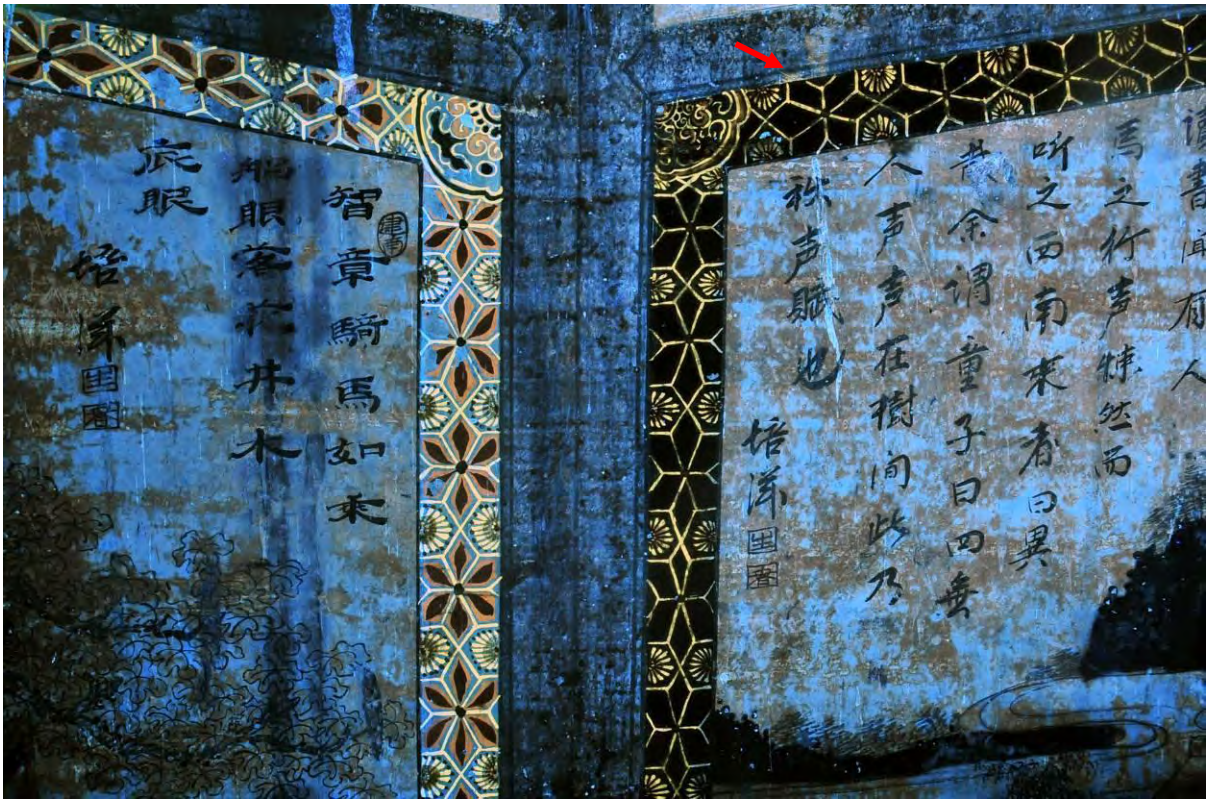


Table 9
Sequence of painting in the pattern with stars and used pigments (analyses with PLM)

	pattern with red stars	*pattern with blue stars*
9		coating or glaze ?
8	red dots in blossoms; black dots in blossoms (fine-grained black)	black and red dots in blossoms; red dots in stars
7	yellow glaze on white blossoms	yellow glaze on white blossoms
6	dark green/blue in clouds and centre of the stars	dark green and pink in corners
5	red (cinnabar)	dark blue (flame carbon + azurite)
4	pink (cinnabar + lead white)	blue (azurite + flame carbon)
3	white (lead white)	white
2	blue (Prussian Blue + lead white)	greenish blue (malachite, azurite)
1	black delineation	black delineation
0	white ground layer	white ground layer

With the exception of yellow, the paints are opaque and pastose. The yellow paint is probably an organic colorant.
The borders with blue stars on bluish green ground look dark and almost dark green. Brush marks running parallel to the outlines of the border are visible, giving the impression that a nowadays brownish coating may have been applied, turning the once bright turquoise blue colour of the ground into a dull green (fig. 142)[54] - but at the microscopic examination of paint flakes (50times magnification) and in a cross section[55] no coating layer could be distinguished.

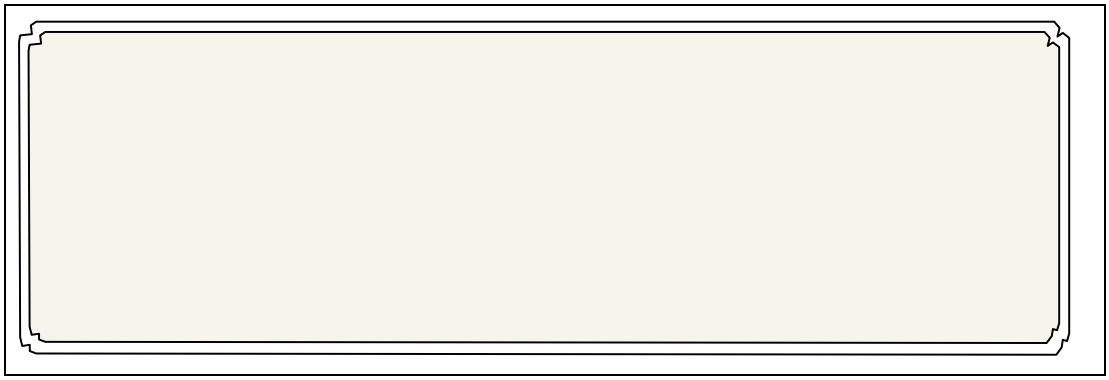
UV-fluorescence
The UV-fluorescence of the star borders (fig. 140 and 141) is dominated by the fluorescence and reflectance/absorption of the pigments, mainly lead white (strong yellow to whitish fluorescence) [56] and the copper pigments (absorption of UV light). The yellow glaze may have a brownish fluorescence.

Fig. 142
Pingfeng xi, border of panel 1 b: The coating or glaze on top of the paint layer is reduced and partly lost, exposing the bright paint layers underneath.

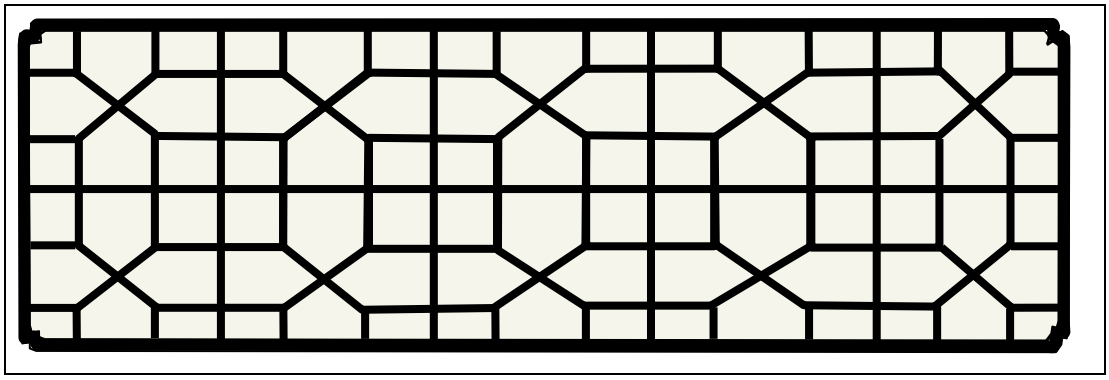
[54] In the water-damaged part of the border of panel 1 *b*, the bright turquoise green hue of the ground is visible as the brownish material was partly lost.

[55] Sample *pfx* 10. The sample was taken from the filling of a star segment. The cross section *pfx* 10 CS 1, taken from the blue filling of a star segment, does not contain a coating or glaze.

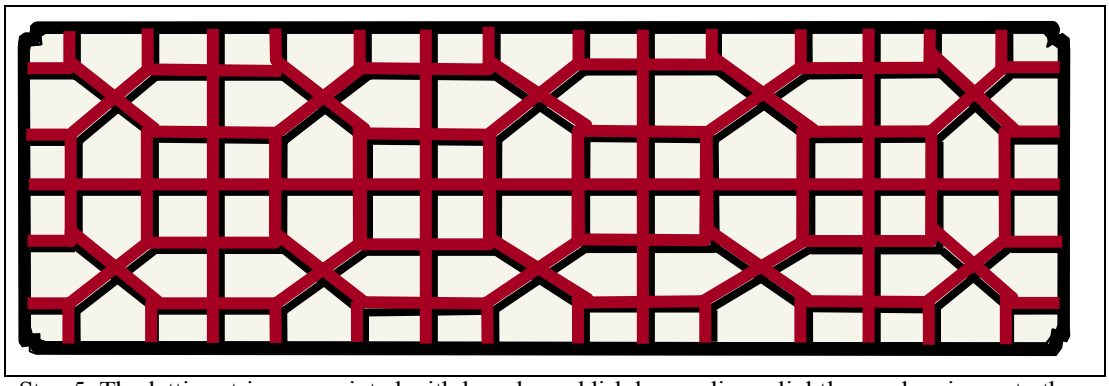
[56] Pure lead white should have a strong UV reflectance and usually looks bright greenish under UV light, so there may be an influence of the binding medium on the fluorescence as well.



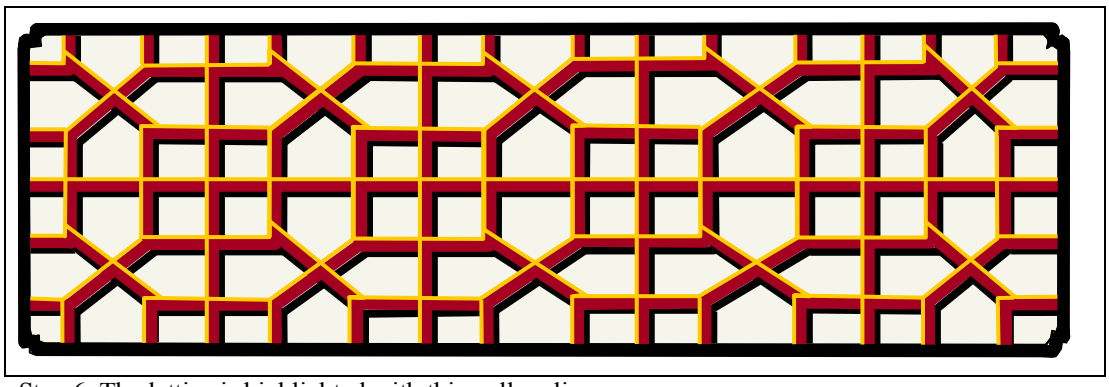
Step 1: The filling frame is delineated with two black lines.
Step 2: The panel filling is painted white



Step 3 and 4: The lattice strips are painted with black lines. The filling frame is painted with black contours and coloured black.



Step 5: The lattice strips are painted with broader reddish brown lines slightly overlapping onto the filling frame.



Step 6: The lattice is highlighted with thin yellow lines.
Step 7: Red ends overlapping onto the filling frame are covered with dabs of black paint.

Fig. 143
Scheme for painting the lattice in the *a*-panels of the *pingfeng xi*-painting

Panel fillings

The panels are described from top (panel *a*) to bottom (panel *e*).

Panels a*: decorative latticework*

The panel fillings show a latticework with a geometrical design of interlaced octagons. The strips (bars and lines) are reddish brown, shaded in black on a white background (fig. 145). The steps of the painting process can be reconstructed as follows (also see: fig. 144):

(1) black delineation of filling frame
(2) white layer
(3), (4) black lattice lines / black filling frame: outlines and black colour
(5) red lattice
(6) yellow highlighting
(7) retouch black filling frame to cover red lattice strokes

After first step of the delineation of the filling frame (step 1), the panel background was painted white (step 2). The black delineation remained partly visible through the white paint (fig. 149). The off-white panel background today has the same colour shade as the white ground layer. As it was painted with lead white[57], a difference must have been originally intended: Either the lead white was brighter than the ground layer consisting of white earth or there was a dyestuff which has faded. A lattice in the *sanguo dong*-painting painted in the same way shows traces of a blue glaze on the white ground, proving that glazes could have been used. A comparable phenomenon can be seen in the *long*-painting, the white dragon's breath (probably containing lead white) being differentiated from the white background (kaolin), although this is not visible anymore (see: p. 169).

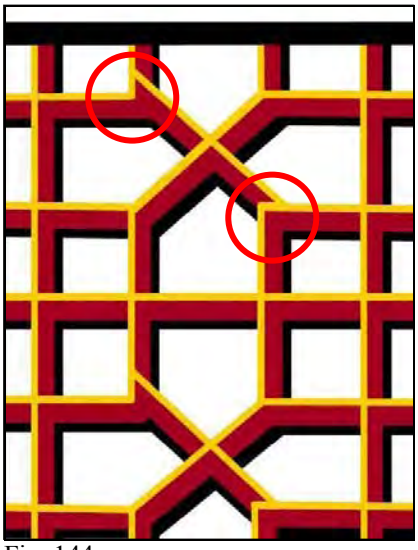


Fig. 144
Pingfeng xi, *a*-panels, reconstruction of the lattice. The joints of the oblique strips show problems in realising a perspective effect.

The lattice was painted firstly with black lines which form the shadowed edge of the strips. It can be assumed that some sort of auxiliary lines or a line grid was used to construct the lattice, but no traces of it are visible. At the same time, the final contours and the black of the filling frames were painted (step 3 and 4).

Next the reddish brown lines were drawn with a fine-grained red iron oxide[58] (step 5). Finally, thin bright yellow lines were applied for highlighting the light edge of the strips (step 6). As a last step, some ends of red lines overlapping onto the black filling frame were covered with dabs of black paint (step 7).

Painting a perspective view created a problem: The joints fitted correctly in the first layout in black, but by staggering the red and yellow lines upwards and to the left, the joints of the oblique strips were misaligned (fig. 144). Today the yellow lines either lost or faded except for small traces (figs. 148-150), and almost invisible. Better preserved parts show a thicker application and a bright yellow colour. Maybe the discoloration is the result of fading of an organic colorant or orpiment.

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[57] Sample *pfx* 14: The white background contains lead white (slide preparation PP Z 71). The black lines were painted before the red ones were applied.

[58] Sample *pfx* 14, analysed with PLM, presence of iron confirmed with XRF (Tucic 2012).

Fig. 145
Pingfeng xi, panel 7 *a*: lattice with white background and black filling frame

Fig. 146
Pingfeng dong, panel 1 *a*: lattice with bluish grey background and green filling frame

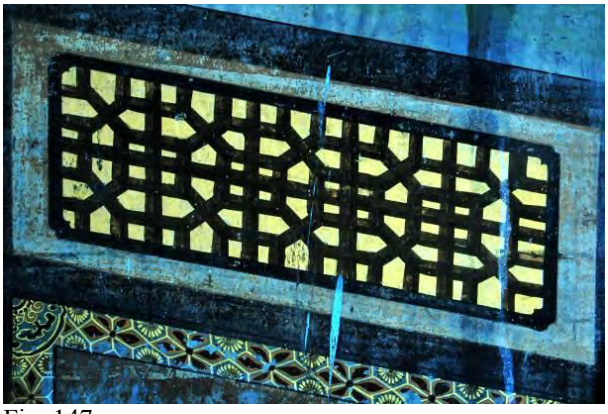


Fig. 147
Pingfeng, panel 7 *a* under UV light

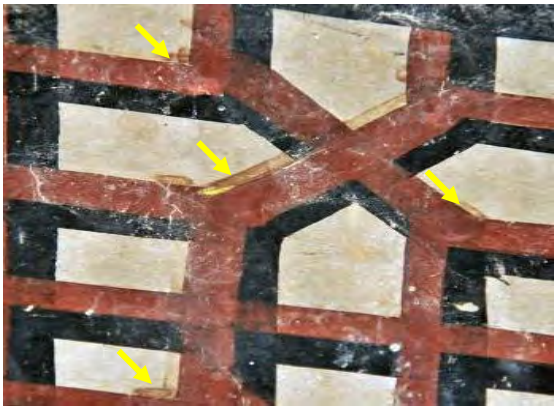


Fig. 148
Pingfeng xi, panel 3 *a*, yellow or orange lines originally highlighted the reddish brown lattice

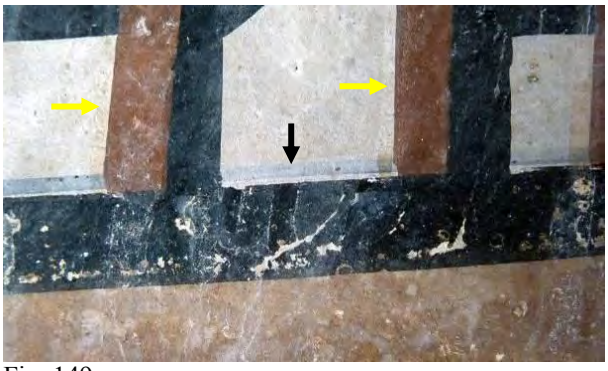


Fig. 149
Pingfeng xi, panel 4 *a*: Black delineation visible through the lead white of the background (black arrow). Faded (?) yellow highlighting (yellow arrows).

Fig. 150
Pingfeng xi, corner of *a*-panel: Black delineation visible through the lead white of the background and through the light pink paint of the panel frames (black arrows).

The *a*-panels of the *pingfeng dong*-painting show the same design (fig. 146), but on a greyish blue background, which proves that the lattice is not meant to be open, but backed with a coloured paper or textile. The bright yellow highlights are much better preserved.

Under UV light, the white background appears bright yellowish because of the use of lead white (fig. 147).[59] The black paint appears black and the reddish brown dark brown (no fluorescence?).

[59] Lead white has a strong UV fluorescence at wavelength in the range of 300 to 400 nm (*Artists' Pigments* 1993, vol. 2, p. 79). The lamp used has a wavelength of 315 to 405 nm, with a peak at 365 nm.

Fig. 151
Pingfeng xi, panel 2 *b,* poet Cui Zhongshi looking into the sky: carved and lacquered wooden chair; table with inlays of rare stones, a vase with a coral (or antlers?) and a peacock feather, a painted screen. Next to the poet a marbled pink vessel. The lady is holding a three-coloured fan. In the foreground banana trees

Fig. 152
Pingfeng xi, panel 5 *b*, drunken poet lead by two boys

Test to reconstruct the painting process:

a pale red lines and shades on traced outlines

b grey washes

c red and black drawing and shading finished

d after application of coloured washes (green, red and pink)

Panels b *and* d*: figurative depictions*

The *b*- and *d*-panels of the *pingfeng xi*-painting are described together because the painting technique is identical. The paintings are executed in the style of Chinese ink drawings. The lines in light red, grey and black are dominant, coloured areas are used rather sparsely, and large areas of the white ground remained visible as background and light colour.

Painting process

First the delineation and shading in pale red and grey was done, and then colours were filled in. All the visible lines remained visible. If the delineation also served to define the composition of the depiction, no differentiation between preliminary and final drawing can be observed. The pale red lines were probably drawn before the grey and black ones.[60] Shades in diluted pale red and black (appearing grey) were executed together with or directly after drawing the lines. As there are more lines in black than in pale red, this working sequence seems strange, but reconstruction tests showed that it is possible to start with the red lines and shades. As there also are parts without red outlines, however, this would have required a preliminary layout of the depictions.

For the colouration, coloured washes (green, brown and red) were filled in first, followed by opaque colours (red, blue, green). The last step was the addition of black circles and green dots which depict leaves and often do not really seem to fit into the depiction. Table 10 shows the sequence of the painting process as far as it could be reconstructed.

The figurative scenes were painted after the borders with the star pattern and probably the framework too had been finished, but some washes of the landscape seem to lie underneath the black delineation of the filling frames.[61] This may indicate that the very first step, even before delineating the framework, was the application of thin washes which may have helped to set out the paintings.

Table 10
Sequence of the painting process in *b*- and *d*-panels of the *pingfeng xi*-painting

painting the depictions of the panel fillings *step no.*		*work step on filling frames*
9	transparent coating ?	
8	green dots on top of black circles and dots (plant parts)	
7	black circles and dots	
		filling frame in *d*-panels filled in black
6	opaque blue and green are applied thickly, pastose	
5	washes in green, brown and red, and opaque red	
4	drawing in grey to black lines, diluted black paint in several shades (light grey to black), areas and modulation in grey	
3	modulation of flesh tones with light red lines and light red washes	
2	drawing with pale red lines ? [62]	
		black contours of *b*- and *d*-panels
1	light-coloured washes in the background (today brownish) ?	

[60] Only in one area, the poles of pavilion in the lake in panel 3 *a*, fig. 180, the black lines seem to lie on top of the light red lines.

[61] Recognisable in panels 4 *b* and 8 *b*: The brownish washes of the landscape can be found in lacunae of the black contour line of the filling frame.

[62] On the northern edge of panel 8 *d*, the light red lines overlap the black contour line of the filling frame.

Fig. 153
Pingfeng xi, panel 3 *d*, bat painted in dark red over a pale red line

Fig. 154
Pingfeng xi, panel 4 *b*, hat of a man: pale orange red lines accompanying black contours are covered with the red paint layer

Fig. 155
Pingfeng xi, panel 5 *b*, boy carrying a bonsai tree: Pale red lines contour flesh tones, cuffs and trousers, but not the robe. Height of the figure: ca. 12 cm.

Drawing

Pale red is used as shading. Like in water-colour technique, the pale red lines were partly covered with darker or more intense colours, but remained visible as slight, unobtrusive shading. There are parts without sketches in pale red lines, for example robes which just have black (or grey and black) lines (fig. 155). Washes of pale red in different shades or different dilution were used for the modulation of the flesh tones. The pigment of the slightly translucent lines may be red lead.[63] The nowadays pinkish impression of the colour may have been increased by a slight darkening of the red lead, reducing the orange shade.

Grey may have been achieved by diluting black paint to different extent. Different shades of grey were used for lines and colouration of clothes (figs. 173 to 175), furniture and objects, and extensively in plants and architecture (fig. 181).

Black lines are used for drawing, contrasts, deep shades and black coloured details (for example hair and eyes). They may have been drawn before or after the grey lines and shades.

Translucent colours

Red, brown and green washes or glazes can still be recognised today, though often with some

[63] No analysis was done. The assumption is based on the colour shade. Reconstruction tests showed that mixtures with white are not suited for this purpose. The most similar results were obtained with red lead very much diluted.

difficulty because of a greyish brown layer of protective coating.
Red was used as a translucent wash (fig. 154), but also as a more opaque dark red (fig. 153). A translucent red was used for parts of clothing and architecture (for example the gable in fig. 181), objects and furniture. It is darker than the pale red lines, looks more like a glaze than a wash and seems to be sensitive to water: On the hat of the man with the fur coat (fig. 154), lighter spots may be watermarks.
Medium or light *brown* translucent parts are found in the architecture (decorations on the roof ridges, fig. 181), objects and parts of the landscape (mountains in panel 4 *b*, fig. 202), and seldom in cloths (fur coat of man in panel 4 *b*, fig. 154). Areas painted in light brown, like the ridge decorations of a roof, look brown under UV.
Green washes look brown or olive-green today. They were used in the garments and in the landscape. In one case, an analyse revealed malachite as pigment.[64] Brownish discoloured green areas can be distinguished from areas painted brown, because they appear black under UV light (fig. 177 and 178).
Yellow: The (mostly lost) yellow highlights in the *a*-panels and the brownish yellow glazes in the star pattern borders show that yellow shades, too, may have been used, but today no yellowish tints can be recognised in the *b*- and *d*-panels.

Opaque pastose layers
Opaque colours occur in *blue* and *green* areas. The paint is thick and pastose. The pigment seems to be rather coarse (figs. 176 and 179). The surface looks dull, greyish or brownish up to almost black today, but in damaged areas a bright blue and a bright green are visible. Under UV light, the areas appear black, indicating the use of copper pigments. The opaque blue and green were used only in small areas, as details of clothes and furniture (blue chest of drawers; marbled green frames of screens). Figure 176 shows the translucent and the opaque green next to each other: The bright green, marbled frame of a screen was painted with an opaque green, the olive-green mountain with a translucent brownish green.

White or mixtures with white were not used for highlighting. In the skies, no blue shades are recognisable.

Fluorescence of the paint layers under UV light
Under UV light, green and blue areas and greenish brown washes in the landscape and in the robes appear black (figs. 177, 178 and 156-163). This is probably caused by the use of copper pigments and thus indicates areas which originally were green (or blue). Parts of the landscape, looking olive-green today, show a haze around the green details (fig. 160). Under UV light, the olive green and the haze appear black (fig. 161). UV light can be used to distinguish the originally green areas, now turned brownish by discolouring, from those painted brown or changed into brownish by the coating/sizing as green areas appear black under UV light because of the use of copper pigments while other colours appear brown or grey (see roof ridge in figs. 162, 163 and streaks of brown coating/sizing in figs. 156/157 and 158/159).

Black lines appear dark grey under UV light. In panel 8 *b*, the black columns of the pavilion (grey under UV light) could be distinguished from the now framing of a painted screen inside the pavilion: it appears black under UV light and originally was green (figs. 158/159).

[64] Sample pfx 9, either from the marbled border of the screen in panel 7 *d* or from the olive green mountain next to it.

Fig. 156
Pingfeng xi, panel 7 *b* in 2012, VIS: The washes of the landscape and the streaks of coating and/or sizing both appear brownish.

Fig. 157
Pingfeng xi, panel 7 *b*, UV: The coating can be distinguished from the greenish wash of the scenery which appears dark brown up to black and was applied imprecisely overlapping the figure of a servant (arrows).

Fig. 158
Pingfeng xi, panel 8 *b,* VIS: The black columns and the black-appearing frame of painting inside the house seem to have the same colour.

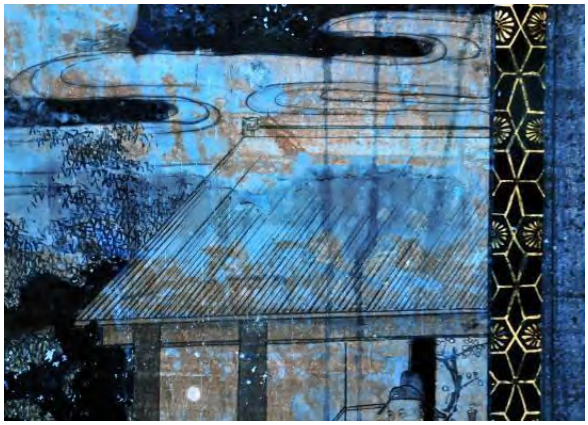


Fig. 159
Pingfeng xi, panel 8 b, UV: The originally green frame appears black, the black columns appear grey.

Fig. 160
Pingfeng xi, panel 8 *d*, VIS: brown haze around the green leaves.

Fig. 161
Pingfeng xi, panel 8 *d*, UV: Green vegetation and brown haze appear black.

Fig. 162
Pingfeng xi, panel 6 *b* and 7 *b*, VIS

Fig. 163
Pingfeng xi, panel 6 *b* and 7 *b*, UV: The brown paint in the architecture appears light

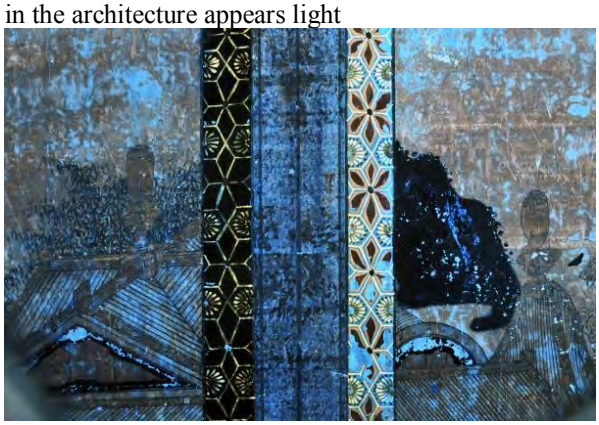
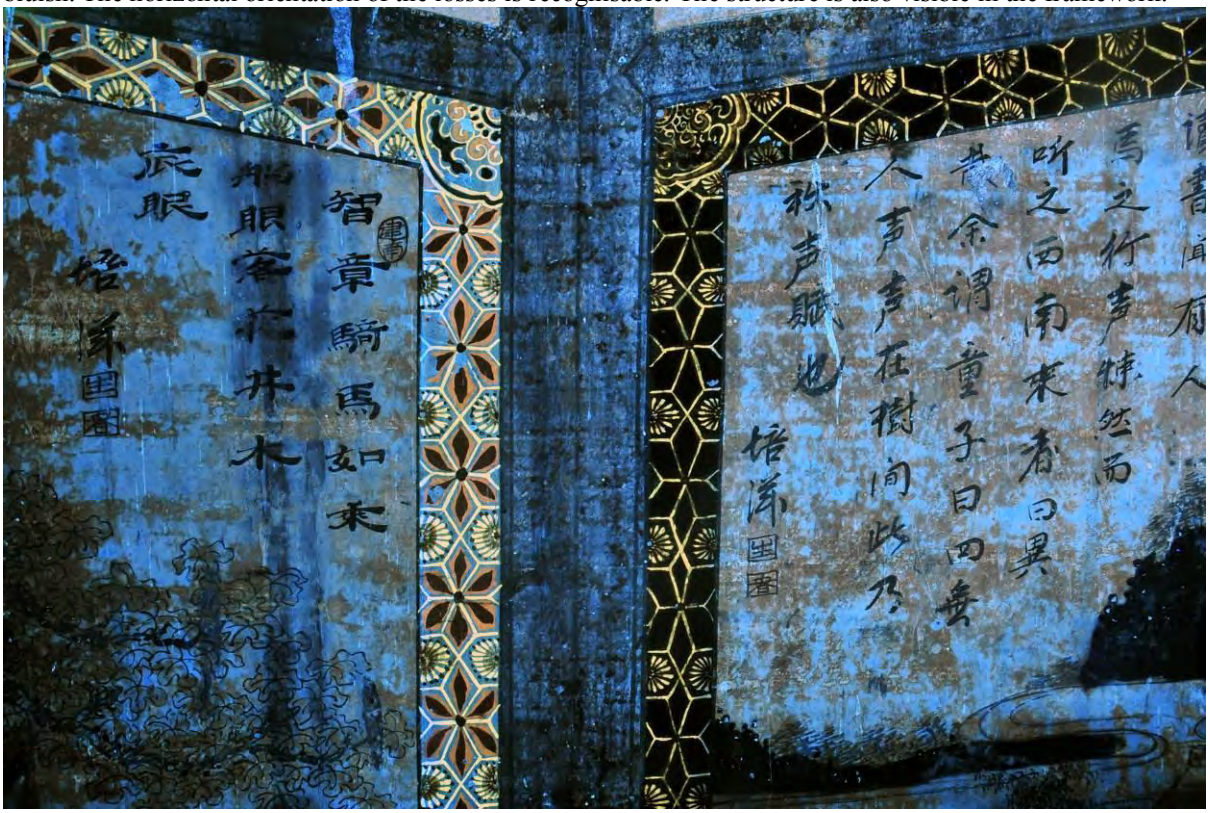


Fig. 164
Pingfeng xi, panel 5 *b*/6 *b*, VIS: A brownish layer is visible in the background of the *b*-panels, emphasizing the horizontal brush marks of the white ground layer.

Fig. 165
Pingfeng xi, panel 5 *b*/6 *b* UV: The brownish layer appears brownish, the exposed white ground layer light bluish. The horizontal orientation of the losses is recognisable. The structure is also visible in the framework.



Transparent layers – sizing, intermediate layers and coating
The presence of transparent media is visible in the *b*- and *d*-panels as a brownish or greyish layer. The white ground seems soaked and looks more transparent and slightly darkened.

Transparent material has been applied in several layers:
1. sizing of the ground layer before painting
2. intermediate binding medium layer(s) applied during the painting process
3. protective coating
4. There also could be later coatings to "refresh" the paintings or as fixation, though there is no definite evidence for such a treatment.

The presence of a sizing applied before painting or after the delineation of the framework could be confirmed (see above: pp. 91). In cross sections, an isolation layer on top of the fine coat layer is visible. An isolation or sizing, not forming a layer, but penetrated into the surface of the ground layer, can be assumed because of the lighter UV fluorescence. Along the edges of the folding screen, the visible edges of the sizing are only slightly darker and more transparent than the white ground. In the *b*-panels (e.g. panel 3 *b*, 5 *b* and 6 *b*) drops of transparent material (grey in VIS, light brown in UV) than and seem to lie underneath the brownish coating (brown in UV), so the drops probably belong to the sizing.

The presence of coatings was more difficult to prove and even more difficult to distinguish from the sizing. In cross sections, no coatings or transparent layers were visible between or on top of the paint layers.[65] Furthermore, it is difficult to distinguish transparent layers from only slightly coloured washes: Sometimes they have almost the same colour shade today as the washes (fig. 171), or they conceal the washes, especially light orange-pink or light brown shades (fig. 182: pink stones at the base of the garden wall, pink trousers of the boy and shading of the roof, and fig. 166: pink robe of the man on the left side and shades in the landscape above). Brownish material was found to lie on top of the red characters[66] of the name seals of the inscription in the *b*-panels (fig. 168). Only in panel 4 *b*, transparent material applied on the sky overlaps on the star border (fig. 172), proving that only the narrative scene received a coating, but not the frame. As panel 4 *b* technically differs from the other *b*-panels, it is not clear if all narrative scenes were treated that way.
No indication was found that a protective coating or consolidation material was applied at a later time, yet this cannot be ruled out.

Areas with transparent material(s) appear brownish in the *b*-panels. In thicker applications, the brown hue is rather dominant (fig. 168). In the *d*-panels, the material seems lighter and greyish rather than brown. Under UV light, the material in the *b*- and the *d*-panels appears brownish up to pink while the ground layer appears lighter and bluish white.[67]
The brownish material has a streaky structure indicating horizontally orientated brush marks. These brush strokes continue across the panel frames and the framework (figs. 165), but they are not visible in the borders with star patterns (fig. 165: left side), the lattice in the *a*-panels or the panel fillings of the *e*-panels, i.e. in areas with opaque and thicker paint applications.
Losses have occurred following the brush marks where the application of the material was thinner. In the *d*-panels, these losses are not as distinct as in the *b*-panels. The material was affected by water, resulting in a patchy and blotchy appearance (figs. 154 and 155). Imbedding of surface dirt may have increased the discolouration of the transparent material.

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[65] A sample taken from the black framing (*pfx* 6) shows a thin transparent layer with a light UV fluorescence on top of the black paint layer, but the severely damaged sampling area may have undergone partial repair.

[66] At the black lines and characters it is not recognisable if the transparent material lies underneath or on top of the lines.

[67] It is not clear if the material has a UV fluorescence or if it is just blocking the light and looking brownish due to its inherent colour.

Fig. 166
Pingfeng xi, panel 3 *b*. The transparent medium appears brownish (lower left part), splashes of dripped down material are above the head of the sitting scribe (green arrows).

Fig. 167
Reconstruction test: drips of animal glue on the finish coat dripped down from above.

Fig. 168
Pingfeng xi, panel 6 *b*: discolouration by transparent media; coating on top of red characters; drips of transparent material (green arrows).

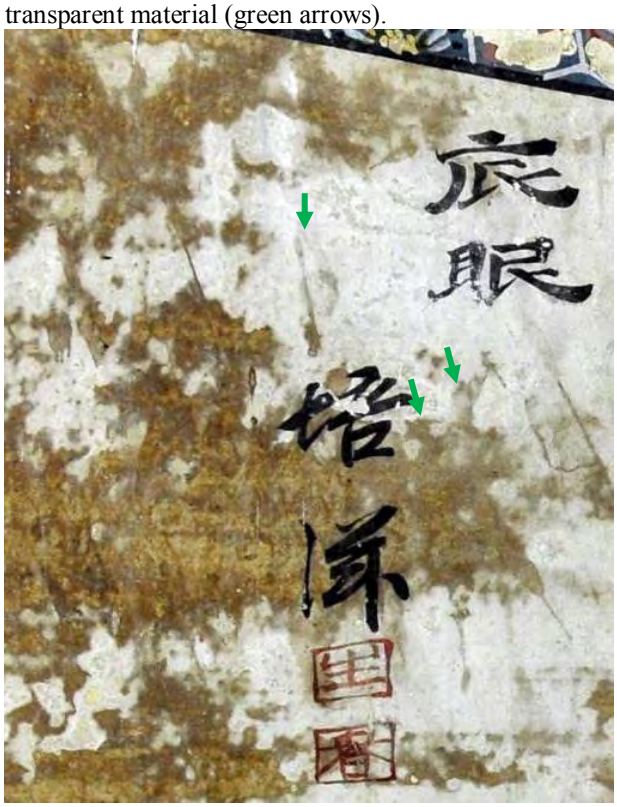

Fig. 169
Pingfeng xi, panel 8 *b*: detail above the roof, VIS

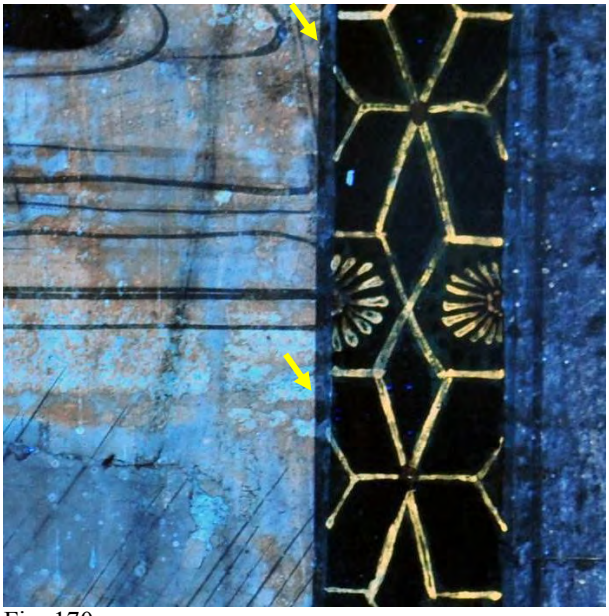

Fig. 170
Pingfeng xi, panel 8 *b*, UV: the fluorescence of the brownish material is visible on the black contour of the star border (yellow arrow).

Fig. 171
Pingfeng xi, panel 4 *b*, next to the stepmother: The plant was omitted when applying a shade (arrow) which today has the same light grey colour as the transparent material in the background.

Fig. 172
Pingfeng xi, panel 4 *b*: glaze or coating brushed in the sky, overlapping onto the star pattern of the border (black arrow).

Additionally splashes of transparent material are recognisable in the *b*- and *d*-panels, running vertically or in a slightly inclined angle (fig. 166). In VIS they are greyish or brownish, darker than the ground layer, but lighter than the brownish material. Tests to reproduce the effect showed that drops and splashes of corresponding shape only occur if the material hits the surface from above, i.e. coming down vertically (fig. 167). It is not recognisable at what time they occurred, they may be part of the original painting process.

A possible explanation of the phenomena is that the brush strokes belong to the ground layer. The brownish transparent "layer" consists of the slightly brownish sizing which was applied all over the folding screen, and a protective coating which probably was restricted to the narrative scenes of the *b*- and *d*-panels. The brush marks inherent to the ground layer become visible because they had an influence on the thickness of application of the sizing and coating, and their ridges were more susceptible to damage.

Fig. 173
Pingfeng xi, panel 3 *b*, man with officials' hat: pink flesh tone shaded at the forehead, around ears, eyes and mouth. The robe is coloured with a light grey wash.

Fig. 174
Pingfeng xi, panel 5 *b*, poet and boy: sparingly applied colouring: The flesh tones are almost white, the robes only accentuated with grey borders. Splashes of transparent medium in the background.

Fig. 175
Pingfeng xi, panel 5 *b*, boy carrying a bonsai tree: face outlined in black and orange-red with few orange-red shades. Hair painted with dark grey wash and black lines.

▲ Fig. 176
Pingfeng xi, panel 7 *d*, old lady: pink flesh tone with grey shading. Blue diadem and undergarment, robe with grey wash. Marbled green border of painted screen and olive green mountain. Railing in front of mountain with red glaze.

◄ Fig. 177
Pingfeng xi, panel 3 *d*: boy with translucent greenish brown robe (originally green), holding a blue jug. The clouds are shaded in light red.

► Fig. 178
Pingfeng xi, panel 3 *d*, boy: UV

Fig. 179
Pingfeng xi, panel 8 *d*: The blue pastose paint of the cabinet has a darkened surface

Observations on details of the depiction

Human Figures and Animals

The figures are delicate and small: The largest figure (daughter-in-law in panel 8 *d*), is only 16.5 cm high. Figures of humans and animals are painted in a graphic manner. Black calligraphy-like brushstrokes give shape to the clothes. By changing the pressure onto the brush tip, the painter modified the thickness of the lines, giving the impression of a fabric with a certain stiffness. The delicate parts of skin, i.e. faces, hands or legs, were drawn with much finer brush strokes, illustrating the softness of a body. The lines in the faces are extremely fine, resembling miniature paintings.

Flesh tones

Pale red lines emphasise the modulating of faces and hands (fig. 173 to 175). At many figures, the modulation of the flesh tones comprises only these red and black lines, while the white ground layer represents the skin colour. Other faces are coloured with light pink (fig. 173), thus different tints of skin colours were depicted. The face of an old lady (fig. 176) has a pink skin colour and greyish brown shades. The poet in panel 5 *b* (fig. 174) shows a very light partial modelling in light pink. Lips were not coloured red, but shaded with grey.

Robes

The clothing is painted with many details: Garments have several layers, decorated borders and collars. There are hats, caps, hairpins, earrings, ties and belts; pendants with ornaments are hanging from belts, shoes are differentiated in heel and toe parts.

Parts of the clothing are coloured with washes in grey, pale red or brownish green. Folds are sometimes additionally shaded along the black lines. Most of the robes are white (= ground layer) or shaded light grey (fig. 173), some are olive-green (fig. 177).[68] Borders are often grey (fig. 174), but some are green or blue. Undergarments visible only in small areas are red, green, blue or grey. Belts and the strings of the belt pendants are often coloured. Pink (pale red) may represent gold in suits or armour or staffs.[69] Blue is restricted to small areas as diadems, borders of robes or belts. Opaque green is only used in equally small areas.[70]

The colouring of the robes seems not to be related to the importance or the rank of the figure, as panel 4 *d* shows: The eldest son was forced to wear thin and simple clothes while the younger stepbrothers were robed in warm and nice clothes, but this is not reflected in the colouration: The robes of the eldest son are shaded in light red, and those of the two stepbrothers are painted differently (fig. 183): The robes of the one standing on the left are coloured in olive-green (nowadays appearing brown), grey and red, but the robes of the other have no colouration except for the belt and the string of the belt pendant.

Animals

The few animals - two horses and some cranes[71] - are painted similar to the human figures. Pale red and black lines form the outer contours. Thin brushstrokes are used to draw details. Red, pastose green and blue are found in some details of the horse tacks (saddles and harness). The heads of the cranes in panel 2 *b* are coloured with a red wash.

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[68] Fig. 177 shows the boy in the clouds in panel 3 *d*. Other examples are the robe of the stepbrother in panel 4 *d* and the robe of the boy leading the drunken poet in panel 5 *b*.

[69] Pink probably representing gold: suit of armour and helmet of the bandit in panel 5 *d*; hat and the attribute of the deity standing in the clouds, panel 3 *d*.

[70] For example panel 2 *b*, maidservant with teapot (green undergarment); panel 8 *d*, lady Tang (apron in translucent olive-green with folds in dark green). In both figures green is combined with red shades. The man with the fur coat in panel 4 *b* and the servant with fan in panel 7 *b* wear red hats with opaque green brim.

[71] Horses: panels 4 b and 7 *b*; cranes: two flying cranes in panel 3 *b*, one standing crane in panel 2 *b*.

▲Fig. 180
Pingfeng xi, panel 3 *b*: Red lines accompany black lines of the architecture.

►Fig. 181
Pingfeng xi, panel 6 *b*, roof: red wooden panels at the gable, framing in dark blue and green edges; brown ornaments on the roof ridges. Rows of roof tiles indicated with strips of darker grey alternating with lighter grey.

Fig. 182
Pingfeng xi, panel 8 *b*, boy leaving the close by night with a lantern: the original shading of the robe, the thatched roof, the wall and the pavilion are difficult to recognize due to discolouration of coating (and sizing?).

Architecture, furniture, and decorative objects

The architecture is set out in pale red and/or black lines. Straight lines were drawn with rulers (fig. 180). The pale red lines are less uniform in thickness and straightness than the black ones. Like the figures, the architecture is coloured to a varying extent. Railings and parapets are sometimes filled in translucent red (fig. 183). Columns are black; facades and roofs are coloured in grey, red, brown and green, scarcely also blue, in different combinations. Details of the architecture and their furnishing are embellished with dedications: Ornaments are painted on parapets and column bases, small panel doors have ornaments, decorations are put on roof ridges. Lines and colours were used to represent different materials as wooden planks of a gable, grey roof tiles and decorated glazed ridge decorations (fig. 181). Different kinds of precious stones are imitated (fig. 184).[72] Paintings on scrolls or screens are framed by green borders with a marble pattern showing veins in dark green or black painted on top of the green (fig. 176).

In various small objects as teapots, flower vases and small cabinets, scrolls and ink wells, painted screens and fans are embellished with the same devotion (figs. 156 and 151). They often show combinations of colours in stronger contrasts, like red, grey, green and blue. In the panels 2 *b* (fig. 151) and 4 *d* (fig. 184), brush paintings are depicted, including inscription and red seal of the painter's name in panel 4 *d*. Objects are standing on tables with inlays of rare stones. Basins in the panels 1 *b* and 2 *b* show a 'marble pattern' with black veins on a pink or red ground. Furthermore there are tools and weapons, as a hoe (panel 3 *d*) and a sword (panel 4 *b*) showing a green sheath with a red border.

The more vivid colouration seems to be restricted to architecture, objects in the backgrounds, and ornaments, while the figures are executed with larger areas and less details. In this way, the attention is focussed to the facial expressions, gestures and movements.

▲Fig. 183
Pingfeng xi, panel 4 *d*: stepbrothers

◄Fig. 184
Pingfeng xi, panel 4 *d*: rare stone table top with a pot holding paint brushes, ink well and small cabinet; behind the table a painting with inscription framed by a green 'marbled' border.

[72] Stone with grey and black bands and spots: table in panel 2 *b*; inlay of the panel door in panel 3 *b*.

Fig. 186
Pingfeng xi, panel 2 *d*, trees behind a garden wall: light red and black drawing, mottled grey trunks; leaves in grey and black

Fig. 185
Pingfeng xi, panel 7 *d*, next to green marbled border of a screen: plant drawn in pink and grey, black and green dots as highlights

Fig. 187
Pingfeng xi, panel 8 *b*: waves

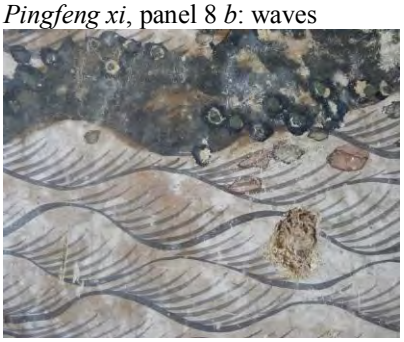


Fig. 188
Pfx, panel 4 *b*: waves with froth

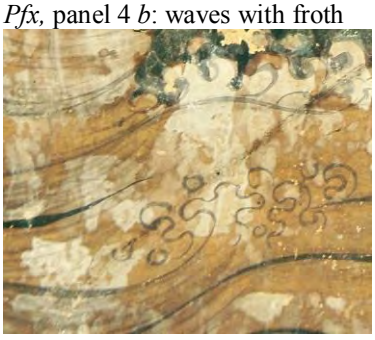


Fig. 189
Pingfeng xi, panel 6 *d*: cracked ice

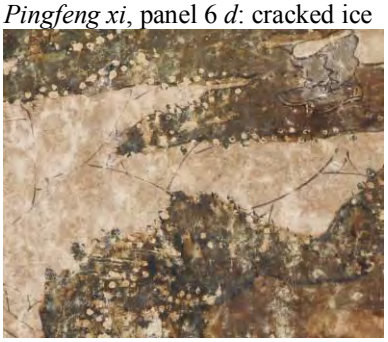


Fig. 190
Pfx, panel 5 *b*: grass and clover (?)

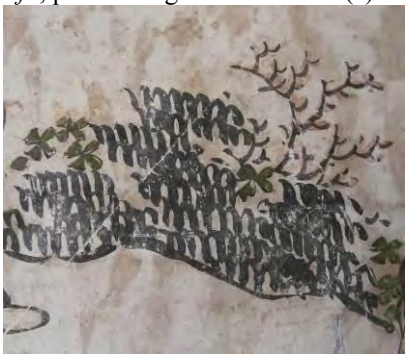


Fig. 191
Pfx: tree with five-lobed leaves

Fig. 192
Pingfeng xi, panel 5 *b*: acacia

Landscape and vegetation

Views into the nature are part of the scenes in the *b*- und *d*-panels. In the *b*-panels, the landscapes fill the major part of the depiction, enclosing single figures. In the d-panels, the figures are more prominent, with small vistas of nature in the background.

Painted sceneries show rocks and hills, water and vegetation. The water is painted with black lines indicating calm flowing water (fig. 194), waves (fig. 187) or froth (fig. 188). The cracked ice of the frozen lake in panel 6 *d* is depicted like the marble with 'veins' indicating cracks (fig. 189).

Hills and mountains were sketched in black and then coloured and shaded with brown and olive-green translucent washes (fig. 202). The brownish washes appear dark under UV light, indicating the use of copper pigments: originally the landscape was green, not brown. In panel 7 *b* showing the drunken poet on a horse, the wash was applied imprecisely, covering parts of the face, hat and shoulders of the servant holding the fan. This is just recognisable in visible light (VIS), proving that the wash was very light in colour (figs. 156 and 157).

There is a great variety in vegetation with trees, shrubs, grass and single leaves, but there are almost no flowers: The only blossoms to be found are those on the bonsai tree the boy is carrying in panel 5 *b* (fig. 155), and on painted screens or scrolls in panels 4 *d* and 8 *b* (maybe peach trees; fig. 184). Some plants, however, are painted rather realistically as stone pine trees (e. g. panel 5 *b:* fig. 194 and 7 *b*), bamboo (e. g. panel 2 *b*, 3 *b* and 6 *b*, fig. 198), water lilies (panel 6 *b*, fig. 197), banana trees (e. g. panel 2 *b*), plants looking like azalea (panel 5 *b*, 6 *b* and 7 *b*, fig.), willows (panels 6 *b*, 8 *b*, 2 *d* and 7 *d*), a tree with leaves like an acacia tree (panel 5 *b*, fig. 192), plants resembling magnolia, rubber or ficus trees, and trees with five-lobed leaves (fig. 151, background, and fig. 187), or a tree with leaves growing in circular bushels like an aralia (panel 4 *b*, fig. 195). Grass is painted less realistically with black vertical strokes connected to each other, like rows of flat spirals (fig. 190).

Plants and trees are outlined or are completely drawn in black or sketched with light red first (fig. 186). Thicker trunks and branches are outlined in black and filled with grey or red lines or circles (fig. 194) indicating the structure of the bark. Some tree trunks are also coloured red or reddish brown before applying the bark structure (tree on the southern edge of panel 3 *b*). Around the aralia-like tree in panel 4 *b*, the background is shaded with washes, omitting the leaves. Thus the leaves are standing out light in front of a background which was shaded in green (now brown) and in light grey (fig. 195). A similar, even lighter grey shading could be observed in panel 4 *d* where a light grey shade is omitting the plant behind the railing next to the stepmother. In other paintings, the green shading of the landscape did not omit the trees, like the pine tree in fig. 194.

Some leaves are coloured with a pastose green like the clover-shaped leaves growing on the grounds, leaves of azalea shrubs or another shrub with rounded leaves (fig. 187). These green leaves have flaked off in parts, probably due to the thickness of the application.

After the paintings were finished, small black circles or dots (up to 0.4 cm in diameter) were applied and "highlighted" with thickly applied green dots on the plants and landscape. Size and style differ from the leaves painted with opaque green. These dabs and green dots are placed all over the scenery, covering rocks, branches and hill sides. They are independent of the type of plant and thus seem inconsistent of a design in which individual species are carefully characterised. Sometimes they give the impression of small leaves, but they can also be found on pine trees, and in the background they appear like shrubs on the hills of the distant lakeshore (fig. 194). It seems unlikely that they were applied by the same artists who painted the trees. Like the blue and few opaque green areas, the green dots, too, are superficially darkened. A lot of dots have flaked off, maybe due to the thick application (fig. 185 and 197, shore at lower edge).

Fig. 193
Pingfeng xi, panel 2 *d*: willow twigs drawn in several shades of grey and emphasized in black

Fig. 194
Pingfeng xi, panel 5 *b*: defoliated tree and a pine tree. The structure of the bark is indicated with grey lines and scribbles. Green dots put on dabs of black cover the branches of both trees.

Fig. 195 (left)
Pingfeng xi, panel 4 *b*: tree resembling an aralia tree

Fig. 196
Pingfeng xi, panel 7 *b*: azalea (?) and grass

Fig. 197
Pingfeng xi, panel 6 *b:* two boys picking water lilies under a willow tree

Fig. 198
Pingfeng xi, panel 6 *b*: bamboo

Fig. 199
Pingfeng xi, panel 6 *b*: inscription

Inscriptions

The inscriptions are written in black, probably by the same person. Imitations of name seals (two with each inscription) are painted in red. The name seals are identical on all *b*-panels.

Fig. 200
Pingfeng xi, panel 4 *b*

Fig. 201
Pingfeng xi after retouching in 2013: panel 4 *b* (red arrow) appears darker and greyer

Fig. 202
Pingfeng xi, panel *4 b:* landscape shaded with grey and two browns hues, and green dots

Fig. 203
Pfx, panel 4 *b*, sky: brittle flaking, exposing finish coat

Fig. 204
Pingfeng xi, panel 4 *b*, lower part: horizontally oriented losses exposing the ground layer

Divergences in painting technique: panel 4 *b*

Panel 4 *b* visually deviates from the other *b*- and the *d*-panels. While in the other paintings background and sky appear white or have discoloured by the coating, in panel 4 *b* the sky looks grey (fig. 203), and the landscape appears darker and more opaque than elsewhere. In the sky, losses have occurred with distinguished edges. As the paint layer flaked off from the finish coat, the losses are rather deep. This is a type of damage that is rarely found in the other parts of the wall, where most of the losses occur within the ground layer and show soft and undistinguished edges. The lower part of panel 4 *b* shows the same type of superficial losses as the main part of the wall (fig. 149).

In a cross section from the area of the poem[73], two applications of ground layer are visible, each covered by a very thin layer containing black particles. The upper application seems to be soaked with brownish binding medium and looks brownish under UV light, while the lower one has a bluish white fluorescence (figs. 205 and 206). The composition of the two priming layers is identical.[74] The second layer may have been applied because of some mistake or problem that occurred during painting and could not be corrected. A difference in the content of binding medium may have had the result that the coating penetrated deeper, and perhaps it caused the separation of the upper application from the lower as well.

Fig. 205
Pingfeng xi, panel 4 *b*, cross section taken from the sky, VIS

5 thin layer with dark particles and few black pigments
4 second application of ground layer
3 thin layer with dark particles
2 first application of ground layer
1 sizing
0 *xi ni* (fine coat), with fibres

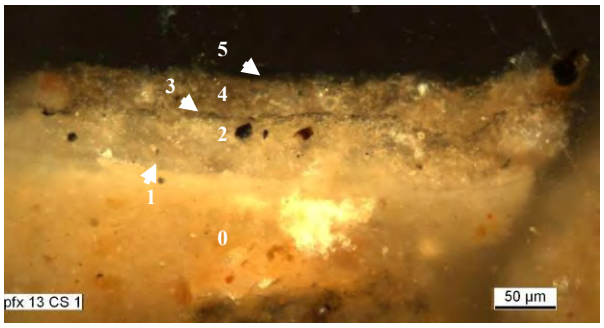
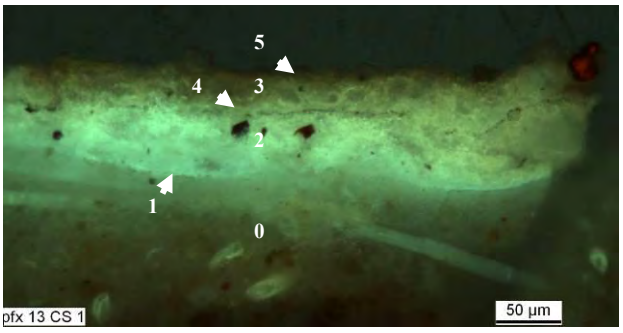


Fig. 206
Pingfeng xi, panel 4 *b*, cross section taken from the sky, UV

5 thin layer with few black pigments, appearing red
4 second application of ground layer, looking brown
3 thin layer with dark particles
2 first application of ground layer, looking bluish white
1 sizing, strong bluish white fluorescence
0 *xi ni* (fine coat), with fibres



[73] Sample *pfx* 13, cross section CS 1.

[74] PLM: Slide preparations PP Z 74, 75.

▲ Fig. 207
Pingfeng xi, panel 5 *c,* head of the lady on the northern side: delicate modulation and colourless lips

◄ Fig. 208
Pingfeng xi, panel 7 *c*, white monkey holding a peach: The depictions were omitted when the background was painted.

Fig. 209
Pingfeng xi, panel 5 *c* in August 2012: two old men with a kite

Panels c*: figurative depictions and still lives depictions*

The *c*-panels are similar to the *b*- and *d*-panels in style and technique. No detailed examination was done here, but the principal steps of the painting process could be recognised:

7 black colour of filling frame (blanching in contact with water)
6 dark background
5 opaque colours: pastose blue and green applied thickly, opaque red
4 washes in green, brown and red
3 drawing in grey lines, probably diluted black paint in several shades (light grey up to dark grey), modulation in grey / black lines
2 modulation of flesh tones with light red lines and light red washes
1 drawing in pale red lines
(0 black delineation to mark the outlines of the panel fillings)

The sequence of the paint application is the same as on the *b*- and *d*-panels. The modulation of the flesh tones is the same, also the style of the faces and lips coloured only in grey, not with red (fig. 208). Different from the *b*- and *d*-panels, the *c*-panels have a monochrome background which was applied after the figures had been painted, omitting the depicted scenes. The background colour of a purplish brown resembles the one used in the *e*-panels.[75] There are zones along the upper edge of the *c*-panels in which the brown background colour tends to flake off (figs. 209 and 210, yellow arrows). This seems connected to a layer of binding medium applied rather imprecisely on the framework before the brown background was painted, maybe wash or a sizing applied on the panel frames.

Fig. 210
Pingfeng xi, panel 8 *c* in August 2012: still life with chess board, censer, wrapped *qin* zither (?) and a vessel decorated with blossoms; areas with reduced adhesion along the edges (yellow arrows).

[75] There was no sample taken form the brown background.

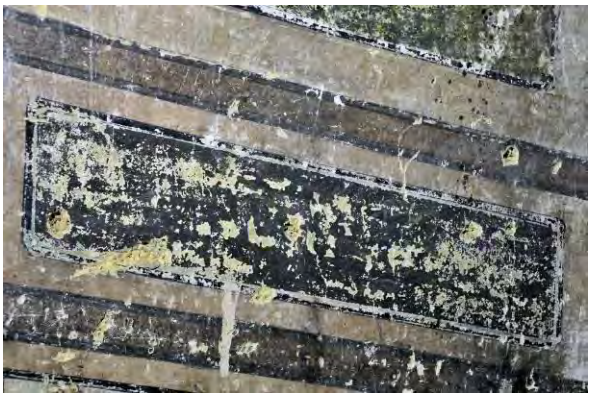


Fig. 211
Pingfeng xi, panel 5 *e*

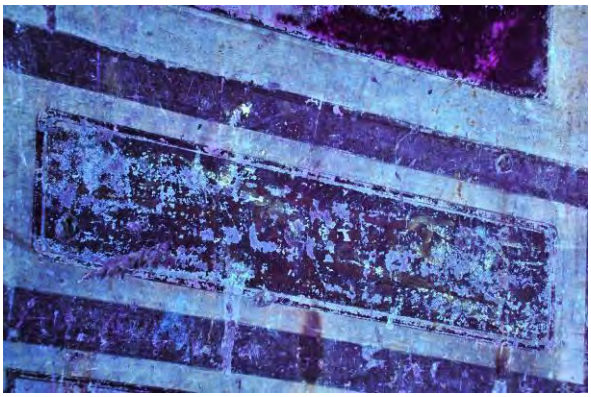


Fig. 212
Pingfeng xi, panel 5 *e* exposed to UV light

Fig. 213
Pingfeng xi, panel 8 *e*: losses follow the geometric ornament

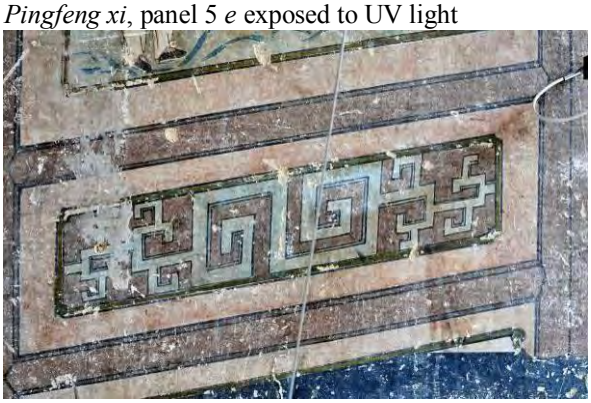


Fig. 214
Pingfeng dong, panel 6 *e*: *yunleiwen* ornament in pale blue with brown background

Fig. 215
Pingfeng xi, panel 5 *e*: traces of the yellow floral ornament

Fig. 216
Pingfeng bei, panel 1 *e*

Fig. 217
Pingfeng xi, panel 3 *e*: ornament on dark brown

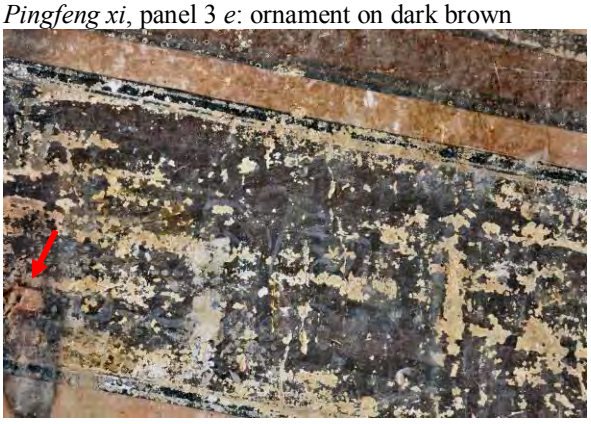
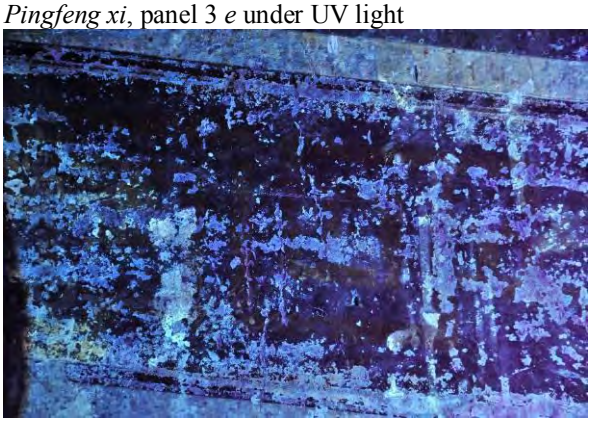


Fig. 218
Pingfeng xi, panel 3 *e* under UV light



Panels e*: geometrical ornaments*

The *e*-panels are severely damaged. The background is dark brown, almost black[76], like the background of the *c*-panels, but it covers the whole panel and does not omit a decoration.
Closer examination revealed traces of ornamental decoration which today are almost invisible consisting of fragmentary strokes of yellow paint applied onto the dark brown ground (fig. 215). Where the yellow paint has flaked off, a whitish haze is preserved on the dark background, maybe an accumulation of the binding medium. Exposed to UV light, the yellow strokes have a yellow fluorescence. Style and colour of the fragmented ornament resemble the floral decoration of the *e*-panels in the *pingfeng bei*-painting (fig. 216).

The examination under UV light also revealed that underneath the brown layer another ornament is concealed: Broad lines with a light brown fluorescence become visible which can be recognised as parts of a "cloud-and-thunder-pattern", *yunleiwen* 云雷纹, an ornament consisting of interlaced angular spirals. In VIS the *yunleiwen*-ornament is discernible though its lines have the same colour as the background. Increased losses of paint seem to have occurred in the areas of the pattern (fig. 213). At a spot damaged by heat (candle flame), the *yunleiwen* line appears red (fig. 217, red arrow), indicating that the ornament has been painted with a pigment which turns red if heated (e.g. yellow ochre, lead white or massicot).
Similar *yunleiwen* ornaments are depicted on the *e*-panels of the *pingfeng dong* (fig. 214): The slightly varying ornaments stand out in pale blue in front of a brown background in the same colour as that of the framework. Double contours in black indicate a relief effect, as if the ornament was carved (although the perspective is incoherent). The *yunleiwen*-ornament was omitted when the brown background was applied[77], like the figurative depictions in the *c*-panels.

As the *pingfeng xi*-paintings were executed with translucent layers, it can be assumed that the *yunleiwen* was overpainted with the dark background colour. In a cross section of the background of the area (*pfx* 12), a dark layer is visible on top of a reddish one. Structure, shade and pigments are very similar to the paint layer sequence of the frame (sample *pfx* 7 CS 1), although it seems to be much darker when one is looking at the wall.
The overpainting of the *yunleiwen*-ornament seems to have been part of the original painting process as the black filling frame paint overlaps the brown background colour of the *e*-panels. There may have been some "last minute" changes which perhaps occurred at the time when the paintings in the *zhengdian* (*pingfeng bei*-painting) were executed, or were made by the same painters.

[76] The PLM sample, PP Z 78, taken from sample *pfx* 12, contains black, angular particles and fine reddish brown particles (maybe iron oxide?).

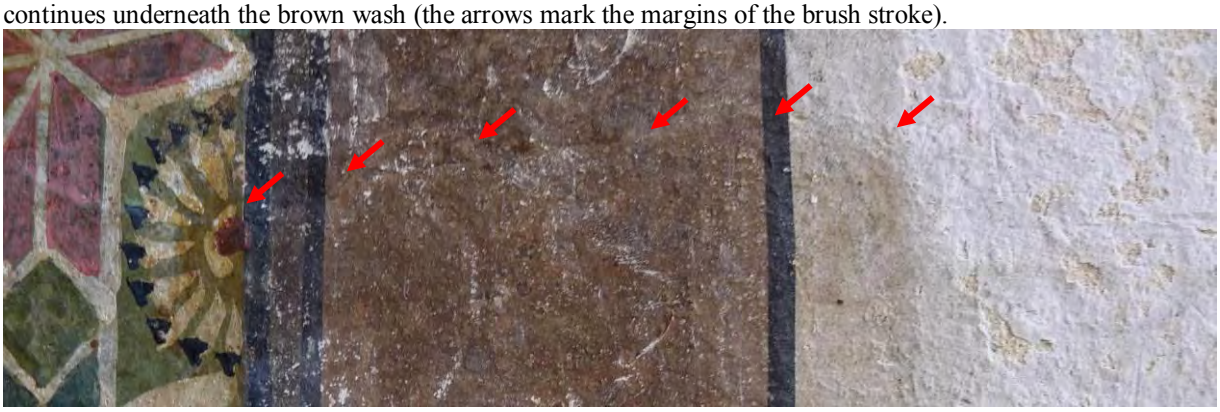
[77] Sample *pfd* 3 from panel 6 *e* only contains light blue. There is no brown paint layer underneath the very thin paint layer, probably just a wash containing Prussian blue.

Fig. 219
Pingfeng dong, southern edge of panel 8: Brush strokes from applying a transparent material are visible next to panel *c*.
[Detail from overview picture 2011: Shaanxi Institute for Conservation]

Fig. 220
Pingfeng dong, lower southern edge of panel 8 *b*, sizing below paint layer: Visible brush strokes appear darker due to higher saturation of the ground layer.

Fig. 221
Pingfeng dong, framework at the southern edge of panel 8 *b* and *c*, UV light: The sizing appears bluish white, but darker areas look brownish.

Fig. 222
Pingfeng dong, framework at the lower southern edge of panel 8 *b*: The end of a brush stroke of the sizing continues underneath the brown wash (the arrows mark the margins of the brush stroke).



Guodian: *Pingfeng dong*-painting

The *pingfeng dong*-mural was designed as the counterpart of the *pingfeng xi*. Composition, proportions, contents of the depictions and the type of the colouration are the same. The *pingfeng dong*-painting could not be examined in detail, but it can be assumed that the technique and steps of the procedure of painting are equivalent to those confirmed at the *pingfeng xi*-painting. The description of the *pingfeng dong*-painting therefore is restricted to the differences between the two paintings.

The most obvious differences are those in the style of the c- and d-panels, showing that they were executed by another painter, while the *b*-panels may have been painted by the same painter as the scenes on the *pingfeng xi*-painting. This other painter also used a slightly different technique.

Other differences concern the colouration and the decoration of the *e*-panels.

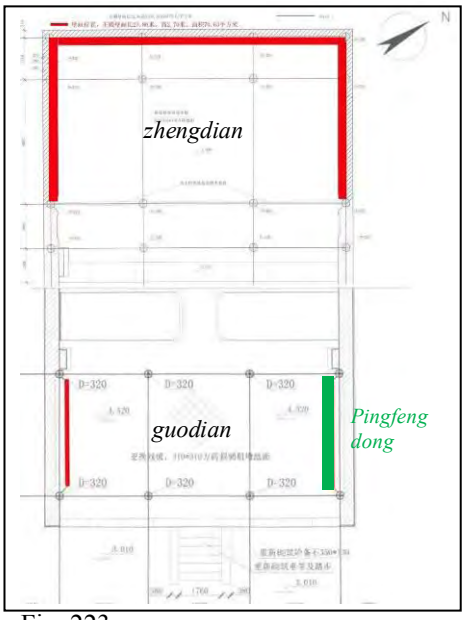


Fig. 223
Position of *pingfeng dong*-painting

Framing

The 10 to 11 cm wide black framing and the black line bordering the white framing were painted like at the *pingfeng xi*-painting. At the lower edge, a black line is still visible that was used to mark the black contour of the white frame (fig. 224). The chalk line may have been made using a black powdery material.

Fig. 224
Pingfeng dong, black horizontal chalk line marking the black contour of the white framing; green filling frame of an *e*-panel.

Framework

Isolation layer (sizing) underneath the brown washes

On the *pingfeng dong*-wall, too, traces of a sizing are visible which was applied before the colours were inserted into the folding screen. The outer margins of the sizing are still visible. Different from the *pingfeng xi*-painting, they do not only run parallel to the outlines of the folding screen, but also across them where the brush strokes followed the rails of the folding

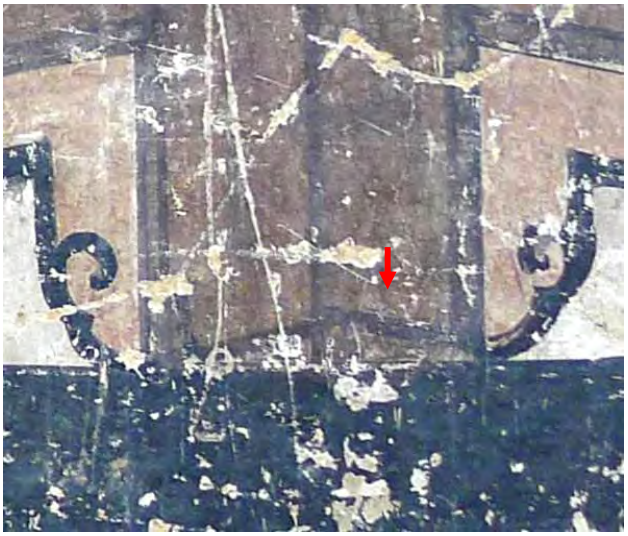


Fig. 225
Pingfeng xi, frame 6 to 7, legs: black trimming and problems with perspective (arrow)

Fig. 226
Pingfeng dong, frame 6 to 7, legs: green trimming and perspective depiction of the end of the stiles.

Fig. 227
Pingfeng dong, panel 7 *b* and 8 *b*: geometrical pattern

Fig. 228
Pingfeng dong, panel 3 *b* and 4 *b*: geometrical pattern

Table 11
Pingfeng xi: type of patterns in borders of *b*-panels

Frame	*colour of background*	*ornaments*
1, 8	green	dark green and dark pink eight-pointed stars, half blossoms
2, 7	dark green	pink and dark green half six-pointed stars, full blossoms
3, 6	light green	green and dark pink six-pointed stars, half blossoms
4, 5	light blue	white half blossoms, dark blue half rectangular ornaments

screen (figs. 219, 220 and 222). Under UV light, the brush strokes of the sizing appear bluish white, but they have brownish spots where the layer is thicker (fig. 221).
It is not clear if the sizing was applied before or after the black delineation was drawn. The fact that the application followed the shape of the rails may indicate the attempt to minimise the danger of smudging already existent lines - either the chalk lines or the delineation drawn with paint brushes.
A visible difference between the sizing and the protective coating might be that the sizing followed the zigzag-shape of the folding screen while the protective coating was applied horizontally and restricted to the narrative scenes. A clear differentiation, however, was not possible.

Brown washes on the framework

No closer examination was done. Like on the *pingfeng xi*-painting, the bevelled edges are painted darker. There are less rings from air bubbles visible than on the *pingfeng xi*-painting, and the effect of 'white lines' along the black lines also is less prominent. The framework appears homogeneously brown; it is not possible to discern if the paint was applied in two or three layers like in the *pingfeng xi*-painting. The bevelled edges are slightly darker.

Panel frames and filling frames

As on the *pingfeng xi*-painting, the panel frames are 3 cm wide and differentiated between the monochrome frames of the *a*-, *c*-, *d*-, *e*-panels and the *f*-zone and the patterned borders of the *b*-panels.

Panel frames of the a-, c-, d-, e-*panels and the legs*

The colour is slightly lighter and more yellowish than on the *pingfeng xi*-painting.

Filling frames of the a-, c-, d-, e-*panels and the legs*

The filling frames and the trim border along the legs are filled with green instead of the black used on the *pingfeng xi*-painting. Although the application is thin, the green is not a translucent wash but opaque. It was applied using a ruler, carefully avoiding an overlapping onto the black contours. Often a narrow white strip of omitted white background is visible between the green and the black delineation. The legs have a slight different shape (three-lobed ornament instead of two-lobed one). The perspective problem of placing the legs on the black framing was solved in a bit more convincing manner than on the *pingfeng xi*-painting.

Borders of b-panels ("star patterns")

The *b*-panels are framed with 3.3 cm wide borders showing geometrical patterns (figs. 227, 228). There are four different patterns with three ground colours (light green, dark green and blue, table 11) whereas in the *pingfeng xi*-painting there is only one pattern in two different colourations. Only the pattern on the frames 3 and 6 has a design similar to the ones on the *pingfeng xi*-painting. The corner ornaments are quarters of blossoms. At the borders with green ground (frames 2, 3, 6 and 7), the blossoms are shaded with a yellow glaze.

Lead white (white lines and white in pink and light blue), Prussian blue (blue), cinnabar (red in pink), botallackite and azurite (green background of panel frame 8 *b*) were identified as pigments.

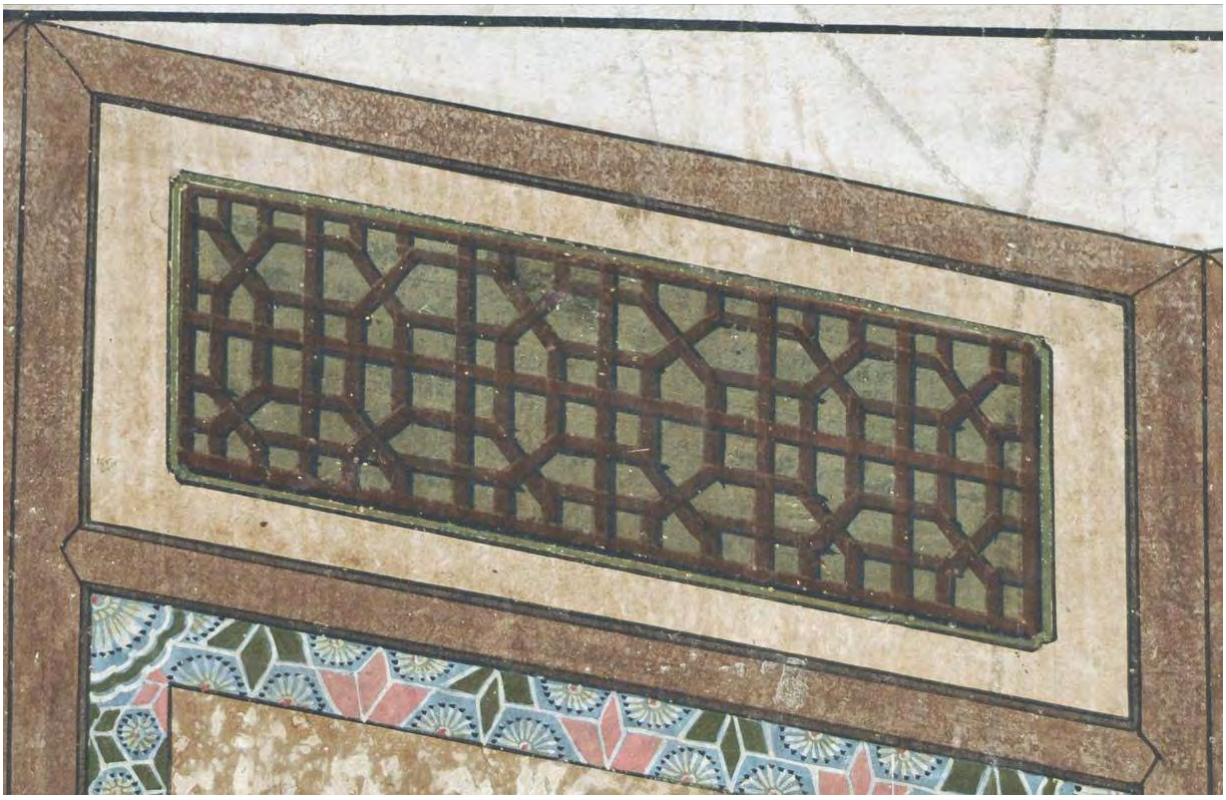


Fig. 229
Pingfeng dong, panel 7 *a*

Fig. 230 a and b
Pingfeng dong, panel 8 *a*: bluish grey background, preserved yellow highlights; framed with green filling frame

Panel fillings

The panels are described from top (panel *a*) to bottom (panel *e*).

Panels a*: decorative latticework*

The panel filling (fig. 229) show a lattice with the same type of decoration formed by overlapping and linked octagons as in the *pingfeng xi*-painting, but there are some differences (fig. 231): In the *pingfeng dong*-painting, the background of the lattice is of a bluish grey that may originally have been of a more vivid hue. The lattice strips are set in a rectangular frame of the same reddish brown colour and highlighted with yellow. The yellow highlighting is better preserved than on the *pingfeng xi*-painting (fig. 230).

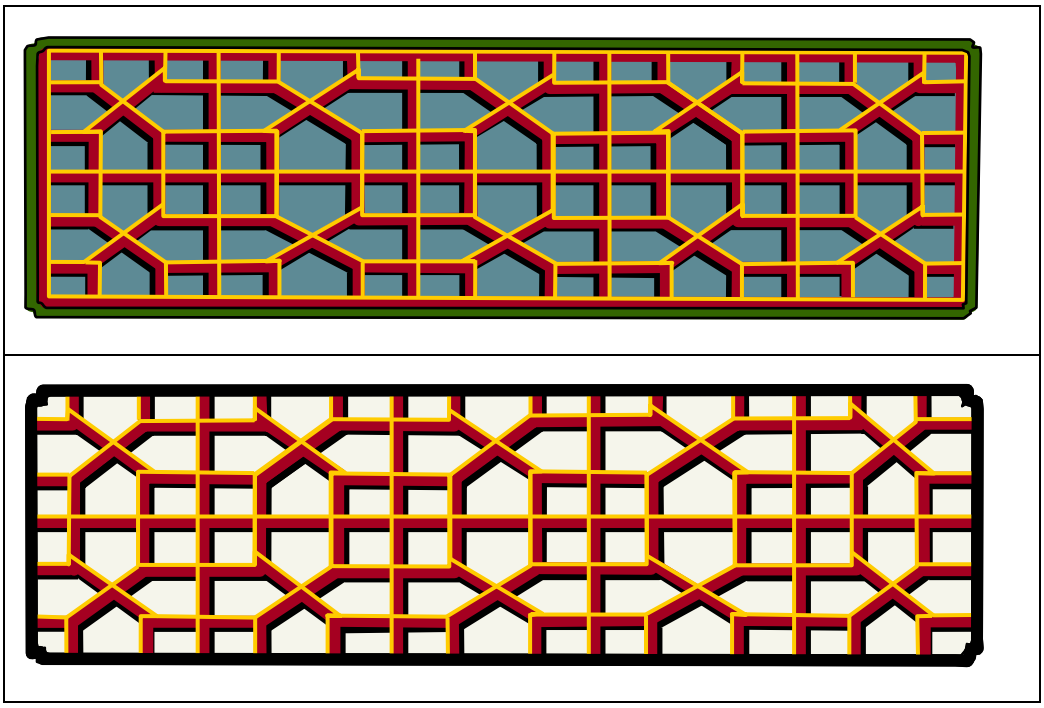


Fig. 231
Scheme of design of the *a*-panels: *pingfeng dong* (top) and *pingfeng xi* (below).

Panels b, c *and* d*: figurative depictions and still lives*

In the *pingfeng dong*-painting, style and technique of the b-panels and d-panels are different from each other.

The *b*-panels resemble the figurative scenes in the *pingfeng xi*-painting: The scenes are painted in the same fine calligraphic manner with rather reduced colouration. The style of faces and robes, the types of painted plants (including the same species and also showing green dots), the way of painting water and clouds and the details of the architecture are the same as in the *pingfeng xi*-painting or very similar to it (fig. 232-236). The same decorative objects like tables inlaid with rare stones, vases, small cabinets with drawers, scrolls with marbled borders (fig. 234, close to upper edge) can be observed. The inscriptions show the same handwriting and the same name seals. The only difference in technique is that some of the ladies have red lips (fig. 235, young lady). The phenomena of transparent layers (sizing and coating) are the same as the *pingfeng xi*-painting.
The *b*-panels were painted when the ornamental borders had already been finished. This is indicated by the brush strokes of the black delineation overlapping onto the border, e. g. in panel 8 *b*.

Fig. 232
Pingfeng dong, panel 8 *b*: lady in a pavilion

The *d*-panels differ from the *b*-panels in style and technique: The composition is simpler; the drawings are less refined and show broader strokes (fig. 237). The figures are stiffer in their postures and movements and often show peculiarly bent hands (fig. 238). They appear less artistic although they are rich in details.
Technically they show a considerable deviancy. Light tones and highlights are only partly omitted during the painting process: Mostly they were mixed with white and applied in the final steps of the painting process. White highlights can be seen on the clothes like single folds or belts, but white was also applied to indicate white parts of the clothing as shoe soles, trousers, sleeve cuffs and collars. Larger white parts are shaded with pink (fig. 239, collar). Highlights were also set in light blue on pale blue parts of the clothing (fig. 239, cap). The flesh tones were mixed with white and red and applied overlapping and in parts omitting the black drawing. Eyes, eyebrows and hair were painted with black on top of the flesh tones. The lips are coloured pink to red, with the exception of the faces of very old persons. The skies in the background of the scenes are sometimes shaded with light blue (fig. 240). The vegetation does not show green dots.
The *d*-panels do not have inscriptions giving the title of the scene like in the *pingfeng xi*-painting. The only inscription is written on a screen painted in the background of panel 3 *d*. The handwriting is different from the *b*-panels (more cursive and flowing). The screen has no green marbled border or pilaster like the screens in the *pingfeng xi*-painting and the b-panels of the *pingfeng dong*-painting.

B-and *d*-panels show the same type of transparent brownish layers as the *pingfeng xi*-painting. The more brownish material in the b-panels emphasizes the structure of horizontal brush strokes of the ground layer. The transparent material in the *d*-panel is greyish, thin and almost not visible. This also may indicate the activity of different painters.
The lower part of the painting, from the *d*-panels downwards, shows numerous splashes of material that is invisible in VIS, but bright and bluish white under UV light. The splashes continue on the brick wall. It can be assumed that they are traces of some kind of 'accident' (binding medium hitting the wall in an uncontrolled action) happening after the paintings had been finished.
The *c*-panels show the same characteristics regarding technique and style as the *d*-panels. Different from the *pingfeng xi*-painting, the background is painted in a lighter brown, very similar to the colour of the framework.
It can be assumed that the narrative scenes of the *pingfeng dong*-wall were painted by two different painters. While the b-panels seem to be painted by the same painter as the narrative scenes in the *pingfeng xi*-painting, the *c*- and *d*-panels were painted by another person.

Panels e*:* yunleiwen

The *e*-panels show *yunleiwen* 云雷纹-ornament ("cloud-and-thunder-pattern", figs. 242 and 243). The ornament is repeated on each frame, arranged mirror-inverted on each second frame depending on the direction of inclination of the frame (the patterns of the frames 1, 3, 5 and 7 are of the same kind, the frames 2, 4, 6 and 8 show them mirror-inverted). There are small variations in the details, like the size of central ornament.

The pattern is painted in pale blue. The background is brown, in the same colour as the background in the *c*-panels. Dark grey edges accompanying each line of the *yunleiwen* give the impression of three-dimensionality, indicating a carved ornament set on a panel or a lattice.[78]

[78] The interruption in the pattern in panel 4 *e* is a mistake resulting from the restoration in 2012. As the photographs from 2011 show, the ornaments were interlaced as in the other frames.

▲ Fig. 233
Pfd, panel 5 *b*, playing chess in a boat

▼ Fig. 234
Pfd, panel 1 *b*, man and boy in bamboo pavilion

▲ Fig. 235
Pingfeng dong, panel 4 *b*: women and boy meeting an old carrier

▼ Fig. 236
Pingfeng dong, panel 8 *b*: man at goldfish pond, behind him banana leaves and marble basin

Fig. 237
Pingfeng dong, panel 3 *d* (after retouching)

Fig. 238
Pingfeng xi, panel 8 *d*: flesh tone in opaque pink; staff highlighted with white; strangely bent hand

Fig. 239
Pingfeng xi, panel 5 *d*: face in opaque pink, light blue and white highlights (cap and collar)

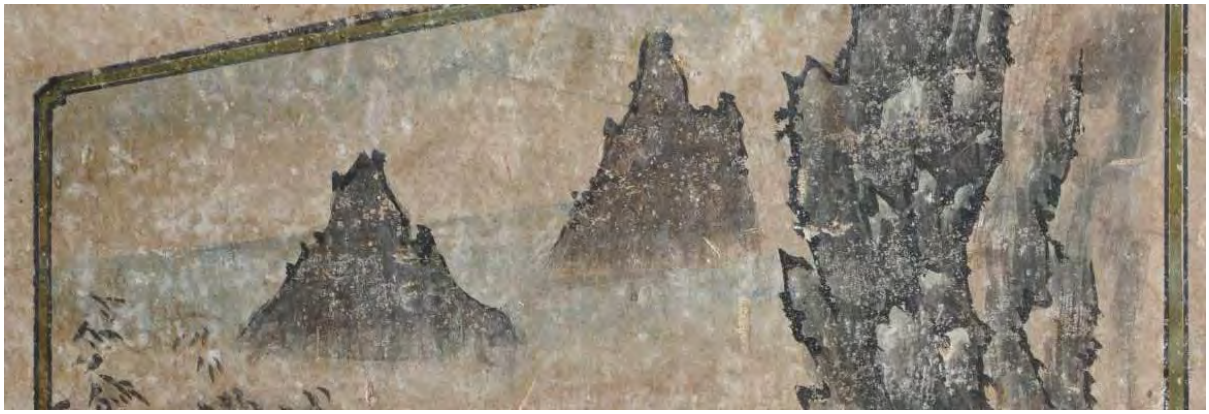


Fig. 240
Pingfeng dong, panel 8 *d*: detail of mountain in the background (after retouching)

Fig. 241
Pingfeng dong, panel 7 *c*, after retouching in 2012

Fig. 242
Pingfeng dong, panel 5 *e*, after retouching

Fig. 243
Pingfeng dong, panel 6 *e,* after retouching

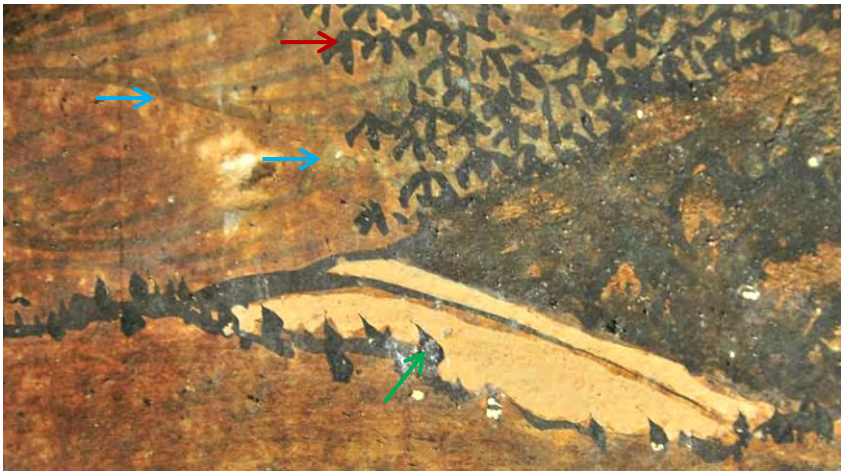


Fig. 244
Sanguo dong. Lower edge, left side: Shore of river with small waterfall accentuated in white. Wave and plants were sketched in grey before the isolation layer was applied (blue arrow), and accentuated in more opaque paint on top of the isolation layer (red arrows). After filling in the opaque white, black dots (green arrows) and green dabs (missing here) were added to the landscape.

Fig. 245
Sanguo dong: Left edge: The isolation layer overlapping the outline of the painting formed a white margin along the outline (red arrow). The washes/glazes applied for the landscape provoked the same effect on the black contour lines drawn after the isolation layer had been applied (blue arrow).

Fig. 246
Sanguo xi: coloured washes in roof tiles, roof ridge and mountains underneath a brown layer

Fig. 247
Sanguo dong: bluish-green washes underneath the brown isolation layer (blue arrows), brown washes (red arrow) underneath or on top of the isolation layer

Zhengdian: The paintings of the "three kingdoms" - *sanguo xi* and *sanguo dong*

The *sanguo*-murals are the biggest and probably the most important paintings in *the beiwusheng huiguan* halls. They were designed as counterparts: there is a corresponding arrangement of the main elements (architecture, landscape, cloud with riders, and background with sky). They show scenes of the same legend, and the main characters as Guan Yu, Liu Bei or Cao Cao can be recognised as their facial features and typical appearance are the same in both paintings. The technique and style indicate that they were painted by the same team of painters.

The *sanguo*-paintings are rather different from the other paintings in the halls. Only at these paintings the background was completely coloured, and gilding was used.[79] The painting process, with a multi-layered structure, is more complex than at the other paintings.

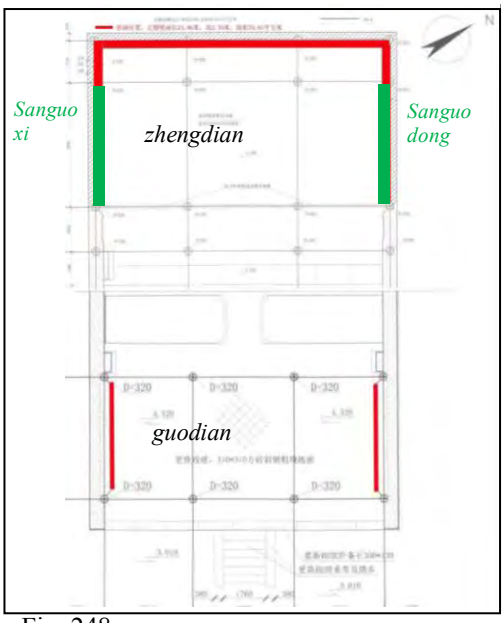


Fig. 248
Position of *sanguo*-paintings

Painting process

Because most of the paint layers are very thin and several of them have altered and discoloured, it is difficult to understand the painting technique. The examination was done using magnifying lenses, VIS, UV light and IR reflectance. Cross sections were made from selected areas, but the multi-layered stratigraphy with very thin washes and intermediate binding medium layers is not discernable in the cross sections. The recognisable steps of the painting process are compiled in table 12.

Table 12
Steps of the painting process of the *sanguo*-paintings

Sequence of working process	*Applied layer*
10	complete coating or partial coatings on light areas
9	red and blue shades, green glazes on opaque colours / green and brownish washes in the parts of the landscape omitting the figures
8	partial repetition of contour drawing in black, e.g. red cloths, reins of horses; black dots and green dabs in the landscape
7	b white lines for details and highlights (overlapping black contours) a opaque paint layers omitting contour drawing // dark green in the landscape (mountains)
6	gold: leaf gilding, maybe also gold powder for fine ornaments
5	partial repetition of contours in black, black drawings of the natural scenery
4	c coating on top of the flesh tones b eyeballs, iris, eyebrows and lips a semi-transparent flesh tones
3	overall application of a binding medium layer ("isolation layer"), nowadays brown
2	translucent washes in red, brown, green, blue
1	delineation in grey up to black

[79] Gilding is also used at the paintings on the wooden constructions (column heads and lintels of the *zhengdian*) but not at the other murals.

Fig. 249
Sanguo xi: Black delineation (yellow arrows). Opaque colours (the horse's coat) omitting the delineation with red, grey and green washes for shading (green and red arrow). The grey mane on top of the opaque colours is only visible on the white horse coat (black arrow). The reins were painted last.

Fig. 250
Sanguo dong, upper part: Underneath the thickly applied green of the robe the first delineation coloured with an olive green wash becomes visible.

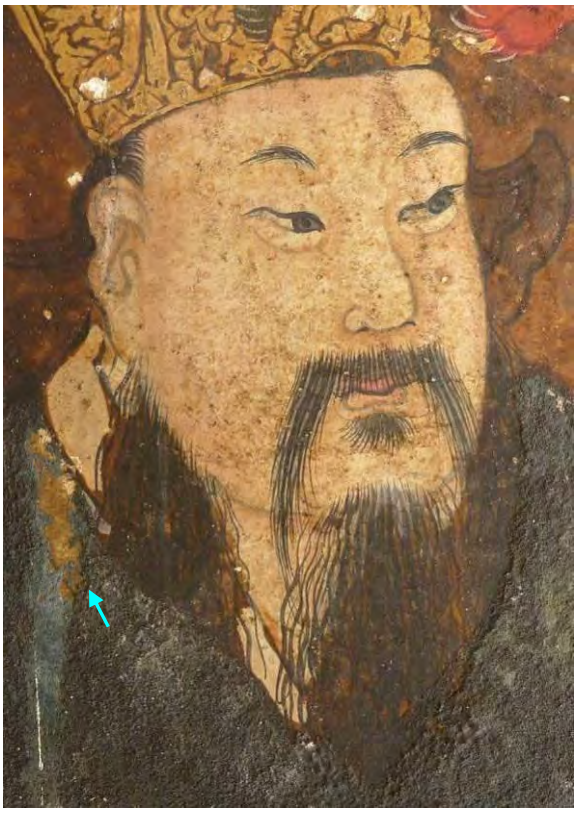
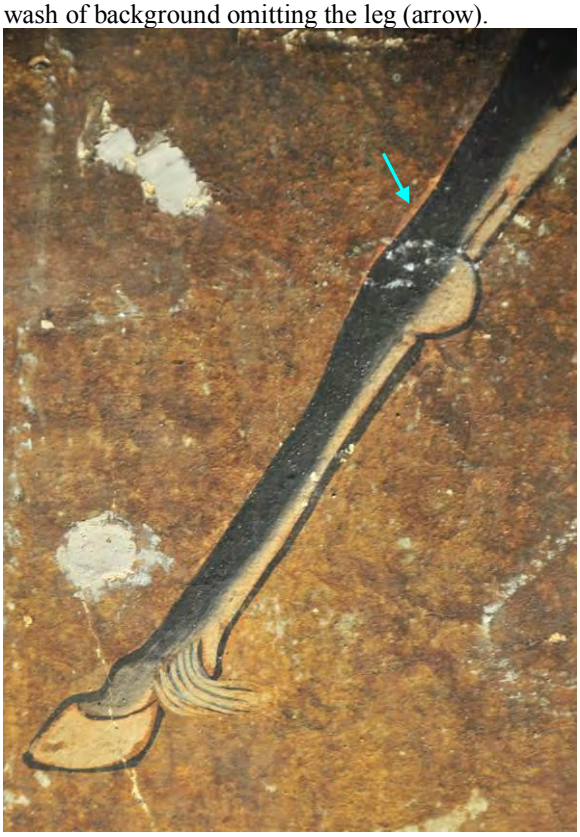


Fig. 251
Sanguo dong, lower northern corner, black horse from chariot: Black contour repeated on the isolation layer and filled in white, grey and black. Olive green wash of background omitting the leg (arrow).



(1) The first step of the painting process was the ***delineation***. The fine lines are black up to grey (= diluted black paint) and give a very detailed and precise drawing including almost all the details of the depiction (fig. 249 and 263). The delineation remained visible in parts of the paintings. Only in few parts the execution of the paint layer deviated from the delineation.

The surface of the white framing appears yellowish white under UV light, while parts with damaged surface appear bluish. This may indicate the presence of a ***sizing*** that may have been applied before or after the delineation.

Fig. 252
Sanguo xi, upper part, "lion head" on the prow of a boat: Black delineation (yellow arrows) visible in lacunae. In the boat and the waves the delineation remained visible.

(2) Pale, but subtly nuanced ***coloured washes*** gave the first colour impression. Today they are only visible in very small areas that were not covered with brown layers. Reddish brown, brown, blue and bluish green can be distinguished (fig. 246 and 247). The architecture and objects like the chariot or the boats were coloured with washes of different shades (red, brownish, grey and bluish grey). These washes are almost concealed underneath brown layers nowadays, but in parts they become discernable with infrared reflectance (fig. 262 and 263). The colouration of the architectural elements and the roof tiles, depicted as strips with alternating shades of grey, correlate with the paintings in the *b*-panels of the folding screens in the *guodian* (*pingfeng xi* and *pingfeng dong*). In this state of colouration, the *sanguo*-paintings probably resembled the *b*-panels of the folding screens in the type of drawing and delicate colouration. Plants and architecture may even have been painted by the same painter.

(3) A layer of binding medium was applied all over the paintings with long horizontally running brush strokes, probably intended as an ***intermediate isolation layer***. This layer nowadays is dark brown, but it does not contain pigments. It is not visible in cross sections (probably too thin and no UV fluorescence), and it could not be identified analytically.[80] The fact that white margins formed along black lines (as in the *pingfeng xi*-painting, see p. 95) means that the material must have had an aqueous component that served as the continuous phase of an emulsion.

Little care was taken to restrict the application to the paintings or to avoid runners and drops on the white framing (fig. 246, next to the roof, and fig. 247). Regarding the richness of details and embellishments in the natural scenery, architecture and objects it seems implausible that these finely designed parts should be deliberately concealed underneath a brown layer to an extent that made them almost unrecognisable. As it is almost impossible to distinguish water from mountains, or grass and chariot wheels, horse manes, the bodies of the deer, boats, clouds, roofs and parapets from the background, the legibility of the scenes is impaired. This indicates that originally the isolation layer must have been colourless or only very slightly tinted. The discolouration of the isolation layer was the biggest change in the visual impact of the paintings that occurred by ageing.

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[80] Analyses with GC-MS and Py FT-IR at the University of Pisa: In sample *sx* 10, from the white framing next to the northern edge of the *sanguo xi*-painting, egg and polysaccharides could be identified in the brown layer. The presence of aged oil, identified in the white ground layer of this sample, cannot be explained yet. The brown material does not contain pigments (analysis with PLM: *sx* 10 PP Z 41).

Fig. 253
Sanguo dong, northern corner, flight in the chariot, head of Liu Bei (figure no. 26): Underneath the green of the cape the brown isolation layer is visible (arrows). Blotchy coating on the face. Height of the face: ca. 4 cm.

Fig. 254
Sanguo dong: Detail of the head of a guard (figure no. 4) with gilded helmet, staff and suit of armour, probably decorated with leaf gilding. The orange-red mordant is partly visible (arrows). Semi-translucent paint layer in the face, covered with a yellowish coating. Height of the face: ca. 4 cm.

Fig. 255
Sanguo xi, hand of guard at the terrace (figure no. 8) in front of the pavilion: The protective coating of the hand ran down over the opaque paint of the terrace. The white paint of the terrace was applied twice. Black lines were shaded with pink.

(4) The application of non-translucent paints was probably started with painting the ***flesh tones***. A semi-translucent, non-pastose paint was used, possibly to avoid the fine delineation to be covered. The eyeballs were painted white and sometimes shaded with bluish grey (fig. 250, 254 and 253); then the irises, eyebrows and nostrils were accentuated with black lines and the lips coloured in reddish pink. A binding medium layer of irregular thickness was applied to the flesh tones. In parts it seems to lie underneath the opaque paint layers (figs. 266/267), but at the *sanguo xi*-painting it appears to lie on top of them (fig. 255).

(5) Black ***contours*** were partly drawn again, using darker and slightly wider lines than in the first delineation. In the nature scenery, details like leaves were repeated, giving more volume to shrubs and trees. While the first delineation appears greyish, the second drawing is black.

(6) The ***gilding*** was put on a reddish mordant, containing fine cinnabar[81] in a mixture of glue and polysaccharides.[82] Gold is only applied in small areas. For larger areas, like weapons, leaf gilding can be proved (fig. 119, gilded head of staff next to Liu Bei). The typical edges and wrinkles of cut gold leaves are visible (fig 256). But small gilded decorations, e. g. at the harnesses of the horses (fig. 249), on belts, caps (fig. 254) or suits of armour, seem to have been made with leaf gilding as well, even though the golden lines and dots are very small (fig. 254).

Fig. 256
Sanguo dong: Sample taken from a weapon showing gold leaf and reddish mordant

(7) ***Opaque paint layers*** were used for figures, architecture, objects and small parts of the natural scenery. Black contour lines were partly omitted during the application of the paint, especially when the paint was mixed with white and the contours were intended to be black (fig. 257: white paint at pavilion terrace). The white paint was partly applied twice as slightly overlapping edges show (fig. 255, right edge of terrace). The delineation was sometimes covered with opaque paint and repeated with black lines, e.g. in the red robe of Liu Bei kneeling in the *ganlusi*-hall, *sanguo dong*-painting (fig. 119 and 120), or with black and coloured lines, e.g. the rider no. 30 in the *sanguo xi*-painting, where the folds in the purplish skirt were repeated with black lines, while the seam and the folds in the pink tunic were drawn again with a red glaze (fig. 107). Black lines in white areas were often shaded with pink or red lines. In the landscape scenery, semi-opaque green paint was used to colour hills and bushes.

(8) In the landscape scenery, ***black dots*** were added and highlighted with ***green dabs*** of paint (fig. 268). Contour lines, too, seem to have been drawn again.

(9) ***Washes*** and ***glazes*** were used to shade the opaque colours in figures, objects and architecture. Some parts, like a bright ochre table cloth in the *sanguo xi*-painting or pinkish horse coats, were underpainted with opaque lead white and coloured and modulated with glazes. Opaque and translucent paint layers may have been applied as subsequent steps for smaller units, like single figures or objects: The opaque paint of the carpet pattern in the *ganlusi*-hall (*sanguo dong*-painting) overlaps the glazes on the figures' robes, showing that the carpet was painted after the figures had been completed (fig. 258).

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[81] HU et al. 2012, SEM with element mapping: mordant: Hg, S; gold: Au (92,4%), Ag, Cu.

[82] Analyses with GC-MS and Py FT-IR at the University of Pisa.

Fig. 257
Sanguo dong, glazes overlapping on the opaque paint layers: bright green glaze of banana leaf (blue arrow), red glaze of railing (red arrow)

Fig. 258
Sanguo dong, enlarged detail of the pavilion: the carpet was painted after the terrace and the figures had been finished

Fig. 259
Sanguo dong, figure no. 53 from a group of horsemen: The eyes of the horses and one hand of the old man remained unpainted by mistake (blue arrow). At the forehead of the old man, the olive green wash of the background overlaps onto his face (green arrow).

Fig. 260
Sanguo dong, soldier, figure no. 43 from the group with Guan Yu and Zhang Fei at the left edge of the painting: One hand remained unpainted by mistake.

Green and brown washes were used to modulate the landscape. In parts they are slightly overlaping on to the figures, showing that they were applied after painting the figures.

(10) The presence of slightly brownish material is visible in all light-coloured parts and thus may be interpreted as ***protective coating***. It could not be proved if the coating was applied to the complete paintings or only partially, as it is not possible to distinguish it in most of the darker and more strongly coloured areas. The topmost parts of the paintings which were covered with whitewash appeared lighter after removing the whitewash. The paint layer was thinned and damaged, but in some parts only a brownish hue seemed to be lost from the otherwise still intact pictorial layer. This may indicate that a protective coating was applied all over to the paintings (fig. 261).

There are few "***mistakes***" within the colouration of higher parts less visible for observers: The painters forgot to colour hands and other small details, background washes are overlapping on to the figures. Such mistakes were less visible before the isolation layer(s) turned brown (figs. 259 and 260).

Under UV light uniformly white parts like horse coats or robes show different fluorescence colour, appearing partly white and partly brownish. Shapes become perceptible which deviate from the visible ones (figs. 264/265 and 266/267). They seem to indicate some ***changes***, but it was not possible to assign the two fluorescence colours to layers/coatings recognisable in visible light.

Because of the discoloration of the isolation layer, many details of the paintings are concealed and invisible today. Infrared reflectography can be used to see the drawing and some shades of colour clearer (fig. 262/263). The examination under UV light also revealed details not discernible in VIS like the accentuations in a horse mane or the differences between mane, tail and coat of a horse now looking completely white (fig. 266/267).

Fig. 261
Sanguo xi, warrior on a boat: The upper part was covered with the whitewash (border marked with yellow line) and now looks lighter, probably because the protective coating is lost, visible especially in the face, but also in other parts of the painting (e. g. left upper arm).

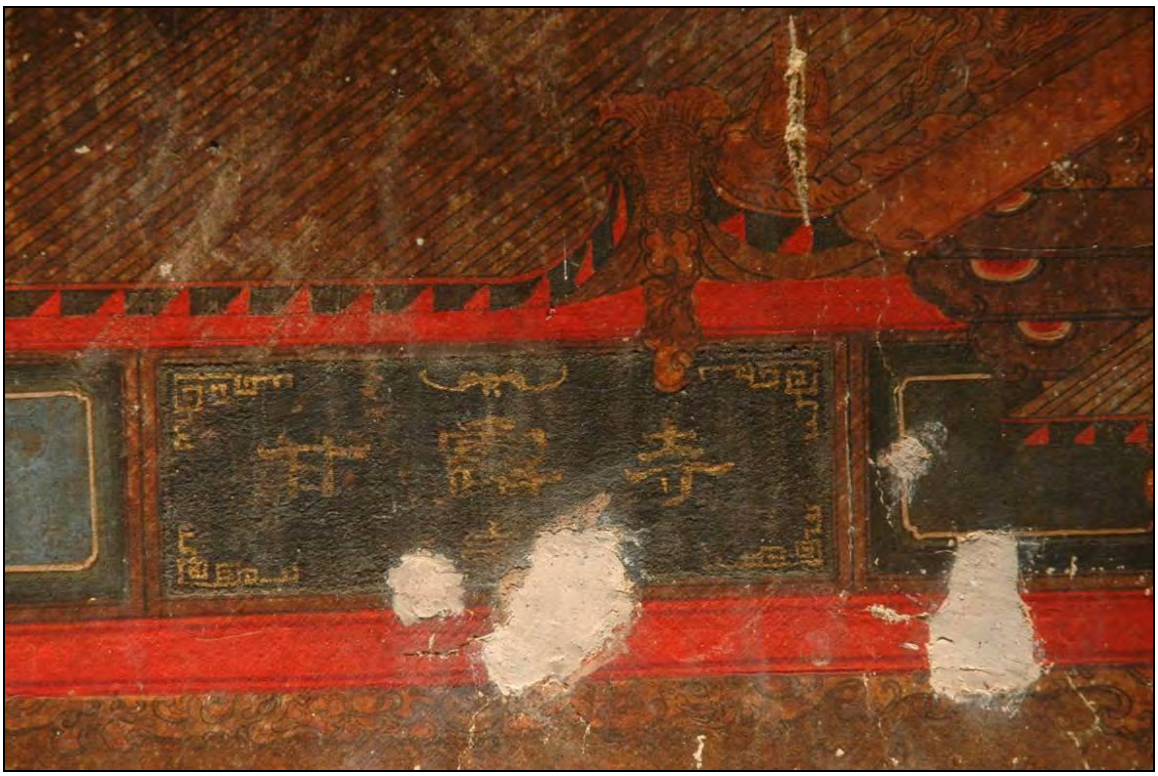


Fig. 262
Sanguo dong, entrance gate of *ganlusi*-hall: Brown layers obscure the intended chromaticity.

Fig. 263
Sanguo dong, IR reflectance: The delineation and shading of roof tiles and ornaments become visible.

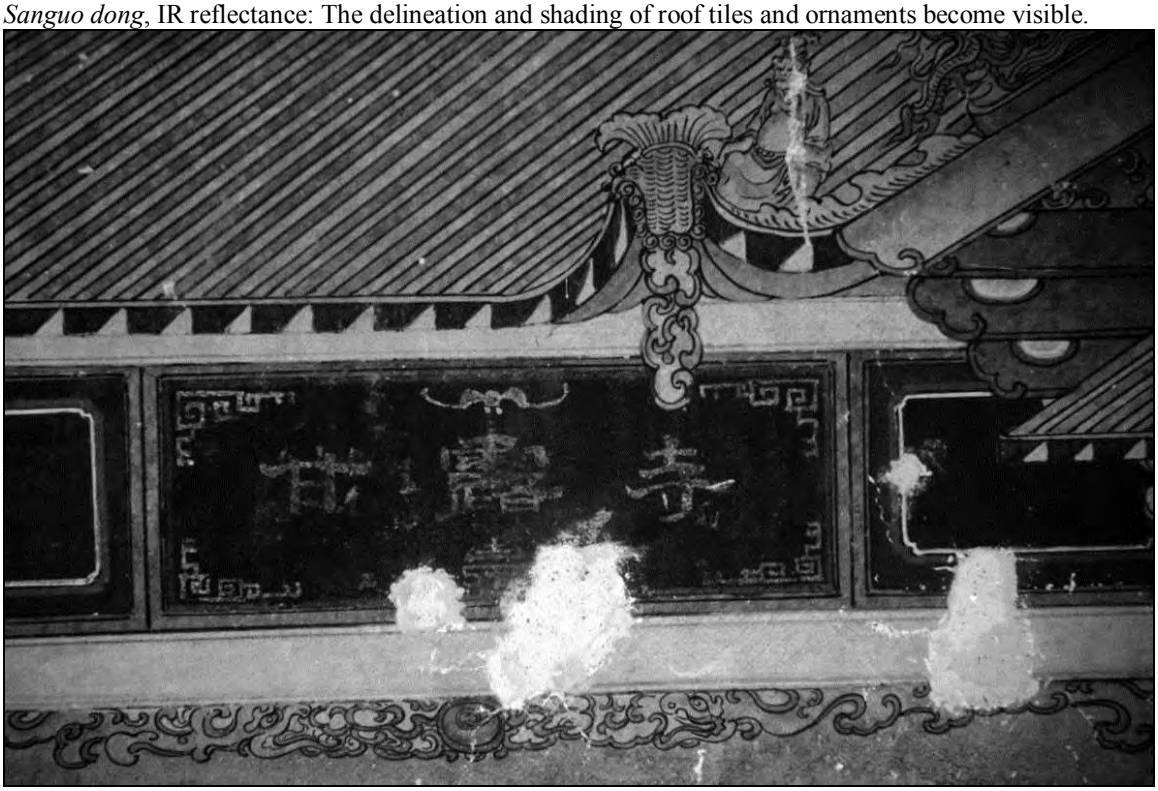


Fig. 264
Sanguo dong: soldier (figure no. 23) with horse, VIS (during filling)

Fig. 265
Like fig. 264, UV: Changes in the robe can be recognised by UV fluorescence (red arrows); the forelegs of the horse have a different fluorescence. The grassland appears dark under UV light, while the architecture is light brown.

Fig. 266
Sanguo dong, lower northern edge: Liu Bei's horse (white), horse of a chariot (black), and hand of a soldier (figure no. 27), detail in VIS

Fig. 267
Like fig. 266, UV: The hand of the soldier was omitted when painting the horse white (brown arrow). A change in the shape of the sleeve cuff is revealed by different UV fluorescence (red arrow). Accents in the mane of the black horse are not discernible in VIS (green arrow). A whitish glossy glaze on its chest has a brownish fluorescence (white arrow), The grassland in the background looks dark under UV light.

Fig. 268
Sanguo dong, deer standing on a hill: Without intense illumination only the white lines of hair and antlers are discernible, but the coat of the deer is painted with fine lines in two brown hues. Hills are shaded greenish. Black dabs highlighted in green are applied along the ridges.

Fig. 269
Sanguo dong: lower left edge in VIS, 2011
[Shaanxi Institute for Conservation]

Fig. 270
Sanguo dong, lower left edge: In UV light, different tones are clearly visible in the landscape (picture taken without filter and blurred due to long exposure time)

Colouration of the landscape (brown background)

In visible light the landscape, consisting of hills and rocks, rivers and grassland and containing numerous different plants, seems to be homogeneously brown. Brown elements as boats, parts of the chariot and the architecture and animals do not stand out anymore, but are almost concealed in the brown background. The fine delineation can only be recognised at very close observation. The *sanguo dong*-painting appears even darker than the *sanguo xi*-painting.

The use of brown, green and bluish washes as a first step of colouration proves that the landscape was planned to be light-coloured with single elements being silhouetted against the background. Under UV light at least three different types of landscape areas could be distinguished (grassland, hills and rocks) as well as water. A cross section from a small hill top proves the presence of a green wash underneath a green opaque layer and two phases of black drawing as well as brownish media, one staining the white ground, another covering the opaque green layer (*sd* 8 CS 1, fig. 450). Characteristics of the investigated layers are compiled in table 13.

Table 13
Overview of examined brown areas and their particularities

area	*depiction*	*characteristics*	*UV fluorescence*	*pigments*	*binders*	*sample no.*
sx, lower edge	grassland	delineation with crescent-shaped lines, small shrubs appear darker	purplish dark brown	- Prussian blue - malachite - black (flame carbons?) (Ca-oxalate)	animal glue egg	*sx* 4
sd, above entrance gate (see fig. 265)	grassland or soil	no delineation	purplish dark brown	- malachite - green with low IF - carbon black - Prussian blue, few - flame carbon		*sd* 1
sd, left edge of painting, right to Guan Yu's horse	grassland	delineation with crescent-shaped lines, small plants	purplish dark brown	- malachite - red lake, few - cinnabar - Prussian blue		*sd* 7
sx, next to flag no. F6	hills?	no delineation; maybe slight shading	purplish dark brown	- malachite - black		*sx* 11
sd, next to deer (see figs. 431-435, 450)	top of small green hill	stratigraphy (CS 1) - thick green layer (malachite) - black line - thin layer with green pigments - black line - white ground layer stained brown		- malachite - azurite, few (from malachite) - maybe bone black, rather coarse - binding medium - cinnabar, few - red lake, 1 particle - lead white, few		*sd* 8
sd, left edge of painting (see fig. 244)	water	lines for waves; brownish wash underneath brown isolation layer; slight shading of wave troughs towards the rear shore	medium brown	- malachite, small - bone black, few - cinnabar, few - red lead, few - graphite - iron oxides - charcoal black - lead oxide or orpiment		*sd* 6
sx, upper left part	probably boat (falsely labelled as background)	stratigraphy: - thin dark brown layer - brown layer - black lines, drawn with ruler	brown	- Prussian blue - botallackite (?) (Ca-oxalate) black lines: - fine-grained black	animal glue egg	*sx* 9
sx = sanguo xi; *sd = sanguo dong*						

Fig. 271 and 272 (top)
Sanguo xi, right edge, VIS and UV: The ravine (showing stylised square blocks of rock) below the feet of the men and the trees were omitted when applying the olive green glaze (= black in UV light). The brown isolation material is brushed onto the white framing, but not the olive green glaze.

Fig. 273 and 274 (below)
Sanguo xi, right edge, VIS and UV: Two shades of brown in the rock (white and yellow arrows); olive green glaze appears black in UV light (copper pigments). Traces of bright green wash (green arrows) and olive green glaze (black arrows) running down at the lower edge.

Samples from the landscape contain malachite and black, and often Prussian Blue. Graphite found in the waves may indicate sketching with pencils. Red pigments found in the waves and in a sample of the grassland next to Guan Yu's red horse either come from shading or were spread from other paint layers. Prussian blue and botallackite were identified in a sample coming from a part of a boat that likely depicts wooden planks (i.e. brown). This may mean that yellowish or brown components (dyestuffs or coloured binders) were used that cannot be identified as they cannot be distinguished from the discoloured binding medium.
Figures 269 and 270 show that under UV light various parts of the landscape can be differentiated: hills and flat grassland appear purplish (red in fig. 270), ridges of hills and coast parts coloured with opaque green appear black, water appears brownish while plants with a lot of black delineation stand out greyish.

"Grassland"
The areas depicting more or less flat land are characterised by small curved lines (crescent-shaped, open to the top) which may represent the structure of grass or soil (fig. 275). In visible light, the "grassland" appears medium brown today. An olive green appearing glaze was used to shade these areas (containing malachite, Prussian blue and fine-grained black). Under UV light it looks very dark with a purplish red tinge due to the content of copper pigment. The glaze was repelled by the black contour of the painting, forming a 'white border' next to the black line. Leaves of plants are painted with dots of malachite. In some parts the olive green glaze overlaps the opaque colours broadly showing its light colouration, e.g. *sanguo xi*, "red light" F4 (fig. 280/281).
The lower parts of hills are painted like the "grassland", but without the crescent-shaped lines. They were coloured with bright green and brownish washes before the application of the isolation layer (figs. 273/274 and 276/277). Under UV light at least two different brown or greenish shades become distinguishable (fig. 274), in addition to the olive green glaze. In some parts of the *sanguo dong*-painting, especially the damaged upper part, green and brown hues can be distinguished in the landscape (fig. 268).
The olive green glaze was applied to the background omitting figures and objects, but partly overlapping onto their opaque paint layers.

Fig. 275
Sanguo dong: crescent-shaped lines characteristic of the grassland; width of section corresponds to ca. 3 cm (vertical lines on the left belong to the retouches carried out in 2012).

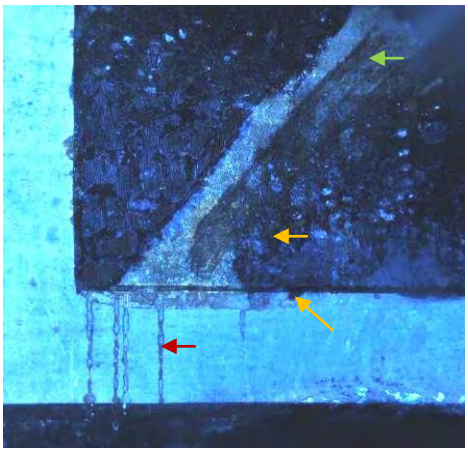


Fig. 276, 277
Sanguo xi, left edge, after retouching, VIS and UV:
Red arrow: A greenish wash ran down, UV: brown with yellow borders. Green arrow: darker brush stroke was used along the ridge. Orange arrow: Olive green glaze on the hill flank.

Fig. 278
Sanguo dong. lower left edge: chariot

Fig. 279
Sanguo dong, like fig. 278, UV light: The chariot and the patch of grass stand out lighter against the grassland which was shaded with a copper-containing green. The wheel and floor of the chariot look slightly reddish due to the use of brown or red pigments; the axis is even redder. The filling of the door shows the deep black typical of green copper pigments.

Fig. 280
Sanguo xi, lower part of "red light", VIS: Olive green glaze of grassland brushed over the light is almost invisible.

Fig. 281
Sanguo xi, lower part of "red light", UV: Olive green glaze becomes more discernible in UV light.

Green parts of hills and mountains
Ridges of mountains, coasts and shades in a hilly landscape appear brown up to dark brown today. They were painted with a thicker layer of a coarse green pigment and appear matt in VIS and black under UV light (copper pigment, probably malachite). Underneath the green layer, a brown layer is visible (the isolation layer or a first shading of the green parts).

Rocks
At the right edge of the *sanguo xi*-wall, rocks with stylised, rather quadrangular boulders are situated at a ravine underneath a group of five men, among them Cao Cao (fig. 271/272). In visible light the rocks appear medium brown, under UV light they are light brown, similar to areas of water. Shading in nuances nowadays appearing brown is discernible, but there probably was no overall wash: the brown colour seems to come from the isolation layer.

Water (rivers, lakes and waterfalls)
Water can be recognised by the structure of waves or vertical lines indicating a still surface of a lake. The water appears brown today and is brown under UV light (fig. 244 and 245). There are two applications of brown-looking material. The darker brown material seems to be the colour of the water, while the lighter brown is the isolation layer.
In the battle on the river depicted in the *sanguo xi*-painting, the waves are topped by fringes of froth. Both paintings show small waterfalls (*sanguo xi,* upper part, right side, and *sanguo dong*, lower part, left side, fig. 244). Froth and waterfalls were painted white and have a strong orange UV fluorescence (probably lead white+ binding medium).

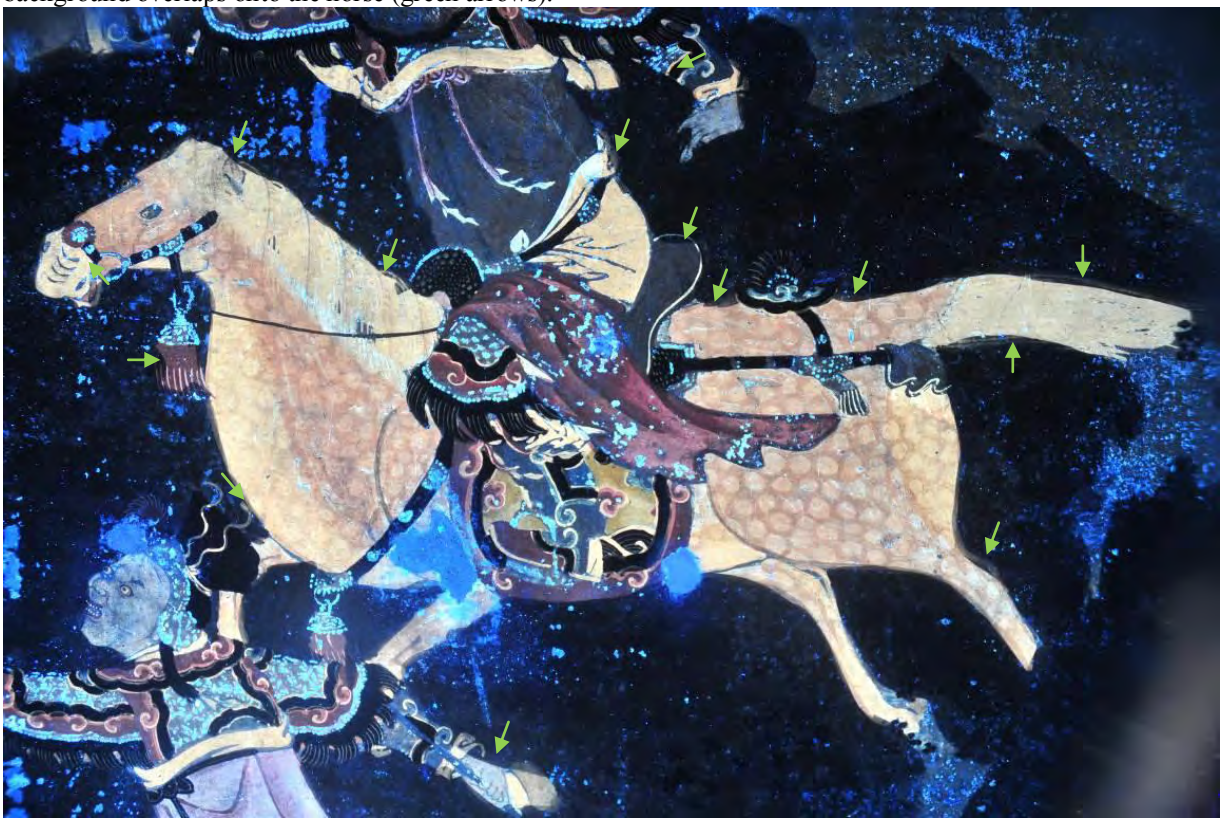
Sky
The sky is lighter than the landscape. No blue hues are visible today (fig. 282), but they may be concealed by the brown isolation layer. The skies on both paintings are yellowish brown ('honey-coloured'), appearing light brown under UV light.

Fig. 282
Sanguo dong, upper edge, northern part: Pine trees in front of the 'honey-coloured' sky, landscape with green dots.

Clouds
There is a large cloud whirl with two riders above the roof of the main pavilion in both paintings. In the *sanguo xi*-painting, the cloud whirl was filled with white paint (orange UV fluorescence, probably lead white). The surface shows small spots of a yellowish coating and innumerable droplets of a material with a similar colour. The phenomenon of the droplets is very similar to the backgrounds of the *b*- and *d*-panels of the *pingfeng xi*- and *pingfeng dong*-paintings. The white paint covered the already finished roofing of the pavilion which is faintly visible through the white paint.
On the *sanguo dong*-wall, the cloud whirl was not filled with (lead) white paint and is difficult to see and distinguish from the likewise brown background today.

Fig. 283
Sanguo xi, lower right edge, horse of figure no. 31: horse coat painted in white (lead white) and an orange pink (cinnabar, red lead and yellow iron oxide); pattern of circlets as structure of the horse coat

Fig. 284
Sanguo xi, like fig. 283, UV: The circlets in the horse coat stand out more clearly. The olive green glaze in the background overlaps onto the horse (green arrows).



Colours and colourants in figures, architecture and objects

The stratigraphy of individual areas of the *sanguo*-walls was not investigated, as the focus was set on the material identification (table 14) and the examination of the brownish layers. All parts have several layers, from the delineation to the coloured washes up to opaque paint layers which were shaded and highlighted, but thin layers are not visible in the cross sections. All light-coloured and white parts contain white pigments, i.e. they were applied to a darker ground and not omitted in the painting process ("water-colour"-style) as in the paintings in the *guodian*. The analysed pigments show a rather wide range of materials, including smalt, copper chloride and indigo which are not present in the samples taken from the *guodian*.

In the faces, the eyeballs are painted white and shaded bluish, and the lips are pink. Light-coloured faces appear slightly yellowish today, but originally they were white or light pink. Brown faces do not stand out from the background in VIS, but under UV light it becomes visible that they were painted and modulated with brown paint.
Objects made of wood, like the boats, the chariot's wheels, axis and floor, or parts of the architecture were painted with shades of brown. Under VIS they differ only slightly from the landscape (more reddish brown and slightly darker), but under UV light they show a fluorescence and colours different from landscape and water (fig. 278/279).
Some parts were underpainted, for example the bright ochre table cloth in the smaller pavilion in the *sanguo xi*-painting. The "red light" (F4) over the head of Zhao Yun (figure no. 27), appearing white today, is underpainted in lead white. The glaze contains yellow iron oxide and isotropic pinkish yellow particles which may indicate the presence of a faded dyestuff. Many horse coats show a pattern of circlets.

There are problems in the preservation which seem to be related to the painting technique: Red parts in the *sanguo xi*-painting (containing cinnabar) have developed a distinct crack net. The flakes show a slight cupping and tend to become detached. The separation occurs within the ground layer (see figs. 458-459). The strong reactions of the red paint layer to liquid water and ethanol, resulting in an increased cupping (see p. 239), may indicate that the damages are related to fluctuations in the humidity.
Losses in thicker red paint layers containing cinnabar also occurred at the *pingfeng xi*-painting, but not in the *sanguo dong*- and the *pingfeng dong*-murals. Comparable phenomena of cracks, cupping and losses are visible in the gildings at both *sanguo*-paintings. The mordant is a rather thick layer and may have caused the problems.

Table 14
Overview on colours and colourants used in the *sanguo*-paintings

colour	*area*	*pigments*	*remarks*	*sample no.*
black	framing	fine-grained black, probably flame carbons	black areas in paintings were not analysed	*sx* 1
white	underpainting of "red light", pink horse (fig. no. 31), ochre table cloth in *sanguo xi*	lead white	strong UV fluorescence, whitish or orange (depending on binding medium?)	*sx* 12 *sx* 13 *sx* 14
yellow ochre	glaze of ochre table cloth in *sanguo xi*	very fine yellow iron oxide	opaque yellow areas were not analysed	*sx* 13
red	column	cinnabar red lead	red lead partly underneath cinnabar (underdrawing?)	*sx* 5
pink to purple	robe	cinnabar red lake or dyestuff (unidentified) red lead	cinnabar used for underpainting, red dyestuff/lake in the glaze	*sd* 6
green	robe	malachite (+azurite, black) spherical copper chloride	both appear very dark green today	*sx* 7 *sx* 6
blue	architecture	smalt mixed with indigo and black	looks dark green up to black	*sx* 8

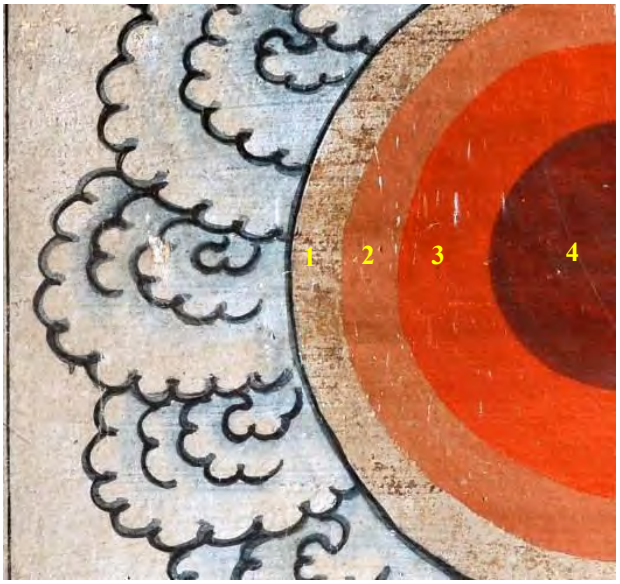


Fig. 285
Yunqi dong: Pearl with four zones (ring 1 to 3 and centre); accumulation of the thin paint layer of ring 1 in the surface relief of the ground layer. The clouds were outlined and shaded in blue.

Fig. 286
Yunqi xi, outer contour of pearl and clouds: blue shading of clouds containing blue and black particles; black contours on top of blue contours of cloud

Fig. 287
Yunqi xi, ring 1 to ring 2: bulge of low viscose paint accumulated at the outer edge of ring 2

Fig. 288
Yunqi xi, ring 1 to ring 2: In ring 2 the paint was applied twice, the two applications do not overlap perfectly (yellow arrows).

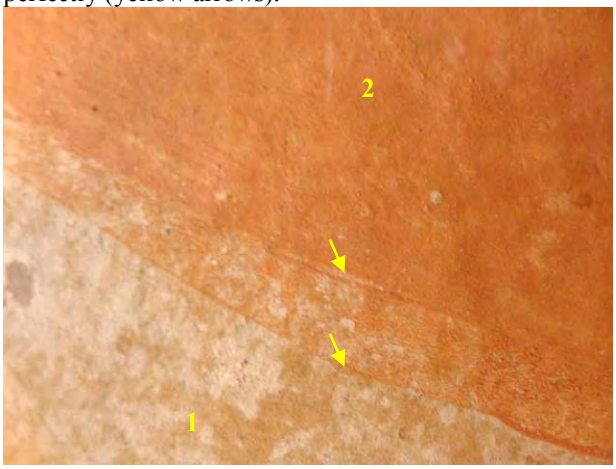
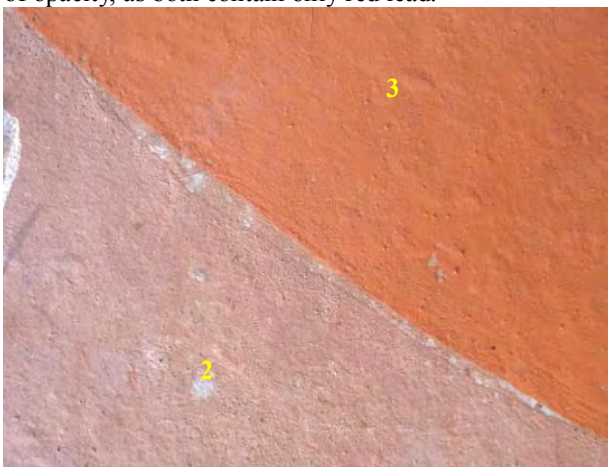


Fig. 289
Yunqi xi, ring 2 to ring 3: The difference in colour between ring 2 (here appearing pink) and 3 is a result of opacity, as both contain only red lead.



Zhengdian, northern bay: *yunqi, tianguan cifu, pingfeng bei* and *long*

The paintings once included in the niches built into the northern bay of the *zhengdian* were not examined in detail. Peculiar phenomena, however, were attentively inspected and compared with the other paintings.

Yunqi-*paintings*

The *yunqi*-paintings show large shapes and broad lines and are executed less finely than the other paintings. As originally they were almost hidden on the sides of the niches in the northern bay, they were probably carried out quickly and rather carelessly.

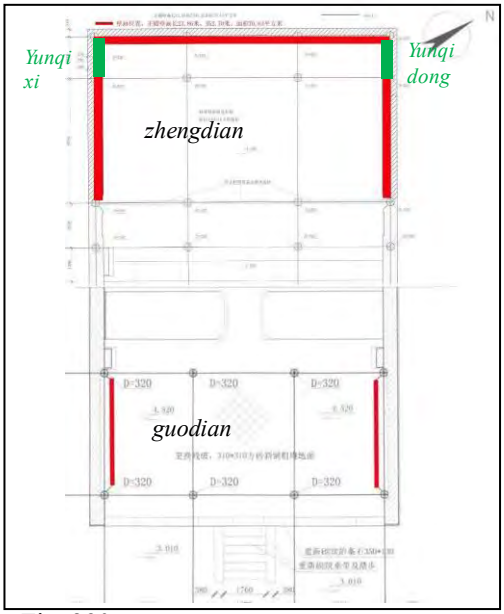


Fig. 290
Position of *yunqi*-paintings

Painting process

The ground layer was applied with broad brushes. The brush marks run horizontally and are more prominent than in the other paintings (fig. 276). Animal glue was found as binding medium in the ground layer or the sizing below it, but the surface contains egg and polysaccharides.[83] This may mean that the ground layer was bound with egg and that it was put on an isolation layer containing animal glue. The presence of a sizing seems to be confirmed by the UV fluorescence that is light orange at the surface, while damaged parts appear bluish white. In VIS the surface looks slightly brownish.

The first step of painting was the delineation with black or dark grey lines. It included the clouds and the outer contour of the pearl. In the clouds, the delineation was repeated in dark blue and the clouds were shaded with blue washes. Agglomerations of blue (Prussian blue) and black particles are visible in the shades (fig. 286). After the outermost ring (ring 1) had been coloured, the black contours were drawn again (visible on the wall and in *yx* 2 CS 1).

The four zones of the pearl, numbered 1 to 4 from the outside to the centre (fig. 285, were painted starting at the outermost one (ring 1). Ring 1 has a pale semi-transparent paint layer that accumulated in the surface structure of the ground layer. The paint layer looks brownish today and is partly lost, but originally it probably was yellow as it contains ochre and another yellow pigment.

Ring 2 is light orange. The paint, consisting of diluted red lead, was applied twice, but is still slightly transparent (fig. 288 and 289). At the lower edge, it partly formed a thick ridge showing that it had a low viscosity (fig. 287). The slight pinkish appearance is caused by the transparency, but may also indicate a slight alteration (blackening) of the red lead.

Ring 3 is darker orange. The red lead was applied as a thicker opaque layer (fig 289).

The inner circle 4 appears brownish today. Besides cinnabar, the paint layer contains a brownish binding medium in which a discoloured dyestuff may be concealed.

A protective coat may finally have been applied to the pearl, as there is a brownish transparent material which penetrated into the paint layers and partly into the ground layer of the rings 2 and 3. It is possible, however, that it is a later coating, maybe coloured by dirt. All colourants identified in the *yunqi*-paintings are listed in table 15.

[83] Analyses with GC-MS on sample yx1 by Anna Lluveras, University of Pisa.

◀ Fig. 276
Yunqi dong: The horizontal structure from applying the ground layer is visible.
[Shaanxi Institute for Conservation]

Table 15
Colourants and binders identified in the *yunqi*-paintings (all samples taken from *yunqi xi* [*yx*])

Layer	*colourants*	*binding media* (GC-MS)	*sample no.*
white ground layer	- clay minerals[84] - calcium carbonate, yellow iron oxide[85]	ground layer or sizing: animal glue ground layer, total or surface: egg + polysaccharides	*yx* 1
blue line (on top of black line)	- Prussian blue - bone black or flame carbons[77] / charcoal black[86]		*yx* 2
ring 1	- fine yellow ochre - greenish yellow pigment, fine, RF higher than 1.662, IF yellow - red lead, few - coarse black (charcoal?), few[77]		*yx* 6
ring 2	- red lead[77, 87]		*yx* 3
ring 3	- red lead[77, 88]		*yx* 4
central circle 4	- cinnabar[77, 89], brownish medium: containing dyestuff?[77]		*yx* 5

[84] Analysed with PLM by C. Blaensdorf, Munich, preparations PP Z 8 (background), PP Z 1, 2 (blue), PP Z 101 (ring 1), PP Z 9 (ring 2), PP Z 10 (ring 3), PP Z 11 (central circle).

[85] HU et al. 2012, table 1. - The analysed sample may have contained remnants of the fine coat (*xi ni*) that consists of clay and lime.

[86] HU et al. 2012, table 5.

[87] HU et al. 2012, table 3, XRD.

[88] HU et al. 2012, table 1.

[89] HU et al. 2012, table 1 and 5.

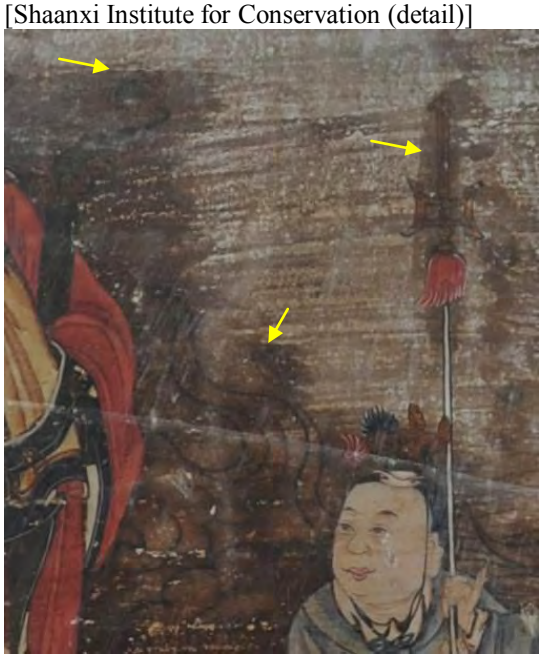
Fig. 277
Tianguan cifu, hand of demon: The delineation is still visible, repeated in dark brown at the hand; the brown glaze omitted the hand (yellow arrows) and stained the ground layer brown (red arrows).

Fig. 278
Tianguan cifu, water below the cloud with heavenly official: overlapping of brown coating; splashes of dripped down material
[Shaanxi Institute for Conservation]

Fig. 279
Tianguan cifu, landscape covered with brown appearing glaze or coating: coating applied in horizontal brush strokes in five columns slightly overlapping each other (yellow arrows), omitting the upper left corner and small parts next to the pedestal (red arrows) [Shaanxi Institute for Conservation]

Fig. 280
Tianguan cifu: "brown glaze" on the cloud overlapping onto the water (yellow arrow)
[Shaanxi Institute for Conservation (detail)]

Fig. 281
Tianguan cifu: "brown glaze" imprecisely applied to staff, *ruyi* and cloud (yellow arrows)
[Shaanxi Institute for Conservation (detail)]



Tianguan cifu-*painting*

The *tianguan cifu*- and the *long*-painting are similar in style and obviously designed as counterparts. Different from the *long*-painting, the *tianguan cifu*-painting is covered with a dark, brownish coating.

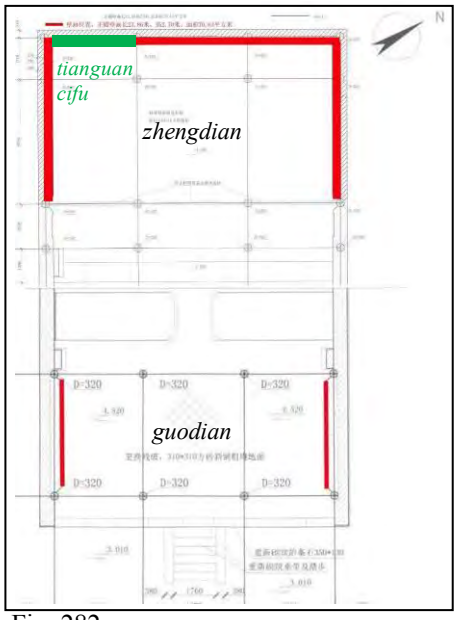


Fig. 282
Position of *tianguan cifu*-painting

Painting process

(1) The details of the depiction were delineated with greyish lines. An isolation material is discernible on top of the ground layer which was applied before or after the delineation was made (visible in cross section of *tg* 2).

(2) The black delineation of the background was repeated with darker and thicker lines.

(3) Landscape, clouds and at least parts of the figures were coloured with transparent to semi-translucent washes or glazes. The cloud on which the heavenly official is standing was painted reddish pink with shades in darker colour. The headdresses of the figures, the ornament on the staff of the boy and the *ruyi* were coloured with ochre yellow (fig. 281).

(4) The flesh tones were painted with semi-translucent to opaque white or light pink. Contours were repeated in brown. Lips were coloured pink, eyes, a line for the upper eyelashes, eyebrows and moustaches were applied in black. The lower lid was highlighted with opaque white.

(5) "Brown glaze": A wash or glaze was applied to the landscape and clouds, omitting the figures. It penetrated into the pictorial layer and stained the ground layer (fig. 277). It is not clear if it originally was colourless or tinted, but it can be assumed that it was not dark brown, because otherwise it would have concealed the vivid colours of the washes. The fact that it appears like a shade behind the "demon with mask" may indicate that it was slightly coloured, whereas the imprecise overlapping of the layer on smaller elements like the staff or cloud tips (fig. 281) implies that the material was only faintly visible (if at all). The binding medium of the brown layer may be water-sensitive as water-marks have formed which seem to have dissolved the layer. Under UV-light the layer appears brown, in a lighter to darker tone of brown depending on the thickness of the application.

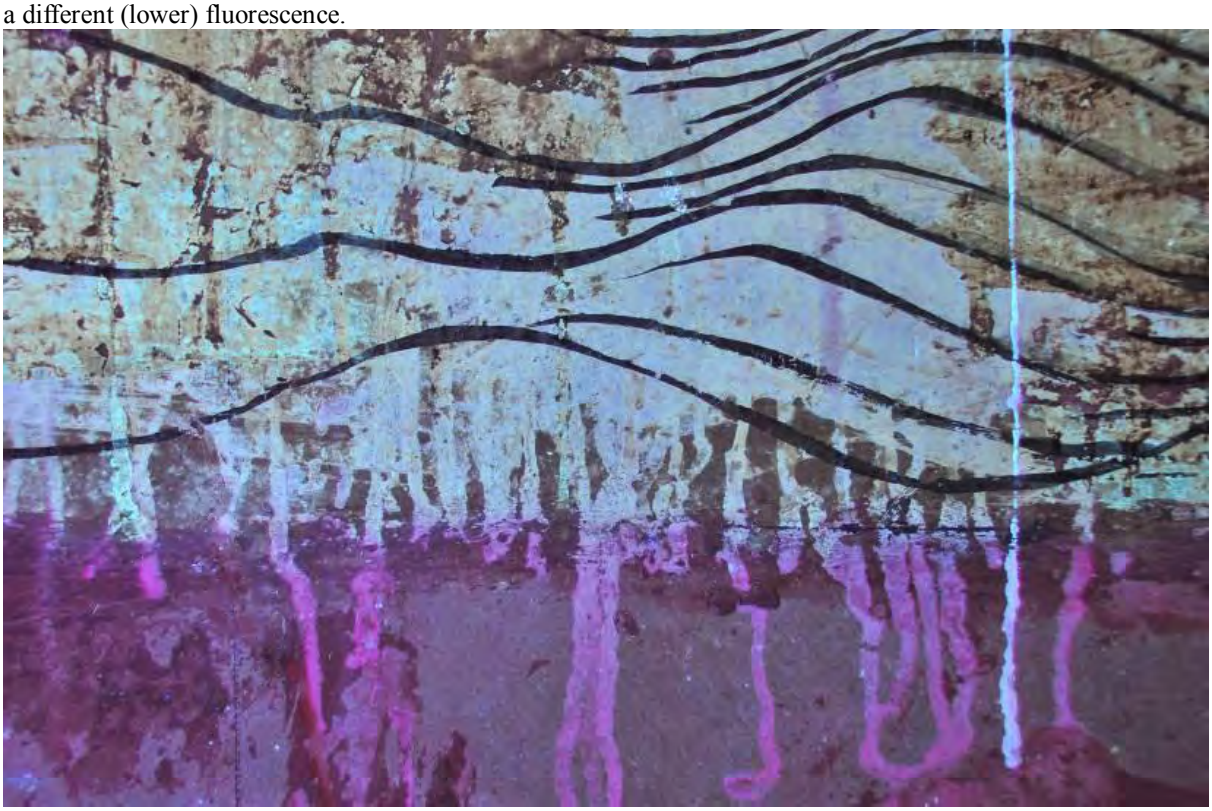
(6) Opaque paint layers: The figures were coloured with opaque paint layers. The coloured areas were shaded with one or two darker nuances. Outlines were omitted or repeated on top of the paint. White areas and highlights were painted at the end (e. g. after the yellow robe of the young man had been finished including shades in different colours).

(7) A slightly brownish and irregularly applied coating is visible on the clothes of the figures. It seems to omit the flesh tones. The flesh tones, too, are covered with a thin yellowish coating, maybe thinner and in a lighter tone than the one of the clothes. It is not recognisable at which step of the painting process the coating of the flesh tones was applied.

Although the paintings look rather different, the succession of layers is similar to the *sanguo*-paintings, including delineation, coloured washes, a brown appearing glaze, flesh tones, opaque paint layers and a slightly irregular application of a protective coating.

Fig. 283
Tianguan cifu: area above the pedestal omitted during the application of the brown coating (the centre of the pedestal is recognisable by the black chalk line)

Fig. 284
Tianguan cifu, detail of the segment shown in fig. 283, UV light (without filter): The brown coating appears brown, the brightness depending on the thickness of the application. The part covered over by the pedestal shows a different (lower) fluorescence.



(8) "Brown coating": A binding medium layer was applied to the whole painting. The work was carried out with broad horizontal brush strokes from top to bottom in five adjacent "columns" which overlap slightly (fig. 279, yellow arrows). There are some splashes and runs where the material dripped or ran down the wall. Few areas were omitted during the application: the ledge of the upper left edge, a part next to the centre above the lost pedestal and another area at the right side of the pedestal (fig. 279, red arrows; fig. 283). This implies that the omitted areas were not easily accessible at the time of the application of the material, probably because the wooden construction of the niche and maybe a figure on the pedestal obstructed the space. This may mean that the application of the brown coating was a later intervention or at least carried out after the niche had been furnished. It can be assumed that the material was less brown in the beginning. Losses occurred where the brown coating was applied to the ground layer (i.e. depiction of water) or the landscape (countryside and cloud), following horizontal brush marks. These brush marks seem stem from the ground layer, not from the brown coating, though both are often overlapping. Under UV light the brown coating is brown, the brightness depending on the thickness of the application. Brown glaze and brown coating seem to have the same UV fluorescence (or both no fluorescence).

Colourants

Different from the *sanguo*-paintings and the *long*-painting, the waterfalls at the lower edge of the painting are not coloured with lead white.

The lotus leaf on which the young man and the demon are standing, does not seem to contain copper pigments, as the UV fluorescence is brown, not black.

The red robe of the official contains cinnabar and red iron oxide, and red lake that probably was used for shading (sample *tg* 2). The black lines contain a fine grained black (flame carbons or bone black).

Fig. 285
Long-painting: The sizing and/or protective coating are affected by water, as well as the clouds; the large dragon's breath, horns and tail are unaffected (red arrows). The lower part is damaged by water and salts (yellow arrows indicate border) in a height corresponding to a former coal heap outside the building.

Fig. 286
Long-painting: Detail of the head of the large dragon. The water did not affect the parts painted with opaque white (breath and horns).

Fig. 287
Long-painting under UV light (without filter): In the damaged part the binding medium is leached out and the fluorescence reduced.

Long-*painting*

The *long*-painting with the two dragons is designed as the counterpart of the *tianguan cifu*-painting. Different from it, there are no human figures, no dark colours and no brown coating.

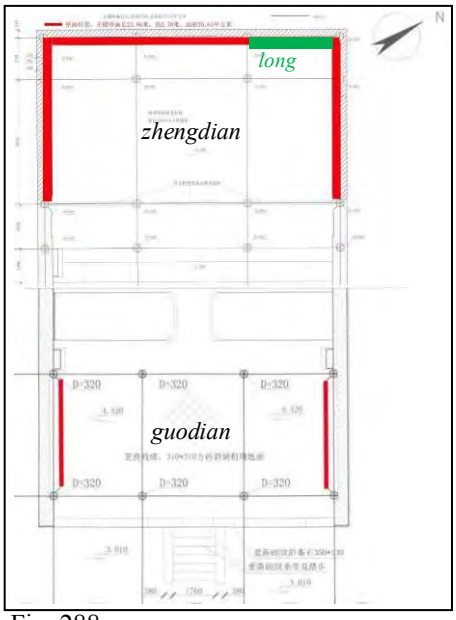


Fig. 288
Position of *long*-painting

Painting process

(1) The details of the depiction were delineated with lines that appear greenish. A sizing was applied before or after the delineation. The material is highly-sensitive against water as watermarks show where the sizing was completely dissolved or leached out. The sizing has a slightly yellowish UV fluorescence. Brush marks from applying the ground layer are visible and run horizontally. Sizing (and dirt) accumulated at the ridges of the brush strokes.

(2) The black delineation was repeated with darker and thicker lines.

(3) In the dragons, coloured washes were applied, mostly omitting the black contour lines. The sky was shaded blue in the topmost part. The dragons were coloured with orange and red semi-translucent washes (skin, tongue, fire on pearl).

(5) Few areas were coloured with opaque paint layers, mainly white. Opaque white was used for the dragon's breath, the horns, teeth and talons of the dragons, the tail of the big dragon and for the waterfalls at the left lower edge. The paint layer was not water-soluble or at least less sensible against water than the material on top of the priming layer. The pearl on the dragon's breath was omitted when painting the breath.

(6) At least in the case of the dragon's breath a protective coating was made. It is visible as a yellowish layer that was applied slightly irregularly.

The lower part of the painting shows damages caused by water and/or salts (the contours of the damage correspond to the traces of a coal heap on the outside of the building, fig. 285: yellow arrows). The paint layer appears lighter and damaged. Under UV light, the ground layer is slightly yellowish in the upper, undamaged part, but bluish in the lower damaged area (fig. 287).

Opaque white areas probably contain lead white as they have a strong UV fluorescence. In the well-preserved areas, the UV fluorescence is orange and in the lower, damaged part (e.g. talons of the small dragon) it is yellowish white, proving the influence of the binding medium on the UV fluorescence colour. The dragon's breath is glossy and not sensitive to water: Water marks running down the wall which damaged the sizing, did not visibly affect it (fig. 286). On the dragon's breath vertical lines with a slightly raised relief are visible: They stem from the application either of a protective coating or the paint layer itself with a rather small brush.

It can be assumed that originally the dragon's breath stood out clearer against the background than today, either because the lead white was of a brighter white or because there was a tinted glaze that has faded (maybe bluish, as the breath should be water or vapour).

Fig. 289
Pingfeng bei, frame 1: Horizontal structures from application of ground layer visible wherever the paint layers are thin; brownish wash around the peonies in panel 1 *b*.

Pingfeng bei-*painting*

The painting in the central bay of the *zhengdian* (fig. 290) shows another folding screen. Compared to the ones painted in the *guodian* (*pingfeng xi* and *pingfeng dong*), it is less fine and less artistic in style (fig. 291), less precisely drawn and painted, and more colourful. A connection with the *guodian* is given by the proportions, a lattice in the *a*-panels, figurative scenes with ornamental borders in the *b*-panels, two scenes of Filial Piety in the *d*-panels and floral decorations on a dark ground in the *e*-panels.

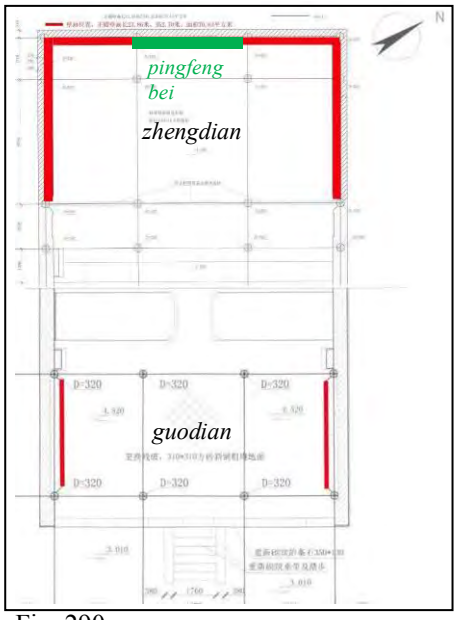


Fig. 290
Position of *pingfeng bei*-painting

Painting process

The white ground layer was applied with broad paint brushes. The horizontal structure of the application remained visible. As in the *b*-panels of *pingfeng xi* and *pingfeng dong* and the *tianguan cifu*-painting, the streaky appearance of the surface is intensified by layer(s) of binding medium applied during the painting process.

(1) The layout of the folding screen was drawn on the base of chalk lines. It is not recognisable if a sizing was applied to the folding screen, as it could be detected in the *pingfeng xi* and *pingfeng dong*-paintings.
(2) After drawing the black outlines or together with them, the black framing of the painting was coloured. Before or after the black outlines were drawn, thin washes were applied to the framework (pale, dark brown) and the panel frames of the *d*-panels.
(3) The framework was filled in brown.
(4) Panels painted: The succession in painting the individual parts was not investigated.

Framework

The reddish brown colour was applied in at least two thin applications. The bevelled edges are not shaded. At least the last application overlaps the black outlines.

Panel frames

The panel frames of the *a*-, *c*- and *e*-panels are coloured bright yellow with orpiment.[90]
The panel frame of the *d*-panels is coloured red with a highly diluted paint which shows a structure of coagulated pigment similar to the panel frames of the *pingfeng xi*-painting. The paint is powdering, maybe due to a too low amount of binding medium. The pigmentation appears homogeneously red (no orpiment added).[91]
The *b*-panels show an ornamental pattern (fig. 289, border). The opaque medium blue ground contains a mixture of Prussian blue and lead white.[92] Blossoms are painted with lead white. [93] Black dots were applied to the end of the white petals, and a red dot as centre of the blossom. A yellow glaze covering the blossom is partly brownish today due to discoloration, and often the glazed area is lost, indicating a problem of the painting technique (too high amount of binding medium?). Twines between the blossoms were painted with dark blue.

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[90] Identified on sample *pfb* 4 from panel frame 1 *c*, with PLM (PP Z 29, C. Blaensdorf) and Raman spectroscopy (Hu et al. 2012).

[91] No samples taken for analysis.

[92] Sample *pfb* 2 from panel frame 5 *b* (PP Z 5 and 20, and Hu et al. 2012, table 5).

[93] Sample *pfb* 2 from panel frame 5 *b* (PP Z 21 and Hu et al. 2012, Raman spectroscopy).

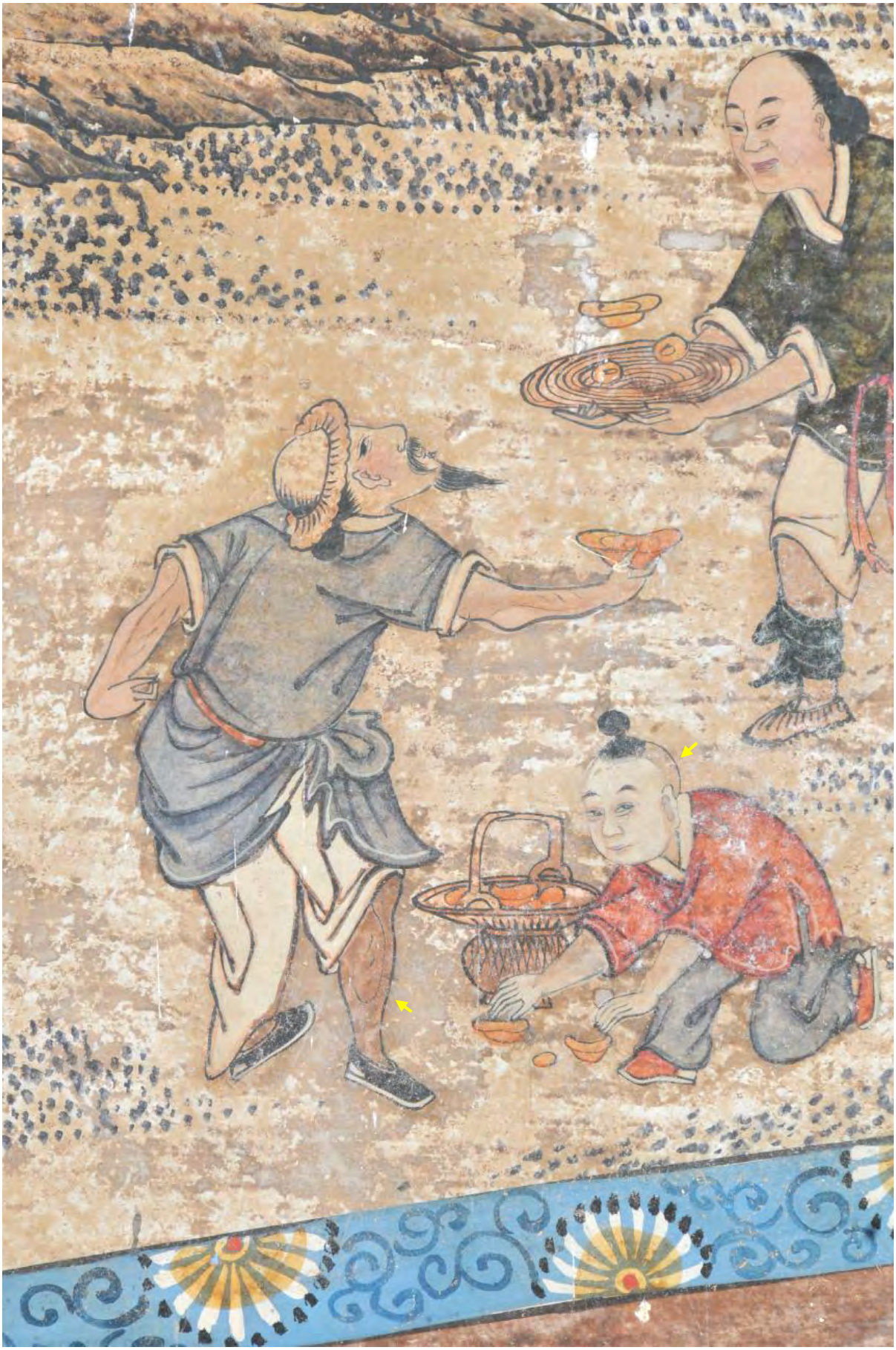

Fig. 291
Pingfeng bei, detail from panel 5 *b*: In the right leg of the old man and the back of the head of the boy, no opaque paint was applied (yellow arrow).

Panel fillings

A-panels
The *a*-panels were not examined in-depth. The panel is filled with a *yunleiwen*-ornament painted as open-work. After the side view of the strips had been painted in black, the front view of the strips was coloured yellow. The background looks white (as the background of the painting) today.

B-panels
The main steps of the working process can be reconstructed:
(1) The first step was a delineation that is visible as grey lines today.
(2) Washes in pale nuances: In the landscapes of the panels 2 *b* and 5 *b*, washes in green, grey and orange pink can be recognised as well as drawings of twigs and leaves in orange pink. The flesh tones received pinkish washes. In panel 1 *b*, green and grey washes are discernible.
(3) The black delineation was repeated in a dark black colour. A binding medium layer was applied as isolation layer, covering also the figures (visible for example in the bare right leg of the old man in panel 2 *b* that was not painted with opaque colours: fig. 291).
In the panels 1 *b* and 6 *b*, a layer appearing brownish today was applied around the flowers, giving the impression of a shadow (fig. 289). It is not clear if it contains colourants and if it was applied before or after the isolation layer.
(4) Semi-translucent up to opaque colours were applied. Glazes were used to shade the coloured areas. Outlines were repeated in black and other colours (e.g. red in the peonies of panel 1 *b*). The flesh tones were applied. The eyes, a line of the eyelashes of the upper lid, the eyebrows and the hairline were emphasized with black lines. Lips were coloured pink. The colours are semi-translucent except for those mixed with higher amounts of white (probably lead white). The white parts seem to have been applied last, omitting the contour lines. The black lines in the white areas were shaded with pink to reddish brown lines.
(5) A protective coating was applied to the paintings. It is well-visible on bright colours as a slightly blotchy yellow layer (for example on the large peonies in panel 1 *b*).

C-panels
(1) The first step was the delineation in black or grey.
(2) Pale washes were applied to the flowers, vessels and other objects.
(3) Petals of flowers were painted with opaque white. In panel 5 *c*, the layer contains lead white and is 2 to 10 µm thick.
(4) The background was painted in bright dark blue, containing Prussian blue.[94] Extensive losses of the blue background in panel 5 *c* and 6 *c* (fig. 292) may be connected to the painting technique or to the presence of salts (see white accumulations visible in fig. 293).
(5) Contour lines were repeated with black lines. In panel 5 *c*, the lines are applied rather thickly. The pigment could be identified as charcoal black with rather large particles.[95]
(6) Opaque up to semi-translucent paint layers were applied to the flowers and objects. Botallackite was identified in the green leaves of the peonies in panel 5 *c*.[96]
(7) The paint layers of the flowers and objects were shaded with washes and coloured lines. The black veins of the leaves in panel 5 *c* were carried out with flame carbons.[97]
(8) There may be a transparent coating of the paintings.

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[94] Sample *pfb* 6 from panel frame 3 *c* (PLM preparation PP Z 7 ab).

[95] PLM on sample *pfb 3*, taken from a leaf of the white peonies.

[96] PLM on sample *pfb 3* (PP Z 13-17).

[97] Sample *pfb 3*, PLM (PP Z 13-17) and XRD (Hu et al. 2012, table 5).

Fig. 292
Pingfeng bei: losses of blue background in the panels 5 and 6 *c*.

Fig. 293
Pingfeng bei, panels 1 and 2, *c* to *e*: The *d*- and the *e*-panels only show a depiction in frames 1 and 6, while frames 2 to 5 are painted black.
Panel 1 *d* is covered with a brownish (discoloured) coating.
White material on the surface may be salt (contains calcium sulphate).

Fig. 294
Pingfeng bei, e-panel and leg of frame 1: The brownish coating from the *d*-panel overlapped the panel frame and ran down (yellow arrow). Partly faded or abraded yellow ornament on *e*-panel (green arrow). The reddish brown of the framework overlaps onto the black framing (red arrow).
Yunleiwen-ornament next to leg without colouration.

D-panels

The *d*-panels differ from other paintings due to a kind of grisaille style against a black background. Only the panels 1 *d* and 6 *d* show depictions because they were fully visible, whereas the d-panels of the frames 2 to 5 were mainly positioned behind the lost pedestal and coloured black without any depiction (fig. 293).

In the panels 1 *d* and 6 *d* only one application of black lines is visible. Smaller areas were coloured with washes that appear grey. The paintings are covered with a brownish coating overlapping onto the red panel frames. Partly it ran or dripped down (fig. 294). Today the coating is so dark and blotchy that the legibility of the scenes is reduced. The layer does not contain pigments.[98]

E-panels

The *e*-panels were filled in black. A floral ornament was applied with yellow lines. The yellow paint seems to have faded or flaked off in parts where it had been applied thinner (fig. 294).

F-zone

Next to the legs a *yunleiwen*-ornament is inserted (fig. 294), characterised as open-work by a perspective depiction of the strips. The pattern is similar to the one in the *a*-panels, but at least today the ornament has no colouration.

[98] Sample *pfb* 1, PLM slide preparation PP Z 12.

Fig. 295
Sanguo dong: Liu Bei accompanying the carriage (figure no. 26)

Fig. 296
Sanguo xi, panel 7 *b*: horseman (figure no. 49)

Fig. 297
Pingfeng xi, panel 7 *b*: drunken poet on horse (mirror-inverted)

Fig. 298
Pingfeng xi, panel 4 *d*: father wearing a *jin*-cap

Fig. 299
Pingfeng xi, panel 5 *b*: drunken poet with *putuo*-cap

Fig. 300
Zhengdian, south side: lintel (mirror-inverted)

Fig. 301
Pingfeng dong, panel 1 *b*: scholar with *putuo*-cap in bamboo pavilion

Fig. 302
Pingfeng dong, panel 5 *c* (mirror-inverted)

COMPARISON OF DIFFERENT WALLS – TECHNIQUE AND STYLE

It can be assumed that the murals and probably also the painted decoration of the wooden architecture of the *guodian* and the *zhengdian* date from the same time. There are several factors supporting this assumption:

- The paintings in the *zhengdian* are painted on the same support. There are no seams visible between the *sanguo*- and *yunqi*-walls that would indicate an independent execution of the single walls (in different times or by different artisans).
- The inscription in the *sanguo dong*- and the *pingfeng xi*-painting indicate that the two paintings were finished in the same year.
- All the paintings are enclosed in a framing consisting of a black outer frame and a white inner frame with a black contour on the inner edge towards the paintings. This creates the impression of an ensemble though they are different in style.

Comparisons were made regarding technique and style. Stylistic studies are part of the art historical research and thus were limited to questions of comparing peculiarities of the single paintings, focusing especially on faces, hands and characteristics in the vegetation.

The comparisons include seven of the murals in the *guodian* and the *zhengdian* of the *beiwusheng huiguan* (the *yunqi*-paintings were left out of consideration). Some observations on the paintings at the wooden architecture of both halls and the paintings in the Jiangxi *huiguan* were included as well, though these paintings have not yet been examined thoroughly.

Technological aspects of the murals of the guodian *and the* zhengdian

The examination of the murals showed that in principle the succession of the work steps is the same with all paintings. The plasterwork may have been done by another group of craftsmen. The composition of the plasters seems to be identical on all the walls. After the plaster surfaces had been finished, the painting comprised the following steps:

(1) sizing of the fine coat // marking the layout of the paintings with chalk lines (borders between *sanguo*- and *yunqi*-paintings; central horizontal axes of the paintings at the northern wall of the *zhengdian* probably in order to install the pedestals)

(2) white ground layer (identical composition on all the walls)

(3) marking the outlines of the paintings and the folding screens with chalk lines

(4) black delineation of all lines and details // sizing

(5) translucent washes and lines to start the colouration including flesh tones

(6) intermediate isolation layer (not proved in the *guodian*)

(7) leaf-gilding (*sanguo*-paintings only)

(7) semi-translucent up to opaque paint layers

(8) shading and repeated delineation in parts with opaque paint layers; glazes; white highlights

(9) protective coating

It can be assumed that this procedure was in accordance with traditional painting techniques that may have been passed on in a single workshop or were common knowledge of artists and artisans. Though all the nine murals were painted following in general this succession of steps, there are differences indicating that the work was done by different painters or teams:

- At all the murals, the brush marks from applying the ground layer are running horizontally except for the *sanguo*-paintings where diagonal and crossing brush marks can be observed.

Faces of bearded men; gilded caps

Fig. 303
Sanguo xi, Cao Cao (figure no. 35): caps with leaf gilding

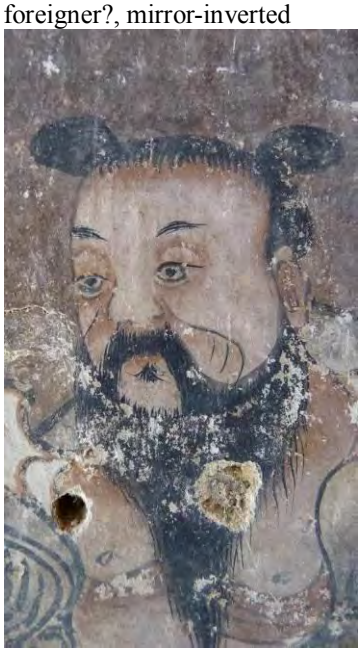
Fig. 304
Pingfeng xi, panel 3 *b*: man in the palace, mirror-inverted

Fig. 305
Pingfeng xi, panel 3 *d*: heavenly official cap like Cao Cao, pink representing gold

Fig. 306
Pingfeng xi, panel 4 *b*: head of man with fur coat

Fig. 307
Guodian, south side, lintel: helmet in *lifen tiejin*-technique

Fig. 308
Pingfeng dong, panel 5 *c*: foreigner?, mirror-inverted



- At the paintings in the *guodian*, the surface of the ground layer is smoother than at the paintings in the *zhengdian* and may have been polished. The rather coarse and noticeable brush marks in the *yunqi*-paintings may indicate that less time and care was taken for these paintings as they got almost hidden when the niche architecture was built in.

- The paintings in the *zhengdian* have a preliminary drawing that remained partly visible, but was repeated with darker lines during the painting process. The figurative scenes of the *pingfeng xi*-painting and the *b*-panels of the *pingfeng dong*-painting have only one visible drawing, though lines were repeated or shaded with darker lines or pink. This difference is probably related to the fact that these paintings are carried out like water-colour paintings on paper, without white highlights and only few accents in opaque paint. In this way the allusion of a folding screen with paintings on paper is increased.

- At all the paintings, the use of binding medium layers as sizing, intermediate isolation layer and protective coating could be proved. These layers are yellowish or brownish and blotchy, but to a very different extent, ranging from a very low tinge of the sizing of the paintings in the *guodian* up to the dark brown discoloured intermediate isolation layer in the *sanguo*-paintings. These differences indicate the use of different materials, qualities or mixtures. This may mean that different teams were at work or material supplies were restocked gradually, resulting in changes of the quality.

- The use of gold may have been restricted to the most important paintings because of the costs for the material and the application. At the *pinfeng xi*-painting, gilded objects were coloured pink[99], as the comparison of two caps from the *sanguo xi*-painting and the *pingfeng xi*-painting shows (figs. 303 and 305).

Technological remarks of the paintings on the wooden architecture of the guodian *and the* zhengdian

As a close examination was not possible, only few observations could be compiled. The figures are set against a dark blue background which partly shows vegetation in green, black and a light colour. The figures are coloured with opaque paint layers. Visible contour lines and shades are painted on top of the opaque layers. The gilding was applied last: edges of gold leaf are overlapping the highlights of the opaque areas, while at the *sanguo*-paintings the gold was applied before the opaque paint layers were laid on. The leaf gilding was used at the exterior (and maybe also the interior) of the halls, even though the details of the paintings are less visible there: The reason may rather have been to emphasize the importance of the buildings than to add to the weight of the paintings.

Stylistic aspects of the paintings in the guodian and the zhengdian

The stylistic analysis was a by-product of the technological investigation and was not carried out systematically. During the examination of the painting technique it became obvious that characteristics of the technique at least partly correspond to characteristics of the style. Two aspects were taken into consideration:

(1) characteristics of selected parts such as types of vegetation or facial features

(2) repetition and variations of characteristic subjects such as special figures, objects or ornaments

While the first aspect gives information about the different artists involved in the work, the second sheds light on the question of templates or master drawings on which the design of the paintings was based.

[99] The use of pink as substitute for gold is common in China.

Fig. 309
Pingfeng dong, panel 7 *b*, man and a boy: red colouration of the lips

Fig. 310
Pingfeng xi, panel 5 *b*, head and hands of a boy leading the drunken poet: the lips are colourless

Fig. 311
Sanguo dong, guard (fig. no. 4)

Fig. 312
Sanguo xi, figure no. 46

Fig. 313
Sanguo xi, figure no. 44

Fig. 314
Zhengdian, south side, lintel

Fig. 315
Zhengdian, south side, lintel

Fig. 316
Sanguo xi, figure no. 43

According to the observations made in 2012 and 2013, the paintings can be divided into the following groups:

Figurative scenes in the b-*,* c- *and* d-*panels of* pingfeng xi*, and* d-*panels of* pingfeng dong

These scenes are very similar in style. They show a skilled, calligraphy-like brushstroke with varying width. The faces are outlined with very thin black lines. The eyes are almond-shaped and rather far apart. The noses are mostly straight with a broad back. The earlobes are mostly large. The lips are outlined with upper and lower lip, and at some figures the lower lip is just a small semicircle (figs. 309 and 310). At the *pingfeng xi*-painting, lips are not coloured or shaded with grey, while on the *pingfeng xi*-painting some lips of ladies and boys are coloured with a red translucent paint.

The anatomy and the posture of figures are correct and graceful. Most figures are slender and fine-built. The movements appear fluent and natural. Hands are anatomically correct in every posture, the fingers long and slim. There are no white or light-coloured highlights. Figures 317 and 318, showing two maid servants carrying a tray with a teapot, show how similar some of the figures at the two walls are. They also point to the use of a template as even the bamboo pattern on the teapot is similar. Nevertheless the variations in the posture and drapery, in the shape and perspective of the teapot and the hand posture make the maids individual and lively. It is very likely that all the figures have been painted by the same artist.

Fig. 317
Pingfeng dong, panel 3 *b*: maid servant with teapot on tray

Fig. 318
Pingfeng xi, panel 2 *b*: maid servant with teapot on tray

Fig. 319
Tianguan cifu: man on island

Fig. 320
Pingfeng dong, panel 1 *d*: young man

Fig. 321
Pingfeng bei, panel 2 *b*: young man

Fig. 322
Tianguan cifu: boy on the cloud

Fig. 323
Pingfeng dong, panel 5 *d*: man

Fig. 324
Pingfeng bei, panel 2 *b*: boy

Fig. 325
Tianguan cifu: 'demon' with conch

Fig. 326
Pingfeng dong, panel 5 *c*: 'demon' with cup

The same correlations can be observed in the depiction of the vegetation, objects and architecture: The same kinds of plants can be found, and they are painted the same way. Shrubs and grass are characterised by parallel black lines painted as a flat spiral in a slightly inclined angle (fig. 335, yellow arrow), very often there are clover-shaped leaves (fig. 335, red arrow). Tree trunks are often gnarled with marks from healing-over of broken-off branches. The bark is indicated by a grey mottled structure. A great number of different species can be identified. Water with smooth surface, waves and froth is depicted in the same way. Black dots highlighted with green dots are scattered over the landscape.
There are different kinds of architecture, but single elements are depicted in the same way like the roof tiles (strips created by black lines, alternatively filled with darker and lighter grey), wooden elements or panel doors. Several objects like vessels, cabinets, chess boards, marbled pots, tables inlaid with rare stone, are of the same type. The borders of painted screens are designed as strips or pilasters with green marbling. The handwriting of the inscriptions in the *b*-panels may be the same.
It is not clear if one artist painted a whole painting or if a team worked together, one artist painting the figures and another one the vegetation or the architecture, but it is very likely that the same person(s) painted the figurative scenes of the *pingfeng xi*- paintings and those of the *b*-panels of the *pingfeng dong*-painting.

Figurative scenes in the panels c *and* d *of* pingfeng dong*, and* tianguan cifu

The panels *c* and *d* of the *pingfeng dong* have not been painted by the painter(s) who executed the *b*-panels. The figures are less elegant and their movements stiffer. The hands look clumsy and sometimes bent awkwardly (fig. 301). The lips are rather big and coloured pink. The ears are painted simple, showing just the helix (outer rim), not the concha (inside the ear), in contrast to the *b*-panels in the *guodian*. The still lives in the *c*-panels of the *pingfeng dong*-painting also differ from those in the *pingfeng xi*-painting, even though similar objects (censers, chess boards, chime stone pendants etc.) are depicted. The *d*-panels show differently designed landscapes and architectures.
It is not clear if the *c*-panels and the *d*-panels in the *pingfeng dong*-painting were carried out by the same painter: they are similar in style, but not identical (figs. 302, 320 and 323).
Both show similarities to the figures in the *tianguan cifu*-painting: They have similarly stiff postures, rather large heads, big mouths and similar, strangely bent hands. The facial features of the figures in *tianguan cifu* are slightly different, however: The noses are broader, the eyes larger, but imbedded between thick lids. The lips are full and protruding (figs. 319, 320, 322 and 323). The boy holding a staff (fig. 322) shows problems with the anatomy of the hands and his head is much too large, while the figure of the official (fig. 319) is quite elegant. The figure of the 'demon' behind him shows a strong resemblance to a figure in the *c*-panels of the *pingfeng dong*-painting (figs. 325 and 326). Maybe two painters with a very similar style were active, and for the 'demon' there probably was a master drawing that both copied.

Figurative scenes in the pingfeng bei-*painting*

The figures in the *b*-panels show again other features with stiff, but more elegant hands and a different kind of facial features. The eyes are rather large; the iris is always set in one corner of the eye and half covered with the upper lid (fig. 324, 321 and 345). The style of the landscape and the flowers, too, is not similar to the other paintings.
The two grisaille paintings in the *d*-panels appear unskilled and crude in comparison to other paintings in the halls, but their eyes are depicted as in the figures of the *b*-panels. The difference between the *d*-panels of *pingfeng xi* and *pingfeng bei* can be seen in figures 332 and 333 showing the same scene ('she suckles her mother-in-law'). As the figures in the *d*-panel of *pingfeng bei* are bigger than those of the *pingfeng xi*-painting, they appear even more unelegant.

Fig. 327
Pingfeng dong, panel 4 *b*: old lady carrying a cock

Fig. 328
Pingfeng xi, panel 7 *d*: old lady

Faces of old ladies and men

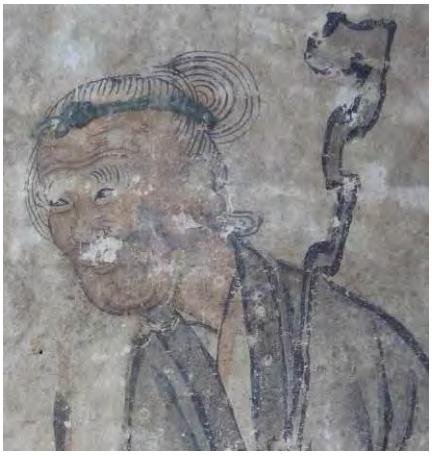


Fig. 329
Pingfeng xi, panel 2 *d*: old woman with walking stick

Fig. 330
Pingfeng dong, panel 1 *d*, old woman: whitish highlights on robe

Fig. 331
Pingfeng dong, panel 6 *d*: elderly woman

Fig. 332
Pingfeng xi, panel 8 *d*: 'suckling her mother-in-law'

Fig. 333
Pingfeng bei, panel 1 *d*: 'suckling her mother-in-law'

Sanguo-*paintings*

The *sanguo*-paintings are identical in style, showing the same type of faces, architecture, objects, horses, landscape and vegetation. The figures are elegant, postures and proportions look natural and diversified. Figures and all elements show similarities to the *b*-panels of the *pingfeng xi* and *pingfeng dong*, for example the same structure of spiral lines in shrubs and grass (fig. 334), plants with similar leaves (fig. 336), the same type to depict roof tiles and similar objects (vessels, cabinets) in the pavilions. The faces are painted in a comparably fine and skilled way. The golden square cap with decorations, which Cao Cao is wearing in the *sanguo xi*-painting (figure no. 35, fig. 303), re-appears almost identical as cap of the heavenly official in panel 3 d of the *pingfeng xi*-painting (fig. 305). Horses show a similar anatomy and the same way of drawing of the nose, the mane and the tail.
But there are also differences: The figures are not so slender, the faces fuller. The phalanxes of the fingers are thicker and more emphasized. Often the upper eyelids curve downwards above the iris (fig. 296, 303, 311, 312 and 313), but there are also figures with almond-shaped eyes (figs. 316, 341 and 343). The eyeballs are shaded bluish grey towards the corners. In the landscape most of the trees have bushels of four leaves that cannot be found in the paintings of the *guodian* (fig. 334, yellow arrow). The pine trees at the upper edge of the *sanguo dong*-painting are straighter and more uniform than the ones painted in the *guodian* (figs. 337 and 339).

Figurative scenes at the wooden architecture of the halls

The figures on the lintels of the *guodian* and the *zhengdian* are similar in style. The proportions of the faces are similar to those at the *b*-panels of the *guodian* and the *d*-panels of *pingfeng xi*. The ears have the same shape, and the shading with pink lines is arranged similarly, including circles around the eyes. Some have a small semicircle lower lip, too. The lips are not coloured.
The eyes, however, are much smaller and seem to be completely filled by the dark iris (fig. 300, 307, 314 and 315). The hands are clumsy, in parts they are only roughly outlined (fig. 315).

The observations show that at least six artists were involved in painting the two halls:

Table 16
Different artists recognisable in the paintings; D 1and D2 are either one or more persons

painter	*painted parts*
A	*pingfeng xi*, panels *b*, *c*, *d*; *pingfeng dong*, panels *b*; *sanguo*-paintings, vegetation?
B	*sanguo*-paintings, human figures
C	*pingfeng dong*, panels *d*
D 1 D 2	*pingfeng dong*, panels *c* *tianguan cifu*, human figures
E	*pingfeng bei*, panels *b* also *pingfeng bei*, panels *d*?
F	wooden architecture, lintels, exterior side

Ornamental decorations

Ornamental decorations as the ‘star borders’, the lattices of the a-panels and the *yunleiwen*-ornaments in the three *pingfeng*-paintings reappear in folding screens and architectural parts of the *sanguo*-paintings. They probably belong to a standard repertoire of ornaments that

Fig. 334
Sanguo dong, hill behind the deer: trees with four-lobed leaves (arrow) appear frequently in in *sanguo*-paintings, but not in the paintings of the *guodian*, while the other types of plants can be found in all four paintings

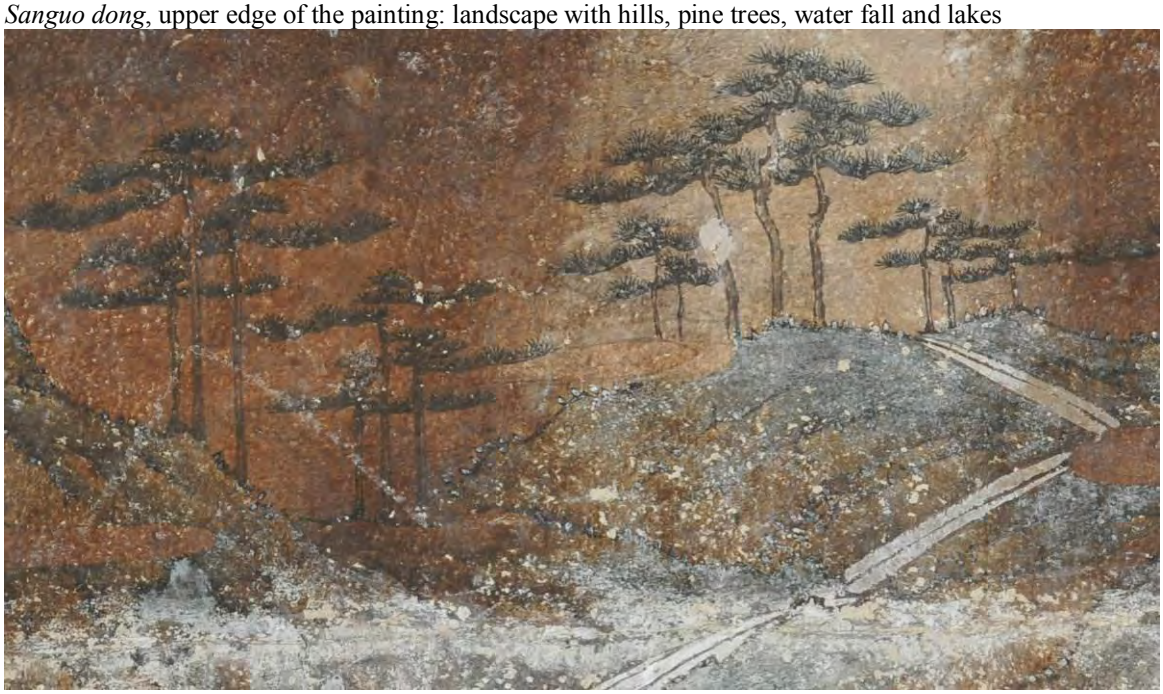
Fig. 335
Pingfeng xi, panel 2 *b*, trees and shrubs in the garden; hills with pine trees in the painting of the scroll: structure of black lines in shrubs and grass (yellow arrow) and plant with bushels of four leaves (red arrow)

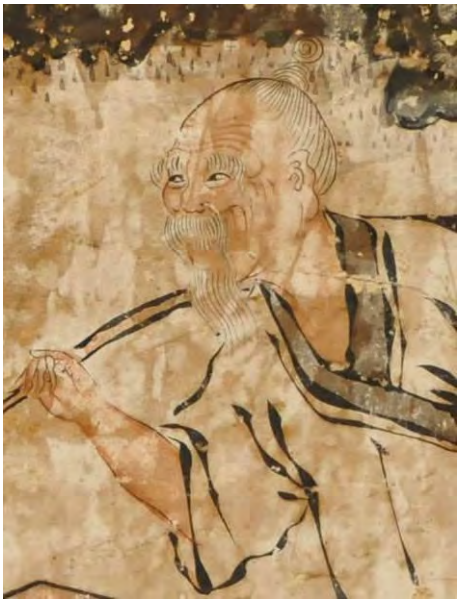
Fig. 336
Sanguo dong: willow twigs with two shades of grey and black, plant with bushel of four leaves or clover (right lower edge)

Fig. 338
Pingfeng xi, panel 2 *d*: willow leaves in four shades of grey

Fig. 337
Pingfeng dong, panel 2 *b*: pine trees

Fig. 339
Sanguo dong, upper edge of the painting: landscape with hills, pine trees, water fall and lakes





◀ Fig. 340
Pingfeng dong, panel 4 *b*: carrier

▶ Fig. 341
Sanguo dong, left edge: boatman (figure no. 25)

◀ Fig. 342
Sanguo xi: old man (figure no. 9)

▶ Fig. 343
Sanguo dong: old man with square *putuo* cap (figure no. 8)

◀ Fig. 344
Pingfdeng dong, panel 4 *c*: old man with musical instrument(?)

▶ Fig. 345
Pingfeng bei, panel 5 *b*: old man

probably does not point to individual artists. It is noticeable, however, that the three *pingfeng*-paintings differ in regard to the ornaments. The paintings of *pingfeng xi* and *pingfeng dong* are more similar, being designed as counterparts. Here the differences may have been introduced deliberately as variations to make the paintings more interesting, or different teams of painters were free to choose individual solutions for details.
The *yunleiwen*-ornament originally planned for the *e*-panels of the *pingfeng xi*-painting, would have corresponded to the ones in the *e*-panels of the *pingfeng dong*-painting on the opposite side of the hall. In the final version, the *yunleiwen* at the *pingfeng xi* was covered with a floral yellow pattern on dark ground that resembles the *e*-panels in the *pingfeng bei*.

The influence of master drawings or templates

Some details, types of figures or even groups of figures can be found in a very similar appearance in different paintings, which, according to the observations described above, can be assigned to different painters. One example is the cap of Cao Cao in the *sanguo xi*-painting and the heavenly official in the *pingfeng xi*-painting (figs. 303 and 305) that was mentioned before. The similarities in details of the two maid servants are striking, though painted by the same painter (317 and 318), and indicate the use of a master drawing as well. Black boots with white heel and sole appear on the *pingfeng xi b*-panels (painter A, fig. 346), the *pingfeng dong d*-panels (painter C, fig. 347), the *tianguan cifu*-mural (painter D, fig. 348) and the lintels (painter E, fig. 349 and 353). In the *sanguo*-paintings, the figures wear other kinds of footgear, such as decorated boots or “cloud head” boots.

Fig. 346
Pingfeng xi, panel 4 *b*: man with fur coat

Fig. 347
Pingfeng dong, panel 5 *d*: standing man

Fig. 348
Tianguan cifu: boy on the cloud

Fig. 349
Zhengdian, southern side, lintel

▲ Fig. 350
Guodian, south side, painting on panel: man falling under an advancing horse

Fig. 351 ▶
Sanguo xi: Zhao Yun (figure no. 27), and a man (figure no. 28) falling under his horse

Fig. 352
Sanguo xi: horseman figure no. 31 on a pink horse, holding a lance

Fig. 353
Guodian, south side, painting on panel: horseman on pink horse with lance (mirror-inverted)

There are three paintings showing a heavenly official standing in the clouds, accompanied by one or two boys: the *tianguan cifu*-painting (fig. 354), panel 2 *b* of the *pingfeng bei* (fig. 356) and panel 3 *d* of the *pingfeng xi*-painting (fig. 355). The correspondence between the officials is striking, regardless of the different dimensions (at the *pingfeng xi*, the official is 14 cm high, at the *tianguan cifu* about 60 cm and at the *pingfeng bei* about 35 cm high): the posture of the body and the movement of the drapery are very similar. At the *pingfeng bei*- and the *tianguan cifu*-painting even the colours of the clothes are identical, and both officials carry the *ruyi* under the left arm, while in the *pingfeng xi*-painting the colours are different (and less rich), and the official is holding the *ruyi* with his right hand. Each of the officials is accompanied by a boy who pours bats (as symbols of luck) downwards to the earth. These boys, however, are not similar.

A comparable correspondence can be found between the *sanguo*-paintings and the decorations of the lintel of the *guodian*: A man falling under a horse (fig. 350) has the same posture as the man falling under Zhao Yun's horse in the *sanguo xi*-painting (fig. 351), while the horseman resembles other horsemen in the *sanguo*-paintings, for example figure no. 31 (fig. 352). On the lintel, too, pink horses can be found and horses with circlets in their coat. The harnesses are identical as well as the saddles (including the pattern of golden dots at the breastplate of the saddle), the suits of armour, the tunic, the boots and the weapons (fig. 353).

Fig. 354
Tianguan cifu: official and boys on a cloud

Fig. 356
Pingfeng bei, panel 2 *b*, official with two boys [Zhao Zhou 2012]

Fig. 355
Pingfeng xi, panel 3 *d*:
official holding a *ruyi* and boy pouring out red bats

Fig. 357
Jiangxi *huiguan*, front room, east wall, upper part: stucco frame with traces of paintings (persons on clouds?) and stucco ornaments (left side); a-panels with three interlaced octagons; b-panels with star borders with green (and red) ground and figurative scenes

Fig. 358
Jiangxi *huiguan*, front room, west wall, upper part: stucco mask next to folding screen; lattice with six interlaced octagons in the a-panels; star pattern with green ground discernible at the panel frame of the *b*-panel

Fig. 359
Beiwusheng huiguan, *pingfeng xi*, panel 5 *a*: lattice with four interlaced octagons

Jiangxi *huiguan*

The Jiangxi *huiguan* could be visited twice, in 2011 and in 2012. During the work on the *beiwusheng huiguan*, namely the *pingfeng xi*-painting, resemblances between the murals in the two *huiguan* became obvious. It would be important to make an attempt to protect and rescue the paintings in the Jiangxi *huiguan*, even though they are in a very bad condition. The strong connections between the paintings in the two *huiguan* are highly interesting for the historical and art historical research. They can also help to understand the damaged paintings in the Jiangxi *huiguan*.

Technical aspects

The Jiangxi *huiguan* has a different building technique. The lower parts of the walls are built with quarry stones, the upper parts with fired bricks. The clay plasters are thinly applied over the stones and bricks.

The front room has three doors, the one in the east wall leading to the antechamber which lost the roof a long time ago so that no traces of plasters are left. The door in the south wall is blocked, originally it led to the theatre tribune. Opposite, in the north wall, a door leads to the rear room.

In the front and the rear rooms, decorations are only discernible at the gable walls (east and west walls). If the eaves' walls, too, had murals, they disappeared without trace. The murals on the gable wall are surrounded by a frame made of stucco, in the front room they are additionally decorated with masks and cloud scrolls formed out of the stucco at the upper corner (fig. 357). The stucco lintel above the paintings in the front room was also painted with figurative scenes (fig. 358). In the rear room the stucco frame is flat, undecorated and painted black.

Depictions – folding screens

The three preserved murals, on the west and the east wall of the front room and on the west wall of the rear room, show folding screens. The ones in the front rooms have eight frames, the one in the rear room have six frames.

The folding screens show the same type of zonings as the ones in the *beiwusheng huiguan*: There are five panels (*a* to *e*) and the legs.

Front room

The narrow *a*-panels show a lattice of interlaced octagons, with three octagons per panel at the east wall (fig. 357) and six octagons at the west wall (fig. 358). The *pingfeng xi*- and *pingfeng dong*-walls have four octagons (fig. 359). The large *b*-panels show figurative scenes set in landscapes and/or architecture. There are inscriptions with painted seals above the scenes like at the *pingfeng xi* and *pingfeng dong*-paintings. The narrow *c*-panels probably show small figures in landscapes (fig. 370). The *d*-panels contain smaller figurative scenes. In the *e*-panels still lifes are discernible, containing censers, chime stone pendants and other objects (fig. 364 and 365). The arrangements are thus comparable to the still lives in the *c*-panels of the *pingfeng xi* and *pingfeng dong*-paintings.

The framework was probably brown and shows the same details as the *pingfeng xi* and *pingfeng dong*-paintings: corner connections with mitre joints, bevelled edges along the framework, panel frames and filling frames (except for the *e*-panels). The legs show rounded decorations like the ones at the *pingfeng xi* and *pingfeng dong*-paintings.

Fig. 360
Jiangxi *huiguan*, front room, west wall: star pattern on green ground. The filled-in paint layers of the star segments and the cloud scroll in the corner are faintly visible as well as traces of the blossoms between the stars.

Fig. 361
Beiwusheng huiguan, *pingfeng xi*, panel 8 *b*: star pattern and cloud scrolls as corner ornament

Fig. 362
Jiangxi *huiguan*, front room, west wall: Star border on red ground. The corner ornament is a larger quarter blossom.

Fig. 363
Beiwusheng huiguan, *pingfeng dong*, panel 3 *b*: star pattern and quarter blossom as corner ornament

Fig. 364
Jiangxi *huiguan*, front room, west wall, *e*-panel with still life (censer)

Fig. 365
Jiangxi *huiguan*, front room, east wall, *e*-panel with still life (censer, chime stone, rock or root)

Fig. 366
Jiangxi *huiguan*, front room, west wall, panel 5 *d*, in April 2011

Fig. 367
Beiwusheng huiguan, *pingfeng xi*, panel 7 *d*, August 2012

▲ Fig. 368
Jiangxi *huiguan*, front room, west wall, panel 5 *d*
(Aug. 2012)

▼ Fig. 369
Beiwusheng huiguan, *pingfeng xi*, panel 7 *d*
(Aug. 2012)

The panel frames were coloured orange red. The *b*-panels had an ornamental decoration in two alternating colours: Against green and red grounds, the same star pattern was painted as at the *pingfeng xi*-painting. Against the green ground, the corner ornament shows a cloud whirl like the one at the *pingfeng xi*-painting (figs. 360 and 361), against the red ground the corner ornaments are blossoms like those at the *pingfeng dong*-painting (figs. 362 and 363).

The *b*-and *d*-panels showed figurative scenes. One better preserved scene at the west wall in panel 5 *d* shows the same scene as panel 7 *d* of the *pingfeng xi* in the *beiwusheng huiguan* (figs. 366-369): An old lady is sitting next to a young lady who is holding a stick with a tassel hanging down from the end. Behind them there is a painting with a marbled border. Next to the lady, on the right part of the painting, there is a view into a landscape or garden. Two men are depicted in front of the ladies, one standing, the other one kneeling.

Although the painting in the Jiangxi *huiguan* is severely damaged, the strong resemblance of the two paintings is still recognisable: The two women are seated in the same way. The young lady wears a robe with grey borders that in both paintings may be pink. The undergarment has a different colour (in the *pingfeng xi*-painting green). She is holding the stick with the right hand, leaning it over her elbow (in the Jiangxi *huiguan* her hand and the tassel on the stick can be recognised). Her left hand is raised to her chest. The old lady has the same headdress and hairstyle on both pictures. The hairband and the undergarment in both paintings are blue, while the robe has a grey border.

In the Jiangxi *huiguan*, a painted screen can just be recognised behind the two ladies. As in the *pingfeng xi*-painting, it has a marbled frame: the veins are still clearly visible. Next to it there is a wooden balustrade with strips arranged into ornaments and coloured red.

The two men on the right part of the painting are depicted in the same way in both paintings: The one kneeling in front of the ladies has his raised hands covered by the sleeves. His robe is shaded pink in both paintings. The other man, standing to the right of him, is mostly lost in the Jiangxi *huiguan*, but the feet and the cap can still be recognised. The men wear the same kind of cap in both paintings.

In the *pingfeng xi*-painting, the view behind the balustrade goes into a landscape with hills, while in the Jiangxi *huiguan* a lot of leaves are visible. The same type of leaves, and clusters of four leaves arranged like a clover, can be found on many depictions in the *guodian* of the *beiwusheng huiguan*. In both pictures, there is a banana tree in front of the young lady. In other paintings of the Jiangxi *huiguan* (panels *b* and *d*), the landscape is highlighted with the same black dots with green dabs as they can be observed in the *beiwusheng huiguan*.

The conformance of the two depictions including the design of details and the choice of the colours is so high that it cannot be coincidental. There either must have been master drawings or published depictions serving as templates for both paintings, or the same painters were active in both *huiguan*. The brush strokes of the black drawing in the Jiangxi *huiguan* looks different from the calligraphic style with varying broadness that is characteristic of the paintings in the *b*- and *d*-panels of the *pingfeng xi*-painting: The paintings were probably not carried out by the same painter. The choice of the border patterns, however, being exactly like those in the *pingfeng xi*-painting, with a variation of the corner ornament realised in the *pingfeng dong*-painting, is a very strong link. Maybe the same teams of painters were active in both *huiguan*. This would also mean that at least the paintings in the Jiangxi *huiguan* are not much older than those in the *beiwusheng huiguan*.

Fig. 370
Jiangxi *huiguan*, front room, west wall, *c*-panel

Fig. 371
Jiangxi *huiguan*, rear room, west wall: folding screens with six frames

Rear room

The preserved painting on the west wall shows a folding screen with six frames (fig. 371). The design is slightly different from those in the front room and the *beiwusheng huiguan*. The *a*-, *c*- and *e*-panels are rather narrow and of about the same height. The *b*-panels are the biggest paintings. The *d*-panels are higher than in the *beiwusheng huiguan*.

The framework was painted brown. The corner connections are depicted as mitre joints. The rails between the panels have a partition line in the centre, probably indicating two adjoining wooden battens. Towards the *c*-panels, a bevelled edge is painted.

B- and *d*-panels have a coloured panel frame in which a filling frame is inserted. The corners of the filling frame are curved like the filling frames at the *pingfeng xi*- and *pingfeng dong*-paintings (fig. 372, lower right edge). The sides of the filling frame are also shown, indicating a trimming that protrudes from the panel frame.
The panel frames had a colourful decoration, probably comparable to the "star borders" of the *b*-panels in the front room. Traces of the green ground are visible in the *b*- and *d*-panels of frame 1 and 5. Panel 4 *d* had a red ground.

The *a*-panels show a lattice of closely set strips, probably also interlaced octagons. The black lines on the shadowed sides of the strips can still be recognised. There is no panel frame and no filling frame: The lattice is painted to be inserted directly into the framework.

The *b*-panels showed figures and architecture in a landscape. In panel 4 *b*, a man on a horse pulling a two-wheeled rickshaw on which a lady is sitting could still be recognised in April 2011 (fig. 372). Behind them was a building with a balustrade and trees. In panel 1 *b*, a building and some vegetation were still recognisable in 2012. Black dots with green highlights are scattered in the landscape like in the paintings of the *beiwusheng huiguan*.

The *c*-panels probably showed small figures in landscapes: In panel 4 *c* two men sitting side-by-side surrounded by leaves were still recognisable in 2011. As the *a*-panels, the *c*-panels are painted without panel frame and filling frame: The depicted scenes are framed only by the framework of the folding screen.

The depictions of the *d*- and *e*-panels could not be recognised.

Summary

The comparison of technical and stylistic aspects of the paintings in the *beiwusheng huiguan*, including different details, showed that the paintings can be assumed to date from the same time, and that at least six different painters were involved in painting the figures. There may have been more painters, adding ornaments or applying paint layers following the directions given by colour names written into single areas. There may have been a master supervising the whole work.
Templates, either sketches or works by the master of the workshop or motifs from published illustrations, were obviously used for single figures which re-appear on different walls.
There may even have been designs for whole scenes as the identical depictions in the panel 7 *d* in the *pingfeng xi*-painting of the *beiwusheng huiguan* and in the panel 5 *d* of the west wall (i.e. *pingfeng xi*-painting) of the Jiangxi *huiguan* prove. The close connections between the drawings of the two *huiguan* also indicate that they were painted by the same teams of painters or workshop(s). Though most of the paintings are severely damaged, the Jiangxi *huiguan* still shows the high artistic quality of the paintings and once must have been comparable to the *beiwusheng huiguan* with regard to the richness of decoration and style.

Fig. 372
Jiangxi *huiguan*, rear room, west wall, panel 4 *b*: Rider on an orange horse pulling a rickshaw or sedan chariot in which a lady is sitting. In the background on the right side, a wooden balustrade is discernible.

ANALYSES OF MATERIALS AND STRATIGRAPHY

57 samples were taken from the wall paintings in 2011.[100] The sample material was divided into two charges, so analyses could be made on each sample parallel in China and in Germany. 53 of the samples were brought to Germany.[101]
Abbreviations were introduced for labelling the samples and analysis methods. In China abbreviations different from those used in Germany were chosen (table 17). The results of the examination and analyses were recorded in *sample record sheets* containing all information on each sample. An overview on the sampling areas[102] and the results in tabular form can be found in the appendix 1 to 5, p. 247-281.
Samples were taken from the clay plasters and the paint layers. Samples from the paint layers were selected with the idea of covering the different colours present in the paintings. Within the groups of paintings (*guodian*; *sanguo*-walls; *yunqi*-paintings; *zhengdian* north wall), only one sample was taken of each type, resulting in an unequal distribution of sampling areas on the single walls. The greatest number of samples was taken from the *sanguo xi*- and the *pingfeng xi*-paintings.

Table 17
Abbreviations used for labelling the samples

wall painting	*abbreviation in Germany*	*walls labelled by the Shaanxi Institute for Conservation*	*abbreviation by Shaanxi Institute for Conservation*
GUODIAN			
pingfeng xi	*pfx*	*guodian xi*	Gx
pingfeng dong	*pfd*	*guodian dong*	Gd
ZHENGDIAN			
sanguo xi	*sx*	*zhengdian xi* 1	Zx 1
sanguo dong	*sd*	*zhengdian dong* 1	Zd 1
yunqi xi	*yx*	*zhengdian xi* 2	Zx 2
yunqi dong	*yd*	*zhengdian dong* 2	Zd 2
tianguan cifu	*tg*	*zhengdian bei*	Zb [1?]
pingfeng bei	*pfb*	*zhengdian bei* 2	Zb 2
long	*long*	*zhengdian bei*	Zb [3?]
SAMPLING TECHNIQUE			
cross section	CS		
slide preparation for PLM	PP Z		
thin section	TS		

[100] 51 samples taken by Mr. Bai Ke and Mr. Liu Dongbo, six samples were taken by the German conservators together with the Chinese conservators in July 2011.

[101] The samples *pfx* 17-21 were taken by the German-Chinese team in July 2011, but not brought to Germany.

[102] The Chinese conservators prepared the mapping of the sampling areas was and numbered the samples.

Experimental methods

Cross sections

49 cross sections were prepared. Some of the cross sections were processed into thin sections.[103] The samples were imbedded in Technovit® (Heraeus Kulzer), a light-curing methacrylate. They were polished by hand with Micro-mesh® (Micro-Surface Finishing Products, Inc.). The examination was done using a Leica DMLM microscope with 5, 10, 20 and 50 times magnifying objectives (plane achromatic), eyepieces: 10x, and UV light source (wavelength 390-440 nm). The preparation and examination was carried out by Miriam Schanz and Catharina Blaensdorf, TUM.

PLM

101 slide preparations of the paint layers and 5 samples for fibre identification were provided for polarised light microscopy (PLM). The samples were imbedded in Meltmount™® (Cargille Labs), n_D = 1.662 at 25° C. The analysis in transmitted polarised light was done with a Leica DMLP microscope, magnifications of 20, 40 and 63 times magnifying objectives (plane achromatic); eyepieces: 10x. The analysis was made by Catharina Blaensdorf and Miriam Schanz, TUM, supported by Anna Krez, student at the TUM.

XRD and XRF

For some questions XRD with semi-quantitative analysis and XRF were made by Vojislav Tucic, Bayerisches Landesamt fuer Denkmalpflege, Central Laboratory, Munich.
XRD: PW 1800 (Philips), copper x-ray tube with Kα-radiation of 1,542 Å; detector: Xenon proportional counter.
XRF: MiniPal 4025/00 (Philips) for the range of elements between sodium and uranium; concentrations between ppm and 100%; sample size up to 42 mm.

SEM with element mapping

SEM with element mapping for distribution of elements were made by Christian Gruber, Bayerisches Landesamt fuer Denkmalpflege, Central Laboratory, Munich, on selected cross sections. SEM: Zeiss DSM 960; EDX: SSD detector (Bruker), WDX: Microspec with five crystals.

Binding media and organic colourants

Organic materials were analysed by Anna Lluveras Tenorio and Ilaria Bonaduce, Università di Pisa, Dipartimento di Chimica e Chimica Industriale, and Francesca Sabatini. As analysis method mainly GC-MS was used, additionally Py-GC-MS, FT-IR and HPLC. The procedure is described in SABATINI 2012.

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[103] The first samples were examined during a work stay in Munich by Mr. Bai, Mr. Liu and Mrs. Fan Binbin together with Laura Thiemann, Linda Zachmann and Miriam Schanz from the TU Munich in October 2011. The complete and systematic investigation and analysis was done by Catharina Blaensdorf und Miriam Schanz between November 2011 und April 2012, some additional analyses followed between October 2012 and May 2014

MATERIAL ANALYSES

Preparation layers - clay plaster layers and white ground layer

The three clay plaster layers were characterised according to the traditional Chinese terminology as *cu ni* ("coarse clay" layers) and *xi ni* ("fine clay" layer; table 18). In Germany no comprehensive analysis of the clay layers was made.

Table 18
Characterisation and approximate proportions of components of plasters analysed by Fan Binbin and Hu Kejia in 2012. The samples were very small, so the results concerning the proportions are only preliminary data.

plaster layer	*characterisation*	*thickness of layer*	*approximate proportion*		
			sand	*clay*	*plant or fibrous additives*
xi ni 细泥 fine coat	yellowish white plaster: clay, sand (size 1-2 mm), lime, plant fibres	2-4 mm	not invest-tigated	not invest-tigated	high amount of fibres
2nd *cu n* 粗泥 2nd undercoat	yellowish brown plaster: clay, threshing residues (rice husks and straw), single stones < 0.5 cm, sand		26.0 %	73.7%	0.3 % straw
1st *cu ni* 粗泥 1st undercoat	greyish brown plaster: clay, straw, small amount of small stones and sand		19.0 %	75 %	6 % straw

1st layer of undercoat cu ni

The layer contains straw and threshing residues. There is no addition of coarser sand (examination at 50 times magnification). The lower *cu ni* layer is more compact than the upper one. XRD analyses performed in Xi'an identified the main components in a sample from the *sanguo xi*-wall by wt% as quartz (73,3 %), feldspars, the clay minerals illite (6.)%) and kaolin (4.0%). The sample did not contain calcite (table 19).[104] A high amount of Si (quartz) and the absence of calcium were confirmed with SEM in Munich, on a cross section of the *cu ni* of another sample taken from the *sanguo xi*-painting.[105] The organic additives were identified in China as rice straw.[106]

2nd layer of undercoat cu ni

According to the analyses made in Xi'an, the upper layer of *cu ni* is less compact than the lower one, more uniform in particle size, and containing more, but smaller pores. The composition of the analysed samples is given in table 19.[107] The three samples showed no evident difference between the individual walls or between *guodian* and the *zhengdian*.
A sample analysed in Munich taken from another wall in the *guodian* (*pfx* 2) gave comparable results: Besides a high amount of quartz (77 %), the clay minerals muscovite (10 %), albite, and corrensite were found, as well as a low amount of calcite (3%).[108] The light colour of the plaster layers can be assigned to the high content of white minerals, as quartz, muscovite, albite, corrensite, illite and calcite. Iron oxides, giving the ochre colour, were not identified with XRD and may be amorphous.
With the small number of the analysed samples in China as well as in Germany, at least, a distinct difference between the composition of the first and the second *cu ni* layer could not be detected.

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[104] MA et al. 2012, table 3 (no page numbers). The text preceding the table anorthose and illite mentions instead of the other clay minerals. The same results are given in: HU et al. 2013 b, table 3.

[105] SEM with element mapping on sample *sx* 2: Christian Gruber.

[106] HU et al. 2013 b, figure 4, identification with microscopic properties (transmitted light and SEM). – Mr. Jiang Bo assumed the use of rice straw in 2012, from a macroscopical investigation.

[107] MA et al. 2012 (no page numbers). Information taken from table 3.

[108] V. Tucic, XRD with semi-quantitative analysis.

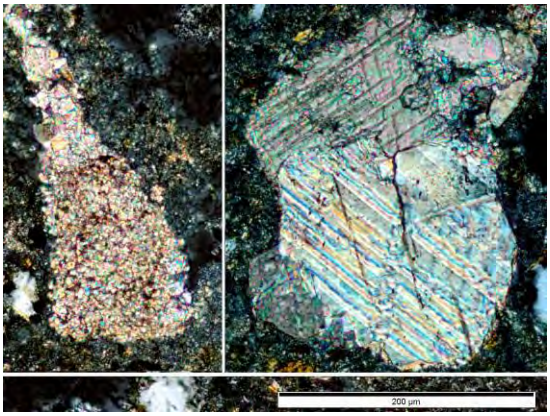

Fig. 373: *sx* 1 TS, crossed polars: diffuse, matrix-like accumulation of lime (left) and calcite particle (right)

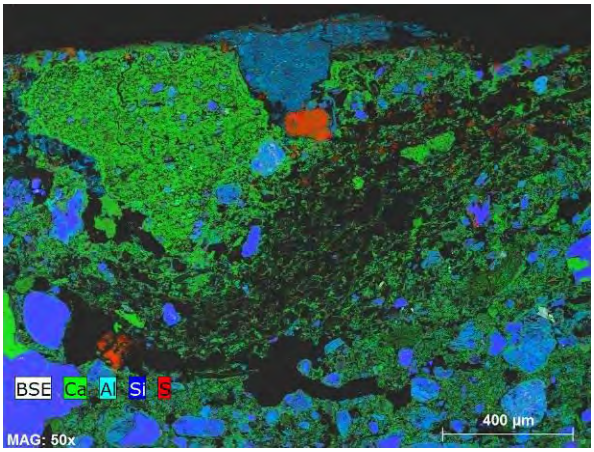

Fig. 374: *sx* 1 CS 1 element mapping

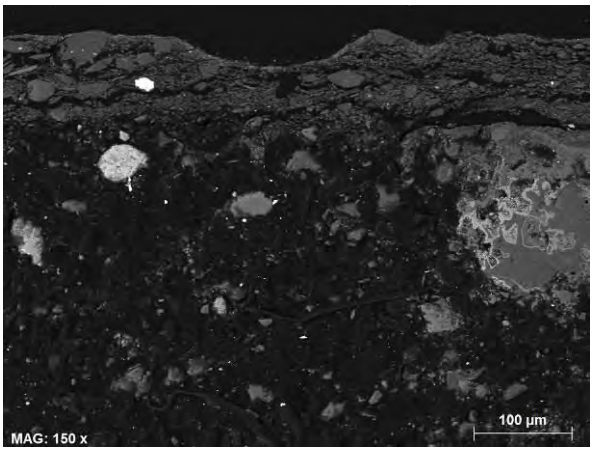

Fig. 375: *pfx* 7 CS 2 BSE

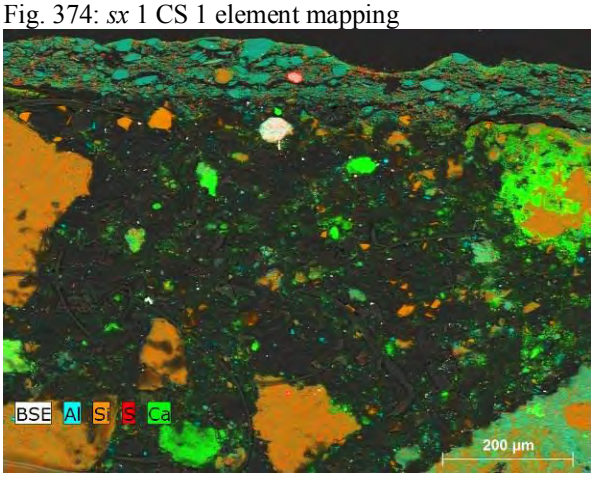

Fig. 376: *pfx* 7 CS 2 element mapping

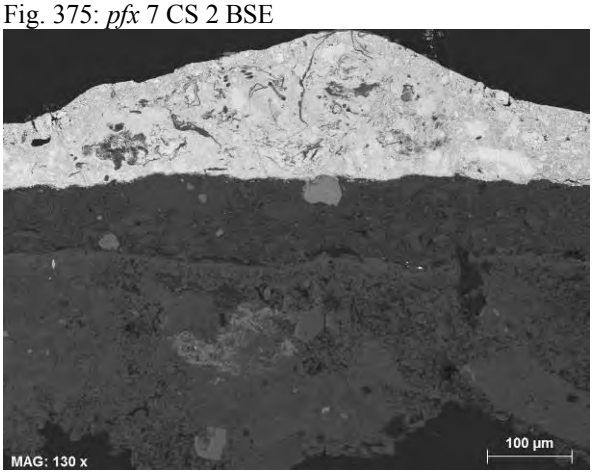

Fig. 377: *sx* 12 CS 2 BSE

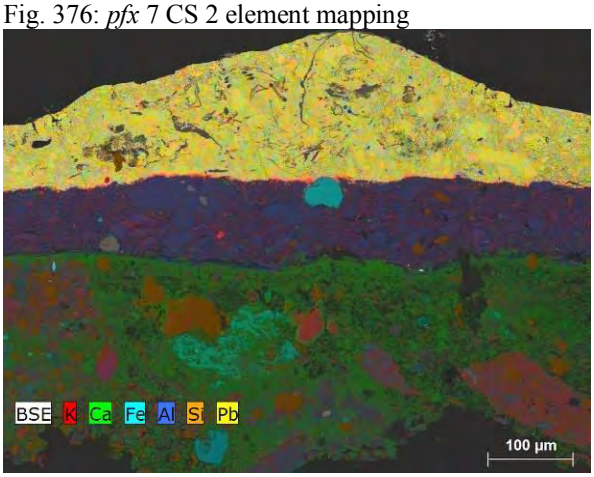

Fig. 378: *sx* 12 CS 2 element mapping

Fig. 379: *sx* 12 CS 2 VIS

Fig. 380: *sx* 12 CS 2 UV

The organic material was identified as rice straw in Xi'an.[109] In sample *pfx* 6 (examined in Munich), the upper *cu ni* additionally contains bast fibres, like the *xi ni*.

Table 19
Composition of plaster layers analysed by XRD in Xi'an [wt %] according to HU et al. 2013, table 3:

layer (sample) / *material*	*1st layer of cu ni (1 sample: Zx 1-3)*	*2nd layer of cu ni (3 samples: Gd-2, Zx1-2, Zb 3-2)*	*xi ni (4 samples:Gx-3, Zx1-1, Zx 1-9, Zb 3-2)*
quartz	73.3	73-75	52,7-65.0
calcite	0	0-5	10.4-31.0
plagioklas	9.0	6-9	3.7-7.3
kali feldspar	4.3	1.2-3.8	0-1.8
gypsum	1.4	0-3.3	0.3-5.6
montmorillonite	0	0-2.0	0-1.0
illilte	6.0	4.0-9.0	7.0-9.0
kaolinite	4.0	3.0	0-7.0
chlorite	2.0	0	0-3.0

Fine coat xi ni

The *xi ni* is light brown to off-white. Some sand grains and larger dark particles are visible already at the wall. The inorganic components were analysed with XRD. Four samples from the paintings *pingfeng xi*, *sanguo xi* (2x) and *long* analysed in Xi'an (table 19) show big differences in the contents of quartz, calcite and kaolinite which seem to indicate an inhomogeneous distribution as they also occur in samples taken from the same wall. The calcite probably results from addition of lime. Thin sections and element mapping made in Munich on samples from the *pingfeng xi*-wall (*px* 7) and the *sanguo* xi-wall (*sx* 1) show a fine, matrix-like structure of the calcium carbonate, but also calcite particles and quartz that may be components of the clay (figs. 373-376). In cross sections also brown to yellowish iron oxides are visible with VIS and SEM, as fine particles distributed in the layer or as larger clusters (fig. 378 and 379).
In the samples analysed in Xi'an, a thin layer (3-10 µm) with an even higher amount of Ca was detected on the surface. Reconstruction tests showed that the accumulation of calcium (lime) can be reached by polishing and compacting of the layer about 15 times.[110]
In Xi'an, the particle sizes of the sand grains were also determined: They do not vary between the three clay layers, but the data may indicate that the amount of bigger grains is higher in the lower *cu ni* than in the upper *cu ni* and the *xi ni*. The *xi ni* contains mainly sand grains of 0.1-0.5 mm (81-86 %) and a smaller amount of grains between 0.5-1 mm (12.9-13.6 %). This may indicate that the sand was sieved more carefully for the *xi ni* than for the second *cu ni* which contains the same particle sizes, but in greater variation.[111]

The amount of fibres varies between the samples (from bundles to almost no fibres) and between different parts of the wall, indicating a non-uniform incorporation of the fibrous material.[112] Hu Kejia identified cotton using SEM (fig. 383).[113] Fibres taken from *pfx* 6 in Munich were not cotton, but bast fibres.[114] From twelve fibres analysed from sample *pfx* 5 one was identified as cotton white the others are bast fibres (figs. 381-384). A cotton fibre is

[109] MA et al. 2012 (no page numbers); HU et al. 2013 b, fig. 4 a-d.

[110] HU et al. 2013 b.

[111] MA et al. 2012 (no page numbers), table 5.

[112] Samples *pfx* 1 to *pfx* 4 contain almost no fibres; sample *pfx* 8 contains thick bundles of fibres.

[113] SEM pictures: MA et al. 2012 (no page numbers); HU et al. 2013 b, fig. 4.

[114] Sample *pfx* 5, *xi ni*. Analysis with PLM, C. Blaensdorf: The fibres show microscopic characteristics correlating to hemp (Herzog test, dislocations and transverse markings / cross hatchings), but they are finer.

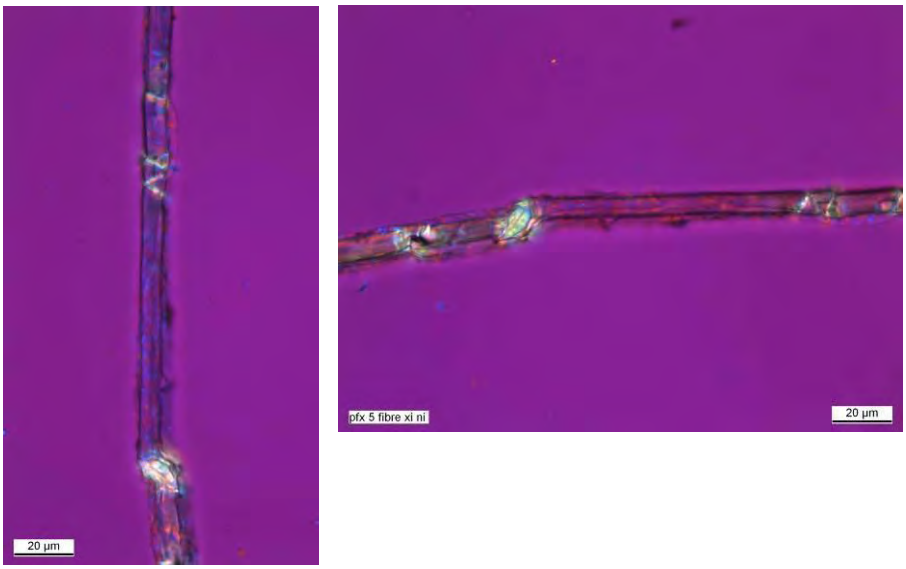

Fig. 381: *pfx* 5, thin fibre, Herzog test

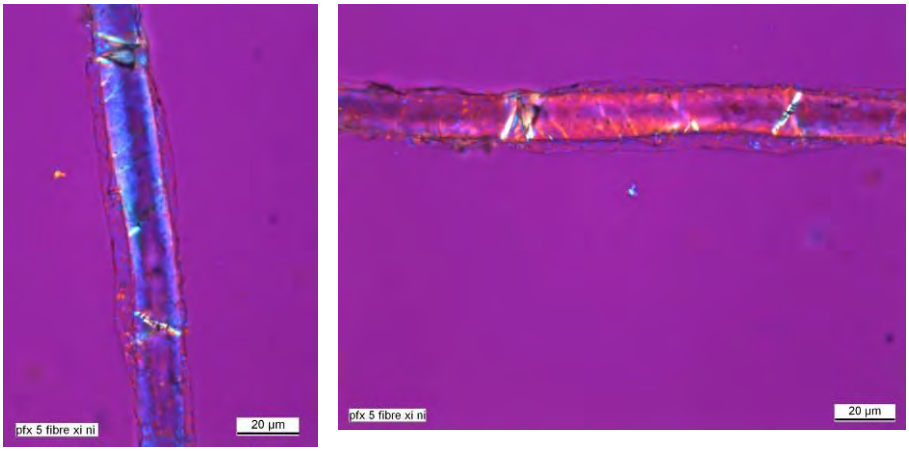

Fig. 382: *pfx* 5, thick fibre, Herzog test

◀ Fig. 383: HU et al. 2013 b, fig. 4e: Cotton fibers; there may be one bast fibre as well (arrow)

▶ Fig. 384: *pfx* 5, cotton fiber 1) and bast fibre (2)

visible in a thin section of sample *sx* 1. There may be a bast fibre among the fibres analysed in China as well (fig. 383: arrow).[115] A mixture of different fibres, perhaps clippings from textile or paper production, might explain the occurrence of a mixture of different fibres.
Further analyses would be necessary for a definite identification of the bast fibres and the fibre mixture. The comparison with Asian fibrous plants used for the productions of paper (as mulberry or bamboo species) should be included.[116]

White inclusions in plaster layers and white material on surfaces

Plaster layers, especially from the north wall of the *zhengdian*, show inclusions of white material which are visible even without magnification. Such inclusions, though smaller in amount and dimension, can also be found in the plasters of the paintings of the *guodian*. The white inclusions and a white powdery layer on top of the paint layer of the *long*-wall contained large amounts of calcium sulphate, and some quartz and clay minerals.[117] Pores in the lower *cu ni* layer of sample *sx* 2 contain Ca and S and thus maybe indicating inclusions of gypsum.[118]
Gypsum may have been added to improve the spreading qualities of the plaster. Clusters and small lumps of gypsum may indicate that the gypsum was added to the clay paste and not mixed with the dry clay powder before adding the water.[119]
The presence of gypsum was not confirmed in the samples analysed in China. The white inclusions were identified as calcite and interpreted as components of the added lime.[120]

White ground layer

The ground layer shows an off-white hue. The main component is kaolinite[121], with lower amounts of other minerals typical of clay earths as muscovite and albite.[122] The samples also contain varying, but low amounts of calcite and calcium sulphate. FT-IR analyses proved the presence of calcium oxalates.[123]
All the PLM samples (except for one) additionally contain charcoal particles and single red and yellow iron oxides that also can be seen in cross sections (fig. 379, centre; fig. 397: c).[124]

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[115] Hu Kejia, personal communication and discussion on the SEM pictures of her study.

[116] Refrences for Asian plants were not available. - Mr. Kang Yongfu assumed fibres from „dragon whiskers“ (*long xu cai* 龙须菜, *Sechium edule*, engl. chayote), an edible plant belonging to the gourd family Cucurbitaceae, along with melons, cucumbers and squash.

[117] XRD, semi-quantitative, sample *long* 2, white inclusions picked out of the bulk from 2nd undercoat layer: gypsum (62 %) and quartz (30 %) | sample *long* 1, white efflorescence on the surface of paint layer: mainly gypsum (50%) and quartz (30%).

[118] SEM with element mapping on sample *sx* 2, C. Gruber, Munich.

[119] Information based on practical experience by Prof. E. Emmerling.

[120] HU et al. 2013 b.

[121] Analyses in China (FT-IR and EDX): MA et al. 2012 (no page numbers), paragraph 3.3.2 and table 6; analyses in Munich: XRD on samples *sx* 5, *sx* 7 and *sx* 8 and PLM on samples *sx* 13, *sx* 14, *pfx* 6, *pfx* 7, *pfx* 11, *pd* 2 and *pfd* 3; analyses in Pisa (FT-IR) on paint layer samples.

[122] XRD by V. Tucic, samples *sx* 5, *sx* 7 and *sx* 8. In sample *sx* 5 the quartz content is low, no albite.

[123] University of Pisa, samples *pfx* 15, *sx* 4, *sx* 8 and *sx* 9.

[124] Cross sections were made from the walls of *pingfeng xi*, *pingfeng dong, sanguo xi*, *sanguo dong*, *pingfeng bei*, *tianguan cifu* and *yunqi xi*. No cross sections were taken from the *long*-wall.
Priming layer contains iron oxide and charcoal black: *pfx* 9 CS 2; *pfx* 12; *pfd* 1 CS1; *pfd* 2 CS 2; *pfd* 3 CS 1; *sx* 5 CS 1; *sx* 7 CS 2; *sx* 10 CS 1; sx 12 CS 2; sx 13 CS 1; *sd* 1 CS 1 ; *sd* 3 CS 1; *sd* 4; *pfb* CS 1. - Charcoal black was identified in: *pfx* 6 CS 1; *pfx* 7 CS 1 and 2; *pfx* 8 CS 1; *pfx* 11 CS 1; *pfx* 13 CS 1; *pfx* 14 CS 1; *pfd* 3 CS 1; *sx* 4 CS 1, *sx* 6 CS 2; *sx* 8 CS 2; *sx* 9 CS 2; *sx* 13, CS 1 and PP Z 44; *sx* 14 CS 1 and 2; *pfb* 6 CS 1; *yx* 1 CS 1; *yx* 4 CS 1; *yx* 5 CS 1; *long* 5 CS 1. - Only yellow iron oxide: *pfx* 17 CS 1 (only cross section). - No charcoal and no iron oxide in *sx* 11 CS 2.

In addition, there are particles which could not be identified, but presumably are natural compounds of the white earth as they can be found in almost all samples.[125] In SEM pictures, the high amount of clay minerals can be recognised (Al, K), as well as small quartz grains (Si) and occasionally occurring iron oxides (Fe) (figs. 374, 376 and 378).

In sample sx *14* slight differences in the composition of the two applications of the ground layer were detected: the lower layer contains more Ca and S (gypsum?; figs. 446 and 449).

The origin of kaolin in the area of Ziyang is discussed in HU et al 2013 b. It can be assumed that local deposits could be used.

Slide preparations of two samples of the ground layer and two samples of paint layers contain single starch grains, round or angular.[126] Their origin is not clear yet. Starch grains may indicate the use of starch paste, either as addition to the *xi ni* or the ground layer, or as a (later?) coating or consolidation material. Starch grain may also come from the fibre material added to the *cu ni* or, regarding the very low amount of starch in the analysed samples, an accidental contamination.

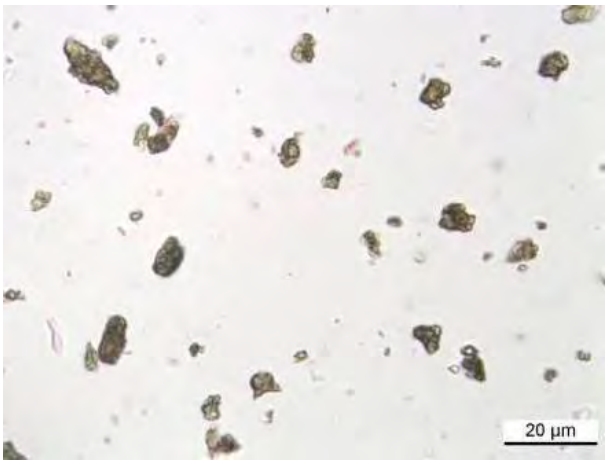


Fig. 385: *sx* 12, PP Z 42, lead white

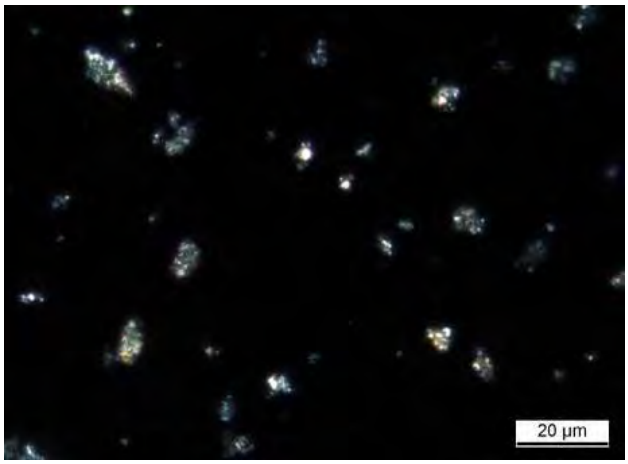
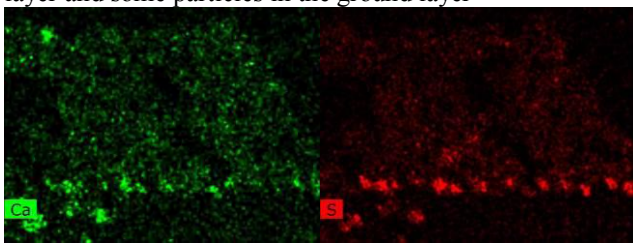


Fig. 386: *sx* 12, PP Z 42, crossed nicols

Fig. 387: *sx* 6 CS 2, thin layer containing black particles underneath green layer (arrow)

Fig. 388: *sx* 6 CS 2, element mapping for Ca and S: high contents of calcium sulphate corresponding to thin grey layer and some particles in the ground layer



[125] 1. White?, n> 1.662, rounded, very high relief, high IF (Similar particles contained in the clay and white ground layer of the Shuilu'an were identified as natural titanium dioxide). 2. White?, n> 1.662, slab- to needle-shaped, high relief, high birefringence. 3. White, similar to clusters of titanium white.

[126] Ground layer: Sample *pfx* 6 PP Z 48: one angular starch grain; sample *pfx* 11, PP Z 61: one round starch grain. Paint layers: *sx* 1 PP Z 27 (black): several starch grains, *pfx* 8 PP Z 73 (pinkish brown): one rounded starch grain.

Colourants

18 different colourants could be definitely identified and there are indications of two more. An overview of the analysed colourants is given in table 20.

Table 20
Overview on colourants analysed on samples of the wall paintings

colour	*pigments analyses in Munich and Pisa*	*pigments analysed in Xi'an*
white	white ground layer (kaolinite) lead white	gypsum** cerussite
yellow	orpiment yellow iron oxide yellow dyestuff or lake?	orpiment yellow iron oxide lead oxide (listed as brown)**
orange	red lead	red lead
red	cinnabar red iron oxide	cinnabar red iron oxide
purplish pink	pinkish red lake or red dyestuff	red dyestuff
blue	Prussian blue azurite smalt indigo*	Prussian blue azurite smalt
green	malachite spherical copper chloride botallackite	malachite atacamite botallackite
brown	reddish brown iron oxide	iron oxide lead di-oxide
black	charcoal black (black contour) flame carbon (black paint layers) flame carbon or bone black (black paint layer) graphite (pencil drawing?)	charcoal black (paint layers)** flame carbon graphite (?)
* analysed in the university of Pisa		** missing in the list on HU et al. 2103 b, table 1

White

White was either obtained by omitting the white ground layer in the painting process or by applying white paint. All the examined white paint layers consist of lead white.

Lead white

Lead white was used for white and in mixtures to obtain light colours (light blue, pink and light green). Often the application is slightly pastose and the layers are opaque. Areas containing larger amounts of lead white appear brightly yellowish-pink under UV illumination (the colour resulting from a combination of the strong UV reflectance of lead white at wavelengths above 410 nm and the binding medium, see figs. 280/281).
Lead white was also used as underpainting for translucent glazes, for example in the bright ochre yellow table cloth (4-8 µm thick, *sanguo xi*, figs. 389-394), in the purplish pink robe of a servant (5 µm thick, *sanguo dong*, fig. 399) and in pink horse coats (sample *sx* 14).
Mixtures of pigments with lead white resulted in opaque paint layers, e.g. the blue and pink colours of the star borders (frames of *b*-panels of folding screens). The white pigment in sample *pfb* 2 from the light blue border of the *pingfeng bei*-painting could not be identified in Munich; in China it was interpreted as lead white (sample *pfb* 2). Table 21 lists the samples in which lead white was identified.

Fig. 389: *Sanguo xi*-wall, small pavilion, ochre table cloth

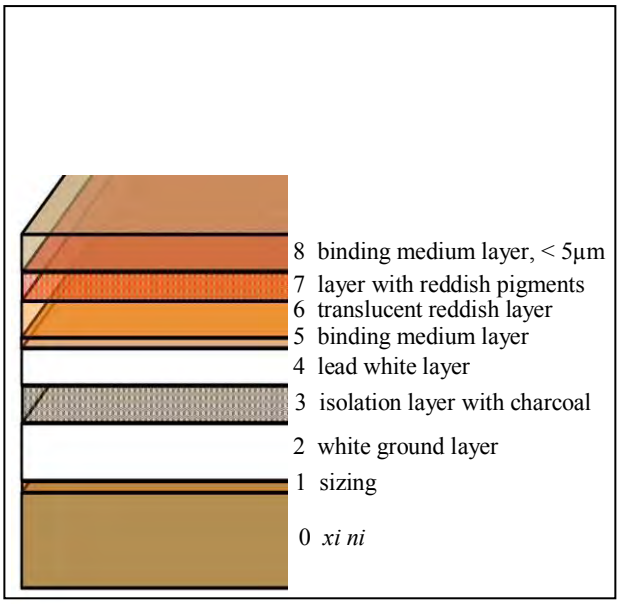


Fig. 390: *sx* 13, schematic view of stratigraphy

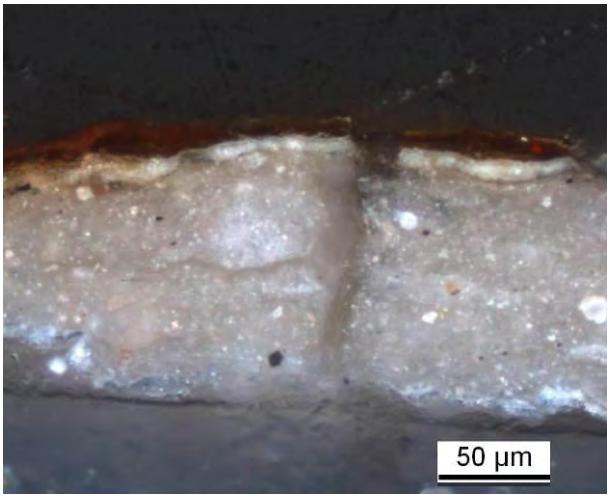


Fig. 391: *sx* 13 CS 1 (*xi ni* not imbedded)

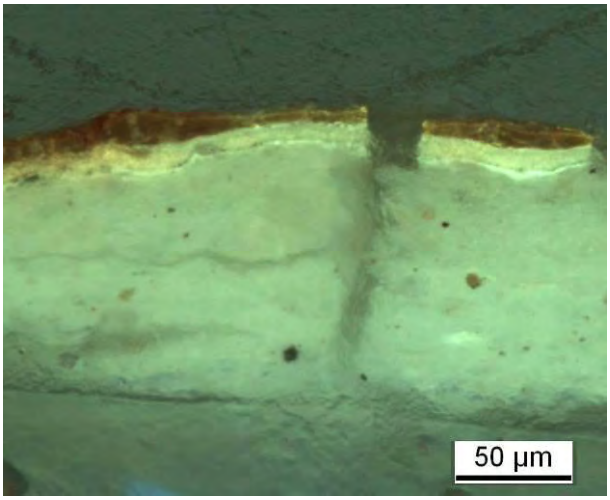


Fig. 392: *sx* 13 CS 1, UV

Fig. 393: *sx* 13 CS 1, BSE

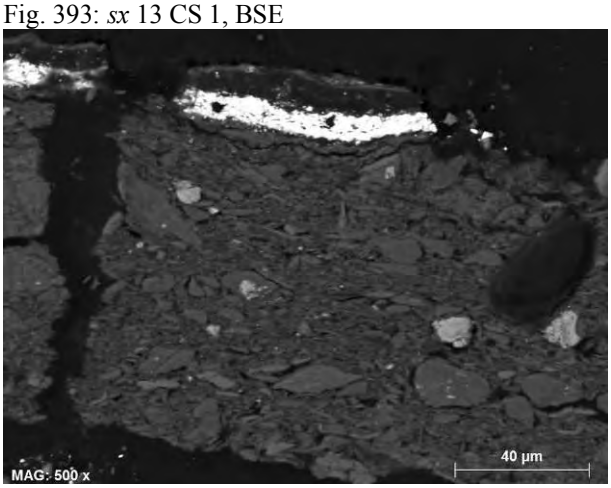


Fig. 394: *sx* 13 CS 1, element mapping

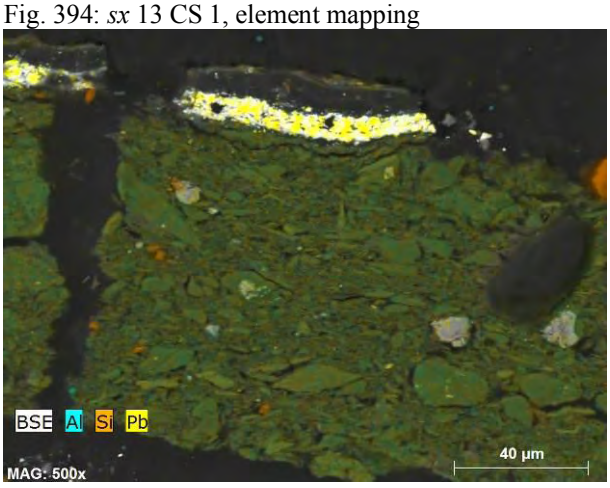


Table 21
Samples containing lead white

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to HU et al. 2013 b, table 1*
pfx 11	panel 2 *b*, blue ground	PLM (PP Z 60)	- lead white - Prussian blue	- Prussian blue
	panel 2 *b*, pink star	PLM (PP Z 59)	- lead white - cinnabar	- lead white, cinnabar
pfx 14	panel 4 *a*, reddish brown lattice	PLM (PP Z 71)	- lead white	- lead white
pfx 15	panel 4 *b*, star border, blue ground	PLM (PP Z 63)	- lead white - Prussian blue	- Prussian blue
pfx 15	panel 4 *b*, star border, white line	PLM (PP Z 76)	- lead white	- lead white
pfx 17	panel 3 *c*, blue fruit bowl	PLM (PP Z 64)	- azurite (main component), malachite - lead white, mixed with Prussian blue - dark red, isotropic - fine black particles	
pfd 1	panel 7 *b*, pink of star	PLM (PP Z 65)	- lead white - cinnabar	- cinnabar, lead white
pfd 1	panel 7 *b*, blue ground	PLM (PP Z 66)	- lead white - Prussian blue	
sx 12	"red light" flag	PLM (PP Z 42), fig. 378/379, 385/386)	- lead white - very fine yellow iron oxide, - organic yellowish particles	- lead white
sx 13	ochre table cloth	PLM (PP Z 43, 44)	- lead white	- lead white
sx 14 (fig. 283, 344-349)	pink horse (figure no. 31), glazes on pink to white layer	PLM (PP Z 45)	- lead white - red iron oxide (?) - very fine yellow iron oxide - cinnabar, red lead (1 part. each) - organic red?	- red ochre, lead white
sd 3	purplish pink robe of servant (figure no. 1)	PLM (PP Z 25)	- lead white (underpainting, 5µm thick) - cinnabar - pink dyestuff in binding medium - fine black particles - dark red iron oxide	- lead white (white layer) - dyestuff (red layer)
pfb 2	panel 5 *b*, white line	PLM (PP Z 42)	- lead white - plate-shaped isotropic particles	
pfb 2	panel 5 *b*, light blue ground of panel frame	PLM (PP Z 5, 20)	- Prussian blue - unidentified white	- Prussian blue - lead white*
pfb 3	panel 5 *c*, white petals and green leaves	PLM (PP Z 13)	- lead white	- lead white - botallackite (leaves?)
long 5	dragon's breath	PLM (PP Z 100)	- lead white	
* only in: Hu et al. 2012, table 5.				

Gypsum

MA et al. 2012 list gypsum as white pigment without specification where it was used.[127] In Munich and Pisa, Ca and S and calcium sulphate have been identified in nine samples of different colour, either in the paint layers or in the white ground[128], and in the thin layer containing black particles underneath a green layer (robe of a man, *sx* 6), but it is not clear if it has been used as a white pigment or accumulated there (figs. 387 and 388).[129] Gypsum is the main component of a salt-like accumulation on top of the black paint layer of the framing of the *long*-painting.[130] Gypsum is interpreted as a minor component or as contamination/salt, but not as a material used as white pigment.

[127] MA et al. 2012 (no page numbers), table 7.

[128] Sample *pfx* 7, framework (XRF); *pfx* 10, green border of *b*-panel (XRD); *pfx* 15 blue border of *b*-panel (FT-IR); *sx* 4, brown background (FT-IR), *sx* 9, boat (FT-IR); *sx* 10, white ground layer (FT-IR), sample *sx* 13, ochre table cloth (XRF); *sx* 14, horse (XRF); *pfb* 3, green leaf (XRD, Hu Kejia).

[129] EDX with element mapping, C. Gruber.

[130] *Long* 1, black framing, white fluffy material on top of paint layer: 50 % gypsum (XRD, semi-quantitative).

Fig. 395: sampling area of *pfx* 8 and visual impression of pinkish panel frame (panel 7 *d*)

Fig. 396: Sample *pfx* 8 (1.0 x 1.6 cm), accumulations of pigments in the paint, discernible yellow clusters (arrow)

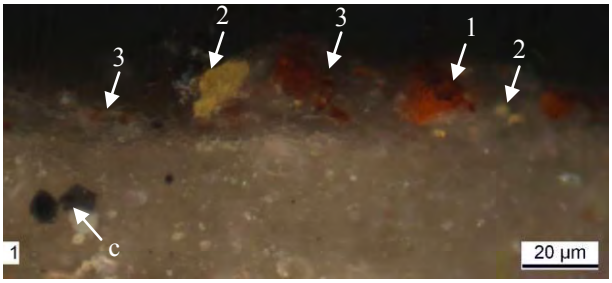


Fig. 397: *pfx* 8 CS 1, panel frame of panel 7 *d*, paint layer containing accumulations of: red lead (1), orpiment (2), reddish brown iron oxide (3); ground layer contains charcoal black (c)

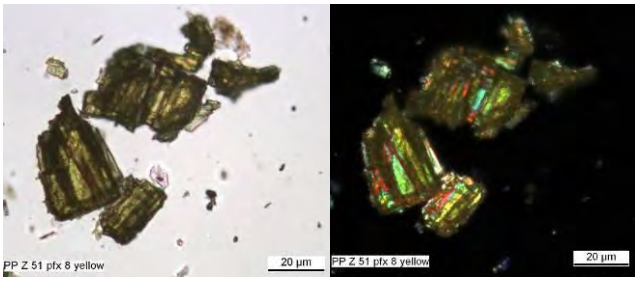


Fig. 398: *pfx* 8 PP Z 51, large orpiment particles from yellow clusters in the paint layer

Table 22
Samples containing yellow and ochre pigments

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to Hu et al. 2013 b, table 1*
pfb 4	panel 1 *c*, yellow panel frame	PLM (PP Z 29)	- orpiment	- orpiment
pfx 8	panel 7 *d*, pinkish panel frame	PLM (PP Z 51: yellow) PP Z 52: brown PP Z 73: red clusters)	- orpiment - red lead - fine brown iron oxide - cinnabar (very few)	- red lead - lead white - lead di-oxide PbO_2 - orpiment
sx 12	"red light" (F4), appearing off-white	PLM (PP Z 42) CS 1: SEM	- lead white - very fine yellow iron oxide, imbedded in binding medium - round yellowish pink, organic, isotropic	- lead white
sx 13	ochre cloth, top layer	PLM (PP Z 43)	- iron oxide - organic dyestuff?	- yellow ochre
yx 6	pearl, ring 1	PLM (PP Z 101)	- fine yellow iron oxide - a more greenish type of iron oxide or dyestuff on earth pigment? - red lead , few - charcoal black	

Yellow

Samples containing yellow pigments are listed in table 22.

Orpiment

Bright yellow was obtained with natural orpiment, for example in the filling frames of the *pingfeng bei*-painting. Often the pigment particles or clusters of them are so large that they can be seen with the naked eye, for example in the pinkish brown panel frames of the *pingfeng xi*-painting (fig. 397 and 398).
Orpiment is assumed to be used in the highlights of the lattice in the *pingfeng xi*-painting which are almost completely faded today. Fading or flaking is also visible in the bright yellow floral ornaments in the *e*-panels of the *pingfeng bei*-painting. Orpiment is known to fade under the influence of daylight, but the fading may also have other causes, for example the admixture of organic colourants or a reaction to other materials, as the impact of daylight on the walls must have been negligible as long as the walls were intact.

Yellow iron oxide

The yellow iron oxide used as pigment is extremely fine and difficult to identify by optical methods. The paint layer of a bright ochre yellow table cloth in the *sanguo xi*-painting proved to be painted with thin glazes over a lead white layer (sample *sx* 13, fig. 389-394). Shades are applied with darker hues and black lines, using fine grained black and Prussian blue.[131] In the cross section, a layer containing fine red appearing particles (fig. 390: layer 7) can be distinguished above a layer rich in binding medium (fig. 390: layer 6). In slide preparations, the fine yellow pigment could not be definitely identified. With XRF a higher content of iron could be confirmed, indicating that the pigment is iron oxide.
The same fine yellow iron oxide was also confirmed with XRF in the "red light" above the head of Zhao Yun in the same painting.[132] Element mapping shows the presence of finely distributed iron in the lead white layer (fig. 378).
The fineness of the yellow iron oxide may indicate a synthetic production, but very fine and pure qualities of natural ochre are known as well.

Yellow lake or dyestuffs

The presence of yellow lakes was not proved. A possible use was discussed for the brownish yellow glazes which can be found on floral elements in the frames of the folding screens and the *sanguo*-paintings, as they have no visible body.
The presence of yellow dyestuff was considered for the paint layer of the ochre tablecloth (sample *sx* 13) as there are brownish organic particles in the PLM slide preparation which can be interpreted as brownish or tinted binding medium, and for the first ring of the *yunqi*-pearls: Besides fine yellow iron oxide there may be greenish looking iron oxide stained with yellow dyestuff.

Lead oxides

According to MA et al. 2012 und HU et al. 2013 b, lead oxide or lead dioxide (listed under brown) were found in the paint layer of the brownish pink panel frames of the *pingfeng xi*-painting and the background of the *e*-panels of the *pingfeng dong*-painting.[133]

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[131] Sample *sx* 13, cross section CS 1. PLM: PP Z 43: fine grained black and Prussian blue.

[132] Sample *sx* 12, PP Z 42 and CS 1. XRF: Tucic, May 2012.

[133] MA et al. 2012 (no page numbers), table 7. HU et al. 2013 b, table 1: samples Gx 8, Gd 3. – The sample from the *e*-panel pf the *pingfeng dong*-painting analysed in Munich (*pfd* 3) did not contain the brown background.

Fig. 399
Sanguo dong, servant with purplish pink robe (figure no. 1): sample *sd* 3 was taken from the right sleeve

(2a) darker shade of pink
(2) pink of robe
(1) lead white layer,
(i) isolation layer

Fig. 400
sd 3, PP Z 26: fragment of the paint layer in slide preparation

Fig. 401
Sanguo xi, Cao Cao (figure no. 48): distinctive damage of red paint layer in the robe, while the cap of the soldier is well-preserved

Table 23
Red, pink and brown samples containing orange and red colourants

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to Hu et al. 2013 b, table 1*
pfx 11 (fig. 404)	panel 2 *b*, pink star with red core	PLM (PP Z 58: red) (PP Z 59: pink)	- cinnabar (red) - cinnabar + lead white (pink)	
pfd 1	panel 7 *b*, pink star	PLM (PP Z 65)	- cinnabar + lead white	- lead white
sx 5	red column: bright red partly on top of orange	PLM (PP Z 33, 81: red) (PP Z 33b: orange)	- red: cinnabar - orange: red lead	
sx 14 (fig. 344-349)	pink horse (of figure no. 31), paint layer and glaze	PLM (PP Z 45)	- lead white - red iron oxide - red lead, cinnabar (1 particle) - binding medium, stained red? - calcite	
sd 3 (fig. 399)	purplish pink robe of figure no. 1, translucent pink with shades in darker pink	PLM (PP Z 25, 26)	- red dyestuff in binding medium - cinnabar - flame carbon or bone black - dark red iron oxide - calcite - lead white (underpainting)	- dyestuff - lead white (white layer)
yx 3	pearl, 2nd ring, light orange	PLM (PP Z 9)	- red lead	- red lead
yx 4	pearl, 3rd ring, orange	PLM (PP Z 10)	- red lead	- red lead
yx 5	pearl, centre, brownish red glaze	PLM (PP Z 11)	- cinnabar - brown medium (tinted?)	- cinnabar - red lead (lower layer)
pfx 6	black framing below panel 7 *e*	PLM (PP Z 47)	- flame carbon (?) - Prussian blue, few - red iron oxides	
pfx 7	brown framework	PLM (PP Z 49)	- very fine brown iron oxide - dark brown organic material - fine-grained black	- red ochre
pfx 12	panel 5 *e*, brown (background?), black on red ?	PLM (PP Z 78)	- fine black pigment - iron oxide (?)	- red lead
pfx 14	panel 4 *a*, reddish brown lattice	PLM (PP Z 62, 72)	- fine reddish brown iron oxide - brownish organic material	- red ochre
pfd 1	panel 7 *b*, pink star	PLM (PP Z 65)	- cinnabar + lead white	- lead white

Orange, red, pink and brown

Samples containing orange, red and brown pigments are listed in table 23.

Red lead

Red lead was identified in areas appearing orange red today, as the rings 2 and 3 of the pearl in the *yunqi*-paintings. Red lead may also have been used for drawing and partial underpainting underneath bright red paint layers containing cinnabar, e.g. at the columns of the pavilions in the *sanguo xi*-painting (sample *sx* 5). The columns were not completely underpainted in red lead, however, for many flakes in the sample do not contain the red lead layer underneath the cinnabar. Diluted red lead may also have been used for the pink lines and the flesh tones in the *pingfeng xi* figural scenes (panels *b*, *c*, and *d*).

Cinnabar

Cinnabar was used for bright red. The particles mostly are fine, but not homogeneous in size. Cinnabar is found in translucent and opaque red layers, and in bright pink paint layers (mixed with lead white), e.g. the star patterns (fig. 402). Red areas on the *sanguo xi*-wall partly show problems of cracks, cupping and flaking, e.g. the red columns (fig. 412 and 459), the coat of Guan Yu's red horse (figure no. 42) or the robe of Cao Cao (fig. 401). This indicates problems related to the painting technique. Some red paint layers, like the cap of the man behind Cao Cao (fig. 401, upper left corner), however, are not affected by this damage.

Red iron oxides

There were different variations: While the red iron oxide used for the sash bars of the lattice in the *pingfeng xi*-painting is dark and almost brown, a more reddish type mixed with other pigments has been used to obtain the brown colour of the framework, the pinkish tone of the panel frames in the *pingfeng xi*-painting and the pinkish hue of horse coats in the *sanguo*-paintings (sample *sx* 14). All the variations of red iron oxides are extremely fine-grained.
In a sample taken from the background of the purplish brown backgrounds of the *e*-panels in the *pingfeng xi*-painting a dark layer seems to lie on a red one. The pigments were identified as a fine black pigment and iron oxide in Munich, in China, however, as red lead.[134]

Pinkish red dyestuff or lake

A pinkish red organic material was used in glazes, for example in purplish pink garments (fig. 399) where it was applied over a thin lead white layer (5 µm thick). In slide preparations, no isolated lake particles were discernible, but fragments of a translucent purplish coloured layer (fig. 400). This could mean that not a lake, but a dyestuff added to binding medium was used. The dyestuff could not be identified.[135]
A red dyestuff may also have been used in the coat of the pink horse of figure no. 31 in the *sanguo xi*-painting (fig. 283), because the binding medium is tinted in an unusual strong reddish colour (sample *sx* 14). A comparable colouring of the binding medium was observed on a sample from the centre of the *yunqi*-pearl (sample *yx* 5).
It was discussed if a red dyestuff for tinting the "red light" reddish may have been used as a glaze, but no evidence could be found analytically. The streaks of brownish material visible in the cross section (fig. 379) may indicate an incomplete homogenisation of the paint, but also point to the admixture of a medium containing an organic colourant.

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[134] Sample *pfx* 12: In HU et al. 2013 b, table 1, only red lead is listed. According to Hu Kejia, red iron oxide was found with PLM, and Fe and Pb with EDX (personal communication).

[135] Sample *sd* 3, purplish pink robe. The analysis with HPLC (in Pisa) brought no result regarding the dyestuff.

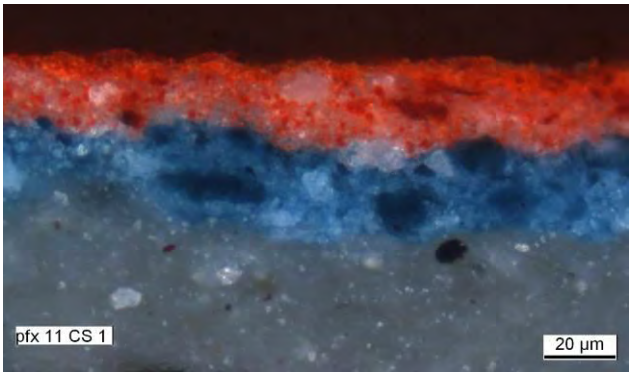


Fig. 402: *pfx* 11 CS 1. Large, translucent and fine blue Prussian blue particles; pink: lead white + cinnabar

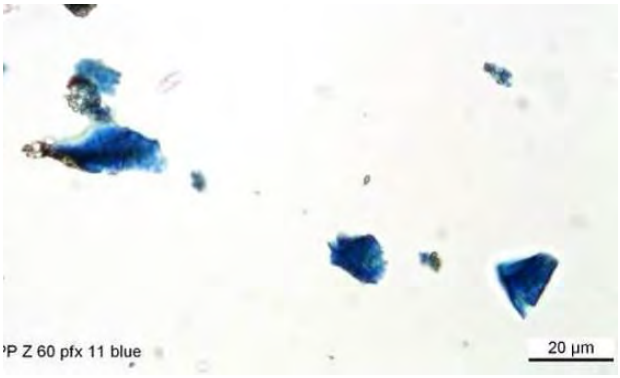


Fig. 403: *pfx* 11 PP Z 60, Prussian blue and lead white

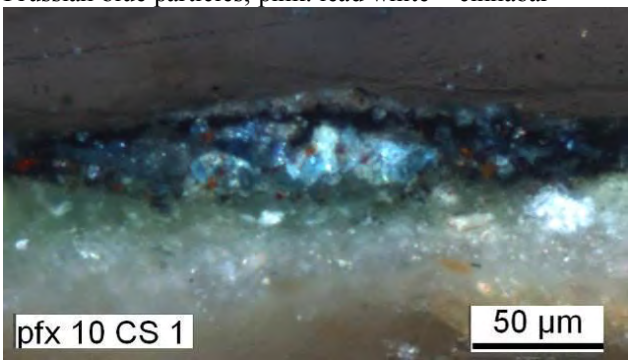


Fig. 404: *pfx* 10 CS 1, blue star segment: azurite and flame carbons, some red iron oxide; green layer underneath: malachite

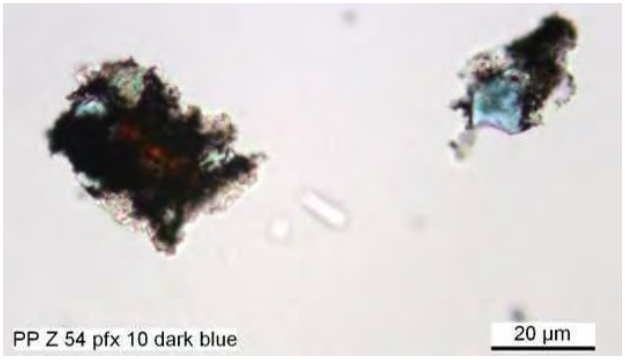


Fig. 405: *pfx* 10 PP Z 54, dark blue centre of star segment: azurite, fine grained black (flame carbons?), dark red iron oxide in the left cluster

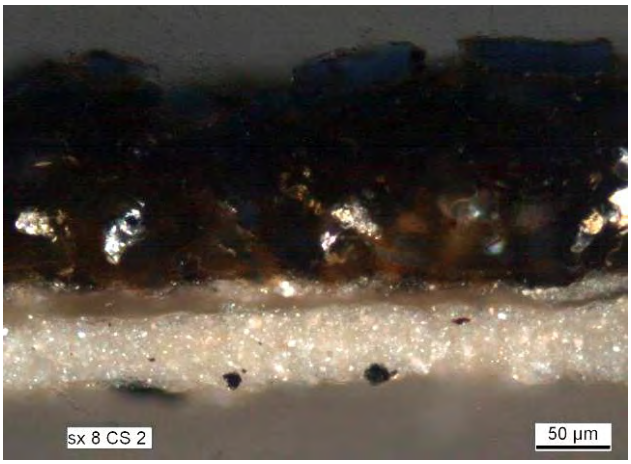


Fig. 406: *sx* 8 CS 2, smalt particles in brown medium

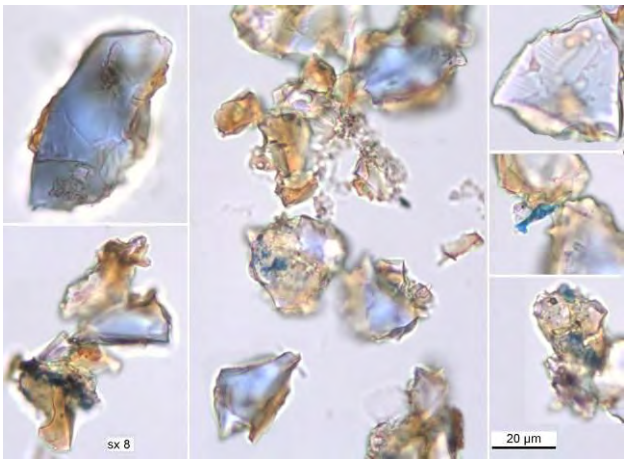


Fig. 407: *sx* 8 PP Z 36, smalt, Prussian blue and brown binding medium

Fig. 408: *sx* 8 CS 2, UV: orange fluorescence of medium

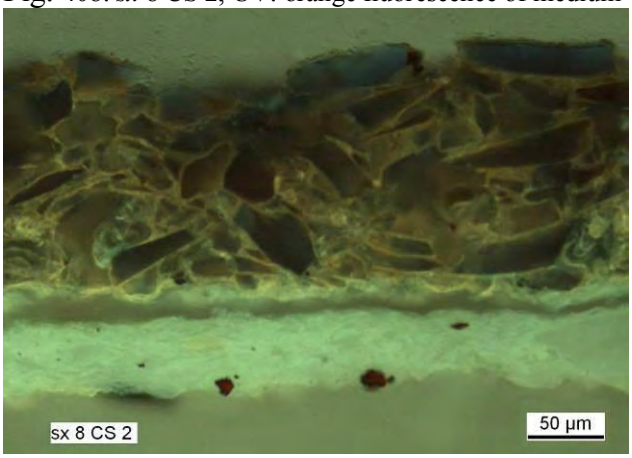
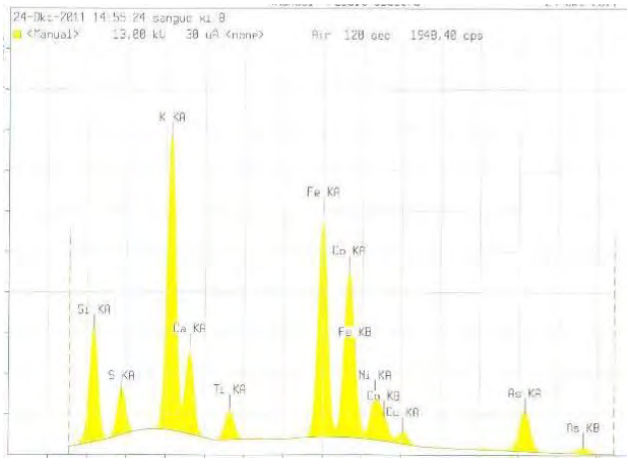


Fig. 409: *sx* 8, XRF analysis of paint layer



Blue

Azurite (table 24)

Azurite has a more greenish hue than Prussian blue. Samples taken from blue to greenish blue areas also contain smaller amounts of malachite which occurs naturally in paragenesis with azurite. Dark red particles found together with azurite are either iron oxide or pyrite. Azurite was probably used pure, shaded with flame carbons and mixed with green pigments as malachite and botallackite to obtain bluish green nuances.

Prussian blue (table 25)

Prussian blue was identified with PLM in dark up to light blue opaque layers, mostly showing bright blue colours. In cross sections, the Prussian blue contains large translucent particles of a dark blue[136], but also very fine and small particles which appear as blue clusters or "matrix".[137] In slide preparations large translucent particles, looking like dark blue glass with darker inclusions, can be observed, but also almost bodiless ink-like agglomerations with the optical properties of present-day Prussian blue.
Plate-shaped particles of Prussian blue are known from European works of art from the 18th century. The "modern" type of Prussian blue is produced by washing the product with acid to destroy the alumosilicate plates. It is not known when this procedure became standardised, but it could have been used in the 19th century.[138]
Prussian blue was used pure, shaded with black or mixed with lead white for a lighter blue. Opaque paint layers of Prussian blue with lead white were used at the borders of the *b*-panels of the folding screens, while the darker blue backgrounds of the *c*-panels of the *pingfeng bei*-painting were coloured with pure Prussian blue. Small amounts of Prussian blue were added to the dark black of the framing of the *pingfeng xi*-painting[139], probably to increase the deepness of the colour. Washes containing Prussian blue were used in the nowadays brown landscapes of the *sanguo*-paintings, proving that they originally had cool, bluish green hues.

Azurite and Prussian blue – contrast and mixtures

For the borders of the *b*-panels in the *pingfeng xi*-painting, two colour combinations were used:

panels 1, 3, 6 and 8 sample *pfx* 11 (fig. 402)	greenish blue ground blue star segments dark blue segment centres	malachite + few azurite + few lead white azurite + malachite + (charcoal) black azurite + flame carbons	
panels 2, 4, 5, 7 sample *pfx* 10 (fig. 404)	bright blue ground pink star segments red segment centres	Prussian blue + lead white lead white + cinnabar cinnabar	

The gradation in the amount of malachite (more than 50 %, few, none) shows that malachite and azurite were mixed to obtain different shades between bluish green and blue. Prussian blue with its more reddish blue hue, was combined with pink and red star segments.

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[136] Equidimensional to elongated, diameter about 7-8 µm.

[137] Large, translucent and fine particles: *pfd* 1 CS 1; *pfx* 11 CS 1, *pfb* 6 CS 1.

[138] Prof. Dr. Stefan Wülfert, Bern University of the Arts, Division Conservation-Restoration: personal communication.

[139] Sample *pfx* 6, PP Z 47 and CS 1, black framing around folding screen.

Azurite and Prussian blue were mostly used as two contrasting blue hues, but there are also samples where they were mixed: In a very small sample both of them were found, stemming either from a mixture or from superimposed layers which were not identified during sampling.[140] The *yunleiwen*-ornament in the *e*-panels of the *pingfeng dong*-painting that nowadays appears light greenish-grey is carried out with a very thin (1-2 µm) layer containing Prussian blue and few azurite particles. It may originally have been a light blue or light green glaze.[141]

Smalt and indigo (table 26)

Smalt was identified only in a dark green appearing paint layer[142] of a sunshade in the *sanguo xi*-painting (sample *sx* 8). The paint layer contains dark blue smalt (fig. 407), small amounts of Prussian blue and indigo. With XRF, the elements K, Si, Fe, Co, As, Cu, Ti, S were detected (fig. 409), showing that potash (potassium carbonate) was used for the production of the blue glass.[143]

Indigo and gallic acid were detected with HPLC. The purpose and the origin of the gallic acid are not understood yet.

The binding medium appears dark brown and is either discoloured or may have contained a dyestuff. It shows a strong orange UV fluorescence, very different from other samples (fig. 406 and 408).

Table 24
Layers containing azurite

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to HU et al. 2013 b, table 1*
pfx 10	panel 1 *b*, dark blue centre of star segment	PLM (PP Z 54)	- flame carbons - azurite - malachite, few - dark red, isotropic	
pfx 10	panel 1 *b*, blue star segment	PLM (PP Z 55)	- azurite - malachite, less than azurite - dark red, isotropic - angular black	- azurite
pfx 10	panel 1 *b*, bluish green ground	PLM (PP Z 56)	- azurite - malachite, less than azurite - red and yellow iron oxide - angular black - lead white	- malachite - lead white
pfd 2	panel 8 *b*, green from border (background?)	PLM (PP Z 67)	- azurite - botallackite	- malachite* - azurite*
pfx 17	panel 3 *c*, blue fruit bowl of area 3 c	PLM (PP Z 64)	- azurite (main component) - Prussian blue - malachite - lead white, mixed with Prussian blue or not mixed - dark red, isotropic - clusters of fine grained black	
* only in: Hu et al. 2012, table 5.				

[140] Sample *pfx* 17, from a fruit bowl in panel 3 *c*. PP Z 64: azurite, Prussian blue, lead white, black and dark red particles. The sample was too small to see the stratigraphy.

[141] Sample *pfd* 3, PP Z 3 ab: Besides Prussian blue, the sample contains green or white (no malachite). PP Z 70 from the same paint layer additionally contains very few azurite particles.

[142] Description by Liu Dongbo, July 2011, during the discussion of the samples in Xi'an.

[143] XRF: Tucic, May 2012.

Table 25
Layers containing Prussian blue (without brown background of *sanguo*-paintings)

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to HU et al. 2013 b, table 1*
pfx 6	black framing	PLM (PP Z 47)	- flame carbons (?) - Prussian blue, few - red iron oxides	
pfx 11	panel 2 *b*, blue ground of border	PLM (PP Z 59, 60)	- Prussian blue in glassy parts - Prussian blue mixed with lead white	
pfx 15	panel 4 *b*, blue ground of border	PLM (PP Z 63)	- Prussian blue in glassy parts - Prussian blue mixed with lead white	- Prussian blue
pfd 1	panel 7 *b*, background of border	PLM (PP Z 66)	- Prussian blue - lead white	
pfd 3	panel 5 *e*, pale greyish green ornament	PLM (PP Z 3ab, 70)	- Prussian blue - unknown white or green (PP Z 3 ab) - one particle azurite (PP Z 70)	- Prussian blue
pfb 2	panel 5 *b*, bright blue ground of border	PLM (PP Z 5)	- Prussian blue - green or white (no malachite, no lead white)	- Prussian blue
pfb 3	blue, coarse-grained, dark – background of panel 5 *c*	PLM (PP Z 14)	- Prussian blue	
pfb 6	panel 3 *c*, background of panel filling	PLM (PP Z 7 ab)	- Prussian blue	
yx 2	dark blue shade of line; black line underneath and on top of blue	PLM (PP Z 1, 2)	- Prussian blue, mixed with black and on top of black line (charcoal black or flames carbons)	- Prussian blue - flame carbons (black underneath blue)

Table 26
Layer containing smalt, indigo and Prussian blue

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according HU et al. 2013 b, table 1*
sx 8	sunshade. dark blue or green	PLM (PP Z 36)	- smalt - brownish binding medium - Prussian blue - fine-grained black	- smalt

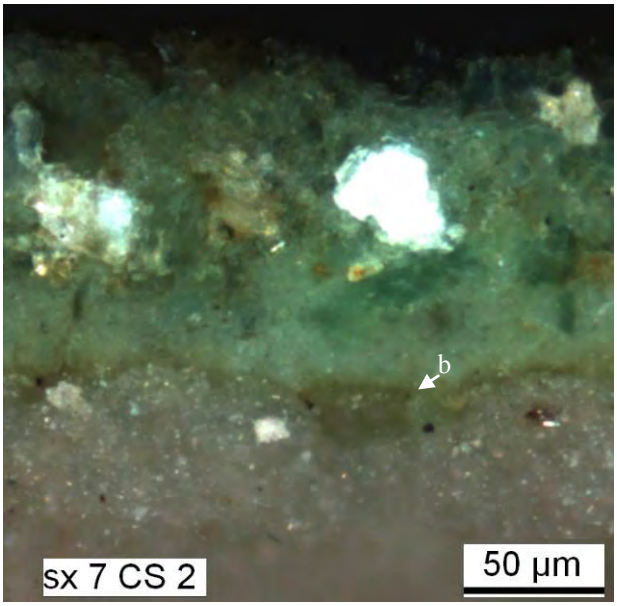


Fig. 410: *sx* 7 CS 2: green robe painted with malachite, underneath a thin layer of binding medium (b)

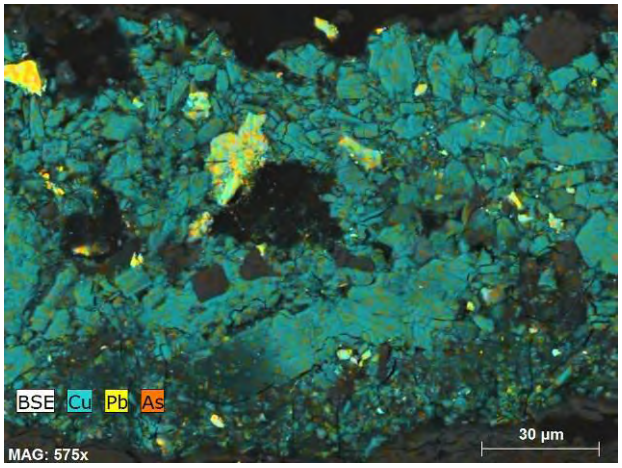


Fig. 411: *sx* 7 CS 2, element mapping: green particles containing lead and arsenic are scattered over the paint layer

Fig. 412: *Sanguo xi*-wall, three men in green robes: Figure no. 10 in bright green robe (*sx* 6, copper chloride), figure no. 9 in pale green robe (no sampling) and figure no. 18 in dark green robe (*sx* 7, malachite).

Green

Green areas range from light green to dark green and from cool, bluish hues to more brownish greens. Three different pigments could be identified, two of them rather unusual. The current impact of the green areas and areas containing green pigments does not reflect the colour of the pigments. The difference between the three different green pigments is not visible, all areas appear rather dark and brownish (darkened) where the surface is intact. Areas with damaged surfaces reveal light, bright bluish green colours. It is not clear which hue was originally intended. Samples containing green pigments (without the background of the *sanguo*-paintings) are listed in table 27.

Malachite

Malachite was identified in the green robe of a man (figure no. 18, fig. 412, right side) in the *sanguo xi*-painting (sample *sx* 7). The sample contains only very few particles of azurite, showing that pure qualities of malachite were available, and some lead white. In the cross section the paint layer looks homogenously green. Underneath there is a thin layer rich in binding medium that is more brownish and darker than binding medium layers visible in other samples. It may be a coloured wash or a brownish layer (fig. 413: b). XRF showed that the paint layer also contains lead and arsenic. Lead partly comes from lead white (small particles containing only lead), but there also are angular green particles containing Cu, As and Pb (fig. 411). It is not clear what kind of minerals they are. They may be to be a green by-product of the malachite.
Malachite mixed with azurite was found in the ground colour of the greenish-blue borders of the *b*-panels in the *pingfeng xi*-painting. Bright green dots or parts in the landscapes were probably painted with malachite, as larger green particles sampled from the background of the *pingfeng xi*- and the *sanguo*-paintings consist of malachite.

Spherical copper chloride pigment (atacamite?)

The lighter green robe of another man in the *sanguo xi*-painting (figure no. 12, fig. 412, left side) is painted with an unusual pigment: Compared to the robe painted with malachite, the colour is bright green. The paint layer is thick and consists of rather coarse spherical particles which can be recognised using a microscope already at low magnification.
Cu and Cl were identified as the main components of the green particles in Munich (sample *sx* 6, SEM and element mapping, fig. 415). In China, the pigment was interpreted as atacamite, $Cu_2(OH)_3Cl$.[144]
The spherical particles with slightly irregular shapes measure 20-40 µm in diameter (fig. 413). The paint layer is of unusual thickness, measuring 120-160 µm, while most paint layers have a thickness of less than 20 µm (often only 2-4 µm).
Natural atacamite has pale up to rather dark green angular particles, sometimes needle- and plate-shaped, and bright, slightly bluish interference colours.[145] Spherical aggregates of atacamite were identified in other sites in China, for example in the Mogao grottoes in Dunhuang (8th century AD), the Yungang grottoes near Datong (4th to 5th century AD) and the clay sculptures in the Shuilu'an near Lantian (16th century). The atacamite in the Mogao grottoes was discussed to have derived from an alteration of malachite,[146] as it was found together with malachite and the murals show alterations of pigments to a large extent. In Shuilu'an, the atacamite can be interpreted as the original pigment, not an alteration, and no malachite was found there. The particles with dimensions mostly up to 20 µm often show a

[144] HU et al. 2012, table 1.

[145] SCOTT 2002, p. 187 and observations by C. Blaensdorf.

[146] SCOTT 2002, p. 134.

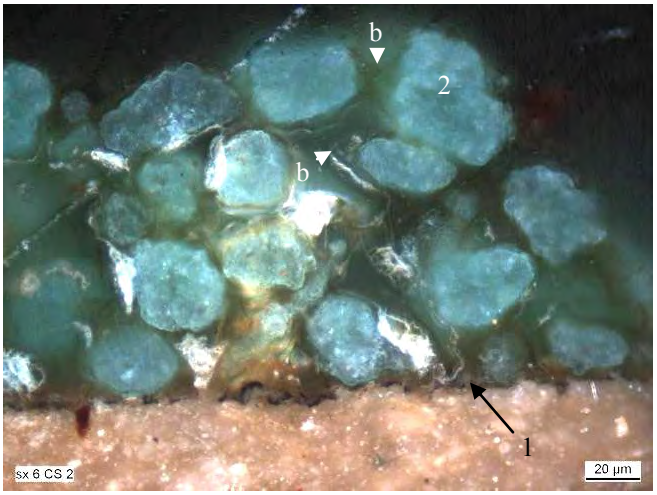


Fig. 413: *sx* 6 CS 2, green robe: large green spherical pigments (2) coated with binding medium (b); black/grey underpainting (1)

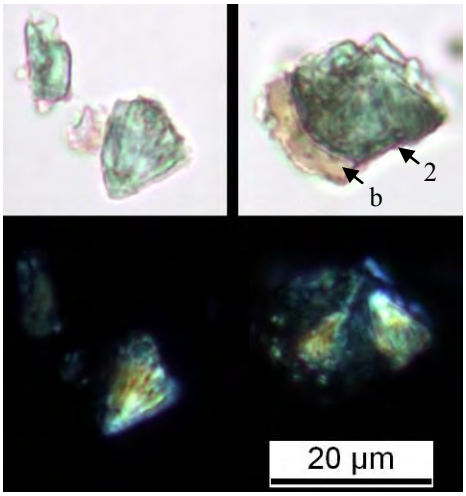


Fig. 414: *sx* 6, PP Z 34, fragments of spherical particles fractured during preparation of the sample; fractured particle (2) with a coating of the binding medium (b)

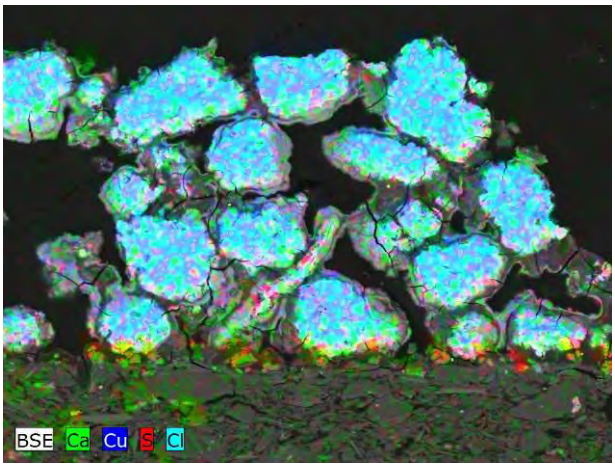


Fig. 415: *sx* 6 CS 2, mapping for Ca, S, Cu, S: pigments contain Cu and Cl, underpainting Ca and S

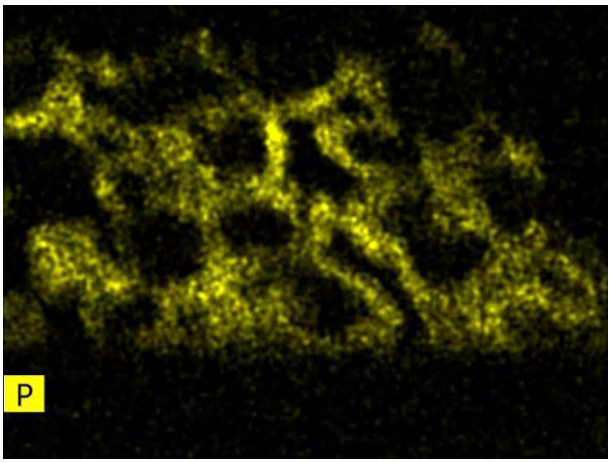
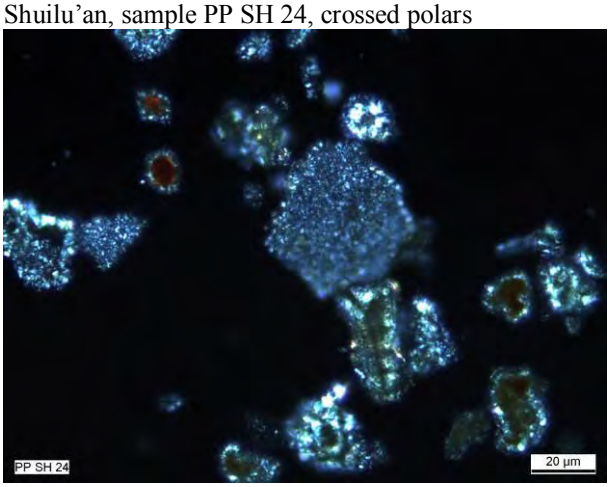


Fig. 416: *sx* 6 CS 2: the binding medium layer around the particles contains phosphor

Fig. 417: atacamite from a green paint layer in the Shuilu'an, sample PP SH 24

Fig. 418: atacamite from a green paint layer in the Shuilu'an, sample PP SH 24, crossed polars



dark or red core and a bright white up to bluish birefringence. The particles with dimensions mostly up to 20 µm often show a dark or red core and a bright white up to bluish birefringence (fig. 417 and 418).
The particles of the copper chloride used in the *beiwusheng huiguan* are bigger and more homogenous in dimension and shape than the atacamite used in Shuilu'an, and they do not have a darker or reddish core. They broke into fragments during the imbedding for the slide preparations, what did not happen to the atacamite particles used in Shuilu'an. The birefringence is comparably low, especially for flat particles (fig. 414).

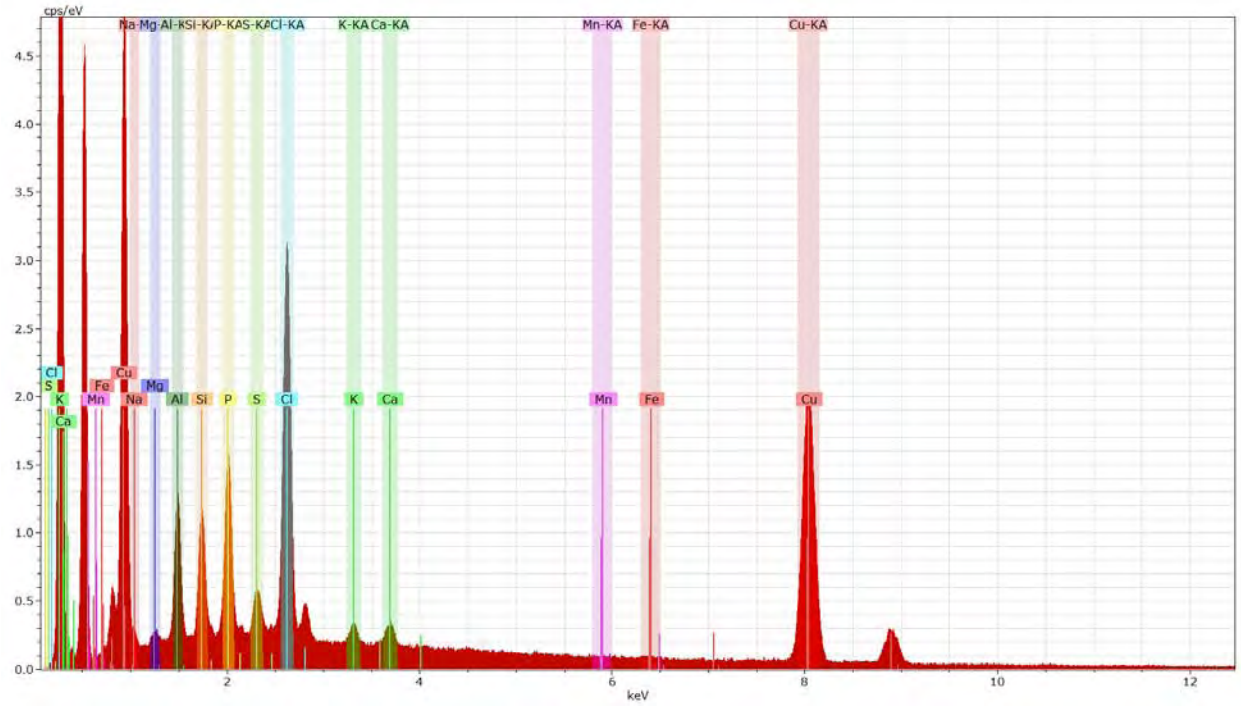


Fig. 419: *sx* 6 CS 2, result of element mapping

Botallackite

Botallackite, another type of copper chloride with the same molecular formula $Cu_2(OH)_3Cl$, is a rather unusual finding. It was identified in light to dark green layers (figs. 421-425) that are less bluish and paler than layers containing malachite. Without additions, the pigment is of a bright, cool green colour.[147] In slide preparations, the particles are small, rounded and pale green with low or no interference colours (fig. 422). Bottallackite was identified using XRF, XRD (fig. 423) and element mapping (fig. 424).
Botallackite was identified in Mogao/Dunhuang, in the polychromy (cave 328: bodhisattva from the early Tang Dynasty) and in murals of the Dunhuang caves, but has been discussed to be an alteration of malachite. Spherical particles with dark centres suggesting a synthetic preparation were found in an Iranian manuscript of the fifteenth century.[148] The botallackite found in the *beiwusheng huiguan* does not contain spherical particles, but neither the angular particles typical for a natural mineral. The rounded particles may point to a man-made product rather than a natural source. Botallackite was found in several samples and on different walls (*sanguo*-paintings, see table 29), *pingfeng dong* and *pingfeng bei*, table 27). It seems to have been a usual pigment in the palette of the painters of the hall.

[147] In sample *pfb* 3 (light to dark green leaves) botallackite was identified (XRF, XRD: Tucic, June 2012, and by Hu Kejia on her part of sample *pfb* 3). Comparing the polarisation optical properties, the same pigment could be identified in other samples using PLM.

[148] Scott 2002, p. 134 and 138.

Fig. 420: *pingfeng bei*, panel 5 *c*, light pink peonies on blue ground; sampling area of *pfb* 3

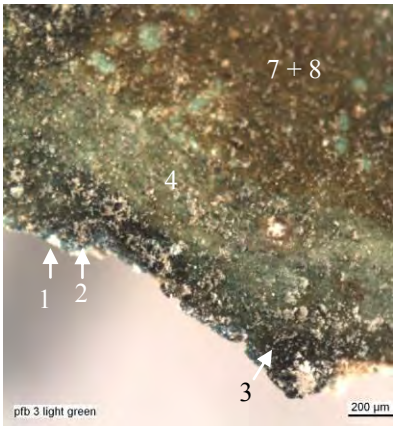


Fig. 421: detail of sample *pfb* 3,
7+8 brown glaze / coating
4 green layer; 3 black contour
2 blue layer; 1 white layer

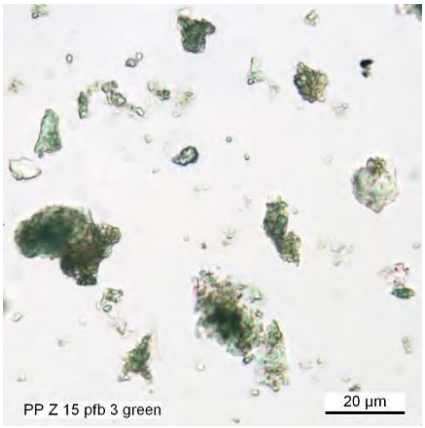


Fig. 422: *pfb* 3, PP Z 15: botallackite particles in polarised transmitted light (low IF under crossed polars)

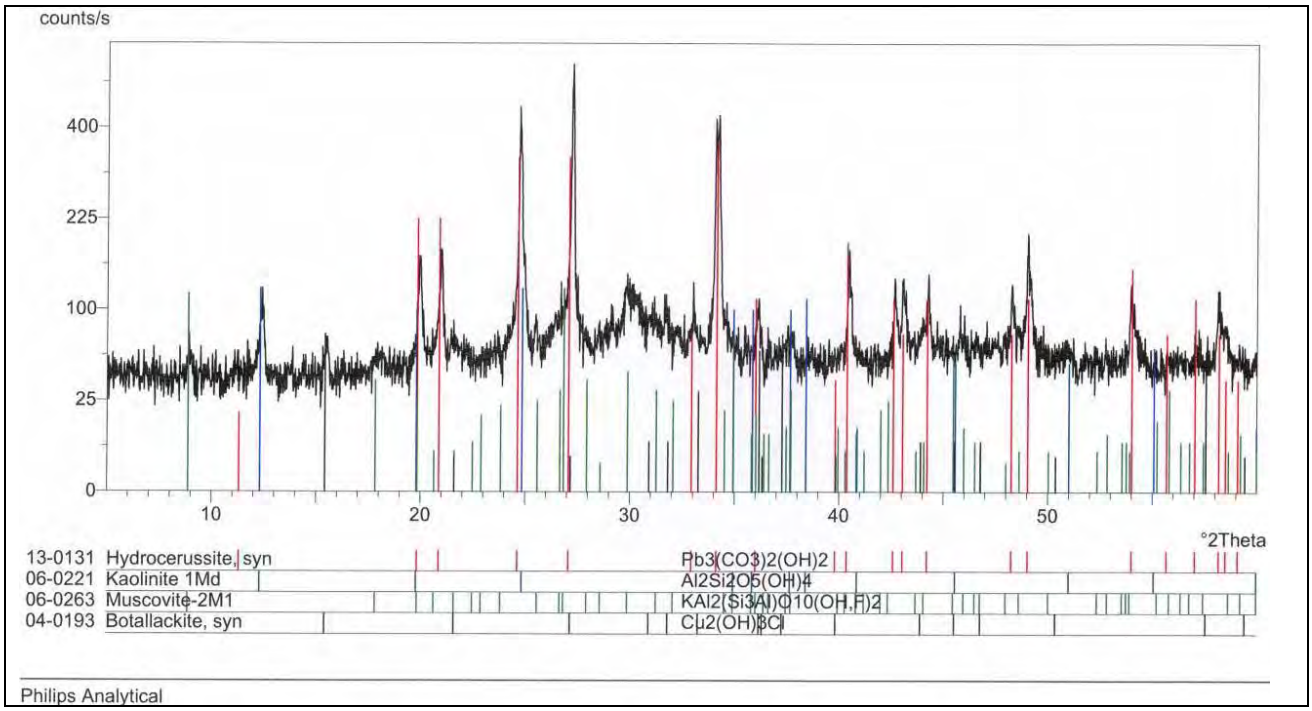
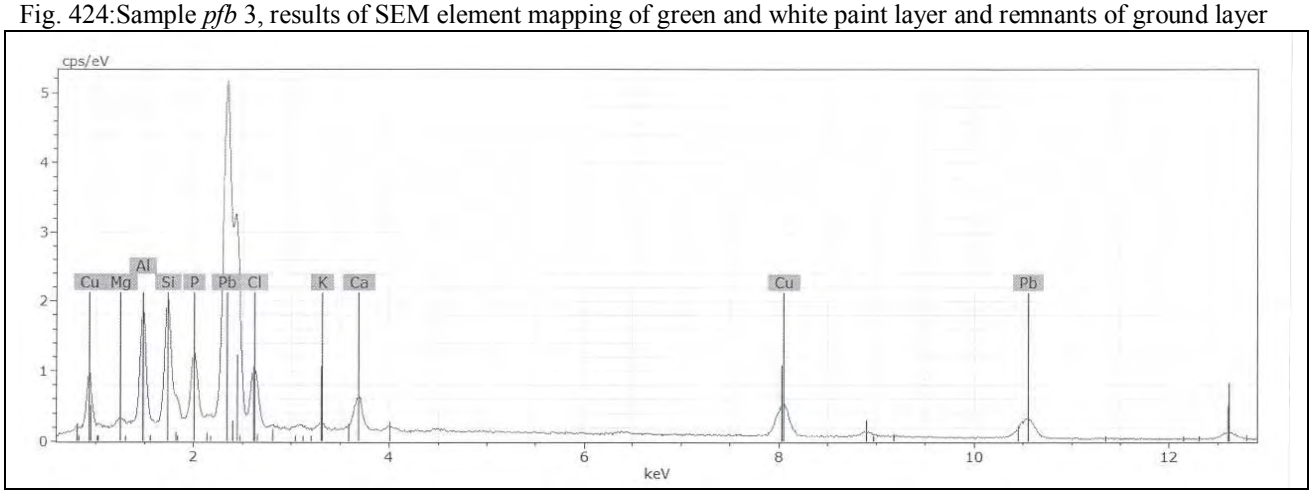


Fig. 423: Sample *pfb* 3, XRD (June 2012): The measured sample contained the green layer (botallackite), the white layer underneath (lead white) and traces of the ground layer (clay minerals).

Fig. 424:Sample *pfb* 3, results of SEM element mapping of green and white paint layer and remnants of ground layer



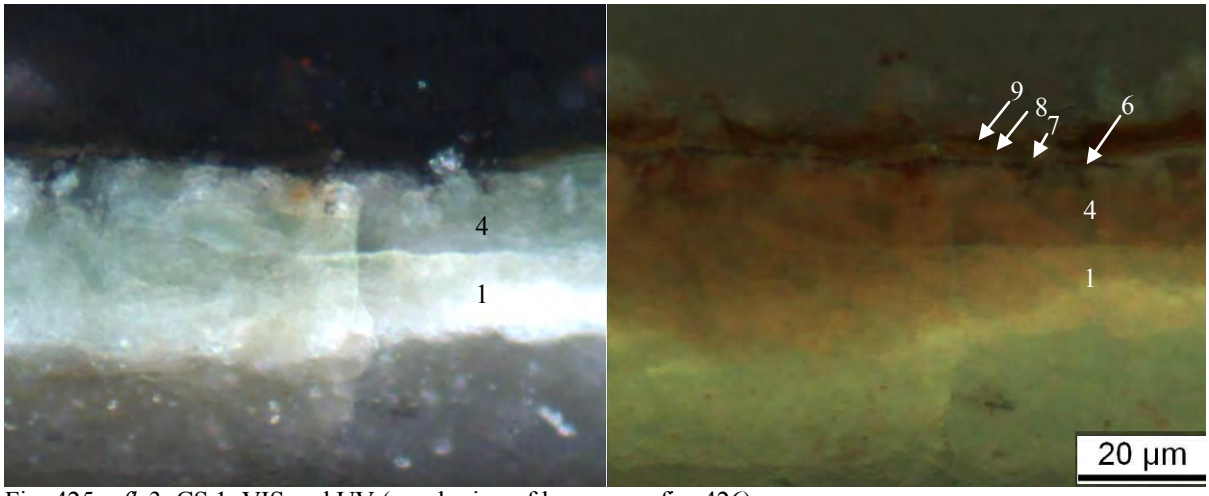
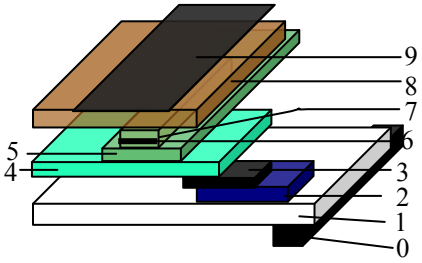


Fig. 425: *pfb* 3, CS 1, VIS and UV (numbering of layers: see fig. 426)



sample *pfb* 3, stratigraphy
9 dark brown coating, 2 µm (UV dark brown)
8 brown glaze, 5 µm (UV brown)
7 binding medium layer (UV: white), around black contour
6 black contours of leaf: flame carbons
5 shades in dark green, botallackite
4 green of leaf, botallackite, 2-10 µm
3 black contour: charcoal black, fine ground?
2 blue > blue background. Prussian blue
1 with layer, probably from peony petal, 2-10 µm
0 black delineation, charcoal black

Fig. 426: Scheme of stratigraphy of *pfd* 3

Table 27
Layers containing green pigments (without brown background of *sanguo*-paintings)

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to Hu et al. 2013 b, table 1*
pfx 9	panel 7 *d*, green mountain or border of screen	PLM (PP Z 53)	- malachite - brownish organic medium or glaze	- malachite - lead white
pfx 10	panel 1 *b*, bluish green ground	PLM (PP Z 56)	- azurite - malachite, less than azurite - red and yellow iron oxide - angular black	- malachite - lead white
pfx 10	panel 1 *b*, blue star segments	PLM (PP Z 55)	- azurite - malachite, less than azurite - dark red, isotropic - angular black	
sx 7 (fig. 389 and 410)	green robe of figure no.18	PLM (PP Z 35)	- malachite, including green particles containing As and Pb - few azurite - lead white - black, rather coarse, but rounded (charcoal black?) - brownish binding medium	- malachite - lead white
sx 6 (fig. 413)	bright green, robe figure no. 10	PLM (PP Z 34)	- copper chloride, large spherical aggregates, diameter 20-40 µm	- atacamite - botallackite
pfd 2	panel 8 *b*, border (colour of ground?)	PLM (PP Z 67)	- azurite - botallackite	- azurite - malachite
pfb 3 (figs. 422-425)	panel 5 *c*, light green of leaves	PLM (PP Z 15)	- botallackite (other layers of sample: lead white, Prussian blue, charcoal black and flame carbons)	- botallackite - lead white
pfb 3 (fig. 421)	panel 5 *c*, dark green glaze of leaves	PLM (PP Z 16)	- botallackite: XRD (Tucic)	

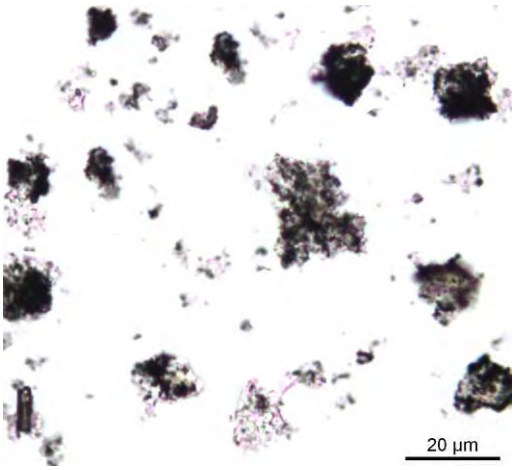
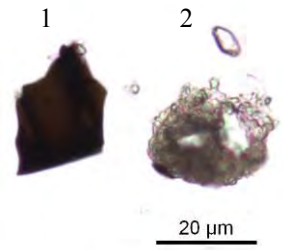


Fig. 427: sample *pfb* 5, PP Z 19, panel 4 *c*, black colour : flame carbon



(1) charcoal black from delineation (fig. 426: layer 0)
(2) lead white from white layer (fig. 426: layer 1)

Fig. 428: sample *pfb* 3, PP Z 13

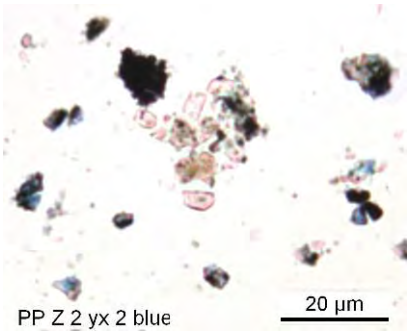


Fig. 429: sample *yx* 2, PP Z 2, black lines below blue lines in *yunqi xi*-painting : flame carbons and/or bone black

Table 28
Layers containing black pigments (without brown background of *sanguo*-paintings)

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to Hu et al. 2013 b, table 1*
pfx 6	black framing, below panel 7 *e*	PLM (PP Z 47)	- flame carbons (?) - Prussian blue, few - red iron oxides	
sx 1	black framing	PLM (PP Z 27)	- flame carbons or bone black - calcite, few - starch grains	- flame carbons
long 1	black, maybe framing	PLM (PP Z 21)	- flame carbons	
pfb 5	panel 2 *d*, black ground	PLM (PP Z 19)	- flame carbons	
pfx 7	brown framework, next to panel 2 *e*	PLM (PP Z 49)	- very fine brown, maybe iron oxide - dark brown organic - fine-grained black	
pfx 10	panel 1 *b*, dark blue centre of star segment	PLM (PP Z 54)	- flame carbons - azurite - malachite, few - dark red, isotropic	- flame carbons (top layer, 2-3 µm)
sd 3	translucent pink with shading in darker pink	PLM (PP Z 25, 26)	- red lake or dyestuff - cinnabar, few, small - dark red iron oxides, few - flame carbons or bone black, few - calcite, few	
sx 6	green robe with very thin grey or black underpainting	PLM (PP Z 34)	- black, small, angular (charcoal black?) - brownish binding medium - Ca, S (- copper chloride)	
sx 7	green robe of figure no.18	PLM (PP Z 35)	- malachite, few azurite - charcoal black (?, rather rounded) - brownish binding medium	
sx 8	sunshade, dark blue or green	PLM (PP Z 36)	- smalt - brownish binding medium - Prussian blue - fine-grained black	
pfb 3	panel 5 *c*, black line on top of green leaves	PLM (PP Z 17)	- flame carbons	
pfb 3	panel 5 *c*, black line underneath white	PLM (PP Z 13)	- charcoal black	
yx 2	dark blue shades of black lines	PLM (PP Z 2)	- bone black or flame carbons, mixed with Prussian blue	- flame carbons

Black

Black is found in black paint layers and in black contour lines. In some of the samples, the identification of the black pigments was not possible with PLM as the rather fine-grained black often is found in clusters or embedded in remnants of the binding medium. The use of flame carbons and charcoal black could be confirmed by PLM. In some samples the presence of bone black is probable, although it could not be proven definitely. MA et al. 2012 only list charcoal black, HU et al. 2013 b only flame carbons as black pigment.[149] Layers containing black pigments are compiled in table 28.

Flame carbons

The pigment of deep black and slightly glossy paint layers of the black framing of three walls was identified as flame carbons (*pingfeng xi*-, *pingfeng bei*- and the *long*-paintings). In the sample taken from the *pingfeng xi*-painting, Prussian blue and some dark red iron oxide were also identified. They may have been added to obtain an even darker hue of black (sample *pfx* 6, PP Z 74). Flame carbons were also used in mixtures to achieve darker hues, e.g. in the dark blue centres of the star segments in the borders of the panels with blue stars at the *pingfeng xi*-painting.

Bone black or flame carbons

A black pigment with larger, slightly angular to rounded particles was used in the black framing of the *sanguo xi*-painting[150] and occurs in several samples of blue, green and pink layers. The same pigment was used for drawing the lines of the waves surrounding the *yunxi*-pearls. It was not possible to identify the pigment without doubt using PLM: the pigment could either be bone black or flame carbons or a mixture of both.

Charcoal black

Particles of charcoal black are present in many samples of the white ground layer. They may rather be a soiling from heating or lightening rooms than a deliberate addition.
Coarse charcoal black was identified in the black delineation of the peony blossoms or their leaves (fig. 426: layer 0, fig. 428). The thin black underpainting underneath the green probably also consists of charcoal black (fig. 426: layer 3)[151], while flame carbons were used for the black lines on top of the green leaves (fig. 426: layer 7). Charcoal black was probably also used in the black or grey underpainting of the green robe containing copper chloride (sample *sx* 6, 412 and 413). Black or grey underpaintings for green and blue are well-known in the Western world as well as in China (for example Shuilu'an), but in the *beiwusheng huiguan* this was the only paint layer in which a grey underpainting could be detected.[152]

Graphite

Graphite was found by Hu Kejia in the *sanguo dong*-painting in a sample taken from the background (landscape)[153] and also identified in Munich in a sample from an area depicting water (sample *sd* 6, PP Z 95). Observations on the rather destroyed upper part of the *sanguo*-paintings indicate that pencils may have been used for a preliminary drawing, so the graphite may originate from the lines of the underdrawing rather than from paint layers.

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[149] MA et al. 2012 (no page numbers), table 7; HU et al. 2013 b, table 1.

[150] Sample *sx* 1, PP Z 27.

[151] Sample *sx* 6, PP Z 34: the particles of the black are small, but angular.

[152] The thin dark layer was only visible in the cross section and not during observation on the mural.

[153] Personal communication with Ms. Hu Kejia.

Fig. 430: S*anguo dong*-painting, different parts of the landscape. Hill tops and coast: malachite; grassland and the slopes of hills: Prussian blue, malachite or botallackite and black (greenish hues?), partly also cinnabar and red lake (brown hues?)

Fig. 431: Sample *sd* 8, sampling area (see fig. 430)

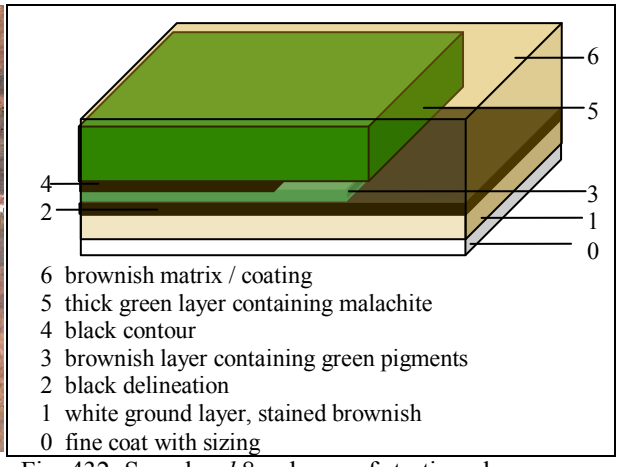


Fig. 432: Sample *sd* 8, scheme of stratigraphy

Fig. 433: *sd* 8 CS 1: ground layer stained brown; paint layer and two black contour lines

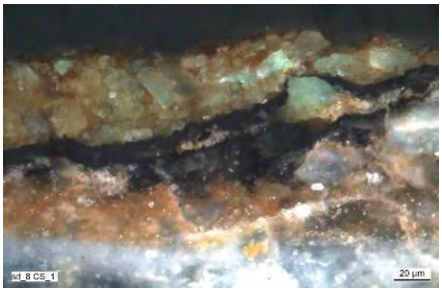


Fig. 434: *sd* 8 CS 1, thin section, VIS

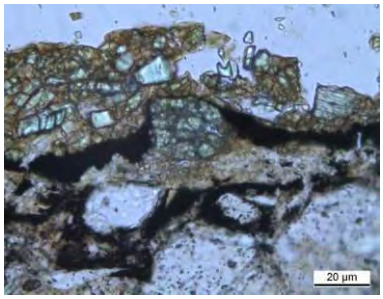
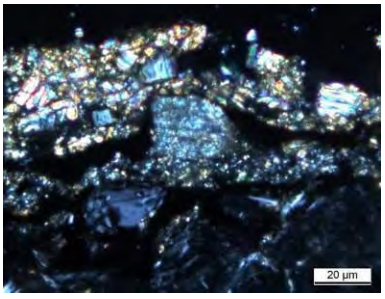


Fig. 435: *sd* 8 CS 1, thin section, UV: green pigments in the layer between the black contours



Brown looking background of sanguo*-paintings*

The landscape in the *sanguo*-paintings looks brown today. Though different shades are still recognisable as darker or lighter brown, the intended colours are not discernible anymore (fig. 430). The strongly discoloured binding medium layer applied over the whole paintings on top of the washes does not contain pigments, but only brown medium (sample *sx* 10). It probably is the main reason for the brown appearance of the background.

Samples were taken from the parts of the landscape classified as "grassland", hills and water. Another brown sample probably comes from a boat (sample *sx* 9).[154] The paint layers contain Prussian blue, malachite, botallackite, black pigments (flame carbons and maybe another black), some layers also include red lake and cinnabar, indicating that the landscape was originally coloured bluish green to brownish.

The tops of the hills which nowadays look dark, the coast lines and some highlights in the landscape had originally been green, the paint layers containing malachite. In sample *sd* 8, taken from a dark appearing "hill top" next to the deer (fig. 430 and 431), the sequence of layers can be distinguished: The first delineation was drawn in black, followed by a first wash that contains green particles (probably malachite). The outline was drawn again in black before a thicker green layer containing malachite was applied (fig. 434 and 435). The malachite layer is covered and encased in a brown binding medium layer. The brown medium that stained the upper half of the ground layer brown (fig. 433) probably is the isolation layer applied on top of the washes (i.e. the material present in sample *sx* 10).

Table 29
Brown background of *sanguo*-paintings

sample no.	*area / description of paint layer*	*analysis method (prep. no.)*	*colourants in sample*	*colourants according to HU et al. 2013 b*
sx 10	brown layer on the white framing next to painting	PP Z 41	- only organic, no pigments	
sx 4	"brown background" (grassland), greenish layer	PLM (PP Z 30, 32)	- Prussian blue - brownish binding medium - malachite - PP Z 31: charcoal black?	
sx 9	"brown background", probably boat; in UV brown, original colour not clear	PLM (PP Z 38, 39)	- brownish layer with Prussian blue - white or green with high IF - botallackite - fine-grained black pigment (no lead white, no malachite)	
sd 1	brown background above entrance gate ("grassland"?), originally maybe bluish green	PLM (PP Z 24)	- Prussian blue + flame carbons - brown binding medium in lumps - malachite and botallackite - charcoal black	
sd 6	water (left edge of painting)	PPZ 91, 92	- bone black or flame carbons, few - charcoal black - malachite, few - lead oxide or orpiment, few - graphite	
sd 7	olive-green "grassland" next to Guan Yu's horse	PPZ 87, 88	- malachite - black (angular?) - red lake (few) (PP Z 88) - cinnabar (PP Z 88) - Prussian blue (PP Z 88)	
sd 8 (figs. 431-435)	hill next to deer, green	PP Z 89, 90	- malachite with few azurite part. - maybe bone black, rather coarse - cinnabar, few; red lake, 1 particle - lead white, few	

[154] The sample was described as „brown background" in the Chinese sample list, and an area of hilly land was marked as sampling area, but the straight black lines drawn with a ruler let assume that the sample actually was taken from a boat some centimeters above the indicated sampling area.

Gilding

Two samples were taken from gilded weapons painted at the *sanguo dong*-wall (samples *sd* 2 and *sd* 4). It can be assumed that even for the tiny gilded decorations leaf gold was used. Creases and rips in the gold leave can be recognised (fig. 436). Underneath the gold a reddish transparent layer (14-27 µm thick) is visible that can be interpreted as the mordant to apply the gold. In UV light, the mordant has a strong yellowish fluorescence (visible in the cross section, fig. 439). The layer does not contain pigments. There is a thin (about 3 µm thick) red layer underneath containing fine red pigments (fig. 438 and 439).

According to the analyses carried out in China on sample *sd* 2, the mordant was found to contain C and Pb which was interpreted as a colouration by red lead. The thin red layer underneath contains Hg and S, thus the red pigment can be identified as cinnabar. The gold leaf was analysed to contain 89.3 w% Au, 8.5 w% Ag and 2.2 w% Cu.[155]

Fig. 436
Sanguo dong-wall: detail of gilded lance head (height of picture corresponds to 2.5 cm)

Fig. 437
Sample *sd* 2: gold lead on reddish transparent mordant.

Fig. 438
Sd 4 CS 1, VIS: the mordant layer looks reddish, but there are no pigments in the layer
4 gold leaf
3 mordant layer
2 thin red layer
1 ground layer

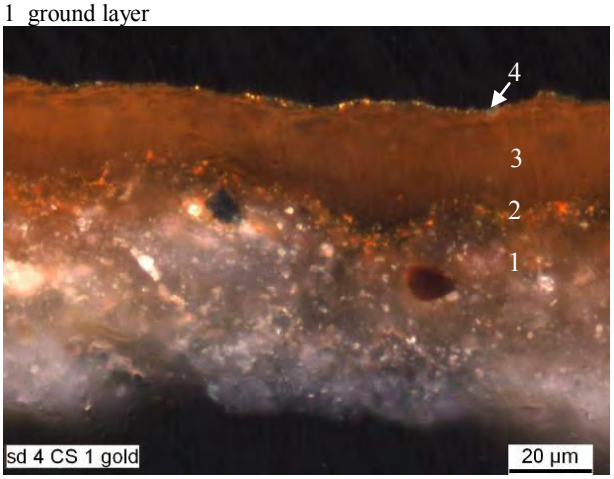
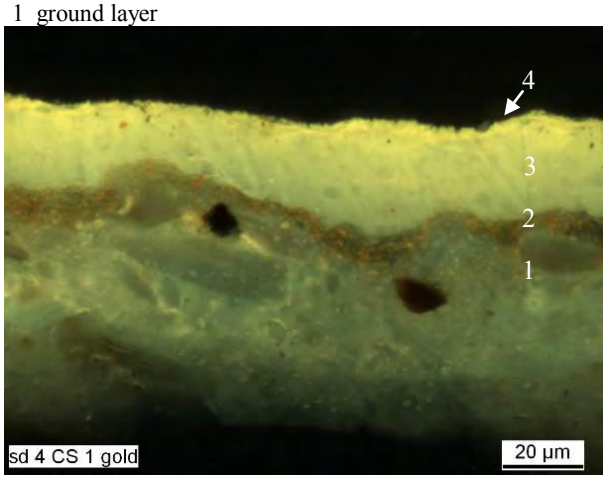


Fig. 439
Sd 4 CS 1, UV: the mordant has a bright yellowish UV fluorescence
4 gold leaf
3 mordant layer
2 thin red layer
1 ground layer



155 HU et al. 2013 b, paragraph „Gold“.

Binding media

The binding media were analysed examined using two different approaches:
- Observations on the layers and the UV fluorescence gave some evidence on the properties of binding media and the layers in which they are contained.
- Analyses of the binders were carried out on selected samples.

Observations on the paint layers

The examination of cross sections using UV fluorescence, SEM with element mapping and comparison to phenomena visible on the wall resulted in the characterisation given in table 30:

Table 30
Characterisation of layers regarding binding media

Sequence in stratigraphy	*layer*	*characteristics*
6	glazes / coatings	- brown glazes cannot be differentiated from brown coatings - mostly no UV fluorescence - few samples with bright UV fluorescence (fig. 457) - some coating partly water-soluble - coating without pigmentations in *pingfeng bei*, *d*-panels (*pfb* 1, PP Z 12)
5	paint layers	- visible UV fluorescence colours depend on pigments - probably emulsion with liquid phase aqueous (dispersed phase fatty?) - there may be different binders / mixtures of binders for subsequent layers or different pigments: - binding medium with yellowish fluorescence: lead white containing areas appear orange (sample *sx* 12, fig. 453) and layers of pure binding medium/low pigmentation in samples *sx* 9 and *sx* 11 (fig. 455) - binding medium of sample *sx* 6 has no UV fluorescence, contains phosphor (fig. 416), layer around pigment particles: 2-3 µm thick - binding medium of sample *sx* 8 has unusual, strongly orange UV fluorescence (fig. 408), layer around pigment particles: 1-2 µm thick
5 x	intermediate isolation layer (*sanguo*-walls)	- applied after the washes - does not contain pigments (sample *sx* 10) - no UV fluorescence - partly stained ground layer (fig. 450 and 451) - probably emulsion with liquid phase aqueous (dispersed phase fatty?)
4	isolation layer	- isolation layer visible in seven cross sections, bright yellowish UV fluorescence[156] -in eight cross sections surface of ground layer brighter under UV light[157] - water-soluble (?)
3	white ground layer	- several applications visible in many samples - UV fluorescence of most samples is bright (yellowish to slightly bluish), similar to *xi ni* - layers without strong UV fluorescence have been soaked by binding media from upper layers and/or by coloured washes (green layers, fig. 450 and 451)
2	sizing	- thin layer with a strong, bright yellowish UV fluorescence - discernible in 30 cross sections, from all investigated walls (*pingfeng xi*, *pingfeng dong, sanguo*-paintings, *pingfeng bei* , *yunqi xi*)[158] (fig. 440-443) - often visible as layer, sometimes penetrated into surface of *xi ni* - In sample *sx* 14, the layer contains higher amounts of sulphur (fig. 446)
1	fine coat *xi ni*	UV fluorescence of most samples is bright (yellowish to slightly bluish)

[156] Samples *pfx* 14 CS 1, *sx* 5 CS 2, *sx* 12 CS 2, *sx* 13, *sx* 14 CS 1 (fig. 380), *sd* 3, *tg* 2 CS 1.

[157] Samples *pfx* 12, *pfd* 1, *pfd* 2, *pfd* 3m *yx* 5, maybe also *pfx* 11, *yx* 2, *yx* 4.

[158] For sample numbers see: *Analses. Appendix 5.* Not found in five samples in which the fine coat layer is missing.

Table 31
Results of binding media analyses

Samples / Layers	*yx* 1 white ground	*sd* 2 gilding	*sd* 4 gilding	*sd* 3 pink robe	*sx* 4 grassland	*sx* 5 red column		*sx* 6 green robe	*sx* 8 dark blue sunshade	
(6) glazes / coating		coating?	coating?							
(5) paint layer/ mordant	area has no paint layer	animal glue + poly-saccha-rides	animal glue + poly-saccha-rides + egg	animal glue + poly-saccha-rides + egg	animal glue + egg*	animal glue + poly-saccha-rides (red on white and red on brown)	animal glue + Poly-saccha-rides	animal glue	animal glue + egg -- gallic acid	animal glue + egg
(4) isolation layer	egg + fruit tree gum					possibly also part of the bulk				
(3) ground layer	animal glue, no polysac-charides									
(2) sizing		possibly part of the bulk	possibly part of the bulk	possibly part of the bulk	possibly part of the bulk					
(1) *xi ni*										
2nd *cu ni*										

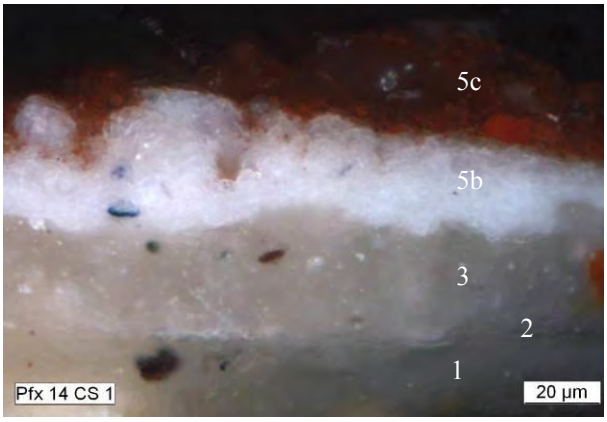


Fig. 440: *pfx* 14 CS 1, panel 4 *a*, red lattice:
5 c red rion oxide (lattice)
5 b lead white layer (background of lattice)
3 white ground layer
2 sizing
1 fine coat *xi ni*

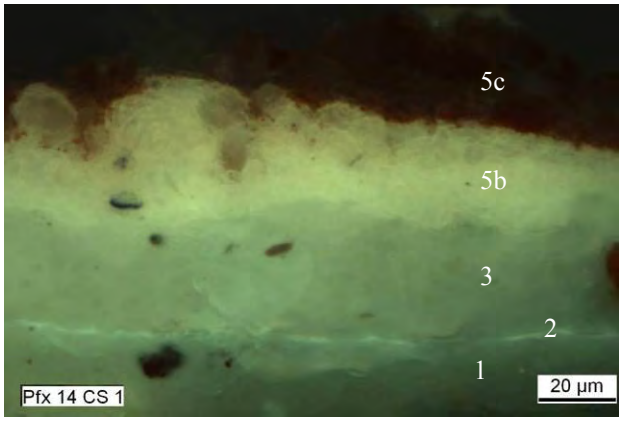


Fig. 441: *pfx* 14 CS 1, panel 4 *a*, red lattice:
5 c red iron oxide (lattice)
5 b lead white layer (background of lattice)
3 white ground layer
2 sizing: whitish UV fluorescence
1 fine coat *xi ni*

Table 31 (cont.)
Results of binding media analyses

Samples / Layers	*sx* 9 boat	*sx* 10 isolation on white ground	*pfx* 2 2nd *cu ni*	*pfx* 8 pink panel frame	*pfx* 11 *b*-panel, star border (blue-pink-red)		*pfx* 15 *b*-panel, star border (green-blue)
(6) glazes / coating				possibly also part of the bulk		possi-bly part of the bulk	
(5) paint layer/ mordant	animal glue			animal glue	animal glue	animal glue	animal glue + poly-saccharides + egg
(4) isolation layer	possibly analysed with ground layer	animal glue + egg				possi-bly part of the bulk	
(3) ground layer	animal glue + poly-saccha-rides	animal glue + egg + oil				animal glue	
(2) sizing	possibly analysed with ground						
(1) *xi ni*							
2nd *cu ni*			poly-saccha-rides + egg				

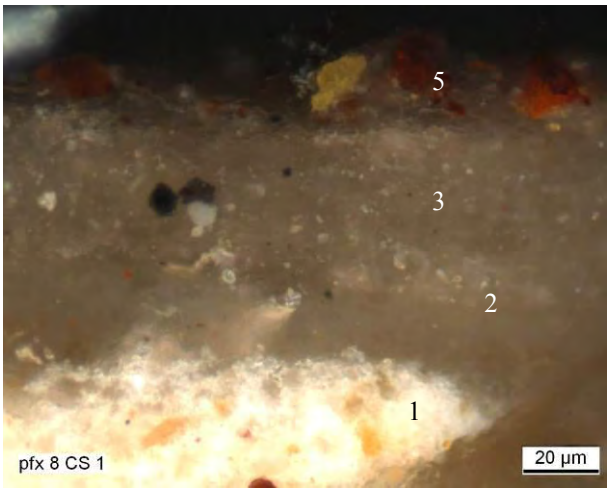


Fig. 442: *pfx* 8 CS 1, pink panel frame
5 paint layer containing red lead, iron oxide and orpiment
3 white ground layer
2 sizing
1 fine coat *xi ni* (upper part soaked with imbedding resin)

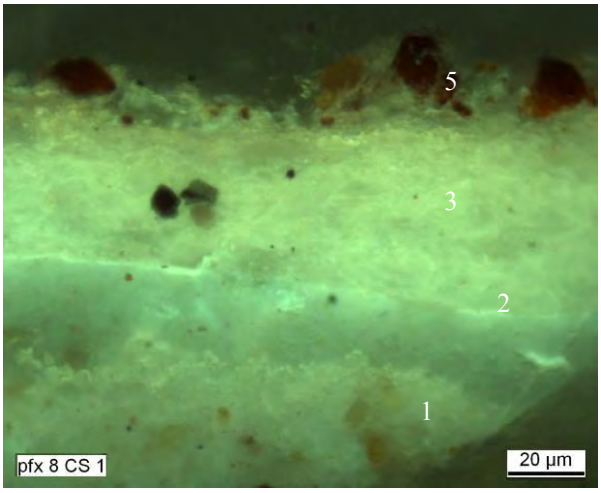


Fig. 443: *pfx* 8 CS 1, pink panel frame
5 paint layer containing: binding medium has a whitish UV fluorescence
3 white ground layer
2 sizing: whitish UV fluorescence
1 fine coat *xi ni* (upper part soaked with imbedding resin)

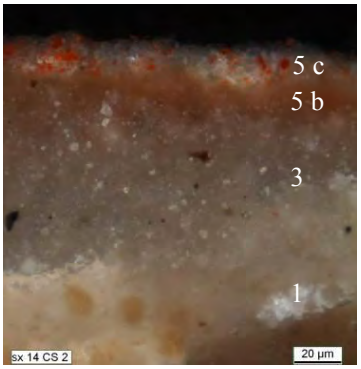


Fig. 444: *sx* 14 CS 2, pink horse
5 paint layer
4 binding medium layer
3 white ground layer
2 sizing
1 fine coat *xi ni*

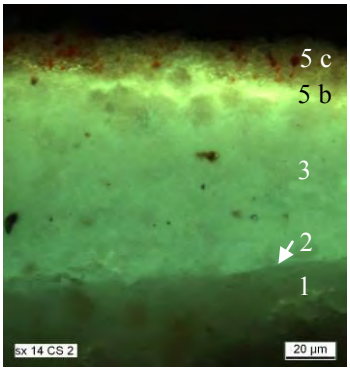


Fig. 445: *sx* 14 CS 2, UV
5 paint layer
4 binding medium layer
3 white ground layer
2 sizing
1 fine coat *xi ni*

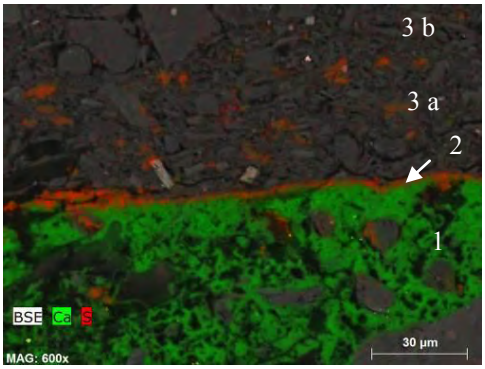


Fig. 446: *sx* 14 CS 2, element mapping
3 b white ground layer, upper application
3 a white ground layer, lower application
2 sizing, containing sulphur
1 fine coat *xi ni*

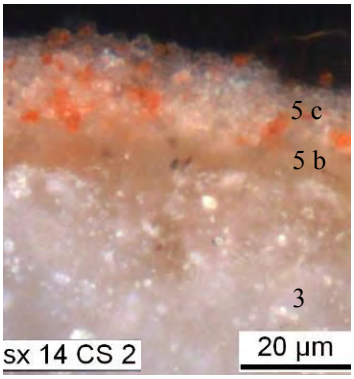


Fig. 447: *sx* 14 CS 2
5 c paint layer (lead white, iron oxide)
5 b binding medium layer
3 white ground layer

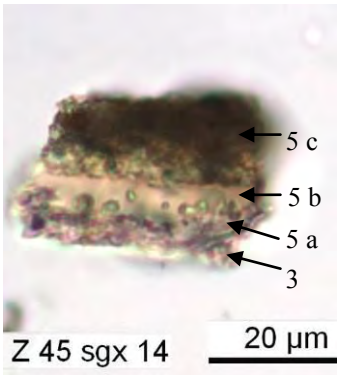


Fig. 448: *sx* 14 PP Z 45:
5 c paint
5 b binding medium layer
5 a thin paint layer(?) with lead white and black particles
3 white ground layer

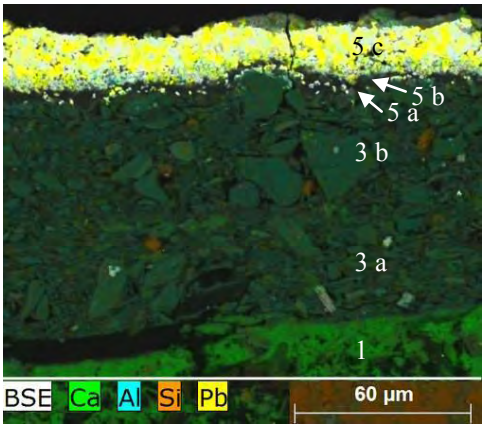


Fig. 449: *sx* 14 CS 2, element mapping
5 c paint
5 b binding medium layer
5 a lead white and black
3 b white ground layer, upper application
3 a white ground layer, lower application
2 sizing, containing sulphur
1 fine coat *xi ni*

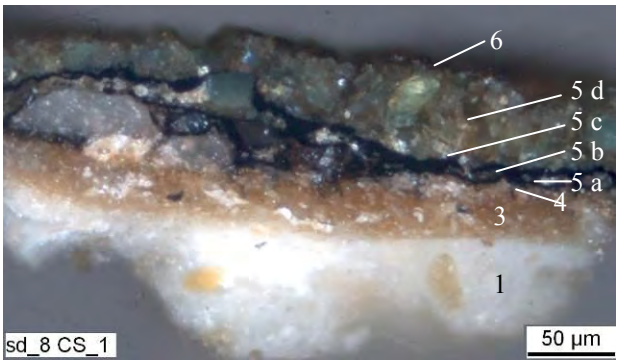


Fig. 450: *sd* 8 CS 1, green hill top (see fig. 431)
6 brown glaze / coating
5 d opaque paint layer
5 c black contour line
5 b green wash
5 a black delineation
4 less stained surface (isolation layer?)
3 white ground layer, stained brown
2 sizing
1 fine coat *xi ni*

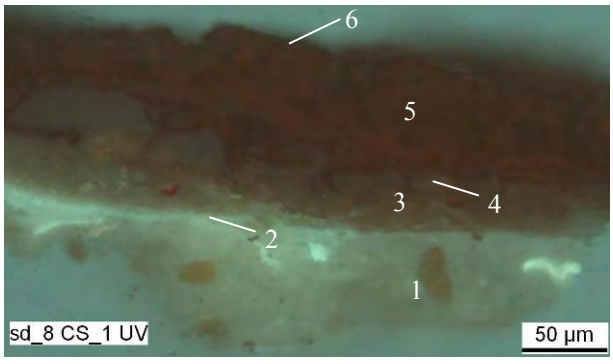


Fig. 451: *sd* 8 CS 1, green from hill
6 brown glaze / coating
5 paint layer
4 less stained surface (isolation layer?)
3 white ground layer, stained brown
2 sizing
1 fine coat *xi ni*

Binding media analyses

The results of the binding medium analyses are given in table 31. An attempt to assign the results to individual layers is shown in table 32.

Table 32
Interpretation of binding media analyses regarding layers

Sequence in stratigraphy	*layer*	*results*	*remark*
6	glazes / coatings	fruit tree gum?	fruit tree gum in sample *yx* 1 can come from the isolation layer or a protective coating
5 b	mordant and coloured underpainting for gold	animal glue + polysaccharide animal glue + polysaccharide + egg	
5	paint layers	animal glue animal + egg animal glue + polysaccharide animal glue + polysaccharide + egg	there may be different mixture/binders for different colours or different layers
5 x	intermediate isolation layer (*sanguo*-walls)	animal glue + egg (+oil?)	the presence of oil in the white ground of *sx* 10 cannot be interpreted so far
4	isolation layer	or animal glue + egg // animal glue	fruit tree gum in sample *yx* 1 can come from the isolation layer or a protective coating
3	white ground layer	animal glue animal + polysaccharide	
2	sizing	animal glue	
1	fine coat *xi ni*	--- (no sample analysed)	
0	2nd *cu ni*	egg + polysaccharide	contamination from upper layers or binding medium addition to clay?

Evaluation

Including observations and analyses the results can be interpreted preliminary:

The result of the *cu ni*-sample seems surprising as egg seem to be unrealistic as addition to clay plasters. Maybe a contamination of the layer occurred by binding media penetrating from subsequent layers.

Investigations on the wall let assume that for the preparatory layers in principle the same materials were used on all walls. Variations, however, may occur, especially regarding ratios of mixtures. Before the white ground layer was applied, the clay fine coat received a coating with animal glue. In many cross sections it is visible as a definite layer, but partly it has penetrated into the fine coat. The varying thickness can depend on the temperature of the glue and wall, the time of the application, the permeability of the wall surface or the thickness of the application.

The binding medium of the white ground layer and the isolation of the ground is animal glue or a mixture of animal glue and polysaccharides. Additionally or instead also mixtures of dilution of egg mixed with fruit tree gum may have been used as isolation or protective coating (sample *yx* 1).

All examined paint layers contain animal glue. Additionally in some layers egg and/or polysaccharides were analysed. Different media or mixtures may have been used for different colours or layers. The observation indicating an emulsion medium with an aqueous liquid is

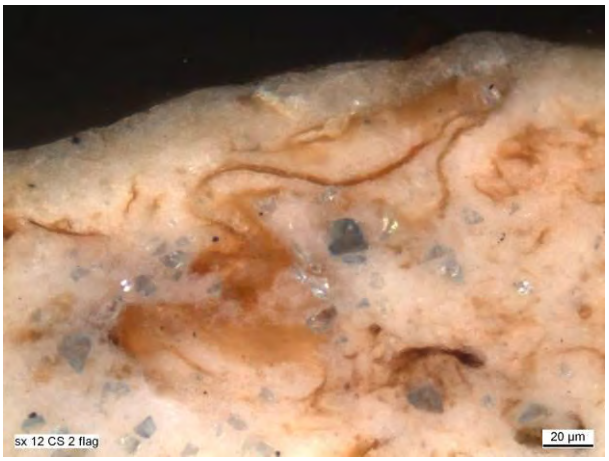


Fig. 452: *sx* 12 CS 2, "red light":
Streaks of organic material in the lead white layer (greyish angular particles: corundum from polishing)

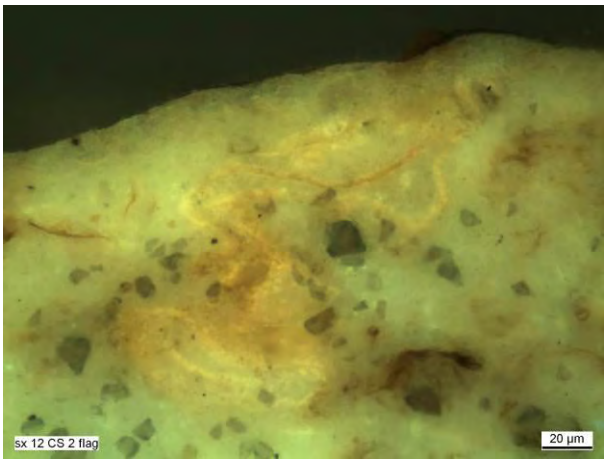


Fig. 453: *sx* 12 CS 2, UV:
Streaks of organic material have an orange fluorescence

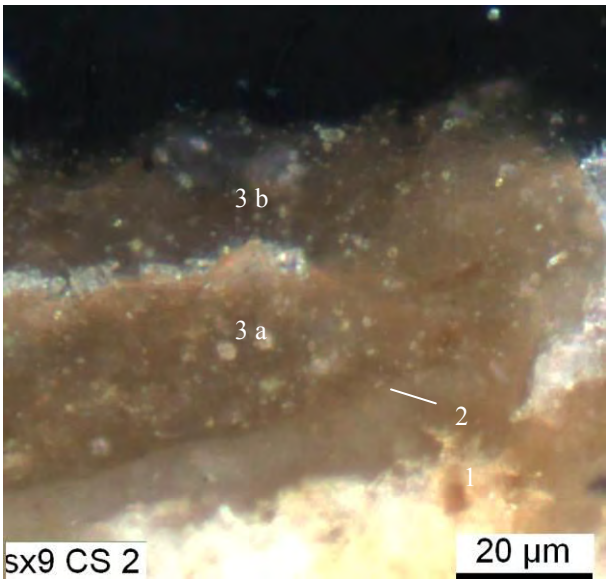


Fig. 454: sx 9 CS 2, boat (?): brown with black line
6 dirt or later coating? (inside crack)
5 c thin brown layer
5 b transparent or brown glaze
5 a black contour line
3 a, b white ground layer, two application visible
2 sizing
1 fine coat *xi ni* (upper part soaked with imbedding resin)

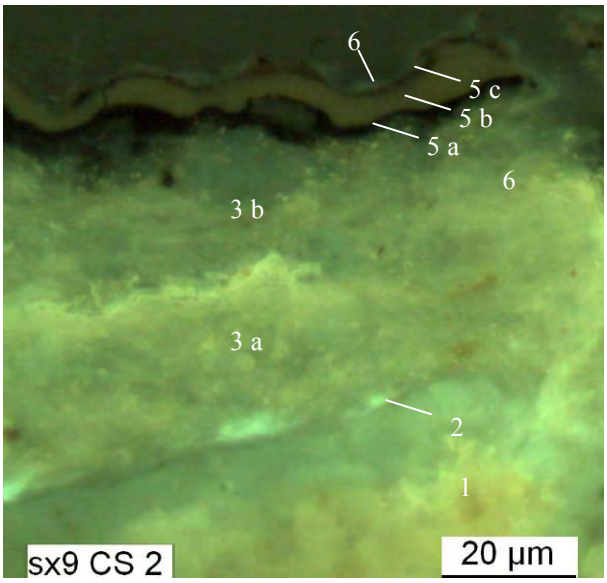


Fig. 455: sx 9 CS 2, boat (?), UV
6 dirt or later coating? (inside crack): whit UV fluorescence
5 c thin brown layer
5 b transparent or brown glaze : yellowish UV fluorescence
5 a black contour line
3 a, b white ground layer, two application visible
2 sizing
1 fine coat *xi ni* (upper part soaked with imbedding resin)

Fig. 456: *sx* 5 CS 2, red column:
(6) brownish coating on top of cinnabar layer

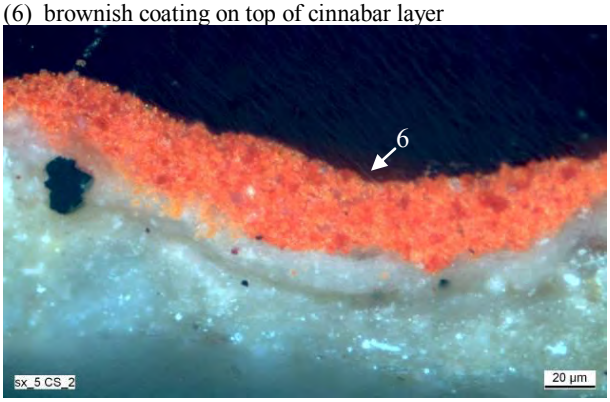
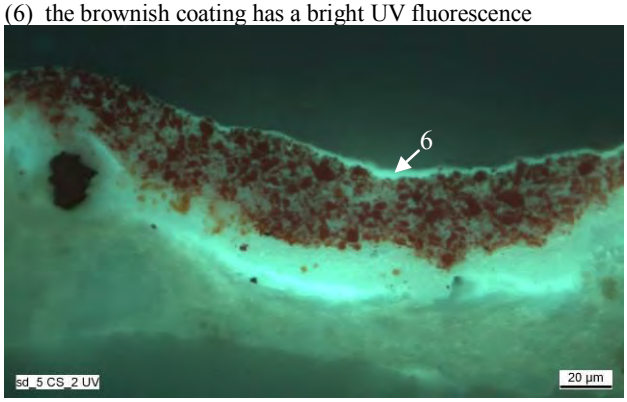


Fig. 457: *sx* 5 CS 2, UV
(6) the brownish coating has a bright UV fluorescence



in accordance with the use of egg or egg mixtures. The detection of different degrees of water-sensitivity of adjacent pictorial layers support the assumption of the use of different media depending on the colour. Reconstruction tests showed that larger amounts of gum arabic result in a higher gloss and a high water-sensitivity, both being not characteristic of the paintings in the *beiwusheng huiguan*. Maybe polysaccharides were restricted to smaller ratios in mixtures or to the upper layers.

Tests on flakes of the severely damaged red paint from the *sanguo xi*-wall (sample *sx* 5, red columns, fig. 458) showed that the paint layer is highly sensitive to water and ethanol: The white ground layer partly dissolved after the flake had been immersed in a drop of water. The slight cupping of the paint layer relaxed, the flakes became straight. When the water evaporated after 1.5 minutes, the flakes contracted within a fraction of a second, the cupping being much worse than before. A large flake broke into two parts. The effect was even more drastic when ethanol was applied first. This reaction may explain the extensive losses in the red paint layers in the *sanguo xi*-painting (fig. 401). It also has to be seen as a warning never to use water or ethanol (for cleaning or consolidation) on these wall paintings in larger scale.

Sometimes brown material penetrated into cracks and lacunae of the paint layer. It is possible that this is partly dirt, but it also confirms the observation that the brownish binding media layers or brown appearing glazes are partly water-soluble.[159]

The preparation layer for the gilding could not be differentiated between the mordant and the thin red layer underneath as it was not possible to separate the layers. The layers analysed as a bulk contain animal glue and polysaccharides, and in sample *sd* 4 also egg. The gilding technique cannot be reconstructed from these analyses, but obviously some kind of water-gilding was used and not oil-gilding, although the appearance of the gilded areas visually resembles oil-gilded decorations.

The question of the composition of the brown discoloured layers at the *sanguo*-paintings and, though different in appearance, at the *tianguan cifu* and *pingfeng bei*-painting could not be answered. In a sample taken from an area where no paint layers cover the layer (sample *sx* 10) animal glue and egg were identified in the brown layer, while the unstained white ground additionally contained oil. The fact that oil was not found in any other sample of the

Fig. 458: *sx* 5 CS 2
Many flakes of the sample show browned margins, also staining the reverse. Length of picture = 3 mm

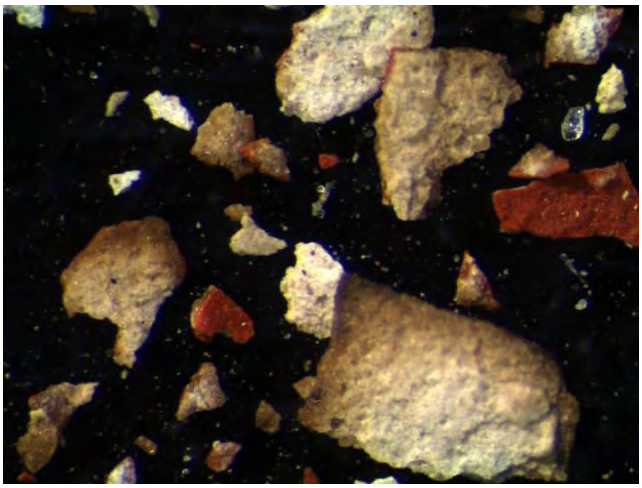
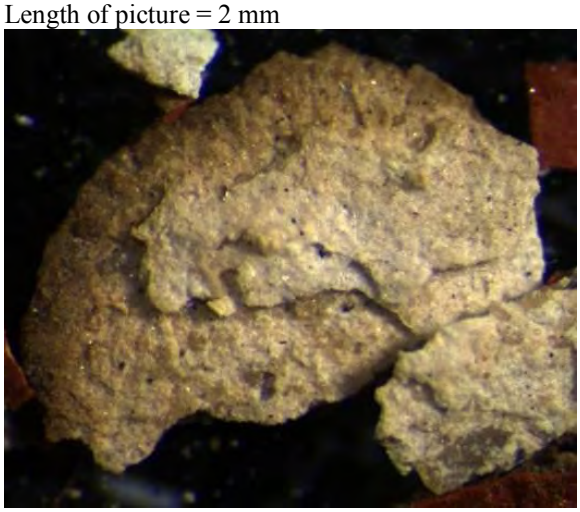


Fig. 459: *sx* 5 CS 2, UV
Large flake showing a distinct cupping from reverse: white ground with several applications; Length of picture = 2 mm



[159] Brownish material penetrated into cracks: *sx* 5, through holes in the paint layer: *sx* 8, into the paint layer: *sx* 12 CS 2; into lacunae: *sx* 11. Colourless or slightly brown material penetrated into lacunae: *sx* 6, *yx* 2, *yx* 3 *pfx* 6 (black framing), *pfx* 8 (panel frames), *pfx* 13.

Fig. 460: Flake of sample *pfx* 15, reverse
Brush marks and imprints of the surface of the *xi ni* are discernible. Length of picture corresponds to 4.5 mm.

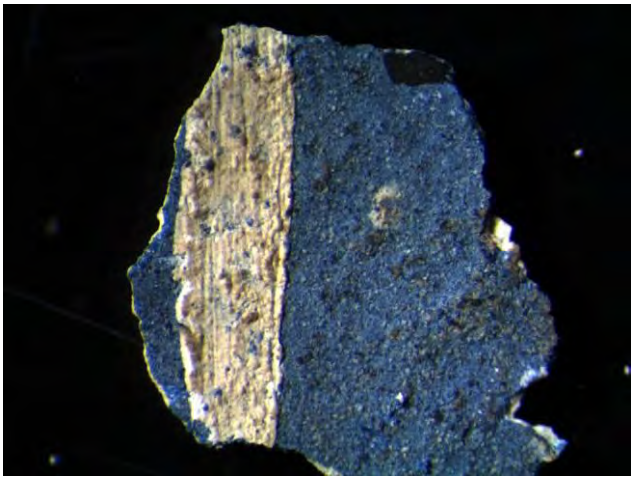


Fig. 461: Flake of sample *pfx* 15, front
Brush marks and pastose texture are visible in the white line. Length of picture corresponds to 4.5 mm.

Table 33
Thickness of layers

Sequence in stratigraphy	*layer*	*thickness measured in Munich*	*thickness measured in Xi'an* (HU et al. 2013 b)
6	glazes / coatings	> 3 µm	
5 b	mordant and coloured underpainting for gold	transparent layer: 14-27 µm red layer: 3 µm	transparent layer: 10-15 µm red layer: 2-3 µm
5	paint layers	- mostly 1-10 µm - thickest layers: -- *sx* 6, copper chloride: 120-163 µm; -- *sx* 8, smalt: 140-180 µm -- *sx* 7, malachite: 55-90 µm - star borders (all layers included): up to 50 µm - green layers: 2-35 µm - thin glazes: < 1 µm	10-40 µm in general thicker: 60-100 µm *sx* 6: 70-100 µm *sx* 8: 40-70 µm *sx* 7: 50-90 µm star borders (all layers incl.): 23-55 µm green opaque layers: 11-28 µm
5 x	intermediate isolation layer (*sanguo*-walls)	not visible as layer	
4	isolation layer	- penetrated into white ground - when visible as layer: < 5 µm, transparent orange layer in *sx* 14 CS 2 : 5-11 µm (figs. 444-445)	
3	white ground layer	23-100 µm	20-60 µm
2	sizing	mostly 1-5 µm, up to 14 µm (*sx* 12 CS 2)	
1	fine coat *xi ni*	2-4 mm	3-5 mm
0	2nd *cu ni* 1st *cu ni*	not measured (in samples only incompletely preserved)	5-7 mm 10-12 mm

sanguo-paintings seems to exclude the assumption that the layer consists of oil- as it was assumed by the Chinese scientists in the discussion about the state of preservation of the *sanguo*-murals. What material or property caused the extreme browning could not be explained.

Protective coatings which seem to be present on all paintings contain either animal glue or polysaccharides.

Thickness of layers

The thickness of layers was measured on cross sections. An overview is compiled in table 33.

The white ground layer was applied as a diluted suspension. Several applications were necessary to reach a layer of homogeneous thickness, evenness and opacity. Two to five applications could be distinguished in cross sections,[160] in sample *sx* 14 also the composition of the applications is slightly different, the lower containing more Ca and S (figs. 446 and 449), maybe indicating slight variations in the quality of the white earth. The total thickness of the white ground measures 20-100 µm. Brush marks or imprints from the *xi ni* surface are visible on the reverse sides of the ground layer in the samples *sx* 4, *pfx* 11 and *pfx* 15 (fig. 460).

Most of the paint layers are much thinner than the white ground layers, often below 10 µm. Thicker layers were caused by the use of coarser pigments such as coarse malachite, smalt or copper chloride (up to 180 µm). The paint layers of the star borders, which appear rather thick, measure about 50 µm. Very thin layers and glazes measure less than 1 µm.

The thinness of the layers is connected with the painting technique which in many parts is executed in thin water-colour-style washes or using semi-transparent glazes. A deepening of the colour could be reached with a second application of the same thin paint which became opaque only in the second application. The orange circles of the *yunqi*-pearls were painted in this technique. The paints seem to have been used as diluted suspension: Black paint ran down the wall behind the pedestal of the *pingfeng bei*-paintings. Bulges of paint formed at the lower edges of larger areas, such as the orange circles of the *yunqi*-pearls.

Although being thin, in some paint layers pastose applications are visible, such as in the green dabs in the landscape or dark blue areas. Lead white layers are always slightly pastose and some have distinct brush marks (fig. 461). Some lead white layers are thick, as the paint layer of the "red light" (sample *sx* 12: 45-196 µm), but there are thin lead white layers as well as in the pink horse (sample *sx* 14) or the ochre table cloth (sample *sx* 13), measuring 4-8 µm.

Glazes and washes are so thin that often they cannot be recognised in cross sections, or can be recognised only partly. The observation of the pink horse of horseman no. 30 in the *sanguo xi*-painting (fig. 283) showed that the horse coat was modelled in light tones between white and orange pink. Then slightly darker pink circlets were added as pattern of the horse coat. These were covered with reddish glazes at least in the darker parts. There is a slightly yellowish coating that covers the complete horse. In the cross section, however, only one layer, containing a mixture of lead white and iron oxide, is visible. A very thin layer containing lead white and some black particles can be distinguished underneath the paint layer (figs. 448 and 449), maybe the first colouration with a wash which is not visible anymore when looking at the wall. This shows that the complicated multi-layered painting technique can only be partly understood from the examination of cross sections and material analyses.

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[160] Samples *sx* 5. *sx* 9, *sx* 10 CS 1, *sx* 13 CS 1, *sx* 14, *pfx* 7 CS 2, *pfx* 12 CS 1. The layering becomes more prominent in samples which have been soaked with a brownish material.

Fig. 462
Pingfeng xi, panel 3 *d*: Prince Tang's Palace

SUMMARY

The German-Chinese co-operation on the *beiwusheng huiguan* focussed on two main aspects: investigations into the painting technique and conservation of selected sections of the mural paintings. As the conservation treatment of the German-Chinese team focussed on the *pingfeng xi*-painting, it was this wall that was examined most extensively. This first part of the report describes the technique, while the state of preservation, the damages and the conservation treatments are described in the second part of the final report.

The research on the painting technique included a description and comparison of the walls, a thorough examination of the painting process and material analyses. Besides the nine murals of the two halls (*guodian* and *zhengdian*) of the *beiwusheng huiguan*, for some aspects the paintings at the wooden architecture of the halls and the severely damaged paintings of the Jiangxi *huiguan* were also included, although they were not examined in detail.

PAINTING TECHNIQUE

In all the murals, the same system of building up the layers was observed: The fine coat of the clay received a sizing before the white ground was applied. Based on chalk lines, the general layout of the walls arranged. The design was delineated with black or grey lines. Another layer of sizing was applied, probably in order to prevent the paint layers to penetrate into the white ground layer. Colours were applied first as coloured washes in a water colour-style, followed by opaque layers. All paintings seem to have a protective coating. Although later interventions cannot be ruled out, there are no clear indications of any later additions such as coatings or retouches. The examination revealed the high artistic quality and the elaborate technique of the paintings.

This principal sequence of work steps may have been a standard of all painters involved in the work or even of wall painting in the 19th century in this region of China. Regarding the single walls, differences in technique and style became visible. It was possible to determine at least six different painters or teams of painters by similar features of style and distinctions in the technique.

The *b*-, *c*- and *d*-panels of the *pingfeng xi*-painting and the *b*-panels of the *pingfeng dong*-painting, both works of the same painter, are the only paintings that are carried out in a kind of water-colour technique, without colours mixed with white or white highlights. The fact that the *c*- and *d*-panels of the *pingfeng dong*-painting were executed by another painter (different in style and using colours mixed with white) shows that more than one painter were involved in the work of each mural.

The *sanguo*-paintings show a complex sequence of work steps in which a water-colour style painting was transformed in one with opaque paint layers and gildings. Marking the colour to be painted in single areas by the colour names may indicate that a team of painters was active or that a design was transferred including the colouration.

The nowadays dark brown layer that covered the background and part of the architecture could be found not to be a coating, but an intermediate application of binding medium between the washes and the opaque paint layers. Originally it was colourless or only slightly yellowish. It cannot be removed without destroying the painting, even if a technique of dissolving the layer would be found. The alteration in the visual impression caused by the strong discoloration of this layer has to be accepted as part of the history of the murals. The reason for the discolouration could not be found.

It was not possible to understand the sequence of the painting process completely and for all murals. Especially the positions of binding medium layers applied between and on top of paint layers are difficult to understand as they did not form layers, but penetrated into the layers below.

Historical record in form of two inscriptions in the paintings, the observations on the sequence of work steps and comparisons between the paintings indicate that all the murals were painted at the same time, with probably only months between the completion of single walls: The inscriptions give evidence that the *sanguo*-walls were painted before the murals in the *guodian*; the technical examination indicates that the folding screen in the *guodian* preceded the one in the *zhengdian* (*pingfeng bei*-painting).

There are remarkable similarities between single figures and motives connecting murals in the *beiwusheng huiguan* with each other, but also with the paintings on the lintels of the halls, and in the Jiangxi *huiguan*. The concordance between the *pingfeng xi*-painting and paintings in the front hall of the Jiangxi *huiguan* is so great that the use either of the same master designs or templates, or the execution by the same workshop has to be assumed, even though probably not by the same painter. The protection of the Jiangxi *huiguan* is urgent because of its importance, but it would also be highly interesting for comparisons with the *beiwusheng huiguan*.

MATERIAL ANALYSES

51 samples were analysed to identify the materials. The fine coat *xi ni* was found to contain clay and lime, and a mixture of bast fibres and cotton. The white ground layer of all paintings is a white earth rich in kaolin.

The identified pigments are: lead white, orpiment, yellow iron oxide, red lead, cinnabar, a pinkish red dyestuff, red iron oxides of different colour, Prussian blue, azurite, smalt, indigo, malachite, a spherical copper chloride, botallackite, charcoal black, flame carbons and maybe bone black. Graphite may come from the use of pencils in the preliminary drawing. Areas which were not included in the sampling may contain yellow dyestuff. The use of the spherical copper chloride and of botallackite is an interesting result, as both are not confirmed to be used in China in larger scale yet.

The results of the colourants were also evaluated regarding the mixtures to obtain different colours, showing a careful selection of pigments to achieve subtle nuances of colours. Nowadays these differences are only partly visible, mostly because of discolouration of binding media and coatings. The samples taken from the more or less homogeneously brown background of the *sanguo*-paintings revealed the presence of green, blue and red pigments and proved that these areas had been intended to be coloured in different and bright shades.
Not all areas of different colour were sampled, so there may be more mixtures of pigments than found during the analyses, but the sampled areas probably contain all pigments used on the murals.

The analyses of binders are not completed yet. Animal glue, polysaccharides and egg could be identified. The preliminary interpretation is that animal glue was used as binder for the white ground and the material of the sizing (of the *xi ni* and the white ground), while mixtures of animal glue, polysaccharides and egg where used for the pictorial layers, probably with variations between the layers and the colours. The brown intermediate layer of the *sanguo*-paintings contains animal glue and egg as well, what does not explain the discolouration of the layer. In one sample, the polysaccharide could be identified as fruit tree gum; it comes from a coating of the white ground layer (either the sizing or a protective coating).

Tests on samples taken from the *sanguo*-walls showed that the paint layer is highly sensitive to liquid water, especially in a mixture or a pre-treatment with ethanol: Wetting resulted in a swelling, followed by a strong spontaneous contraction of the paint layer when the liquid evaporated: the paint layer deformed and a small flake even broke apart. This means that the murals must never be touched with liquid water or ethanol because this will lead to severe damage in micro-scale that over the time will result in visible damage such as turbid areas caused by micro-cracks and losses of the paint layer.

REFERENCES

AGNEW 2009 — Agnew, Neville (ed.), *Conservation of ancient Sites on the Silk Road. The Proceedings on the Second International Conference on the Conservation of Grotto Sites, Mogao Grottoes, Dunhuang, Reople's Republic of China, June 28-July 3, 2004*. Getty Conservation Institute, Los Angeles 2009

Artists' Pigments 1993, vol. 2 — Roy, Ahok (ed.), *Artists' Pigments. A Handbook of their History and Characteristics*. Vol. 2. Oxford University Press 1993

HU et al. 2012 — Hu Kejia 胡可佳, Bai Chongbin 白崇斌, Ma Linyan 马琳燕, Bai Ke 柏柯, Liu Dongbo 刘东博, Fan Binbin 范宾宾, Catharina Blaensdorf, Miriam Schanz, Isabell Wagner, *Shaanxi Ankang Ziyang beiwusheng huiguan bihua yanliao fenxi yanjiu* 陕西安康紫阳北五省会馆壁画颜料分析研究 *A study of the mural pigments of the five north provinces assembly hall in Ankang* (used as manuscript; place of publication unknown)

HU et al. 2013 — Hu Kejia 胡可佳, Bai Chongbin 白崇斌, Ma Linyan 马琳燕, Bai Ke 柏柯, Liu Dongbo 刘东博, Fan Binbin 范宾宾, *Shaanxi Ankang Ziyang beiwusheng huiguan bihua yanliao fenxi yanjiu* 陕西安康紫阳北五省会馆壁画颜料分析研究 *A study of the pigments on murals of the Five Northern Provinces' Assembly Hall in Ankang*. In: Wenwu baohu yu kaogu kexue 文物保护与考古科学 Sciences of conservation and archaeology, 25, 4, 2013, p. 65-72

HU et al. 2013 b — Hu Kejia, Bai Chongbin, Ma Linyan, Bai Ke, Liu Dongbo , Fan Binbin, *A study on the painting techniques and materials of the murals in the Five Northern Provinces' Assembly Hall, Ziyang, China*. *Heritage Science* 2013, **1**:18 doi:10.1186/2050-7445-1-18. http://www.heritagesciencejournal.com/content/1/1/18 (last access 2014-05-31)

MA et al. 2012 — Ma Linyan 马琳燕, Bai Chongbin 白崇斌, Hu Kejia 胡可佳, Bai Ke 柏柯, Liu Dongbo 刘东博, Fan Binbin 范宾宾, Catharina Blaensdorf, Miriam Schanz, Isabell Wagner, *A study on technique of mural of the five north provinces assembly hall in Ankang* 陕西安康紫阳北五省会馆壁画制作工艺研究: (used as manuscript; place of publication unknown)

MA LINYAN 2014 — Ma Linyan 马琳燕, *Shaanxi sheng Ziyang beiwusheng huiguan bihua de baohu xiufu yanjiu* 陕西省紫阳北五省会馆壁画的保护修复研究, to be published in 2014

SABATINI 2012 — Sabatini, Francesca, *Caratterizzazione dei materiali pittorici del beiwusheng huiguan mediante un approccio multinalitico*. Thesis of corso di laurea triennale in chimica. Pisa 2012

SCHILLING et al. 2009 — Schilling, Michael R. / Mazurek, Joy / Carson, David / Su Bomin / Fan Yuquan / Ma Zanfeng, *Analytical Research in Cave 85*. In: AGNEW 2009, S. 438-449

SCOTT 2002 — Scott, David A., *Copper and Bronze in Art. Corrosion, Colorants, Conservation*. Getty Publications, Los Angeles 2002

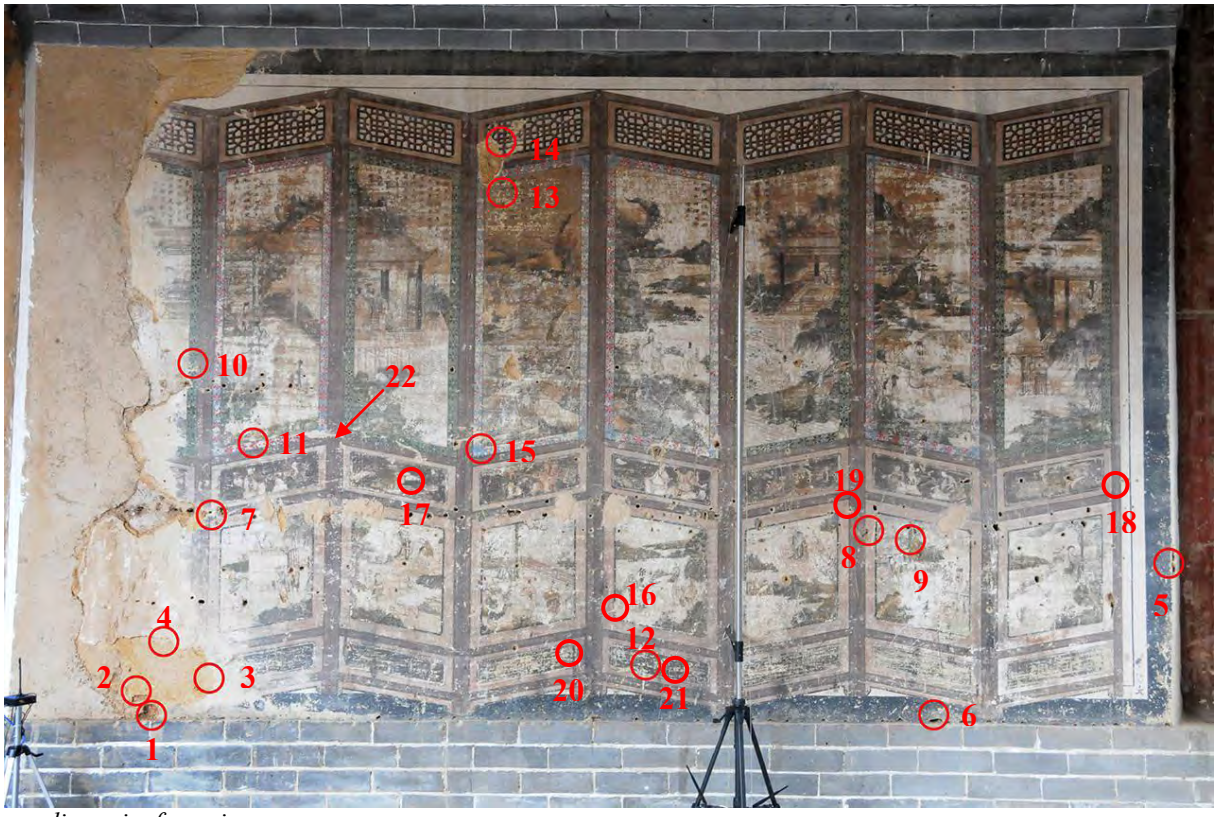
SHEKEDE et al. 2009 — Shekede, Lisa / Fan Zaixuan / Piqué, Francesca / Wong, Lorinda, *The Role of In Situ Examination in the Technical Investigation of the Cave 85 Paintings*. In: AGNEW 2009, S. 430-437

ZHANG FANG 2011 — Zhang Fang.张芳, *Ziyang beiwusheng huiguan pingfeng bihua tizi xiaokao* 紫阳北五省会馆屏风壁画题字小考-《文博》2011 年 06 期：61－63 页, *Wenbo* 6, 2011, p. 61-63

ZHAO et al. 2014 — Zhao Zhou et al.. *Shaanxi Ankang Ziyang beiwusheng huiguan bihua yanjiu baogao* 陕西安康紫阳北五省会馆壁画研究报告, to be published in Wenwu chubanshe 文物出版社 2014

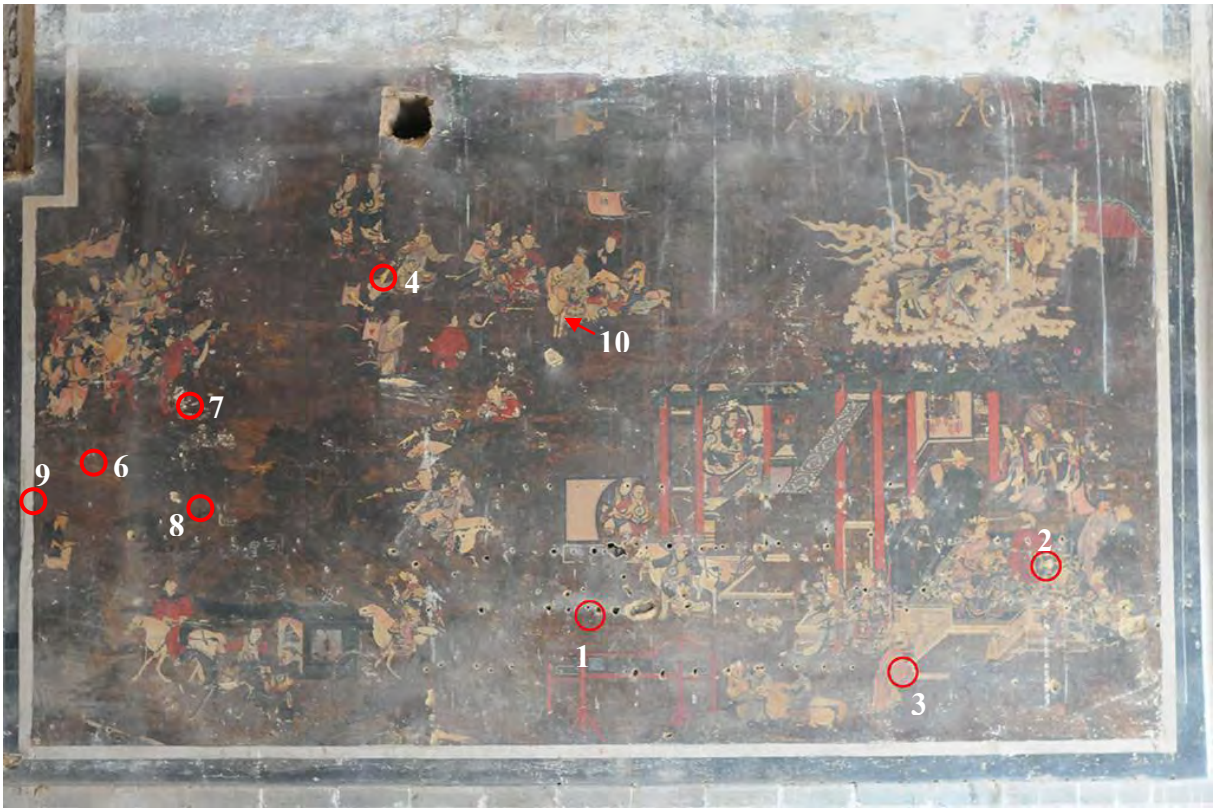
Ziyang beiwusheng huiguan bihua baohu yanjiu 2006 — *Ziyang beiwusheng huiguan bihua baohu yanjiu* 紫阳北五省会馆壁画保护研究, 2006, internal report. Translated into German by Mrs. Cai Jiehua (Studie über den Schutz der Wandmalereien des Beiwusheng Gasthauses im Kreis Ziyang)

Analyses, Appendix 1: Sampling areas



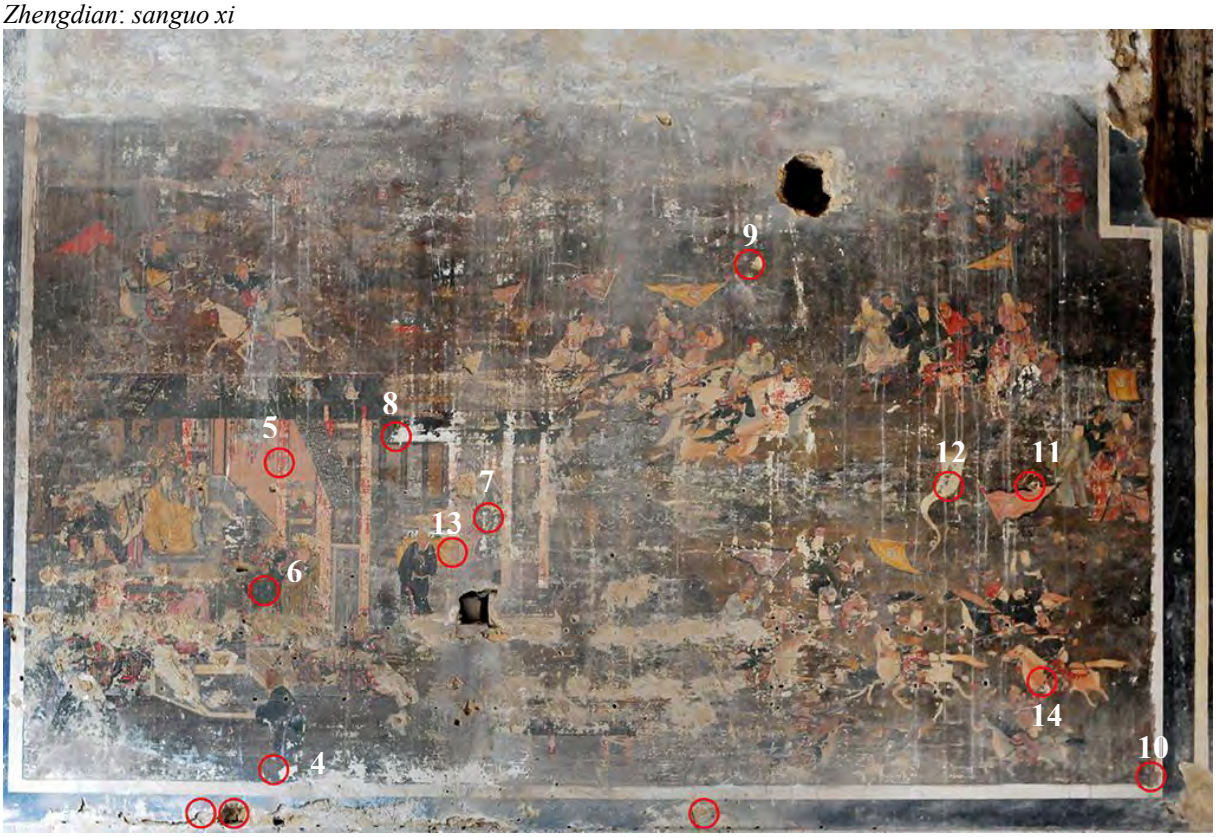
guodian: *pingfeng xi*

guodian: *pingfeng dong*



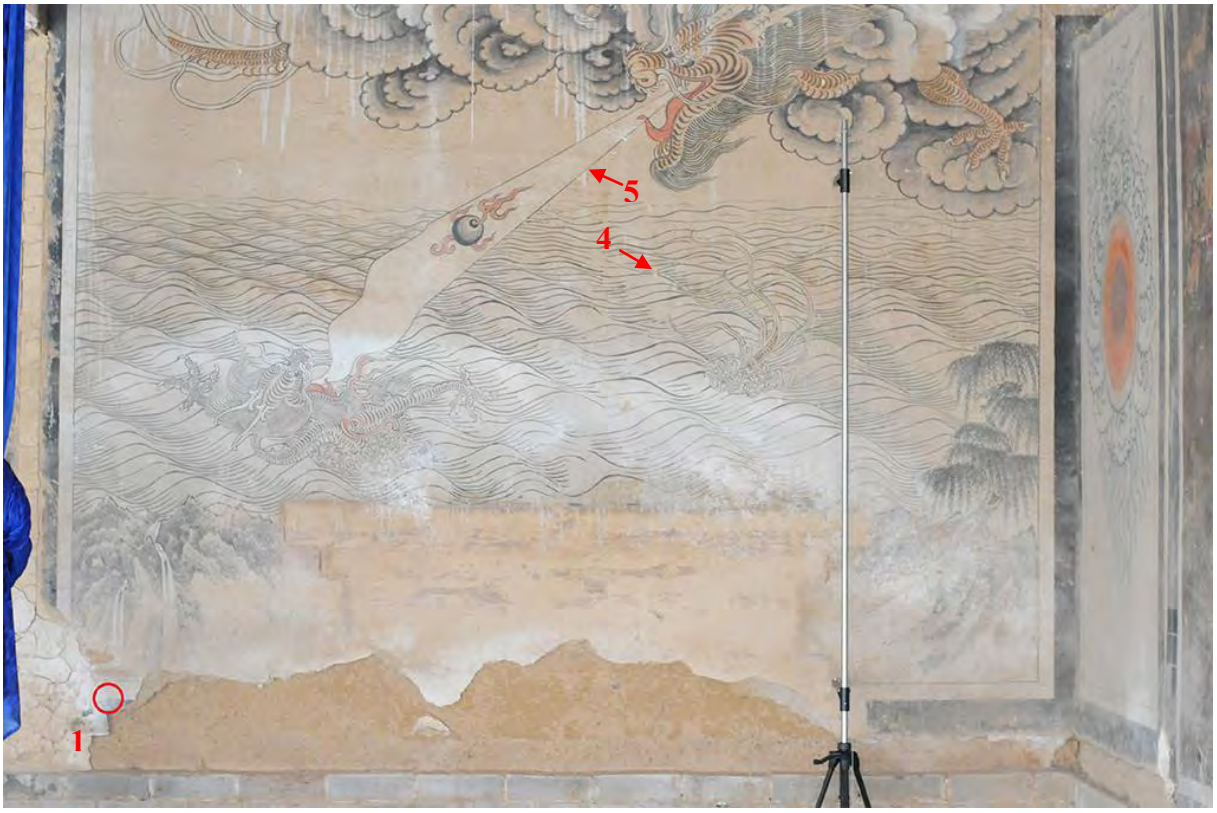
Zhengdian: *sanguo dong*

Zhengdian: *sanguo xi*



Zhengdian: *tianguan cifu*

Zhengdian: *pingfeng bei*



Zhengdian: long

Zhengdian: yunqi xi

Analyses, Appendix 3: Sample list

GUODIAN: *pingfeng xi*

sample no.	*abbrev*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
pingfeng xi 1	*pfx* 1	*cu ni*, 1st layer	*cu ni*	x			a lot			x			x					
pingfeng xi 2	*pfx* 2	*cu ni*, 2nd layer	*cu ni*	x			a lot	yellow to brown, darker than other clay plaster samples		XRD 2011-10-18 XRD, semi-quantitative: - quartz, 77 % - muscovite, 10% - albite, 5 % - corrensite, 5% - calcite, 3 %			x -egg + polysac ch.					additives? salts ?
pingfeng xi 3	*pfx* 3	*xi ni*	*xi ni*	x			2.5 x 1.5 x 0.3 cm	light coloured, contains a lot of sand, particles sized 0,5-1,0 mm, surface less smooth than *other xi ni* samples, no fibres, white inclusions		x			x					additives?
pingfeng xi 4	*pfx* 4	panel 1 *e*, filling frame	black / reddish brown	*xi ni*	x	few	m+	- sand - black and / on reddish brown - white ground - sizing? - *xi ni*	x							sample		
pingfeng xi 5	*pfx* 5	*xi ni*, northern edge of wall	*xi ni* with fibres, traces of black				3.0 x 1.0 x 0.3 cm	?	- bast fibres - 1 cotton fibre				x			sample		
pingfeng xi 6	*pfx* 6	black framing, below panel 7 *e*	black	x	x	x	1.5 x 1.0 x 0.3 cm	CS 1 - transparent, UV white - black - white priming - sizing, contains charcoal black - *xi ni* - *cu ni*	PP Z 48 (black) - flame carbons - red iron oxide - Prussian blue, few PP Z 47 (w. g.) - kaolin - starch grain - bast fibres							sample PP Z 47 (white ground)	Hu et al. 2012, table 1 and 5: charcoal black	Hu et al. 2012, table 3 (XRD): graphite, kaolinite, quartz, calcite, illite
pingfeng xi 7	*pfx* 7	framework, next to panel 2 *e*	brown: (dark brown on reddish brown)	x	x	x	1.1 x 0.9 x 0.5 cm	CS 1 // CS 2 - dark brown - reddish brown, together < 9 µm -white ground, 62-73// 100 µm - sizing, 3// 6 µm - *xi ni* (ochre in CS 1)	PP Z 49 (w. g.) PP Z 50 (brown) - fine brown iron oxide - brown organic - fine-grained black		- Ca - Fe - S - Ti - Si, K, Al > gypsum	white ground: Al; S distributed over layer > glue ? paint layer: more Ca	x?			sample micro PP Z 49 CS	Hu et al. 2012, table 1 and 5: red iron oxide	- what does the *xi ni* contain except for Ca and some sand?

pingfeng xi (cont.)

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
pingfeng xi 8	*pfx* 8	panel 7 *d*, panel frame	light pinkish brown	x	x	x	1.0 x 0.6 x 0.5 cm	CS 1 - layer with yellow, orange and small red part., 18 µm - white ground, stained brownish, 41 µm - sizing, 1µm - *xi ni*	PP Z 51, 52, 73 - orpiment - fine brown iron oxide - red lead - few cinnabar			iron in the paint layer	SABA-TINI 2012: glue			sample micro CS 1 PP Z 51, 52	HU et al. 2012, table 5: fine grained brown = lead dioxide ? ---- HPLC	HU et al. 2012, table 3 (XRD): red lead, lead oxide, cerussite; kaolinite, quartz, gypsum
pingfeng xi 9	*pfx* 9	panel 7 *d*, mountain or green border of screen	green	x	x	x	m	CS 1 - transp., penetrated in lacunae - dark glaze/coating - bright green - wash (green?) - white ground - sizing - *xi ni*	PP Z 53 (green) - malachite - brownish organic medium							sample micro PP Z 53 CS 1	HU et al. 2012, table 1 and 5: malachite	HU et al. 2013 b, table 1: mala., lead white
pingfeng xi 10	*pfx* 10	panel 1 *b*, border with stars	greenish blue ground, star segments blue and dark blue	surface	x	x	m- / s+	CS 1 - brownish surface - dark blue (star) - medium blue (star) - green-blue (ground) - white ground - sizing - *xi ni*	PP Z 54-57 - flame carbon - azurite - malachite - red iron oxide/pyrite - PP Z 56, ground: + lead white	2011-10-18 - quartz - calcite - Fe (III) chamosite - gypsum - muscovite - clinoclase - azurite	x - Cu, Ca, Si, Fe - Pb					sample PP Z 54, 57	MA et al. 2012: - green - yellow - *xi ni*	HU et al. 2012, table 5: azurite, malach., cerussite
pingfeng xi 11	*pfx* 11	panel 2 *b*, border with stars	blue ground, pink star with red core		x	x	max. 0.2 x 0.2 cm	CS 1 - red (star), 3-4 µm - pink (star), 10-20 µm - blue (ground), 13-25 µm - white ground, 60 µm, with charcoal black - sizing - *xi ni*	PP Z 58-61 red: cinnabar pink: cinnabar + lead white blue: Prussian blue, large and small + lead white w. g.: starch grain				SABA-TINI 2012: T, PL: glue			sample micro PP Z 58-60 CS 1	HPLC: gallic acid	HU et al. 2012, table 5: cinnabar, Prussian blue
pingfeng xi 12	*pfx* 12	panel 5 *e*, background ?	dark brown	surface	x	x	0.5 x 0.4 x 0.2 cm	CS 1 - translucent brown - brown, opaque (dark on red, 12-22 µm) - isolation? - white ground, with char-coal + iron oxide, 34-60 µm - sizing, 2.5 µm - *xi ni*	PP Z 78 black on red in CS PLM: - black - iron oxide ? - clay minerals			red ?				sample micro CS 1	Hu Kejia: XRD: red lead, gypsum PLM: red iron oxide EDX: Fe, Pb	HU et al. 2012, table 3 (XRD): red lead, kaolinite, quartz
pingfeng xi 13	*pfx* 13	panel 4 *b*, background	brownish no paint layer	surface	2 x		m	CS 1 - thin, dark part., 0.5 µm - white layer 2, stained brown, 32-40 µm - thin, dark part., 0.5 µm - white ground 1, 32-48 µm - sizing, 3 µm - *xi ni*	PP Z 74, 75 - both white ground layers: clay minerals, no pigments							sample micro CS 1		

pingfeng xi (cont.)

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
pingfeng xi 14	*pfx* 14	panel 4 *a*, brown lattice strips	dark red or brown on white	x	x	x	0.7 x 0.3x 0.3 cm	CS 1 - red (strips) - black (shade of strips) - white (background) - white ground - sizing - *xi ni*	PP Z 62, 72 (red) - red iron oxide - brown organic material - 1 cinnabar PP Z 71 (white background) - lead white							sample PP Z 72	Hu Kejia: PLM: red iron oxide XDR: red lead, gypsum EDX: upp. layer: HgS, low. layer: Pb	Hu et al. 2012, table 5: iron oxide, cinnabar, cerussite // Hu et al. 2013 b, tab. 1 red ochre (cinnabar not men-tioned)
pingfeng xi 15	*pfx* 15	panel 4 *b*, border with stars	blue, on top white line and black dot		x	x	m-	*compare pfx 11* - black dot // white line pastose - blue - white ground	PP Z 63 (blue) - Prussian blue - lead white PP Z 76 (white line) - lead white PP Z 77 (black dot) - fine grained black				Sabatini 2012: glue, egg, polysac-charides	Sabatini 2012: ??	kaolinite gypsum quartz Ca-oxalate Prussian blue	sample	Hu et al. 2012, table 5: Prussian blue, cerussite	
pingfeng xi 16	*pfx* 16	panel 5 *d*, *cu ni* : fibres														sample	fibre analysis	
pingfeng xi 17	*pfx* 17	panel 3 *c*, blue from still life (2 flakes)			x	x	0.01 x 0.01 cm	CS 1 malachite and azurite are mixed in one layer, no stratigraphy visible	PP Z 64 - azurite - Prussian blue - malachite - lead white - Prussian blue - starch grain - dark red iron oxide (pyrite ?) - clay minerals - clusters of black								samp-ling area sample CS 1 PP Z 64		
pingfeng xi 18	*pfx* 18	White back-ground next to panel 8 *c*		x	x	x	m	White with grey on top, next to black and brown										no brought to Germany, not analysed
pingfeng xi 19	*pfx* 19	framework, next to panel 6 *d*	brown	x	x	x	m	Sequence: 1. light brown 2. brown	x?									
pingfeng xi 20	*pfx* 20	panel 4 *e*, panel outline	black line?			x	m to s	sequence: 1. black, 2. light red, 3. black	x?									
pingfeng xi 21	*pfx* 21	panel 5 *e*	yellow			x	s		x									
pingfeng xi 22	*pfx* 22	black line of framework, between panel 2 *b* and 3 *b*, bottom edge	black		x	x	s	CS 1 - brown wash - black contour - white ground - sizing - *xi ni*	PP Z 96 - fine grained black -few charcoal black particles -earth							sampli ng area sample CS 1		

pingfeng dong

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
pingfeng dong 1	*pfd* 1	panel 7 *b*, border with ornaments: pink star	pink	x	x	x	0.3 x 0.3 x 003 cm	CS 1 - spots of dark red - pink - blue - white ground - (sizing)	PP Z 65, 66 pink: cinnabar + lead white blue: Prussian blue + lead white							sample PP Z 65	HU et al. 2012, table 5: cinnabar, Prussian blue	large particles Prussian blue
pingfeng dong 2	*pfd* 2	panel 8 *b*, border: background ?, ca. 10 flakes	light green	surface	x	x	up to 0.3 x 0.2 x 0.2 cm	CS 1 - brown coating/ glaze, 1 µm - green - isolation? - white ground - sizing - *xi ni*	PP Z 67 (green) - botallackite - azurite PP Z 67 (white g.r) - white earth							sample Micro CS		HU et al. 2012, table 5: malachite, azurite
pingfeng dong 3	*pfd* 3	panel 6 *e*, ornament	light blue	x	x	x	1.0 x 0.3 x 0.03 cm	CS 1 - thin greenish layer,1.2-1.5 µm - isolation - white ground, 53 µm, with charcoal - sizing, 1.25 µm - *xi ni*	PP Z 3ab, 4, 69, 70 - Prussian blue - green or white (no malachite) - 1 part. azurite							sampling area sample Micro CS		HU et al. 2012, table 5: Prussian blue
pingfeng dong 3	*pfd* 3	panel 6 *e*, background	brown														HU et al. 2013 b, table 1: red lead, PbO_2	brown was not contained in the sample analysed in Germany

ZHENGDIAN :*sanguo xi*

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions – done – returned to China in Oct. 2011* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
sanguo xi 1	*sx 1*	*xi ni*	black		x	x	4.5 x 2.5 cm	CS 1, TS 1 - dirt - black - white ground - sizing - *xi ni*, 1-15 mm - *cu ni*	PP Z 27 (black) - flame carbon or bone black PP Z 28 (w. g.) - white earth TS: cotton fibre			- w. g.: Al - *xi ni*: a lot of Ca; S in clusters: glue (or salt ?)				sample PP Z 27 CS 1 SEM TS	- ion chromatography:	where does the sulphur come from ? Ca = binding medium > thin section
sanguo xi 2	*sx 2*	*cu ni, lower layer* several particles		*cu ni*			1.8 x 1.5 x 0.3 cm	CS 2, TS 2 - *cu ni* with straw and "canals" in the layer				- canals and pores: Ca, S - *cu ni*: no Ca; a lot of Si				sample CS 2 SEM TS	- ion chromatography: NO_3: 7.00 SO_4: 36.62 F: 0.08 Cl: 1.01	where do the canals come from?
sanguo xi 3	*sx 3*	*cu ni, second layer* several particles		*cu ni*			0.7 x 0.7 x 0.4 cm									sample		
sanguo xi 4	*sx* 4	background, lower edge, next to figure no. 1 grassland	brown, UV: black		x	x	1.2 x 0.6 x 0.5 cm	CS 1 - brown or dark green drops - green to brown layer white ground - sizing - *xi ni*	PP Z 30 (green). 32 (dark green) - Prussian blue in brownish binder - malachite - probably flame carbons PP Z 31 (w. g.) - white earth				SABATINI 2012: T: glue, egg*		SABATINI 2012: T, PR: kaolinite, gypsum, Ca-oxalate PL: kaolinite, Ca-oxalate	sample UV sampling area PP Z 31, 32 CS 1		is the Prussian blue layer underneath the malachite? > TS
sanguo xi 5	*sx* 5	pillar of emperor's hall many flakes	red	surface	x	x	m	CS 1 - red on white - white ground CS 2 - transp. brown, inside cracks, UV white - red - white layer - isolation - white ground - sizing - *xi ni*	PP Z 33, 81 PP Z 33a: red with some white: - cinnabar, - red lead, few PP Z 33b: red on top of orange: - cinnabar - red lead	XRD 2012 kaolinite, low content of quartz			SABATINI 2012: T, B (red + brown), M (red + white): glue, polysacch.		SABATINI 2012: T: kaolinite, protein		HPLC ----- test with flake in water	HU et al. 2012, table 5: red on white? cinnabar, cerussite (see: CS1) HU et al. 2012, cinnabar on top of red lead
sanguo xi 6	*sx* 6	robe of figure no. 10 inside big pavilion	green large spherical particles		x	x	0.5 x 0.4 x 0.2 cm	CS 1 CS 2 - transp. brown - green, 123-161 µm - thin black/grey - isolation, 1.4 µm white ground, 30-60 µm - sizing - *xi ni*	PP Z 34 - large, rosette shaped green particles: Cu, Cl; binder contains P - black underpainting: charcoal black			green: Cu, Cl binder of green: P black underp. Ca, S	SABATINI 2012: T: glue		SABATINI 2012: PR (white ground)	sample micro PP Z 34 CS 1, CS 2 SEM of CS 2		HU et al. 2013 b, table 1: atacamite botallackite

sanguo xi (cont.)

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions – done – returned to China in Oct. 2011*										remarks
								CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	
sanguo xi 7	*sx* 7	robe of figure no. 18 in small pavilion	bright green (grass green)		x	x	m	CS 1 CS 2 - transp. layer - green, some charcoal black - thin brown or green - white ground - sizing - *xi ni*	PP Z 35 - malachite - azurite, few - black, few - lead white	2011-10-18 - malachite - kaolinite - quartz - albite - muscovite	x Pb, As	some green contains C, As, Pb, but are green as malach. > which mineral?				sample PP Z 35 CS 1, CS 2	HU et al. 2012, table 5: malachite, cerussite	lighter green layer below malachite layer
sanguo xi 8	*sx* 8	sunshade of small pavilion several flakes	dark blue (or green ?)		x	x	up to 0.8 x 0.7 cm	CS 1 CS 2 - transp. brown, in holes - dark blue, 140-180 µm white ground, two appl., 80-90 µm - sizing - *xi ni*	PP Z 36, 37 - smalt - brown binding medium - Prussian blue - fine-grained black	2011-10-18 - kaolinite - quartz - muscovite	x K, Si, Fe, Co, As, Cu, Ti, S >from glass		SABATINI 2012: T: glue, egg* PL: glue, egg	SABATINI 2012: PL: glue, egg	SABATINI 2012: PL: kaolinite, protein PR: kaolinite, protein, Ca-oxalate	sample PP Z 36, 37 CS 1, CS 2	HPLC indigo gallic acid	HU et al. 2012, table 1 (PLM) and Raman: smalt HU et al. 2012, XRD: Si, As, K, Co, Pb, traces of Bi, Ni
sanguo xi 9	*sx 9*	"background" probably boat the description and the picture from the sampling position are wrong !!	brown, UV: brown	*xi ni*	x	x	2.4 x 1.5 x 0.2 cm	CS 1 CS 2 - dirt? (UV white) - dark brown thin - brown on top or around black line, UV: light-colour. - black line, drawn with ruler - white ground, 2 applications, with charcoal black - sizing - *xi ni*	PP Z 38-40 - brown medium with Prussian blue - botallackite black line: - fine-grained black			x	SABATINI 2012: B (white): glue, polysacch. S (brown surface): glue		SABATINI 2012: B (white) ? S (brown surface): kaolinite, gypsum, Ca-oxalate, calcite	(sampling area) sample CS 1 CS 2 PP Z 38, 39		
sanguo xi 10	*sx 10*	brown on white next to painting	brown, UV: brown	*xi ni*	x	x	0.7 x 0.4 cm	CS 1, TS 1 - brown material penetrated into white ground - white ground, two applications - sizing - *xi ni*	PP Z 41 brown material does not contain pigments				SABATINI 2012: B (white ground): glue, egg, oil	SABATINI 2012: M (brown surface): glue, egg	SABATINI 2012: B (white): kaolinite, calcite, gypsum, quartz M. ?	sampling area UV sample CS 1 TS 1		no pigments in brown!!! just binding medium!

sanguo xi (cont.)

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions – done – returned to China in Oct. 2011* CS	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
sanguo xi 11	*sx 11*	background next to yellow flag - Some twigs or plants	brown, UV: black	*xi ni*	x	x	1.2 x 0.8 x 0.3 cm	CS 1 CS 2, TS 2 - brown transp., penetrated in lower l., - brown layer, 7-11 µm // green particles, < 25 µm - white ground, 4 layers, 24-83 µm - sizing, 2-5 µm - *xi ni*	PP Z 83 (green) - malachite PP Z 84 (brown) - fine-grained black			x?	x?			sample samp-ling area UV CS 1		
sanguo xi 12	*sx* 12	"red light" F4, above the head of Zhao Yun rescuing the baby prince	white or light brown yellowish -pinkish under UV	x	x	x	0.9 x 0.5 x 0.2 cm	CS 1 CS 2 - thin, UV light - thin brown/green <5 µm, UV dark - white layer with brownish streaks, 45-196 µm - isolation, 4 µm - white ground, 100 µm - sizing, <14 µm - *xi ni*	PP Z 42 - lead white - yellow iron oxide, extremely fine or imbedded in medium - round yellow pink, isotropic, organic			x ?	x ?			samp-ling area UV sample micro CS 1 CS 2 PP Z 42	Hu Kejia: XRD: lead white and gypsum (not clear which layer)	Hu et al. 2012, table 3 (XRD): cerussite; (kaolinite, quartz, calcite)
sanguo xi 13	*sx* 13	small pavilion, cloth on table	yellow ochre	sur fac e	x	x	0.3 x 0.2 x 0.1 cm	CS 1 - coating, 2.6 µm - thin transp., 1.5-5 µm, UV white - thin with reddish pigments, 2 µm - thin ochre, transl., 8 µm - isolation, 2 µm - lead white layer,3-8 µm - isolation layer, contains charcoal, UV: light-colour, 1.8 µm - white ground, 40-86 µm - sizing, 1.4 µm	PP Z 43 (paint layer) - lead white (underpainting) - few yellow iron oxide - Prussian blue, few - some black - organic > dyestuff PP Z 44 (white ground) - white earth (clay minerals etc.)		2012 Ca, Fe, Pb S, Si, Al, K					sample samp-ling area CS 1 PP Z 43	Hu Kejia: upper layer: Pb, Si, K, Cl Hu et al. 2012, table 1, PLM: iron oxide yellow	Hu et al. 2012, table 5: yellow iron oxide, cerussite
sanguo xi 14	*sx* 14	horse of figure no. 31	pink	x	x	x	0.6 x 0.5 x 0.2 cm	CS 1 CS 2, TS 2 - pink translucent, 1.5 µm - layer with red + red, 16-20 µm, cracks - lead white, 2 µm - isolation, 5-11 mm, contains charcoal - thin, with lead white - white ground, 78-100 µm, contains charcoal - sizing - *xi ni*	PP Z 45 (pink) - lead white - fine red iron oxide - single cinnabar, red lead, reddish binding medium PP Z 46 (white ground) - white earth (clay minerals etc.)		2012 Ca, S Fe	- S in isolation between *xi ni* and white ground				sample CS 1 TS 2 PP Z 45	Hu Kejia: upper red layer: Pb, Ca, Fe, Al, Si, organic paint layer: Pb, K, Ca Hu et al. 2012, table 1: red iron oxide	Hu et al. 2013 b, table 1: lead white and red ochre on lead white layer

sanguo dong

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
sanguo dong 1	*sd* 1	background above entrance gate grassland?	brown, UV: black	x	x	x	0.6 x 0.5 x 0.2 cm	CS 1, TS 1 - thin brown layer with green particles - white ground, several layers, partly stained brownish - sizing - *xi ni*	PP Z 24 - a lot of brown binding medium - malachite - botallackite - carbon black - Prussian blue, few - flame carbon (together with Prussian blue)							sample CS TS	fibres	
sanguo dong 2	*sd* 2	gilded weapon 2 flakes	gilding		x	x	0.2 x 0.1 cm // 0.1 x 0.1 cm	*comparable to sd 4* gold on thick transparent layer, thin reddish layer underneath					x proteins SABATINI 2012: T: glue, polysacch.	SABATINI 2012: T: glue, polysacch.		sample micro	Hu Kejia, SEM, element mapping: - red layer: Hg, S - mordant: N, Pb > ?	HU et al. 2012: gold: Au 92.94%, Ag, Cu red mordant: C, Hg, S: cinnabar
sanguo dong 3	*sd* 3	robe of figure no. 1	light red to pink	x	x	x	0.4 x 0.4 x 0.1 cm	CS 1 - coating?, 2 µm - darker red for folds - thin reddish pink layer, 5 µm - white layer, 5 µm - isolation - white ground - sizing - *xi ni*	PP Z 25 (pink), 26 (dark pink) - red lake or dyestuff mixed with binding medium - cinnabar, few, small - rounded like starch, but no cross - white > titanium white? - black : flame carbon or bone black - some calcite - dark red iron oxide - lead white in lower layer				dyestuff? SABATINI 2012: ground + p.l.: glue, egg*, polysacch.			sample micro PP Z 25, 26 CS 1	HPLC dyestuff? HU et al. 2012, table 1: red dyestuff; XRF: Pb > cerussite in lower layer	red layer has no fluorescence HU et al. 2013 b, table 1: dyestuff, lead white
sanguo dong 4	*sd* 4	sword	gilding		x	x		CS 1 - gold leaf - transparent orange layer, 14-27 µm - thin red layer, 3 µm - isolation? - white ground. 32-42 µm - sizing - *xi ni*				element of red layer?	SABATINI 2012: T glue, egg*, polysacch.			sample micro CS 1		
sanguo dong 5			dark, may be blue													sample		not in the sample list: not analysed

sanguo dong (cont.)

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done*										remarks
								CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	
sanguo dong 6	*sd* 6	water, today looking brown, left edge of painting two flakes	brown (?) UV: brown		x	x	0.3 x 0.2 cm	CS 1, CS 2, CS 3 brownish layer with green and other particles - white ground, stained brown - sizing - *xi ni*	PP Z 91 (red or blue) PP Z 91, red or blue? - bone black, few - malachite, few - binding medium PP Z 92, (blue, black) - bone black - charcoal black? - orpiment or lead oxide? - soil comp. PP Z 93 (red) - red lead, few -lead oxide or orpiment (green IF) -iron oxides -charcoal particles PP Z 94 (bluish) -iron oxides - fine-grained black - cinnabar - PP Z 95 (bluish) iron oxides -small malachite particles -graphite, -bone black, few -few cinnabar - lead oxide or orpiment (green IF)							samp-ling area sample micro CS 2, CS 3		different pigments from shading of different areas or spread from adjacent figures?
sanguo dong 7	*sd* 7	grassland/ edge of coast of island, right to Guan Yu's horse: a black line and a brown wash included	olive green UV: purplish black		x	x	0.4 x 0.5cm	CS 1, CS 2 - brown translucent with green, red and dark particles - black line - white ground, stained brown	PP Z 86 (black line) - charcoal black - Prussian blue PP Z 87- 88 green part.: malachite background: - malachite - red lake, few - cinnabar - Prussian blue - charcoal (?) black							samp-ling area sample micro CS 1, CS 2		

sanguo dong (cont.)

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done*										remarks
								CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	
sanguo dong 8	*sd* 8	hill top, left to the deer: with green, semi-opaque layer several small flakes	dark green (covered with brown) UV: dark black		x	x	up to 0.2 x 0.2 cm	CS 1, TS 1 - brown coating or glaze - thick green layer - black contour - thin layer with green pigments - black delineation - white ground, stained brown - sizing - *xi ni*	PP Z 89(background) - malachite - azurite, few - black, rather coarse (bone black?) - binding medium PP Z 90 (green area) - bone black or flame carbons - malachite - cinnabar, few - red lake 1 part. - lead white, few - white earth from ground layer							sampling area sample micro CS 1, TS 1		
sanguo dong 9	*sd* 9	brown material brushed onto white framing, left edge, outside of contour	brown UV: lighter brown		x	x	s						x BM			sampling area		as sx 10
sanguo dong 10	*sd* 10	yellow layer on top of white horse, middle of the wall	transparent yellow, scraped off		(x)	x	s						x colourants?			sampling area		colourants, binding medium

yunqi xi

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done*										remarks
								CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	
yunqi xi 1	*yx* 1	background	white	x	x	?	m+	CS 1 - thin brown layer - white ground, contains charcoal black - (sizing) - *xi ni*	PP Z 8 - clay minerals - few calcite part.				preparation: animal glue - surface: egg + polysacch. SABATINI 2012: I (isol. + ground): glue PL: polysacch.			sample	HU et al. 2012, table 1: - calcium carbonate - yellow iron oxide	
yunqi xi 2	*yx* 2	cloud	blue (on top of black)	x	x	x	1.0 x 0.3 x 0.1 cm	CS 1 - transp. brown - black - blue - black - white ground - sizing - *xi ni*	PP Z 1, PP Z 2 - Prussian blue -Bone black or flame carbons							sample Micro PP Z 1, 2 CS 1	HU et al. 2012, table 5: Prussian blue, charcoal black	
yunqi xi 3	*yx* 3	pearl, 2nd ring	orange			x	0.5 x 0.4 cm	- transpr. brown - orange, two applications - white ground - *xi ni*	PP Z 9 - red lead							sample PP Z 9	HU et al. 2012, table 1: - red lead	HU et al. 2012, table 3 (XRD): - red lead - kaolinite, quartz, calcite
yunqi xi 4	*yx* 4	pearl, 3rd ring	deep orange			x	0.6 x 0.5 x 0.1 cm	CS 1 - orange, only one layer visible - thin transl. orange - white ground, with charcoal - sizing - *xi ni*	PP Z 10 - red lead							sample	HU et al. 2012, table 1: - red lead	HU et al. 2012, table 3 (XRD): - red lead
yunqi xi 5	*yx* 5	pearl, centre	dark red glaze on deep orange	x	x	x	0.3 x 0.2 cm	CS 1 - red transl. glaze - red - orange white ground - sizing - *xi ni*	PP Z 11 (red) - cinnabar - binding medium very brownish, discoloured or stained with dyestuff							sample PP Z 11	HU et al. 2012, table 1 and 5: - cinna-bar - red lead	
yunqi xi ***6***	*yx* 6	pearl, 1st ring	light brownish		x	x	s	CS 1 - transparent layer with single black ore red particles - white ground - sizing - *xi ni*	PP Z 101 - fine yellow ochre - greenish yellow pigment, fine, RF higher than 1.662, IF yellow: iron oxide (?) - red lead, few - coarse black (charcoal?), few - calcite? (in lumps of binding medium)			x	x			sampling area CS 1		organic colourants ?

tianguan cifu

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
tianguan cifu 1	*tg* 1	rock formation, left side	dark brown		x?	x	0.5 x 0.3 x 0.02 cm	CS 1 - brown medium with dark particles, - white ground, stained brown (- sizing)	?				?			sample micro CS 1		
tianguan cifu 2	*tg* 2	official; surrounded by brown layer of cloud, lower area of robes: brown material partly covered by red paint layer	red on top of brown		x	x	b	CS 1 - thin coating?, UV whitish - pinkish glaze - lead white layer - isolation - white ground - sizing - *xi ni*	PP Z 97 red and black - cinnabar, few -red iron oxide -cinnabar -red lake or dyestuff mixed with binding medium - red lead? -flame carbons or bone black -calcite - white earth - quartz - carbon black, 1 part. PP Z 98 red on top of white				?			samp-ling area sample CS 1		

pingfeng bei

sample no.	*abbrei-vation*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
pingfeng bei 1	*pfb* 1	panel 6 *d*, lighter coloured area? several flakes	brown, with salts		x	x	up to 1.5 x 1.5 cm	- salts? - brown layer - ground layer, stained brown - traces of *xi ni*	PP Z 12 brown = organic							sample		
pingfeng bei 2	*pfb* 2	panel 5 *b*, border with flowers	sky blue with white line		x	x	0.4 x 0.2 cm	- white line - medium blue ground - white ground layer	PP Z 5 - Prussian blue - botallackite? - unknown white (untypical lead white?) PP Z 6 (ochre) - yellow iron oxide PP Z 20 (w. g.) - white earth PP Z 21 (white line) - lead white, with hexagonal plates							sample Micro PLM	Hu et al. 2012, table 5: Prussian blue, cerussite Hu et al. 2013 b: no lead white in blue	Hu et al. 2012, Raman of white layer (white lines?): lead white
pingfeng bei 3	*pfb* 3	panel *5 c*, peony leaves	green		x	x	1.3 x 0.5 cm	CS 1 - dark brown, very thin - brown glaze, 2-6 µm, UV white - black lines of leaf, 2 µm - brown glaze, 2.5 µm - green with dark green shade, 18-21 µm - black > contour - blue > background - isolation? - lead white layer> 10 µm - isolation - white ground > 22 µm	PP Z 13-17 - Prussian blue (blue) - lead white (white) - botallackite (green) - flame carbons or bone black (black inner contours) - charcoal black (lower outer contour)	botta-lackite gyp-sum	2012 - Cu - Ca - Pb - S - Fe - Ti - Si - Al - K	Cu, Cl	x brown glaze				sample Micro CS PLM	Hu Kejia, XRD> kaolinite gypsum anglesite bottallackite	Hu et al. 2012, table 5: botallackite, azurite, cerussite table 3 (XRD): - botallackite, gypsum; kaolinite
pingfeng bei 4	*pfb* 4	panel 1 *c*, panel frame	bright yellow	surface	x	x	0.8 x 0.5 x 1.0 cm	- thin brown coating - yellow - white ground - *xi ni*	PP Z 29 (yellow) - orpiment							sample PLM	Hu et al. 2012, Raman: orpiment	
pingfeng bei 5	*pfb* 5	panel 2 *d*, white fluffy material on surface	black				m	- fluffy white material - black - white ground	PP Z 18, 19 (black) - flame carbons	x white						sample PP Z 19		
pingfeng bei 6	*pfb* 6	panel *3* c, background of panel filling	dark blue		x	x	0.1 x 0.1 cm	CS 1 - blue - white ground	PP Z 7 ab - Prussian blue, big and small particles							sample PLM CS 1		
pingfeng bei 7	*pfb* 7	salt efflorescence	grey					salt efflorescence dusted off from the unpainted surface behind lost pedestal		x							ion chromatography	
pingfeng bei ***8***	*pfb* 8	fragments from 2nd *cu ni*		*cu ni*				collected from floor										consolida-tion tests
pingfeng bei ***9***	*pfb* 9	fragments from *xi ni*, collected from floor		*xi ni*														analysis of inorganic binding medium (lime?)

long

sample no.	*Abbrev*	*position / description*	*colour*	*clay*	*ground*	*paint layer*	*size*	*analyses: questions - done* CS / stratigraphy	PLM	XRD	XRF	SEM on CS	GC-MS	Py-GC-MS	FT-IR	photo	others	remarks
long 1	*L* 1	white layer on the black surface	?	x	x	x	2.5 x 1.4 x 0.3 cm	- white fluffy material - black - white ground - *xi ni* - *cu ni*	PP Z 2 (black) - flame carbons PP Z 23 (white ground) - white earth	XRD white, 2011-10-18 - gypsum, 50 % - quartz, 30 % - calcite, 10 % - kaolinite, 8 % - muscovite, 8 %						sample	ion chro-matogrphy Fluoride 0,045 g/kg Phosphate 0,250 g/kg Chloride 1,740 g/kg Sulphate 3,145 g/kg Nitrate 13,985 g/kg	
long 2	*L* 2	*cu ni*, detached flake	contains white "crystals"	*cu ni*			b			XRD white inclusions from plaster, 2011-10-21 - gypsum, 62 % - quartz, 30 % - albite, 4 % - muscovite, 4 %						sample		
long 3	*L* 3	*xi ni*, seven detached flakes		*xi ni*			max. 5.0 x 4.0 x 0.4 cm			XRD, white ground - quartz, 74% - muscovite, 10 % - chlinochlore, 7 % - albite. 5 % - calcite, 4 %						sample		
long ***4***	*L* 4	background depicting water, water-soluble layer	off-white		x	?	s	CS 1 - thin layer with red and black particles, UV white; ridges more brown - white ground	PP Z 99 (surface) - white earth - quartz - calcite, few - 1 cinnabar, small - fine black in clusters (flame carbons?) - charcoal black, few				x BM			samp-ling area CS 1		pigments organic colourants binding media
long ***5***	*L* 5	dragon's breath, not water-soluble	off-white, glossy		x	x		CS 1 - lead white layer - white ground - *xi ni*	PP Z 100 - lead white				x dyestuff ?					pigments organic colourants binding media

Annotation:

Classification of samples

size					analysis of organic materials						
abbreviation	b	m	s	w. g.	B	T	PR	PL	I	M	S
meaning	big	medium	small or powder	white ground layer	bulk	total	preparation layer	paint layer	isolation layer	layers above ground	surface

+ = rather big within category, - = rather small within category

Analyses, Appendix 3: Evaluation of samples according to materials

pigment	*sample*	*Preparation / CS*	*layers / description*	*all components / remarks*
WHITE				
lead white	*pfb* 2	PP Z 21	panel 5 *b*, white (line) on top of blue	lead white (with hexagonal plate; plate-like particles are isotropic)
	pfb 3	PP Z 13	panel 5 *c*, white petals	- lead white
	sx 12	PP Z 42 *sx* 12 CS 1	flag, white paint layer with "snake-shaped" orange inclusions	- lead white - very fine yellow iron oxide ?, imbedded in medium - round yellowish pink, organic, isotropic
	sx 13	PP Z 43, 44	ochre cloth, white underpainting	- lead white
	sx 14	PP Z 45	pink horse (figure no. 31), paint layer and glaze	- lead white - red, probably iron oxide - 1 red lead; 1 cinnabar - red binding medium - calcite
	sd 3	PP Z 25	purplish pink robe of servant (figure no. 1)	- lead white (underpainting) - cinnabar - pink dyestuff in binding medium - fine black particles - dark red iron oxide
	pfx 10	PP Z 56	panel 1 *b*, bluish green ground of border	- malachite - azurite, less then malachite - red and yellow iron oxide - angular black - lead white
	pfx 11	PP Z 59	panel 2 *a*, pink star	- lead white - cinnabar
	pfx 14	PP Z 71	panel 4 *a*, white background of lattice	- lead white
	pfx 15	PP Z 63	panel 4 *b*, blue ground of border	- Prussian blue in glassy parts (of binding medium) - Prussian blue mixed with lead white
	pfx 15	PP Z 76	panel 4 *b*, white line on top of blue	- lead white
	pfx 17	PP Z 64	blue fruit bowl, panel 3 *c*	- azurite (main component) - Prussian blue - malachite - lead white, mixed with Prussian blue or not mixed - dark red, isotropic - clusters of black
	pfd 1	PP Z 65	bright pink star pattern, panel 7 *b*	- cinnabar - lead white
	pfd 1	PP Z 66	background of border, panel 7 *b*	- Prussian blue - lead white
	long 5	PP Z 100	dragon's breath	- lead white
calcite	*pfd* 3	PP Z 3a		
	sd 3	PP Z 25, 26	pink robe	
	sx 1	PP Z 27 PP Z 28	black white ground layer	
	sx 14	PP Z 45	in white ground layer or paint layer	
	pfx 6	PP Z 47, 48	probably from ground layer	
	pfx 7	PP Z 50	white ground layer	few particles
calcite with coccoliths	*yx* 1	PP Z 8		1 coccolith
	pfd 2	PP Z 68	white ground layer	
	pfd 3	PP Z 69	white or ground layer	

pigment	*sample*	*Preparation / CS*	*layers*	*all components / remarks*
WHITE (CONT.)				
starch grains	*sd* 3	PP Z 25	pink robe, paint layer	rounded particles like starch, but no cross under crossed nicols; not clear from which paint layer
	sx 1	PP Z 27	black	several starch grains
	pfx 6	PP Z 48	ground layer	1 angular starch grain
	pfx 11	PP Z 61	ground layer	1 starch grain
	pfx 17	PP Z 64	blue	azurite, Prussian blue, malachite, 1 starch grain
	pfx 8	PP Z 73	red particles in pinkish brown layer	red lead, iron oxide, orpiment, 1 starch grain
charcoal in white ground layer	*pfx* 6	CS 1		
	pfx 7	CS 1, CS 2		
	pfx 8	CS 1		
	pfx 11	CS 1		
	pfx 13	CS 1		
	pfx 14	CS 1		
	pfd 3	CS 1		
	sx 4	CS 1 CS 2		
	sx 6	CS 2		
	sx 8	CS 2		
	sx 9	CS 2		
	sx 13	CS 1 PP Z 44		
	pfb 6			
	yx 1	CS 1		
	yx 4	CS 1		
charcoal and iron oxide in white ground layer	*pfx* 9	CS 1		
	pfx 12	CS		
	pfd 1	CS 1		
	pfd 2	CS 2		
	pfd 3	CS 1		
	sx 5	CS 1		
	sx 7	CS 1		
	sx 10	CS 1		
	sx 12	CS 2		
	sx 13	CS 1		
	sd 1	CS 1		
	sd 3	CS 1		
	sd 4	CS 1		
	long 5	CS 1		a lot of coarse, bright yellow iron oxide
	pfb 3	CS 1		
iron oxide, no charcoal	*pfx* 17	CS 1		yellow iron oxide
no charcoal, no iron oxide	*sx* 11	CS 2		
YELLOW				
orpiment	*pfb* 4	PP Z 29	panel 1 *c*, bright yellow panel frame	- orpiment
	pfx 8	PP Z 51	panel 7 *d,* pinkish brown panel framing, yellow particles	- yellow particles: orpiment - other particles: red lead, reddish brown iron oxide
yellow iron oxide	*sx* 12	PP Z 42 *sx* 12 CS 1	flag, white paint layer with streaky orange inclusions	- lead white - very fine yellow iron oxide, imbedded in medium - round yellowish pink, organic, isotropic
	sx 13	PP Z 43	ochre cloth, top layer	- iron oxide - organic dyestuff?
	yx 6	PP Z 101	pearl, ring 1	- fine yellow iron oxide - more greenish iron oxide, maybe stained with dyestuff? - red lead, few - charcoal black

pigment	*sample*	*Preparation / CS*	*layers*	*all components / remarks*
ORANGE, RED AND BROWN				
red lead	*yx* 3	PP Z 9	light orange	thin layer, translucent
	yx 4	PP Z 10	dark orange	opaque layer
	sx 5	PP Z 33b	orange below red	- red lead
	sx 14	PP Z 45	pink horse (of figure no. 31), paint layer and glaze	- lead white - red iron oxide - 1 red lead - 1 cinnabar - red binding medium - calcite
	pfx 8	PP Z 51	pinkish brown panel framing	- orpiment - reddish brown iron oxide - angular black - red lead - small particles cinnabar, few
	pfx 8	PP Z 73	pinkish brown panel framing, red particles	- red lead - few cinnabar ? - orpiment - clusters of fine brown particles. maybe iron oxide - starch grain
cinnabar	*sd* 3	PP Z 25, 26	translucent pink which shades in darker pink	- red lake or dyestuff in binding medium - cinnabar, few, small - dark red iron oxides, few - flame carbon or bone black, few - calcite, few
	sd 7	PPZ 88	olive-green “grassland”	- malachite - black (angular?) - red lake (few) - cinnabar - Prussian blue
	sx 5	PP Z 33, 81	bright red	- cinnabar
	sx 14	PP Z 45	pink horse (of figure no. 31), paint layer and glaze	- lead white - red iron oxide - 1 red lead - 1 cinnabar - red binding medium - calcite
	yx 5	PP Z 11	brownish red glaze	- cinnabar in brown medium
	pfx 8	PP Z 51	pinkish brown panel framing	- orpiment - reddish brown, maybe iron oxide - angular black - red lead - small particles cinnabar, few
	pfx 11	PP Z 58	panel 2 *b*, red centre of star segment	- cinnabar
	pfx 11	PP Z 59	panel 2 *b*, pink star segment	- cinnabar - lead white
	pfd 1	PP Z 65	panel 7 *b*, bright pink star pattern	- cinnabar - lead white
red lake	*sd* 3	PP Z 25, 26	translucent pink which shades in darker pink	- red lake or dyestuff in binding medium - cinnabar, few, small - dark red iron oxides, few - flame carbon or bone black, few - calcite, few
	sd 7	PPZ 88	olive-green “grassland”	- malachite - black (angular?) - red lake (few) - cinnabar - Prussian blue
dark red iron oxide	*sd 3*	PP Z 25, 26	translucent pink which shades in darker pink	- red lake or dyestuff in binding medium - cinnabar, few, small - dark red iron oxides, few - flame carbon or bone black, few - calcite, few

pigment	*sample*	*Preparation / CS*	*layers*	*remarks*
ORANGE, RED AND BROWN (CONT.)				
red iron oxide	*sx* 14	PP Z 45	pink horse (of figure no. 31), paint layer and glaze	- lead white - red iron oxide - 1 red lead - 1 cinnabar - red binding medium - calcite
	pfx 6	PP Z 47	black frame	- flame carbons (?) - Prussian blue, few - red iron oxides
	pfx 8	PP Z 51	pinkish brown panel framing	- orpiment - reddish brown, maybe iron oxide - angular black - red lead - small particles cinnabar, few
	pfx 8	PP Z 73	pinkish brown panel framing, red particles	- red lead - few cinnabar ? - orpiment - clusters of fine brown particles. maybe iron oxide - starch grain
reddish brown, dark	*pfx* 14	PP Z 72 PP Z 62	panel 4 *a*, reddish brown lattice	- fine reddish brown iron oxide - brownish organic material
	pfx 12	PP Z 78	panel 5 *e* (background?), in CS: black on red)	- fine black pigment - iron oxide (?)
brown iron oxide	*pfx* 7	PP Z 49	brown framework, UV: brown	- very fine brown particles, maybe iron oxide - dark brown organic - fine-grained black
BLUE				
azurite	*sx* 7	PP Z 35	green robe	- malachite, few azurite - green with high relief and low IF - black, rather coarse, but rounded - brownish binding medium
	pfd 2	PP Z 67	panel 8 *b*, green from border	- azurite - green: like lead white, but low IF
	pfd 3	PP Z 70 PP Z 3ab	panel 5 *e*, light greyish green ornament	- Prussian blue - unknown green ? (PP Z 3 ab) - one particle azurite (PP Z 70)
	pfx 10	PP Z 54	panel 1 *b*, dark blue centre of star segment	- flame carbon - azurite - malachite, few - dark red, isotropic
	pfx 10	PP Z 55	panel 1 *b*, blue star segment	- azurite - malachite, less than azurite - dark red, isotropic - angular black
	pfx 10	PP Z 56	panel 1 *b*, bluish green ground of border	- malachite - azurite, less then malachite - red and yellow iron oxide - angular black - lead white
	pfx 17	PP Z 64	panel 3 *c*, blue fruit bowl of area 3 c	- azurite - Prussian blue - malachite - lead white, mixed with Prussian blue or not mixed - dark red, isotropic - clusters of black
smalt	*sx* 8	PP Z 36	sunshade. dark blue or green	- smalt - brownish binding medium - Prussian blue - fine-grained black

pigment	*sample*	*Preparation / CS*	*layers*	*remarks*
BLUE (CONT.)				
Prussian blue	*pfb* 2	PP Z 5	panel 5 *b*, bright blue ground of border	- Prussian blue - unknown white (probably no lead white)
	pfb 3	PP Z 14	blue, coarse-grained, dark – background of panel 5 *c*	- Prussian blue
	pfb 6	PP Z 7 ab	panel 3 *c*, background of panel filling	- Prussian blue
	yx 2	PP Z 1; 2	dark blue	- Prussian blue on top of black (charcoal black or flames carbons)
	sd 1	PP Z 24	brown (originally maybe bluish green)	- few Prussia Blue, mixed with flame carbon, - brown binding medium in lumps - malachite - botallackite - charcoal black
	sx 4	PP Z 30, 32	"brown background": greenish layer	- Prussian blue - brownish binding medium - malachite PP Z 31: charcoal black ?
	sx 8	PP Z 36	sunshade, dark blue or green	- smalt - brownish binding medium - Prussian blue - fine-grained black
	sx 9	PP Z 39	"brown background", in UV brown, original colour not clear	- brownish layer with inclusions of Prussian blue - white or green with high IF - botallackite - titanium white ? - fine-grained black (no lead white, no malachite)
	sd 7	PPZ 87, 88	olive-green "grassland"	- malachite - black (angular?) - red lake (few) (PP Z 88) - cinnabar (PP Z 88) - Prussian blue (PP Z 88)
	pfd 3	PP Z 3 ab PP Z 70	panel 5 *c*, greyish green ornament	- Prussian blue - green or white? - 1 particle azurite (PP Z 70)
	pfx 6	PP Z 47	black framing	- flame carbons (?) - Prussian blue, few - red iron oxides
	pfx 11	PP Z 59, 60	panel 2 *b*, blue ground of border	- Prussian blue in glassy parts (of binding medium) - Prussian blue mixed with lead white
	pfx 15	PP Z 63	panel 4 *b*, blue ground of border	- Prussian blue in glassy parts (of binding medium) - Prussian blue mixed with lead white
	pfx 17	PP Z 64	panel 3 *c*, blue fruit bowl	- azurite (main component) - Prussian blue - malachite - lead white, mixed with Prussian blue or not mixed - dark red, isotropic - clusters of black
	pfd 1	PP Z 66	panel 7 *b*, background of border	- Prussian blue - lead white

pigment	*sample*	*Preparation / CS*	*layers*	*remarks*
GREEN				
malachite	*sx* 4	PP Z 30, 32	"brown background": greenish layer	- Prussian blue - brownish binding medium - malachite - PP Z 31: charcoal black ?
	sx 7	PP Z 35	green robe of figure no.18	- malachite, some green particles contain As and Pb - few azurite - lead white - black, rather coarse, but rounded (charcoal black?) - brownish binding medium
	sd 1	PP Z 24	brown (originally maybe bluish green)	- malachite - brown binding medium in lumps - unknown green with low IF - Prussian blue mixed with flame carbon - charcoal black
	sd 6	PP Z 91, 92	water (left edge of painting)	- bone black or flame carbons, few - charcoal black(?) - malachite, few - lead oxide or orpiment, few - graphite
	sd 7	PPZ 87, 88	olive-green "grassland"	- malachite - black (angular?) - red lake (few) (PP Z 88) - cinnabar (PP Z 88) - Prussian blue (PP Z 88)
	pfx 9	PP Z 53	panel 7 *d*, green mountain or border of screen	- malachite - brownish organic medium or glaze
	pfx 10	PP Z 55	panel 1 *b*, blue star pattern	- azurite - malachite, less than azurite - dark red, isotropic - angular black
	pfx 10	PP Z 56	panel 1 *b*, blue star pattern, background	- malachite - azurite, less then malachite - red and yellow iron oxide - angular black - lead white
	pfx 17	PP Z 64	panel 3 *c*, blue fruit bowl	- azurite (main component) - Prussian blue - malachite - lead white, mixed with Prussian blue or not mixed - dark red, isotropic - clusters of black
spherical copper chloride	*sx* 6	PP Z 34	bright green, robe figure no. 10	- copper chloride, in large spherical aggregates, diameter 20-40 µm
botallackite (green with high relief and low IF)	*pfb* 3	PP Z 15	panel 5 *c*, light green of leaves	- botallackite
	pfb 3	PP Z 16	panel 5 *c*, dark green glaze of leaves	- botallackite: XRD (Tucic)
	sd 1	PP Z 24	brown (originally maybe bluish green)	- botallackite - brown binding medium in lumps - malachite - Prussian blue mixed with flame carbon - charcoal black
	sx 9	PP Z 39	"brown background", in UV brown, original colour not clear	- brownish layer with inclusions of Prussian blue - white or green with high IF (no lead white or mala.) - botallackite - titanium white ? - fine-grained black
	pfd 2	PP Z 67	panel 8 *b*, border (colour of ground?)	- azurite - botallackite
unknown green or white	*pfb 2*	PP Z 5	blue	Prussian blue mixed with green or white (lead white?)
	pfd 3	PP Z 3 ab	light greyish green ornament of 5 e	Prussian blue mixed with green or white (lead white?)

pigment	*sample*	*Preparation / CS*	*layers*	*remarks*
BLACK				
flame carbon	*sd* 1	PP Z 24	brown (originally maybe bluish green)	- few Prussia Blue, mixed with flame carbons - brown binding medium in lumps - malachite - botallackite - charcoal black
	pfx 6	PP Z 47	black framing, below panel 7 *e*	- flame carbons (?) - Prussian blue, few - red iron oxides
	pfx 10	PP Z 54	panel 1 *b*, dark blue of star pattern	- flame carbons - azurite - malachite, few - dark red, isotropic
	pfb 3	PP Z 17	panel 5 *c*, black line on top of green leaf	- flame carbons
	pfb 5	PP Z 19	panel 2 *d*, black ground	- flame carbons
	long 1	PP Z 21	black, maybe framing	- flame carbons
bone black or flame carbon	*yx* 2	PP Z 2	dark blue	- bone black or flame carbons, mixed with Prussian blue
	sd 3	PP Z 25, 26	translucent pink which shades in darker pink	- red lake or dyestuff in binding medium - cinnabar, few, small - dark red iron oxides, few - flame carbons or bone black, few - calcite, few
	sd 6	PP Z 91, 92	water (left edge of painting)	- bone black or flame carbons, few - charcoal black(?) - malachite, few - lead oxide or orpiment, few - graphite
	sx 1	PP Z 27	black framing	- flame carbons or bone black - calcite, few - starch grains
charcoal black	*pfb* 3	PP Z 13	panel 5 *c*, black line underneath white	- charcoal black
	sd 1	PP Z 24	brown (originally maybe bluish green)	- few Prussia Blue, mixed with flame carbons - brown binding medium in lumps - malachite - botallackite - charcoal black
	sd 7	PPZ 88	olive-green “grassland”	- malachite - black (angular?) - red lake (few) - cinnabar - Prussian blue
	sx 6	PP Z 34	thin grey or black underpainting of green robe	- black, small, angular (charcoal black?) - brownish binding medium - Ca, S (- copper chloride, large spherical aggregates, diameter 20-40 µm)
	sx 7	PP Z 35	green robe of figure no.18	- malachite, few azurite - charcoal black (?, rather rounded) - brownish binding medium
unknown black	*sx* 8	PP Z 36	dark blue or green	- smalt - brownish binding medium - Prussian blue - fine-grained black
	sx 9	PP Z 38, 39	“brown background”, in UV brown, original colour not clear	- brownish layer with inclusions of Prussian blue - white or green with high IF - botallackite - titanium white ? - fine-grained black pigment (no lead white, o malachite)
	pfx 7	PP Z 49	brown frame	- very fine brown particles, maybe iron oxide - dark brown organic - fine-grained black

pigment	*sample*	*Preparation / CS*	*layers*	*remarks*
ORGANIC				
binding medium very discoloured or coloured with dyestuff	*pfb* 1	PP Z 12	brown layer	- only organic, no pigments
	sx 10	PP Z 41	brown layer	- only organic, no pigments
	yx 5	PP Z 11	dark red glaze on red lead	- contains cinnabar
	sd 1	PP Z 24	brown (originally maybe bluish green)	- brown binding medium in lumps - botallackite - Prussian blue mixed with flame carbon - carbon black
	sx 14	PP Z 45	pink horse (of figure no. 31), paint layer and glaze	- lead white - red, probably iron oxide - 1 red lead - 1 cinnabar - red binding medium > dyestuff? - calcite

Analyses, Appendix 4: Evaluation of samples according to colours

colour	*sample*	*preparation*	*description of layer*	*pigments*
WHITE				
white	*pfb* 3	PP Z 13	white petals (or white underpainting?)	- lead white
	pfx 14	PP Z 71	white background of lattice	- lead white
	pfx 15	PP Z 76	white line on top of blue	- lead white
	long 5	PP Z 100	dragon's breath	- lead white
white, slightly orange-tinged	*sx* 12	PP Z 42 *sx* 12 CS 1	flag, white paint layer with bands of orange inclusions	- lead white - very fine yellow iron oxide, imbedded in medium - round yellowish pink, organic, isotropic
white underpainting	*sd* 3	PP Z 25, 26	white underpainting of pink robe	- lead white
	sx 13	PP Z 43	white layer underneath ochre	- lead white
white ground layer	*yx* 1	PP Z 8	white	- white clay minerals - calcite, few - a coccolith?
	pfb 2	PP Z 20	white	- white clay minerals
	sx 1	PP Z 28	white	- white clay minerals - calcite, few
	sx 4	PP Z 31	white	- white clay minerals
	sx 8	PP Z 37	white	- white clay minerals - titanium dioxide-like particles
	sx 9	PP Z 40	white	- white clay minerals
	sx 10	PP Z 41	white with dark coating	- white clay minerals - particles like natural titanium dioxide - clusters like titanium white - brown organic plates - brown iron oxide
	sx 13	PP Z 44	white	- white clay minerals - many like titanium dioxide (?) - angular black - yellow and red iron oxide
	sx 14	PP Z 46	white	- white clay minerals - white lath-shaped, n>1.662 - gypsum?
	pfx 6	PP Z 47	white	- white clay minerals, calcite - 1 angular starch grain - white, angular, high relief, high IF (titanium oxide or orpiment - ??) - white: rounded, like lead white, but very high IF
	pfx 7	PP Z 50	white	- white clay minerals - some like titanium dioxide - calcite, few
	pfx 11	PP Z 61	white	- white clay minerals - like titanium dioxide - reddish brown iron oxide - starch grain
	pfd 2	PP Z 68	white	- clay minerals - calcite, coccoliths - some yellow iron oxide
	pfd 3	PP Z 69	white ground or white layer	- white clay minerals - calcite, some coccoliths
	long 4	PP Z 99	white background	- white clay minerals, calcite, quartz - coarse yellow iron oxide - 1 part. cinnabar - fine-grained black, charcoal black

colour	*sample*	*preparation*	*description of layer*	*pigments*
YELLOW AND OCHRE				
yellow	*pfb* 4	PP Z 29	panel 1 *c*, bright yellow panel frame	- orpiment
ochre	*sx* 13	PP Z 43	ochre in different shades: thin ochre layer on top of lead white layer	- ? (iron oxide ?, organic ?) - one Prussian blue - some black
light yellow brown	*yx* 6	PP Z 101	pearl, ring 1	- fine yellow iron oxide - more greenish iron oxide, maybe stained with dyestuff? - red lead, few - charcoal black
ORANGE, RED AND PINK				
orange to red	*yx* 3	PP Z 9	light orange	- red lead, thin layer
	yx 4	PP Z 10	dark orange	- red lead, opaque layer
red	*yx* 5	PP Z 11	brownish red glaze	- cinnabar in brown medium
	sx 5	PP Z 33 PP Z 81	bright red	- cinnabar
	sx 5	PP Z 33b	red on top of orange	- cinnabar - red lead
	pfx 11	PP Z 58	panel 2 *b* , red of star pattern (inner part of petal)	- cinnabar
pink	*sd* 3	PP Z 25, 26	translucent pink robe which shades in darker pink over underpainting with lead white	- red lake or dyestuff in binding medium - cinnabar, few, small - dark red iron oxides, few - flame carbon or bone black, few - calcite, few
	sx 14	PP Z 45	pink horse, pink paint layer	- lead white - red probably iron oxide
	sx 14	PP Z 45	pink horse (figure no. 31), paint layer and glaze	- lead white - red probably iron oxide - 1 red lead - 1 cinnabar - red binding medium - calcite
	pfx 11	PP Z 59	dark pink of star pattern (outer part of petal)	- cinnabar - lead white
	pfd 1	PP Z 65	bright pink star pattern, area 7 b	- cinnabar - lead white
BROWN				
pinkish brown	*pfx* 8	PP Z 51	pinkish brown panel framing	- orpiment - reddish brown, maybe iron oxide - angular black - red lead - small particles cinnabar, few
	pfx 8	PP Z 73	pinkish brown panel framing, red particles	- red lead - few cinnabar ? - orpiment - clusters of fine brown particles, maybe iron oxide - starch grain
reddish brown, dark	*pfx* 14	PP Z 72 PP Z 62	panel 4 *a*, reddish brown lattice	- fine reddish brown iron oxide - brownish organic material
brown, framework, UV: brown	*pfx* 7	PP Z 49	brown frame	- very fine brown particles, maybe iron oxide - dark brown organic - fine-grained black
brown (in CS: black on red)	*pfx* 12	PP Z 78	panel 5 *e* (background?),	- fine black pigment - iron oxide (?)

BLUE				
blue	*pfb* 2	PP Z 5	panel 5 *b*, bright blue ground of border	- Prussian blue - unknown white (probably no lead white)
	pfb 3	PP Z 14	blue background of panel 5 *c*	- Prussian blue
	pfb 6	PP Z 7 ab	blue background of panel 3 *c*	- Prussian blue
	sx 8	PP Z 36	sunshade, dark blue or green	- smalt - brownish binding medium - Prussian blue - fine-grained black
	pfx 11	PP Z 59, 60	panel 2 *b*, blue ground of border	- Prussian blue in glassy parts - Prussian blue mixed with lead white
	pfx 15	PP Z 63	panel 4 *b*, blue ground of border	- Prussian blue in glassy parts - Prussian blue mixed with lead white
	pfx 10	PP Z 55	panel 1 *b*, blue star segment	- azurite - malachite, less than azurite - dark red, isotropic - angular black
	pfx 17	PP Z 64	panel 3 *c*, blue fruit bowl of area 3 c	- azurite (main component) - Prussian blue - malachite - lead white, partly mixed with Prussian blue - dark red, isotropic - clusters of black
	pfd 1	PP Z 66	panel 7 *b*, background of border	- Prussian blue - lead white
dark blue	*pfx* 10	PP Z 54	panel 1 *b*, dark blue centre of star segment	- flame carbon - azurite - malachite, few - dark red, isotropic
	yx 2	PP Z 1, PP Z 2	dark blue shade of line	- Prussian blue - black (flame carbons or bone black)
blue-green	*pfx* 10	panel 1 *b*, bluish green ground	blue star pattern, background	- malachite - azurite, less then malachite - red and yellow iron oxide - angular black - lead white
light blue / greenish	*pfd* 3	PP Z 3 ab PP Z 70	light greyish green ornament of 5 e	- Prussian blue - unknown green (PP Z 3 ab): no malachite - one particle azurite (PP Z 70)

colour	*sample*	*Preparation*	*colour of layer*	*pigments*
GREEN				
green	*pfb* 3	PP Z 15	panel 5 *c*, light green of leaves	- botallackite
	pfb 3	PP Z 16	panel 5 *c*, dark green glaze of leaves	- botallackite
	sx 6	PP Z 34	bright green, robe figure no. 10	- copper chloride, in large spherical aggregates which break during preparation of samples, diameter 20-40 µm
	sx 7	PP Z 35	green robe of figure no.18	- malachite, including green particles containing As and Pb - few azurite - lead white - black, rather coarse, but rounded (charcoal black?) - brownish binding medium
	pfx 9	PP Z 53	panel 7 *d*, green mountain or border of screen	- malachite - brownish organic medium or glaze
	pfd 2	PP Z 67	panel 8 *b*, border (colour of ground?)	- azurite - botallackite
	sd 7	PPZ 87	olive-green "grassland"	- malachite - black (angular?)
	sd 8	PP Z 89	background next to deer: brown or green?	- malachite - azurite, few (from malachite) - black, rather coarse, maybe bone black - binding medium
	sd 8	PP Z 90	green particle from sample	- malachite - bone black - cinnabar, few - red lake, 1 particle - lead white. few
BLACK				
black	*pfb* 5	PP Z 19	panel 2 *d*, black ground	- flame carbon
	pfx 6	PP Z 47	black framing, below panel 7 *e*	- flame carbons (?) - Prussian blue, few - red iron oxides
	long 1	PP Z 22	black, probably from framing	- flame carbon
	sx 1	PP Z 27	black framing, lower edge	- flame carbons or bone black - calcite, few - starch grains
black lines underneath paint layer	*pfb* 3	PP Z 13	panel 5 *c*, green leaves, black line underneath white	- charcoal black with visible cell walls
black lines on top of paint layer	*pfb* 3	PP Z 17	panel 5 *c*, black lines on top of green leaves	- flame carbons or bone black?
black underpainting	*sx* 6	PP Z 34	green robe of figure no.18, underpainting	- malachite, including green particles containing As and Pb - few azurite - lead white - black, small, angular (charcoal black?) - brownish binding medium
	sx 9	PP Z 38	"brown background", probably boat, in UV brown, original colour not clear	- fine-grained black - some Prussian blue, maybe from layer below

colour	*sample*	*Preparation*	*colour of layer*	*pigments*
BROWN IN BACKGROUNDS OF LANDSCAPE				
brown coating, UV yellowish brown	*pfb* 1	PP Z 12	panel 6 *d*, brown coating	- organic, not pigments
brown intermediate layer	*sx 10*	PP Z 41	brown layer outside of the painting on white framing	- organic, no pigments
brown, UV brown	*sx* 9	PP Z 39	"brown background", probably boat, in UV brown, original colour not clear, maybe brown	- brownish layer with inclusions of Prussian blue - white or green with high IF - botallackite - titanium white ? - fine-grained black pigment (no lead white, no malachite)
brown, UV brown	*sd* 6	PPZ 91, 92	water (left edge of painting)	- bone black or flame carbons, few - charcoal black - malachite, few - lead oxide or orpiment, few - graphite
brown, UV black	*sx* 4	PP Z 30, 31	greenish layer: "brown background", UV black	- Prussian blue - brownish binding medium - green part. in medium: malachite - PP Z 31: charcoal black ?
	sd 1	PP Z 24	brown background above entrance gate ("grassland"?), originally maybe bluish green	- few Prussian blue, mixed with flame carbons - brown binding medium in lumps - malachite - botallackite - charcoal black
	sd 7	PPZ 87, 88	olive-green "grassland"	- malachite - black (angular?) - red lake (few) (PP Z 88) - cinnabar (PP Z 88) - Prussian blue (PP Z 88)
	sd 8	PP Z 89	hill next to deer, brown or green?	- malachite - azurite, few (from malachite) - black, rather coarse, maybe bone black - binding medium
	sd 8	PP Z 90	green particle from sample	- malachite - bone black - cinnabar, few - red lake, 1 particle - lead white, few

Analyses, Appendix 5: Evaluation of structure and layers

Stratigraphy

question	*samples*
isolation below white ground layer	- *pfx* 6 CS 1 - *pfx* 7 CS 1, CS 2 - *pfx* 8 CS 1 (brown frame) - *pfx* 9 CS 1 - *pfx* 10 CS 1 - *pfx* 11 CS 1 ? (*xi ni* missing) - *pfx* 12 CS 1 - *pfx* 13 CS 1 - *pfx* 14 CS 1 - *pfx* 22 CS 1 - *pfd* 1CS 1 - *pfd* 2 CS 2 - *pfd* 3 CS 1 - *sx* 4 CS 1 : maybe isolation layer - *sx* 6 CS 2 (green) - *sx* 7 CS 2 (robe) - *sx* 9 CS 2 (boat) - *sx* 10 CS 1 (white next to painting) - *sx* 11 CS 1, CS 2 (brown background) - *sx* 12 CS 2 ("red light") - *sx* 13 CS 1 (ochre table cloth) - *sx* 14 CS 2 (pink horse) - *sd* 1 - *sd* 3 - *sd* 4 CS 1 (gold) - *yx* 1 - *yx* 2 - *yx* 4 - *yx* 5 - *pfb* 6
isolation below white ground layer not visible	- *pfb* 3 - *sx* 8 CS 2 (no *xi ni*) - *pfx* 11 - *pfx* 17 (lower part of white ground lost) - *sx* 5 CS 2 (no *xi ni*)
isolation layer between white ground layer and paint layer	- *pfx* 14 CS 1 - *sx* 5 CS 2 - *sx* 12 CS 2 - *sx* 13 CS 1 (ochre cloth) - *sd* 3 -*tg* 2 CS 1 official's robe
binding medium layer below paint layer	- *sx* 7 CS 2: brownish, no fluorescence
isolation below and above white ground layer (two isolation layers)	- *sx* 12 CS 2 ("red light") - *sx* 14 (pink horse) - *sd* 3 - *tg* 2 CS 1
white ground layer on top lighter (>isolation layer?)	- *pfx* 11 ? - *pfx* 12 - *pfd* 1 - *pfd* 2 - *pfd* 3 - *yx* 2 ? - *yx* 4 ? - *yx* 5 - *pfb* 6 - *sx* 6

question	*samples*
strongly coloured glazes	- *pfx* 9 CS 1: dark glaze or coating - *sx* 8 (PP Z 36): dark blue or green: smalt particles surrounded by dark brown (UV orange) - *sx* 11: very thin brown layer on top of green - *sx* 13 (PP Z 43): ochre colour achieved with coloured glazes on lead white - *sx* 14 (PP Z 45), pink horse: red glaze for shading or pink coloured binding medium for top layers - *sd* 3: translucent pink robe: the glaze is used for the shading of the robe - *pfb* 3 CS 1 and PP Z 13: dark glaze on brown overlaps black line: looks brownish, 2 µm - yx 5 (PP Z 11), *yunqi*-pearl inner circle: cinnabar in glaze on red lead
slightly coloured glaze or coating	- *pfx* 9 (PP Z 53): glaze or binding medium - *sx* 9 (PP Z 38): black line, coating brownish: 2-3 µm - *pfd* 2 (PP Z 67): green of border in b-panel
colourless layer / coating on top	- *pfx* 6, PP Z 47 (black framing) - *pfx* 8 (pinkish brown panel framing) - *yx* 1: brownish
coating penetrated into the paint layers	- *pfx* 8 CS 1, brown frame > coating or glaze ? - *pfx* 9 coating penetrated into upper white ground layer - *sx* 6 CS 1 - *sx* 8 - *sx* 11 (brown background) - *sx* 12 CS 2 (flag): thin brown coating has penetrated into paint layer - *sd* 1 CS 1 - *sd* 6 CS 2. CS 3 - *sd* 7 CS 1, CS 2 - *sd* 8 CS 1 - *yx* 3 (not visible in CS) - *yx* 2 (not visible in CS)
White ground layer discoloured brown	- *pfx* 13: upper layer of ground layer - *sx* 5 (red columns) --*sx* 10 CS 1, PP Z 10, CS 1 (white framing) - *tg* 1 CS 1: white ground layer is completely brown
brownish binding medium	- *pfb* 1 (PP Z 12): the brown layer does not seem to contain pigments - *sd* 1 (PP Z 24): brown background of painting, original colour bluish green ? - *sx* 4 (PP Z 30): “brown background”: greenish layer - *sx* 7 (PP Z 35): green robe - *sx* 9 (PP Z 39): “brown background”: colour unclear - *pfx* 9 (PP Z 53): glaze or binding medium - *pfx* 7 (PP Z 49): frame: brown binding medium or lake ?
colourless binding medium	- *pfb* 5 (PP Z 19): background of *d*-area
binding medium with strong UV fluorescence	- *sx* 8 (PP Z 36): dark blue or green: smalt particles surrounded by dark brown (UV orange)
lead white underpainting	- *pfb* 3 (PP Z 13): white underneath green: could be paint layer of lowers - *sd* 3: translucent pink robe - *sx* 13: translucent ochre yellow cloth
black underpainting	- *sx* 6 (PP Z 34; CS 2): very thin not continuous black layer
several applications of white ground layer visible	- *pfx* 7 CS 2 - *pfx* 12 CS 1 - *sx* 5 (flakes) - *sx* 9 CS 2 - *sx* 10 CS 1 - *sx* 13 CS 1 - *sx* 14 CS 2

Thickness of layers

sample	*prep / CS*	*thicknesses*
pfb 3 (green leaves)	PP Z 13 mini thin section	all layers together: about 18 µm - thin dark brown surface, 2 µm - brown-stained layer, 5 µm - green layer, 2-10 µm - lead white layer, 2-10 µm
pfb 3	CS 1	- thin brownish layer, light under UV: 1 µm, VIS: 2 – 6 µm > later coating ? - black, light material inside cracks: 2 µm, black VIS: 2 µm - brownish transparent, partly, 2.5 µm - green: rather dark: 18-21 µm, at surface lighter: 1 µm - white layer: light, no distinct borders: top part lighter: 2 µm, lower part, UV light: 8, together ca. 7-10 µm - white ground layer : UV not very light: 2-22 µm
sd 3 (pink robe)	PP Z 25 PP Z 26	- brownish layer, 2 µm, isotropic - red layer, 1 - 3 µm thick, isotropic - lead white, 5 µm thick - white ground layer, 1-3 µm (preserved in mini thin sections)
sd 4	CS 1	- gold leaf - transparent layer: 14-27 µm - pink layer: 3 µm - white ground layer: 32-42 µm - isolation layer
sx 4	CS 1	- brown: 6 µm, surrounding green - green particles: up to 22 µm
sx 5	CS 2	- thin coating on top or red: 1-2 µm - red layer: 15-40 µm
sx 6	CS 2	- green layer: 120-163 µm, single particles around 20-40 µm - black line: 1.4 µm - white ground layer: 30-60 µm - isolation layer
sx 8	CS 2	- blue: 140-180 µm, binding medium around smalt particles: 1-2 µm - white ground layer: 80-90 µm
sx 9 (black line)	CS 2 PP Z 38	- brownish transparent layer with black surface: 2-4.5 µm, surface line: 0.7 µm - black line: 1.5 µm - white ground layer, two zones, upper part looks darker, lower: 22-26 µm, upper 25 µm - isolation layer, 2.4 µm
sx 10	CS 1	- white ground layer: 8-104 µm - brownish stained part 15-20 µm
sx 11	CS 2	- brown: 1-2 µm - green particles: 25 µm - brown, below green: 7-11 µm - white ground layer: 24-83 µm - isolation layer: 3-5 µm
sx 12	CS 2	- paint layer: 45-196 µm, top part 28 µm - isolation layer: 4 µm - white ground layer: 100 µm - isolation layer: 14 µm
sx 13	PP Z 43	- brownish transparent layer: 1.5-5 µm - white layer - white ground layer
sx 13	CS 1	- coating: 2.6 µm - thin layer: 1 µm - layer with small red looking pigments: 2 µm - binding medium layer, partly thick (8 µm), partly very thin > shading - isolation layer: 2 µm - white underpainting: 4-8 µm - isolation layer: 1.8 µm - thin black line: 0.4 µm - white ground layer, at least two applications: 86 µm - isolation layer 1.4 µm

sample	*prep / CS*	*thicknesses*
sx 14 (pink horse)	PP Z 45	- pinkish coloured glaze: 1.5 µm - layer with white and red particles: 5 µm - thin white layer (sometimes): 2 µm - orange transparent layer: 5 µm - white ground layer
sx 14	CS 2	- surface: dark line - layer with white and red: 16 – 20 µm - orange transparent layer: 5-11 µm - white ground layer, contains charcoal: 78 – 100 µm - isolation layer (not visible): 2 µm
tg 1	CS 1	- brown layer on top of white ground: 3.6 µm
pfd 2	CS 2	- dark layer: 1 µm - coating: 3 -6 µm - green: 22-25 µm - white ground layer: 18-35 µm - isolation layer: 2 µm
pfd 3	CS 1	- blue: 1.2-1.5 µm - white ground layer: 53 µm - isolation layer: 1.25 µm
pfx 7	CS 1	- red and black together max. 7 µm - white ground layer: 62-73 µm - isolation layer: 3 µm - *xi ni,* very yellow
pfx 7	CS 2	- thin black layer: 1 - max. 9 µm - layer with reddish brown fine particles: 2 - max. 8 µm - white ground layer, several applications: 100 µm - isolation layer, 6 µm - *xi ni* (normal colour)
pfx 8	CS 1	- paint layer: up to 18 µm - white ground layer: 41 µm - isolation layer: 1 µm
pfx 9	CS 1	- very thin, dark - green: 31-35 µm - white ground layer: 50 µm - isolation layer: 1 µm
pfx 11	CS 1	- red layer, 3-4 µm - pink layer: red with white particles, 10-20 µm - blue layer: blue with white particles, 13-25 µm - white ground layer, 60 µm
pfx 12	CS 1	- black on red, together: 12-22 µm - white ground layer with several applications: 34-60 µm - isolation layer: 2.5 µm
pfx 13	CS 1	- thin layer containing fine black particles, not continuous: 0.5 µm - white ground layer 2 ?: looking brown: 32-40 µm - thin black line, charcoal: 0.5 µm - white ground layer 1, looking white: 23-48 µm - isolation layer (not visible in VIS): 3 µm - *xi ni* with fibres and sand grains