14-16 MAY 2026, LONDON, UK

TRANSPARENT JOURNEYS ALONG THE SILK ROADS

GLASS AND CONNECTIVITY ACROSS CENTRAL ASIA AND BEYOND

Programme and Abstracts



UCL Institute of Archaeology

The British Museum

The Association for the History of Glass

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INTRODUCTION

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It is a great pleasure to welcome colleagues from around the world to the conference *Transparent Journeys Along the Silk Roads*. Pioneering work by Drs. An Jiayao in Beijing and Roberty H. Brill in Corning drew attention to the strong evidence for the movement of glass objects along the Silk Roads in the nineteen-eighties. Over the past two decades research interest has intensified, fueled by new archaeological discoveries and by the application of sensitive provenancing techniques to glass assemblages from a vast area. In addition to vessels, attention is also focused on small objects such as glass beads and bangles, which carry important information about their origins and the participation of diverse regions in international trading networks.

International conferences provide important opportunities for researchers to exchange ideas and information, and to build collaborations, as well as to open new avenues for investigation. The Association for the History of Glass, UCL Institute of Archaeology and The British Museum therefore came together to convene the present meeting. It is the result of a great deal of hard work by members of the organising committee, as well as the generosity of our sponsors and the host organisations, which has allowed us to bring the participants together in London. We are grateful to those colleagues who will present the results of their endeavours, which promise to make this an exciting event.

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PROGRAMME

PROGRAMME

DAY 1, 14 MAY

REGISTRATION **10:30**	UCL Institute of Archaeology, 31-34 Gordon Square, WC1H 0PY | foyer
	Optional free visits (pre-booked)
09:00	The British Museum's Hawaii exhibition
10:30	Tour of BM science labs
10:30	Handling session - Egyptian glass in the Petrie Museum
13:30	Registration closes
SESSION 1 **13:50-17:20**	UCL Institute of Archaeology, 31-34 Gordon Square, WC1H 0PY | Room G6
	Chair: Ian Freestone
13:50-14:00	Introduction
14:00-14:40	The importance of glass for the study of the Silk Roads: changing perspectives **Julian Henderson**
14:40-15:00	Glass beads of the Fergana Valley in the system of cultural exchanges along the Great Silk Road **Zamirakhon Koraeva**
15:00-15:20	Scientific analysis of early Islamic glass from the Ush-Tur site in Xinjiang: provenance and technology **Anqi Chen, Jianzhe Niu, Jianfeng Cui**
15:20-16:00	Coffee and tea break
16:00-16:20	Chemical and mineralogical assessment of potential frit from Akhsiket, Uzbekistan **Marcel Frenken and Thilo Rehren**

16:20-16:40 Metal-in-glass beads across Central Asia: a regional review (1st millennium CE)
Agnes Puiyee Sung

16:40-17:00 From England to China and back: exploring the connections between 18th century glass workshops
Kirill Vlasov, Kate Newnham, Elisa Ricci, Jamie Lewis, Tim Elliott, Benjamin Buse, David Barry, Claire Corkhill

17:00-17:20 Tracing Central Asian Islamic plant-ash glass: Sr–Nd isotope insights
Qin-Qin Lü, Marcos Martinón-Torres, Thilo Rehren

17:20 Close of Session

POSTER SESSION 17:20 UCL Institute of Archaeology, 31-34 Gordon Square, WC1H 0PY | Room 612

WINE RECEPTION 18:00 UCL Institute of Archaeology, 31-34 Gordon Square, WC1H 0PY | Room 609

DAY 2, 15 MAY

SESSION 2 09:30-12:30 UCL Central House, 14 Upper Woburn Place, WC1H 0NN | Lecture Hall 225

Chair: Daniela Rosenow

09:30-10:10 Glass circulation along the Silk Road: a view from South Asia
Laure Dussubieux

10:10-10:30 Northern Wei blue — Localized production of sodium calcium glass in Northern China from the 4th to the 6th century AD
Yanqin Jia, Xiaoli Duan, Jianfeng Cui

PROGRAMME

10:30-10:50	Chemical analysis of glass beads excavated in the Eurasian Steppe **Tomomi Tamura, Daisuke Nakamura, Onggaruly Akhan, Kairmagambetov Arhat, Aitkali Azat, Zhanbolat Utubaev**
10:50-11:30	Coffee and tea break
11:30-11:50	Central Asian glass bangles in the Persian Gulf **Charlotte Nash-Pye**
11:50-12:10	Shifting the focus to production: new archaeological evidence from Pabalugala fills a critical gap in Indo-Pacific glass bead research **Mangala Katugampola, Jianan Fan**
12:10-12:30	Edges of connectivity: access to Silk Road exchange in the Northern Netherlands and Lower Saxony. A case study of Zweeloo and Rasquert **Nina Schreuder**
12:30	Close of Session
12:30-14:00	Lunch
SESSION 3 **14:00-17:00**	UCL Central House, 14 Upper Woburn Place, WC1H 0NN | Lecture Hall 225 **Chair: Michael Charlton**
14:00-14:40	Glass vessels travelling East **Brigitte Borell**
14:40-15:00	Glass beads and trans-peninsular connections: new evidence from excavations at Khao Thalu archaeological site, Chumphon Province **Putsadee Rodcharoen**

15:00-15:20	Glass from India? Provenance and Manufacture study of archaeological glass unearthed from the southern route of the Silk Road in Xinjiang, 1st BCE - 4th century CE **Qian Cheng, Jinlong Guo, Bo Wang, Jianfeng Cui, Thilo Rehren**
15:20-16:00	Coffee and tea break
16:00-16:20	The introduction and distribution of Indo-Pacific beads in China's mainland from the mid-1st millennium BCE to the 1st millennium CE **Siwen Xu**
16:20-16:40	From the Middle East to the Caucasus to Berlin – a journey of medieval glassware through the centuries **Sujatha Chandrasekaran**
16:40-17:00	Zircons, hafnium isotopes and Silk Road glass: new paths to provenance **Gry Barfod, I. C. Freestone, C. E. Lesher**
17:00	Close of Session
CONFERENCE DINNER 19:00	Antalya Restaurant, 103-105 Southampton Row, WC1B 4HH (pre-booked; additional £40 apply)

DAY 3, 16 MAY

SESSION 4 09:30-13:00	UCL Wilkins Building, Gower St, WC1E 6BT | Gustave Tuck Lecture Theatre
	Chair: Andrew Meek
09:30-10:10	Urban centres as stepping stones along the Silk Roads **Nadine Schibille**

PROGRAMME

10:10-10:30	Following glass in the Indian Ocean trade: a preliminary study on glass items from the site of Banbhore (Sindh, Pakistan) **Luca Furno, Tania Chinni**
10:30-10:50	Two glass bowls from the Chermedil Necropolis, Azerbaijan **Elif Hanar**
10:50-11:30	Coffee and tea break
11:30-11:50	A Medieval glass production site discovered at Kashgar, Xinjiang **Shan Huang, Ailijiang Aisha, Ian C. Freestone**
11:50-12:10	Adoption and development of glass culture in Central Asia **Takako Hosokawa, Tamako Takeda, Ayano Endo**
12:10-12:30	On the spread of Central Asian glasswares along the Silk Roads **Maliya Aihaiti**
12:30-12:50	Glass recipes in motion - chemical evidence for circulation in Central Asia **Valerie Jing Yeung**
12:50	Concluding Remarks
AFTERNOON (EXACT TIMES TO FOLLOW)	**Optional conference related activities** (book at the registration desk on Day 1, 14 May)
BM glass map	Visit to BM - self-guided with Chen Chen's BM glass map and commentary
	BM Gallery talk - Ian Freestone and Chen Chen
	Visit to the IoA Wolfson Archaeological Science Laboratories with Michael Charlton

POSTERS UCL Institute of Archaeology, 31-34 Gordon Square, WC1H 0PY | Room 612 (DAY 1, 14 May)

New trace element data on Sasanian glass from the collections of the British Museum
Yuewen Jin

North Africa in the Silk Roads networks: The case of Early Medieval glass beads from Walīla, Morocco
Veronica Occari, Kelsi Kaviani, Barbara Lepri, Asmae El Kacimi, Hassan Limane, Corisande Fenwick

Compositional analysis and origins of Warring States beads in the collections of the British Museum
Valerie Jing Yeung, Ian Freestone, Martina Bertini, Andrew Meek, Michael Charlton

Grinding tools in primary glass making – Understanding the chaîne opératoire and its impact on chemical composition
Marcel Frenken, Qin-Qin Lü, Thilo Rehren





ABSTRACTS

JULIAN
HENDERSON

(School of International Studies, University of Nottingham, China; Department of Classics and Archaeology, University of Nottingham, UK)

THE IMPORTANCE OF GLASS FOR THE STUDY OF THE SILK ROADS: CHANGING PERSPECTIVES

The term ‘Silk Roads’ encapsulates a range of possible images in terms of the connected movement of peoples, ideas and things. Arguably the Proto Silk Roads date to the Bronze Age and the later Silk Roads can be traced to at least as late as the Song Dynasty. I will discuss what we mean by the ‘Silk Roads’ and how the study of glass contributes to our understanding of trade, exchange, materiality and acculturation using examples including the foundational research by Prof An Jiao, Dr Bob Brill and Prof Gan Fuxi, amongst others.

The use of science to investigate Silk Road glasses has borne a range of important fruit, covering a time span from the Bronze Age to the Song Dynasty. Studies of eastern, southern, central and western Asian glasses have provided a means of mapping the terrestrial and maritime Silk Roads adding to evidence from other sources. By presenting selected case studies, I will show in what ways science contributes to our understanding of interactions across the Silk Roads in different ways.

ZAMIRAKHON **KORAEVA**

(Samarkand Institute of Archaeology, Samarkand, Uzbekistan)

GLASS BEADS OF THE FERGANA VALLEY IN THE SYSTEM OF CULTURAL EXCHANGES ALONG THE GREAT SILK ROAD

Due to its geographical position, the Fergana Valley has, since antiquity, functioned as a major hub of interregional cultural and commercial interactions formed within the framework of the Great Silk Road. A significant archaeological source for investigating these processes is the collection of glass beads from the Munchaqtepa necropolis (the ancient city of Pap). Archaeological excavations at the site have yielded more than 20,000 beads, a substantial proportion of which are made of glass. The assemblage is characterized by pronounced typological diversity and includes monochrome and polychrome specimens, among them eye beads distinguished by their complex manufacturing techniques and stable symbolic semantics.

Technological analysis of the eye beads indicates the use of a technique involving the application of colored glass droplets onto a softened base, followed by their fusion, which finds close parallels in the craft traditions of the Northern Black Sea region and the Near East. Analysis of the surface chemical composition points to the use of manganese - and iron-based pigments typical of opaque colored glass.

The symbolism of the eye motif can be traced back to the traditions of Mesopotamia, Egypt, and Iran, where the eye was interpreted as an apotropaic (protective) symbol. A comparative analysis of technological and decorative features allows for the assumption that part of the assemblage was imported, attesting to intensive transregional contacts and the transfer of technological and symbolic traditions. This evidence makes it possible to regard the Fergana Valley as one of the active regions integrated into interregional communication networks.

ANQI **CHEN**[1],
JIANZHE **NIU**[2],
JIANFENG **CUI**[1]

([1]School of Archaeology and Museology, Peking University, China; [2]National Museum of China, Beijing, China)

SCIENTIFIC ANALYSIS OF EARLY ISLAMIC GLASS FROM THE USH-TUR SITE IN XINJIANG: PROVENANCE AND TECHNOLOGY

This study presents a chemical and isotopic investigation of 38 early Islamic glass samples excavated from the Ush-Tur site in Xinjiang. Analytical techniques including LA-ICP-AES and Sr-Nd isotopic analysis were combined with Canonical Discriminant Analysis (CDA) to determine the geologic provenience and production technology of the assemblage. To ensure statistical reliability, the CDA model was trained on a comprehensive database of 376 reference samples from major Islamic production centers across Central and Western Asia.

Chemical analysis reveals that the assemblage is dominated by plant ash soda-lime-silica glass (n=37), dating primarily to the 8th–10th centuries, with a single outlier (#16) identified as Egyptian natron glass. Provenance determination reveals a diverse supply network: 19 samples originate from Merv (Central Asia), 8 from Mesopotamia, and 5 from the Iranian Plateau (attributed to the G1 and G2 groups). Sr-Nd isotopic ratios ($^{87}Sr/^{86}Sr \approx 0.7084$) for the Mesopotamian group provide further geologic evidence of production using alluvial sediments from the Tigris-Euphrates basin.

Technological analysis of an opaque yellow shard (#36) identified the use of lead-tin yellow (3.32% PbO, 0.14% SnO_2), marking the shift from antimony to tin-based opacifiers during the early Islamic period. Typological features, such as facet-cut vessels and folded rims, correspond well with the chemical findings. These results highlight Ush-Tur as a key destination for high-quality glass imports from multiple Islamic manufacturing hubs, reflecting the complex circulation of glass commodities along the medieval Silk Road.

Keywords: Early Islamic Glass, Ush-Tue site, glass trade along the Silk Road

MARCEL **FRENKEN**, THILO **REHREN**

(Science and Technology in Archaeology and Culture Research Center (STARC), The Cyprus Institute, Nicosia, Cyprus)

CHEMICAL AND MINERALOGICAL ASSESSMENT OF POTENTIAL FRIT FROM AKHSIKET, UZBEKISTAN

Excavations of an Early Islamic glass workshop from Akhsiket, Uzbekistan in the Fergana Valley have yielded technical ceramic in the form of furnace remains with attached glass. In a few cases, there seems to be partially molten material attached to the ceramic furnace wall, forming a porous, white material instead of the usual black (very dark green), green, aqua or purple coloured glass seen in the other technical remains. The initial interpretation of this material is that they are partially molten raw materials, or frit, with residual quartz grains and interstitial glass formed. This frit, whether or not it was an intentionally made intermediate product, or an accidental incomplete melt, would supply evidence for primary glass production from raw materials. Chemical and mineralogical analysis with SEM-EDS of the bricks that the furnace was constructed from, as well as the organic tempered furnace lining are compared to the proposed frit. If we can confirm the material as frit, this would implicate Akhsiket as the first site of Early Islamic Central Asia with an archaeologically confirmed primary glassmaking workshop.

AGNES PUIYEE **SUNG**

(The Chinese University of Hong Kong, China)

METAL-IN-GLASS BEADS ACROSS CENTRAL ASIA: A REGIONAL REVIEW (1ST MILLENNIUM CE)

Metal-in-glass beads (also known as gold- or silver-foil glass beads) are composite ornaments made by enclosing a thin metal foil between two layers of glass. The earliest dated manufacture of metal-in-glass beads dates to the late third century BCE in the Hellenistic Mediterranean (Spaer 1993) and are widely circulated during the first millennium CE.

Recent scientific work shows that metal-in-glass beads from Inner Mongolia and Xinjiang were made using plant-ash soda-lime glass, pointing to production traditions linked to Central Asia or Iran (Zhou et al. 2024; Cheng 2021; Lin 2009). Some examples from Xinjiang contain higher-alumina glass and have been associated with South Asian (Bara) production (Wang et al. 2022). In contrast, comparable material from the interior of Central Asia, which lies at the interjection of routes entering these regions, has so far received limited synthetic and scientific attention.

This paper presents a regional review of metal-in-glass beads from Central Asian archaeological sites, focusing on their distribution, typology, and archaeological contexts. The review is supplemented by preliminary SEM and micro-CT analyses of a group of beads from eastern Kazakhstan. These results provide new insights on manufacturing sequences and material choices, and refine our understanding on how metal-in-glass beads circulated across Central Asia.

Keywords: metal-in-glass; glass beads; Central Asia.

KIRILL **VLASOV**[1,3], KATE **NEWNHAM**[2], ELISA **RICCI**[2], JAMIE **LEWIS**[3], TIM **ELLIOTT**[3], BENJAMIN **BUSE**[3], DAVID **BARRY**[4], CLAIRE **CORKHILL**[3]

([1]Department of Physics, University of Aberdeen, UK; [2]Bristol Museum and Art Gallery, UK; [3]School of Earth Science, University Of Bristol, UK; [4]Bristol Blue Glass Ltd., UK)

FROM ENGLAND TO CHINA AND BACK: EXPLORING THE CONNECTIONS BETWEEN 18TH CENTURY GLASS WORKSHOPS

The eighteenth century saw an increase in the speed at which glass recipes, glassmaking materials and finished objects travelled to China. One of the most popular European glass types of this period, used primarily for luxury goods, is lead crystal (lead-potash glass). Based on a pXRF survey of over 300 objects in the Burrows Abbey collection of Chinese glass (held at the Bristol Museum and Art Gallery), we identified 18th century lead-potash glass vessels and compared them to a reference database of English glass compiled through new analysis (WDS, LA-ICP-MS) of the collections at Bristol and cullet from the 'Albion' shipwreck, now at the British Museum. This allowed us to identify Chinese vessels that may have been produced from English-made cullet or using English-like recipes. Additionally, this allowed us to uncover English glass within the collection, most notably a hookah base with an Arabic inscription, previously believed to be Chinese.

This study was partially funded by The Brigstow Institute. We would like to thank Dr. Andrew Meek and Dr. Ian Freestone for their assistance with this study.

TRACING CENTRAL ASIAN ISLAMIC PLANT-ASH GLASS: SR–ND ISOTOPE INSIGHTS

QIN-QIN **LÜ**[1], MARCOS **MARTINÓN-TORRES**[1], THILO **REHREN**[2]

([1]University of Cambridge, UK; [2]The Cyprus Institute, Cyprus)

Strontium and neodymium isotopes have become an important tool in the study of plant-ash glass, providing insights into raw material sources, production organisation, and regional interaction. To date, however, Sr–Nd isotope data remain sparse for glass assemblages east of Iraq, including Central Asia, limiting our ability to assess glass production and exchange across the Silk Roads. This paper introduces new Sr and Nd isotope results from Islamic-period plant-ash glass excavated from both the western and eastern regions of Central Asia. The isotope signatures are discussed in relation to compositional characteristics and archaeological context, and also evaluated against a large-scale Sr–Nd isotope baseline previously proposed for plant-ash glass from the eastern Silk Roads. By integrating new datasets and combining multi-proxy evidence, this contribution aims to advance isotope-based approaches to Central Asian glass provenance and discussions of glass production and trade networks along the Silk Roads.

ABSTRACTS: SESSION 2

LAURE
DUSSUBIEUX

(Field Museum,
Chicago, USA)

GLASS CIRCULATION ALONG THE SILK ROAD: A VIEW FROM SOUTH ASIA

Geographically, South Asia holds a central location along the Silk Road, and was an important connection point between the East and the West for goods, people and ideas. Focusing our attention on glass, this presentation will address objects transiting through South Asia and will also consider the contribution of South Asia, and more specifically, India to the trade along the Silk Road. India was a major glass bead producer in ancient times and Indian beads started appearing in Southeast Asia as early as the mid-1st millennium. These small objects are found all over the Indian Ocean and way beyond, as far as Europe and China. We will attempt to follow their trail and try to understand their movement across sea and land in the context of the Silk Road.

NORTHERN WEI BLUE — LOCALIZED PRODUCTION OF SODIUM CALCIUM GLASS IN NORTHERN CHINA FROM THE 4TH TO THE 6TH CENTURY AD

YANQIN **JIA**[1,2]
XIAOLI **DUAN**[2],
JIANFENG **CUI**[3]

([1]School of Archaeology and Museology, Shanxi University Shanxi, China; [2]Datong Museum, Shanxi, China; [3]School of Archaeology and Museology, Peking University, Beijing, China)

The Pingcheng period of the Northern Wei Dynasty (398–494 AD) saw a significant revival of the Silk Road, bolstering trade between the East and West. As the capital, Pingcheng (today's Datong City, Shanxi Province) played a pivotal role in the introduction of Western glass products and their fabrication techniques to Eastern regions. While the Book of Wei: Western Regions provides textual evidence of the introduction of glassmaking technology, modern instrumental analysis is required to understand the components and craftsmanship of Pingcheng-period glassware.

In this study, three typical glassware from the Northern Wei period in Datong area were analyzed using a 3D digital microscope with an extended depth of field and a scanning electron microscope-energy dispersive spectrometer (SEM-EDS). This non-destructive, micro-level analysis focused on the glass' chemical composition and microscopic morphology. Preliminary investigations were conducted into production techniques, raw materials, and their sources. Compared with the same type of glassware and pottery unearthed in neighboring areas of the same period, the research shows that the foreign blowing technology and aesthetic exchange and fusion of Xianbei nationality produced a unique style of ware. The findings indicate that these glassware belonged to a high Mg, plant ash-based Na_2O-CaO-SiO_2 glass system, the average content of MgO is 7.2%, and high magnesium sodium calcium glass is relatively rare in the world's ancient glass lineage. The glasswares' shape, micro shape, and high Mg concentration suggest local production using indigenous materials, likely influenced by Roman glassblowing techniques.

This study provides important scientific information regarding the trade and technical exchange of glass between China and foreign countries in Pingcheng period of the Northern Wei Dynasty.

TOMOMI **TAMURA**[1], DAISUKE **NAKAMURA**[2], ONGGARULY **AKHAN**[3], KAIR-MAGAMBETOV **ARHAT**[3], AITKALI **AZAT**[3], ZHANBOLAT **UTUBAEV**[3]

([1]Nara National Research Institute for Cultural Properties, Japan; [2]Saitama University, Japan; [3]Margulan Institute of Archaeology, Kazakhstan)

CHEMICAL ANALYSIS OF GLASS BEADS EXCAVATED IN THE EURASIAN STEPPE

This study aimed to clarify the origin and distribution routes of ancient glass beads excavated from burial sites in the Eurasian Steppe dating from the late 1st millennium BC to the early 1st millennium AD. Despite the Eurasian Steppe's strategic location in the inland trade network, systematic scientific investigations of glass beads in this region remain limited. In this study, representative glass bead groups excavated from multiple sites in Kazakhstan and Mongolia were analyzed using stereomicroscopy, X-ray computed radiography, X-ray fluorescence (XRF), and strontium (Sr) and lead (Pb) isotope analysis.

The results showed the presence of both natron glass and plant ash glass, indicating multiple origins and supply routes. In addition to these, potash glass was also present in the Mongolian glass beads, suggesting an additional supply route from India between Kazakhstan and Mongolia. Natron glass beads, particularly those with foiled and cobalt blue segments, exhibit major element compositions and Sr isotope ratios consistent with local origins in the Eastern Mediterranean, particularly the Levant and southeastern Mediterranean basin. Furthermore, Pb isotope data suggest that the cobalt- and lead-based colorants originated from Iranian or geologically related ore sources. In contrast, some plant ash glass beads, despite similar major element compositions, exhibit high Sr isotope ratios distinct from typical West Asian products, suggesting a Central Asian or Indo-Pakistan source.

These findings highlight the complexity of glass circulation in the Eurasian steppe and demonstrate the need to integrate chemical and isotopic data for robust provenance determinations. This study provides new evidence for long-distance glass exchange linking the Mediterranean world, Central Asia, and East Asia around the Common Era.

CHARLOTTE **NASH-PYE**

(The British Museum, UK; University of Kent, UK)

CENTRAL ASIAN GLASS BANGLES IN THE PERSIAN GULF

Previous research had identified a single high alumina plant ash (v-Na-Al) composition amongst one of eight c.14th century glass bangles analysed using LA-ICP-MS from Siraf, Iran, by the Corning Museum of Glass. Since then, glass with elevated alumina (>4.5 wt%) has become strongly associated with Central Asian production. Recent LA-ICP-MS analysis of over 100 glass bangle fragments from Siraf in the British Museum has identified several further examples with the same v-Na-Al composition.

This paper reassesses published compositions of this nature in light of an improving understanding of 9th–14th century glass from the historic Greater Khurasan region. It identifies at least three major Central Asian glass production groups in circulation during this period (CA1–3), differing primarily by alumina, titanium and zirconium ratios, as well as by REEs. Distinct patterns of dissemination are also observed: CA3 remained relatively local, CA2 shows the widest circulation along caravan routes, and CA1 exhibits the greatest maritime distribution.

These findings refine current characterisations of this elusive category of glass, clarify its periods of production, and contribute to a more nuanced understanding of glass and glass bangle connectivity across Central Asia and beyond.

MANGALA **KATUGAMPOLA,** JIANAN **FAN**

(University of Kelaniya, Sri Lanka)

SHIFTING THE FOCUS TO PRODUCTION: NEW ARCHAEOLOGICAL EVIDENCE FROM PABALUGALA FILLS A CRITICAL GAP IN INDO-PACIFIC GLASS BEAD RESEARCH

The Pabalugala site in Sri Lanka represents a critical center for glass bead production spanning the 2nd to the 5th century CE, recognized for manufacturing historically significant Indo-Pacific glass beads. The 2025 joint archaeological season, comprising both excavation and regional survey, aimed to elucidate the site's industrial layout and technological capacities. Excavations across 51.5 square meters revealed two well-preserved, semi-subterranean glass-melting furnaces (YL2 and YL3) that exhibit a structural clarity rare for the South Asian region. These furnaces display distinct construction techniques, suggesting the presence of specialized functional zones or different stages of production.

The recovered artifact assemblages, which include over 18,000 pieces of glass frit and nearly 1,400 glass tubes and finished beads, offer crucial material evidence for reconstructing the complex pyro-technologies employed at the site. Additionally, resource surveys identified abundant local sources capable of supplying core raw materials, including high-purity silica (quartz), natural alkali fluxes, and potential metal oxides for colorants. This proximity of resources suggests a resource-oriented, potentially self-sufficient, and large-scale manufacturing base.

By uncovering these primary manufacturing features, this study shifts the focus of Indo-Pacific bead research toward production origins. Ongoing scientific analysis will further refine the site's chronology and define Pabalugala's significant role within ancient South Asian maritime trade networks.

NINA
SCHREUDER

(University of Groningen, Netherlands)

EDGES OF CONNECTIVITY: ACCESS TO SILK ROAD EXCHANGE IN THE NORTHERN NETHERLANDS AND LOWER SAXONY. A CASE STUDY OF ZWEELOO AND RASQUERT

This paper discusses early medieval glass bead assemblages from the northern Netherlands and Lower Saxony, exploring regional variations in their composition and connectivity within the framework of the Silk Roads. Preliminary results suggest that assemblages from the northern North Sea coasts differ from inland assemblages, possibly indicating varying exchange networks within a relatively small geographic area.

The study highlights glass beads from the sites of Zweeloo (Drenthe) and Rasquert (Groningen) in the Netherlands, and combines typological classification with portable X-ray fluorescence (pXRF) analysis.

Particular attention is given to beads typologically identified as Indo-Pacific, of which the base glass composition is associated with South and Southeast Asian production. Compositional results in this research, however, indicate that some of these Indo-Pacific types are made from Mediterranean-type glasses. This suggests a complex relationship between bead exchange, as well as possible technological transmission, which could have us re-evaluate existing knowledge on bead production models. By integrating chemical analysis with typology and archaeological datasets that cross boundaries of modern-day countries, this research contributes to broader debates on glass circulation, technological transmission, and the archaeological visibility of Silk Road connectivity at Europe's northwestern edge.

ABSTRACTS: SESSION 3

BRIGITTE **BORELL**

(University of Heidelberg, Germany)

GLASS VESSELS TRAVELLING EAST

Within a time frame spanning the Roman Imperial, Sasanian, and early Islamic periods, the talk will take a closer look at Mediterranean, Middle Eastern, and Central Asian glass vessels that travelled farther to the east. This will include also glass vessels from such important collections as those from Begram (Afghanistan), the Silla Tombs at Gyeongju (Korea), and the Famen Temple (China). Special focus will be given to Central Asian glass vessels as well as to shapes selected and manufacturing techniques involved. Briefly addressed will be the topic of routes of transmission and possible changes in different periods, whether land routes across Central Asia or maritime routes were used, the searoutes getting increasingly traceable by finds of glass vessels fragments.

QIAN **CHENG**[1,2], JINLONG **GUO**[3], BO **WANG**[3], JIANFENG **CUI**[4], THILO **REHREN**[2]

([1]China National Centre for Archaeology, China; [2]STARC, The Cyprus Institute, Cyprus: [3]Xinjiang Uygur Autonomous Museum, China; [4]Peking University, China)

GLASS FROM INDIA? PROVENANCE AND MANUFACTURE STUDY OF ARCHAEOLOGICAL GLASS UNEARTHED FROM THE SOUTHERN ROUTE OF THE SILK ROAD IN XINJIANG, 1ST BCE-4TH CENTURY CE

The Xinjiang region was a trade and cultural hub between East and West since antiquity. In parallel with pottery and bronze wares, glass wares and beads are particularly unique and colourful amongst the various types of archaeological finds on the Southern Line of Silk Road. More than 2000 glass beads were excavated from the Khotan and Qiemo cemetery sites. The glass beads were mainly strung into necklaces, bracelets and earrings mixed with plant seeds and bone beads in various assortments.

This research concentrates on glass beads collected in the Xinjiang Autonomous Region Museum by using a combination of scientific analytical methods such as LA-ICP-AES, Confocal Raman Microscopy, SEM-EDX and Sychrontron micro-CT, etc. The study aims to investigate the types, origins and manufacturing techniques of those glass finds.

This presentation focuses on two types of glass beads—gold- and silver-foil beads and red opaque beads—excavated from sites in Khotan. These beads are compared with those recovered from a Tibetan sacrificial site through chemical compositional and internal structural analyses. The archaeological evidence and scientific results demonstrate the existence of complex trade networks linking northern Pakistan, the southern Indian subcontinent, the southern branch of the Silk Road in Xinjiang, and the Ali region of the Tibetan Plateau during the Han to the Wei–Jin periods (1st century BCE–4th century CE). The findings further suggest that local populations were actively engaged in long-distance trade and cultural exchange prior to the widespread dissemination of Buddhism along the Silk Road.

Keywords: glass, Silk Road, Xinjiang, origins, manufacture

ABSTRACTS: SESSION 3

PUTSADEE **RODCHAROEN**

(Department of Archaeology, Silpakorn University, Thailand)

GLASS BEADS AND TRANS-PENINSULAR CONNECTIONS: NEW EVIDENCE FROM EXCAVATIONS AT KHAO THALU ARCHAEO-LOGICAL SITE, CHUMPHON PROVINCE

Archaeological research in southern Thailand demonstrates long-distance interaction networks linked to maritime exchange routes for over two millennia. Sites such as Khao Sam Kaeo, Phu Khao Tong, Khuan Luk Pat, Tha Chana, and Phum Riang have yielded material culture indicative of interregional trade, particularly stone and glass bead whose scientific analyses point to production centers in India, Sri Lanka, the Middle East, China, Vietnam, and Thailand.

Excavations at Khao Thalu (Kao Kob) site, Chumphon Province in 2025 uncovered four burials—two adult females, one adult male, and one infant—with Radiocarbon dating of charcoal samples associated with the burials yielded calibrated age ranges of 1,630–1,540 BCE for Burial 1, 550–400 BCE for Burial 2, and 5,620–5,520 BCE for Burial 4.

Key archaeological evidence includes a bronze knobbed-ware vessel placed inverted over the facial area of Burial 2, along with 18 small black glass beads, approximately 1 mm in diameter, recovered from both sides of the skull near the ears. In the infant burial, 152 glass beads were found around the torso; these are oblate to spherical in shape, opaque red in color, and range from 2–5 mm in size. In addition, two carnelian beads were recovered from the general soil matrix; both are of the faceted truncated bicone type.

Dental morphology suggests diverse biological backgrounds, with Burial 2 exhibiting Caucasoid traits and Burials 1 and 4 showing Mongoloid traits. The presence of knobbed ware, a vessel type known from the Indian subcontinent, reinforces evidence for trans-peninsular connections via the maritime Silk Road into the region of Suvarnabhumi. These findings highlight both the movement of

artefacts and the presence of individuals of diverse biological backgrounds.

Glass beads constitute an important class of artefacts for interpreting interregional exchange networks. Ongoing compositional analyses of the glass beads from Khao Thalu aim to refine provenance interpretations and expand understanding of early exchange networks in southern Thailand.



ABSTRACTS: SESSION 3

SIWEN **XU**

(Department of Archaeology and Anthropology, University of Chinese Academy of Sciences, China)

THE INTRODUCTION AND DISTRIBUTION OF INDO-PACIFIC BEADS IN CHINA'S MAINLAND FROM THE MID-1ST MILLENNIUM BCE TO THE 1ST MILLENNIUM CE

Trade in Indo-Pacific glass beads between China's mainland and external regions flourished from the mid-1st millennium BCE to the 1st millennium CE, evolving through three stages.

First, during the Warring States Period, m-K and potential m-Na-Al beads entered Xinjiang via land routes and then spread further into the interior of China.

Second, the Han Dynasty marked a shift toward South China, with various compositional types indicating South/Southeast Asian origins via the emerging Maritime Silk Road and inland river transportation. Concurrently, Xinjiang maintained overland trade of m-K glass with South/Southeast Asia, while receiving v-Na-Al beads from Central Asia/northern South Asia.

Third, in the mid-to-late first millennium, maritime trade sustained m-Na-Al bead supplies to South China, while the Northwest accumulated v-Na-Ca beads from West Asia via the Land Silk Road. Compositional divergence reveals distinct networks: the dominance of v-Na-Ca beads in the Northwest and their absence east of Shaanxi, where m-Na-Al beads predominated, precludes selective overland transmission to Central China.

Despite active Sogdian-led commerce in the North with Central/West Asia, the southward shift of China's economic core and the efficiency of waterways suggest that m-Na-Al beads were bulk transferred from South to Central China. These transitions offer critical insights into the evolving geopolitical dynamics and foreign trade networks of early Imperial China.

SUJATHA **CHANDRA-SEKARAN**

(Staatliche Museen zu Berlin, Germany)

FROM THE MIDDLE EAST TO THE CAUCASUS TO BERLIN – A JOURNEY OF MEDIEVAL GLASSWARE THROUGH THE CENTURIES

The medieval enamel-decorated glass beakers of the Berlin Museum of Islamic art constitute the largest collection of such finds in the modern museum landscape today. Purchased by the Berlin museums in the early 20th century from collectors working in the south of the Russian Empire, the beakers are characteristic of medieval Syrian or Egyptian manufacture. This collection's significance lies not only in its numbers, but from the beakers' find region in the Caucasus, where they functioned as part of funerary assemblage in burial rites differing greatly from those in the region of their production.

This paper presents the collection of medieval glass beakers currently in the Berlin Museum of Islamic Art. I will look at their modern acquisition history and players involved in order to identify relevant find sites and contexts. An examination of the objects' placement in the burials will reveal the function and significance of the beakers in these rites, enabling a comparison with medieval Syria and Egypt, and leading to a final discussion addressing aspects of ethnicity, identity and religion of the interred.

ABSTRACTS: SESSION 3

GRY H. **BARFOD**[1], I.C. **FREESTONE**[2], C.E. **LESHER**[1]

([1]Cobb Meadow Research, Camden, USA; [2]Institute of Archaeology, UCL, UK)

ZIRCONS, HAFNIUM ISOTOPES AND SILK ROAD GLASS: NEW PATHS TO PROVENANCE

Hafnium isotopes offer a powerful yet under-explored tool for tracing the provenance of ancient glass along the Silk Roads. Because the values of Hf isotopic ratios are inherited from zircon-bearing source sediments and remain largely unexplored by glassmaking processes, they provide a robust fingerprint of raw material origins.

This talk presents new data showing variations in Hf isotope compositions in different glass types found along the Silk Roads that distinguish primary production centres. Hafnium data are integrated with major- and trace-element compositions and strontium–neodymium isotope ratios from the same samples to refine provenance models and explore patterns of material circulation.

NADINE
SCHIBILLE

(IRAMAT-CEB,
CNRS,
Université
d'Orléans, France)

URBAN CENTRES AS STEPPING STONES ALONG THE SILK ROADS

The compositional evidence of glass assemblages from Samarra (Irak), Nishapur (Iran), Merv (Turkmenistan) and Bukhara (Uzbekistan) reveals the transformation of the Islamic glass industry in the 9th century. Raw glass no longer travelled in large quantities over long distances, as had been the case previously. Instead, the composition of the different assemblages demonstrates a diversification of primary production of glass in urban centres along the northern Silk Roads.

The old model of a globalised glass trade breaks down in the 9th century in favour of a more flexible and diverse model of production, reflected in a multiplication of primary production centres and the local supply of glass. There was still some movement of finished glass artefacts, notably in the form of a high quality colourless glass from Samarra as well as cobalt blue glass. The multiplication of primary production makes glass supply less dependent on global geo-political factors. These developments are therefore closely related to the wider processes of socio-economic change.

The global comparison shows that urban centres of the Silk Road may have served as stepping stones for the transfer of glassmaking technologies from the traditional glassmaking centres on the shores of the Mediterranean to the eastern Islamic regions.

LUCA **FURNO**[1], TANIA **CHINNI**[2]

([1]University of Bologna, Italy; [2]Association Internationale pour l'Histoire du Verre – Italian Committee)

FOLLOWING GLASS IN THE INDIAN OCEAN TRADE: A PRELIMINARY STUDY ON GLASS ITEMS FROM THE SITE OF BANBHORE (SINDH, PAKISTAN)

The paper presents the preliminary results of the study of a selection of over 3160 glass fragments found at the site of Banbhore (Sindh, Pakistan), within the Italian Historical-Archaeological Project conducted by the Catholic University of the Sacred Heart of Milan (Italy) in collaboration with the General Directorate of Antiquities and Archaeology of Sindh.

During the Early Islamic Period (8th-early 13th century), Banbhore was an important commercial port in the delta of the Indus River and many scholars identify the site with the great port of Debal/Daybul mentioned in medieval Arabic and Persian written sources. Recent discoveries of significant ivory crafting debris further support the city's prominent economic role in the region.

The present study represents the first contribution towards a chrono-typology of the glass items, comparing these with catalogues of other regions from the Near East and the African coast to Indonesia, China and Japan. The research contextualizes Banbhore within the broader Maritime Silk Road, integrating glass data with ceramic and ivory evidence to reconstruct the complex socio-economic networks of the medieval Indian Ocean. By investigating trade routes and the potential for local glass workshops, this study aims to fill a significant gap in the knowledge of glass trade and consumption in the region.

ELIF **HANAR**

(Department of Archeology, Mardin Artuklu University, Türkiye)

TWO GLASS BOWLS FROM THE CHERMEDİL NECROPOLİS

During archaeological excavations conducted in 2012 by specialists from the Institute of Archaeology and Anthropology at the Azerbaijan National Academy of Sciences at the Chermedil Necropolis—located 500 m south of Chermedil village (Ismayilli District) on a flat area atop small hills along the left bank of the Girdiman River—one kurgan, eight jar burials, and 25 earthen graves were identified. Among the finds, a facet-cut beaker was recovered from Jar Burial No. 2, while a pinched-out beaker was excavated from Jar Burial No. 8.

Our literature review reveals that early examples of glass beakers with comparable forms and decorations were in use across numerous Roman settlements as early as the I. century AD. Furthermore, these beakers—though influenced by Roman glassmaking traditions—emerged as one of the characteristic forms of Sasanian glass production during the IV-VI. centuries AD, attested by numerous examples across a wide geographical distribution. Notably, a Sasanian-period coin from Jar Burial No. 2 provided a secure chronological context for the facet-cut beaker.

This study examines the facet-cut beaker and pinched-out beaker—discovered in situ as grave goods alongside datable materials like coins—through multiple analytical lenses: production techniques, structural features, decorative elements, functions, and usage contexts.

Keywords: Azerbaijan, Chermedil (Çermedil) Necropolis, Sasanian Glass, facet-cut, pinched-out, beaker, ancient glass

SHAN **HUANG**[1], AILIJIANG **AISHA**[2], IAN C. **FREESTONE**[3]

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A MEDIEVAL GLASS PRODUCTION SITE DISCOVERED AT KASHGAR, XINJIANG

Keywords: Kashgar, Glassmaking Centre, Soda-rich Plant-ash Glass

Glass artefacts and glass production debris have been frequently identified at medieval city sites near Kashgar, Xinjiang, representing the westmost concentration of glass discoveries in China. Archaeological surveys conducted between 2018 and 2022 at the Hannuoyi ancient city site, located northeast of modern Kashgar, yielded a substantial assemblage of glass and glazed ceramic sherds dating to the 9th-13th centuries. From over 300 glass fragments, 53 representative samples were selected for material analysis and research on the basis of *in situ* pXRF examination. SEM-EDS, ICP-MS and 3D OM were employed to understand their chemical compositions and microstructural features.

Preliminary results suggest the presence of a local glass production centre in Kashgar by the 13th century. The glass artefacts were shaped by blowing and moulding and are mainly soda-rich plant-ash types, with potash values up to 6%. Alumina contents are variable and high, ranging up to 11% and high niobium and thorium values are notable characteristics of the glass. Many samples are various intensities of a natural yellowish-green. Copper, manganese and cobalt were added as colourants, while white and turquoise glasses were opacified by tin oxide. The recovered glass is highly fragmentary, which may suggest recycling of larger fragments. The elevation of copper and lead above background but below the threshold for colouration in many samples is consistent with a significant recycling practice.

The technological characteristics demonstrate close connections with Central Asian glassmaking traditions and material exchange along the Silk Road.

TAKAKO **HOSOKAWA**[1], TAMAKO **TAKEDA**[2], AYANO **ENDO**[3]

([1]Tokyo Gakugei University, Japan; [2]Yokohama Museum of Eurasian Cultures, Japan; [3]University of Nottingham, UK)

ADOPTION AND DEVELOPMENT OF GLASS CULTURE IN CENTRAL ASIA

After the invasion of Islamic forces originating from the Arabian Peninsula, a new material culture has spread throughout Central Asia. Among these cultural elements, glass products, manufacturing techniques, and artisans have been introduced, resulting in the spread of glassmaking across the area.

Since 2016, our excavation surveys in the Bukhara Oasis have revealed various glass artefacts that show two distinct characteristics. First, glass objects that incorporate Islamic style have been discovered, including bowls, dishes, pitchers, and other dining and drinking vessels, as well as storage containers such as jars and bottles, along with medical instruments and special instruments for distillation. Conversely, excavations have clarified glass artefacts influenced by local culture. For example, the "sumak" and "tuvak", which are implements for infant care, and inkpots embedded in stucco were used for specific purposes. Moreover, the double-circular pontil marks suggest the possible spread of unique manufacturing techniques and tools.

This presentation explores the adoption and development of glass production that was established alongside the Islamisation of the region, as evidenced by these objects. Where applicable, we also discuss the findings of the chemical analyses.

ABSTRACTS: SESSION 4

MALIYA **AIHAITI**

(The Palace Museum, Beijing, China)

ON THE SPREAD OF CENTRAL ASIAN GLASSWARES ALONG THE SILK ROADS

Keywords: Glass bowl with ring-shaped reliefs, the Tang treasure of Hejiacun, the Pinehill temple in Chigok-Gun of Kogrea, Shosgin in Nara of Japan

In 1970, a glass bowl with ring-shaped reliefs has been unearthed from the Tang Dynasty Hejiacun Hoard in the south suburb of Xi'an. Many scholars have interpreted this bowl as originally a Sasanian glassware from Iran. This research aims to argue that this bowl was one of the tributes paid by the Kapiś Kingdom in 619 AD.

On the basis of scientific testing, it can be seen that this glassware was made of plant-ash glass, as identified at many sites. Furthermore, similar glass bowls have been discovered at archaeological sites along the Silk Roads, including the Tagujai site at Moji Village in Khotan, the Thousand-Buddha Caves of Kumtura at Kuche in Xinjiang, the Pinehill stupa of the Unified Silla Kingdom at Chilgok-Gun in Korea, and the Shōsōin of Narain Japan. All the glasswares have now been misinterpreted.

This research therefore aims to discuss the introduction of these glasswares from Central Asia to the Tarim Basin, the Yellow River region, Korea and Japan.

VALERIE JING **YEUNG**

(Institute of Archaeology, UCL, UK)

GLASS RECIPES IN MOTION: CHEMICAL EVIDENCE FOR CIRCULATION IN CENTRAL ASIA

Central Asia has long been recognised as a key zone of interaction in premodern exchange networks, where glass circulated across multiple cultural, political, and technological contexts. This paper examines circulation as an analytical problem that can be addressed through glass chemistry.

Preliminary LA-ICP-MS results are presented for glass assemblages dating from the pre-Islamic to Early Islamic periods from three regions: the Murghab river delta, the Surkhan Darya valley, and the southern Caucasus. Compositions are analysed through the concept of the recipe: a reproducible chemical pattern reflecting raw material selection and primary mixing, capable of persistence, modification, and recombination as materials move. Recipes are identified inductively using combined principal component analysis and hierarchical clustering, with attention to overlap and group stability.

The results reveal spatially and temporally structured continuity within a broadly continuous chemical space. Some recipes recur across regions and periods with limited compositional drift, while others form transitional variants consistent with recycling, remelting, and local reworking. By foregrounding recipe mobility, this paper demonstrates how glass chemistry can be used to trace circulation across Central Asia.

YUEWEN **JIN**

(Institute of Archaeology, Chinese Academy of Social Science, Beijing, China)

LA-ICP-MS ANALYSIS OF SASANIAN GLASS FROM MESOPOTAMIA

This work focuses on the LA-ICP-MS analysis of Sasanian glass from Mesopotamia. The glass samples are all soda-lime glass from the collections of the British Museum made with both natron and plant ash as flux. The natron glass is of a more varied origin, including Egyptian and Levantine sources with types of bowls and lamps. The plant ash glass samples are mainly small utilitarian containers from Mesopotamia. They are all transparent glass with iron-coloured green or yellow and hardly decolourised.

In comparison with the previous work, the composition of the analysed plant ash glass is more compatible with Sasanian 1b while Sasanian 2 is less common, and several outliers are included. This may be related to the locations of the finds, which are closer to the North than to the centre of modern Iraq and Syria. A few samples within the outliers show traces of mixing with natron glass, and other samples have high alumina content, indicating another potential silica source. Moreover, the potential correlation between magnesia and lithium in plant ash glass is explored, suggesting ideas to find out plant types.

GLASS BEADS IN EARLY MEDIEVAL WALĪLA, MOROCCO: INVESTIGATIONS OF TECHNOLOGY AND PROVENANCE

VERONICA **OCCARI**[1,2], KELSI **KAVIANI**[1,3], BARBARA **LEPRI**, IAN **FREESTONE**[1], ASMAE **EL KACIMI**[4], HASSAN **LIMANE**[4], CORISANDE **FENWICK**[1]

([1]Institute of Archaeology, UCL, UK; [2]KU Leuven, Belgium; [3]University of Cambridge, UK; [4]Institut National des Sciences de l'Archéologie et du Patrimoine (INSAP), Morocco)

Glass beads are one of the most prolific vitreous finds of the first and second millennium CE, offering a unique opportunity to explore questions of identity, local technological practices, and movement. However, the lack of typological and chemical analyses of glass from North Africa limits our knowledge of early Islamic glass bead production and trade within the region.

This work presents new LA-ICP-MS data for 120 glass beads from the early Islamic site of Walīla (Roman Volubilis) in northern Morocco. The results show that most of the beads analysed are made from plant ash glass of 'Mesopotamian' or Iranian origins, with the largest group resembling 9th century glass from Sāmarrā, Iraq and 9th – 11th century glass from sites in Iran such as Sīrāf and Gorgan. Two groups, comprised mainly of Fustat Fused Rod beads, somewhat resemble Sasanian glass from Veh Ardašīr, Iraq, and suggests a recycling of 3rd – 7th century Mesopotamian plant ash glass. Six high-lead glass beads were identified, a much rarer glass type in the Islamic Mediterranean. Natron glass beads of Levantine and Egyptian origins were also identified, with most of them showing mixed compositions due to recycling.

Overall, these data shed light not only on bead making practices at Walīla, but also on its integration within broader networks in the Mediterranean and Southwest Asia.

COMPOSITIONAL ANALYSIS AND ORIGINS OF WARRING STATES BEADS IN THE COLLECTIONS OF THE BRITISH MUSEUM

VALERIE JING **YEUNG**[1], IAN **FREESTONE**[1,2], MARTINA **BERTINI**[2], ANDREW **MEEK**[2], MICHAEL **CHARLTON**[1]

([1]Institute of Archaeology, UCL, UK; [2]Department of Scientific Research, The British Museum, UK)

This paper investigates the compositions and technologies of the "eye" beads made in the Central Plain of China in the Warring States period (5th-3rd centuries BCE). At this time, not only was the BaO-PbO-SiO_2 system used to manufacture glass beads, but also the glazes on ceramic beads. It is generally considered that the strong, stylistic resemblance between the Chinese and Western eye-beads is evident of Chinese imitations of soda-lime-silica beads from the Western Mediterranean. Laser Ablation Inductively Coupled Plasma Mass-Spectrometry (LA-ICP-MS) has been used to analyse 21 Warring States eye-beads (5 true glass beads and 16 glazed ceramic beads) from the collections of the British Museum. It is shown that there was a difference in barium sources exploited by the glassmaking and glazing industries, suggesting production in separate locations Furthermore, glass and glaze used different colour and opacification technologies.

It has recently been proposed that moderate amounts of soda in Warring States lead-barium-silica glass reflects the addition of natron glass imported from the West along the Silk Roads. Although this cannot be unequivocally dismissed the present results suggests it is unlikely because (1) ceramic glazes show similar high Na_2O contents to the glasses, yet their technologies do not show otherwise show similarities to those of Mediterranean glass, (2) the blue glass of the Chinese beads used a source of cobalt previously unrecognised from the West, (3) the Warring States beads do not contain the high levels of antimony that might be expected if Iron Age glass from the West was being recycled.

GRINDING TOOLS IN PRIMARY GLASS MAKING – UNDERSTANDING THE CHAÎNE OPÉRATOIRE AND ITS IMPACT ON CHEMICAL COMPOSITION

MARCEL **FRENKEN**[1], QIN-QIN **LÜ**[2,3], THILO **REHREN**[1]

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The use of grinding tools to crush quartz down to sand grain size that will dissolve during the glassmaking process is a mandatory step in the "silica from a rock source" branch of the glassmaking chaîne opératoire. This process was documented in Robert Brills "Glassmakers of Herat" documentation, and also suspected archaeologically, e.g. from the Bronze Age workshops in Amarna and Qantir-Pi-Ramesse.

We present here a set of experiments that recreate the use of simple pestle and mortar grinding tools as seen in "Glassmakers of Herat", to crush quartz pebbles in order to test the impact of the stone tools on the composition of the resulting quartz powder. Four different grinding tools were used, made from a basaltic andesite, granite, gabbro and brass. Quartz pebbles were crushed and ground to three different grain sizes, and combined with soda, salt, lime and heat to form glasses. Those glasses, alongside two blanks made with quartz crushed in an agate mortar, were analysed with LA-ICP-MS for their trace element composition. The results show trends in the final chemical composition that match the composition of the grinding tool materials, which had been analysed with WD-XRF and SEM-EDS. Particularly interesting is the contribution of the grinding tools to trace elements commonly used in provenanceing, such as chromium and lanthanum.

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DIRECTIONS TO LECTURE THEATRES

Directions to G6 Lecture Theatre:

Entrance to the Institute of archaeology (31-34 Gordon Sq. WC1H 0PY)
Take an immediate right through the double doors into the Leventis gallery
Walk to the end of the hall and enter through the two sets of double doors

Directions to Central House:

The entrance is at 14 Woburn Pl WC1H 0NN, across the street from Hilton hotel
Enter through the doors and show your badge to security at the desk and they will let you through the barrier
If the door is locked, press the call button and tell them you are there for the conference
Continue to the second floor to room 225.

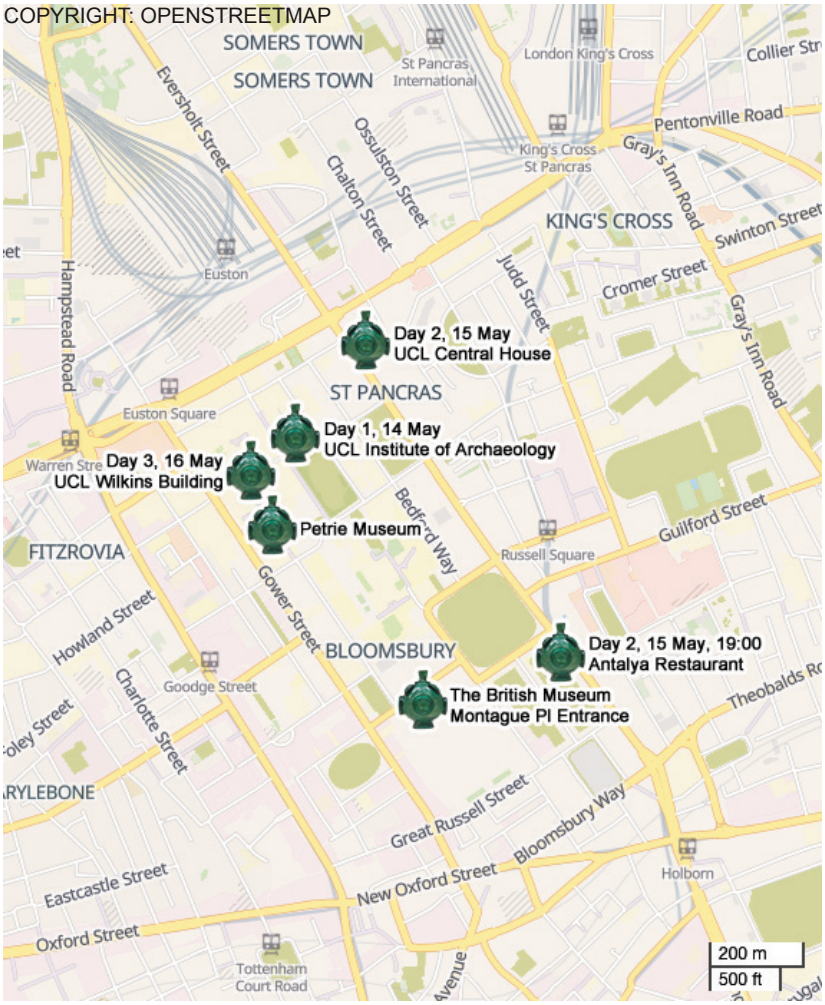
Directions to Gustav Tuck Lecture Theatre:

If entering via Gorden Street:
Enter the automatic doors of the Student Centre (27-28 Gordon Sq. WC1H 0AW)
Go up the stairs and through the revolving doors
Cross straight across the courtyard and enter through the automatic door into the South Cloisters
Take a left down the hallway, and take a right at the end of the hallway
Take a slight left past two sets of doors and go up the stairs to the second floor
The entrance to the lecture theatre will be on your right

If entering via Gower Street:
Enter through the main entrance of UCL (Gower Street WC1E 6BT)
Head to the southeast corner of the courtyard and enter through the door
Take a right and head through a second set of doors
Head straight to the stairs and go to the second floor
The entrance to the lecture theatre will be on your right

CONFERENCE MAP





DAY 1, 14 MAY
UCL Institute of Archaeology, Room G6, 31-34 Gordon Square, WC1H 0PY

DAY 2, 15 MAY
UCL Central House, Lecture Hall 225, 14 Upper Woburn Place, WC1H 0NN
Dinner (7 pm): **Antalya Restaurant**, 103-105 Southampton Row, WC1B 4HH

DAY3, 16 MAY
UCL Wilkins Building, Gustave Tuck Lecture Theatre, Gower St, WC1E 6BT

UCL Institute of Archaeology

The British Museum

The Association for the History of Glass