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Cone mosaic façades in Mesopotamia (4th millenium BCE): archaeometric approach to an architectural innovation

Fanny Alloteau, Sarah Dermech, Adriana Iuliano, Stefan Röhrs, Stefan Simon, Sonja Radujkovic, Helen Gries, Barbara Helwing

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Mosaik in situ – transloziert – museal

Beiträge des 15. Konservierungswissenschaftlichen Kolloquiums
in Berlin / Brandenburg



Brandenburgisches Landesamt für Denkmalpflege
und Archäologisches Landesmuseum

Mosaik in situ – transloziert – museal

Beiträge des 15. Konservierungswissenschaftlichen Kolloquiums in Berlin / Brandenburg
am 4. November 2022 im Friedenssaal
der Evangelischen Friedenskirchengemeinde Potsdam

Mit Beiträgen von

Fanny Alloteau, Sarah Dermech, Thomas Drachenberg, Helen Gries, Sophie Haake-Harig,
Barbara Helwing, Adriana Iuliano, Knut Joachimsen, Ute Joksch, Raphaela Knein, Veronika Koudelková,
Kathrin Lange, Polytimi Loukopoulou, Wolfgang Maßmann, Franziska Motschmann, Ursula Müller,
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Jaroslav Valach, Marco Verità, Astrid Will

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Vorwort

Das Mosaik (Mosaicum) ist ein den Musen gewidmetes Werk und heute eine der ältesten Kunstgattungen, die wir kennen. Durch das Zusammenfügen von verschiedenfarbigen oder verschieden geformten Teilen entstehen geometrische Muster oder figürliche Bilder.

Unser am 04.11.2022 in Potsdam stattfindendes 15. Konservierungswissenschaftliches Kolloquium in Berlin/Brandenburg befasst sich mit dem Thema Mosaik, von den Anfängen mit einem Beispiel in der mesopotamischen Stadt Uruk über bedeutende Schöpfungen der Antike und des Mittelalters nördlich und südlich der Alpen bis hin zu den von der Firma Puhl & Wagner geschaffenen Werken des 19. und beginnenden 20. Jahrhunderts.

Beschrieben werden unter anderem werktechnische Varianten, naturwissenschaftliche Untersuchungen und restauratorische Vorgehensweisen von in situ erhaltenen bzw. translozierten und museal präsentierten Mosaiken. Anlass für die Tagung war die Restaurierung des Apsismosaiks der Friedenskirche in Potsdam. Zwischen 1834 und 1854 von der venezianischen Insel Murano in einen zeitgenössischen preußischen Kirchenbau überführt, fungiert es als Bindeglied zwischen den Mosaikkünsten im Mittelmeerraum des 13. und im Berliner Raum des 19. Jahrhunderts. Die gemeinsame Besichtigung am Tag des Kolloquiums verknüpft die Inhalte der Vorträge mit dem existenten Kunstwerk.

Wir möchten mit diesem Kolloquium und der Publikation den aktuellen Stand des Wissens über Mosaik zusammentragen. Wir stellen dabei anhand von Fallbeispielen die historische Entwicklung der Mosaikkunst und die Geschichte der Restaurierung bis zu aktuellen Methoden der Analyse, Restaurierung und Konservierung von Mosaiken dar. Es werden die Inventarisierung und Katalogisierung von musealen Beständen und der aktuelle Stand der Erkenntnisse zur Geschichte der 1889 gegründeten Berliner Werkstätten für Mosaik und Glasmalerei Puhl & Wagner thematisiert.

Wir hoffen dabei möglichst viele Interessenten zu erreichen, die sich zu diesem Thema weiterbilden bzw. austauschen können.

Gerne danken wir an dieser Stelle allen Referent*innen und Autor*innen für ihre Beiträge und den Kolleg*innen, die beim Lektorat engagiert waren. Ellen Egel vom Brandenburgischen Landesamt für Denkmalpflege hat in enger Zusammenarbeit mit dem Verlag in hoher Qualität dafür gesorgt, dass diese Publikation wieder direkt zur Tagung als Tagungsband erscheint.

Die Reihe der sehr erfolgreichen konservierungswissenschaftlichen Kolloquien entsteht im Verbund des Brandenburgischen Landesamtes für Denkmalpflege und Archäologischen Landesmuseums mit der Fachhochschule Potsdam, der Stiftung Preußische Schlösser und Gärten Berlin-Brandenburg und dem Rathgen-Forschungslabor der Staatlichen Museen zu Berlin – Stiftung Preußischer Kulturbesitz. Sie ist ein fest etabliertes Podium für den fachlichen Austausch von Interessierten der Wissenschaft, Denkmalpflege, Kunstgeschichte und Restaurierung. In diesem Jahr tagen wir im Friedenssaal der Evangelischen Friedenskirchengemeinde Potsdam. Für diese unkomplizierte Zusammenarbeit sind wir sehr dankbar.

Wir wünschen diesem Kolloquium und dem aktuell vorliegenden Arbeitsheft die Fortsetzung des Erfolgs und der Reichweite der früheren Veranstaltungen und Publikationen dieser Reihe.

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Cone mosaic façades in Mesopotamia (4th millennium BCE): archaeometric approach to an architectural innovation

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Abstract

We present an archaeometric study of clay mosaic cones from the archaeological site of Uruk, excavated in the earlier 20th century and currently kept in the Museum of the Ancient Near East in Berlin (Vorderasiatisches Museum – VAM). Clay cones have been found in major and distant centres of the 4th millennium BCE Uruk period and are characteristic for monumental architecture. They were used to create colourful geometric patterns on the façades of buildings. Research focused on reconstructing the colouring of the cone heads by investigating colourants and the technical processes of their application. From microscopic observations and spectroscopic analyses, the main colouring materials were identified as dolomite for the white-coloured clay cones, hematite/ochre for the red ones, and bitumen for the black ones. These colouring materials are assumed to have been applied cold, after the firing of the ceramic, and in association with an organic binder for the white- and the red-coloured cones.

1. Background

The World's first cities emerged during the 4th millennium BCE in Southwest Asia. This unprecedented urbanization process transformed societies and entailed a hierarchically organized social structure with a paramount leader known from pictorial records. One epicentre of this process was South Mesopotamia, where the city of Uruk represents one major and most likely the largest urban centre of the Late Uruk period (c. 3500–3250 BCE). The new social order is archaeologically attested through monumental buildings of unprecedented dimensions that are variously interpreted as places of power or religious centres (Nissen, 1988; Algaze, 1993; Forest, 1999; Butterlin, 2003/2021; Selz 2020). They stand out from domestic architecture, among other things, by their size and the richness of their decoration, as a comparison with household architecture from sites like Habuba Kabira/Tell Qannas further north on the Euphrates indicates (Strommenger, 1979/1980; Trokay, 1981).

Architectural decoration and especially cone mosaics are limited to monumental constructions of a public, religious or collective nature (Dermech, 2018). This decoration reached an unprecedented degree of elaboration, featuring a wide variety of techniques and materials (Muller, 2012): bi- or polychrome cone mosaics, wall paintings, reliefs, niches and recesses and the use of differently coloured bricks (Dermech, 2018).

Cone mosaics are known from Uruk but also from neighbouring regions, from southwestern Iran to northern Syria and south-eastern Turkey. The cone technique is emblematic of the monumental architecture of the second half of the 4th millennium BCE, but only at Uruk were mosaics documented in situ.

The city of Uruk in southern Mesopotamia (Fig. 1), modern Iraq, offers to date the most extensive and best preserved remains for this time period and is the focus of this study. Excavations began in the mid-nineteenth century and have with interruptions continued to the present day (van Ess,



Fig. 1: Map of main Late Uruk sites in Mesopotamia, image: S. Dermech

2013a/b). The site was apparently founded in the 6th–5th millennium BCE as a small rural settlement of the Ubaid period and was inhabited until the Sassanid period at the end of the 3rd century CE (van Ess, 2013c). In the middle of the 4th millennium BCE, it extended over an area of 250 ha with a population estimated at 40,000 inhabitants (Nissen, 2013). The site took then on the features of a city, and reflected architectural, religious and cultural transformation were visible in the development of writing, arts and administration.

During the Late Uruk period, the two main excavated areas of the site are the “Eanna” district and the “Anu Ziggurat”. The stratigraphy of the site is complex, and comprises more than 18 main levels with several construction and occupation phases in the Eanna district (Eichmann, 2007); those of interest to us here are part of the archaic layers (archaische Schichten), in particular levels VI–IV assigned to the *Späte Uruk-Zeit*, i. e. the Late Uruk (c. 3500–3250 BCE), as well as level III assigned to the Jemdet Nasr period (c. 3250–3000 BCE)¹ (Fig. 2). These layers have been excavated since 1912. According to the rules of partage valid, finds were divided between Germany and the Ottoman Empire, respectively Iraq, and Germany. Among the shared finds are cone mosaics now kept in the collections of the

Vorderasiatisches Museum, Staatliche Museen zu Berlin – Stiftung Preußischer Kulturbesitz (VAM, SMB – SPK). Within Eanna, courtyards, halls and temples are organised in a complex system of terraces. The buildings are made of small rectangular mud bricks (of the *riemchen* type), whose regular module facilitates the construction of niches and recesses on the façades. Most of the feature cone mosaics set into the façades with only their heads sticking out (Fig. 3), forming complex patterns (Eichmann, 2007).

2. The cone mosaic technique

Mosaic cones are cone-shaped pieces of fired clay (Tonstifte) or stone (Steinstifte).² There are several types of clay cones: they come in various sizes, small to large, with plain or with hollow heads (Grubenkopfstifte). Only their head is visible in the mosaic: in the case of coloured cones, it is this part that is coloured, as their shafts are set in mortar to adhere to the underlying masonry (Fig. 4). The cones are combined on the face of the construction to form mosaics.

Mosaics have a double function: on the one hand, they form a facing to the mud brick architecture, thus protecting the masonry from erosion. On the other hand, mosaics

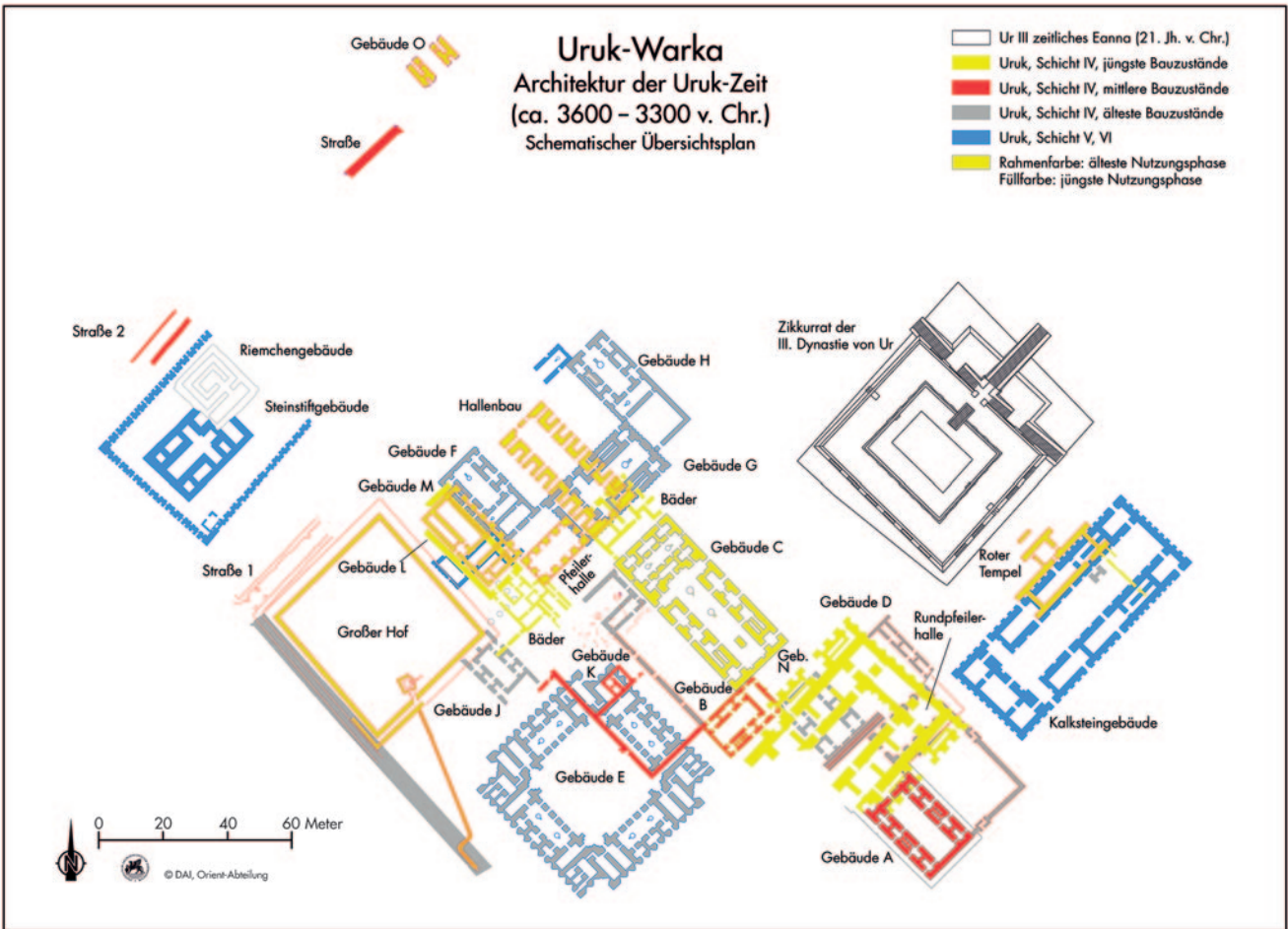


Fig. 2: Uruk, plan of the Eanna district during the Late Uruk period, showing different architectural phases, image: DAI, Orient Department, T. Urban, modified after Nissen, 2013 (Fig. 14.5)



Fig. 3: Virtual reconstruction of the wall and the mosaic layout of the Stone Cone Building (Steinstiftgebäude). This building featuring stone cones is an exception, as most mosaics used clay cones. In the latter case, spikes – as shown above – were not used to support the mortar and the mosaics. Image: DAI, Orient Department, R. Eichmann/artefacts-berlin.de, S. Hagenauer, from: van Ess, 2013d (Fig. 17.3)



Fig. 4: The cone mosaics of the Eanna mosaic court, Uruk, late 4th millennium BCE. They were dismantled and reassembled in the Vorderasiatisches Museum. Image: VAM, SMB – SPK, Berlin, O. M. Teßmer

create a bi- or polychrome decoration, usually geometric (chevrons, zigzags, rectangles, parallel lines etc.), and can be combined with figurative modules.³ There is a wide variety of contexts in which cones are used: inside or outside buildings, on the upper part of terraces as well as in other architectural features such as columns, semi-columns, pillars or podiums in monumental complexes.

In Uruk, the oldest in situ mosaics come from level VI (late Uruk) and belong to the Stone Cone Building (Steinstiftgebäude – with stone cones) and its courtyard walls with clay cones. Later, in level IV, clay cone mosaics were recovered from several buildings, including: the Round Pillar Hall (Rundpfeilerhalle), the North-South Terrace (Nord-Südterasse), the Pillar Hall (Pfeilerhalle) and from other buildings and areas of the site. Most clay cones in situ were not documented at the time of their excavations. Thus, for most of them, it is not possible to assign them to a specific building (van Ess, 2021).

Clay cones were also recovered from a destruction layer (Profilschnitt 50) containing Middle Uruk pottery, i. e., mid 4th millennium BCE. However, it is not possible to ascertain their chronological context (van Ess, 2021). It has been proposed that the technique of the cone mosaic

started to develop during the first half of the 4th millennium, in roughly 3600 (van Ess, 2013d).

The dimensions of the cones appear to be related to their purpose. Cones adorning niches or small-scale structures are smaller, as illustrated by the façade of the Stair Platform (Trep-penpodeste) of the Round Pillar Hall (Fig. 2 for a localization of the buildings and see van Ess, 2013d, Fig. 17.1), a small platform equipped with stairs, which allowed access to a neighbouring building on an elevated terrace. Conversely, larger cones coated with bitumen were used on the upper part of a terrace at Tell ‘Uqair (Late Uruk, Lloyd et al., 1943) further north in Babylonia. As bitumen is water resistant, it is likely that these cones protected the structure from rain and erosion. In Uruk, the average dimensions for a plain cone (with a flat head) of the levels IV is 8–10 cm length and 1,5–1,8 cm diameter. The *Grubenkopfstifte* (hollow heads) are usually bigger, but their precise dimensions are not given in the reports. Longer and thicker cones seem to belong to the oldest level, with a diameter up to 7 cm in the Anu Ziggurat area (van Ess, 2021). In the most recent levels of transition from the Late Uruk to the Jemdet Nasr, the cones sometimes have a flattened head with a square or rectangular section.

Considering the enormous quantity of cones found at Uruk, they are considered mass products (van Ess, 2021). The *chaîne opératoire* of these objects initially raised little interest: they were quickly described as hand-made clay cones, fired and dipped in paint in order to obtain a coloured head suitable for a polychrome decoration (Van Buren, 1946). More recently, M. van Ess (2021) studied a corpus of cones from different contexts and levels of Uruk, highlighting different typologies and manufacturing techniques. She confirmed the usage of clay cones in architectural decoration since Uruk VI at the latest, and a development through time, with finer and smaller cones appearing more typically in the later phases.

Archaeometric studies have shown that the technology of colouring pottery shards by modulating the firing temperature to obtain beige, white-yellow or red-brown was understood (Daszkiewicz et al., 2012). Firing at high temperatures also produces colours ranging from olive green to dark green. Pottery shards fired in reduction have a grey to black colour. The same technique was used for colouring many of the cones. The other colouring technique, consisting of the application of red, black or white layers, would have involved a smaller number of cones (van Ess, 2021).

3. Issues of polychromy in cone mosaics in a monumental architecture context

Colour is essential in the function of the mosaic cones that served the creation of a polychrome architectural decoration that lasts over time. How the colouring was achieved is therefore a question at the heart of the *chaîne opératoire*.

In the attempt to reconstruct the colouring processes, we hope to approach the original aspect of the ornamentation, which we suspect to be highly contrasted, especially for the red, black and white polychrome mosaics. This decoration also raises other questions: why were some cones coloured by applying a coloured layer on surface and others coloured by firing? Is there a hierarchy of value between stone cones, painted clay cones and cones coloured by simple firing? Are these differences significant at the scale of the buildings and the site? Is there an evolution in the use of colouring materials through the occupation of the site?

4. Archaeometric study of the colouring processes

Despite the exceptional nature of the cone mosaics, the processes of colouring by application of colouring materials have been very little explored. The study presented here

was carried out by the Rathgen-Forschungslabor and the VAM in Berlin on clay cones from Uruk with the aim to complement and further specify the observations by M. van Ess on these colouring processes.

4.1 Corpus of study and methods

Ten clay cones from Uruk coloured by application of colouring materials, today kept in the VAM and assigned to the late Uruk period, have been selected for a scientific investigation of the colouring processes. None of the clay cones analysed have a find number from the Uruk excavation that would allow an exact location of the find spot. However, it is likely that the cones originally belonged to one of the cone mosaic façades uncovered in situ in the Eanna district. To which façade or building the cones originally belonged cannot be determined with certainty (see above). Three coloured cones are illustrated in Fig. 5: according to their dimensions, they correspond to Form N°5 as determined above by M. van Ess and previous excavators. We can thus assume that they initially belonged to a building of level IV (at the earliest), i. e. the Late Uruk.

The selection was based on their conservation state: it was required that remains of a supposedly original coloured layer are still present. Secondly, the samples were selected to represent the different colours observed in the whole VAM corpus: black, white, bright red/dark red (Fig. 5).

The coloured layers were characterized in terms of composition, mineralogy and morphology by a combination of different analytical tools. In particular, cross-sections and thin-sections were prepared to study the stratigraphy, morphology, interaction zones and composition of the layers and the ceramic by optical microscopy and Environmental Scanning Electron Microscopy – Energy Dispersive X-Ray Spectroscopy (ESEM/EDX). Polarized light microscopy on thin-sections, μ -Raman spectroscopy and Fourier Transformed Infrared spectroscopy (FTIR) were used for the mineralogical identification of the pigments and of other inclusions. FTIR spectroscopy was also considered to identify the possible presence of binders or later consolidation treatments, although it is unlikely that organic binders have remained over time.

In this article, we present the analytical data for the three cones shown in Fig. 5 only. These have been more thoroughly studied and the analyses carried out on the other cones are consistent with the observations detailed below.

4.2 Main findings

The ceramic paste of the clay cones is fine- to medium-textured with inclusions of quartz, feldspar and other clay minerals, and are yellowish in colour (Fig. 6–9). Two thin-sections comprising a sufficiently large part of the clay body analysed by ESEM/EDX revealed the use of calcareous clay



Fig. 5: Photographs of coloured clay cones of the corpus of study, a) with a dark red/bright red layer (object P6, VAM Inv. Nr. RU200130_VA14917_Diss323014), b) with some remains of a white layer (object P2, VAM Inv. Nr. RU200130_VA14917_Diss322998), c) with a black layer (object P5, VAM Inv. Nr. RU200130_VA14917_Diss323010); on the graduated scale, the space between two consecutive lines corresponds to 1 mm, images: VAM, SMB – SPK, Berlin

(CaO between 11 and 16 wt%) with a relatively high Fe_2O_3 content (around 7.5 wt%). The composition is similar to Mesopotamian ceramics from the Late Uruk period published by Daszkiewicz et al. (2012). However, as the clays from the Mesopotamian South are the result of large-scale alluvial processes, they show a high degree of similarity in composition, which cannot therefore be used for provenancing ceramics.

Observations show that the interface between the coloured layers with the ceramic paste is not flat (Fig. 6 and 8). This is probably due to the roughness of the head of the hand-shaped cone surface. Apparently, a higher degree of surface smoothing was not required for these architectural ceramics and was not considered beneficial for increasing the adhesion and durability of the paint.

The main pigment of the white-coloured layers was identified by μ -Raman spectroscopy as dolomite, $\text{CaMg}(\text{CO}_3)_2$. Regarding the red-coloured layers, either bright or dark, the mineral hematite was identified by μ -Raman as colouring material. This mineral is part of different red earths that were used, containing various amounts of iron-oxides and of other earth components such as kaolinite, quartz and other silicates. For the black-coloured layers FTIR analysis indicates the presence of bitumen.

Some of the samples reveal a stratigraphy of several coloured layers. As seen on Fig. 6 in some part of the thin-section of a red-coloured cone, a white dolomite layer (visible as Ca- and Mg-rich material in Fig. 6e) is present between two red-coloured layers, the upper one being covered by a beige

material on top. Due to their semi-transparent character, these white- and beige-coloured layers appear dark on the dark field image (Fig. 6b). Compared to the ceramic paste, the coloured materials (red, white, beige) are more finely ground. A slight pleochroism was observed for the white and beige materials under cross-polarised light. No pleochroism was observed for the red material, probably due to the very finely ground red pigment particles (Fig. 7). The bottom red layer appears denser and richer in iron than the top red layer (Fig. 6d), while the middle white layer shows the same characteristics (in composition, particle size and opacity) as the white layer on white-coloured cones with dolomite grain sizes of the order of a micron to few microns. Therefore, the top red layer and the white middle layer would have been applied in same technique. They might represent a retouching in ancient times. For the upper beige layer, the question arises as to whether this is a product of retouching or rather a deposition/concretion caused by environmental conditions. From ESEM/EDX analysis, this layer appears as a concretion consisting mainly of silicates and calcite. The texture of the calcite in the beige layer does not suggest that it had a binding function here. For the black-coloured clay cones, two zones were observed in the thin-section (Fig. 8). The zone on top is a layer of “archaeological bitumen”, a processed mixture of natural asphalts or bitumen with various minerals and possibly organic debris that was widely used in the Near-East from the Neolithic period onwards (Connan, 1999; Connan and Oates, 2018). Cracks and mineral aggregate in the organic

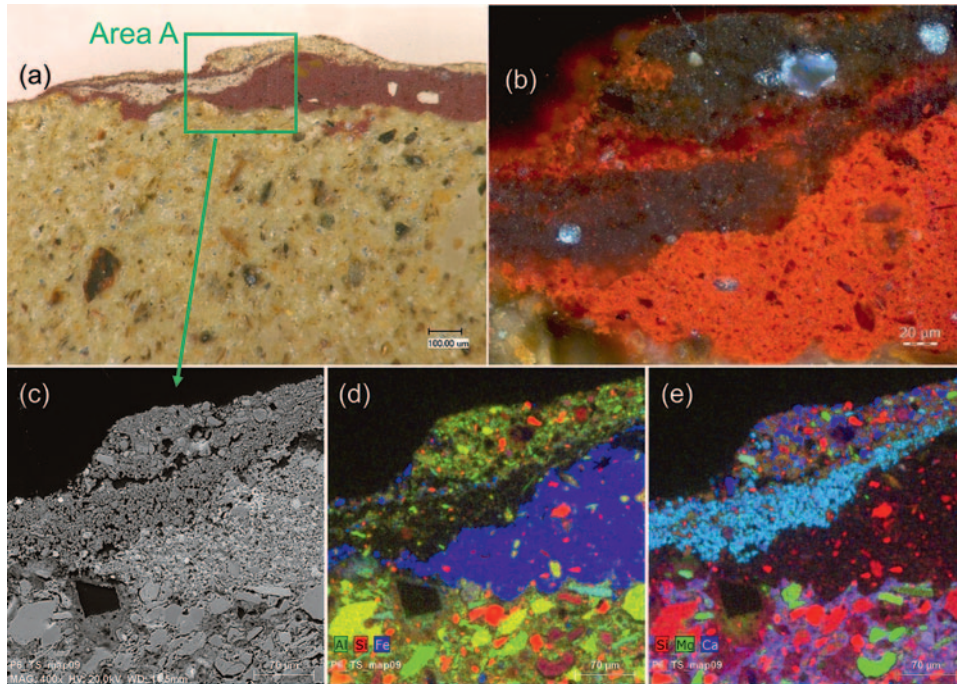


Fig. 6: Microscopy and ESEM/EDX analysis of the thin-section of a red-coloured clay cone (object P6, Fig. 5a), a) microphotograph by digital microscopy with white background showing the analysis area A, b) microphotograph in reflected light (dark field) of the area A, c–e) ESEM/EDX analysis of the area A extended towards the ceramic paste: BSE-image (c) and elemental distribution of respectively Al, Si, Fe (d) and Si, Mg, Ca (e), images: Rathgen-Forschungslabor, SMB – SPK, Berlin

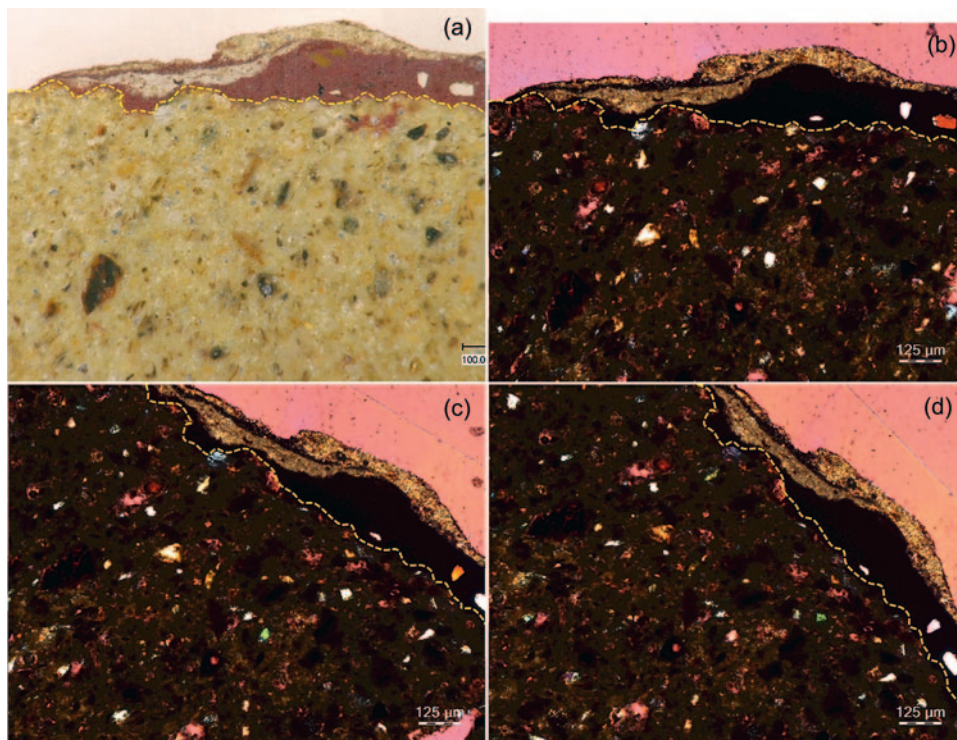


Fig. 7: Microscopy analysis of the thin-section of a red-coloured clay cone (object P6, Fig. 5a), a) microphotograph by digital microscopy, b–d) the corresponding microphotographs under cross-polarised light at different angles of observation b) 0°, c) 30°, d) 45°; the dotted line help to discern the bottom of the red layer from the ceramic paste, images: Rathgen-Forschungslabor, SMB – SPK, Berlin

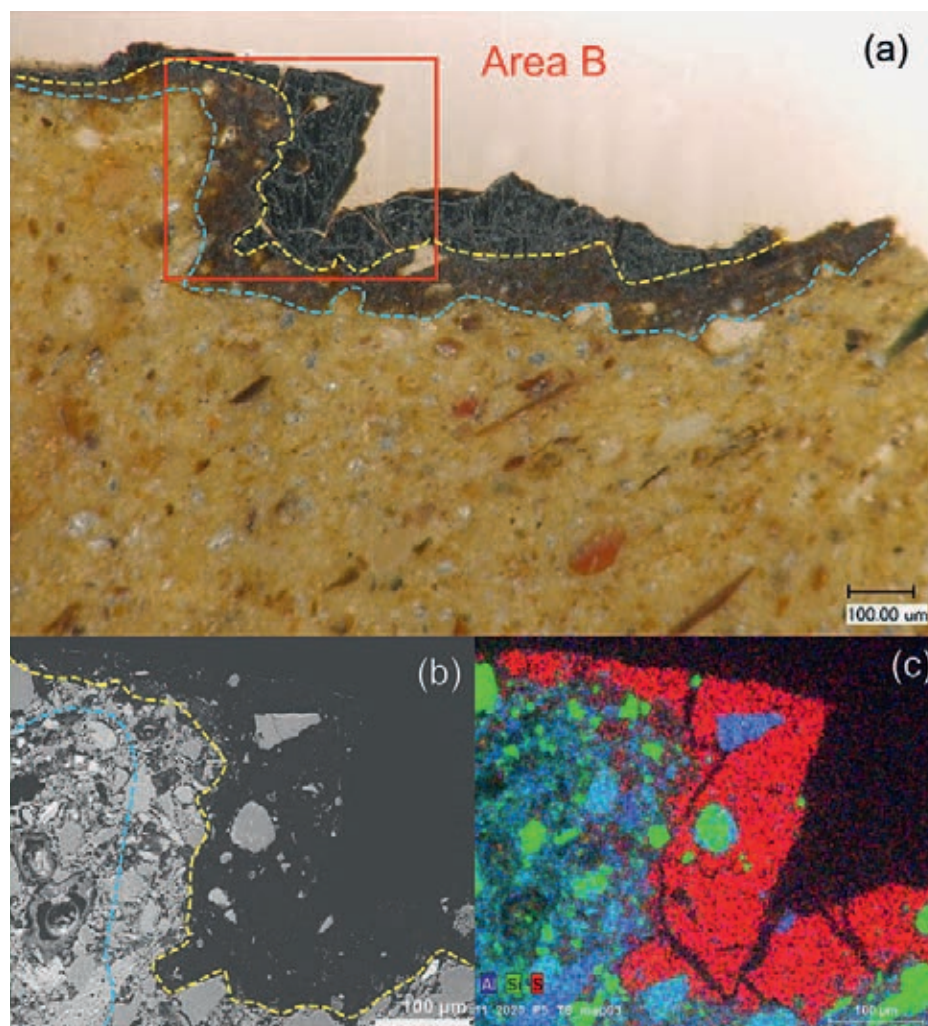


Fig. 8: Microscopy and ESEM/EDX analysis of the thin-section of a black-coloured clay cone (object P5, Fig. 5c), a) microphotograph by digital microscopy with white background showing the analysis area B, b–c) ESEM/EDX analysis of the area B: BSE-image (b) and elemental distribution of Al, Si and S (c); the blue respectively yellow dotted line in a) and b) help to discern the bottom of the two black layers, images: Rathgen-Forschungslabor, SMB – SPK, Berlin

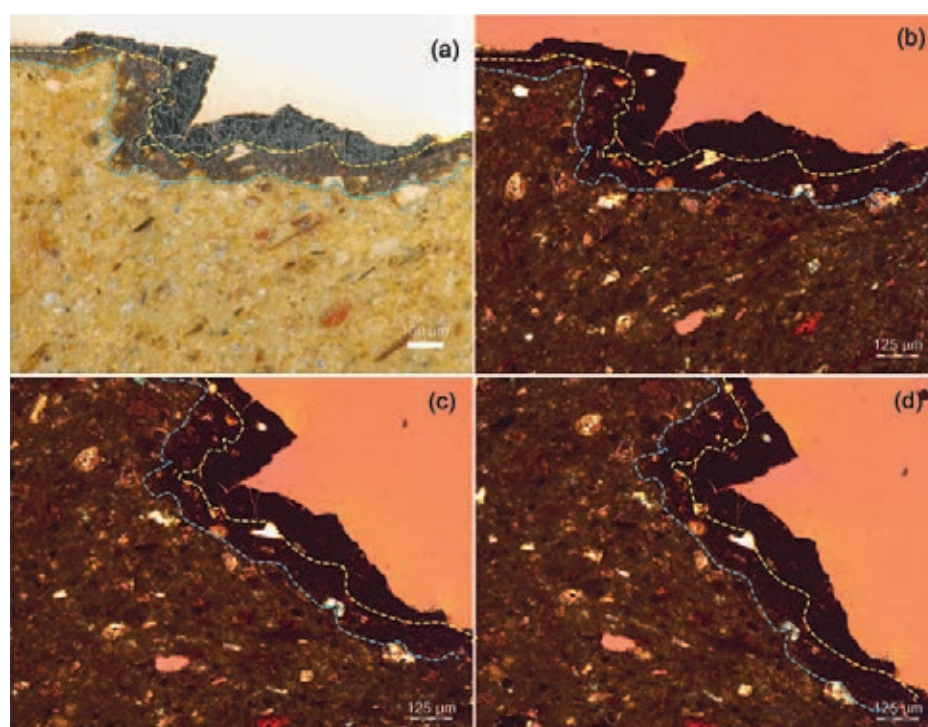


Fig. 9: Microscopy analysis of the thin-section of a black-coloured clay cone (object P5, Fig. 5c), a) microphotograph by digital microscopy, b–d) the corresponding microphotographs under cross-polarised light at different angles of observation b) 0°, c) 30°, d) 45°; the blue respectively yellow dotted line help to discern the bottom of the two black layers, images: Rathgen-Forschungslabor, SMB – SPK, Berlin

matrix are present. In the elemental distribution map, the organic matrix shows a high sulphur content (Fig. 8c). The second zone beneath this layer appears equally black in the optical microscopy, but in ESEM/EDX and analysis under cross-polarised light, it resembles the ceramic paste in terms of mineralogy (Fig. 8 and 9) and differs from the deeper ceramic bulk material only by a slightly higher content of sulphur (Fig. 8). The characteristics of the black bottom zone suggest that it had formed by the migration of components with lower viscosity from the bitumen into the ceramic.

As for the question of the application of the colours, a thermal reaction in the zone of interface between the ceramic paste and the coloured layer was not identified. Additionally, the dolomite of the white layer would not withstand a high firing temperature and would decarboxylate at temperatures around 600–780 °C in a CO₂-containing atmosphere (Xie et al., 2016; Sasaki et al., 2013), as it is assumed for the firing atmosphere of the clay cones. This range of temperature is lower than the firing temperature proposed for the Late Uruk ceramics investigated by Daszkiewicz et al. (2012). Therefore, the white dolomite layers cannot have been fired and were applied after the ceramic firing. Also bitumen could not be applied before firing the cone. Archaeological bitumen was applied without firing in the Ancient Near East as joint mortar in building constructions, as waterproofing agent on various surfaces, or as adhesive to repair broken ceramics for instance (Connan, 1999). In our samples, the grains of angular-shaped mineral aggregates within the organic does not show any sign of firing (Fig. 8). More importantly, archaeological bitumen would not withstand the ceramic firing temperature. For various archaeological bitumen samples it was shown, that there is a peak of hydrocarbon release due to pyrolysis at a temperature around 430 °C indicating the decomposition of the material (Connan and Oates, 2018). Remarkably, in a refiring experiment of a small black-coloured cone fragment from Uruk, the black layer has completely disappeared leaving the bare ceramic surface after a firing for one hour at 750 °C, a temperature well below the assumed ceramic firing temperature. Regarding the red-coloured sample shown in Fig. 6 and Fig. 7, as stated above, the presence of a white dolomite layer on a red layer suggests that this layer was applied as retouch, either during manufacturing the cone or possibly as a retouch of the cone in situ at the monument, or is the result of a contamination during the manufacture of the cones. As discussed

above, dolomite would not withstand a high firing temperature; secondly, if this white represents a retouching of the cone in situ at the monument any kind of firing would be impossible without removal of the cone from the monument. The red layer is not showing evidence of thermal sintering between grains and therefore of a firing process. The red-earth and the white might have been applied cold in association with a binder, after the firing of the ceramic. Since calcite was not found neither in the white nor in the red layer, carbonate binder can be excluded, but an organic binder might have been applied for the adhesion and cohesion of the red-earth.

5. Conclusion

The analyses conducted on a collection of ten fired clay cones from unknown contexts in Uruk but dating from the Late Uruk period resulted in the identification of methods and materials used to create specific colours on the heads of the cones. Dolomite was used for white; hematite/ochre for red, and bitumen for black. These results are consistent with previous proposals regarding the materials used.

There is no evidence that the colouring agents were applied before firing. On the contrary, firing the cones would have deteriorated the bitumen or the dolomite. Thus the current hypothesis is that the material is a “cold” paint.

This raises the question of the binders used to ensure that the coloured layer adhered to the fired clay. The observation of a rougher surface at the head may indicate a search for some mechanical adhesion of the coloured layer. The question of the binder for the white and red – organic or inorganic – remains open and should be investigated. The observation of a stratigraphy of red/white/red layers on a cone may indicate, as proposed above, a retouch. Either during the manufacture of the cone itself or it may point to a renovation of the architectural decoration at some point in the history of the building, indicating surface alteration but also the search for a constant brilliance of colours, constitutive of the monumentality of the architecture. It is also possible to imagine a change in the patterns of the mosaics, where red cones would become white.

In the future, the study of a larger corpus of cones could reveal chronological evolutions in the colouring techniques and colour agents used and thus enrich and complement the typo-chronological evolution proposed by M. van Ess (2021).

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Notes

- 1 The dating at Uruk deviates somewhat from the conventionally chronology for the Late Uruk and Jemdet Nasr periods in southern Mesopotamia; for absolute chronology at Uruk, cf. van Ess and Heußner, 2015.
- 2 Stone cones are made of red limestone (red), bituminous limestone (black) or alabaster (white). They are more rarely used, and we will only discuss clay cones here.
- 3 Some inlays in a shape of a human eye have been found in a fill layer associated to the Late Uruk (level VI), indicating that there may have been figurative motifs decorating some buildings (Becker and Heinz, 1993, p. 82 and Fig. 90; Eichmann, 2007, p. 372; Behm-Blancke, 1989).

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