The Matter of Tang Tomb Figures

A New Perspective on a Group of Terracotta Animals and Riders

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Detail of fig. 6

A group of tomb figures in the Rijksmuseum's collection is a striking example of these objects from an important period of development in Chinese history. This group consists of four horses and two camels made of grey terracotta. Two detachable saddles and four detachable riders with saddles are placed on the back of the animals, making it a twelve-piece set (fig. 1).

Acquisition

The group was acquired in 1939 by the diplomat Reijnier Flaes, who took up his post as first secretary at the Dutch embassy in Beijing that year. He probably bought the group from a Hungarian art dealer, Mathias Komor, who was living and working in Beijing at that time.[1] Flaes left Beijing in 1942, but the group had already been packed in crates and stored before that. After the Second World War, the crates travelled by train and boat from Beijing to Europe by a circuitous route.[2] In 1965, with the support of the Vereniging Rembrandt, the Vereniging van Vrienden der Aziatische Kunst (Asian Arts Society in the Netherlands, VVAK) bought the group directly from Flaes.

The VVAK archives contain the correspondence between the society's secretary and curator, H.F.E. Visser (1890-1965), and Flaes, which reveals that the figures had suffered some considerable damage when they arrived in the Netherlands and needed to be restored. Visser did not see that as too great a problem, however. 'But there is a blessing in disguise; they were all completely wrapped in a type of gauze. This means everything has been kept together and we know exactly what belongs to what. I have only unpacked one horse; the result is a body with, fortunately, a neck and head attached to it, but stumps of four legs. The rest of the legs and the base-plate are in pieces, but everything is obviously present and will be painstakingly kept together.'[3]

The first restoration in the Netherlands was carried out at the end of the 1950s by the private restorer F.A.J. Smoorenburg (1912-1963). As far as we have been able to establish, there are no surviving records of this procedure, but at that time it was quite usual not to keep notes. Since then, as Flaes stipulated in the sale, the group has been permanently exhibited and on occasions loaned for exhibitions, in such places as Groningen in 1994, The Hague in 2004 and in Apeldoorn from 2004 to 2008.

Shortly after the acquisition, Jan Fontein, the then curator of Asiatic Art at the Rijksmuseum, carried out an in-depth investigation into the stylistic features of the riders and animals, all of which he described accurately and

I II III

Fig. 1
Set of Six Tomb Figures,
China, 650-750.
Terracotta, heights vary between 43 and 58.3 cm.
Amsterdam, Rijksmuseum.
From left to right:
AK-MAK-68-A and B (I);
AK-MAK-65-A and B (II);
AK-MAK-69-A and B (III);
AK-MAK-67-A and B (IV);
AK-MAK-66-A and B (V);
AK-MAK-70-A and B (VI).
The riders and saddles have suffix –B, the 6 animals have suffix –A.

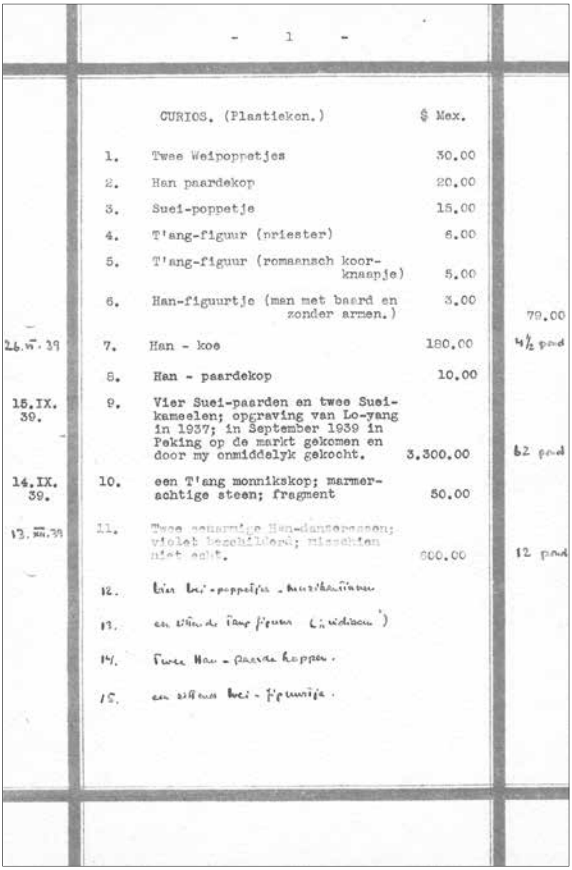
individually. For example, one of the riders is a woman (AK-MAK-69-B) with typical characteristics of the Tang hairstyle, while another (AK-MAK-68-B) has a comparatively long nose and could consequently be identified as a foreigner.[4] Some years later, in 1989, his successor, Klaas Ruitenbeek, wrote a thoughtful article in which he established a link between the group and the literary work of F.C. Terborgh, the pseudonym Flaes published under.[5]

In 2012 the VVAK bulletin published an article on the first results of the new research into the tomb figures that was started in 2010.[6] At the end of that article members of the society were asked if they were able to help the researchers with information about the provenance of the group. A reply from one of the members led them to Reinier Flaes Junior, Flaes's son, who provided them with new information in the form of a copy of the original purchase ledger, in which Flaes noted that the group was said to have come from an excavation in Luoyang in 1937 (fig. 2).[7] He noted the following, 'Four Suei horses and two Suei camels; excavation in Lo-yang in 1937, came on to the market in Peking in September 1939 and I purchased them immediately.'

Dating

In 1950, one of the early publications about the group mentioned that it came from the Six Dynasties (220-589) or a slightly later period.[8] From the correspondence with Flaes it emerged that he believed it dated from the Sui dynasty (581-618).[9] Some authors classified them as Wei dynasty on the basis of the group's grey clay body, a reference to the Toba Wei or Northern Wei (368-557). This was a complex historic period with many competing power blocks that sometimes only existed for a short time. 'In the South, the Chinese gentry became the standard bearers and preservers of the Han legacy. The North remained at the mercy of contending barbarians until after 386 when a Turkish tribe, the T'opaWei, began unifying the Northern territory from their frontier foothold calling themselves the Northern Wei Dynasty. In 535, the Northern Wei Empire split into rival dynasties, Eastern

IV V VI



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Date	No.	CURIOS. (Plastieken.)	$ Mex.	
	1.	Twee Weipoppetjes	30.00	
	2.	Han paardekop	20.00	
	3.	Suei-poppetje	15.00	
	4.	T'ang-figuur (priester)	6.00	
	5.	T'ang-figuur (romaansch koorknaapje)	5.00	
	6.	Han-figuurtje (man met baard en zonder armen.)	3.00	79.00
26.VI.39	7.	Han - koe	180.00	4½ pond
	8.	Han - paardekop	10.00	
15.IX.39.	9.	Vier Suei-paarden en twee Suei-kameelen; opgraving van Lo-yang in 1937; in September 1939 in Peking op de markt gekomen en door my onmiddelyk gekocht.	3.300.00	62 pond
14.IX.39.	10.	een T'ang monnikskop; marmer-achtige steen; fragment	50.00	
13.XII.39	11.	Twee eenarmige Han-danseressen; violet beschilderd; misschien niet echt.	600.00	12 pond
	12.	Vier Wei-poppetjes - muzikantinnen		
	13.	een staande Tang figuur ([illegible])		
	14.	Twee Han - paarde koppen.		
	15.	een zittend Wei - figuurtje.		

Wei (534-550) succeeded by Northern Ch'i (550-575) and Western Wei (535-556) succeeded by Northern Chou (557-581). Finally the North and South were reunited, first under the short lived Sui Dynasty (581-617) and then under the T'ang (618 to 906).'[10]

In 1966 Fontein remarked in his article that during excavations in China in the 1960s this type of tomb figure made of grey terracotta turned up as indicative of this period.[11] Based on his research and the style characteristics of the group they were catalogued in the Rijksmuseum inventory as Tang burial figures.

Much has changed in the field of research since then. Nowadays there are new ways of carrying out investigations into technique and materials, and it is now possible, using an entirely different approach, to establish both the period of production and the way the pieces were made.

Fig. 2
Reinier Flaes's Purchase Ledger.

Fig. 3
Detail of a rider (fig. 1, VI) showing the broken surface of the foot.

Fig. 4
Detail of camel with rider (fig. 1, IV) showing the broken surface of the base.

The Material

The animals are approximately fifty centimetres tall. They are made of grey terracotta bearing traces of cold decoration. All six animals stand on rectangular grey ceramic bases. Tomb figures with bases of this kind were produced for the first time during the Wei dynasty, undoubtedly because it was necessary to support the slender, fragile legs that first appeared at this time.[12]

In some places there are small areas of damage where the red core of the clay body is visible under the thin grey outer layer. The broken foot of one of the riders (AK-MAK-70-B) actually reveals three different colours of fired clay (fig. 3). Three rings can be seen on the surface of the break: from the outside in, the material is grey, red and a lighter grey. These colour differences are caused by the firing process. We can see a solid grey core at the damaged corner of the base of one of the camels (AK-MAK-67-A); this is the first indication that it was made of a different material (fig. 4).

In 1984 the raised arm of a rider (AK-MAK-68-B) belonging to one of the camels was broken; the restoration was done by Coenraad Hartman, the Rijksmuseum's ceramics restorer at that time (fig. 5). In 1985 the first Thermoluminescence (TL) dating of the material of this rider was carried out in the laboratory at Oxford University. The result indicated that the object was fired between AD 235 and 285. In 1995, also in Oxford, another dating was done on a sample of a probable addition to the hind leg of horse AK-MAK-66-A (fig. 6).[13] This addition, made of fired clay, proved to be less than a hundred years old, and had probably already been attached before the piece was purchased in China. The addition was made of uniform fine grey terracotta, to which we will return later.

New Research

With the new research, which was started in 2010, we first and foremost

Fig. 5
Detail of a rider with a raised arm (fig. 1, I).

Fig. 6
Detail of a horse (fig. 1, V) showing the hind legs.

wanted to discover the period in which each part of the group was made. This test required us to take a small sample from the innermost core of the clay body of each of the twelve figures. The Optically Stimulated Luminescence (OSL) dating was done in Delft, and the results gave an average date of around 750 with a margin of around 97 years.[14] However the dating of the different parts varies from 485 to 985, and this cannot be fully explained without further research.

The next step was an attempt to verify this data by another method. All six animals contain remnants of burnt fibres, which makes radiocarbon dating possible.[15] The fibres are visible in the abdominal cavity through an opening in the underside of the belly. Fibre samples were taken from all the animals and sent to Groningen, however only two of the samples proved to contain enough carbon to give a reliable dating. All the results are given in the chart (fig. 7). We can see that carbon-14 gives a relatively precise dating of AD 687 with a margin of thirty-five years for AK-MAK-65 and of AD 680 with a margin of thirty years for AK-MAK-66. On the basis of these results we concluded that the date the group was produced lay between AD 680 and 750.

The Metal

Let us return to 1995. One of the horses (AK-MAK-66-A) had been damaged while on loan and had to be restored. Fortunately the damage and the subsequent restoration were accurately documented and photographed (fig. 8). Metal was found in a number of places in this horse's broken legs. At that time it was thought that the metal pins might have been put in during an earlier restoration. It seemed highly unlikely that the metal strips had been part of the production process. Firing terracotta with an iron core was regarded as well-nigh impossible because the expansion of the two materials at high temperatures is

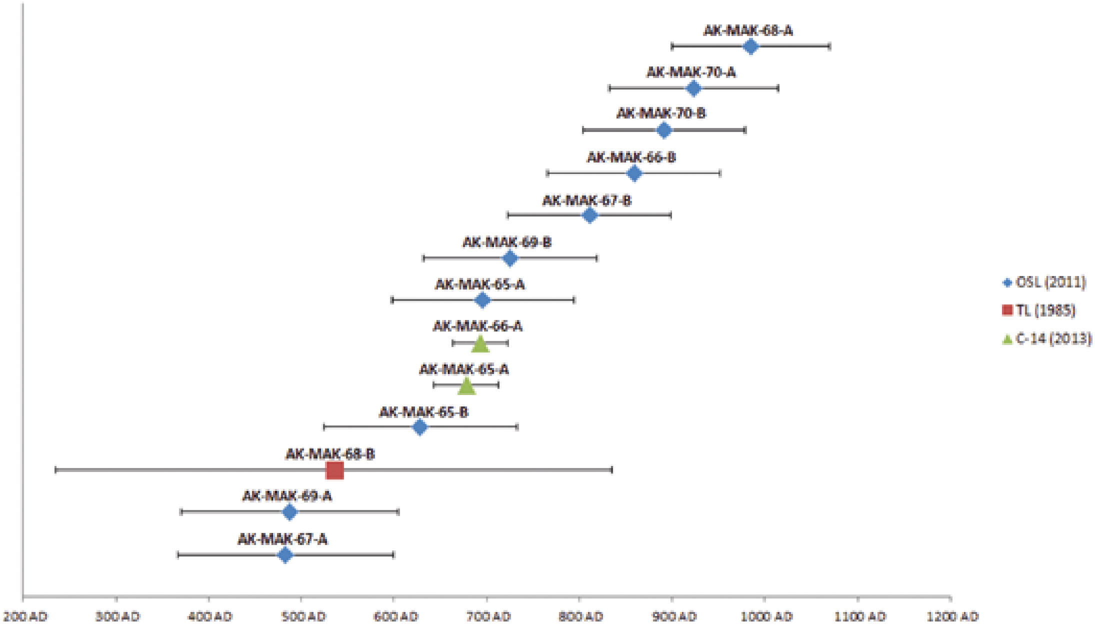


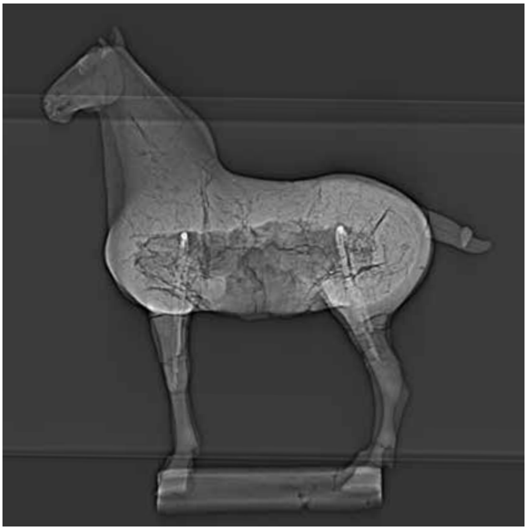
Fig. 7
Dating of the twelve elements of the group of grave figures: one by Thermoluminescence (TL 1985) shown in red; ten by Optically Stimulated Luminescence (OSL 2011) shown in blue; two by C14 (C-14 2013) shown in green. Graph: Guus Verhaar, Rijksmuseum, Amsterdam.

Figs. 8a, b
One of the horses (fig. 1, v) during the restoration in 1995 (a); Tomography image from 2012 (b).

different, and this would cause the figures to disintegrate.

After extensive research in the literature, however, it became clear that there were a number of other examples of Chinese objects with metal armatures in western museums: the British Museum in London, the Brooklyn Museum of Art in New York and the Royal Ontario Museum in

A



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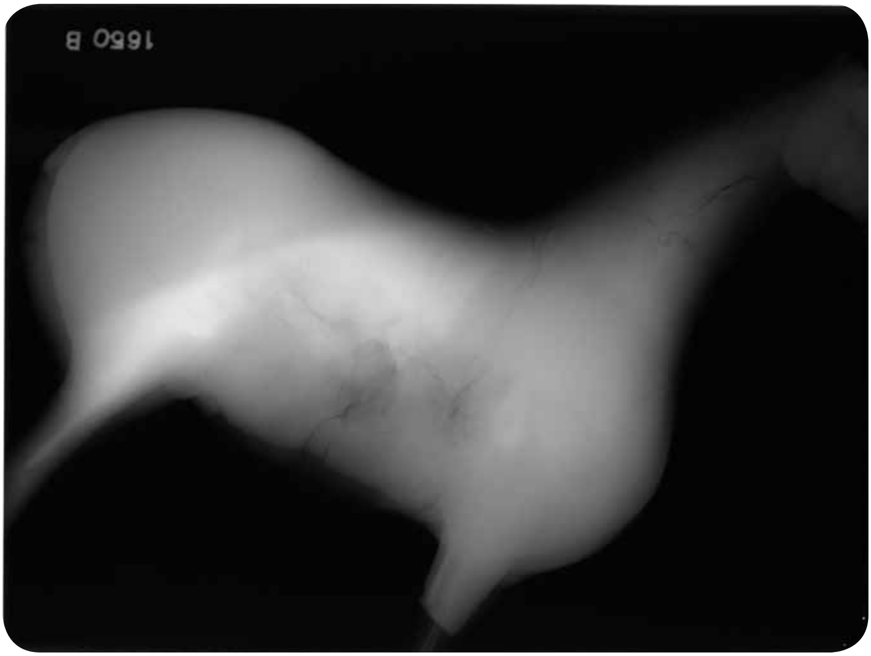


Fig. 9
The first X-radiograph of the horse (fig. 1, v) during the restoration in 1995.

Toronto all have them.[16] All these objects are grave gifts: some of them are horses, but there are also descriptions of human figures and a temple guard. A publication on the restoration of a damaged terracotta figurine of a lady-in-waiting in the Royal Ontario Museum in the 1950s gives some insight into the use of a metal armature. The armature was seriously corroded, and because of this the material was broken in many places. The metal was removed in its entirety to forestall further damage. Vague impressions of fibres could be seen in some places, where the clay was in direct contact with the metal. Helen E. Fernald suggested that the metal armature might have been put in when the figure was made and fired with the object. The impressions could have been caused when organic material between the metal strip and the clay burned off during the firing process.[17]

X-Radiographs

The first X-radiographs of the horse (AK-MAK-66-A) were taken in the Rijksmuseum in 1995. The images might help to establish whether the metal armature was put in during a recent restoration or while the figure was being made. The X-rays revealed a U-shaped metal strip running through the horse's forelegs and chest. A similar U-shaped strip runs through the horse's hindquarters and hind legs. The quality of the X-radiograph allowed us to see little more in the way of details beyond the white stripes of the metal and the grey of the clay body (fig. 9). It did, though, show that the metal strips were embedded in the clay of the horse's legs and body such that they must have already been in place while the piece was being modelled. With the latest X-ray equipment now available for research it is possible to make higher resolution images in which more details can be seen. This would allow us to get a picture of the entire metal armature.

A test was carried out on the horse in October 2010. The horse's condition was compared with X-radiographs taken of it in 1995 and a number of aspects not previously observed now proved to be visible (fig. 10). The metal is attached closely to the clay body.

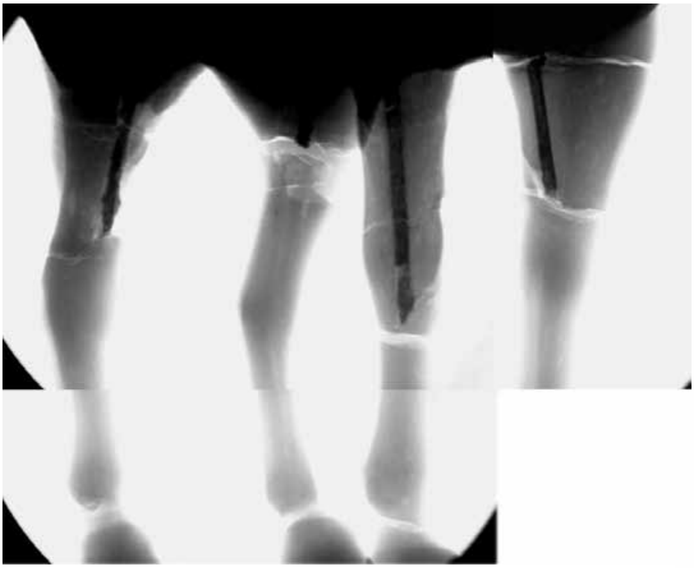


Fig. 10
Digitally composed X-radiograph of the horse (fig. 1, v).

Fig. 11
The X-radiographs of the hind legs of a camel printed and assembled manually (fig. 1, 1).

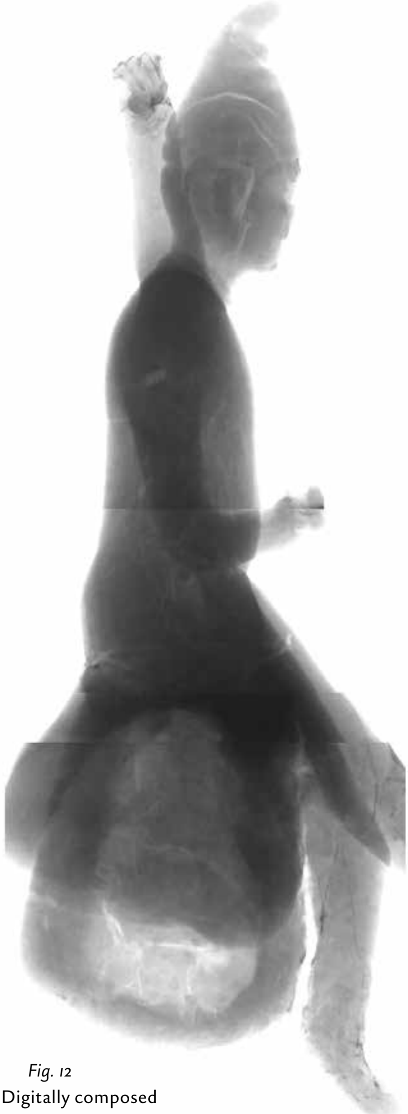


Fig. 12
Digitally composed X-radiograph of a rider (fig. 1, 1).

In a number of places there are cracks running without interruption through both the metal and the clay. Parts of the metal are darker (less dense material) and other parts are lighter (denser material). There are indications of metal corrosion in some areas.

After all the OSL dating results had been received, we were also able to investigate other objects in the group. It soon became clear that all the horses have a similar U-shaped metal armature.

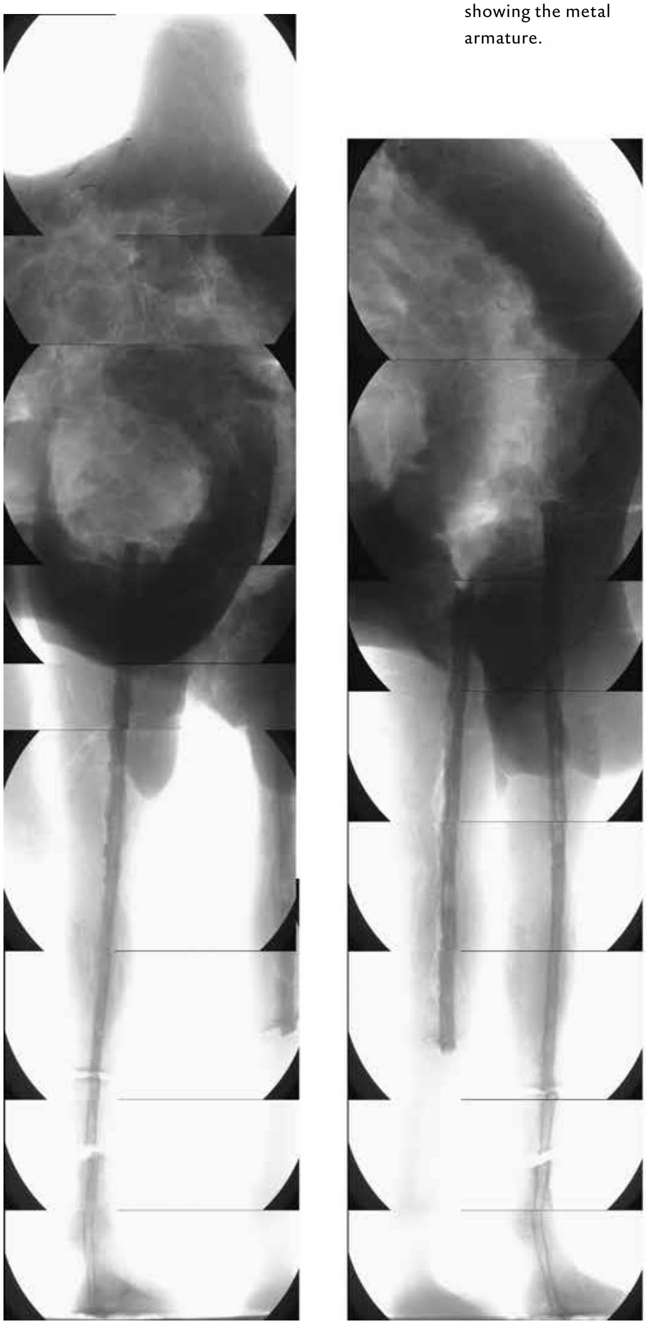


Fig. 13
Digitally composed X-radiograph of a camel (fig. 1, v) showing the metal armature.

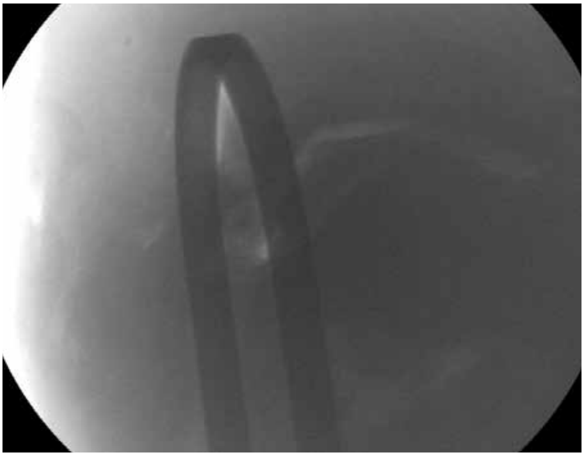
The subsequent X-radiograph of a camel (AK-MAK-66-A) produced a surprise. The animal had a metal armature, but different from that of the horses. In the camel a straight metal strip runs from the foot to the shoulder of each foreleg, and we saw the same in the hind legs, from the feet to the hindquarters. These strips are not connected in the animal's trunk. It is not entirely clear in the X-radiograph whether the junction has disappeared, perhaps as a result of corrosion, or never existed (fig. 11). X-radiographs of the second camel show that it has the same straight metal strips without an internal joint. One of the riders (AK-MAK-68-B) was also X-rayed, revealing that it contained no metal (fig. 12).

Although the new test provided additional information, the images were still not good enough to be able to identify the nature of the metal armature. X-radiographs of thicker areas like the stomach produced particularly poor images. Compounding this, the digital images cover only a small part of the figure (no more than 15 x 15 cm) and had to be put together afterwards (fig. 13). Digital amalgamation was attempted where possible, but it often created problems. Printing the parts and then putting them together by eye sometimes produced a better image (see fig. 11).

We decided to reproduce part of a horse to get an impression of the production process, sticking as closely as possible to the material and dimensions of the original. The drying process

A

B



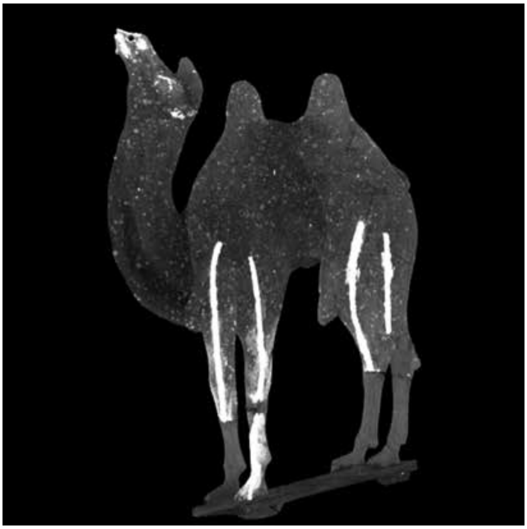
C

was rigorously monitored, and it became clear that the main problem was the shrinkage of the clay along the metal. Deep cracks, similar to the cracks in the original horses, formed in the clay. This was quite evident when the X-radiographs of the dummy were compared with the originals (fig. 14).

Computer Tomography (CT)

There is now a new method for looking into an object, and again it has come from the medical world. Computer Tomography can produce a scanned image that shows where there is metal in objects.[18] The research department of the Shell Geological Service offered us the opportunity to perform this research. It was decided to carry out a test on the dummy first in order to spare the fragile originals. The result was promising; the three-dimensional scan provided considerably more information than the X-ray. The position of the metal could now be seen from different sides and could be rotated on the monitor. Inside the mass of clay we saw the drying cracks and the places where clay had consolidated during modelling. Based on these results we decided to scan two of the original figures, a horse and a camel (figs. 15, 16).[19] The scans immediately revealed

Figs. 14a, b, c
Detail of an original horse (fig. 1, v) with shrinkage cracks (a); an unfired clay dummy, made by Lucien van Valen (b); X-radiograph of metal in the clay dummy (c).


A


B

that the camel did indeed contain four straight strips of metal, visible as white stripes. They are not linked together and probably never had been. The U-shaped iron strips in the horse show up as two white curves in the figure. The white flecks distributed throughout the figure indicated inclusions in the clay body.

The scans also clearly showed which pieces were later additions and where restorations had been done. Each animal has several modern added parts. The original clay body is clearly recognizable from the many inclusions,

Figs. 15a, b
Two images of a camel (fig. 1, i), both made using Computer Tomography (CT-scan).
Photo: Rock and Fluid Science Technology, Shell International Ltd.

Figs. 16a, b
Two images of a horse (fig. 1, v), both made using Computer Tomography (CT-scan).
Photo: Rock and Fluid Science Technology, Shell International Ltd.

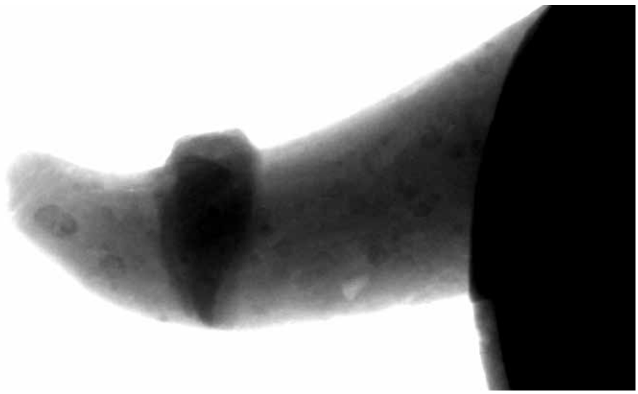

A


B

whereas the terracotta in all the additions is a uniformly fine grey fired clay. These later ceramic additions were glued to the original and the joins were almost invisibly smoothed away (see fig. 16). It was also established that the bases are not original; we do not know whether the animals actually had bases. The tails of three horses also consist of the same added grey material. One horse (AK-MAK-65-A) does have its original tail, but the decoration on the tail is a recent addition, made from a filler (fig. 17). Both camels and one horse have original ears and the camels each have one complete original leg. The other legs of the camels and the horses have been partially augmented with substitute lower legs and hooves made from modern, fine grey clay.

Figs. 17a, b
Detail of a horse (fig. 1, II) showing the tail (a); X-radiograph of the tail (b).

A



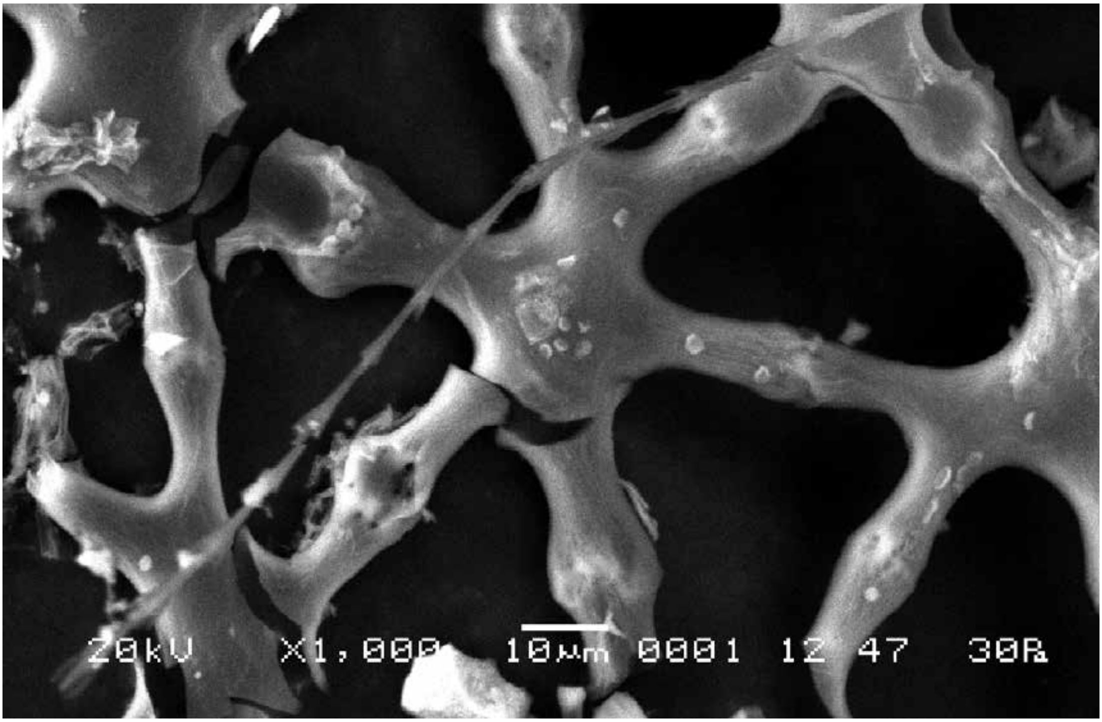
B

Firing Test

Additional firing tests were performed by ceramicist and experimental archaeologist Loe Jacobs in the ceramics workshop at the Faculty of Archaeology at Leiden University. After consultation he made a second dummy with internal metal wrapped in fibres. This test again confirmed that the drying process caused the biggest problem. This could be overcome by filling the cracks in the clay as it dried. The firing process then went ahead with no problem at all.[20] These experiments were extremely useful in gaining a better understanding of how the figures were produced, and proved that the firing of terracotta with iron reinforcement is technically possible.

Production and Material

All the materials used to make the objects were researched using different methods. Clay, fibres, pigment and metal were analysed. An endoscope was used to look into the abdominal cavities, where the traces of partially burnt fibres were discovered. The irregular thickness of the walls of the animals' bellies indicates that the animals were formed by hand. Under the microscope we could see various types of fibres in the clay. Samples of these fibres were prepared in a cross-section, photographed in a Scanning Electron Microscope (SEM) and analysed (fig. 18). Three of the varieties have now been identified: a type of sedge (*carex*), soft rush (*juncus effusus*), and hemp (*cannabium*). A number of smaller fibres were also found; they have yet to be researched. We also found other examples of organic matter, including the antenna of a dust mite and the skin of a carpet moth caterpillar. In view of the condition in which they were found, they must have found their way into the animals over time (fig. 19). The metal was analysed using various methods, microscopy, X-Ray Fluorescence (XRF) and SEM, which established that it was wrought iron.



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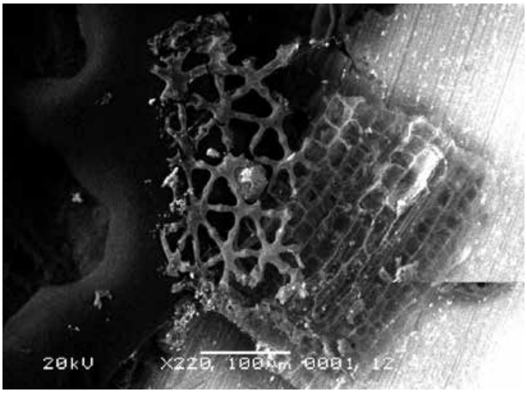
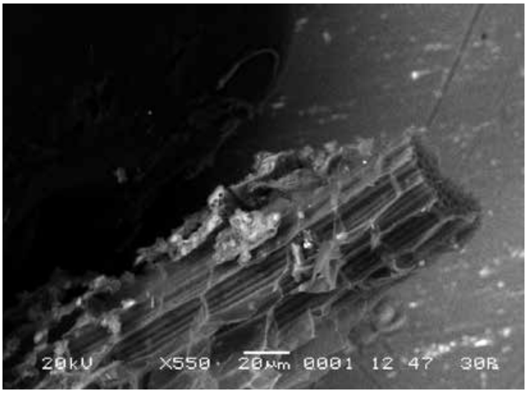


A



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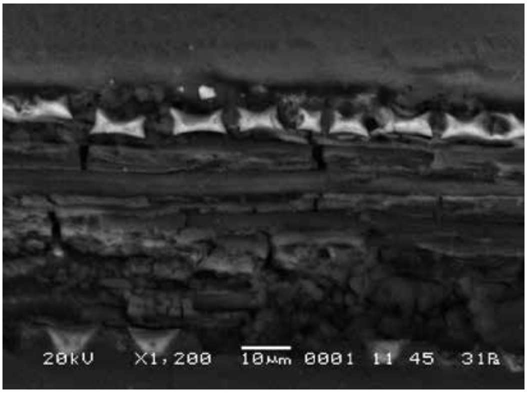


D

Figs. 18a, b, c, d
SEM micro-images of identified plant fibres found in a horse's abdomen (fig. 1, II): fibres of soft rush (*juncus effusus*) and sedge (*carex*), magnification 220X (a); the characteristic cartwheel microstructure of soft rush (*juncus effusus*), magnification 1000X (b); hollow tubes of soft rush (*juncus effusus*), magnification 550X (c); sedge (*carex*), magnification 1200X (d). Photos: Ineke Joosten, Cultural Heritage Agency of the Netherlands.

On the basis of the research into the iron, the clay body and the fibres, we were able to establish how the animals were made (fig. 20). A bundle of grass and soft rush was twisted together to form the trunk and covered with a thin layer of clay. The armature was made of wrought iron strips wrapped in soft rush. These strips were pushed into the clay-covered bundle. The body and the legs were modelled from clay on the base thus created. The iron-rich loess clay used was also mixed with snippets of grass, soft rush and hemp fibres. The fibres reinforce the cohesion of the clay and have a regulating effect as the clay dries.

In China soft rush (*juncus effusus*) is called 灯草 (*dengcao*, lamp wick grass). The plant has long fibres with a core that looks like a cartwheel in cross-section (see also fig. 18b). The capillary effect created by the hollow tubes draws the oil in lamps to the top, where it can be burned. This property also makes the stems ideal for creating some space for the iron in the clay during the drying and firing processes. The fibres largely burn off in the kiln during firing, but a small part remains, in a more or less carbonized state (see fig. 20b).

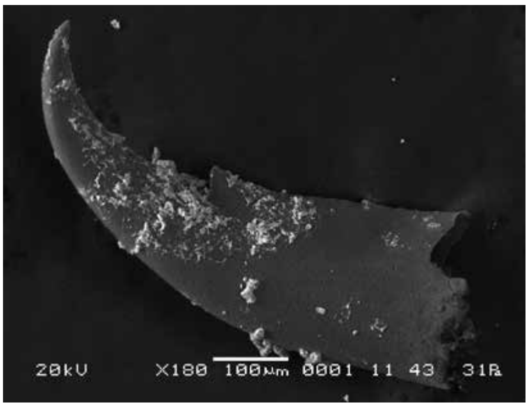
A number of other fibres were found in the clay body. In one of the horses (AK-MAK-70-A) we found *carex*, *juncus effusus*, rough silk, cotton, camel hair and another kind of hair (probably fox).

A question that arises is whether the clay used for the group was purified and washed first, as is usually done during the production of earthenware utensils. Another possibility is that a

A

B

C



D

Figs. 19a, b, c, d
Microscope images of the skin of a carpet moth caterpillar found under the base of a camel (fig. 1, I; a, b); antenna of a dust mite found in the abdomen of a horse (fig. 1, VI; c, d).

Figs. 20a, b, c, d, e
Iron strips (a); iron strips wrapped in fibre (b); bundle of grass with strips (c); the horse before firing (d); the horse after firing (e). Drawing: Isabelle Garachon.

raw, unwashed clay was used in which the plant remnants and possibly also the round inclusions were already present in part. Further research is currently going on.

In publications on Chinese ceramic grave gifts it is often assumed that moulds were used to make the figures in parts.[21] The traces where the separate parts were joined together with slip are often evident. One of the specific characteristics of the use of moulds is that the objects have thin, regular walls. None of these specific characteristics were found during the examination of these animals. In fact, the reverse is true; everything indicates that the animals were made piece by piece and individually designed. The horses' heads, for example, all differ in size and shape. The thickness of the ceramic stomach wall varies considerably.

Colour

The remnants of the cold painting were analysed. Traces are still visible of the most important colours: red, black, white and yellow. We found remnants of vermilion on the eyelid, for example, and traces of lead white on the lip of one of the animals. The lead white and vermilion can clearly be seen in the UV photograph (fig. 21).

Fig. 21
UV photograph of a camel (fig. 1, IV).

Fig. 22
Detail of a lady (fig. 1, III) showing the head with the headdress.

Figs. 23a, b
Ridges on the back of two horses: fig. 1, V (a); fig. 1, VI (b).

Most of the red, however, is red iron. The white is mainly lead white. The black on the figures is not the same everywhere, part is a manganese iron compound, and another small sample is black soot. This sample came from the headdress of the woman (AK-MAK-69-B; fig. 22). The analysis indicated that this black came from pine tree soot.[22] This is a type of black that has been much used in China down the centuries in such things as black ink. However the chemical analysis also revealed that the material in the sample had been underground for a long time, which is consistent with objects that come from an archaeological dig. The analysis of this sample therefore confirmed the claimed provenance from an excavation.

Ridges on the Horses

This research has greatly increased our understanding of the way the group was made. It proved important for the correct arrangement of the group in the display case. The objects were once numbered; all the animals have a number that ends in A, and the numbers of the saddles and riders end in B. These numbers therefore indicate which rider or saddle belongs to which

A

B

Fig. 24
Casts of the ridges.

horse, for instance horse AK-MAK-65-A goes with saddle AK-MAK-65-B.

It emerged during the research that there were a number of ridges in bas-relief on the backs of three of the horses (fig. 23). They are not normally visible because they are covered by the saddles or the riders. Through careful observation it became clear that there were ridges in high relief on the undersides of three saddles. From the shape of the ridges and the way they are placed there can be no doubt that they are part of the original material and were put on before firing. Impressions were made of all the ridges found and it soon became clear that they shed new light on the link between horse and saddle or rider (fig. 24). We assumed that the ridges formed a way of indicating which horse belongs to which saddle or rider. The ridge pattern of one combination of a horse (AK-MAK-69-A) and a rider (AK-MAK-69-B) does not correspond. However in terms of shape and position the ridges on this rider do exactly match the ridges of another horse (AK-MAK-66-A). What is more the ridges of saddle AK-MAK-66-B match those of horse AK-MAK-69-A. On the basis of this conclusion and with the aid of this simple marking method, the rider and saddle were placed on the right horse in the new arrangement in the display case in the Asian pavilion (fig. 25).

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Fig. 25
Display case with the new arrangement of the group.
From left to right AK-MAK-66-A and AK-MAK-69-B; AK-MAK-65-A and B; AK-MAK-67-A and B; AK-MAK-68-A and B; AK-MAK-70-A and B; AK-MAK-69-A and AK-MAK-66-B.

NOTES

1 Reinier Flaes Jr, son of Reijnier Flaes, personal communication, 2012.
2 K. Ruitenbeek, 'Een grenskozak in China; de schrijver F.C. Terborgh en zijn collectie Chinese kunst', *Aziatische Kunst* 19 (1989), no. 1, pp. 3-24, esp. p. 7.
3 'Maar er is een blessing in disguise; ze waren alle geheel omwonden met een soort gaas. Daardoor is alles bij elkaar gehouden en weten wij precies wat bij elkaar hoort. Ik heb slechts een paard uitgepakt; het resultaat is een lichaam met gelukkig hals en kop eraan, maar met vier stompjes van poten. De rest van de poten en de grondplaat is dus in diggelen, maar alles is natuurlijk aanwezig en wordt zorgvuldig bij elkaar gehouden. VVAK archives, letter dated 4 February 1950 from H.F.E. Visser to R. Flaes.
4 J. Fontein, 'Een serie graffiguren uit de T'ang tijd', *Bulletin van het Rijksmuseum* 14 (1966), no. 1, pp. 19-28, esp. p. 20.
5 Ruitenbeek, op. cit. (note 2), pp. 3-24.
6 I. Garachon and L. van Valen, 'Gewapende paarden en kamelen', *Aziatische Kunst* 42 (2012), no. 3, pp. 15-23.
7 Personal communication Reinier Flaes, 2013.
8 H. Visser, 'Belangrijke bruikleen', *Bulletin van de Vereniging van Vrienden der Aziatische Kunst*, Nieuwe Serie, no. 8 (1950), pp. 25-27.
9 J. van Campen, *Vormen uit vuur* 189 (2004), no. 4, pp. 33-48; H.F.E. Visser, *Museum van Aziatische Kunst in het Rijks-museum, Amsterdam: catalogus*, Amsterdam 1952, cat. no. 72.
10 A.L. Juliano, *Teng-Hsien: An Important Six Dynasties Tomb*, Ascona 1980 (*Artibus Asiae*, suppl., vol. 37), p. 1.
11 Fontein, op. cit. (note 4), no. 1, pp. 19-28.
12 Juliano, op. cit. (note 10), p. 63.
13 Doreen Stoneham, Research Laboratory for Archaeology and the History of Art, Oxford University, 1995.
14 Jakob Wallinga, Netherlands Centre for Luminescence Dating, Wageningen University, reports NCL-7909b and 7211, 2011-12.
15 Johannes van der Plicht, Centrum voor Isotopenonderzoek, Rijksuniversiteit Groningen, 2013. Methods: Carbon is pretreated with the AAA method (acid/alkali/acid) to clear possible contamination and provide a clear datable fraction. This fraction is burned to pure CO2 gas, which is reduced to graphite. In the graphite, the 14C concentration is measured with the accelerator mass spectrometry method. The result is reported in BP (conventional 14C years). These are calibrated to calendar years relative to a standard curve of dendrochronology.
16 Lisa Bruno, conservator, Brooklyn Museum, New York, private communication, 1997. H.H.F. Jayne, 'Notes on Chinese Pottery Horses', *Parnassus* 2 (1930), no. 6, pp. 29-31; H.E. Fernald, 'Discovery of Iron Armatures and Supports in Chinese Grave Figurines of the Sixth and Early Seventh Centuries', *Far Eastern Ceramics Bulletin* 11 (1950), pp. 105-08; W. Todd, 'Iron Armatures and Supports in Chinese Grave Figurines', *ROMA Bulletin* (March 1952), no. 18, pp. 17-18; S. Smith et al., 'The Conservation of Eleven Tang Tomb Figures', *The Ceramics Cultural Heritage: Proceedings of the International Symposium 'The Ceramic Heritage' of the 8th CIMTEC-World Ceramics Congress and Forum on New Materials, Florence, Italy, June 28-July 2, 1994*, Faenza 1995, pp. 621-34.
17 Fernald, op. cit. (note 16).
18 Fons Marcelis, Rock and Fluid Science by Shell International Ltd, 2012. CT scans were performed with a Siemens Somatom, 140 kV, 50 mA for 99.6 seconds, 512 images.
19 These are inv. nos. AK-MAK-68-A and AK-MAK-66-A, which were examined by Rock and Fluid Science Technology, Shell International Ltd. on 19 March 2012.
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21 D.K. Strahan and A. Boulton, 'Chinese Quadrupeds: Construction and Restoration', in J.S. Mills et al. (eds.), *The Conservation of Far Eastern Art: Preprints of the Contributions to the Kyoto Congress, 19-23 September 1988*, London (The International Institute for Conservation of Historic and Artistic Works) 1988, pp. 149-54.
22 Henk van Keulen, Cultural Heritage Agency of the Netherlands (RCE), 2012. Method: thermally assisted hydrolysis and methylation gas chromatography-mass spectrometry (THMGC-MS) in combination with pyrolysis. The pyrolysis unit used was a Frontier Lab 3030D pyrolyser mounted on a Thermo Scientific Focus GC/ISQ mass spectrometer combination.

Detail of fig. 4