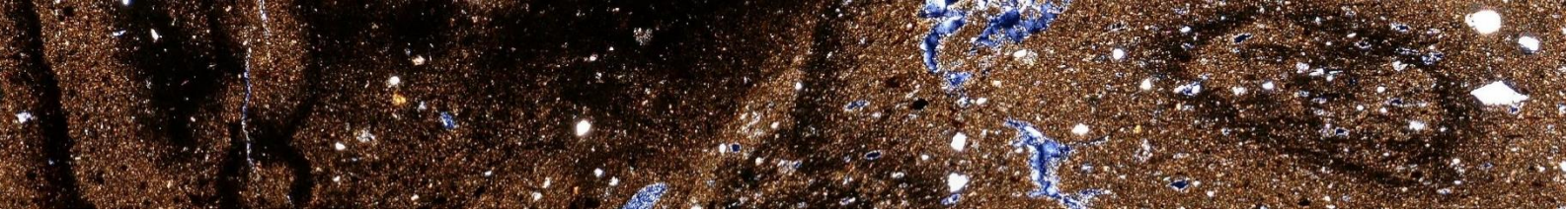

The British Museum

Mellon Foundation

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Scientific advances in the study of cuneiform collections and scribal practices in the ancient Middle East

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BOOK OF ABTRACTS

3D Visualization and Interactive Exploration of Encased Cuneiform Tablets with the Portable X-ray Micro-CT Scanner ENCI

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Our interdisciplinary project, funded by the German Research Foundation (DFG), aims to study encased cuneiform tablets non-invasively. We developed and built the portable X-ray microcomputed tomography (micro-CT) scanner ENCI (Extracting Non-destructively Cuneiform Inscriptions) to acquire high-resolution material density data from encased cuneiform tablets. In two missions in 2024, to the Louvre Museum in Paris and to the Museum of Anatolian Civilisations in Ankara, we scanned 60 encased cuneiform tablets, mainly from the Kültepe archaeological site in Anatolia. To extract the surface structures of the encased cuneiform tablet from the captured density data and to virtually separate the hidden tablet from its envelope, we developed and implemented data processing and visualisation software.

Our interactive visualisation application facilitates the analysis of the cuneiform tablets by supporting 3D presentation on autostereoscopic displays and exploitation of surface features to improve recognition of inscriptions. The automated separation and virtual unpacking of the tablet from its envelope reveals the hidden cuneiform text on the tablet. In addition, the data processing and visualisation methods offer insights into the manufacturing process of these artefacts – such as how the envelope was wrapped around the tablet. These methods also allow us to detect inclusions in the clay, including organic materials such as fibres, snails, and seeds. We automatically characterise these inclusions based on their size and shape. Furthermore, the density distribution within the explored volume allows a comparative analysis of the clay used in different tablets and between the tablets and their envelopes.

Synchrotron powder X-ray diffraction: non-invasive analysis of cuneiform clay artefacts

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In the course of this study, Synchrotron Powder X-ray Diffraction is proven to be an important non-invasive analytical method that can give information on the material used for manufacturing cuneiform clay artefacts, and on other manufacturing processes such as firing. The object of this research was 11 original cuneiform tablets from the collection of the Staatsbibliothek Hamburg, alongside an additional 26 tablets and cones from the collection at the Museum für Kunst und Gewerbe (MK&G). Our aim was to investigate the origin of the clay used in these artefacts, which is expected to be determined by local availability. In fact, the mineral composition aligns closely with the sediments of the Tigris and Euphrates alluvial plains. Another aspect is that the presence of pyroxenes in some artefacts, often accompanied by low amounts of carbonates, suggests the potential application of thermal treatments, especially when compared with mineral equilibria observed in pottery. Epigraphic data can then give the historical context for inferring manufacturing trends, after considering a greater number of artefacts. However, while the mineral composition may suggest markers for traditional pottery practices, cuneiform clay artefacts might also have been fired for conservation purposes by museums, a practice less common in recent times.

Understanding the significance of organic evidence from cuneiform tablets

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Optical microscopy and scanning electron microscopy have revealed the presence of organic remains within cuneiform tablets. These show evidence for aspects of the natural environment and resources that were present at the time the cuneiform tablets were made (Cartwright and Taylor 2011; Taylor and Cartwright 2011). In many instances this evidence reflects specific habitats and ecological niches. In additional to the organic remains within the matrix of the cuneiform tablets, ongoing research has documented traces of both plant and textiles on the surface of some cuneiform tablets, thus broadening the scope for interpretation of the significance of this category of evidence (Cartwright, Reifarth and Taylor 2024). This presentation assesses the current challenges associated with the recognition, identification and interpretation of organics and cuneiform tablets.

Conservation Science and Ethics in the Analytical Studies of Clay Cuneiform Tablets from Ancient Near Eastern Archives

Yuval Goren

Ben Gurion University of the Negev, Israel

The Bronze and Iron Ages (approximately 3rd-1st Millennia BC) represented the peak of the great empires of the ancient Near East (ANE). Extensive written records were created during this time, including archives of cuneiform texts. These archives contain numerous tablets whose origins remain uncertain. Additionally, the exact locations of many ANE countries and cities have yet to be clearly identified. As a result, uncovering the origins of these documents has the potential to provide new insights into the history of ANE and beyond. This paper will discuss the application of a range of non-destructive testing (NDT) and minimally destructive testing (MDT) methods to analyse the composition, technology, and provenance of ancient cuneiform tablets. Such an approach opens new avenues for interpreting these clay documents. We have applied these analyses to hundreds of tablets from sites such as el-Amarna, Ras Shamra/Ugarit, Boğazköy/Hattuša, and recently from the Assurbanipal library, as well as locations in Cyprus and the southern Levant. The methods, methodology and results raise important ethical and practical issues regarding the study and conservation research of these invaluable artifacts.

Bricks as Information Carriers: Multidisciplinary Approaches to Study Ancient West Asian Bricks

Helen Gries

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Bricks were a fundamental building material in ancient West Asia, not only serving as structural components but also as carriers of written and pictorial information from the 3rd millennium BCE. While inscriptions on bricks have long been the focus of scholarly research and have been published in standard corpora, the brick itself as a medium for conveying information has gained increasing attention in recent years. With the development of new analytical methods, a variety of techniques are now available for studying this group of artifacts. This paper aims to explore the different scientific approaches for researching bricks, with a particular focus on glazed bricks.

Returning Iraqi Antiquities

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The Ministry of Culture of Iraq is keen, in cooperation with the Iraqi Ministry of Foreign Affairs, to retrieve Mesopotamian antiquities that were stolen during military conflicts or through random excavation, the antiquities trade, antiquities smuggled illegally to countries around the world, or antiquities displayed in public auctions around the world.

Iraqi antiquities have been subjected to smuggling for many decades. It is not possible to count these pieces that were stolen from archaeological sites directly because they are not numbered and are also unknown, especially in areas witnessing armed conflicts. Some of these operations are intentional and come within the framework of organized crime, and some of these thefts are unintentional, especially in remote areas, as local residents resort to searching for precious stones and selling antiquities to secure a living.

Archaeological sites throughout Iraq were subjected to great destruction, theft, and neglect. About 15,000 archaeological pieces were stolen from the Iraqi Museum and 32,000 pieces from archaeological sites. Iraq was able, through persistent efforts of cultural diplomacy, to recover many antiquities stolen from archaeological sites before and after 2003 and the overthrow of the regime, leading to the terrorist Islamic State's seizure in 2014 of parts of the country, especially the ancient city of Nineveh.

The Iraqi Ministry of Foreign Affairs, through the Embassy of the Republic of Iraq in Washington, was following up on Iraqi antiquities illegally smuggled into the USA, displayed at public auctions and American museums, or in the possession of antiquities dealers and collectors of antiquities. They also follow up on Iraqi antiquities loaned to American universities and museums from the Iraq Museum and the State Board of Antiquities and Heritage for the purposes of research, classification and conservation. And through the recovery department of the State Board of Antiquities and Heritage, whose mission is to recover antiquities, the Authority was able to recover many of them.

Geoarchaeology of Mesopotamian clays: composition, provenance and archaeological use

Jaafar Jotheri

University of Al-Qadisiyah, Iraq

This talk aims at presenting the main characteristics of clay deposits in Mesopotamia, highlighting the difficulty of their characterisation for provenance studies of archaeological artefacts.

Geologically, the Mesopotamian region represents the foreland basin to the Zagros fold-and-thrust belt, and the Tigris and Euphrates rivers are axial drainage systems that pass along this basin from northwest to southeast. The Mesopotamian floodplain was mainly built by the Holocene sediments of the Tigris and the Euphrates rivers that were deposited in a climate warming up after the last phase of the pluvial conditions of the Pleistocene.

Two main geological formations contain massive clay units: Fat'ha (Lower Faris), Middle Miocene, and Injana (Middle and Upper Faris) Upper Miocene. Both formations consist of clastic sediments, such as clay and sandstone, which are prone to rapid erosion. These sediments are then transported by rivers and deposited within the floodplain basin. They are extensively exposed across large regions in Iraq and Iran, and the majority of rivers, valleys, and tributaries flowing into the floodplain traverse these formations: most Mesopotamian clay originates from these.

In southern Mesopotamia, the Tigris and Euphrates rivers frequently change their courses due to natural and human activities. Consequently, the floodplain sediments are not stable and are subject to erosion, mixing, transportation, and redeposition. The lateral and vertical variation of the sediment is not uniform across the floodplain, making it difficult to identify distinctive soil characteristics for each section of the floodplain.

Floodplain topsoil typically consists of clay, silt, and fine sand. Layers of pure red clay, sand, and marsh sediments are shallow, usually within the first meter. That is why it was easy for the Mesopotamian people to find the proper sediment for their use. The mixed topsoil is suitable for making mud bricks. Red clay and sand are located a few centimetres below the surface, suitable for pottery and construction.

Full description of tablet AO2663 clay mineralogy by using sequential fractionation of the clay fraction

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Mesopotamian tablets are at risk of structural damage and text loss due to the salts present in the original clay material. The Louvre Museum has been desalinating tablets using tetraethyl orthosilicate (TEOS) as a consolidant to preserve their integrity during the desalination process in water. To fully understand the effect of the TEOS treatment on the tablets, a complete description of the clay mineralogy is first required.

Initial quantitative mineralogical results from five cuneiform tablets (two from Susa and one each from Kish, Uruk, and Larsa) obtained by X-ray diffraction (XRD) on bulk samples show that clay minerals constitute 40 to 60% of the composition, mainly of the 2:1 type (illite, smectite, chlorite and interstratified) with the addition of palygorskite and potentially serpentine. This bulk approach, even when complemented by the identification of clays minerals in the clay fraction (<2 µm), remains too rough as the finest and most reactive clay minerals cannot be identified. To overcome these limitations, the sequential fractionation of the clay fraction into five subfractions (from <0.02 to 0.2-2 µm) was performed. The results obtained on tablet AO2663 (Old Babylonian Empire) show a specific signature with a low amount of sand and coarse silt (6%), a majority of fine silts and coarse clays (0.2-20 µm), and a significant proportion of fine clays (25% <0.2µm). Ongoing analysis by XRD will provide a full description of the clay mineralogy, and the results will be interpreted in terms of source and implications for tablet properties.

Confiscated tablets: identification of looted cuneiform tablets in the Iraq Museum, Baghdad

Ali Murad

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The SBAH and the Iraq Museum are committed to collecting and identifying looted cuneiform tablets from Iraqi archaeological sites, coming from clandestine excavations, and seized or sold on the art market. This talk will present current issues in studying such artefacts, as well as a series of material and epigraphic criteria than can be combined to facilitate their analysis.

Shapes, volumes and colours of the clay tablets vary according to chronological periods. Early Dynastic texts usually have a round shape, with long fields of text divided by lines impressed on the clay, while tablets from the Akkadian period exhibit a longer shape. Tablet shapes may also be related to the type of document, either economic, administrative, contracts or letters for instance. Finally, epigraphic data such as the wedges shapes, the personal and divine names, complement the toolbox for identifying cuneiform artefacts lacking their original archaeological context.

The Louvre's collection of cuneiform tablets, from curation to research

Véronique Pataï and Grégoire Nicolet

Département des Antiquités orientales, musée du Louvre, France

For several years now, the Louvre has been collaborating with various museums and institutions that hold collections of cuneiform tablets to gain a better understanding of the history of these collections in terms of acquisition methods, conservation and digitisation.

As home to one of the largest collections of cuneiform tablets, the Department of Oriental Antiquities has faced numerous challenges in preserving these artefacts since its establishment in 1872. In 2024, the department finally acquired a new space dedicated to the conservation and study of cuneiform tablets, designed in accordance with modern conservation standards. Due to its commitment to avoiding the baking of tablets in order to preserve their original state, the department is also able to support the research into the materiality of cuneiform tablets. Additionally, it serves as key research hub for the digitisation of these artefacts.

This presentation aims to explore the history of conservation and restoration within the department's collection, as well to provide an overview of the various digitisation programmes cuneiform tablets.

Applications of pXRF for Provenience Studies and Beyond

Susanne Paulus

University of Chicago, USA

Portable X-ray fluorescence (pXRF) is a non-destructive and less costly way to analyze the geochemical composition of cuneiform clay tablets, although the method has limits in accuracy, mainly when applied to complex materials like clays. In this talk, I will present the results of our project supported by the National Endowment for the Humanities. Suay Erkusoz and Colton Siegmund analyzed securely provenienced tablets in the Collection of the Institute for the Studies of Ancient Cultures from the sites of Adab, Nippur, Ishchali, Khafajeh, Tell Asmar, and Nuzi, as well as unprovenanced tablets identified to come from the sites of Telloh, Uruk, and Drehem as well as limited material directly on site in Nippur. Lee Drake (University of New Mexico) used a Machine Learning Approach for the Analysis to get the best results. Results show a high accuracy for excavated tablets but less favorable results for tablets from the art market. In discussing the results, I will focus on traditional and clay-based provenience analysis challenges.

Investigating early bureaucratic practices in Mesopotamia, 3500-2700 BCE

Amy Richardson and Roger Matthews

University or Reading, UK

The proto-cuneiform corpus was part of an integrated bureaucratic system of controls mediated in clay, which included tablets, sealings, tags, hollow clay balls and tokens. Through investigations of clay use across the bureaucratic corpus and the demographics of participants in these practices, we can shed light on the organisation of early administration in the late fourth and early third millennium BCE. Here, we consider the preliminary results from elemental composition characterisation through portable X-ray fluorescence analysis (pXRF) of clay bureaucratic objects (CBOs) and the fingerprint traces across their surfaces to examine the organisation of resource use and labour.

This research has been conducted within the framework of the AHRC-DFG funded *States of Clay* project, which brings scientific approaches together with digital imaging, functional and contextual analysis, and iconographic study of the seal impressions across the corpus. This project unites collections from Lower and Upper Mesopotamia (Uruk, Jemdet Nasr, Ur, Fara, Tell Brak, Nineveh, Habuba Kabira, Tell Sheikh Hassan and Kani Shaie), drawing on collections in London, Oxford, Berlin, Heidelberg, and Sulaimaniyah, to consider different trajectories of early social organisation and state formation. The results of established methods of chemical characterisation and fingerprint analysis introduce here new evidence for organisational variability between communities engaged in shared systems of practice and demonstrate different pathways in complex societies.

Examination of the source material for clay tablets: textual, biological and chemical evidence

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In collaboration with Mark Altaweel, Jaafar Jotheri, Patrick Quinn, Anke Marsh, Farouk al'Rawi and Kamal Rasheed Raheem

The study of cuneiform scripts goes back to the early nineteenth century, and numerous texts inscribed on clay tablets have been studied since. Very little attention, however, has been paid to the material aspects of the tablets until recently. In this paper, we would like to present our examination of the clay used for economic and administrative tablets to focus on a question: where did the source material come from? There have been various speculations about the origin of the source material which ranges from the river and canal sediments to special clay deposits, or even recycled clay materials obtained from old tablets. In order to answer this question, we sought textual, biological and chemical evidence which sheds light on the origin of the clay used for tablets. The paper summarizes the methods of examination and the outcome of our investigations so far.